Exhibit 1

United Nations FCCC/CP/2015/L.9

Framework Convention on Climate Change

Distr.: Limited
12 December 2015

Original: English

Conference of the Parties
Twenty-first session
Paris, 30 November to 11 December 2015

Agenda item 4(b)
Durban Platform for Enhanced Action (decision 1/CP.17)
Adoption of a protocol, another legal instrument, or an agreed outcome with legal force under the Convention applicable to all Parties

ADOPTION OF THE PARIS AGREEMENT

Proposal by the President

Draft decision -/CP.21

The *Conference of the Parties*,

Recalling decision 1/CP.17 on the establishment of the Ad Hoc Working Group on the Durban Platform for Enhanced Action,

Also recalling Articles 2, 3 and 4 of the Convention,

Further recalling relevant decisions of the Conference of the Parties, including decisions 1/CP.16, 2/CP.18, 1/CP.19 and 1/CP.20,

Welcoming the adoption of United Nations General Assembly resolution A/RES/70/1, "Transforming our world: the 2030 Agenda for Sustainable Development", in particular its goal 13, and the adoption of the Addis Ababa Action Agenda of the third International Conference on Financing for Development and the adoption of the Sendai Framework for Disaster Risk Reduction,

Recognizing that climate change represents an urgent and potentially irreversible threat to human societies and the planet and thus requires the widest possible cooperation by all countries, and their participation in an effective and appropriate international response, with a view to accelerating the reduction of global greenhouse gas emissions,

Also recognizing that deep reductions in global emissions will be required in order to achieve the ultimate objective of the Convention and emphasizing the need for urgency in addressing climate change,

Acknowledging that climate change is a common concern of humankind, Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples,

local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development, as well as gender equality, empowerment of women and intergenerational equity,

Also acknowledging the specific needs and concerns of developing country Parties arising from the impact of the implementation of response measures and, in this regard, decisions 5/CP.7, 1/CP.10, 1/CP.16 and 8/CP.17,

Emphasizing with serious concern the urgent need to address the significant gap between the aggregate effect of Parties' mitigation pledges in terms of global annual emissions of greenhouse gases by 2020 and aggregate emission pathways consistent with holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C,

Also emphasizing that enhanced pre-2020 ambition can lay a solid foundation for enhanced post-2020 ambition,

Stressing the urgency of accelerating the implementation of the Convention and its Kyoto Protocol in order to enhance pre-2020 ambition,

Recognizing the urgent need to enhance the provision of finance, technology and capacity-building support by developed country Parties, in a predictable manner, to enable enhanced pre-2020 action by developing country Parties,

Emphasizing the enduring benefits of ambitious and early action, including major reductions in the cost of future mitigation and adaptation efforts,

Acknowledging the need to promote universal access to sustainable energy in developing countries, in particular in Africa, through the enhanced deployment of renewable energy,

Agreeing to uphold and promote regional and international cooperation in order to mobilize stronger and more ambitious climate action by all Parties and non-Party stakeholders, including civil society, the private sector, financial institutions, cities and other subnational authorities, local communities and indigenous peoples,

I. ADOPTION

1. *Decides* to adopt the Paris Agreement under the United Nations Framework Convention on Climate Change (hereinafter referred to as "the Agreement") as contained in the annex;

2. *Requests* the Secretary-General of the United Nations to be the Depositary of the Agreement and to have it open for signature in New York, United States of America, from 22 April 2016 to 21 April 2017;

3. *Invites* the Secretary-General to convene a high-level signature ceremony for the Agreement on 22 April 2016;

4. *Also invites* all Parties to the Convention to sign the Agreement at the ceremony to be convened by the Secretary-General, or at their earliest opportunity, and to deposit their respective instruments of ratification, acceptance, approval or accession, where appropriate, as soon as possible;

5. *Recognizes* that Parties to the Convention may provisionally apply all of the provisions of the Agreement pending its entry into force, and *requests* Parties to provide notification of any such provisional application to the Depositary;

6. *Notes* that the work of the Ad Hoc Working Group on the Durban Platform for Enhanced Action, in accordance with decision 1/CP.17, paragraph 4, has been completed;

7. *Decides* to establish the Ad Hoc Working Group on the Paris Agreement under the same arrangement, mutatis mutandis, as those concerning the election of officers to the Bureau of the Ad Hoc Working Group on the Durban Platform for Enhanced Action;[1]

8. *Also decides* that the Ad Hoc Working Group on the Paris Agreement shall prepare for the entry into force of the Agreement and for the convening of the first session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;

9. *Further decides* to oversee the implementation of the work programme resulting from the relevant requests contained in this decision;

10. *Requests* the Ad Hoc Working Group on the Paris Agreement to report regularly to the Conference of the Parties on the progress of its work and to complete its work by the first session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;

11. *Decides* that the Ad Hoc Working Group on the Paris Agreement shall hold its sessions starting in 2016 in conjunction with the sessions of the Convention subsidiary bodies and shall prepare draft decisions to be recommended through the Conference of the Parties to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for consideration and adoption at its first session;

II. INTENDED NATIONALLY DETERMINED CONTRIBUTIONS

12. *Welcomes* the intended nationally determined contributions that have been communicated by Parties in accordance with decision 1/CP.19, paragraph 2(b);

13. *Reiterates* its invitation to all Parties that have not yet done so to communicate to the secretariat their intended nationally determined contributions towards achieving the objective of the Convention as set out in its Article 2 as soon as possible and well in advance of the twenty-second session of the Conference of the Parties (November 2016) and in a manner that facilitates the clarity, transparency and understanding of the intended nationally determined contributions;

14. *Requests* the secretariat to continue to publish the intended nationally determined contributions communicated by Parties on the UNFCCC website;

15. *Reiterates* its call to developed country Parties, the operating entities of the Financial Mechanism and any other organizations in a position to do so to provide support for the preparation and communication of the intended nationally determined contributions of Parties that may need such support;

16. *Takes note* of the synthesis report on the aggregate effect of intended nationally determined contributions communicated by Parties by 1 October 2015, contained in document FCCC/CP/2015/7;

17. *Notes* with concern that the estimated aggregate greenhouse gas emission levels in 2025 and 2030 resulting from the intended nationally determined contributions do not fall within least-cost 2 ˚C scenarios but rather lead to a projected level of 55 gigatonnes in 2030, and *also notes* that much greater emission reduction efforts will be required than those associated with the intended nationally determined contributions in order to hold the increase in the global average temperature to below 2 ˚C above pre-industrial levels by reducing emissions to 40 gigatonnes or to 1.5 ˚C above pre-industrial levels by reducing to a level to be identified in the special report referred to in paragraph 21 below;

[1] Endorsed by decision 2/CP.18, paragraph 2.

18. *Also notes, in this context,* the adaptation needs expressed by many developing country Parties in their intended nationally determined contributions;

19. *Requests* the secretariat to update the synthesis report referred to in paragraph 16 above so as to cover all the information in the intended nationally determined contributions communicated by Parties pursuant to decision 1/CP.20 by 4 April 2016 and to make it available by 2 May 2016;

20. *Decides* to convene a facilitative dialogue among Parties in 2018 to take stock of the collective efforts of Parties in relation to progress towards the long-term goal referred to in Article 4, paragraph 1, of the Agreement and to inform the preparation of nationally determined contributions pursuant to Article 4, paragraph 8, of the Agreement;

21. *Invites* the Intergovernmental Panel on Climate Change to provide a special report in 2018 on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways;

III. DECISIONS TO GIVE EFFECT TO THE AGREEMENT

MITIGATION

22. *Invites* Parties to communicate their first nationally determined contribution no later than when the Party submits its respective instrument of ratification, accession, or approval of the Paris Agreement. If a Party has communicated an intended nationally determined contribution prior to joining the Agreement, that Party shall be considered to have satisfied this provision unless that Party decides otherwise;

23. *Urges* those Parties whose intended nationally determined contribution pursuant to decision 1/CP.20 contains a time frame up to 2025 to communicate by 2020 a new nationally determined contribution and to do so every five years thereafter pursuant to Article 4, paragraph 9, of the Agreement;

24. *Requests* those Parties whose intended nationally determined contribution pursuant to decision 1/CP.20 contains a time frame up to 2030 to communicate or update by 2020 these contributions and to do so every five years thereafter pursuant to Article 4, paragraph 9, of the Agreement;

25. *Decides* that Parties shall submit to the secretariat their nationally determined contributions referred to in Article 4 of the Agreement at least 9 to 12 months in advance of the relevant meeting of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement with a view to facilitating the clarity, transparency and understanding of these contributions, including through a synthesis report prepared by the secretariat;

26. *Requests* the Ad Hoc Working Group on the Paris Agreement to develop further guidance on features of the nationally determined contributions for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

27. *Agrees* that the information to be provided by Parties communicating their nationally determined contributions, in order to facilitate clarity, transparency and understanding, may include, as appropriate, inter alia, quantifiable information on the reference point (including, as appropriate, a base year), time frames and/or periods for implementation, scope and coverage, planning processes, assumptions and methodological approaches including those for estimating and accounting for anthropogenic greenhouse gas emissions and, as appropriate, removals, and how the Party considers that its nationally determined contribution is fair and ambitious, in the light of its national circumstances, and

how it contributes towards achieving the objective of the Convention as set out in its Article 2;

28. *Requests* the Ad Hoc Working Group on the Paris Agreement to develop further guidance for the information to be provided by Parties in order to facilitate clarity, transparency and understanding of nationally determined contributions for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

29. *Also requests* the Subsidiary Body for Implementation to develop modalities and procedures for the operation and use of the public registry referred to in Article 4, paragraph 12, of the Agreement, for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

30. *Further requests* the secretariat to make available an interim public registry in the first half of 2016 for the recording of nationally determined contributions submitted in accordance with Article 4 of the Agreement, pending the adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement of the modalities and procedures referred to in paragraph 29 above;

31. *Requests* the Ad Hoc Working Group on the Paris Agreement to elaborate, drawing from approaches established under the Convention and its related legal instruments as appropriate, guidance for accounting for Parties' nationally determined contributions, as referred to in Article 4, paragraph 13, of the Agreement, for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session, which ensures that:

(a) Parties account for anthropogenic emissions and removals in accordance with common methodologies and metrics assessed by the Intergovernmental Panel on Climate Change and adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;

(b) Parties ensure methodological consistency, including on baselines, between the communication and implementation of nationally determined contributions;

(c) Parties strive to include all categories of anthropogenic emissions or removals in their nationally determined contributions and, once a source, sink or activity is included, continue to include it;

(d) Parties shall provide an explanation of why any categories of anthropogenic emissions or removals are excluded;

32. *Decides* that Parties shall apply the guidance mentioned in paragraph 31 above to the second and subsequent nationally determined contributions and that Parties may elect to apply such guidance to their first nationally determined contribution;

33. *Also decides* that the Forum on the Impact of the Implementation of response measures, under the subsidiary bodies, shall continue, and shall serve the Agreement;

34. *Further decides* that the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation shall recommend, for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session, the modalities, work programme and functions of the Forum on the Impact of the Implementation of response measures to address the effects of the implementation of response measures under the Agreement by enhancing cooperation amongst Parties on understanding the impacts of mitigation actions under the Agreement and the exchange of information, experiences, and best practices amongst Parties to raise their resilience to these impacts;

35. *Decides* that the guidance under paragraph 31 above shall ensure that double counting is avoided on the basis of a corresponding adjustment by both Parties for anthropogenic emissions by sources and/or removals by sinks covered by their nationally determined contributions under the Agreement;

36. *Invites* Parties to communicate, by 2020, to the secretariat mid-century, long-term low greenhouse gas emission development strategies in accordance with Article 4, paragraph 19, of the Agreement, and *requests* the secretariat to publish on the UNFCCC website Parties' low greenhouse gas emission development strategies as communicated;

37. *Requests* the Subsidiary Body for Scientific and Technological Advice to develop and recommend the guidance referred to under Article 6, paragraph 2, of the Agreement for adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session, including guidance to ensure that double counting is avoided on the basis of a corresponding adjustment by Parties for both anthropogenic emissions by sources and removals by sinks covered by their nationally determined contributions under the Agreement;

38. *Recommends* that the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement adopt rules, modalities and procedures for the mechanism established by Article 6, paragraph 4, of the Agreement on the basis of:

(a) Voluntary participation authorized by each Party involved;

(b) Real, measurable, and long-term benefits related to the mitigation of climate change;

(c) Specific scopes of activities;

(d) Reductions in emissions that are additional to any that would otherwise occur;

(e) Verification and certification of emission reductions resulting from mitigation activities by designated operational entities;

(f) Experience gained with and lessons learned from existing mechanisms and approaches adopted under the Convention and its related legal instruments;

39. *Requests* the Subsidiary Body for Scientific and Technological Advice to develop and recommend rules, modalities and procedures for the mechanism referred to in paragraph 38 above for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

40. *Also requests* the Subsidiary Body for Scientific and Technological Advice to undertake a work programme under the framework for non-market approaches to sustainable development referred to in Article 6, paragraph 8, of the Agreement, with the objective of considering how to enhance linkages and create synergy between, inter alia, mitigation, adaptation, finance, technology transfer and capacity-building, and how to facilitate the implementation and coordination of non-market approaches;

41. *Further requests* the Subsidiary Body for Scientific and Technological Advice to recommend a draft decision on the work programme referred to in paragraph 40 above, taking into account the views of Parties, for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

ADAPTATION

42. *Requests* the Adaptation Committee and the Least Developed Countries Expert Group to jointly develop modalities to recognize the adaptation efforts of developing

country Parties, as referred to in Article 7, paragraph 3, of the Agreement, and make recommendations for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

43. *Also requests* the Adaptation Committee, taking into account its mandate and its second three-year workplan, and with a view to preparing recommendations for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session:

(a) To review, in 2017, the work of adaptation-related institutional arrangements under the Convention, with a view to identifying ways to enhance the coherence of their work, as appropriate, in order to respond adequately to the needs of Parties;

(b) To consider methodologies for assessing adaptation needs with a view to assisting developing countries, without placing an undue burden on them;

44. *Invites* all relevant United Nations agencies and international, regional and national financial institutions to provide information to Parties through the secretariat on how their development assistance and climate finance programmes incorporate climate-proofing and climate resilience measures;

45. *Requests* Parties to strengthen regional cooperation on adaptation where appropriate and, where necessary, establish regional centres and networks, in particular in developing countries, taking into account decision 1/CP.16, paragraph 13;

46. *Also requests* the Adaptation Committee and the Least Developed Countries Expert Group, in collaboration with the Standing Committee on Finance and other relevant institutions, to develop methodologies, and make recommendations for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session on:

(a) Taking the necessary steps to facilitate the mobilization of support for adaptation in developing countries in the context of the limit to global average temperature increase referred to in Article 2 of the Agreement;

(b) Reviewing the adequacy and effectiveness of adaptation and support referred to in Article 7, paragraph 14(c), of the Agreement;

47. *Further requests* the Green Climate Fund to expedite support for the least developed countries and other developing country Parties for the formulation of national adaptation plans, consistent with decisions 1/CP.16 and 5/CP.17, and for the subsequent implementation of policies, projects and programmes identified by them;

LOSS AND DAMAGE

48. *Decides* on the continuation of the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts, following the review in 2016;

49. *Requests* the Executive Committee of the Warsaw International Mechanism to establish a clearinghouse for risk transfer that serves as a repository for information on insurance and risk transfer, in order to facilitate the efforts of Parties to develop and implement comprehensive risk management strategies;

50. *Also requests* the Executive Committee of the Warsaw International Mechanism to establish, according to its procedures and mandate, a task force to complement, draw upon the work of and involve, as appropriate, existing bodies and expert groups under the Convention including the Adaptation Committee and the Least Developed Countries Expert Group, as well as relevant organizations and expert bodies outside the Convention, to develop recommendations for integrated approaches to avert, minimize and address displacement related to the adverse impacts of climate change;

51. *Further requests* the Executive Committee of the Warsaw International Mechanism to initiate its work, at its next meeting, to operationalize the provisions referred to in paragraphs 49 and 50 above, and to report on progress thereon in its annual report;

52. *Agrees* that Article 8 of the Agreement does not involve or provide a basis for any liability or compensation;

FINANCE

53. *Decides* that, in the implementation of the Agreement, financial resources provided to developing countries should enhance the implementation of their policies, strategies, regulations and action plans and their climate change actions with respect to both mitigation and adaptation to contribute to the achievement of the purpose of the Agreement as defined in Article 2;

54. *Further decides* that, in accordance with Article 9, paragraph 3, of the Agreement, developed countries intend to continue their existing collective mobilization goal through 2025 in the context of meaningful mitigation actions and transparency on implementation; prior to 2025 the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall set a new collective quantified goal from a floor of USD 100 billion per year, taking into account the needs and priorities of developing countries;

55. *Recognizes* the importance of adequate and predictable financial resources, including for results-based payments, as appropriate, for the implementation of policy approaches and positive incentives for reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks; as well as alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests; while reaffirming the importance of non-carbon benefits associated with such approaches; encouraging the coordination of support from, inter alia, public and private, bilateral and multilateral sources, such as the Green Climate Fund, and alternative sources in accordance with relevant decisions by the Conference of the Parties;

56. *Decides* to initiate, at its twenty-second session, a process to identify the information to be provided by Parties, in accordance with Article 9, paragraph 5, of the Agreement with the view to providing a recommendation for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

57. *Also decides* to ensure that the provision of information in accordance with Article 9, paragraph 7 of the Agreement shall be undertaken in accordance with modalities, procedures and guidelines referred to in paragraph 96 below;

58. *Requests* Subsidiary Body for Scientific and Technological Advice to develop modalities for the accounting of financial resources provided and mobilized through public interventions in accordance with Article 9, paragraph 7, of the Agreement for consideration by the Conference of the Parties at its twenty-fourth session (November 2018), with the view to making a recommendation for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

59. *Decides* that the Green Climate Fund and the Global Environment Facility, the entities entrusted with the operation of the Financial Mechanism of the Convention, as well as the Least Developed Countries Fund and the Special Climate Change Fund, administered by the Global Environment Facility, shall serve the Agreement;

60. *Recognizes* that the Adaptation Fund may serve the Agreement, subject to relevant decisions by the Conference of the Parties serving as the meeting of the Parties to the Kyoto

Protocol and the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;

61. *Invites* the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol to consider the issue referred to in paragraph 60 above and make a recommendation to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

62. *Recommends* that the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall provide guidance to the entities entrusted with the operation of the Financial Mechanism of the Convention on the policies, programme priorities and eligibility criteria related to the Agreement for transmission by the Conference of the Parties;

63. *Decides* that the guidance to the entities entrusted with the operations of the Financial Mechanism of the Convention in relevant decisions of the Conference of the Parties, including those agreed before adoption of the Agreement, shall apply mutatis mutandis;

64. *Also decides* that the Standing Committee on Finance shall serve the Agreement in line with its functions and responsibilities established under the Conference of the Parties;

65. *Urges* the institutions serving the Agreement to enhance the coordination and delivery of resources to support country-driven strategies through simplified and efficient application and approval procedures, and through continued readiness support to developing country Parties, including the least developed countries and small island developing States, as appropriate;

TECHNOLOGY DEVELOPMENT AND TRANSFER

66. *Takes note of* the interim report of the Technology Executive Committee on guidance on enhanced implementation of the results of technology needs assessments as referred to in document FCCC/SB/2015/INF.3;

67. *Decides* to strengthen the Technology Mechanism and requests the Technology Executive Committee and the Climate Technology Centre and Network, in supporting the implementation of the Agreement, to undertake further work relating to, inter alia:

(a) Technology research, development and demonstration;

(b) The development and enhancement of endogenous capacities and technologies;

68. *Requests* the Subsidiary Body for Scientific and Technological Advice to initiate, at its forty-fourth session (May 2016), the elaboration of the technology framework established under Article 10, paragraph 4, of the Agreement and to report on its findings to the Conference of the Parties, with a view to the Conference of the Parties making a recommendation on the framework to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for consideration and adoption at its first session, taking into consideration that the framework should facilitate, inter alia:

(a) The undertaking and updating of technology needs assessments, as well as the *enhanced* implementation of their results, particularly technology action plans and project ideas, through the preparation of bankable projects;

(b) The provision of enhanced financial and technical support for the implementation of the results of the technology needs assessments;

(c) The assessment of technologies that are ready for transfer;

(d) The enhancement of enabling environments for and the addressing of barriers to the development and transfer of socially and environmentally sound technologies*;*

69. *Decides* that the Technology Executive Committee and the Climate Technology Centre and Network shall report to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, through the subsidiary bodies, on their activities to support the implementation of the Agreement;

70. *Also decides* to undertake a periodic assessment of the effectiveness of and the adequacy of the support provided to the Technology Mechanism in supporting the implementation of the Agreement on matters relating to technology development and transfer;

71. *Requests* the Subsidiary Body for Implementation to initiate, at its forty-fourth session , the elaboration of the scope of and modalities for the periodic assessment referred to in paragraph 70 above, taking into account the review of the Climate Technology Centre and Network as referred to in decision 2/CP.17, annex VII, paragraph 20 and the modalities for the global stocktake referred to in Article 14 of the Agreement, for consideration and adoption by the Conference of the Parties at its twenty-fifth session (November 2019);

CAPACITY-BUILDING

72. *Decides* to establish the Paris Committee on Capacity-building whose aim will be to address gaps and needs, both current and emerging, in implementing capacity-building in developing country Parties and further enhancing capacity-building efforts, including with regard to coherence and coordination in capacity-building activities under the Convention;

73. *Also decides* that the Paris Committee on Capacity-building will manage and oversee the work plan mentioned in paragraph 74 below;

74. *Further decides* to launch a work plan for the period 2016–2020 with the following activities:

(a) Assessing how to increase synergies through cooperation and avoid duplication among existing bodies established under the Convention that implement capacity-building activities, including through collaborating with institutions under and outside the Convention;

(b) Identifying capacity gaps and needs and recommending ways to address them;

(c) Promoting the development and dissemination of tools and methodologies for the implementation of capacity-building;

(d) Fostering global, regional, national and subnational cooperation;

(e) Identifying and collecting good practices, challenges, experiences, and lessons learned from work on capacity-building by bodies established under the Convention;

(f) Exploring how developing country Parties can take ownership of building and maintaining capacity over time and spac*e;*

(g) Identifying opportunities to strengthen capacity at the national, regional, and subnational level;

(h) Fostering dialogue, coordination, collaboration and coherence among relevant processes and initiatives under the Convention, including through exchanging information on capacity-building activities and strategies of bodies established under the Convention;

(i) Providing guidance to the secretariat on the maintenance and further development of the web-based capacity-building portal;

75. *Decides* that the Paris Committee on Capacity-building will annually focus on an area or theme related to enhanced technical exchange on capacity-building, with the purpose of maintaining up-to-date knowledge on the successes and challenges in building capacity effectively in a particular area;

76. *Requests* the Subsidiary Body for Implementation to organize annual in-session meetings of the Paris Committee on Capacity-building;

77. *Also requests* the Subsidiary Body for Implementation to develop the terms of reference for the Paris Committee on Capacity-building, in the context of the third comprehensive review of the implementation of the capacity-building framework, also taking into account paragraphs 75, 76, 77 and 78 above and paragraphs 82 and 83 below, with a view to recommending a draft decision on this matter for consideration and adoption by the Conference of the Parties at its twenty-second session;

78. *Invites* Parties to submit their views on the membership of the Paris Committee on Capacity-building by 9 March 2016;[2]

79. *Requests* the secretariat to compile the submissions referred to in paragraph 78 above into a miscellaneous document for consideration by the Subsidiary Body for Implementation at its forty-fourth session;

80. *Decides* that the inputs to the Paris Committee on Capacity-building will include, inter alia, submissions, the outcome of the third comprehensive review of the implementation of the capacity-building framework, the secretariat's annual synthesis report on the implementation of the framework for capacity-building in developing countries, the secretariat's compilation and synthesis report on capacity-building work of bodies established under the Convention and its Kyoto Protocol, and reports on the Durban Forum and the capacity-building portal;

81. *Requests* the Paris Committee on Capacity-building to prepare annual technical progress reports on its work, and to make these reports available at the sessions of the Subsidiary Body for Implementation coinciding with the sessions of the Conference of the Parties;

82. *Also requests* the Conference of the Parties at its twenty-fifth session (November 2019), to review the progress, need for extension, the effectiveness and enhancement of the Paris Committee on Capacity-building and to take any action it considers appropriate, with a view to making recommendations to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session on enhancing institutional arrangements for capacity-building consistent with Article 11, paragraph 5, of the Agreement;

83. *Calls upon* all Parties to ensure that education, training and public awareness, as reflected in Article 6 of the Convention and in Article 12 of the Agreement are adequately considered in their contribution to capacity-building;

84. *Invites* the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session to explore ways of enhancing the implementation of training, public awareness, public participation and public access to information so as to enhance actions under the Agreement;

[2] Parties should submit their views via the submissions portal at <http://www.unfccc.int/5900>.

TRANSPARENCY OF ACTION AND SUPPORT

85. *Decides* to establish a Capacity-building Initiative for Transparency in order to build institutional and technical capacity, both pre- and post-2020. This initiative will support developing country Parties, upon request, in meeting enhanced transparency requirements as defined in Article 13 of the Agreement in a timely manner;

86. *Also decides* that the Capacity-building Initiative for Transparency will aim:

(a) To strengthen national institutions for transparency-related activities in line with national priorities;

(b) To provide relevant tools, training and assistance for meeting the provisions stipulated in Article 13 of the Agreement;

(c) To assist in the improvement of transparency over time;

87. *Urges and requests* the Global Environment Facility to make arrangements to support the establishment and operation of the Capacity-building Initiative for Transparency as a priority reporting-related need, including through voluntary contributions to support developing countries in the sixth replenishment of the Global Environment Facility and future replenishment cycles, to complement existing support under the Global Environment Facility;

88. *Decides* to assess the implementation of the Capacity-building Initiative for Transparency in the context of the seventh review of the financial mechanism;

89. *Requests* that the Global Environment Facility, as an operating entity of the financial mechanism include in its annual report to the Conference of the Parties the progress of work in the design, development and implementation of the Capacity-building Initiative for Transparency referred to in paragraph 85 above starting in 2016;

90. *Decides* that, in accordance with Article 13, paragraph 2, of the Agreement, developing countries shall be provided flexibility in the implementation of the provisions of that Article, including in the scope, frequency and level of detail of reporting, and in the scope of review, and that the scope of review could provide for in-country reviews to be optional, while such flexibilities shall be reflected in the development of modalities, procedures and guidelines referred to in paragraph 92 below;

91. *Also decides* that all Parties, except for the least developed country Parties and small island developing States, shall submit the information referred to in Article 13, paragraphs 7, 8, 9 and 10, as appropriate, no less frequently than on a biennial basis, and that the least developed country Parties and small island developing States may submit this information at their discretion;

92. *Requests* the Ad Hoc Working Group on the Paris Agreement to develop recommendations for modalities, procedures and guidelines in accordance with Article 13, paragraph 13, of the Agreement, and to define the year of their first and subsequent review and update, as appropriate, at regular intervals, for consideration by the Conference of the Parties, at its twenty-fourth session, with a view to forwarding them to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for adoption at its first session;

93. *Also requests* the Ad Hoc Working Group on the Paris Agreement in developing the recommendations for the modalities, procedures and guidelines referred to in paragraph 92 above to take into account, inter alia:

(a) The importance of facilitating improved reporting and transparency over time;

(b) The need to provide flexibility to those developing country Parties that need it in the light of their capacities;

(c) The need to promote transparency, accuracy, completeness, consistency, and comparability;

(d) The need to avoid duplication as well as undue burden on Parties and the secretariat;

(e) The need to ensure that Parties maintain at least the frequency and quality of reporting in accordance with their respective obligations under the Convention;

(f) The need to ensure that double counting is avoided;

(g) The need to ensure environmental integrity;

94. *Further requests* the Ad Hoc Working Group on the Paris Agreement, when developing the modalities, procedures and guidelines referred to in paragraph 92 above, to draw on the experiences from and take into account other on-going relevant processes under the Convention;

95. *Requests* the Ad Hoc Working Group on the Paris Agreement, when developing modalities, procedures and guidelines referred to in paragraph 92 above, to consider, inter alia:

(a) The types of flexibility available to those developing countries that need it on the basis of their capacities;

(b) The consistency between the methodology communicated in the nationally determined contribution and the methodology for reporting on progress made towards achieving individual Parties' respective nationally determined contribution;

(c) That Parties report information on adaptation action and planning including, if appropriate**,** their national adaptation plans, with a view to collectively exchanging information and sharing lessons learned;

(d) Support provided, enhancing delivery of support for both adaptation and mitigation through, inter alia, the common tabular formats for reporting support, and taking into account issues considered by the Subsidiary Body for Scientific and Technological Advice on methodologies for reporting on financial information, and enhancing the reporting by developing countries on support received, including the use, impact and estimated results thereof;

(e) Information in the biennial assessments and other reports of the Standing Committee on Finance and other relevant bodies under the Convention;

(f) Information on the social and economic impact of response measures;

96. *Also requests* the Ad Hoc Working Group on the Paris Agreement, when developing recommendations for modalities, procedures and guidelines referred to in paragraph 92 above, to enhance the transparency of support provided in accordance with Article 9 of the Agreement;

97. *Further requests* the Ad Hoc Working Group on the Paris Agreement to report on the progress of work on the modalities, procedures and guidelines referred to in paragraph 92 above to future sessions of the Conference of the Parties, and that this work be concluded no later than 2018;

98. *Decides* that the modalities, procedures and guidelines developed under paragraph 92 above, shall be applied upon the entry into force of the Paris Agreement;

99. *Also decides* that the modalities, procedures and guidelines of this transparency framework shall build upon and eventually supercede the measurement, reporting and verification system established by paragraphs 40 to 47 and 60 to 64 of decision 1/CP.16 and paragraph 12 to 62 of decision 2/CP.17 immediately following the submission of the final biennial reports and biennial update reports;

GLOBAL STOCKTAKE

100. *Requests* the Ad Hoc Working Group on the Paris Agreement to identify the sources of input for the global stocktake referred to in Article 14 of the Agreement and to report to the Conference of the Parties, with a view to the Conference of the Parties making a recommendation to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for consideration and adoption at its first session, including, but not limited to:

(a) Information on:

(i) The overall effect of the nationally determined contributions communicated by Parties;

(ii) The state of adaptation efforts, support, experiences and priorities from the communications referred to in Article 7, paragraphs 10 and 11, of the Agreement, and reports referred to in Article 13, paragraph 7, of the Agreement;

(iii) The mobilization and provision of support;

(b) The latest reports of the Intergovernmental Panel on Climate Change;

(c) Reports of the subsidiary bodies;

101. *Also requests* the Subsidiary Body for Scientific and Technological Advice to provide advice on how the assessments of the Intergovernmental Panel on Climate Change can inform the global stocktake of the implementation of the Agreement pursuant to its Article 14 of the Agreement and to report on this matter to the Ad Hoc Working Group on the Paris Agreement at its second session;

102. *Further requests* the Ad Hoc Working Group on the Paris Agreement to develop modalities for the global stocktake referred to in Article 14 of the Agreement and to report to the Conference of the Parties, with a view to making a recommendation to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for consideration and adoption at its first session;

FACILITATING IMPLEMENTATION AND COMPLIANCE

103. *Decides* that the committee referred to in Article 15, paragraph 2, of the Agreement shall consist of 12 members with recognized competence in relevant scientific, technical, socio-economic or legal fields, to be elected by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on the basis of equitable geographical representation, with two members each from the five regional groups of the United Nations and one member each from the small island developing States and the least developed countries, while taking into account the goal of gender balance;

104. *Requests* the Ad Hoc Working Group on the Paris Agreement to develop the modalities and procedures for the effective operation of the committee referred to in Article 15, paragraph 2, of the Agreement, with a view to the Ad Hoc Working Group on the Paris Agreement completing its work on such modalities and procedures for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

FINAL CLAUSES

105. *Also requests* the secretariat, solely for the purposes of Article 21 of the Agreement, to make available on its website on the date of adoption of the Agreement as well as in the report of the Conference of the Parties at its twenty-first session, information on the most up-to-date total and per cent of greenhouse gas emissions communicated by Parties to the Convention in their national communications, greenhouse gas inventory reports, biennial reports or biennial update reports;

IV. ENHANCED ACTION PRIOR TO 2020

106. *Resolves* to ensure the highest possible mitigation efforts in the pre-2020 period, including by:

(a) Urging all Parties to the Kyoto Protocol that have not already done so to ratify and implement the Doha Amendment to the Kyoto Protocol;

(b) Urging all Parties that have not already done so to make and implement a mitigation pledge under the Cancun Agreements;

(c) Reiterating its resolve, as set out in decision 1/CP.19, paragraphs 3 and 4, to accelerate the full implementation of the decisions constituting the agreed outcome pursuant to decision 1/CP.13 and enhance ambition in the pre-2020 period in order to ensure the highest possible mitigation efforts under the Convention by all Parties;

(d) Inviting developing country Parties that have not submitted their first biennial update reports to do so as soon as possible;

(e) Urging all Parties to participate in the existing measurement, reporting and verification processes under the Cancun Agreements, in a timely manner, with a view to demonstrating progress made in the implementation of their mitigation pledges;

107. *Encourages* Parties to promote the voluntary cancellation by Party and non-Party stakeholders, without double counting of units issued under the Kyoto Protocol, including certified emission reductions that are valid for the second commitment period;

108. *Urges* host and purchasing Parties to report transparently on internationally transferred mitigation outcomes, including outcomes used to meet international pledges, and emission units issued under the Kyoto Protocol with a view to promoting environmental integrity and avoiding double counting;

109. *Recognizes* the social, economic and environmental value of voluntary mitigation actions and their co-benefits for adaptation, health and sustainable development;

110. *Resolves* to strengthen, in the period 2016–2020, the existing technical examination process on mitigation as defined in decision 1/CP.19, paragraph 5(a), and decision 1/CP.20, paragraph 19, taking into account the latest scientific knowledge, including by:

(a) Encouraging Parties, Convention bodies and international organizations to engage in this process, including, as appropriate, in cooperation with relevant non-Party stakeholders, to share their experiences and suggestions, including from regional events, and to cooperate in facilitating the implementation of policies, practices and actions identified during this process in accordance with national sustainable development priorities;

(b) Striving to improve, in consultation with Parties, access to and participation in this process by developing country Party and non-Party experts;

(c) Requesting the Technology Executive Committee and the Climate Technology Centre and Network in accordance with their respective mandates:

(i) To engage in the technical expert meetings and enhance their efforts to facilitate and support Parties in scaling up the implementation of policies, practices and actions identified during this process;

(ii) To provide regular updates during the technical expert meetings on the progress made in facilitating the implementation of policies, practices and actions previously identified during this process;

(iii) To include information on their activities under this process in their joint annual report to the Conference of the Parties;

(d) Encouraging Parties to make effective use of the Climate Technology Centre and Network to obtain assistance to develop economically, environmentally and socially viable project proposals in the high mitigation potential areas identified in this process;

111. *Encourages* the operating entities of the Financial Mechanism of the Convention to engage in the technical expert meetings and to inform participants of their contribution to facilitating progress in the implementation of policies, practices and actions identified during the technical examination process;

112. *Requests* the secretariat to organize the process referred to in paragraph 110 above and disseminate its results, including by:

(a) Organizing, in consultation with the Technology Executive Committee and relevant expert organizations, regular technical expert meetings focusing on specific policies, practices and actions representing best practices and with the potential to be scalable and replicable;

(b) Updating, on an annual basis, following the meetings referred to in paragraph 112(a) above and in time to serve as input to the summary for policymakers referred to in paragraph 112(c) below, a technical paper on the mitigation benefits and co-benefits of policies, practices and actions for enhancing mitigation ambition, as well as on options for supporting their implementation, information on which should be made available in a user-friendly online format;

(c) Preparing, in consultation with the champions referred to in paragraph 122 below, a summary for policymakers, with information on specific policies, practices and actions representing best practices and with the potential to be scalable and replicable, and on options to support their implementation, as well as on relevant collaborative initiatives, and publishing the summary at least two months in advance of each session of the Conference of the Parties as input for the high-level event referred to in paragraph 121 below;

113. *Decides* that the process referred to in paragraph 110 above should be organized jointly by the Subsidiary Body for Implementation and the Subsidiary Body for Scientific and Technological Advice and should take place on an ongoing basis until 2020;

114. *Also decides* to conduct in 2017 an assessment of the process referred to in paragraph 110 above so as to improve its effectiveness;

115. *Resolves* to enhance the provision of urgent and adequate finance, technology and capacity-building support by developed country Parties in order to enhance the level of ambition of pre-2020 action by Parties, and in this regard *strongly urges* developed country Parties to scale up their level of financial support, with a concrete roadmap to achieve the goal of jointly providing USD 100 billion annually by 2020 for mitigation and adaptation while significantly increasing adaptation finance from current levels and to further provide appropriate technology and capacity-building support;

116. *Decides* to conduct a facilitative dialogue in conjunction with the twenty-second session of the Conference of the Parties to assess the progress in implementing decision 1/CP.19, paragraphs 3 and 4, and identify relevant opportunities to enhance the provision of financial resources, including for technology development and transfer and capacity-building support, with a view to identifying ways to enhance the ambition of mitigation efforts by all Parties, including identifying relevant opportunities to enhance the provision and mobilization of support and enabling environments;

117. *Acknowledges* with appreciation the results of the Lima-Paris Action Agenda, which build on the climate summit convened on 23 September 2014 by the Secretary-General of the United Nations;

118. *Welcomes* the efforts of non-Party stakeholders to scale up their climate actions, and *encourages* the registration of those actions in the Non-State Actor Zone for Climate Action platform;[3]

119. *Encourages* Parties to work closely with non-Party stakeholders to catalyse efforts to strengthen mitigation and adaptation action;

120. *Also encourages* non-Party stakeholders to increase their engagement in the processes referred to in paragraph 110 above and paragraph 125 below;

121. *Agrees* to convene, pursuant to decision 1/CP.20, paragraph 21, building on the Lima-Paris Action Agenda and in conjunction with each session of the Conference of the Parties during the period 2016–2020, a high-level event that:

(a) Further strengthens high-level engagement on the implementation of policy options and actions arising from the processes referred to in paragraph 110 above and paragraph below, drawing on the summary for policymakers referred to in paragraph 112(c) above;

(b) Provides an opportunity for announcing new or strengthened voluntary efforts, initiatives and coalitions, including the implementation of policies, practices and actions arising from the processes referred to in paragraph 110 above and paragraph 125 below and presented in the summary for policymakers referred to in paragraph 112(c) above;

(c) Takes stock of related progress and recognizes new or strengthened voluntary efforts, initiatives and coalitions;

(d) Provides meaningful and regular opportunities for the effective high-level engagement of dignitaries of Parties, international organizations, international cooperative initiatives and non-Party stakeholders;

122. *Decides* that two high-level champions shall be appointed to act on behalf of the President of the Conference of the Parties to facilitate through strengthened high-level engagement in the period 2016–2020 the successful execution of existing efforts and the scaling-up and introduction of new or strengthened voluntary efforts, initiatives and coalitions, including by:

(a) Working with the Executive Secretary and the current and incoming Presidents of the Conference of the Parties to coordinate the annual high-level event referred to in paragraph 121 above;

(b) Engaging with interested Parties and non-Party stakeholders, including to further the voluntary initiatives of the Lima-Paris Action Agenda;

[3] <http://climateaction.unfccc.int/>.

(c) Providing guidance to the secretariat on the organization of technical expert meetings referred to in paragraph 112(a) above and paragraph 130(a) below;

123. *Also decides* that the high-level champions referred to in paragraph 122 above should normally serve for a term of two years, with their terms overlapping for a full year to ensure continuity, such that:

(a) The President of the Conference of the Parties of the twenty-first session should appoint one champion, who should serve for one year from the date of the appointment until the last day of the Conference of the Parties at its twenty-second session;

(b) The President of the Conference of the Parties of the twenty-second session should appoint one champion who should serve for two years from the date of the appointment until the last day of the Conference of the Parties at its twenty-third session (November 2017);

(c) Thereafter, each subsequent President of the Conference of the Parties should appoint one champion who should serve for two years and succeed the previously appointed champion whose term has ended;

124. *Invites* all interested Parties and relevant organizations to provide support for the work of the champions referred to in paragraph 122 above;

125. *Decides* to launch, in the period 2016–2020, a technical examination process on adaptation;

126. *Also decides* that the technical examination process on adaptation referred to in paragraph 125 above will endeavour to identify concrete opportunities for strengthening resilience, reducing vulnerabilities and increasing the understanding and implementation of adaptation actions;

127. *Further decides* that the technical examination process referred to in paragraph 125 above should be organized jointly by the Subsidiary Body for Implementation and the Subsidiary Body for Scientific and Technological Advice, and conducted by the Adaptation Committee;

128. *Decides* that the process referred to in paragraph 125 above will be pursued by:

(a) Facilitating the sharing of good practices, experiences and lessons learned;

(b) Identifying actions that could significantly enhance the implementation of adaptation actions, including actions that could enhance economic diversification and have mitigation co-benefits;

(c) Promoting cooperative action on adaptation;

(d) Identifying opportunities to strengthen enabling environments and enhance the provision of support for adaptation in the context of specific policies, practices and actions;

129. *Also decides* that the technical examination process on adaptation referred to in paragraph 125 above will take into account the process, modalities, outputs, outcomes and lessons learned from the technical examination process on mitigation referred to in paragraph 110 above;

130. *Requests* the secretariat to support the technical examination process referred to in paragraph 125 above by:

(a) Organizing regular technical expert meetings focusing on specific policies, strategies and actions;

(b) Preparing annually, on the basis of the meetings referred to in paragraph 130(a) above and in time to serve as an input to the summary for policymakers referred to in paragraph 112(c) above, a technical paper on opportunities to enhance adaptation action, as well as options to support their implementation, information on which should be made available in a user-friendly online format;

131. *Decides* that in conducting the process referred to in paragraph 125 above, the Adaptation Committee will engage with and explore ways to take into account, synergize with and build on the existing arrangements for adaptation-related work programmes, bodies and institutions under the Convention so as to ensure coherence and maximum value;

132. *Also decides* to conduct, in conjunction with the assessment referred to in paragraph 120 above, an assessment of the process referred to in paragraph 125 above, so as to improve its effectiveness;

133. *Invites* Parties and observer organizations to submit information on the opportunities referred to in paragraph 126 above by 3 February 2016;

V. NON-PARTY STAKEHOLDERS

134. *Welcomes* the efforts of all non-Party stakeholders to address and respond to climate change, including those of civil society, the private sector, financial institutions, cities and other subnational authorities;

135. *Invites* the non-Party stakeholders referred to in paragraph 134 above to scale up their efforts and support actions to reduce emissions and/or to build resilience and decrease vulnerability to the adverse effects of climate change and demonstrate these efforts via the Non-State Actor Zone for Climate Action platform[4] referred to in paragraph 118 above;

136. *Recognizes* the need to strengthen knowledge, technologies, practices and efforts of local communities and indigenous peoples related to addressing and responding to climate change, and *establishes* a platform for the exchange of experiences and sharing of best practices on mitigation and adaptation in a holistic and integrated manner;

137. *Also recognizes* the important role of providing incentives for emission reduction activities, including tools such as domestic policies and carbon pricing;

VI. ADMINISTRATIVE AND BUDGETARY MATTERS

138. *Takes note* of the estimated budgetary implications of the activities to be undertaken by the secretariat referred to in this decision and requests that the actions of the secretariat called for in this decision be undertaken subject to the availability of financial resources;

139. *Emphasizes* the urgency of making additional resources available for the implementation of the relevant actions, including actions referred to in this decision, and the implementation of the work programme referred to in paragraph 9 above;

140. *Urges* Parties to make voluntary contributions for the timely implementation of this decision.

[4] <http://climateaction.unfccc.int/>.

Annex

PARIS AGREEMENT

The Parties to this Agreement,

Being Parties to the United Nations Framework Convention on Climate Change, hereinafter referred to as "the Convention",

Pursuant to the Durban Platform for Enhanced Action established by decision 1/CP.17 of the Conference of the Parties to the Convention at its seventeenth session,

In pursuit of the objective of the Convention, and being guided by its principles, including the principle of equity and common but differentiated responsibilities and respective capabilities, in the light of different national circumstances,

Recognizing the need for an effective and progressive response to the urgent threat of climate change on the basis of the best available scientific knowledge,

Also recognizing the specific needs and special circumstances of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change, as provided for in the Convention,

Taking full account of the specific needs and special situations of the least developed countries with regard to funding and transfer of technology,

Recognizing that Parties may be affected not only by climate change, but also by the impacts of the measures taken in response to it,

Emphasizing the intrinsic relationship that climate change actions, responses and impacts have with equitable access to sustainable development and eradication of poverty,

Recognizing the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change,

Taking into account the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities,

Acknowledging that climate change is a common concern of humankind, Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples, local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development, as well as gender equality, empowerment of women and intergenerational equity,

Recognizing the importance of the conservation and enhancement, as appropriate, of sinks and reservoirs of the greenhouse gases referred to in the Convention,

Noting the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognized by some cultures as Mother Earth, and noting the importance for some of the concept of "climate justice", when taking action to address climate change,

Affirming the importance of education, training, public awareness, public participation, public access to information and cooperation at all levels on the matters addressed in this Agreement,

Recognizing the importance of the engagements of all levels of government and various actors, in accordance with respective national legislations of Parties, in addressing climate change,

Also recognizing that sustainable lifestyles and sustainable patterns of consumption and production, with developed country Parties taking the lead, play an important role in addressing climate change,

Have agreed as follows:

Article 1

For the purpose of this Agreement, the definitions contained in Article 1 of the Convention shall apply. In addition:

1. "Convention" means the United Nations Framework Convention on Climate Change, adopted in New York on 9 May 1992.
2. "Conference of the Parties" means the Conference of the Parties to the Convention.
3. "Party" means a Party to this Agreement.

Article 2

1. This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:
   (a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
   (b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production;
   (c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.
2. This Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

Article 3

As nationally determined contributions to the global response to climate change, all Parties are to undertake and communicate ambitious efforts as defined in Articles 4, 7, 9, 10, 11 and 13 with the view to achieving the purpose of this Agreement as set out in Article 2. The efforts of all Parties will represent a progression over time, while recognizing the need to support developing country Parties for the effective implementation of this Agreement.

Article 4

1. In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.
2. Each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures with the aim of achieving the objectives of such contributions.
3. Each Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.
4. Developed country Parties shall continue taking the lead by undertaking economy-wide absolute emission reduction targets. Developing country Parties should continue enhancing their mitigation efforts, and are encouraged to move over time towards economy-wide emission reduction or limitation targets in the light of different national circumstances.
5. Support shall be provided to developing country Parties for the implementation of this Article, in accordance with Articles 9, 10 and 11, recognizing that enhanced support for developing country Parties will allow for higher ambition in their actions.

6. The least developed countries and small island developing States may prepare and communicate strategies, plans and actions for low greenhouse gas emissions development reflecting their special circumstances.

7. Mitigation co-benefits resulting from Parties' adaptation actions and/or economic diversification plans can contribute to mitigation outcomes under this Article.

8. In communicating their nationally determined contributions, all Parties shall provide the information necessary for clarity, transparency and understanding in accordance with decision 1/CP.21 and any relevant decisions of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.

9. Each Party shall communicate a nationally determined contribution every five years in accordance with decision 1/CP.21 and any relevant decisions of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement and be informed by the outcomes of the global stocktake referred to in Article 14.

10. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall consider common time frames for nationally determined contributions at its first session.

11. A Party may at any time adjust its existing nationally determined contribution with a view to enhancing its level of ambition, in accordance with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.

12. Nationally determined contributions communicated by Parties shall be recorded in a public registry maintained by the secretariat.

13. Parties shall account for their nationally determined contributions. In accounting for anthropogenic emissions and removals corresponding to their nationally determined contributions, Parties shall promote environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting, in accordance with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.

14. In the context of their nationally determined contributions, when recognizing and implementing mitigation actions with respect to anthropogenic emissions and removals, Parties should take into account, as appropriate, existing methods and guidance under the Convention, in the light of the provisions of paragraph 13 of this Article.

15. Parties shall take into consideration in the implementation of this Agreement the concerns of Parties with economies most affected by the impacts of response measures, particularly developing country Parties.

16. Parties, including regional economic integration organizations and their member States, that have reached an agreement to act jointly under paragraph 2 of this Article shall notify the secretariat of the terms of that agreement, including the emission level allocated to each Party within the relevant time period, when they communicate their nationally determined contributions. The secretariat shall in turn inform the Parties and signatories to the Convention of the terms of that agreement.

17. Each party to such an agreement shall be responsible for its emission level as set out in the agreement referred to in paragraph 16 above in accordance with paragraphs 13 and 14 of this Article and Articles 13 and 15.

18. If Parties acting jointly do so in the framework of, and together with, a regional economic integration organization which is itself a Party to this Agreement, each member State of that regional economic integration organization individually, and together with the regional economic integration organization, shall be responsible for its emission level as set out in the agreement communicated under paragraph 16 of this Article in accordance with paragraphs 13 and 14 of this Article and Articles 13 and 15.

19. All Parties should strive to formulate and communicate long-term low greenhouse gas emission development strategies, mindful of Article 2 taking into account their common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

Article 5

1. Parties should take action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases as referred to in Article 4, paragraph 1(d), of the Convention, including forests.

2. Parties are encouraged to take action to implement and support, including through results-based payments, the existing framework as set out in related guidance and decisions already agreed under the Convention for: policy approaches and positive incentives for activities relating to reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon

stocks in developing countries; and alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests, while reaffirming the importance of incentivizing, as appropriate, non-carbon benefits associated with such approaches.

Article 6

1. Parties recognize that some Parties choose to pursue voluntary cooperation in the implementation of their nationally determined contributions to allow for higher ambition in their mitigation and adaptation actions and to promote sustainable development and environmental integrity.
2. Parties shall, where engaging on a voluntary basis in cooperative approaches that involve the use of internationally transferred mitigation outcomes towards nationally determined contributions, promote sustainable development and ensure environmental integrity and transparency, including in governance, and shall apply robust accounting to ensure, inter alia, the avoidance of double counting, consistent with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.
3. The use of internationally transferred mitigation outcomes to achieve nationally determined contributions under this Agreement shall be voluntary and authorized by participating Parties.
4. A mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development is hereby established under the authority and guidance of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for use by Parties on a voluntary basis. It shall be supervised by a body designated by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, and shall aim:
   (a) To promote the mitigation of greenhouse gas emissions while fostering sustainable development;
   (b) To incentivize and facilitate participation in the mitigation of greenhouse gas emissions by public and private entities authorized by a Party;
   (c) To contribute to the reduction of emission levels in the host Party, which will benefit from mitigation activities resulting in emission reductions that can also be used by another Party to fulfil its nationally determined contribution; and
   (d) To deliver an overall mitigation in global emissions.
5. Emission reductions resulting from the mechanism referred to in paragraph 4 of this Article shall not be used to demonstrate achievement of the host Party's nationally determined contribution if used by another Party to demonstrate achievement of its nationally determined contribution.
6. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall ensure that a share of the proceeds from activities under the mechanism referred to in paragraph 4 of this Article is used to cover administrative expenses as well as to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.
7. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall adopt rules, modalities and procedures for the mechanism referred to in paragraph 4 of this Article at its first session.
8. Parties recognize the importance of integrated, holistic and balanced non-market approaches being available to Parties to assist in the implementation of their nationally determined contributions, in the context of sustainable development and poverty eradication, in a coordinated and effective manner, including through, inter alia, mitigation, adaptation, finance, technology transfer and capacity-building, as appropriate. These approaches shall aim to:
   (a) Promote mitigation and adaptation ambition;
   (b) Enhance public and private participation in the implementation of nationally determined contributions; and
   (c) Enable opportunities for coordination across instruments and relevant institutional arrangements.
9. A framework for non-market approaches to sustainable development is hereby defined to promote the non-market approaches referred to in paragraph 8 of this Article.

Article 7

1. Parties hereby establish the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal referred to in Article 2.
2. Parties recognize that adaptation is a global challenge faced by all with local, subnational, national, regional and international dimensions, and that it is a key component of and makes a contribution to the long-term global response to climate change to protect people, livelihoods and ecosystems, taking into account the urgent and immediate needs of those developing country Parties that are particularly vulnerable to the adverse effects of climate change.
3. The adaptation efforts of developing country Parties shall be recognized, in accordance with the modalities to be adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session.
4. Parties recognize that the current need for adaptation is significant and that greater levels of mitigation can reduce the need for additional adaptation efforts, and that greater adaptation needs can involve greater adaptation costs.
5. Parties acknowledge that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate.
6. Parties recognize the importance of support for and international cooperation on adaptation efforts and the importance of taking into account the needs of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change.
7. Parties should strengthen their cooperation on enhancing action on adaptation, taking into account the Cancun Adaptation Framework, including with regard to:
   (a) Sharing information, good practices, experiences and lessons learned, including, as appropriate, as these relate to science, planning, policies and implementation in relation to adaptation actions;
   (b) Strengthening institutional arrangements, including those under the Convention that serve this Agreement, to support the synthesis of relevant information and knowledge, and the provision of technical support and guidance to Parties;
   (c) Strengthening scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision-making;
   (d) Assisting developing country Parties in identifying effective adaptation practices, adaptation needs, priorities, support provided and received for adaptation actions and efforts, and challenges and gaps, in a manner consistent with encouraging good practices;
   (e) Improving the effectiveness and durability of adaptation actions.
8. United Nations specialized organizations and agencies are encouraged to support the efforts of Parties to implement the actions referred to in paragraph 7 of this Article, taking into account the provisions of paragraph 5 of this Article.
9. Each Party shall, as appropriate, engage in adaptation planning processes and the implementation of actions, including the development or enhancement of relevant plans, policies and/or contributions, which may include:
   (a) The implementation of adaptation actions, undertakings and/or efforts;
   (b) The process to formulate and implement national adaptation plans;
   (c) The assessment of climate change impacts and vulnerability, with a view to formulating nationally determined prioritized actions, taking into account vulnerable people, places and ecosystems;
   (d) Monitoring and evaluating and learning from adaptation plans, policies, programmes and actions; and
   (e) Building the resilience of socioeconomic and ecological systems, including through economic diversification and sustainable management of natural resources.

10. Each Party should, as appropriate, submit and update periodically an adaptation communication, which may include its priorities, implementation and support needs, plans and actions, without creating any additional burden for developing country Parties.

11. The adaptation communication referred to in paragraph 10 of this Article shall be, as appropriate, submitted and updated periodically, as a component of or in conjunction with other communications or documents, including a national adaptation plan, a nationally determined contribution as referred to in Article 4, paragraph 2, and/or a national communication.

12. The adaptation communications referred to in paragraph 10 of this Article shall be recorded in a public registry maintained by the secretariat.

13. Continuous and enhanced international support shall be provided to developing country Parties for the implementation of paragraphs 7, 9, 10 and 11 of this Article, in accordance with the provisions of Articles 9, 10 and 11.

14. The global stocktake referred to in Article 14 shall, inter alia:

    (a) Recognize adaptation efforts of developing country Parties;

    (b) Enhance the implementation of adaptation action taking into account the adaptation communication referred to in paragraph 10 of this Article;

    (c) Review the adequacy and effectiveness of adaptation and support provided for adaptation; and

    (d) Review the overall progress made in achieving the global goal on adaptation referred to in paragraph 1 of this Article.

Article 8

1. Parties recognize the importance of averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage.

2. The Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts shall be subject to the authority and guidance of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement and may be enhanced and strengthened, as determined by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.

3. Parties should enhance understanding, action and support, including through the Warsaw International Mechanism, as appropriate, on a cooperative and facilitative basis with respect to loss and damage associated with the adverse effects of climate change.

4. Accordingly, areas of cooperation and facilitation to enhance understanding, action and support may include:

    (a) Early warning systems;

    (b) Emergency preparedness;

    (c) Slow onset events;

    (d) Events that may involve irreversible and permanent loss and damage;

    (e) Comprehensive risk assessment and management;

    (f) Risk insurance facilities, climate risk pooling and other insurance solutions;

    (g) Non-economic losses;

    (h) Resilience of communities, livelihoods and ecosystems.

5. The Warsaw International Mechanism shall collaborate with existing bodies and expert groups under the Agreement, as well as relevant organizations and expert bodies outside the Agreement.

Article 9

1. Developed country Parties shall provide financial resources to assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention.

2. Other Parties are encouraged to provide or continue to provide such support voluntarily.

3. As part of a global effort, developed country Parties should continue to take the lead in mobilizing climate finance from a wide variety of sources, instruments and channels, noting the significant role of public funds,

through a variety of actions, including supporting country-driven strategies, and taking into account the needs and priorities of developing country Parties. Such mobilization of climate finance should represent a progression beyond previous efforts.

4. The provision of scaled-up financial resources should aim to achieve a balance between adaptation and mitigation, taking into account country-driven strategies, and the priorities and needs of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change and have significant capacity constraints, such as the least developed countries and small island developing States, considering the need for public and grant-based resources for adaptation.

5. Developed country Parties shall biennially communicate indicative quantitative and qualitative information related to paragraphs 1 and 3 of this Article, as applicable, including, as available, projected levels of public financial resources to be provided to developing country Parties. Other Parties providing resources are encouraged to communicate biennially such information on a voluntary basis.

6. The global stocktake referred to in Article 14 shall take into account the relevant information provided by developed country Parties and/or Agreement bodies on efforts related to climate finance.

7. Developed country Parties shall provide transparent and consistent information on support for developing country Parties provided and mobilized through public interventions biennially in accordance with the modalities, procedures and guidelines to be adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, at its first session, as stipulated in Article 13, paragraph 13. Other Parties are encouraged to do so.

8. The Financial Mechanism of the Convention, including its operating entities, shall serve as the financial mechanism of this Agreement.

9. The institutions serving this Agreement, including the operating entities of the Financial Mechanism of the Convention, shall aim to ensure efficient access to financial resources through simplified approval procedures and enhanced readiness support for developing country Parties, in particular for the least developed countries and small island developing States, in the context of their national climate strategies and plans.

Article 10

1. Parties share a long-term vision on the importance of fully realizing technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions.

2. Parties, noting the importance of technology for the implementation of mitigation and adaptation actions under this Agreement and recognizing existing technology deployment and dissemination efforts, shall strengthen cooperative action on technology development and transfer.

3. The Technology Mechanism established under the Convention shall serve this Agreement.

4. A technology framework is hereby established to provide overarching guidance for the work of the Technology Mechanism in promoting and facilitating enhanced action on technology development and transfer in order to support the implementation of this Agreement, in pursuit of the long-term vision referred to in paragraph 1 of this Article.

5. Accelerating, encouraging and enabling innovation is critical for an effective, long-term global response to climate change and promoting economic growth and sustainable development. Such effort shall be, as appropriate, supported, including by the Technology Mechanism and, through financial means, by the Financial Mechanism of the Convention, for collaborative approaches to research and development, and facilitating access to technology, in particular for early stages of the technology cycle, to developing country Parties.

6. Support, including financial support, shall be provided to developing country Parties for the implementation of this Article, including for strengthening cooperative action on technology development and transfer at different stages of the technology cycle, with a view to achieving a balance between support for mitigation and adaptation. The global stocktake referred to in Article 14 shall take into account available information on efforts related to support on technology development and transfer for developing country Parties.

Article 11

1. Capacity-building under this Agreement should enhance the capacity and ability of developing country Parties, in particular countries with the least capacity, such as the least developed countries, and those that are particularly vulnerable to the adverse effects of climate change, such as small island developing States, to take

effective climate change action, including, inter alia, to implement adaptation and mitigation actions, and should facilitate technology development, dissemination and deployment, access to climate finance, relevant aspects of education, training and public awareness, and the transparent, timely and accurate communication of information.

2. Capacity-building should be country-driven, based on and responsive to national needs, and foster country ownership of Parties, in particular, for developing country Parties, including at the national, subnational and local levels. Capacity-building should be guided by lessons learned, including those from capacity-building activities under the Convention, and should be an effective, iterative process that is participatory, cross-cutting and gender-responsive.

3. All Parties should cooperate to enhance the capacity of developing country Parties to implement this Agreement. Developed country Parties should enhance support for capacity-building actions in developing country Parties.

4. All Parties enhancing the capacity of developing country Parties to implement this Agreement, including through regional, bilateral and multilateral approaches, shall regularly communicate on these actions or measures on capacity-building. Developing country Parties should regularly communicate progress made on implementing capacity-building plans, policies, actions or measures to implement this Agreement.

5. Capacity-building activities shall be enhanced through appropriate institutional arrangements to support the implementation of this Agreement, including the appropriate institutional arrangements established under the Convention that serve this Agreement. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall, at its first session, consider and adopt a decision on the initial institutional arrangements for capacity-building.

Article 12

Parties shall cooperate in taking measures, as appropriate, to enhance climate change education, training, public awareness, public participation and public access to information, recognizing the importance of these steps with respect to enhancing actions under this Agreement.

Article 13

1. In order to build mutual trust and confidence and to promote effective implementation, an enhanced transparency framework for action and support, with built-in flexibility which takes into account Parties' different capacities and builds upon collective experience is hereby established.

2. The transparency framework shall provide flexibility in the implementation of the provisions of this Article to those developing country Parties that need it in the light of their capacities. The modalities, procedures and guidelines referred to in paragraph 13 of this Article shall reflect such flexibility.

3. The transparency framework shall build on and enhance the transparency arrangements under the Convention, recognizing the special circumstances of the least developed countries and small island developing States, and be implemented in a facilitative, non-intrusive, non-punitive manner, respectful of national sovereignty, and avoid placing undue burden on Parties.

4. The transparency arrangements under the Convention, including national communications, biennial reports and biennial update reports, international assessment and review and international consultation and analysis, shall form part of the experience drawn upon for the development of the modalities, procedures and guidelines under paragraph 13 of this Article.

5. The purpose of the framework for transparency of action is to provide a clear understanding of climate change action in the light of the objective of the Convention as set out in its Article 2, including clarity and tracking of progress towards achieving Parties' individual nationally determined contributions under Article 4, and Parties' adaptation actions under Article 7, including good practices, priorities, needs and gaps, to inform the global stocktake under Article 14.

6. The purpose of the framework for transparency of support is to provide clarity on support provided and received by relevant individual Parties in the context of climate change actions under Articles 4, 7, 9, 10 and 11, and, to the extent possible, to provide a full overview of aggregate financial support provided, to inform the global stocktake under Article 14.

7. Each Party shall regularly provide the following information:

(a) A national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases, prepared using good practice methodologies accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;

(b) Information necessary to track progress made in implementing and achieving its nationally determined contribution under Article 4.

8. Each Party should also provide information related to climate change impacts and adaptation under Article 7, as appropriate.

9. Developed country Parties shall, and other Parties that provide support should, provide information on financial, technology transfer and capacity-building support provided to developing country Parties under Article 9, 10 and 11.

10. Developing country Parties should provide information on financial, technology transfer and capacity-building support needed and received under Articles 9, 10 and 11.

11. Information submitted by each Party under paragraphs 7 and 9 of this Article shall undergo a technical expert review, in accordance with decision 1/CP.21. For those developing country Parties that need it in the light of their capacities, the review process shall include assistance in identifying capacity-building needs. In addition, each Party shall participate in a facilitative, multilateral consideration of progress with respect to efforts under Article 9, and its respective implementation and achievement of its nationally determined contribution.

12. The technical expert review under this paragraph shall consist of a consideration of the Party's support provided, as relevant, and its implementation and achievement of its nationally determined contribution. The review shall also identify areas of improvement for the Party, and include a review of the consistency of the information with the modalities, procedures and guidelines referred to in paragraph 13 of this Article, taking into account the flexibility accorded to the Party under paragraph 2 of this Article. The review shall pay particular attention to the respective national capabilities and circumstances of developing country Parties.

13. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall, at its first session, building on experience from the arrangements related to transparency under the Convention, and elaborating on the provisions in this Article, adopt common modalities, procedures and guidelines, as appropriate, for the transparency of action and support.

14. Support shall be provided to developing countries for the implementation of this Article.

15. Support shall also be provided for the building of transparency-related capacity of developing country Parties on a continuous basis.

Article 14

1. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall periodically take stock of the implementation of this Agreement to assess the collective progress towards achieving the purpose of this Agreement and its long-term goals (referred to as the "global stocktake"). It shall do so in a comprehensive and facilitative manner, considering mitigation, adaptation and the means of implementation and support, and in the light of equity and the best available science.

2. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall undertake its first global stocktake in 2023 and every five years thereafter unless otherwise decided by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.

3. The outcome of the global stocktake shall inform Parties in updating and enhancing, in a nationally determined manner, their actions and support in accordance with the relevant provisions of this Agreement, as well as in enhancing international cooperation for climate action.

Article 15

1. A mechanism to facilitate implementation of and promote compliance with the provisions of this Agreement is hereby established.

2. The mechanism referred to in paragraph 1 of this Article shall consist of a committee that shall be expert-based and facilitative in nature and function in a manner that is transparent, non-adversarial and non-punitive. The committee shall pay particular attention to the respective national capabilities and circumstances of Parties.

3. The committee shall operate under the modalities and procedures adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session and report annually to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.

Article 16

1. The Conference of the Parties, the supreme body of the Convention, shall serve as the meeting of the Parties to this Agreement.
2. Parties to the Convention that are not Parties to this Agreement may participate as observers in the proceedings of any session of the Conference of the Parties serving as the meeting of the Parties to this Agreement. When the Conference of the Parties serves as the meeting of the Parties to this Agreement, decisions under this Agreement shall be taken only by those that are Parties to this Agreement.
3. When the Conference of the Parties serves as the meeting of the Parties to this Agreement, any member of the Bureau of the Conference of the Parties representing a Party to the Convention but, at that time, not a Party to this Agreement, shall be replaced by an additional member to be elected by and from amongst the Parties to this Agreement.
4. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall keep under regular review the implementation of this Agreement and shall make, within its mandate, the decisions necessary to promote its effective implementation. It shall perform the functions assigned to it by this Agreement and shall:
   (a) Establish such subsidiary bodies as deemed necessary for the implementation of this Agreement; and
   (b) Exercise such other functions as may be required for the implementation of this Agreement.
5. The rules of procedure of the Conference of the Parties and the financial procedures applied under the Convention shall be applied mutatis mutandis under this Agreement, except as may be otherwise decided by consensus by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.
6. The first session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall be convened by the secretariat in conjunction with the first session of the Conference of the Parties that is scheduled after the date of entry into force of this Agreement. Subsequent ordinary sessions of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall be held in conjunction with ordinary sessions of the Conference of the Parties, unless otherwise decided by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.
7. Extraordinary sessions of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall be held at such other times as may be deemed necessary by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement or at the written request of any Party, provided that, within six months of the request being communicated to the Parties by the secretariat, it is supported by at least one third of the Parties.
8. The United Nations and its specialized agencies and the International Atomic Energy Agency, as well as any State member thereof or observers thereto not party to the Convention, may be represented at sessions of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement as observers. Any body or agency, whether national or international, governmental or non-governmental, which is qualified in matters covered by this Agreement and which has informed the secretariat of its wish to be represented at a session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement as an observer, may be so admitted unless at least one third of the Parties present object. The admission and participation of observers shall be subject to the rules of procedure referred to in paragraph 5 of this Article.

Article 17

1. The secretariat established by Article 8 of the Convention shall serve as the secretariat of this Agreement.
2. Article 8, paragraph 2, of the Convention on the functions of the secretariat, and Article 8, paragraph 3, of the Convention, on the arrangements made for the functioning of the secretariat, shall apply mutatis mutandis to this Agreement. The secretariat shall, in addition, exercise the functions assigned to it under this Agreement and by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.

Article 18

1. The Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation established by Articles 9 and 10 of the Convention shall serve, respectively, as the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation of this Agreement. The provisions of the Convention relating to the functioning of these two bodies shall apply mutatis mutandis to this Agreement. Sessions of the meetings of the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation of this Agreement shall be held in conjunction with the meetings of, respectively, the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation of the Convention.
2. Parties to the Convention that are not Parties to this Agreement may participate as observers in the proceedings of any session of the subsidiary bodies. When the subsidiary bodies serve as the subsidiary bodies of this Agreement, decisions under this Agreement shall be taken only by those that are Parties to this Agreement.
3. When the subsidiary bodies established by Articles 9 and 10 of the Convention exercise their functions with regard to matters concerning this Agreement, any member of the bureaux of those subsidiary bodies representing a Party to the Convention but, at that time, not a Party to this Agreement, shall be replaced by an additional member to be elected by and from amongst the Parties to this Agreement.

Article 19

1. Subsidiary bodies or other institutional arrangements established by or under the Convention, other than those referred to in this Agreement, shall serve this Agreement upon a decision of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall specify the functions to be exercised by such subsidiary bodies or arrangements.
2. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement may provide further guidance to such subsidiary bodies and institutional arrangements.

Article 20

1. This Agreement shall be open for signature and subject to ratification, acceptance or approval by States and regional economic integration organizations that are Parties to the Convention. It shall be open for signature at the United Nations Headquarters in New York from 22 April 2016 to 21 April 2017. Thereafter, this Agreement shall be open for accession from the day following the date on which it is closed for signature. Instruments of ratification, acceptance, approval or accession shall be deposited with the Depositary.
2. Any regional economic integration organization that becomes a Party to this Agreement without any of its member States being a Party shall be bound by all the obligations under this Agreement. In the case of regional economic integration organizations with one or more member States that are Parties to this Agreement, the organization and its member States shall decide on their respective responsibilities for the performance of their obligations under this Agreement. In such cases, the organization and the member States shall not be entitled to exercise rights under this Agreement concurrently.
3. In their instruments of ratification, acceptance, approval or accession, regional economic integration organizations shall declare the extent of their competence with respect to the matters governed by this Agreement. These organizations shall also inform the Depositary, who shall in turn inform the Parties, of any substantial modification in the extent of their competence.

Article 21

1. This Agreement shall enter into force on the thirtieth day after the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55 percent of the total global greenhouse gas emissions have deposited their instruments of ratification, acceptance, approval or accession.
2. Solely for the limited purpose of paragraph 1 of this Article, "total global greenhouse gas emissions" means the most up-to-date amount communicated on or before the date of adoption of this Agreement by the Parties to the Convention.
3. For each State or regional economic integration organization that ratifies, accepts or approves this Agreement or accedes thereto after the conditions set out in paragraph 1 of this Article for entry into force have been fulfilled,

this Agreement shall enter into force on the thirtieth day after the date of deposit by such State or regional economic integration organization of its instrument of ratification, acceptance, approval or accession.

4. For the purposes of paragraph 1 of this Article, any instrument deposited by a regional economic integration organization shall not be counted as additional to those deposited by its member States.

Article 22

The provisions of Article 15 of the Convention on the adoption of amendments to the Convention shall apply mutatis mutandis to this Agreement.

Article 23

1. The provisions of Article 16 of the Convention on the adoption and amendment of annexes to the Convention shall apply mutatis mutandis to this Agreement.
2. Annexes to this Agreement shall form an integral part thereof and, unless otherwise expressly provided for, a reference to this Agreement constitutes at the same time a reference to any annexes thereto. Such annexes shall be restricted to lists, forms and any other material of a descriptive nature that is of a scientific, technical, procedural or administrative character.

Article 24

The provisions of Article 14 of the Convention on settlement of disputes shall apply mutatis mutandis to this Agreement.

Article 25

1. Each Party shall have one vote, except as provided for paragraph 2 of this Article.
2. Regional economic integration organizations, in matters within their competence, shall exercise their right to vote with a number of votes equal to the number of their member States that are Parties to this Agreement. Such an organization shall not exercise its right to vote if any of its member States exercises its right, and vice versa.

Article 26

The Secretary-General of the United Nations shall be the Depositary of this Agreement.

Article 27

No reservations may be made to this Agreement.

Article 28

1. At any time after three years from the date on which this Agreement has entered into force for a Party, that Party may withdraw from this Agreement by giving written notification to the Depositary.
2. Any such withdrawal shall take effect upon expiry of one year from the date of receipt by the Depositary of the notification of withdrawal, or on such later date as may be specified in the notification of withdrawal.
3. Any Party that withdraws from the Convention shall be considered as also having withdrawn from this Agreement.

Article 29

The original of this Agreement, of which the Arabic, Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations.

DONE at Paris this twelfth day of December two thousand and fifteen.

IN WITNESS WHEREOF, the undersigned, being duly authorized to that effect, have signed this Agreement.

Exhibit 2

GLOBAL CLIMATE LEADERSHIP

MEMORANDUM OF UNDERSTANDING (MOU)

I. Statement of Purpose

A. Climate change presents worldwide challenges and risks to environment and economies, impacting human health, increasing extreme weather events, threatening natural resources and triggering forced migration of populations. Impacts from climate change are already inevitable due to the greenhouse gas emissions (GHG) already resident in the atmosphere. At the same time, climate change responses and solutions create economic opportunities and benefits through sustainable energy and development. International efforts are necessary to ensure protection of humankind and our planet, and to limit the increase in global average temperature to below 2°C. To achieve this will require substantial emissions reductions over the next few decades and near zero emissions of CO2 and other long-lived GHGs by the end of the century.

[*(Intergovernmental Panel on Climate Change – Fifth assessment report (AR5))*]

B. Governments at all levels need act **now** to reduce GHG emissions in order to achieve long-term climate balance. Entities need to harness new technologies, policies, financing mechanisms, and economic incentives to reduce emissions while developing common metrics to measure their progress. Governments must also increase the resilience of infrastructure and natural systems to growing climate impacts.

C. While the signatories to this MOU (hereinafter referred to as "the Parties") acknowledge and affirm support of international activities and declarations to respond to climate change (including the Rio Declaration on Environment and Development (1992), the Montreal Declaration (2009), the Cancun Statement (2011), and the Lyon Declaration (2011)), international efforts on climate change to date have been inadequate to address the scale of the challenge we face. Despite limited progress in cooperation among nations, sub-national jurisdictions—including provinces, states, and cities—have led the world in setting ambitious climate targets and taking actions to reduce GHG emissions and protect against climate impacts.

D. By working together and building on agreements such as the Declaration of Rio de Janeiro 2012 (Federated States and Regional Governments Committed to a New Paradigm for Sustainable Development and Poverty Eradication), subnational governments, together with interested nations, can help to accelerate the world's response to climate change and provide a model for broader international cooperation among nations.

II. Reducing greenhouse gas emissions

A. The guiding principle for reduction of GHG emissions by 2050 must be to limit global warming to less than 2.C. For Parties to this MOU this means pursuing emission reductions consistent with a trajectory of 80 to 95 percent below 1990 levels

by 2050 and/or achieving a per capita annual emission goal of less than 2 metric tons by 2050.

B. In order to achieve this ambitious 2050 target, measurable progress must be made in the near-term to establish the trajectory of reductions needed. Midterm targets, including commitments for 2030 or earlier are critical. Recognizing that each party has unique challenges and opportunities, this agreement does not prescribe a specific path for 2030. Rather, Parties agree to undertake their own unique set of actions and plans in Appendix A to reach 2030 reduction goals and related targets.

C. Parties aim at broadly increasing energy efficiency and a comprehensive development of renewable energy to achieve the GHG emission goals. Parties set forth their 2030 goals and targets for these and other critical areas in Appendix A.

D. Specific areas of action, coordination, and cooperation:

The Parties agree that for actions related to this MOU, coordination and cooperation will be beneficial and will strengthen the efforts of participating states. The Parties agree to work together on solutions that provide near- and long-term environmental and economic co-benefits, including joint efforts where possible. The Parties may expand the list of specific areas of action set forth in this sub-section from time to time. The following is a non-exhaustive list of issues of interest for cooperation and coordination among the Parties:

1. Energy:

   The Parties agree to share information and experience on redesign of the power supply and grid, technical solutions and advances in promoting large-scale switch to renewable energy and the integration of renewable energy sources, actions needed to ensure security of supply, and strategies to promote energy efficiency.

2. Traffic and Transport:

   The Parties agree to take steps to reduce greenhouse gas emissions from passenger and freight vehicles, with the goal of broad adoption of "zero emission vehicles" and development of related zero emission infrastructure. The Parties agree to encourage land use planning and development that supports alternate modes of transit, especially public transit, biking, and walking.

3. Natural Resource Protection and Waste Reduction:

   The Parties agree to collaborate on methods to reduce emissions from the natural resources and waste sectors, which exist at the nexus of climate mitigation and adaptation activity. Parties will share information about management techniques to sequester carbon and protect natural infrastructure. Parties will share technologies to reduce waste or convert waste to secondary raw materials or to energy.

4. Science and Technology:

   The Parties agree to collaborate and coordinate on scientific assessment efforts, and share information and experience in technology development and deployment. Parties seek to help others learn from experience to maximize success of technological transitions and avoid potential obstacles.

5. Communication and Public Participation:

   The Parties agree to collaborate and coordinate on messaging, transparency, public outreach around climate change, mitigation of GHG emissions, adaptation, and the subject matter of this MOU.

6. Short-lived Climate Pollutants:

   The Parties agree to collaborate on the reduction of short-lived climate pollutants such as black carbon and methane, which will provide near-term air quality benefits, while also reducing potent climate forcing pollutants.

7. Inventory, Monitoring, Accounting, Transparency:

   The Parties agree to work towards consistent monitoring, reporting, and verification across jurisdictions, and will work through mechanisms such as the Compact of States and Regions and the Compact of Mayors to that end.

III. Adaptation and Resilience

A. The Parties agree to collaborate on actions to promote adaptation and resilience, with an eye toward maximizing benefits for both GHG emission reduction and climate adaptation.

B. Parties will share best practices in modeling and assessment to understand projected climate impacts, especially at the regional and local scale. Entities will share best practices in integrating these findings into planning and investment.

C. Parties will work together to build metrics and indicators that can help to track progress in reducing the risk of climate change to people, natural systems, and infrastructure.

D. In working to reduce climate risk, Parties will look to natural or "green" infrastructure solutions that maximize ecological benefits while providing protection. Parties will share best practices in designing and deploying these solutions.

E. Parties to this MOU will work to share innovative models for financing and supporting climate adaptation, including public-private partnerships, resilience funds, and competitive approaches.

IV. Means of Implementation

The Parties each have their own strategies to implement and achieve their goals and targets. While some strategies will be unique to particular Parties, others can be shared and/or modified by other Parties.

- Parties agree to collaborate and coordinate to advance respective interim targets consistent with 2050 goals and climate actions at the annual Conference of Parties and other international climate events.
- Parties agree to share and promote effective financing mechanisms domestically and internationally to the extent feasible.

- Parties agree to share technology to the extent feasible, such as through open source information.
- Parties agree to help build capacity for action and technology adaptation through technology transfer and expertise to the extent feasible.

This MOU is neither a contract nor a treaty.

[Signatures on following pages]

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE STATE OF CALIFORNIA

By: _____

Edmund G. Brown Jr.

Governor

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE STATE OF BADEN-WÜRTTEMBERG

By: _____

Winfried Kretschmann

Minister-President

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE STATE OF ACRE

By: _____

Magaly Medeiros

Director-President, The Institute on Climate Change

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE STATE OF BAJA CALIFORNIA

By: _____

Francisco Vega de Lamadrid

Governor

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE PROVINCE OF BRITISH COLUMBIA

By: _____

Christina Joan Clark

Premier

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE STATE OF CATALONIA

By: _____

Santi Vila Vicente

Minister of Territory and Sustainability

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE STATE OF JALISCO

By: _____

Jorge Aristóteles Sandoval Díaz

Governor

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE PROVINCE OF ONTARIO

By: _____

Glen Murray

Minister of the Environment and Climate Change

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE STATE OF OREGON

By: _____

Kate Brown

Governor

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE STATE OF VERMONT

By: _____

Peter Shumlin

Governor

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE GOVERNMENT OF WALES

By: _____

Carl Sargeant

Minister for Natural Resources

This Memorandum of Understanding on Subnational Global Climate Leadership signed as of the 19th day of May 2015.

THE STATE OF WASHINGTON

By: _____

Jay Inslee

Governor

APPENDIX A.1
CALIFORNIA

Overview

California is a leader in climate change action. The California Global Warming Solutions Act of 2006 (AB 32) established California as a global leader in reducing GHG emissions. To meet the goals of AB 32, the state adopted a three-pronged approach to reducing emissions, including adopting standards and regulations, providing emission reduction incentives via grant programs, and establishing a market-based compliance mechanism known as cap and trade. As of May 2014, 23 percent of California's electricity produced derives from renewable sources. California's economy-wide, legally binding emissions trading system, the cap and trade program, is the only such program in the United States. By 2020, California will reduce greenhouse gas (GHG) emissions by 17 percent to 1990 levels to 431 million metric tons of CO2e, and will generate at least 33 percent of its electricity from renewable sources. California is the world's leading market for electric vehicles and for stationary storage, including a requirement of 1300 MW of storage by 2020. These programs have become part of the dynamic economic engine that is California. Over the past five years, the State's gross domestic product has grown by five percent while the amount of carbon pollution has fallen. California solar companies employ more than 44,000 people. Over four decades, the state's appliance and building efficiency policies have saved consumers over $65 billion and created 1.5 million jobs. California's 2030 GHG emission reduction target is 40 percent below 1990 emission levels, which is consistent with its 80 percent reduction target for 2050.

Specific Actions and Commitments

Understanding California's role in reducing GHG emissions to mitigate climate change and protect the state's residents and economy from a changing climate, Governor Jerry Brown issued Executive Order B-30-15 to establish a GHG emission reduction target of 40 percent below 1990 levels by 2030. Along with this target, the most ambitious in North America, the Governor also required state agencies to incorporate climate resiliency into planning and funding decisions to ensure that the State's resources withstand California's changing climate. To meet the GHG emission reduction target specified in the Executive Order, the Administration will pursue the following policies:

By 2030,

- Increase electricity derived from renewable resources to 50 percent.
- Reduce petroleum use in cars and trucks by up to 50 percent.
- Double energy efficiency achieved in existing buildings and make heating fuels cleaner.
- Reduce the release of short-lived climate pollutants, such as methane and black carbon.
- Increase carbon sequestration on farms and rangelands and in forests and wetlands.

Low Carbon Electricity

California will build on its 2020 target of a 33%-plus renewable portfolio with a goal of 50 percent by 2030. California will focus more specifically on GHG emission reductions from the power sector, through an increased renewable portfolio, demand reduction and response, increased storage paired with renewables, increased penetration of distributed renewables and storage, and actions at the grid level.

Decarbonization of Transportation

The transportation sector in California accounts for nearly 40 percent of its greenhouse gas emissions. Strategies for reducing carbon pollution must include transformation of the transportation fleet from older higher pollution vehicles and fuels to newer, near zero and zero emission vehicles and cleaner, less carbon intense fuels. California has set a goal of 1.5 million zero emission vehicles by 2025, adopted a Zero Emission Vehicle mandate, provided incentives for purchasers of ZEVs, established grants to accelerate charging infrastructure for battery electric vehicles and hydrogen fueling infrastructure for fuel cell electric vehicles, and developed programs to support near zero and zero emission vehicles and fuels in a wide variety of fleets from transit buses to port equipment. California's low carbon fuel standard requires a 10 percent reduction in the carbon intensity of transportation fuels in California by 2020. California is providing more zero emission transit options, changing land use and zoning to reduce vehicle miles traveled, and building a high speed rail network that will be the backbone of an integrated transit system. California has also adopted aggressive carbon pollution reduction requirements for all vehicles through 2026 and beyond. By 2030, California's transportation emissions will be significantly reduced, in line with the 2050 reduction goals. The State has set a goal of reducing the use of oil by up to 50% by 2030.

Energy Efficiency

California requires that all new residential construction be Zero Net Energy by 2020, and all non-residential be so by 2030. California's goal is to double energy efficiency in buildings by 2030. The State is developing additional cost-effective minimum efficiency standards for a variety of lighting, electronics and other common products. California is also instituting requirements for energy benchmarking of all non-residential buildings above 30,000 square feet. The State is also using standardized reporting and analysis tools for statewide assessment and trending of existing building energy performance patterns, which will call for evaluation of current and future actions. California's annual energy ratepayer investment of $1.2 billion in end-use energy efficiency is likely to increase. California is promoting a number of financing tools for home energy retrofits and will increase efforts to ensure a higher percentage of energy retrofits for existing homes and buildings.

Climate Policies and Emissions Trading

California's cap and trade program sets statewide limits on sources of 85 percent of greenhouse gas emissions, and helps establish a price for emissions and drive investments

towards cleaner energy, infrastructure, and fuels. The emission cap declines 2 to 3 percent through 2020. Sending the market a signal that the cap-and-trade program will continue in the long-term is critical to fully realizing the benefits of the program. Extending the cap-and-trade program beyond 2020 will also reduce the costs of the program as California industry and households make long-term capital and investment decisions. The level of the cap decline beyond 2020 will be commensurate with the emission reductions needed to meet the 2030 goal.

Natural Resources, Waste and Green Infrastructure

California's 100 million acres are critical to meeting all of the State's climate goals. The land base includes one of the world's biodiversity hotspots, provides more than 65 percent of the potable water used in state, produces food for millions of people, and sequesters carbon in trees, wetlands, grasslands, rangelands and soils, among other land types. California's 2014-15 investment in urban greening nearly exceeds the budget set by the US Forest Service for the entire country. The State's Desert Renewable Energy Conservation Plan couples renewable energy development with conservation in a 23 million acre area. California will target landscape health through broader investments in natural lands to ensure their ability to withstand climate change while increasing sequestration and provisioning of ecosystem services such as clean water, air and erosion control. These efforts will be complemented by organic waste diversion to produce rich compost for California's healthy soils and support reduced fertilizer use in California's agricultural fields. Further, by increasing forest health management efforts, California's residents will experience cleaner air through reduced severity of wildfires and increased access to electricity and heat derived from biomass.

Funding

California has multiple funding mechanisms to drive emissions reductions and is evaluating others. Cap and trade auction revenue, bonds, ratepayer funds, Property Assessed Clean Energy funding, and on-bill financing are among the mechanisms currently being used.

APPENDIX A.2

BADEN-WÜRTTEMBERG

The State of Baden-Württemberg, located in South West Germany, is one of the most prosperous regions in Europe. Baden-Württemberg is a pioneer in Germany and the EU. Though the state is embedded in the national German and the European climate policy, Baden-Württemberg undertakes its own contributions to achieve the political goal of acting as a pacemaker, particularly in Germany and the EU. For example, Baden-Württemberg, along with North Rhine-Westphalia, passed its own 'Climate Protection Act' as the first state in Germany. On this basis and with a broad public participation process an 'Integrated Energy and Climate Protection Action Plan (IEKK)' was developed. The IEKK includes over 100 measures to reduce greenhouse gas emissions in line with the German energy transition "Energiewende" and the decision to phase out nuclear energy production.

In the IEKK reduction targets are also defined for key sectors such as power generation, industry and the transport sector. The necessary basis was derived from an energy scenario for Baden-Württemberg; it shows possible paths to reach the GHG emission targets. The future energy needs were identified in different sectors and the level of potential coverage by renewable energy sources was identified. The greenhouse gas (GHG) emissions are split between three main sectors: electricity and heat production with around 23%, transport with slightly above 28% and energy consumers in household and small business with about 23%. About a third of the greenhouse gas emissions of Baden-Württemberg are covered by the EU emission trading system (ETS). The first ETS worldwide was installed in a pilot phase 2005–2007. In 2021 the fourth phase will start with an annual reduction of the emission-allowances in the EU climbing from 1,74% to 2,2%.

Baden-Württemberg aims to reduce greenhouse gas emissions by 2020 compared to 1990 by at least 25% and by 2050 by 90%. European heads of state have decided a greenhouse emissions reduction target for the year 2030 of 40% compared to 1990 to which a reasonable contribution of Baden-Württemberg is intended. Furthermore, the EU has decided to increase the share of renewable energy to 27% of primary energy in 2030 and to reduce energy consumption by 27%.

<u>The starting position:</u>

Population: 10.8 million (2013)

GDP: 37,472 EUR per capita (2013)

Country: Germany

GHG emissions (year): 76 million tons (2012)

<u>Specific Actions and Commitments:</u>

I. Greenhouse Gas Emissions

By 2020 Baden-Württemberg will reduce GHG emissions by 25% and by 2050 by 90% compared to 1990. The targets are laid down in the "Climate Protection Act Baden-Württemberg" which was enacted by the state parliament on 17th of July 2013. Against

this background an 'Integrated Energy and Climate Protection Action Plan (IEKK)' was developed. A periodical monitoring program will be established for the further development of the IEKK.

With regards to the EU 2030-targets of 40% THG reduction a reasonable contribution of Baden-Württemberg is intended.

II. Renewable Energy:

The amount of renewable energies in final energy consumption by 2020 will be increased up to 25%. The Baden-Württemberg objective for 2030 will be updated depending on the implementation of the EU 2030 target of 27%. Since 2011 Baden-Württemberg has improved the legal planning conditions for wind farms. In 2013 renewable energy covered about 23% of electric power production. In Germany the national Renewable Energy Law (EEG) promotes the generation of renewable energy.

At the national level there is a Statute on the Use of Renewable Heat Energy for new buildings. Additionally there are further funds in Baden-Württemberg for existing buildings. For example, in the case of a change of the radiator the owner must use regenerative heating energies or alternatively the energy efficiency of the house can be improved by better insulation of the roof or the front of the house.

III. Energy Efficiency:

By 2020 the final energy demand compared to 2010 will decrease by 16%. The EU 2030 target aims to increase the energy efficiency by 27%. Baden-Württemberg promotes energy efficiency through a wide range of measures, including a widespread network of regional energy agencies, which provide advice for households and businesses, campaigns for energetically retrofitting residential buildings, grant schemes on the latter for households, and grant schemes for energy efficiency in small and medium sized businesses. Baden-Württemberg emphasizes the combined generation of power and heat, ideally by use of renewable energies. Municipalities and electricity producers are encouraged to develop further local heat networks.

IV. Sustainable Mobility:

Baden-Württemberg has become a pioneering region for sustainable mobility. In the 'transport and mobility' sector Baden-Württemberg aims to reducing GHG emissions by 20 percent by 2020, compared to 1990. By 2050 the GHG emissions in this sector should be reduced by 70%. Therefore several actions are to be taken, like strengthening bicycle traffic, public transport and electro-mobility. To ensure constant progress towards these objectives numerous sub-goals have been agreed upon. For example, Baden-Württemberg intends to increase the share of bicycle traffic from 8% in 2008 to 16% by 2020 and increase the number of electric vehicles to 200.000 until 2020.

V. Role model of the state:

The state administration of Baden-Württemberg is pursuing the objective of near climate neutrally by 2040. Therefore Baden-Württemberg is pursuing a comprehensive retrofitting of its state-owned buildings in order to reduce its own energy consumption and is increasing the number of e-mobile vehicles in its car pools. Part of the scheme is to raise the share of renewable energies for state purposes.

VI. Emission Trading:

Baden-Württemberg industries are taking part in the EU emission trading system (ETS). Baden-Württemberg advocates for ensuring the ETS is an efficient instrument for reducing greenhouse gas emissions and climate protection.

APPENDIX A.3
ACRE

Appendix forthcoming.

APPENDIX A.4

BAJA CALIFORNIA

Baja California is a leading federal entity in the field of climate change and has an institutional framework for the prevention, mitigation and adaptation to the phenomenon, allowing it to make timely decisions, based on:

(a) Preventative State law, mitigation and adaptation of climate change for the State of Baja California (the first law in the country).

(b) State program on climate change for the State of Baja California

(c) Council on climate change for Baja California (where the government levels and the powers of the State are represented, as well as higher education institutions and civil society organizations).

Similarly, we have the results of a study called "Second phase of the State Program on climate change for Baja California", which identifies twenty-five (25) mitigation policies that have the best cost-benefit ratio to be implemented and which will allow us to reduce greenhouse gas emissions between 20% and 25% by the year 2030.

In this sense, the State Development Plan defines as a general objective of sustainable economic development section: managing regional development with representative population participation, with high levels of competitiveness, with the efficient allocation of functions and financial resources in departments of public administration, as well as urban, economic, and environmental institutional coordination for the promotion of investment , research and development of local productive options, the linking of regional vocations and border economy, the use of clean energy and environmental protection and the following commitments for the period 2014-2019 are established:

3.8.2. Environmental policies and climate change

3.8.2.1 Implement sustainable environmental public policies that mitigate the effects of climate change and that can adapt to rationally take advantage of natural resources.

3.8.2.2 Integrate the conservation of natural capital of the entity with the social and economic development. Develop and implement the environmental fund in such a way to ensure resources for the implementation of environmental policies.

3.8.2.3 Develop the environmental geographic information system and integrate it into the general system, to develop, implement and manage the territorial and ecological system of the State.

3.8.2.4. Developing and implementing protected areas, strategies and management plans for the conservation of biodiversity and the sustainable use of natural resources emblematic of Baja California.

Specific Actions and Commitments

CROSS-BORDER LINKAGE

I. 3.8.3. Intergovernmental and international coordination

3.8.3.1 Improve channels for intergovernmental and international coordination to address environmental problems with a regional, cross-border and long term vision.

CLEAN ENERGY

II. 3.9.3 Promote energy efficiency of industrial and commercial usage

3.9.3.2 Adapting current regulations applicable in the construction of state and municipal housing.

3.9.3.3 Promote and disseminate a saving and efficiency culture through institutional strengthening programs and awareness events.

III. 3.9.4. New sources of supplying energy

3.9.4.1. Encourage public and private investment in projects that generate, manage and commercialize alternative clean energy

3.9.4.2. Encourage public and private investment in programs that promote the creation of companies, training courses and professional development in the field of clean energy.

WATER MANAGEMENT

IV. 5.5.3 Use of treated wastewater

5.5.3.1 Promote and implement local and intercity projects of treated wastewater for irrigation of green urban areas, as well as agricultural, industrial, and ecological and recharge of aquifers.

V. 5.5.1. Drinking water

5.5.1.1 Ensure water supply sources and define alternatives for new sources, such as desalination of seawater.

URBAN MOBILITY AND VEHICLE EMISSIONS

VI. Systems of rapid transport (BRT) for the cities of Mexicali and Tijuana.

VII. Planning of bike paths, pedestrian walkways and green corridors – Diversify transportation in cities through the promotion of the use of bicycles, significantly improve the quality of urban routes, improvements in commute times, equity, health, road and personal safety, the environment and the tourist attractions of cities.

VIII. Environmental vehicle verification program. This is intended to verify that the motor vehicles in the State, comply with the emission limits allowed by the Mexican official standards.

IX. Paving programs for the cities of the State.

APPENDIX A.5

BRITISH COLUMBIA

British Columbia was the first jurisdiction in North America to introduce a carbon tax and require greenhouse gas emissions reduction targets by legislation – 33% below 2007 levels for 2020 and 80% below 2007 levels for 2050. The carbon tax was launched together with a suite of ambitious measures outlined in B.C.'s 2008 Climate Action Plan. The carbon tax and complementary policies allowed British Columbians to reach their 2012 interim emissions reduction target of 6% below 2007 levels. In the same period, the province's population and GDP increased, keeping pace with the Canadian average. This was a major milestone for the province and represented the first step in a longer journey toward achieving 2020 and 2050 targets. British Columbia will continue the internationally recognized leadership it began with the Climate Action Plan in 2008 and is currently developing a Climate Leadership Plan to keep British Columbia on track to achieve the 2020 and 2050 legislated greenhouse gas reduction targets, and support a growing economy.

The starting position:

Population: 4, 582, 600 (2013)
GDP: $50, 121.00 CAD per capita (2013)
Country: Canada
GHG emissions: 61.5 million tonnes CO_2e (2012)

Specific Actions and Commitments

Carbon Tax
British Columbia's revenue-neutral carbon tax remains the most comprehensive and ambitious of its kind in North America, establishing a model for other jurisdictions around the world. British Columbia's carbon tax applies to virtually all fossil fuels, including: gasoline, diesel, natural gas, coal, propane and home heating fuel. The carbon tax started at a rate based on $10 per tonne of carbon-dioxide equivalent emissions, and rose $5 each year over four years, reaching $30 per tonne in 2012. The revenue generated by this tax is returned to individuals and businesses through reductions in other taxes. Since the introduction of the tax, independent research has shown that fuel use per capita has fallen 17.4% between 2008 and 2012. British Columbia remains committed to a strong price on carbon, and works to encourage other jurisdictions to adopt similar measures.

Clean Power
The Province has legislation requiring 93% or more clean and renewable electricity generation. In November 2013, the Province approved BC Hydro's Integrated Resource Plan that shows that BC Hydro, the largest electricity utility in the province, is at 96% renewable electricity generation. There is currently no coal power generation in British Columbia. British Columbia's *Energy Plan: A Vision for Clean Energy Leadership*, set out a policy objective to require zero greenhouse gas emissions from any coal thermal electricity facilities in British Columbia. In December 2014, the Province made a final investment decision to develop Site C, a 1,100 MW hydro-electric facility on the Peace River—the third facility on the Peace River, demonstrating British Columbia's commitment to clean power. Energy utilities are required to pursue demand-

side measures (DSM) up to the cost of new clean generation resources before purchasing new generation. BC Hydro is required to meet 66% of new demand through DSM by 2020, and BC Hydro's Integrated Resource Plan shows BC Hydro plans to meet 78% of new demand through DSM.

Energy Efficiency

British Columbia sets energy performance standards to meet targets for market transformation of 66% displacement of electricity demand growth and 20% reduction in energy in houses by 2020. British Columbia recently adopted energy efficiency standards aligned with national and regional leaders for small battery charging systems (e.g., cordless phones, cell phones, power tools, laptops and golf carts), clothes washers, dishwashers and residential gas-fired furnaces. Net present-value energy savings at the provincial level are estimated to be $157 million CAD. Twenty-nine per cent of LEED Gold building projects registered in Canada since 2007 are located in British Columbia, and all new public sector buildings must be built to LEED-gold standard or better. British Columbia was the first jurisdiction in Canada to adopt both the new National Building Code energy-efficiency requirements for housing and small buildings and the National Energy Code for Buildings, which applies to large buildings (2013).

Transportation

By building the key infrastructure, increasing the adoption of cleaner fuels and encouraging the transition to clean energy vehicles, British Columbia is moving toward building a transportation system that reduces distances driven and is powered by clean energy.

Clean Energy Vehicles

Actions in every sector have helped people, communities and businesses reduce their emissions and their costs. For example, in 2011, the British Columbia government launched its $14.3 million CAD Clean Energy Vehicle (CEV) Program to provide incentives for eligible clean energy vehicles and deployment of charging-point infrastructure for these vehicles. The CEV Program has provided British Columbians with more affordable clean energy transportation solutions, and British Columbia leads Canada in clean energy vehicle sales per capita and has the largest electric vehicle charging and hydrogen fueling networks in Canada. In 2015, British Columbia renewed the CEV Program to continue to encourage adoption of clean energy vehicles.

Low-Carbon Fuel Standards

Adopted in 2008, British Columbia's Renewable and Low Carbon Fuel Requirements Regulation has helped reduce the province's reliance on non-renewable fuels and the environmental impact of transportation fuels. This regulation enables the Province to set benchmarks for the amount of renewable fuel in British Columbia's transportation fuel blends, reduce the carbon intensity of transportation fuels and meet its commitment to adopt a low-carbon fuel standard. Currently, the regulation targets a 10% decrease in carbon intensity of transport fuels sold in British Columbia by 2020, and 5% renewable content in gasoline (4% in diesel).

Alternative Fuels

The Province implemented the Greenhouse Gas Reduction (Clean Energy) Regulation in 2012 which permits utilities to offer incentives for the purchase of natural gas vehicles and to make investments in liquefied natural gas and compressed natural gas fuelling

infrastructure in sectors such as medium and heavy duty on-road transportation, marine, mining and locomotive support.

Cleanest LNG Facilities in the World

The British Columbia government had committed to having the cleanest LNG facilities in the world, while maintaining its leadership in clean energy and climate action. The Province has implemented a benchmark approach with the use of offsets and technology fund contributions as flexible means to achieve compliance. Facilities must reduce the intensity of their emissions against a standard that outperforms the cleanest LNG facilities in the world today.

Commitment to Leadership in Government Operations

Each year since 2010, British Columbia's public sector has achieved carbon neutrality, a first for any province or state in North America. Through the Carbon Neutral Government program, the development of British Columbia-based offsets has meant this achievement places British Columbia on the leading edge of growth in the clean-energy and clean-technology sectors. Provincially owned or leased buildings must be LEED gold or equivalent. The Carbon Neutral Capital Program helps public schools, universities, colleges and hospitals reduce energy costs and use innovative clean technologies. Government buildings are able to showcase examples of clean-energy solutions for hundreds of thousands of British Columbians when they access government services, go to work or attend school.

Local Communities

British Columbia can only meet its greenhouse gas reduction commitments with the help of its cities and communities. 95% of local governments have signed a voluntary agreement with the provincial government through the Climate Action Charter. By signing the Climate Action Charter, local governments commit to: working toward carbon neutrality in their corporate operations; measure their community energy and emissions; and create complete, compact, more energy efficient rural and urban communities. To support their commitments, local government signatories that report on their progress each year are granted the same amount paid in carbon taxes on their corporate operations.

APPENDIX A.6

CATALONIA

Catalonia is a historical nationality within the Spanish state, as well as one of its 17 Autonomous Communities. It is the second most populous one, has the highest GDP and its main economic sectors include chemicals, food, energy, metal, transportation and the rapidly increasing tourism sector. It has a strong tradition of research and innovation and seeks to foster a transition to a more sustainable and low carbon economy. This is demonstrated, among other initiatives, by its leadership in smart cities development and implementation, its long tradition of climate and environmental research and its commitment to preserve the unique environment of the region.

Catalonia is fully committed to taking action against climate change, proved by its engagement in international networks and the UNFCCC process, as well as its leadership at a regional level, with the Energy and Climate Change Plan 2012-2020 or the Catalan Strategy for Adapting to Climate Change 2013-2020.

Catalonia accomplished its objectives under the Kyoto Protocol during the 2008-2012 period. Currently, it has a target of increasing energy efficiency by 20%, generate 20% of the gross final energy consumption from renewable sources and reduce energy-related greenhouse gas emissions 25% below 2005 levels by 2020.

Catalonia also acknowledges the importance of adaptation when tackling climate change. The Catalan Strategy for Adapting to Climate Change 2013-2020 identifies the main impacts for this century and aims to incorporate adaptation into public policies, identify arising opportunities and promote research, innovation and knowledge transfer.

Finally, the Catalan Government is currently working on a Climate Change Bill, giving a solid response to the threat of climate change, and thus showing unequivocal commitment and collective responsibility in the fight against climate change.

Starting position:

Population: **7,518,903 (2014)**

GDP: **226,328.65 (US$, 2014)**

Country: Spain

GHG emissions: 43.14 million tons CO2eq (2012)

Emissions per capita: 5.8 t CO2eq (2012)

Specific Actions and Commitments

I. Energy Efficiency and Low Carbon Electricity

Catalonia has an Energy and Climate Change Plan 2012-2020, which demonstrates its focus on clean energy. Its objectives complement the 2020 EU Strategy: the Plan will achieve a 25.3% GHG emissions reduction from 2005 levels; it is also committed to generate 20.1% of the gross final energy consumption through renewable energy sources, and to achieve a 20.2% increase in energy efficiency by 2020. Actions are focused predominantly on energy demand, energy

efficiency and renewable energy. Energy efficiency is based on industrial, building and transportation sectors. The new Plan also promotes renewable energy, in particular wind, including marine wind, biomass and solar (thermal, photoelectric and thermoelectric).

Apart from that, Catalonia has specific legislation for issues related to mitigation actions. That is the case of the Catalan Strategy for Energy Renovation of Buildings 2014-2020, which aims to cut by 22% the CO2 emissions of already-built residential buildings by reducing their energy use by 14,4%, while mobilising public investment, saving money and creating new job opportunities.

At present, Catalonia is drawing the Climate Change Mitigation Plan 2020, which focuses on non-energetic sectors not covered by the Energy and Climate Change Plan 2012-2020, such as waste, agriculture, fluorinated GHG emissions, carbon sinks, and non-energetic emissions from buildings, transport and industry.

Furthermore, a Catalan Climate Change Bill is being drafted and will be passed this year, which will set the path to further emission reduction targets and increased ambition in regional climate action. Targets are designed as a continuous progression from previous ones, in line with the EU objective to reduce its emissions by 80-95% by 2050 compared to 1990, within the context of necessary reductions by developed countries as a group according to the IPCC.

II. Sustainable Mobility

The Government of Catalonia is already heavily involved in initiatives to make EVs ready for the market. In 2010 Catalonia adopted the Strategy to Foster the Electric Vehicle in Catalonia (IVECAT) 2010-2015, for the introduction of electric vehicles (EVs) and, since 2010, a growing number of municipalities have introduced EV fleets thanks to regional subsidies. The strategy has a target of 76,000 electrical vehicle sales and 91,200 charging station installations (83,600 private and 7,600 public access) by 2015.

Furthermore, Catalonia's Transport Infrastructure Plan 2006-2026 (PITC) aims to increase rail freight 8.5% per year and limit private car mobility increase by up to 60% by 2026, resulting in a 10% CO2 emissions reduction compared to business as usual scenario.

III. Natural Resource Protection and Waste Reduction

The General Program of Waste and Resources Prevention and Management 2013-2020 (PRECAT20) aims to achieve a 30% reduction in the carbon footprint of waste management and resources used in Catalonia (based on 2012 levels) and a 15% reduction in primary total waste primary generation reduction (including municipalities, industry and building sector) in 2020 and based on 2010 levels.

Furthermore, Catalonia recently approved the Strategy to Promote the Energy Use of Forest and Agriculture Biomass 2020. Due to its highly forested territory and the deficit in forest management, the strategy is considered a key to protect the environment and promote zero emissions energy.

IV. Adaptation

Catalonia is already suffering the consequences of climate change, and therefore understands the necessity to act rapidly. That is why the Government approved a Catalan Climate Change

Adaptation Strategy 2013-2020. The Strategy identifies the geographic areas and activities at greater risk due to climate change, and considers adaptation options that reduce the vulnerability of socioeconomic sectors and natural systems. It also incorporates and implements measures in sectorial planning, risk management and best practice to improve climate change adaptation and resilience.

The Strategy has been complimented by the Global Indicator of Climate Change Adaptation in Catalonia, designed to measure how the region is adapting to climate change. The study has 29 key indicators that produce a global adaptation indicator quantifying Catalonia's capacity to adapt to climate change, which will be key to evaluate the extent to which policies are being effective.

APPENDIX A.7

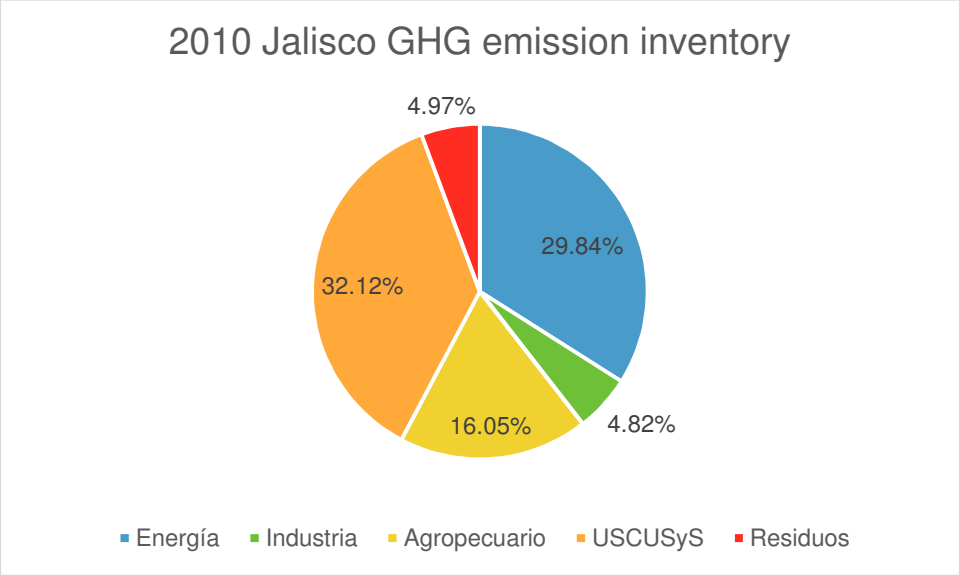
JALISCO

Jalisco, one of the most important economic actors in Mexico, is located in the western part of the country and possess a territory of 78,588 km^2 – a size similar to that of the Czech Republic. With over 7 million inhabitants, Jalisco is the fourth most populous state in Mexico; which about 60% of the population lives within the Greater Guadalajara Area, making it the country's second largest city right after Mexico City.

Jalisco contributes with 6.4% (57,888 million USD) of Mexico's GDP. Even though over 65% of Jalisco's economic activity comes from the tertiary sector (trade, transport, real estate and other services), Jalisco's agricultural sector leads Mexico's national production in several produces such as corn, milk, eggs and pork meat.

When it comes to environmental actions, Jalisco has positioned itself as a local leader thanks to initiatives such as the "Voluntary Environmental Achievement Program", the improvement of public building's energy efficiency, and the inauguration of the Los Altos wind farm, among others projects, all which enable Jalisco to play a significant role in the Mexican environmental policy and politics development.

Based on the inventory of greenhouse gas emissions, in the year 2010 Jalisco generated 42,001.22 Gg of $C0_2$, which results in a per capita emission of 5.16 tons. The sectors that emit the most are land use, changing land use, and energy consumption, followed by the agriculture sector, industrial and waste management.



The state of Jalisco aligned to the National Climate Change Strategy, has set the following goals for reducing emissions based on 2010 emissions:

- 30% by 2030.
- 50% by 2050.

The inventory results allows the state to guide mitigation strategies prioritizing those that have a direct influence on the emitting sectors including:

- **Energy:** transition to energy independence by using renewable energy; which implies the exploitation of the potential of the territory in generating solar power and wind power. Boosting the implementation of energy efficiency programs in both, the public and private sectors through the investment in the construction of infrastructure and new operations.
- **Urban Planning:** increase territory efficiency by reducing urban sprawl, as well as promoting a transition towards public transportation systems that are safe, clean, low-emission alternatives, accessible, comfortable, and that strengthen interconnectivity.
- **Transportation:** Promotion the use of non-motorized mobility by improving bicycle and pedestrian infrastructure, road safety education, and legal reforms to protect the cyclists and pedestrians. Modernization of the vehicle fleet with an eventual transition to electric cars. Increased public transport lines. Modernization of public transport units that can be more accessible, comfortable and with better fuel efficiency. Boosting foreign and inter rail passenger transport.
- **Biodiversity and Forests**: Develop a strategy for reducing emissions from deforestation and land degradation, as well as consider sustainable forest management, increasing carbon stocks and forest conservation schemes by increasing payments for environmental services.
- **Agricultural Sector**: Promoting schemes of agricultural and forest production with potential mitigation through carbon sequestration practices, livestock waste management activities, and reducing emissions from the inappropriate use of fire.
- **Waste:** To promote integrated waste management through enhancement projects, use of organic waste, methane capture at landfills and wastewater treatment.
- **Financial instruments**: Install regional carbon trading schemes, green taxes and environmental funds to finance projects to move towards a low carbon development.

The fourth part of the state territory is very sensitive to global warming; 47% of this area is dedicated to predominantly agricultural activities, 4% to livestock activities and only 3% are human settlements. Climate disruption has various effects such as reduced rainfall and soil moisture or extreme temperatures increase and intensity of rainfall, crop failures, increased pollution, increased presence of natural disasters (such as hurricanes), among others.

Based on opinion surveys for adaptation to climate change made to the population of Jalisco, it is shown that there is a partial ignorance in terms of the causes, consequences, and effects of climate change, as well as a remarkable misinformation about how to tackle climate change, and how to reduce vulnerability and adaptation measures.

To reduce vulnerability and increase resilience of its systems, the state of Jalisco should promote the following initiatives:

- Educate, inform, and raise awareness about climate change, its consequences, and responsibility of the whole society.
- Promote the analysis of vulnerability to climate change areas, economic activities and population groups.

APPENDIX A.8
ONTARIO

Appendix forthcoming.

APPENDIX A.9

OREGON

Oregon has long been a leader in establishing strong policies that help build a more resilient economy while reducing greenhouse gas emissions. Oregon's private sector has been able to leverage this policy environment to make significant investments in maximizing energy efficiency and conservation, building out a renewable energy portfolio and growing the alternative fuel industry. This is good for consumers, good for the environment and good for the state's economy.

Oregon has been recognized nationally and internationally as an innovative leader in working with the clean technology industry to strengthen our economy and environment. The state focuses on how we can continue to transition to new energy systems that save consumers money, create consumer choice, provide for system reliability, remove market barriers for development, and attract significant private capital investment. For example, the Energy Trust of Oregon was created to maximize energy efficiency and conservation. Since the organization's inception, ETO has helped save rate-payers $1.7 billion on their energy bills. Their work keeps energy costs as low as possible, builds a sustainable energy future, creates jobs that cannot be outsourced and protects the environment. The state also has implemented strong building codes, energy efficient appliance standards, residential energy disclosure mechanisms, renewable energy and conservation incentives, alternative transportation options, mass transit alternatives, and the renewable portfolio and carbon dioxide standards, to name a few.

Specific actions and commitments:

I. Greenhouse Gas Emissions Goals

In 2007, the Oregon State Legislature established greenhouse gas emissions reduction goals. The goals call for Oregon to arrest the growth of greenhouse gas emissions and begin to reduce emissions by 2010, achieve greenhouse gas levels that are 10% below 1990 levels by 2020, and to achieve greenhouse gas levels that are 75% below 1990 levels by 2050. Oregon has put in place a number of policies and programs that are moving the state forward to meet these greenhouse gas emissions reduction goals.

II. Clean Electricity

Oregon is one of the largest producers of renewable electricity in the country. The Bonneville Power Administration's hydro system is the backbone of Oregon's renewable energy portfolio. Approximately 44% of the state's energy is hydroelectric. In addition, 2.8% is derived from nuclear, 5.2% from wind and 10% from other renewable resources, such as solar, landfill gas, geothermal, waste and biomass.

In 2007, the legislature passed the renewable portfolio standard which requires large utilities to serve 25% of their retail load from new renewable resources by 2025. To date, this has attracted over $10 billion investment in the state, most of which is in rural Oregon. This investment not only reduces greenhouse gas emissions, it provides much needed property tax and other revenue to hard hit counties. Through maximizing royalties from wind, counties have been able to retain public safety officers, build schools and provide rebates for their citizens. The state is on track to meet the renewable portfolio standard by 2025.

In 2009, the state established a five year solar feed-in tariff pilot program to expand distributed generation solar. In addition, the state requires all new and retrofitted state buildings use 1.5% of their construction budget to install solar on-site and is working to develop a community solar program. The state also provides incentives for renewable energy generation projects.

Oregon's only coal-fired power plant will be decommissioned in 2020.

III. Energy-neutral buildings

Oregon has long been a national leader on energy efficiency. It is the state's policy to maximize energy efficiency and conservation first, as efficiency is the least-cost resource. The region has set a target of meeting 85% of new load growth through energy efficiency and conservation, and due to the investments made by our local utilities Oregon is on track to meet the state's share of this target.

Oregon adopted a reach code to lay the groundwork for significantly reducing energy consumption in the build environment. The state coupled this with providing an incentive for building operators who meet the reach code, helping to buy down the cost of the delta between standard code and the reach code. In addition, the state is pursuing commercial building disclosure mechanisms to capture behavioral energy efficiency, adoption of efficient appliances, on-site generation, smart controls and other features. Oregon consistently ranks in the top three on the State Energy Efficiency Scorecard, published by the American Council for an Energy Efficient Economy.

IV. Clean Transportation

The largest contributing sector to Oregon's greenhouse gas emissions is the transportation sector at 33%. Oregon is taking a comprehensive approach to reducing emissions in this sector. The state prioritizes maximizing mass transit opportunities, investing a significant amount of money is providing strong mass transit opportunities for people in all corners of the state. In addition, the state has established incentive and loan programs to help private and public sector fleets convert to alternative fuels; this not only reduces greenhouse gas emissions, it saves fleet operators significant money that can be reinvested into growing their business or public sector organization. Coupled with work to convert fleets, the state has worked diligently to create Oregon's part of the West Coast Electric Vehicle Highway and to provide alternative fueling stations so consumers and fleet operators have access to alternative fuels. Lastly, Oregon requires its metropolitan planning organizations to develop transportation and land use plans that meet carbon reduction targets. Lastly, Oregon joined with California and other states to significantly increase the adoption of zero emission vehicles.

APPENDIX A.10
VERMONT

Appendix forthcoming.

APPENDIX A.11

WALES

Wales is one of the nations that make up the United Kingdom, located in the west of Europe and covering an area of just over 8,000 square miles (20,722 km²). Climate change action in Wales sits within the wider European and UK framework and the overarching target of at least an 80% reduction in greenhouse gases by 2050 (based on a 1990 baseline). Wales has had a dedicated climate change strategy in place since 2010, encompassing ambitious climate change targets of a 40% reduction in emissions by 2020 and a 3% per annum reduction in those areas devolved to the Welsh Government.

As one of the first nations in the world to have a duty on sustainable development at the heart of its constitution, this commitment has underpinned the approach to climate change in Wales. This has meant that action on key priorities has been taken forward in a way that delivers economically, socially and environmentally. Examples include action on energy efficiency - where the retrofitting of houses has addressed fuel poverty and supported growth in the green economy - and action to reduce waste, which has delivered a significant increase in recycling along with a significant decrease in emissions and increased economic investment. This approach has been further strengthened by the recent passing of the Well-being of Future Generations (Wales) Act 2015, containing a set of statutory sustainable development goals for Wales. The goals encompass the need to act on the causes and adapt to the consequences of climate change, as well as ensuring that Wales is globally responsible in its actions. This is being followed by the Environment (Wales) Bill, which focuses on the sustainable management of Wales' resources and includes a statutory commitment to carbon budgeting to set a clear pathway for decarbonisation. This legislation will sit within the wider EU and UK framework, which includes the EU Emissions Trading Scheme (ETS).

<u>The current position in Wales:</u>

Population: 3,082,412 (2013)

GDP: £53.1 billion (GVA 2013 /

GHC emissions (year): 45.83 MtCO2e (2012)

Specific actions and commitments

Greenhouse Gas Emissions

Wales is committed to reducing its total greenhouse gas emissions by 40% from 1990 levels by 2020 within the overall goal of reducing emissions by at least 80% by 2050 as laid down in the UK Climate Change Act 2008. In addition, the Welsh Government has committed to reducing emissions within areas of devolved competence by 3% from 2010. Reporting against both the targets and delivery of key policies is undertaken annually. As of the latest annual report (December 2014), territorial emissions in Wales had reduced by 17.9% on 1990 levels and to date the 3% per annum target has been successfully delivered. On an end-user consumption basis, this equates to a 32% reduction on 1990 levels.

The legislation currently being brought forward through the Environment (Wales) Bill aims to further accelerate action, by putting in place strengthened requirements for statutory climate change targets and committing to a carbon budgeting approach in Wales.

Renewable energy

In Wales, the percentage of electricity generated from renewable sources has increased nearly three fold from 2005 to 2013 and it is estimated that in 2016 it will account for over 15% of total electricity generation which is approximately the equivalent of 30% of Wales' electricity consumption. Alongside more established technologies, innovative proposals are being developed to harness Wales' natural resources. For example, a proposal to construct a 320 MW tidal lagoon is currently under consideration in the planning system which, if consented, will be capable of powering over 155,000 homes for 120 years. In addition, in delivering on renewable energy, Wales' commitment to sustainable development has also seen and emphasis on community energy with the Welsh Government providing support to 57 community-led renewable energy schemes since 2012. The Welsh Government is also currently developing a Green Growth fund for Wales to accelerate the roll-out and encourage investment in resource efficiency, renewable energy generation and waste efficiency projects.

Energy and Resource efficiency

In taking action on energy efficiency, a key priority has been to address fuel poverty in deprived areas. Schemes in Wales have improved 7900 homes in Wales in some of the most deprived areas. The energy and environmental sector has also grown in sales turnover from £1.24 billion to £2.36 billion - an increase of 90% from 2006 - with employment increasing from 22,160 to 30,100 over the same period.

This action has also been complemented by work to improve the standards of energy efficiency through investment in social housing and the increasing of standards in the Building Regulations in Wales. The funding and regulatory framework in Wales is also supported by Welsh Government funded independent advice and support for people and organisations to invest in improvements that save on energy, water and waste. This Resource Efficient Wales (REW) service provides a range of advice and fully funded energy efficiency improvements targeted in particular at individual low income households and deprived communities across Wales. Going forward, a new Energy Efficiency Strategy for Wales will be published in 2015.

Action to improve resource efficiency through the implementation of the '*Towards Zero Waste'* strategy has seen Wales achieve the highest recycling rates in the UK at 58% and the 4th highest in Europe. This been complemented by initiatives such as the charge for single use carrier bags. The overarching aim is to recycle at least 70 per cent of waste by 2025 and to be a zero waste (100 per cent recycling) nation by 2050. Importantly, the increase in recycling in the waste sector has also significantly reduced emissions – by 20.4% in the sector – whilst also delivering investment and economic growth.

Clean transportation

Action on transport in Wales includes the Active Travel (Wales) Act 2013, which requires new road schemes (including road improvement schemes) to consider the needs of pedestrians and cyclists

at design stage, to enable more people to walk and cycle. The act also requires local authorities to continuously improve facilities and routes for pedestrians and cyclists and to prepare maps identifying the routes for their use. Sustainable Travel Centres have also been put in place to encourage public transport use and effective journey planning. Going forward, the delivery of the Cardiff Capital Region Metro is a key priority. This comprises multiple modes of transport brought together within an integrated network for the region. The objective is to create a region wide alternative to the car and improve accessibility to public transport within city and town centres.

Emissions trading

Wales is a part of the EU Emission Trading Scheme (ETS), which covers 54% of its emissions reflecting both the heavy industry located in Wales and the fact that Wales is a net exporter of electricity. In addition, businesses and public sector bodies in Wales that are high energy users but not covered under the requirements of the EU ETS are part of the Carbon Reduction Commitment (CRC). This is a UK-wide scheme to improve energy efficiency and cut carbon dioxide (CO2) emissions where those organisations covered pay for the carbon they emit. The Welsh Government itself is a participant of the CRC and has decreased emissions on its administrative estate by 27% since 2010-11.

Adaptation

As well as reducing emissions, Wales has a framework in place for building resilience to the impacts of climate change. The adaptation work has focussed on developing Sectoral Adaptation Plans, which take sectors through a risk assessment process to develop a planned response. In addition, the goals contained in the Well-being of Future Generations (Wales) Act include a goal in relation to a '*Resilient Wales'* which specifically makes reference to adapting to the impacts of climate change. The Environment (Wales) Bill also includes legal requirements relating to action on adaptation at both the national and local levels, together with a framework for the sustainable management of natural resources based on the principles from the Convention for Biological Diversity.

Global responsibility

A key part of Wales' commitment to sustainable development has been its work in partnership internationally from being a founding signatory of the Gauteng Declaration in 2002 to most recently signing the global *Compact of States and Regions* in 2014. Wales' work internationally includes the Wales for Africa programme in Mbale, which won the UNFCC Momentum for Change Lighthouse award in 2011 and which has seen the planting of more than one million trees and the launch of an ambitious next phase – 10 million trees. Through the Size of Wales project, an area of forest the Size of Wales has been safeguarded in Africa and in Wales, a tree is planted in both Wales and Africa for every child born. As an active member of The Climate Group and Network of Regional Governments for Sustainable Development (nrg4SD), Wales is committed to working in partnership to tackle climate change and more broadly the support development in all regions to be sustainable. This in underpinned by the commitment in the Well-being of Future Generations Act to a globally responsible Wales.

APPENDIX A.12

WASHINGTON

Washington State has a long history of commitment to its environment and a clean economy. Among the State's many strengths are its established policies that reduce greenhouse gas emissions; support renewable energy, green buildings and clean transportation; promote green economy jobs growth; and address economic and social goals.

In 2008, the state established statewide limits on greenhouse gas emissions for 2020, 2035 and 2050; and set goals to increase jobs in the clean energy sector by 25,000 (above 2004 levels) by 2020, reduce annual per capita vehicles miles traveled by 18 percent by 2020, 30 percent by 2035, and 50 percent by 2050 (from the baseline of 75 billion vehicles miles traveled), and reduce the state's expenditures on imported fuels.

Washington is recognized nationally for its success in implementing innovative approaches to achieving the GHG limits and the goals of a low carbon economy. Strong and well implemented building codes, a combined portfolio of renewable energy and energy efficiency standards, strict emissions performance standards for fossil-fuel generated electricity, cleaner cars and less carbon intensive fuels, and high levels of investments in renewable electricity, energy efficiency, and electric vehicle charging infrastructure are some of the strengths that are reducing Washington's emissions and make it a leader on clean economy. In addition, the State is home to companies on the cutting edge of clean energy technology – including wind, solar and advanced composites manufacturing, the development of advanced biofuels and low-impact hydropower, and energy-efficiency services.

Specific actions and commitments:

I. Greenhouse Gas Emissions Limits

By 2020 Washington State is required by law to limit emissions of greenhouse gases to the 1990 level; by 2035 emissions must be limited to 25 percent of the 1990 level; and by 2050 emissions must be limited to 50 percent below 1990 or 70 percent below the state's expected emissions that year. Since 2009, Washington has been driving down its GHG emissions, which are now relatively flat even as the state's economy grew by 2 percent. In 2008, the state committed to review its limits based on the most recent global, national and regional climate science. The review was completed in December 2014. The conclusion was that Washington State's existing limits should be adjusted to better reflect the current science, and that the limits need to be more aggressive in order for Washington to do its part to address climate risks. The state will recommend new limits after the UN climate conference negotiations are concluded in December 2015, using the results to inform how Washington's limits should be adjusted.

II. Clean Electricity

Washington leads the nation in electricity generation from renewable resources. The state generates more than 75 percent of its electricity from renewable resources, mostly hydroelectric power. Washington produces nearly one-fifth of all renewable electricity produced in the United

States. In 2006, Washington voters, seeking energy independence, required large utilities to obtain an additional 15% of their electricity from renewable resources (in addition to the existing hydroelectricity production) by 2020 and to undertake cost-effective conservation.

The state is on target to meet these required renewable energy targets. In 2013, wind energy provided 6.2% of all in-state electricity production. The state ranked 7th for installed wind capacity. Investments in wind totaled $5.3 billion and created close to 4,000 green jobs. The state is also expanding the use of solar energy. Washington, as a forestry state, is a substantial producer of energy from carbon-neutral biomass, primarily wood and wood waste. The state is also a national leader in integration of nutrient management and energy production (waste-to-energy) through research and development of anaerobic digesters. The largest landfill renewable energy producers in the U.S. Bio Energy Washington, gas-to-energy plant, generates over 15 million kilowatt hours of electricity from the landfill gas, reducing greenhouse gas emissions by about 82,300 metric tons per year. Washington still has room to expand its abundant wave ocean, geothermal, and other renewable energy resources.

Washington's only coal-fired power units, with a capacity of about 1,200 megawatts, will be decommissioned, with the first closing in 2020, and the other closing by 2025. In addition, the state is seeking agreements with key utilities and others to reduce the use of coal-fired electricity generated in other states and consumed Washington. These two efforts will make the state's electricity virtually coal-free.

III. Energy-neutral buildings

Washington's achievement in building energy efficiency is a great clean energy success story. Washington was the first state in the country to adopt high-performance green buildings standards for state-funded buildings. Washington has a long history of implementing energy efficiency in residential, commercial and industrial buildings. The state is on course to ensure all new buildings are energy-neutral by 2030, building on the state's aggressive energy code, with advanced envelopes, efficient appliances, on-site generation, smart controls, and other features. The 2013 State Energy Efficiency Scorecard, published by the American Council for an Energy Efficient Economy, ranked Washington one of the top three states for energy codes.

The state's electric utilities are required to undertake all cost-effective energy conservation. Actions taken, which are part of a regional effort, will yield enough energy savings to meet 85 percent of projected energy demand through 2029.

Washington offers significant incentives for energy efficiency investments and to support research and deployment of new technologies. In 2013 a new Clean Energy Fund was created providing $40 million to support building energy efficiency and renewable energy, advance renewable energy technologies and make Washington more competitive.

IV. Clean Transportation

Washington's greenhouse gas emissions are dominated by the transportation sector, contributing 45% of emissions in 2012. The state is taking concrete actions to drive down these emissions by supporting cleaner cars, clean fuels and reduction in miles travelled. With its clean and low cost electricity, Washington has emerged as one of the best places to own and drive an electric vehicle. Washington is on target to achieve its goal of 50,000 electric cars by 2020. The state is

investing in EV charging infrastructure to support the increase of sale and use of electric vehicles. Also, the state is committed to join with other states in adopting zero emission vehicles.

Washington is prepared to partner with neighboring jurisdictions on a West Coast clean fuels program, building on its state renewable fuel standard. In addition, the state is collaborating with the aerospace industry, airlines, several universities, federal partners and others to advance research and technology related to aviation biofuels being done under the Federal Aviation Administration Center of Excellence in Alternative Jet Fuels and Environment. Washington's largest airline included the use of biofuels in its 2020 sustainability goals and plans to start using biofuels in some of its flights in 2018.

The state is making meaningful investments in multimodal transportation in communities of all types and sizes across the state, and it's working with its local governments to promote transit oriented development and other low-carbon transportation solutions. Washington was the first state to formally adopt reduction goals for vehicle miles travelled, and the above actions support that commitment.

V. Emission Trading

Washington State has completed an extensive evaluation of the benefits of an emission trading system to implement the state's greenhouse gas emission limits from all major sources, and provide a price on carbon and a market program to ensure those limits are met. In January 2015, the Governor proposed legislation to create a carbon pollution market program for Washington State that, if and when enacted, would be linked to emission trading programs in other jurisdictions.

Exhibit 3

Pacific Coast Action Plan *on* Climate and Energy

Preamble

The Governments of California, British Columbia, Oregon and Washington,

Pursuant to the *Memorandum to Establish the Pacific Coast Collaborative* of June 2008, as provided for in Article 6;

Affirming our shared vision of Pacific North America as a model of innovation that sustains our communities and creates jobs and new economic opportunities for our combined population of 53 million;

Recognizing that the Pacific Coast is a region bound together by a common geography, shared infrastructure and a regional economy with a combined GDP of US $2.8 trillion, which makes it the world's fifth largest;

Acknowledging the clear and convincing scientific evidence of climate change, ocean acidification and other impacts from increasing concentrations of carbon dioxide in the atmosphere, which threaten our people, our economy and our natural resources;

Emphasizing that states and provinces around the world are battling climate change through technology innovation and actions that limit greenhouse gas emissions and other air pollution while creating economic growth, consumer savings and new jobs;

Celebrating that our own governments have reduced greenhouse gas emissions by adopting regulatory, policy and market-based measures that shift energy generation to clean and renewable sources, manage energy use through greater efficiency and conservation, and enable and promote consumer choice for clean vehicles;

Recalling the findings of the 2012 *West Coast Clean Economy* report which projected 1.03 million new jobs could be created in key sectors, such as energy efficiency and advanced transportation, assuming the right policy environment;

Supporting positive federal action to combat climate change, including President Obama's climate action plan and proposed rules to limit greenhouse gas emissions from power plants;

Joining the growing international convergence on the need to secure an international agreement to reduce global greenhouse gas emissions, including discussions at the coming Conference of Parties meetings in Warsaw (2013), Lima (2014) and Paris (2015); and

Agreeing that meaningful coordination and linkage between states and provinces across North America and the world on actions to reduce greenhouse gas emissions can improve the effectiveness of these actions, increase their overall positive impact and build momentum for broader international coordination to combat climate change;

NOW THEREFORE HEREBY AGREE AS FOLLOWS:

I. Lead national and international policy on climate change with actions to:

Direct our relevant agencies and officials to work together to:

1) **Account for the costs of carbon pollution in each jurisdiction.**

   Oregon will build on existing programs to set a price on carbon emissions. Washington will set binding limits on carbon emissions and deploy market mechanisms to meet those limits. British Columbia and California will maintain their existing carbon-pricing programs. Where possible, California, British Columbia, Oregon and Washington will link programs for consistency and predictability and to expand opportunities to grow the region's low-carbon economy.

2) **Harmonize 2050 targets for greenhouse gas reductions and develop mid-term targets needed to support long-term reduction goals.**

   Climate scientists have identified the scale of greenhouse gas reductions that must be achieved globally to stabilize the climate. Where they have not already done so, California, British Columbia, Oregon and Washington will establish long-term reduction targets that reflect these scientific findings. To advance long-term reductions, Washington already has in place a mid-term 2035 target. California and Oregon will establish their own mid-term targets. British Columbia has already legislated 2020 and 2050 targets and will explore whether setting a mid-term target will aid their achievement.

3) **Affirm the need to inform policy with findings from climate science.**

   Leaders of California, British Columbia, Oregon and Washington affirm the scientific consensus on the human causes of climate change and its very real impacts, most recently documented by scientists around the world in the Intergovernmental Panel on Climate Change's *Fifth Assessment Report* released in September 2013, as well as other reports such as the *Scientific Consensus on Maintaining Humanity's life Support Systems in the 21st Century*. Governmental actions should be grounded in this scientific understanding of climate change.

4) **Cooperate with national and sub-national governments around the world to press for an international agreement on climate change in 2015.**

   The governments of California, British Columbia, Oregon and Washington will join with other governments to build a coalition of support for national and international climate action, including securing an international agreement at the Conference of Parties in Paris in 2015. The governments of California, British Columbia, Oregon and Washington will coordinate the activities they undertake with other sub-national governments and combine these efforts where appropriate.

5) **Enlist support for research on ocean acidification and take action to combat it.**

   Ocean health underpins our coastal shellfish and fisheries economies. The governments of California, British Columbia, Oregon and Washington will urge the American and Canadian federal governments to take action on ocean acidification, including crucial research, modeling and monitoring to understand its causes and impacts.

II. Transition the West Coast to clean modes of transportation and reduce the large share of greenhouse gas emissions from this sector with actions to:

1) **Adopt and maintain low-carbon fuel standards in each jurisdiction.**

   Oregon and Washington will adopt low-carbon fuels standards, and California and British Columbia will maintain their

existing standards. Over time, the governments of California, British Columbia, Oregon and Washington will work together to build an integrated West Coast market for low-carbon fuels that keeps energy dollars in the region, creates economic development opportunities for regional fuel production, and ensures predictability and consistency in the market.

2) **Take actions to expand the use of zero-emission vehicles, aiming for 10 percent of new vehicle purchases by 2016.**

The Pacific Coast already has the highest penetration of electric cars in North America. The governments of California, British Columbia, Oregon and Washington will work together towards this ambitious new target by supporting public and private fleet managers to shift their procurement investments to catalyze toward electric car purchases and by continuing to invest in necessary infrastructure to enable low-carbon electric transportation.

3) **Continue deployment of high-speed rail across the region.**

Providing high-speed passenger rail service is an important part of the solution to expand regional clean transportation, improve quality of life and advance economic growth. The governments of California, British Columbia, Oregon and Washington continue to support the Pacific Coast Collaborative's Vision for high speed rail in the region, and will continue to seek opportunities to invest in rail infrastructure that moves people quickly, safely and efficiently, and encourages innovation in rail technology manufactured in the region.

4) **Support emerging markets and innovation for alternative fuels in commercial trucks, buses, rail, ports and marine transportation.**

The Pacific Coast of North America is emerging as a center of private sector innovation and investment in cleaner fuels and engine technologies for heavy-duty trucks and buses, rail, ports and marine transportation. The governments of California, British Columbia, Oregon and Washington will develop targets and action plans to accelerate public and private investment in low-carbon commercial fleets and support the market transition to biofuels, electricity, natural gas and other low-carbon fuels in local and export markets.

III. Invest in clean energy and climate-resilient infrastructure with actions to:

1) **Transform the market for energy efficiency and lead the way to "net-zero" buildings.**

Energy efficiency is the lowest cost way to reduce greenhouse gas emissions while creating good local jobs. The governments of California, British Columbia, Oregon and Washington will work to harmonize appliance standards, increase access to affordable financing products, and support policy that ensures that energy efficiency is valued when buildings are bought and sold. Our efforts intend to build a vibrant, growing regional market for energy efficiency products and services.

2) **Support strong federal policy on greenhouse gas emissions from power plants.**

The governments of California, British Columbia, Oregon and Washington will support the U.S. Environmental Protection Agency's initiative to regulate greenhouse gas emissions from power plants and emphasize the importance of allowing state flexibility to design ambitious reduction programs within this regulation. Our jurisdictions will also coordinate and provide joint testimony in federal proceedings on greenhouse gas emissions when appropriate.

3) **Make infrastructure climate-smart and investment-ready.**

The West Coast Infrastructure Exchange (WCX) is demonstrating how to attract private capital for infrastructure projects while increasing climate resilience through best practices and certification standards. To scale up these efforts, the governments of California, Oregon and Washington will sponsor pilot projects with local governments, state agencies and the WCX. WCX also works closely with Partnerships BC, a center of infrastructure financing expertise established by the government of British Columbia that has helped to secure financing for over 40 projects worth more than C$17 billion.

4) **Streamline permitting of renewable energy infrastructure.**

Meeting ambitious carbon-reduction goals will require scaling up wind, solar and other forms of renewable energy and effectively bringing clean power to customers in California, Oregon and Washington. Drawing on emerging models in California and the Pacific Northwest, the governments of California, Oregon and Washington will work with permitting agencies to streamline approval of renewables projects to increase predictability, encourage investment and drive innovation.

5) **Support integration of the region's electricity grids.**

Connecting the markets for buying and selling wholesale electricity in our region can increase local utilities' flexibility and reliability and provide consumer savings by enabling use of a wide variety of energy sources across the region. Integrating our region's electricity markets also expands energy users' access to renewable energy sources, such as solar and wind power.

IV. Interpretation

This Action Plan is intended to spur finding new, smart ways for our governments, agencies and staff to work together, and with other governments and non-government partners, as appropriate, to add value, efficiency and effectiveness to existing and future initiatives, and to reduce overlap and duplication of effort, with the objective of reducing, not increasing, resource demands to achieve objectives that are shared.

V. Limitations

This Action Plan shall have no legal effect; impose no legally binding obligation enforceable in any court of law or other tribunal of any sort, nor create any funding expectation; nor shall our jurisdictions be responsible for the actions of third parties or associates.

Signed at San Francisco, California, on the occasion of the Fourth Annual Leaders' Forum of the Pacific Coast Collaborative, this 28th day of October, 2013.

Original signed by

Edmund G. Brown Jr.
Governor of California

Original signed by

Christy Clark
Premier of British Columbia

Original signed by

John A. Kitzhaber
Governor of Oregon

Original signed by

Jay Inslee
Governor of Washington

Exhibit 4

Exhibit 4

http://www.dailymail.co.uk/sciencetech/article-2208953/Shock-report-claims-100m-people-die-economic-growth-drop-3-2-2030-climate-change-ignored.html

Ignore climate change and 100m people will die by 2030, shocking new report claims

By DAILY MAIL REPORTER
PUBLISHED: 26 September 2012 |

More than 100 million people will die and global economic growth will be cut by 3.2 percent of gross domestic product (GDP) by 2030 if the world fails to tackle climate change, a report commissioned by 20 governments has claimed.

As global average temperatures rise due to greenhouse gas emissions, the effects on the planet, such as melting ice caps, extreme weather, drought and rising sea levels, will threaten populations and livelihoods, said the report conducted by humanitarian organisation DARA.

It calculated that five million deaths occur each year from air pollution, hunger and disease as a result of climate change and carbon-intensive economies, and that toll would likely rise to six million a year by 2030 if current patterns of fossil fuel use continue.

More than 90 percent of those deaths will occur in developing countries, said the report that calculated the human and economic impact of climate change on 184 countries in 2010 and 2030.

It was commissioned by the Climate Vulnerable Forum, a partnership of 20 developing countries threatened by climate change.

'A combined climate-carbon crisis is estimated to claim 100 million lives between now and the end of the next decade,' the report said.

It said the effects of climate change had lowered global output by 1.6 percent of world GDP, or by about $1.2 trillion a year, and losses could double to 3.2 percent of global GDP by 2030 if global temperatures are allowed to rise, surpassing 10 percent before 2100.

It estimated the cost of moving the world to a low-carbon economy at about 0.5 percent of GDP this decade.

British economist Nicholas Stern told Reuters earlier this year investment equivalent to 2 percent of global GDP was needed to limit, prevent and adapt to climate change.

His report on the economics of climate change in 2006 said an average global temperature rise of 2-3 degrees Celsius in the next 50 years could reduce global consumption per head by up to 20 percent.

Temperatures have already risen by about 0.8 degrees Celsius above pre-industrial times.

Almost 200 nations agreed in 2010 to limit the global average temperature rise to below 2C (3.6 Fahrenheit) to avoid dangerous impacts from climate change.

But climate scientists have warned that the chance of limiting the rise to below 2C is getting smaller as global greenhouse gas emissions rise due to burning fossil fuels.

The world's poorest nations are the most vulnerable as they face increased risk of drought, water shortages, crop failure, poverty and disease.

On average, they could see an 11 percent loss in GDP by 2030 due to climate change, DARA said.

'One degree Celsius rise in temperature is associated with 10 percent productivity loss in farming.

'For us, it means losing about 4 million metric tonnes of food grain, amounting to about $2.5 billion.

'That is about 2 percent of our GDP,' Bangladesh's Prime Minister Sheikh Hasina said in response to the report.

'Adding up the damages to property and other losses, we are faced with a total loss of about 3-4 percent of GDP.'

Even the biggest and most rapidly developing economies will not escape unscathed.

The United States and China could see a 2.1 percent reduction in their respective GDPs by 2030, while India could experience a more than 5 percent loss.

The full report is available here:
http://daraint.org/climate-vulnerability-monitor/climate-vulnerability-monitor-2012/report/

Executive Summary here:
http://www.daraint.org/wp-content/uploads/2012/09/EXECUTIVE-AND-TECHNICAL-SUMMARY.pdf

Exhibit 5

REPORT: CLIMATE CRISIS ALREADY CAUSING UNPRECEDENTED DAMAGE TO WORLD ECONOMY; HUMAN IMPACT ON LARGE-SCALE

- New and comprehensive assessment of the costs of climate change
- Inaction on climate change already causing over one trillion dollars in losses
- Costs to escalate rapidly: global GDP stunted by over 3 percent by 2030 – crisis to increasingly hold back growth if urgent action is not taken
- Climate change and carbon economy linked to 5 million deaths each year
- High-level political, scientific and economic leaders call for international action to halt surge in losses to human life and the world economy hitting all nations

NEW YORK, Wednesday 26 September 2012 – DARA and Climate Vulnerable Forum report: Most comprehensive ever assessment of the current global impact of climate change released today.

20 governments commissioned the independent report, the first of its kind to show that tackling the global climate crisis would already reap significant economic benefits for world, major economies and poor nations alike.

"*Climate Vulnerability Monitor*" study's findings point to unprecedented harm to human society and current economic development that will increasingly hold back growth, on the basis of an important updating and revision of previous estimates of losses linked to climate change.

KEY FINDINGS INCLUDE THE FOLLOWING ESTIMATES:

- Climate change and a carbon-intensive economy considered a leading global cause of death today, responsible for 5 million deaths each year – 400,000 due to hunger and communicable diseases aggravated by climate change and 4.5 million carbon economy deaths due mainly to air pollution
- Failure to act on climate change *already costs* the world economy 1.6% of global GDP amounting to 1.2 trillion dollars in forgone prosperity a year
- Rapidly escalating temperatures and carbon-related pollution will double costs to 3.2% of world GDP by 2030
- Losses for lower-income countries are already extreme: 11% of GDP on average for Least Developed Countries already by 2030
- Major economies are heavily hit: in less than 20 years China will incur the greatest share of all losses at over 1.2 trillion dollars; the US economy will be held back by more 2% of GDP; India, over 5% of its GDP

- Economic losses dwarf the modest costs tackling climate change: emission reductions at just 0.5% of GDP for the next decade; and support to the vulnerable: a minimum of 150 billion dollars per year for developing countries

Climate Vulnerable Forum Chair, Bangladesh – one of the largest newly-emerging economies in Asia – represented by **Prime Minister Sheikh Hasina** officially launched the report at a major diplomatic event to coincide with the 67th session of United Nations General Assembly. Commenting on the report she said:

> *"One degree Celsius rise in temperature is associated with 10% productivity loss in farming. For us, it means losing about four million metric tonnes of food grain, amounting to about US$ 2.5 billion. That is about 2% of our GDP. Adding up the damages to property and other losses, we are faced with a total loss of about 3-4% of GDP. Without these losses, we could have easily secured much higher growth."*
>
> *"After seventeen years of international negotiations, we are still without any meaningful agreement or action to reduce global warming. As a climate vulnerable country, every day we see and feel the ramifications of that inaction as outlined in the Climate Vulnerable Monitor. But experts have struggled to tie all the pieces together to design a clear picture of climate vulnerability. This report examines impacts linked to climate change in some new ways and attempts to draw new conclusions. We did not have access to this information until now. Of course, experts may call into question this or that aspect of the Monitor's findings, but we are certain subsequent research will continue to reaffirm the broad conclusions of the report. Its publication is a milestone for the climate negotiations. It is our hope it will help redirect efforts to effectively address the harms being done to today's economy. We continue to work with all governments and other stakeholders to bring about a fair and just outcome to the negotiations."*

The report is the second to be issued by an ongoing international research program on climate-related vulnerability mandated to the independent humanitarian and development research organization, DARA. Its expanded assessment of the costs of inaction on climate change presents a new and original assimilation of the latest scientific evidence, research and data in a survey of thirty-four indicators of climate-related concern. The study estimates human and economic impacts for 184 countries in 2010 and 2030 across a wide range of separate effects. Indicators of impact range from issues such as hunger and skin cancer, to permafrost thawing and sea-level rise, indoor and outdoor air pollution, and fisheries, biodiversity and forest deterioration. Constraints on labor productivity, imposed by rising heat, are the largest single impact due to climate change and a new component of the analysis.

High-level and technical panels of over 50 leading scientists, economists, and policy experts, including former heads of government, reviewed the report

whose development also involved field-based research in Africa and Asia.

Report Panel member, **DARA Trustee and Former President of Costa Rica José María Figueres** said today:

> *"1.3 billion people are still fighting their way out of the most extreme forms of poverty while major economies are today fighting their way out of crippling financial and economic crises. We simply cannot afford to part with more growth. The prospect of economic losses that rise with every decade could destabilize the world economy far before the worst impacts of climate change set in. Governments and international policy makers must act decisively to combat the spiraling costs to national and global GDP resulting from inaction on climate change. The Monitor shows how failure to do so has already caused unprecedented damage to the world economy and threatens human life across the globe. With the investment required to solve climate change already far below the estimated costs of inaction, no doubt remains as to the path worth taking."*

The new Monitor report, entitled "A Guide to the Cold Calculus of A Hot Planet," juxtaposes on the one hand the large-scale anticipated increases in fossil fuel consumption over the coming decades with the enormous human and developmental consequences of this. However, it also points out that decisions taken on cold monetary terms alone would actually favour strong action on climate change globally and regionally.

The report outlines how the first edition of the Monitor is already used as a tool by development, humanitarian and aid agencies concerned with addressing the growing impact of climate change around the world, as well as investment and security analysts among others.

Ends

FOR ADDITIONAL COMMENT, INFORMATION OR TO REQUEST AN INTERVIEW WITH A DARA/FORUM SPOKESPERSON, PLEASE CONTACT:

Daniel Rolle, MHP Communications

daniel.rolle@mhpc.com / +44 (0)203 128 8199 / +44 (0)7946 656 212

Tom Gillingham, MHP Communications

tom.gillingham@mhpc.com / +44 (0)20 3128 8151 / +44 (0) 7585 301 464

About the Monitor

The *Climate Vulnerability Monitor* measures the global impact of climate change and the carbon economy at a national level. It calculates and compares the vulnerability for 184 countries in four areas of impact (environmental disasters, habitat change, health impact and industry stress) using 34 climate and carbon related indicators. The monitor uses five levels of vulnerability, from acute to low, to compare and contrast nations.

The first Monitor was launched in 2010 to assess the effects of global climate change on nations up to 2030. It uses current peer-reviewed scientific research, in-country field research and critical input from two separate external advisory bodies.

About DARA

Founded in 2003, DARA is an international organization headquartered in Madrid, Spain, committed to improving the effectiveness of aid for vulnerable populations suffering from conflict, disasters and climate change.

It is an impartial, non-partisan, non-profit entity independently governed by a foundation Board of Trustees and actively engaged in field research and evaluation work of aid programs and operations in developing countries across five continents. It also produces and issues specialized publications and data in particular on aid accountability and effectiveness issues, as well as emerging strategic concerns for the development, humanitarian and disaster reduction domains.

DARA's Climate Vulnerability Initiative is mandated to develop the Monitor as an independent and politically impartial report and convenes the external advisory bodies that provide third-party guidance and review inputs to this process.

www.daraint.org

About the Climate Vulnerable Forum

Founded in 2009, the Climate Vulnerable Forum is a semi-formal government cooperation group of developing countries facing high degrees of insecurity due to climate change and active in seeking a resolution to the climate crisis.

The Forum has called for ambitious outcomes in international climate change policy, such as setting the temperature increase goal at 1.5° Celsius (2.7° Fahrenheit) which was subsequently also adopted by other groups of countries and played an important boundary definition role in the UN climate negotiations at Copenhagen in 2009. The Forum has advocated for and insisted on accountability to decisions taken in international arena regarding climate change and sustainable development and its members have committed to pursue domestic low-carbon and even carbon neutral development pathways.

The Forum currently has 20 members and meets periodically at head of government, ministerial and delegate levels. The Monitor is an analytical input and communication tool for Forum members, and the two country studies included in this report were undertaken in member countries, Ghana and Vietnam.

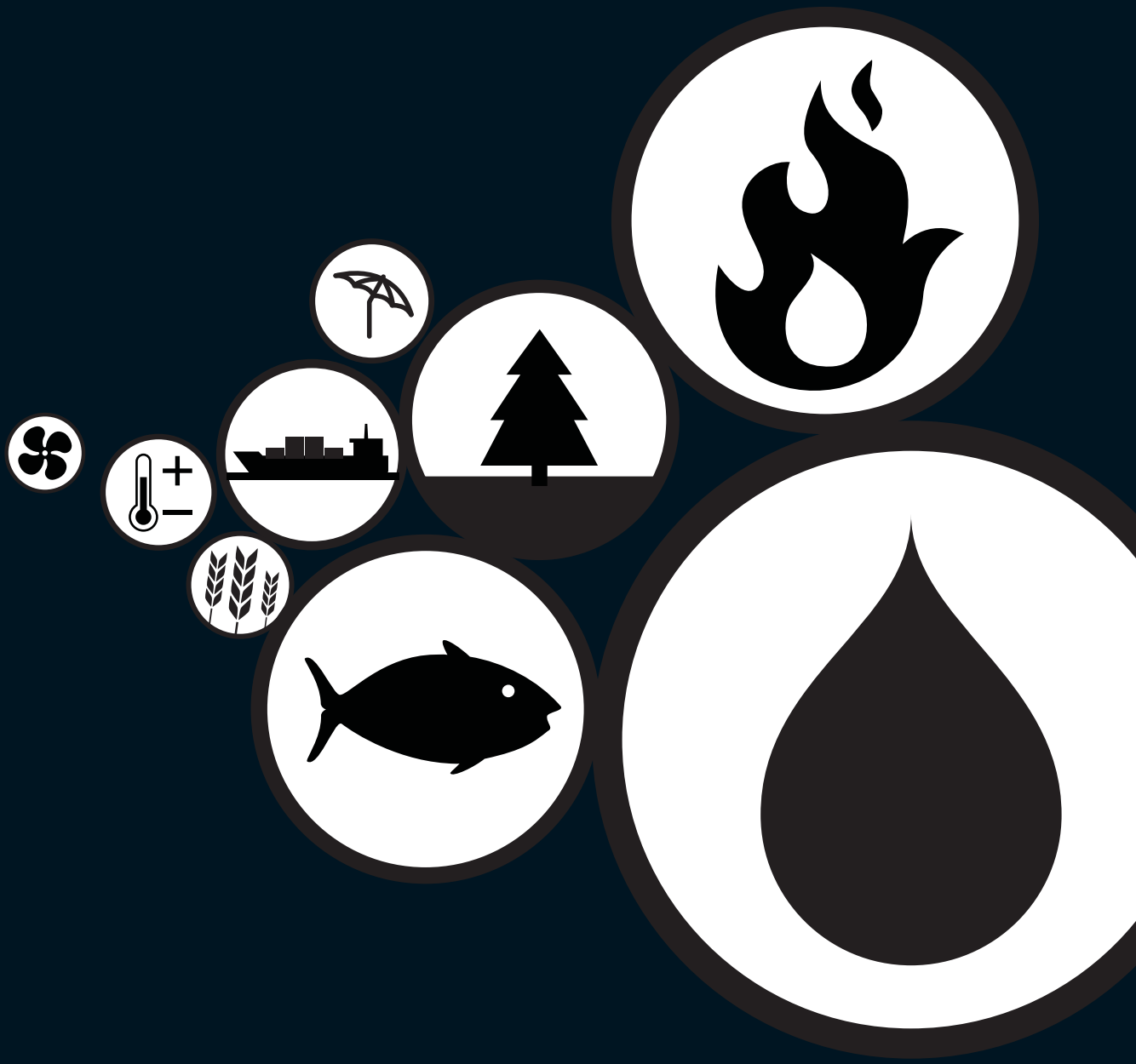
Exhibit 6

2ND EDITION CLIMATE VULNERABILITY MONITOR

A GUIDE TO THE COLD CALCULUS OF A HOT PLANET

Climate Vulnerable Forum

DARA

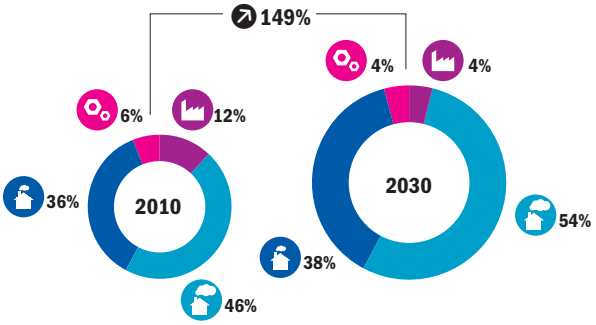


EXECUTIVE SUMMARY

This report provides a reassessment of the human and economic costs of the climate crisis. The reassessment is based on a wealth of the latest research and scientific work on climate change and the carbon economy, research that is assimilated as a part of this report.

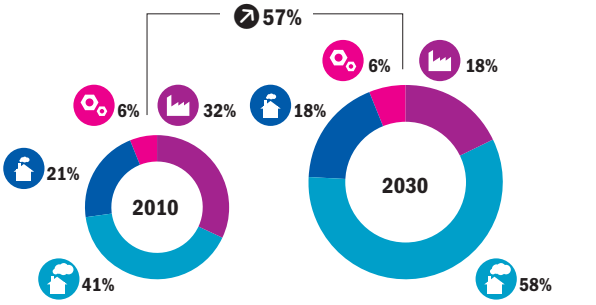
THE MAIN FINDING OF THIS REPORT IS THAT CLIMATE CHANGE HAS ALREADY HELD BACK GLOBAL DEVELOPMENT: IT IS ALREADY A SIGNIFICANT COST TO THE WORLD ECONOMY, WHILE INACTION ON CLIMATE CHANGE CAN BE CONSIDERED A LEADING GLOBAL CAUSE OF DEATH.

CLIMATE – TOTAL COSTS



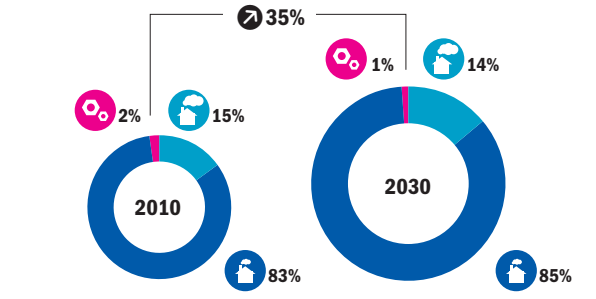
Developed
Developing Country High Emitters
Developing Country Low Emitters
Other Industrialized

CARBON – TOTAL COSTS



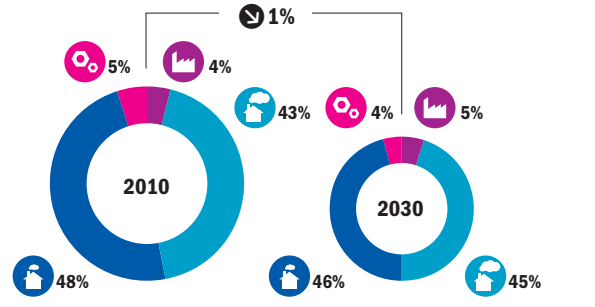
Developed
Developing Country High Emitters
Developing Country Low Emitters
Other Industrialized

CLIMATE – TOTAL DEATHS



Developing Country High Emitters
Developing Country Low Emitters
Other Industrialized

CARBON – TOTAL DEATHS



Developed
Developing Country High Emitters
Developing Country Low Emitters
Other Industrialized

This report estimates that climate change causes 400,000 deaths on average each year today, mainly due to hunger and communicable diseases that affect above all children in developing countries. Our present carbon-intensive energy system and related activities cause an estimated 4.5 million deaths each year linked to air pollution, hazardous occupations and cancer.

OVERALL COSTS

	Losses 2010, Bln PPP corrected USD	Losses 2010, % of GDP	Net Losses, % of GDP 2010	Net Losses, % of GDP 2030
Climate	696	0.9%	0.8%	2.1%
Carbon	542	0.7%	0.7%	1.2%
World	**1,238**	**1.7%**	**1.6%**	**3.2%**

Climate change caused economic losses estimated close to 1% of global GDP for the year 2010, or 700 billion dollars (2010 PPP). The carbon-intensive economy cost the world another 0.7% of GDP in that year, independent of any climate change losses. Together, carbon economy- and climate change-related losses amounted to over 1.2 trillion dollars in 2010.

The world is already committed to a substantial increase in global temperatures – at least another 0.5° C (1° F) due to a combination of the inertia of the world's oceans, the slow response of the carbon cycle to reduced CO_2 emission and limitations on how fast emissions can actually be reduced.[1] The world economy therefore faces an increase in pressures that are estimated to lead to more than a doubling in the costs of climate change by 2030 to an estimated 2.5% of global GDP. Carbon economy costs also increase over this same period so that global GDP in 2030 is estimated to be well over 3% lower than it would have been in the absence of climate change and harmful carbon-intensive energy practices.

Continuing today's patterns of carbon-intensive energy use is estimated, together with climate change, to cause 6 million deaths per year by 2030, close to 700,000 of which would be due to climate change. This implies that a combined climate-carbon crisis is estimated to claim 100 million lives between now and the end of the next decade. A significant

NUMBER OF DEATHS

		2010	2030
Climate	Diarrheal Infections	85,000	150,000
	Heat & Cold Illnesses	35,000	35,000
	Hunger	225,000	380,000
	Malaria & Vector Borne Diseases	20,000	20,000
	Meningitis	30,000	40,000
	Environmental Disasters	5,000	7,000
Carbon	Air Pollution	1,400,000	2,100,000
	Indoor Smoke	3,100,000	3,100,000
	Occupational Hazards	55,000	80,000
	Skin Cancer	20,000	45,000
World		**4,975,000**	**5,957,000**

TECHNICAL SUMMARY

The Monitor presents a new and original analysis, synthesizing the latest research and scientific information on the global impact – including benefits and losses – of climate change and the carbon economy in economic, environmental and health terms. Climate change already causes 400,000 deaths each year on average. The present carbon-intensive economy moreover is linked to 4.5 million deaths worldwide each year. Climate change to date and the present carbon economy are estimated to have already lowered global output by 1.6% of world GDP or by around 1.2 trillion dollars (2010 PPP). Losses are expected to increase rapidly, reaching 6 million deaths and 3.2% of GDP in net average global losses by 2030. If emissions continue to increase unabated in a business-as-usual fashion (similar to the new IPCC RCP8.5 scenario), yearly average global losses to world output could exceed 10% of global GDP before the end of the century, with damages accelerating throughout the century. The costs of climate change and the carbon economy are already significantly higher than the estimated costs of shifting the world economy to a low-carbon footing – around 0.5% of GDP for the current decade, although increasing for subsequent decades.[1]

This report and scientific literature imply adaptation costs

share of the global population would be directly affected by inaction on climate change.

Global figures mask enormous costs that will, in particular, hit developing countries and above all the world's poorest groups. Least Developed Countries (LDCs) faced *on average* in excess of 7% of forgone GDP in 2010 due to climate change and the carbon economy, as all faced inequitable access to energy and sustainable development.

Over 90% of mortality assessed in this report occurs in developing countries only – more than 98% in the case of climate change.

Of all these losses, it is the world's poorest communities within lower and middle-income countries that are most exposed. Losses of income among these groups is already extreme. The world's principal objectives for poverty reduction, the Millennium Development Goals (MDGs), are therefore under comprehensive pressures, in particular as a result of climate change.

The impact for rural and coastal communities in the lowest-income settings implies serious threats for food security and extreme poverty (goal 1 of 8), child health and the ability of children to attend school (goals 2 and 4), maternal health and women's development (goals 3 and 5), the prevalence of infectious diseases (goal 6) and, through water, fisheries and biodiversity impacts, environmental sustainability (goal 7). Furthermore, in a difficult fiscal environment, the advent of climate change has pressured governments to divert Official Development Assistance (ODA) funds from other development commitments and activities in an attempt to provide support for climate change concerns, including to a marginal degree, for helping vulnerable communities adapt to climate change. The Green Climate Fund, agreed upon in incrementally greater detail at the successive international climate talks at Copenhagen, Cancún and Durban, faces an economic environment of declining ODA tied to acute fiscal crises across a host of the world's wealthiest economies (see: climate finance). These developments have ultimately compromised the global partnership for development (goal 8). Lag areas towards MDG achievement also align very closely with the most pronounced vulnerabilities resulting from climate change: sub-Saharan Africa, small island developing states, and South Asia in particular.

Poverty reduction efforts are in peril as the potential temperature increase the world is already committed to has only begun to be realized, and the world's major economies are in no way spared. The United States, China and India in particular are expected to incur enormous losses that in 2030 for these three countries alone will collectively total 2.5 trillion dollars in economic costs and over 3 million deaths per year, or half of all mortality – the majority in India and China.

The whole world is affected by these comprehensive concerns: 250 million people face the pressures of sea-level rise; 30 million people are affected by more extreme weather, especially flooding; 25 million people are affected by permafrost thawing; and 5 million people are pressured by desertification. The pressures that these combined stresses put on affected communities are immense and force or stimulate the movement of populations. As is highlighted in the Ghana country study in this report, they can also fuel violence and an erosion of the social and economic fabric of communities.

The impact of climate change on Labour Productivity is assessed here as the most substantial economic loss facing the world as a result of climate change. A large proportion of the global workforce is exposed to the incessant increase in heat, with the number of very hot days and nights increasing in many places by 10 days a decade.[2] Developing countries, and especially the lowest-income communities, are highly vulnerable to these effects because of geographical location – northern countries like Scandinavia, it is assumed, *benefit* from improved labour productivity due to warmer weather – but also because their labour forces have the highest proportion of non-climate controlled occupational environments.[3] Global productivity in labour is surging due to technological advances and a shift of emphasis from agricultural activities to an industrial and service sector focus for most developing countries, among other key developments.[4] Climate change, however, holds back the full extent of productivity gains the world would otherwise enjoy.[5] In this way, the

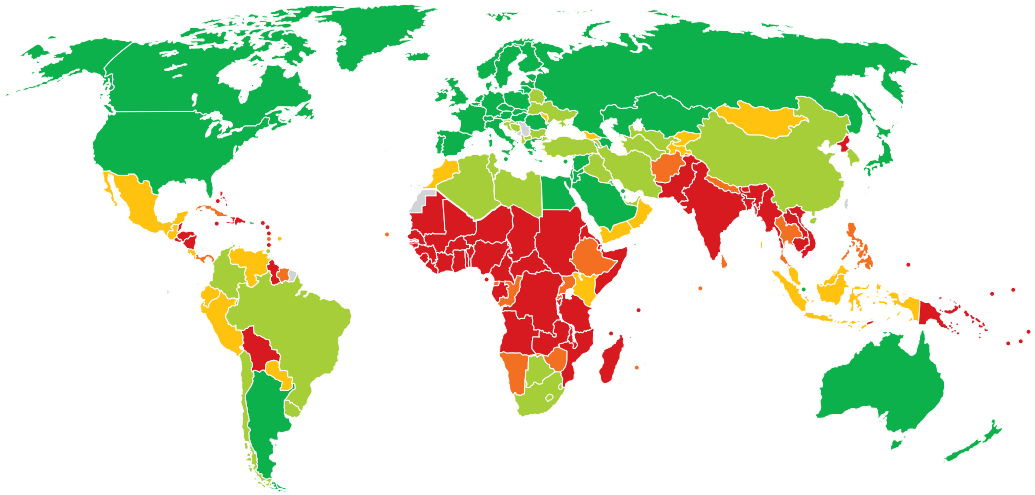
to be at least 150 billion dollars per year today for developing countries, rising to a minimum of more than 1 trillion dollars per year by 2030. These costs are, however, considerably lower than costs of damages to developing countries estimated here, so adapting to climate change is very likely a cost-effective investment in almost all cases and should be central to any climate change policy. Beyond adaptation, this report also emphasizes the urgency of mitigating key risks: tackling food security, indoor fires/ smoke, air pollution and other health issues such as diarrheal illnesses, malaria and meningitis that are all urgent priorities for lessening the extent of the human toll of this crisis.

With costs due both to unabated climate change and the carbon economy expected to rise rapidly over the course of this century, tackling climate change by reducing emissions yields net benefits to the world economy in monetary terms – amounting to around a 1% higher GDP for the entirety of the 21st century (net present value at a 3% discount rate). World net benefits from action on climate change are insensitive to discount rates from 0.1% to 20% (the highest tested). Even the most ambitious reductions in emissions aimed at holding warming below 2°C (e.g. 400ppm CO_2e/IPCC AR5 RCP2.6 scenario) generates economic benefits for the

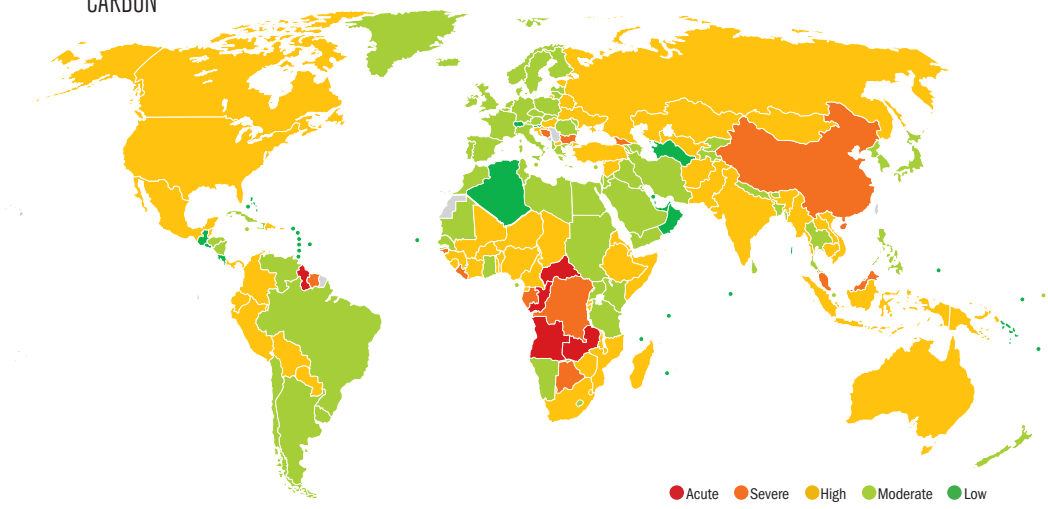
costs of climate change are hidden, which helps to explain in part how their full extent may have been missed. Even so, not all have benefitted from fast expanding labour productivity: labour productivity is a core indicator for MDG 1 (on extreme poverty and hunger), for instance, where little progress has been registered in many developing regions of the world, in particular for sub-Saharan Africa and the Pacific.[6] Not one country is *invulnerable* to the combined effects of climate change and the carbon economy. Inaction on climate change penalizes every country in the world, just as all are set to gain from action

MULTI-DIMENSIONAL VULNERABILITY

CLIMATE



CARBON



world economy after accounting for the costs of reducing emissions (mitigation costs). Limiting warming to this level would limit human, territorial and ecological damage as well as other concerns, such as climate-induced forced movement of human populations.

Over 98% of all climate change mortality and over 90% of all carbon economy related mortality is in developing countries: between 80% and 90% of all economic costs are projected to fall on developing countries. The most extreme effects of climate change are estimated to be felt by the Least Developed Countries, with average GDP losses of 8% in 2030. With respect to carbon economy effects, inequitable access to sustainable development sees Least Developed Countries again incurring the highest relative losses at over 3% of GDP, while between two thirds and three quarters of all carbon economy costs are borne by developing countries.

When the costs of climate change and the carbon economy estimated here are combined, not one country in the world is left unharmed. In terms of regional incentives to tackle climate change, every region is estimated to experience net economic benefits from action on climate change even for the highest levels of action.

The Monitor only analyses incremental impacts as a result of climate change, or changes in the frequency of well-known stochastic events, such as floods and landslides. Not assessed here in any way are potential catastrophic impacts that could occur due to more rapid climate change fuelled

on climate change. Moreover, the vulnerability of the world is shifting with every passing decade. Countries once resilient to marginal weather effects increasingly realize susceptibilities to a changed climate as the increase in heat and associated effects continue to reach new extremes.

Some quite serious damage is now unavoidable, but certain losses can still be reduced in the short term. In particular, human costs can be transferred to economic costs. This can be achieved through programmes aimed at reducing rural poverty – at the origin of hunger deaths and many communicable diseases afflicting the world's poorest groups, with risks that worsen with climate change. Or it can be achieved by ensuring clean air regulations, safer working conditions and modern energy options for people at risk due to carbon-intensive forms of energy. All these measures will save lives but cost money.

Economic losses themselves can also be lessened. A major recent review of humanitarian assistance work noted that Mozambique had requested 3 million dollars from the international community for flood preparations. That sum went unsecured, and 100 million dollars was subsequently spent on emergency flood response.[7] Investment in agriculture might also be cost-effective if the costs of supporting upgraded farming were to generate more benefits (in productivity, output) than the initial outlay.[8]

There are, however, limits to the ability of populations to adapt. The oceans can hardly be refrigerated against marine stresses.[9] Desert encroachment can be prevented but rarely reversed, and if so, generally at great expense.[10] It might be possible to protect a beach, but concrete polders could well be to the detriment of an area's authentic charm and so to the value of properties.

A low-carbon, renewable economy – of hydro, wind, solar, geothermal, tidal and other innovative sources of energy – now competes with the most carbon-intensive forms of power generation in the open market, where they constitute around 10% of the global energy mix today.[11] Shifting the balance in favour of low-carbon energy has been estimated to cost approximately 0.5% or less of GDP for the current decade.[12]

The carbon economy is largely responsible for the incredible growth in overall wealth society has amassed over the last 200 years, although, according to the World Bank, 1.3 billion people continue to remain trapped in dire poverty.[13] Regardless, an economic system developed to support a global population of 1 or 2 billion people in the 19th century is ill suited to a global population in excess of 7 billion and growing.[14]

The climate challenge runs in parallel to other key global developments: a growing world population, a major propensity to urbanization, and structural

by feedbacks such as a release of Arctic methane deposits, more rapid sea-level rise that could result from the disintegration of the West Antarctic Ice Sheet or large-scale climatic disruptions such as the collapse of ocean circulation mechanisms, all of which are understood to pose significantly larger human, economic and ecological risks than anything portrayed here. The possibilities of these events are by no means ruled out, with risks increasing substantially with warming.[2] Other economists have therefore factored such risks into their economic analysis to a degree.[3]

Only with the deep and sustained emissions reductions spelled out in the lowest of the new IPCC RCP 2.6 scenario is there a reasonable chance (comfortably over 50%) of not exceeding the internationally accepted "safety" temperature threshold of 2°C global mean warming above preindustrial.[4] Given the clear human, ecological and,

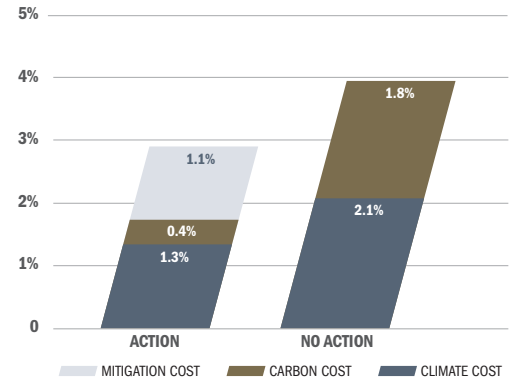
REGIONAL COST BENEFIT ANALYSIS, 2010-2100** PERCENTAGE OF GLOBAL GDP (NOMINAL), NET PRESENT VALUE AT 3% DISCOUNT RATE

	Climate + Carbon Costs				Highest Action		High Action		Moderate Action		Net Benefit		
Region	**No Action**	**Highest action (400 ppm)**	**High action (450 ppm)**	**Moderate action (550 ppm)**	**Avoided costs***	**Mitigation costs**	**Avoided costs***	**Mitigation costs**	**Avoided costs***	**Mitigation costs**	**Highest action**	**High Action**	**Moderate action**
USA	3.0%	1.0%	1.0%	1.5%	2.0%	1.5%	2.0%	1.0%	1.5%	0.5%	0.5%	1.0%	1.0%
Japan	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.0%	0.0%	0.0%
Russia	4.5%	1.5%	1.5%	2.0%	3.0%	2.0%	3.0%	2.0%	2.5%	2.5%	1.0%	1.0%	0.0%
China	4.5%	2.0%	2.0%	2.5%	2.5%	2.0%	2.5%	1.5%	2.0%	1.0%	0.5%	1.0%	1.0%
India	11.0%	5.0%	5.5%	6.5%	6.0%	3.0%	5.5%	2.0%	4.5%	0.5%	3.0%	3.5%	4.0%
EU27	1.0%	0.5%	0.5%	0.5%	0.5%	1.0%	0.5%	0.5%	0.5%	0.5%	0.0%	0.0%	0.0%
ROW	8.5%	3.5%	3.5%	4.5%	5.5%	2.0%	5.0%	1.0%	4.5%	0.5%	3.5%	4.0%	3.5%
World***	4.0%	1.5%	1.5%	2.0%	2.5%	1.5%	2.0%	1.0%	2.0%	0.5%	1.0%	1.0%	1.0%

*Avoided costs: No action (A1B +8.5) minus reduced ppm scenario (400 ppm C02e: RCP2.6; 450 ppm: RCP2.9; 550 ppm: SRES B1)
** Discounted (3%) sum of costs and GDP – mitigation costs from Edenhofer et al., 2010 (regional: Remind + Poles)
*** Median value of all 5 scenarios (Edenhofer et al., 2010)

ACTION VERSUS INACTION OVER THE 21ST CENTURY

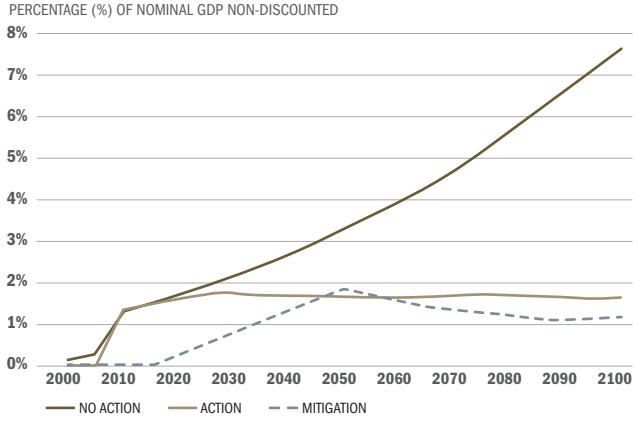
NPV OF GLOBAL CLIMATE/CARBON COSTS AND MITIGATION COSTS RELATIVE TO GDP (NOMINAL 2010-2100, 3% DISCOUNT RATE)



Action equals 450 ppm (RCP 2.9) No action equals mid-point of 2 non-stabilization scenarios (RCP 8.5 and SRES A1B)

21ST CENTURY COSTS OF CLIMATE CHANGE ACTION, INACTION AND MITIGATION

PERCENTAGE (%) OF NOMINAL GDP NON-DISCOUNTED



shifts occurring in economies around the world. All of these tendencies – most pronounced in developing countries, in particular the process of industrialization now spreading more and more widely[15] – can worsen or attenuate vulnerabilities to climate change or the carbon economy.

In order to understand the fuller implications of this study and to make its findings comparable with previous works that take on longer-term perspectives, the costs of climate change and the carbon economy were also estimated for the period up until 2100. On this basis, business-as-usual development could see the costs of inaction exceeding 10% of global GDP in losses prior to 2100.

Reducing emissions results in net benefits for society in every case because the costs of a low-carbon transition are more than outweighed by averted losses due to climate change and the carbon economy.

In the global context, the highest level of emission reductions results in similar global benefits to lower levels of action. However, the highest action sees fewer negative impacts on society –from human health to biodiversity and for the world's oceans – but requires slightly greater investments in low-emission forms of energy. Less ambitious action means accepting larger scales of human and ecological impacts.

The regional analysis of costs and benefits differs little in fundamental terms from the global analysis: all regions benefit from climate action in economic terms. Most regions find optimal climate action in the high-action scenario. The highest action to reduce emissions also limits the risks of crossing tipping points leading to large-scale climate disruptions.[16] Less ambitious action on climate change does not: moderate action on climate change has a high chance of exceeding the accepted international temperature goal of holding warming below 2° C (3.6° F) above pre-industrial levels.[17] The most vulnerable countries have called for warming to be limited below 1.5° C above pre-industrial levels as they believe 2° C is far too damaging and a risk to their survival.

Neither should the risks of catastrophic impacts be discarded as heresy: new research has highlighted great risks associated with *heat*, as opposed to ocean-related immersion of countries, with heat risks concerning far greater shares of the world economy and its population. In particular, at certain levels of high-end warming, large areas of the planet would progressively begin to exceed the thermal maximum at which human beings are able to survive outdoors.[18] The possibilities of very rapid climate change are not implausible or ruled out by climate change models, especially as the planet warms beyond the 2 degrees Celsius temperature threshold

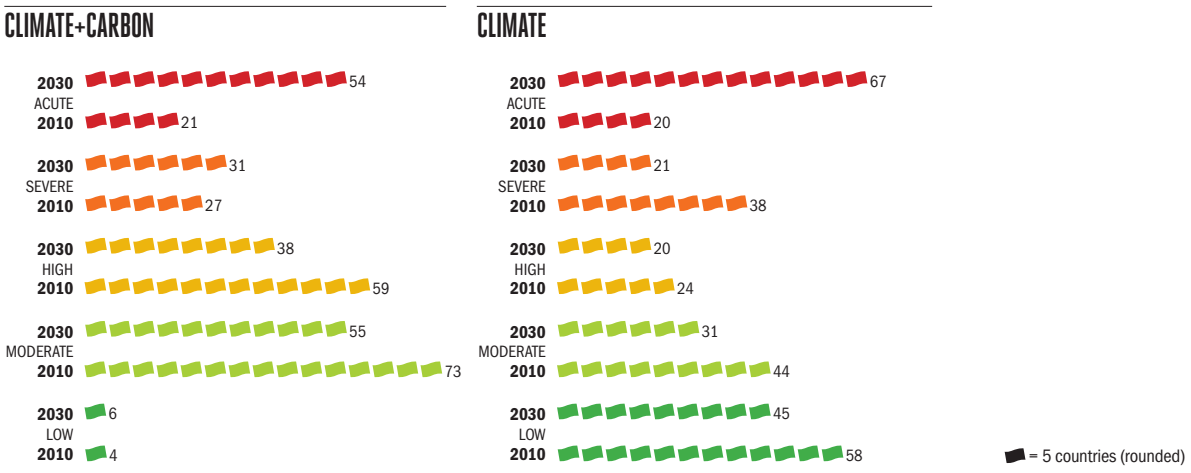
ultimately, economic advantages of aiming for a highest-action scenario, this report's findings imply that the highest action targets would reap the most benefits for the world. Therefore, the highest-action scenario is recommended to policy makers as the preferred target for enhancing and safeguarding global prosperity. Mainstream economic modelling shows that this transition is technologically and economically feasible but that action is needed now to get onto this pathway.[5] *International cooperation will clearly be central to ensuring that the costs of the transition are maintained at the lowest most efficient level and that the transition yields the highest co-benefits.*[6]

[1] See: Edenhofer et al., 2010; IPCC, 2012a
[2] Weitzman, 2007; Hare in Mastny, 2009
[3] For example: Hope, 2006; Stern, 2006
[4] Pope et al., 2010
[5] For an overview of some leading mitigation scenarios, see: Edenhofer et al., 2010; UNEP, 2011; IPCC, 2012a
[6] For example the economic benefits of cross-border emission reduction cooperation: De Cian and Tavoni, 2010

the international community has set for itself.[19] Of particular long-term concern are 1500 gigatonnes of CO_2 ($GtCO_2$) of methane stored in frozen sediments in the East-Siberian Sea at depths of less than 40 to 50 metres.[20] This represents three times the amount of CO_2 that could be released over much of this century if the 2 degrees target is to be kept.[21] As the Arctic sea warms due to climate change, these sediments are thawing and methane is already being visibly released at rates that currently exceed the total amount of methane emitted through natural processes over the entirety of the world's oceans.[22] While all policy pathways for reducing emissions have similar net benefits in economic terms, the highest-action route would clearly reap the greatest human, societal, economic and environmental benefits, since it would ensure the greatest chances of avoiding climate-triggered catastrophe and would minimize the human, social and environmental impacts of a hotter planet. Therefore, the cold calculus of a hot planet implies the most ambitious action on climate change is the savviest choice both in monetary, humanitarian and environmental terms. The highest-action approach is the pathway that the analysis in this report most supports.

The world risks carbon lock-in due to high-intensity carbon infrastructure plans still moving forward in the near term, so the shift in focus to a low-carbon transition should likely occur prior to 2017 and continue aggressively thereafter.[23] Several major economies will need to adjust and enact important domestic policy and legislative initiatives in order to make this a reality. Whatever the case, action on climate change that seeks out international partnership is most likely to further lessen the costs of a low-carbon transition and expand the benefits of this transition for all concerned. This report documents in part the potential benefits of avoided impacts of climate change in addition to the potential co-benefits of emission reductions that are targeted at key economic, health and environmental concerns.[24]

[1] Hansen et al., 2005
[2] Kjellstrom et al., 2009a; McSweeney et al., 2012
[3] ILO LABORSTA, 2012
[4] Storm and Naastepad, 2009; Wacker et al., 2006; Restuccia, et al., 2004; Storm and Naastepad, 2009; McMillan and Rodrik, 2012
[5] Kjellstrom et al., 2009a-b
[6] UN, 2012
[7] Ashdown et al., 2011
[8] Parry et al., 2009; EACC, 2010
[9] Cheung et al., 2010
[10] Puigdefaabregas, 1998
[11] US EIA, 2011
[12] Edenhofer et al., 2010; IPCC, 2012b
[13] Chen and Ravallion, 2012
[14] World Population Prospects/UN DESA, 2011
[15] OECD, 2012; IMF WEO, 2012; World Population Prospects/UN DESA, 2011
[16] Pope et al., 2010
[17] UNFCCC, 2009
[18] Sherwood and Huber, 2010
[19] Wietzman, 2007
[20] Shakhova et al., 2008
[21] Meinshausen et al., 2009
[22] Shakhova et al., 2008 and 2010
[23] IAE, 2011; UNEP, 2011
[24] De Cian and Tavoni, 2010



SUMMARY OF ECONOMIC IMPACT

		NET 2030	NET 2010	LOSSES 2010	GAINS 2010	2010				2030			
CLIMATE	DROUGHT	18	4	4	*	*	2	1	*	4	11	3	1
	FLOODS & LANDSLIDES	94	10	10	*	2	6	1	*	21	66	5	3
	STORMS	100	15	15	*	2	3	7	*	16	64	20	*
	WILDFIRES	*	*	*	*	*	*	*	*	*	*	*	*
	TOTAL	**213**	**29**	**29**	*	**5**	**14**	**10**	**1**	**40**	**142**	**28**	**4**
	BIODIVERSITY	389	78	78	*	8	26	36	9	56	299	80	54
	DESERTIFICATION	20	4	5	*	*	*	2	1	5	4	6	6
	HEATING & COOLING	-77	-33	5	-38	1	2	24	-8	30	7	-65	-49
	LABOUR PRODUCTIVITY	2,400	311	314	-3	135	162	16	-1	1,035	1,364	49	-12
	PERMAFROST	153	31	31	*	1	10	3	17	5	68	5	75
	SEA-LEVEL RISE	526	86	86	*	23	42	15	5	166	310	29	22
	WATER	13	14	44	-30	3	-3	13	7	-21	45	39	39
	TOTAL	**3,461**	**491**	**563**	**-71**	**166**	**235**	**60**	**30**	**1,276**	**1,908**	**144**	**135**
	TOTAL	**106**	**23**	**23**	*	**17**	**5**	*	**0.5**	**84**	**21**	*	**1**
	AGRICULTURE	367	50	51	*	27	17	3	2	208	144	8	10
	FISHERIES	168	13	16	-3	7	7	1	-1	97	80	-3	-6
	FORESTRY	44	6	7	-1	*	4	*	*	9	34	1	1
	HYDRO ENERGY	-24	-4	*	-4	*	-3	*	*	3	-20	-1	*
	TOURISM	*	*	5	-5	2	*	-1	*	19	-16	-2	-1
	TRANSPORT	7	1	1	*	*	*	1	*	*	1	6	*
	TOTAL	**565**	**66**	**80**	**-13**	**37**	**25**	**2**	**2**	**329**	**223**	**8**	**5**
TOTAL GLOBAL RESULTS		**4,345**	**609**	**695**	**-84**	**225**	**279**	**72**	**33**	**1,730**	**2,294**	**179**	**144**
CARBON	OIL SANDS	24	7	7	*	*	*	7	*	2	1	20	0.5
	OIL SPILLS	38	13	13	*	1	6	6	0.5	3	24	9	2
	TOTAL	**61**	**20**	**20**	*	**1**	**6**	**13**	**0.5**	**5**	**25**	**29**	**3**
	BIODIVERSITY	1,734	291	291	*	32	128	114	17	236	1,034	349	115
	CORROSION	5	1.5	1.5	*	*	0.5	0.5	*	1	4	0.5	0.5
	WATER	10	4	4	*	*	*	3	1	*	2	4	4
	TOTAL	**1,749**	**296**	**296**	*	**32**	**129**	**117**	**18**	**238**	**1,038**	**353**	**120**
	TOTAL	**630**	**172**	**172**	*	**74**	**67**	**21**	**10**	**226**	**341**	**37**	**26**
	AGRICULTURE	-171	15	17	-2	1	2	9	4	-58	-121	4	4
	FISHERIES	77	9	9	*	1	7	0.5	*	5	70	2	0.5
	FORESTRY	83	28	28	*	3	9	14	1	13	48	18	4
	TOTAL	**-11**	**52**	**54**	**-2**	**4**	**18**	**24**	**5**	**-40**	**-3**	**24**	**8**
TOTAL GLOBAL RESULTS		**2,429**	**540**	**542**	*	**112**	**220**	**174**	**34**	**429**	**1,401**	**444**	**156**

* Less than one billion dollars

Billions of dollars (2010 PPP) non-discounted. Totals do not correspond exactly due to rounding.

Environmental disasters · Habitat change · Health impact · Industry stress

Developing Country Low Emitters · Developing Country High Emitters · Developed · Other Industrialized

Exhibit 7

Citizens Against LNG Inc
PO Box 1113
North Bend, OR 97459

August 6, 2012

By Email and by Electronic Filing on the Federal
eRulemaking Portal under FE Docket No. 12–32–LNG:
fergas@hq.doe.gov
http://www.regulations.gov

Ms. Larine A. Moore
Docket Room Manager
FE-34
U.S. Department of Energy
PO Box 44375
Washington, D.C. 20026-4375

Re: Application of Jordan Cove Energy Project, L.P. for Long-Term Authorization to Export Liquefied Natural Gas to Non-Free Trade Agreement Nations, FE Docket No. 12-32-LNG

Dear Ms. Moore:

Please accept for filing the following protest of Citizens Against LNG Inc regarding the application of Jordan Cove for Authorization to Export Liquefied Natural Gas to Non-Free Trade Agreement Nations. For the following reasons, we believe the Department of Energy should reject Jordan Cove's application because it would be detrimental to the public interest.

1. Jordan Cove's proposed export facility would hurt consumers in the United States by increasing the prices for domestic natural gas

It is not in dispute that Jordan Cove's proposed LNG export facility would increase the price for domestic natural gas in the United States. The only question is how much domestic natural gas prices in the United States would increase and how badly this would impact consumers. According to the latest assessment of the U.S. Department of Energy, allowing LNG export facilities, including Jordan Cove's proposed LNG export facility, would raise domestic natural gas prices substantially, by as much as 54% under certain scenarios:

> "Increased exports of natural gas lead to increased wellhead prices in all cases and scenarios. The basic pattern is evident in considering how prices would change under the Reference case (Figure 3):
>
> • The pattern of price increases reflects both the ultimate level of exports and the rate at which increased exports are phased in. In the low/slow scenario (which phases in 6 Bcf/d

of exports over six years), wellhead price impacts peak at about 14% ($0.70/Mcf) in 2022. However, the wellhead price differential falls below 10 percent by about 2026.

• In contrast, rapid increases in export levels lead to large initial price increases that would moderate somewhat in a few years. In the high/rapid scenario (which phases in 12 Bcf/d of exports over four years), wellhead prices are about 36 percent higher ($1.58/Mcf) in 2018 than in the no-additional-exports scenario. But the differential falls below 20 percent by about 2026. …..

• Slower increases in export levels lead to more gradual price increases but eventually produce higher average prices, especially during the decade between 2025 and 2035. The differential between wellhead prices in the high/slow scenario and the no-additional-exports scenario peaks in 2026 at about 28 percent ($1.53/Mcf), and prices remain higher than in the high/rapid scenario. ….

"In particular, with more pessimistic assumptions about the Nation's natural gas resource base (the Low Shale EUR case), wellhead prices in all export scenarios initially increase more in percentage terms over the baseline case (no additional exports) than occurs under Reference case conditions. For example, in the Low Shale EUR case the rapid introduction of 12 Bcf/d of exports results in a 54 percent ($3.23/Mcf) increase in the wellhead price in 2018; whereas under Reference case conditions with the same export scenario the price increases in 2018 by only 36 percent ($1.58/Mcf). But the percentage price increase falls in later years under the Low Shale EUR case, even below the price response under Reference case conditions. Under Low Shale EUR conditions, the addition of exports ultimately results in wellhead prices exceeding the $9 per Mcf threshold, with this occurring as early as 2018 in the high/rapid scenario."[1] (Emphasis added).

In a recent Congressional Report prepared by the staff of Representative Edward J. Markey, the Department of Energy's findings were summarized as follows:

"The United States faces a critical decision about whether to export natural gas following the rapid expansion of domestic production in recent years. The Department of Energy has already approved one export application and is currently considering eight others. If these applications are approved and the companies export at full capacity, the United States could soon be exporting more than 20 percent of current consumption. The Energy Information Administration has estimated that exporting even less natural gas than what is currently under consideration could raise domestic prices 24 to 54 percent, which would substantially increase energy bills for American consumers and could potentially have catastrophic impacts on U.S. manufacturing."[2]

[1] U.S. Department of Energy (January 2012) "Effect of Increased Natural Gas Exports on Domestic Energy Markets." http://www.fossil.energy.gov/programs/gasregulation/authorizations/2011_applications/exhibits_11-128-LNG/15._EIA_Effects_of_increased_NG_exports_.pdf

[2] Representative Edward J. Markey (March 2012) "Drill Here, Sell There, Pay More: The Painful Price of Exporting Natural Gas." http://democrats.naturalresources.house.gov/sites/democrats.naturalresources.house.gov/files/2012-03-01__RPT_NGReport.pdf

Therefore, proposed LNG export facilities, including Jordan Cove's proposed facility which could 'substantially increase energy bills for American consumers and could potentially have catastrophic impacts on U.S. manufacturing' are simply not in the public interest.

2. Jordan Cove's proposed LNG export facility would likely cause a net loss in U.S. employment by causing job losses in manufacturing

Jordan Cove argues that its proposed LNG export facility would be in the public interest by creating jobs in Coos County. According to Jordan Cove's application:

> "The jobs impact of construction of the Jordan Cove Project will be consequential. On average, the Project will employ 1,768 workers a year, and it will create 1,530 indirect and 1,838 induced jobs a year. ….
>
> "The employment impacts of the Jordan Cove Project in the typical operating year will include 99 direct jobs at the Jordan Cove terminal and the PCGP pipeline, 51 indirect jobs paid by Jordan Cove (Sheriff's deputies, firefighters, tugboat crews and emergency planners), 404 other indirect jobs and 182 induced jobs for a total of 736 total jobs in Coos County."[3]

What Jordan Cove did not consider is how these possible jobs gained in Coos County would be more than offset by jobs lost in U.S. manufacturing generally. According to the Industrial Energy Consumers of America:

> "In regards to using natural gas for export as LNG, IECA supports free trade. At the same time, affordable, abundant natural gas is critical to U.S. manufacturing growth, which in turn is critical to the U.S. economy. The manufacturing sector uses one-third of all of the natural gas and one-third of all electricity (of which one-third is produced from natural gas) which fuels the employment of 12 million high-paid workers. As with any resource that is critical to America's economic growth, <u>any decision to approve the export of natural gas should include a rigorous analysis of the potential impact on the domestic economy and job creation, and place a high priority on the manufacturing sector</u>. ….
>
> "<u>Affordable and abundant natural gas is vital to the recent renaissance in the nation's manufacturing sector. This renaissance has already contributed to up to a half million new American jobs.</u> In fact, for every manufacturing job created, three to five additional jobs across the broader economy are also created. Natural gas is used as a fuel for the entire manufacturing sector, to make nitrogen fertilizer, and it is also used as a raw material for the production of chemicals that are converted into an immense array of products that are used every day. Manufacturing natural gas consumption creates far more jobs per unit of gas consumed than any other application. The chemical industry

[3] Application of Jordan Cove Energy Project, L.P. for Long-Term Authorization to Export Liquefied Natural Gas to Non-Free Trade Agreement Nations, FE Docket No. 12-32-LNG, at pages 21-22.

alone has estimated that over $35 billion dollars of U.S. investments will be made by abundant, affordable supplies of natural gas."[4]

The Industrial Energy Consumers of America has concluded:

> "Jobs created by natural gas export facilities are small, relative to the opportunities to increase manufacturing jobs. Higher resulting natural gas prices will negatively impact U.S. manufacturing employment and ultimately additional jobs across the broader economy as well."[5]

Therefore, Jordan Cove's proposed LNG export facility, which could cause job losses in U.S. manufacturing that outweigh job gains locally, is not in the public interest.

3. Coos Bay would suffer the aftermath of unemployment that follows temporary employment in large-scale construction works

Unemployment impacts after the construction phase of the Jordan Cove / Pacific Connector project will not be in the public interest. The high unemployment in rural areas such as Coos Bay would be devastating to the local economy and clearly would not be in the public interest.

In 2003/2004 Coos County built a natural gas pipeline from Coos Bay to the Williams Northwest Grants Pass lateral pipeline that that runs along the I-5 hwy. The Coos County pipeline was a $51M gamble sold to the public with the promise of 2,900 jobs for the county. Despite all the promises made by industry speculators, those jobs never materialized and that pipeline currently is only operating at 5 to 7 percent of its capacity.

Jordan Cove estimates that 1,110 different jobs would need to be filled to build their project but the average job would only last 14 months. (FEIS 4.8-11)[6] After that there would be massive unemployment in the area and more people would be out of work than what we have now. The few jobs the facility would estimate to have as permanent jobs in no way justifies the public need for the facility. The Pacific Connector gas pipeline is estimated to end up with only 5 permanent employees after the construction phase of the pipeline is over. [7]

The Portland State University Population Research Center estimated that in July 2007, the population of Coos County was 63,050 people; which represented about a 4 percent increase since 2000. The two closest cities to the proposed Jordan Cove LNG terminal are North Bend, with a population estimated at 9,830 people, and Coos Bay, with a population of about 16,210 in

---

[4] July 16, 2012 letter from the Industrial Energy Consumers of America to the Brookings Institute. Re: Hamilton Project: "A Strategy for U.S. Natural Gas Exports" by Michael Levi. http://www.ieca-us.com/wp-content/uploads/07.16.12_IECA-Response-to-Brookings.pdf

[5] Ibid.

[6] FERC Final Environmental Impact Statement (FEIS) for Jordan Cove LNG Import Facility; http://www.ferc.gov/industries/gas/enviro/eis/2009/05-01-09-eis.asp Page 4.8-11

[7] FERC Jordan Cove Import Terminal Final EIS -http://www.ferc.gov/industries/gas/enviro/eis/2009/05-01-09-eis.asp Page 4.8-22

July 2007 (Proehl 2008). (FEIS 4.8-11) The 56 to 99 jobs promised by Jordan Cove would not make a significant impact to what is truly needed in the area and when you count the jobs that will be lost due to the facilities impacts, the project most likely will end up being a job loser.

There is already high unemployment in the area which has been a continual example of plundering by industry speculators who come to town with big promises of jobs and prosperity and leave us with boondoggles and rotting infrastructure and eyesores. It has been so bad here that several books have been written about our area, the most recent being Wim de Vriend's book, "The Job Messiahs", which came out just this last December and is now in its second edition. Other books include, "Plundertown, USA: Coos Bay Enters the Global Economy" and David Cay Johnston's New York best selling book, "Free Lunch: How the Wealthiest Americans Enrich Themselves at Government Expense (and Stick You With the Bill)," where Johnston devoted two full chapters to Coos County.

4. Jordan Cove's economic analysis rests on the mistaken assumption that U.S. water supplies will be adequate to sustain increased production of natural gas by hydraulic fracturing

Jordan Cove argues that domestic natural gas prices in the United States would not increase that much because the burgeoning use of hydraulic fracturing will continue to create a vast oversupply of domestic natural gas. However, hydraulic fracturing consumes large quantities of water and the continued burgeoning use of hydraulic fracturing rests on assumptions that water supplies will, in the future, be adequate to sustain the continued increased use of this technology.

However, this assumption is likely to be wrong. According to the Pacific Institute:

> "There is some evidence that the water requirements for hydraulic fracturing are already creating conflicts with other uses and could constrain future natural gas production in some areas. For example, in Texas, a major drought in 2011 prompted water agencies in the region to impose mandatory reductions in water use. Water agencies, some of which sold water to natural gas companies, indicated they might have to reconsider these sales if the drought persisted. Natural gas companies also tried to purchase water from local farmers, offering $9,500 to nearly $17,000 per million gallons of water (Carroll 2011). Likewise, at an auction of unallocated water in Colorado during the spring 2012, natural gas companies successfully bid for water that had previously been largely claimed by farmers, raising concerns among some about the impacts on agriculture in the region and on ecosystems dependent on return flows (Finley 2012).
>
> "Concerns over water availability are not limited to drier climates. Pennsylvania is generally considered a relatively water-rich state. However, in August 2011, 13 previously approved water withdrawal permits in Pennsylvania's Susquehanna River Basin were temporarily suspended due to low stream levels; 11 of these permits were for natural gas projects (Susquehanna River Basin Commission 2011). While parts of the state were abnormally dry, the basin was not experiencing a drought at the time, suggesting that natural gas operations are already creating conflict with other uses under normal conditions. In many basins, the application of fracking is still in its infancy and

continued development could dramatically increase future water requirements and further intensify conflicts with other uses."[8]

The United States is experiencing one of the worst droughts in 60 years, and this is affecting energy production in the United States. According to a recent editorial in the New York Times:

> "We're now in the midst of the nation's most widespread drought in 60 years, stretching across 29 states and threatening farmers, their crops and livestock. But there is another risk as water becomes more scarce. Power plants may be forced to shut down, and oil and gas production may be threatened.
>
> "Our energy system depends on water. About half of the nation's water withdrawals every day are just for cooling power plants. In addition, the oil and gas industries use tens of millions of gallons a day, injecting water into aging oil fields to improve production, and to free natural gas in shale formations through hydraulic fracturing."[9]

If Jordan Cove's application is approved and an LNG export facility is built in Coos Bay, then this facility would be contractually bound to continue LNG exports to Asia regardless of whether future drought conditions would constrain the use of hydraulic fracturing to produce natural gas domestically. This would drive up U.S. natural gas prices and would hurt consumers and businesses in the United States by indirectly causing water shortages and exacerbating water scarcity. This would not be in the public interest.

5. If Jordan Cove is mistaken about Asian demand for imported LNG, then the proposed export facility would be mothballed, but after causing substantial impacts during its construction

Jordan Cove cites to Asian demand for imported LNG as the rationale for building its proposed export facility. In its application, Jordan Cove stated:

> "The Jordan Cove facility is the only LNG export terminal proposed for the U.S. West Coast. It is thus uniquely positioned among United States terminals, not only to source its natural gas from Canadian and U.S. Rockies supply basins and to serve Asian demand without the longer routes and Panama Canal transits necessary from the Gulf Coast, but also to provide specific advantages (in addition to the economic benefits already detailed) for gas markets in the United States, in the country's two non-contiguous states of Alaska and Hawaii and in Oregon along the route of the new PCGP pipeline.
>
> "Given North America's enormous shale gas resources and the Asian demand for its production, there is little doubt that Pacific Northwest LNG export facilities will be built."[10]

---

[8] Pacific Institute (June 2012) "Hydraulic Fracturing and Water Resources: Separating the Frack from the Fiction." http://pacinst.org/reports/fracking/full_report.pdf

[9] Webber, E. (July 23rd, 2012) "Will Drought Cause the Next Blackout?" The New York Times.

[10] Application of Jordan Cove Energy Project, L.P. for Long-Term Authorization to Export Liquefied Natural Gas to Non-Free Trade Agreement Nations, FE Docket No. 12-32-LNG, at page 27.

Jordan Cove has already demonstrated its inability to predict demand for natural gas imports and exports. Jordan Cove based the proposed Jordan Cove LNG import terminal in Coos Bay on predictions that an import facility would be needed to meet growing U.S. demand for natural gas imports from overseas. These predictions turned out to be wrong.

Jordan Cove's assumption about sustained Asian demand for LNG imports is likely to be wrong as well; the same factors that created an oversupply of domestic natural gas would likely also create an oversupply of natural gas in Asia, curtailing demand for LNG imports from the U.S. and rendering a West Coast-based LNG export facility economically unviable. According to a recent report of the International Energy Agency:

> "The size of unconventional gas resources in China is at an early stage of assessment, but it is undoubtedly large. At end-2011, China's remaining recoverable resources of unconventional gas totalled almost 50 tcm, comprised of 36 tcm of shale gas, 9 tcm of coalbed methane and 3 tcm of tight gas.5 This is around thirteen times China's remaining recoverable conventional gas resources. China's shale gas resources lie in several large basins spread across the country, with plays in the Sichuan and Tarim Basins believed to have the greatest potential.
>
> "The Chinese government has outlined ambitious plans for boosting unconventional gas exploration and production. These call for coalbed methane production of more than 30 bcm and for shale gas production of 6.5 bcm in 2015; the targets for shale gas output in 2020 are between 60 and 100 bcm. They are accompanied by the goal to add 1 tcm of coalbed methane and 600 bcm of shale gas to proven reserves of unconventional gas by 2015. In support of this effort, China plans to complete a nationwide assessment of shale gas resources and build nineteen exploration and development bases in the Sichuan Basin in the next four years. Efforts are also supported by the international partnerships that Chinese companies have formed in North America to develop shale gas acreage, which will provide valuable development experience. ….
>
> "China's huge unconventional gas potential and strong policy commitment suggest that these resources will provide an increasingly important share of gas in the longer term, though the pace of development through to 2020 – the key period of learning – remains uncertain. Because of China's highly centralised regulatory and policy-making framework and the high priority placed on industrial and economic development, unconventional gas projects may face fewer hurdles stemming from environmental concerns than those in Europe or the United States."[11]

Eastern Europe and Eurasia are also poised to vastly increase production of natural gas from unconventional gas resources. Unlike Jordan Cove, production of natural gas from these locations can supply Asia with natural gas by pipeline.[12]

---

[11] International Energy Agency (2012) "Golden Rules for a Golden Age of Gas: World Energy Outlook Special Report on Unconventional Gas," at pages 115-120. .http://www.worldenergyoutlook.org/media/weowebsite/2012/goldenrules/WEO2012_GoldenRulesReport.pdf

[12] Ibid., at page 87.

The State of Oregon has found that Jordan Cove's proposed LNG import facility would have had adverse impacts on private landowners and the environment because of this facility's construction.[13] If Jordan Cove is mistaken (again) about future demand for LNG exports and imports, then the proposed facility would cause adverse impacts on private landowners and the environment by building a facility that would not be economically viable to operate. This would not be in the public interest. (See Exhibits A-G)

6. Liquefaction of natural gas for export/import is energy intensive and greatly diminishes the benefits of using natural gas

The liquefaction of natural gas requires a great amount of energy to compress methane into a liquid. This inherently wastes a substantial portion of the natural gas, which is burned in order to provide power to run compressors at liquefaction facilities. According to Jordan Cove's own study:

> "Approximately 6.2 percent of the gas delivered to the JCEP terminal would be either consumed as fuel to operate the liquefaction process or be removed from the feed gas stream (trace sulfur compounds, carbon dioxide, nitrogen and water) prior to or during the liquefaction step. Any hydrocarbons recovered that have a higher molecular weight than methane will fuel the power plant."[14] (Emphasis added).

Transoceanic transport and regasification of LNG are also energy intensive processes. According to a life-cycle assessment prepared by researchers with the Tepper School of Business, and Department of Engineering and Public Policy Carnegie Mellon University comparing coal and LNG:

> "The rated power of the LNG tankers ranges between 20 and 30 MW, and they operate under this capacity around 75% of the time during a trip (24, 25). The energy required to power this engine is 11.6MMBtu/MWh(26). As previously mentioned, some of this energy is provided by BOG and the rest is provided by fuel oil. A loaded tanker with a rated power of 20MW, and 0.12% daily boil-off rate would consume 3.88 million cubic feet of gas per day and 4.4 tons of fuel oil per day. The same tanker would consume 115 tons of fuel oil per day on they way back to the exporting country operating under ballast conditions. A loaded tanker with a rated power of 30 MW, and a 0.25% daily boil-off rate would get all its energy from the BOG, with some excess gas being combusted to reduce risks of explosion (22). Under ballast conditions, the same tanker would consume 172 tons of fuel oil per day.
>
> "For LNG imported in 2003 the average travel distance to the Everett, MA LNG terminal was 2700 nautical miles (13, 27). In the future LNG could travel as far as far as 11,700 nautical miles (the distance between Australia and the Lake Charles, LA LNG terminal (27)). This range of distances is representative of distances from LNG countries to U.S.

[13] State of Oregon's Motion to Reopen the Record and Request to Set Aside Order. December 2, 2011.
[14] ECONorthwest Construction Impact Study, at page 4.

terminals that could be located on either the East or West coasts. To estimate the number of days LNG would travel (at a tanker speed of 20 knots (22)), these distances were used. This trip length can then be multiplied by the fuel consumption of the tanker to estimate total trip fuel consumption and emissions, and these can then be divided by the average tanker capacity to obtain a range of emission factors for LNG tanker transport between 2 and 17 lb CO2 equiv/MMBtu.

"Regasification emissions were reported by Tamura et al. to be 0.85 lb CO2 equiv/MMBtu (21). Ruether et al. report an emission factor of 3.75 lb of CO2 equiv/MMBtu for this stage of the LNG life-cycle by assuming that 3% of the gas is used to run the regasification equipment (28). The emission reported by Tamura et al. differs because they assumed only 0.15% of the gas is used to run the regasification terminal, while electricity, which maybe generated with cleaner energy sources, provides the additional energy requirements. These values were used as lower and upper bounds of the range of emissions from regasification of LNG."[15]

These researchers with Carnegie Mellon University concluded.

"In addition to LNG, SNG has been proposed as an alternative source to add to the natural gas mix. The decision to follow the path of increased LNG imports or SNG production should be examined in light of more than just economic considerations. In this paper, we analyzed the effects of the additional air emissions from the LNG/SNG life-cycle on the overall emissions from electricity generation in the United States. We found that with current electricity generation technologies, natural gas life-cycle GHG emissions are generally lower than coal life-cycle emissions, even when increased LNG imports are included. However LNG imports decrease the difference between GHG emissions from coal and natural gas."[16]

The magnitude of the environmental benefits of natural gas fade away when natural gas is liquefied for export and importation. In general, natural gas supplies should be consumed on the continent they are produced, without liquefaction. For this additional reason, the proposed Jordan Cove export facility is contrary to the public interest.

7. Because Jordan Cove is owned and controlled by foreign investors, any profits from the project would only benefit non-U.S. investors.

The N-FTA Federal Register notice for Jordan Cove states the following:

"…Both Jordan Cove and its general partner are owned by the two limited partners in Jordan Cove. The first, Fort Chicago LNG II U.S.L.P., a Delaware limited partnership owns seventy-five percent. It is wholly owned and controlled, through a number of

[15] Jaramillo, P., et al (Sep 2007) "Comparative Life-Cycle Air Emissions of Coal, Domestic Natural Gas, LNG, and SNG for Electricity Generation Environ Sci Technol. 41(17):6290-6. http://www.fossil.energy.gov/programs/gasregulation/authorizations/2011_applications/exhibits_11-128-LNG/32._Jaramillo_ComparativeLCACoalNG.pdf

[16] Ibid., at page 6294.

> intermediate wholly owned and controlled companies, by Veresen, Inc., a Canadian corporation based in Calgary, Alberta, which, prior to its organization as a corporation, was Fort Chicago Energy Partners L.P., a Canadian limited partnership (**although the name of the parent changed, the name of the subsidiary owning Jordan Cove did not**)…'" (Emphasis added)

Fort Chicago Energy Partners L.P. is a Canadian limited partnership in which "only Canadians" are allowed to invest.

> "Fort Chicago is organized in accordance with the terms and conditions of a limited partnership agreement which provides that no Class A Units may be held by or transferred to, among other things, a person who is a "non- resident" of Canada, a person in which an interest would be a "tax shelter investment" or a partnership which is not a "Canadian partnership" for purposes of the Income Tax Act (Canada)."[17]

Profits projected to be made by Jordan Cove would then be funneled out of the country to only foreign investors. This would not be in the public interest. [18]

8. Obtaining natural gas from Hydro-Fracking techniques is not in the public interest

Jordan Cove Energy Project is currently proposing to export hydro-fracked gas from shale beds in Canada or the United States in the form of Liquefied Natural Gas (LNG). The LNG would be exported from their proposed LNG terminal to be located on the North Spit of Coos Bay in Coos County. Just because the industry has learned how to extract fossil fuel natural gas from shale bed formations does not mean this is a reliable, sustainable or environmentally friendly process. There are loads of factors that affect how much natural gas will actually be produced, and for how long.

The wave of fracking that is currently gong on across the country may soon find limitations due to the detrimental impacts of the fracking process itself. New research was recently published in the Proceedings of the National Academy of Sciences that concluded fluids from the Marcellus Shale are likely seeping into Pennsylvania's drinking water.[19] This means hydro-fracking contaminants will find their way into Pennsylvania's water supply also. This issue has create a storm of controversy and after months of research and discussion, Nationwide Insurance issued a memo stating they had determined that the exposures presented by hydraulic fracturing were too great to ignore and they would not be covering fracking damage.[20] Issues such as these

---

[17] CNW Group, "*Canadian Newswire Fort Chicago announces monthly cash distribution for September 2009"* September 21, 2009 http://www.newswire.ca/en/releases/archive/September2009/21/c7157.html

[18] Bloomberg - "*Exports of LNG May Raise U.S. Prices as Much as 54%, Agency Says*" - By Katarzyna Klimasinska – Jan 19, 2012 http://www.bloomberg.com/news/2012-01-19/lng-exports-may-spur-higher-u-s-natural-gas-prices-report-says.html

[19] ProPublica – "*New Study: Fluids From Marcellus Shale Likely Seeping Into PA Drinking Water"* by Abrahm Lustgarten; July 9, 2012; http://www.propublica.org/article/new-study-fluids-from-marcellus-shale-likely-seeping-into-pa-drinking-water

[20] The Huffington Post – "*Nationwide Insurance: Fracking Damage Won't Be Covered*" AP | By MARY ESCH; 07/12/2012; http://www.huffingtonpost.com/2012/07/13/nationwide-insurance-fracking_n_1669775.html?utm_hp_ref=green

could spell a reduction or even a halting of fracking in some areas and as quickly as the shale bed fracking natural gas market has emerged; it could be gone, leaving fast amounts of land taken by the gas industry, possibly by eminent domain, and fossil fuel infrastructure to lay fallow.

9. Jordan Cove's proposed LNG export facility will negatively impact existing local and sustainable jobs and industries in the Coos Bay area

9.1 Tourism and Recreation

According to a 2011 study by Dean Runyan Associates for the Oregon Tourism Commission, during the period of 2007 to 2011, direct spending from tourism travel brought in more than a billion dollars into Coos County, Oregon alone.[21] Tourism travel dollars spent in the area have steadily increased every year going from 94.5 million in 1991 to 220.1 million in 2011. There are 3,090 employment jobs in Coos County related to this industry, a direct result of not developing our beaches, dunes and coastline.

Adjacent to the proposed Jordan Cove LNG export facility is a designated Dunes National Recreation Area that is used year round. In addition to this there is the Sunset Bay State Park and Campground which is also used year round along with multiple trails and beach areas in the area, some directly adjacent to the proposed Jordan Cove project. Other examples in the area include the Shore Acres State Park which has a Christmas light show every year that goes from Thanksgiving until New Years. The Park had an estimated 57,768 visitors for the 2011 light show. People came from 25 countries (other than the U.S.) and 42 states.[22] Winter months can see just as many recreational and tourist activates as summer months in our Coos Bay area.

The Final Environmental Impact Statement (FEIS) for Jordan Cove's Import Facility stated the following with regard to this issue: (Emphasis and photos are added)

FEIS Page 4.7-5: "*...The top five recreational activities along southern Oregon beaches include* ***walking (43 percent), relaxing in a stationary location (24 percent), walking dogs (10 percent), driving OHVs (8 percent), and beachcombing (3 percent)*** *(OPRD 2002).*"

FEIS Page 4.7-6: "*…Sunset Bay State Park includes a beach, picnic tables, hiking trails, 27 full recreational vehicle (RV) hookups, 66 tent spaces, and eight yurts. A public golf course is next to the park.* ***An OPRD study indicated that Sunset Bay State Park receives 800,000 visitors a year*** *(Hillmann 2006)*"

FEIS Page 4.7-6: "*...The Oregon Islands National Wildlife Refuge is administered by the FWS, and covers 1,850 rocks, reefs, islands, and two headlands, spanning a total of 320 miles along the Oregon coast. The* ***Oregon Islands National Wildlife Refuge provides sanctuary for seabirds and marine mammals****.*..."

---

[21] Oregon Travel Impacts *1991-2011p* –May 2011; Dean Runyan Associates; *Prepared for the* Oregon Tourism Commission, Salem, Oregon; Page 83 - http://www.deanrunyan.com/impactsOR.html

[22] Shore Acres State Park Holliday Light Show Stats: http://www.shoreacres.net/images/pdf/stats-hol-lts-2011-wp.pdf

Birds swim just off of tidal sand areas at low tide and several species leave footprints in the wet tidal sands where the LNG slip dock is proposed to be built.

According to the World Newspaper; Monday, November 02, 2009:

> "Coos Bay got a bit of a tourism boost over the last several days, as 200 or so birders came to the bay to see a rare brown booby that is hanging out near Charleston. People came to scope out the tropical bird from places including Eugene, Portland, Bend, McMinnville, Coos Bay and Washington. The rare tropical bird showed up last week and

is the fourth verified sighting of this species of bird in Oregon. The last local sighting was in October 2008, when a dead female washed ashore at Lighthouse Beach."[23]

The Weyerhaeuser site where the Jordan Cove LNG Export facility is proposing to build is arguably one of the best birding destinations in Coos County and attracts a multitude of breeding, migrant and vagrant species year-round.[24] There are species like Wilsons Phalarope and Ring necked Duck. This is a crucial stop-over location for shorebirds during migration where they can rest and refuel, building fat reserves to last them on the next leg of their migration flight.

Oregon has lost much of its shorebird habitat through urban development and filling in wetlands and this site is one of the last significant "refueling stations" left on the Oregon Coast. Shorebirds by the thousands feed in late summer and fall here…

FEIS Page 4.7-7: *Figure 4.7-2 list* ***34 Recreational Areas that are within*** *the* ***LNG Zones of Concern*** *along the waterway for the proposed LNG Marine Traffic.*

FEIS Page 4.7-16: "…*The Siuslaw National Forest administers the* ***Oregon Dunes National Recreation Area (NRA)****. It extends 40 miles along the Oregon Coast between Florence and Coos Bay. The Oregon Dunes NRA contains the largest expanse of coastal sand dunes in North America, as well as a coastal forest and over 30 lakes and ponds.* ***Recreational opportunities at the NRA include OHV use, hiking, camping, horseback riding, angling, canoeing, sailing, water-skiing, and swimming.*** *Thousands of OHV owners take advantage of the three main off-highway riding areas within the Oregon Dunes NRA.* ***The day use and overnight camping facilities are used by over 400,000 visitors a year****…*"

For an Oregon Department of Fish and Wildlife listing of county expenditure estimates for Fishing, Hunting, Wildlife Viewing, and Shellfishing in Coos County and Oregon, see footnote below[25]

Coos County Local Recreation Expenditures, 2008

Category	Value	% of State Total*	% of All Travel**
Hunting	$904,977	2.90%	N/A
Fishing	$2,551,433	3.30%	N/A
Wildlife Viewing	$1,637,158	4.90%	N/A
Shellfishing	$1,080,963	20.60%	N/A
Total	$6,174,531	4.20%	N/A

[23] "*Flocking to see a rare bird*"; The World Newspaper; Monday, November 02, 2009 http://theworldlink.com/news/local/flocking-to-see-a-rare-bird/article_4c58af85-d571-52c5-b820-3301baf6f9d3.html

[24] "*Site Guide: Weyerhaeuser Settling Pond Site on the North Spit of Coos Bay",* Tim Rodenkirk: Oregon Birds 32(2): Pg 68 - 72, Summer 2006

[25] "*Fishing, Hunting, Wildlife Viewing, and Shellfishing in Oregon - 2008 State and County Expenditure Estimates*"; Prepared for the Oregon Department of Fish and Wildlife - Travel Oregon; DeanRunyan Associates; May 2009 http://www.dfw.state.or.us/agency/docs/Report_5_6_09--Final%20%282%29.pdf

Coos County Travel-Generated Expenditures, 2008

Category	Value	% of State Total*	% of All Travel**
Hunting	$2,534,940	2.40%	1.40%
Fishing	$12,253,254	4.60%	6.70%
Wildlife Viewing	$14,110,950	3.10%	7.70%
Shellfishing	$4,552,379	14.70%	2.50%
Total	$33,451,523	3.90%	18.30%

The Jordan Cove Project will clearly negatively impact this industry and all the permanent and sustainable jobs it supports as well as many others. Incredulously, the ECONorthwest study did not take into account the economic impacts of Jordan Cove's proposed LNG export facility on local tourism and recreation.

9.2 Commercial and Recreational Fishing

The ECONorthwest study did not include negative impacts to our commercial and recreational fishing fleet. This could include negative impacts from transiting LNG tankers, the negative impacts from additional Bay dredging, or negative impacts to salmon bearing streams crossed by the pipeline. **This is despite the fact Coos Bay is the third most important harbor in the state of Oregon in terms of total personal income generated from commercial fishing** (exceeded only by Astoria and Newport). Commercial landing data compiled by ODFW indicate that a total of $20.1 million worth of fish and shellfish were landed at Charleston in 2006.[26]

Landowners and non-profit groups who have done restoration projects to help restore fish runs in Southern Oregon will have their projects and efforts destroyed by the pipeline construction. This would not be in the public interest. (See Exhibits A, B)

FEIS Page 4.7-4: "*…According to a 2005 study by the Oregon State Marine Board (OSMB)* ***recreational boaters in Coos Bay took a total of 30,996 boat trips the previous year. Nearly 90 percent of the boat usedays involved fishing*** *(including angling, crabbing, and clamming), 9 percent was for pleasure cruising, and the remainder was for sailing and water skiing. Forty percent of the boating activities in Coos Bay originated from the Charleston Marina, and 20 percent at the Empire ramp…*"

FEIS Page 4.7-4: "*...****Recreational clamming and crabbing occurs year-round and brings tourism based revenue to the region. Crabbing occurs in the main channel areas from the Southern Oregon Regional Airport to the mouth of the bay around slack tides. Clamming occurs year-round in the mud flats of Coos Bay,*** *but is subject to closure as necessary by the ODA Food Safety Division for reasons of public health (Oregon Department of Agriculture Food Safety Division 2008)….*"

[26] FERC Final EIS for Jordan Cove LNG Import Facility; http://www.ferc.gov/industries/gas/enviro/eis/2009/05-01-09-eis.asp - Page 4.8-8

Photo to Left:
People clamming at low tide in the Lower Coos Bay along Cape Arago Hwy.

Photo to Right:
Evidence of Clams in the tidal areas where the LNG slip dock is proposed to be built.

The ECONorthwest study did not account for the total time it would take homeland security to clear the bay before an LNG tanker would transit through the bay, nor did the study account for an accurate number of potential ship transits through the bay. When Freeport LNG import terminal began operating in April of 2008, Petty Officer Second Class Richard Ahlers said it would probably take up to three hours for the boat and its security perimeter to pass through in the first arrivals. Each time a LNG ship crawls into the harbor there, water-borne authorities like the Coast Guard plan on shutting down all boat traffic in a 1,000-meter radius of the transiting LNG vessel. Surfside Beach Mayor Jim Bedward said the village boat ramp, once it opened, would be closed as the ships pass. The City Hall in Freeport would get a 92-hour warning of the oncoming ships but would keep knowledge of the high-security vessels' arrival to themselves — for obvious reasons. [27]/[28]

Likewise the Jordan Cove LNG facility consultants have shown that ship transits would have security zones that are very similar to Freeport except that in some cases security zones for Jordan Cove would encompass the entire width of the Coos Bay and would take from 90 minutes to two hours. This would be an extreme hardship on the Commercial fishing fleet that also need high slack tides in order to transit the Coos Bay.

In Coos County the Pacific Connector is slated to directly negatively impact native Olympia oysters in Haynes Inlet and also Clausen Oyster Company's highly productive silver point Pacific oyster beds. Coos Bay is the largest commercial producer of shellfish in the state of Oregon. Pacific oysters are commercially raised in the mudflats of South Slough and Haynes Inlet and the upper bay east of McCullough Bridge. Clamming also occurs at Haynes Inlet. (FEIS page 4.7-17) In recent testimony provided by the Clausen Oyster Company, Lilli Clausen stated the following:

---

[27] "*Coast Guard preparing for port shutdowns*", The Facts, by Hunter Sauls, April 14, 2008 http://thefacts.com/story.lasso?ewcd=f482d0ca682cb716

[28] Platts LNG Daily April 11, 2008 [subscription required] reports that the Sabine Pass LNG terminal expects to receive its commissioning cargo aboard the LNG carrier Celestine River today. In preparation for the arrival of the ship, the U.S. Coast Guard will impose a security zone at the Sabine Pass in Louisiana for approximately three hours between noon and 7 p.m…

"When the engineer and some other people representing LNG were in our office a few weeks ago my husband, Max, and I tried to explain that the proposed line was too destructive to our oyster business…" (See Exhibit E)

9.3 Timber Production

The Jordan Cove proposal will force a significant change and a significant cost increase in accepted tree farm and forest practices on agricultural and forest lands. Including but not limited to:

- Permanent loss of timber in pipeline right of way.
- Increased loss in timber production due to increased wind in the pipeline right of way. Coos County Commissioner, Fred Messerle, who is also a local private timber operator stated recently in public testimony,

> "Cutting and maintaining an extended "hard edge" in an existing and/or new stand of timber will dramatically increase the wind loss over the 40 year rotation and thus increase cost and decrease yield."

- Increase risk of foot traffic and spread of disease and root rot. Pacific Connector's plan will significantly change the accepted practices involved in raising a 40-year crop and/or in a worst case, eliminates the value of the land all together for timber production.
- Increased risk of noxious weed growth which negatively impacts timber production.
- An open vector (right of way) with dry grass and brush creates a path for fire to "run on." This means an increase in fire hazard exposure and risk in currently high timber production areas.
- Project significantly changes and or increases the costs of accepted practices overall. According to Commissioner Messerle,

> "Timber harvesting (logging) has always had a very "thin margin" of profit. Logging is not a "get rich quick" proposition. Any change to accepted logging practices will increase costs, decrease margins and significantly change the cost of accepted forest practices." (See Exhibit F)

Yankee Creek Forestry also issued similar statements with regard to the negative impacts this proposed LNG project and pipeline will have on timber production. (See Exhibit G)

Construction of the Pacific Connector pipeline would affect about 3,035 acres of forest and woodland, 623 acres of agricultural lands, 488 acres of grasslands-shrubland, and 131 acres of non- riparian vegetation. (FEIS page 5-9). Approximately 151 miles, or 66 percent, of the proposed pipeline route would cross private property, which could be taken by eminent domain. The remaining 79 miles (34 percent) of pipeline route would cross public lands administered by the BLM (18 percent), USFS (12 percent), BOR (0.14 percent), (FEIS page 4.8-25)

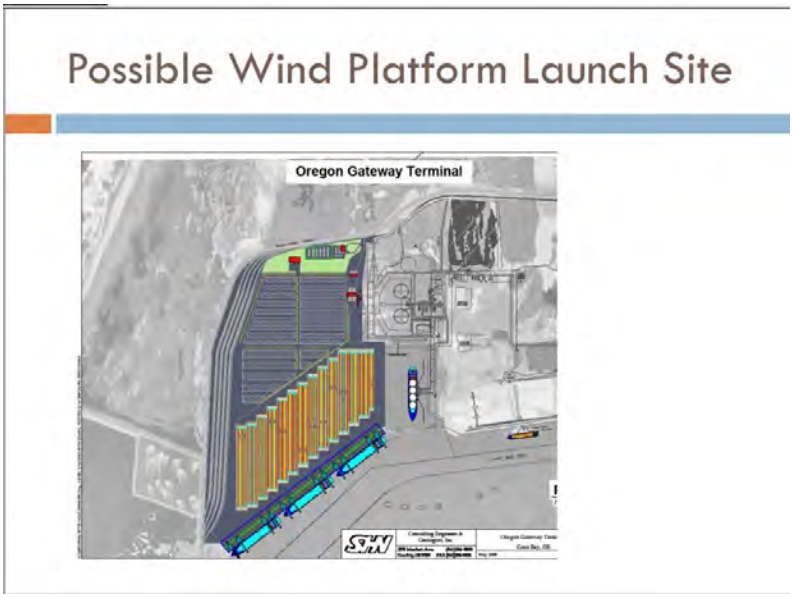
It is difficult enough for a small family owned operation to monitor and oversee its base operation. The Jordan Cove / Pacific Connector project will change family owned and operated practices and increase costs to timber production. Some businesses are likely to go out of business due to this increased cost.

In addition, Jordan Cove did not analyze timber jobs that will be impacted and lost from the flooding of the market with 144 miles of forestlands that will be clear-cut for pipeline construction. This will force timber prices to an all time low which will negatively impact the industry even more than it already has been. It could take years to recover.

9.4 Loss of other Proposed Port Developments

The negative impacts of the Jordan Cove Energy / Pacific Connector pipeline project to bay area businesses, including future potential businesses, industries and land owners was not considered in Jordan Cove's economic reports.

For example, on January 20, 2011 the Oregon International Port of Coos Bay presented the following diagram at their Port Commission meeting concerning a proposed Wind Project the Port is currently working on potentially developing.[29]



Unfortunately the proposed Jordan Cove Energy LNG Project Thermal Radiation Zones and Vapor Dispersion Zones would negatively impact the above proposed development as shown in the following diagrams below taken from the Final EIS of the Jordan Cove Import facility.[30]

[29] January 20, 2011, Oregon International Port of Coos Bay Wind Development presentation: http://www.portofcoosbay.com/minutes/wind.pdf

[30] FERC Final EIS for Jordan Cove / Pacific Connector - Diagrams of Jordan Cove's Thermal Radiation Zones and Vapor Dispersion Zones - Pages 4.12-19 and 4.12-21 : http://www.ferc.gov/industries/gas/enviro/eis/2009/05-01-09-eis.asp

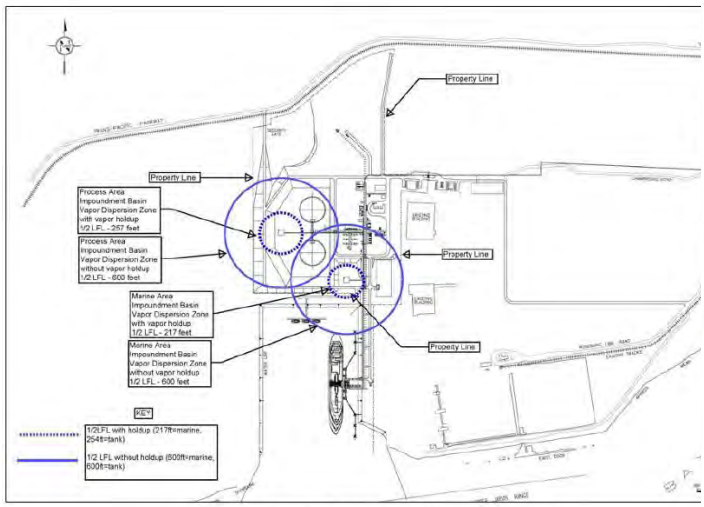


Figure 4.12-2. Vapor Dispersion Zones

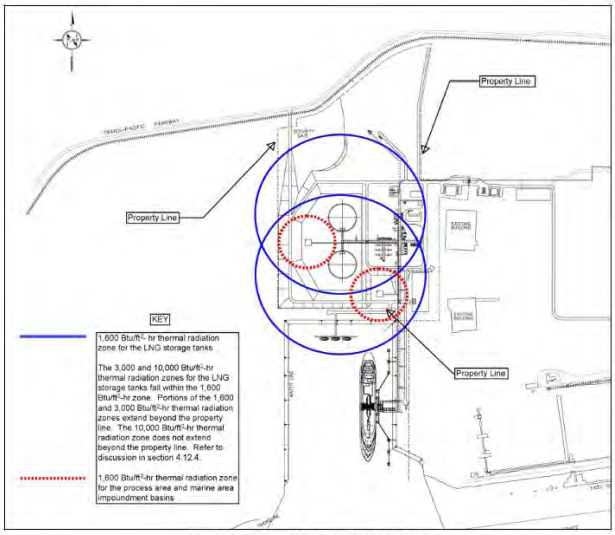


Figure 4.12-1. Thermal Radiation Zones

On October 8, 2010, FERC sent a letter to Jordan Cove requesting that Jordan Cove revise their Flammable Vapor-Gas Exclusion Zone requirements and modeling to be in compliance with PHMSA Recent Guidance contained in Title 49 CFR Part 193.2059.[31] It is highly likely that the Jordan Cove facility's hazard exclusion zones will end up being much larger than they currently are when they are calculated properly to be in compliance with PHMSA**.** This could have devastating impacts to other users of the harbor, adjacent landowners and industrial development including the Port's proposed Oregon Gateway cargo terminal, which would not be allowed to operate in these hazard zones. Jordan Cove has not to date filed with FERC their revised Flammable Vapor Gas Exclusion Zone requirements and modeling. Clearly Jordan Cove is aware of this problem and by now the Port should be.

In December 2011, a revised Land Option Agreement with the Jordan Cove Energy Project took back a large portion of Henderson Marsh to the west of the Jordan Cove facility to satisfy these thermal radiation and flammable vapor gas exclusion zone requirements. These thermal radiation and flammable vapor gas exclusion zones must be controlled by the Jordan Cove Energy Project at all times and must remain within the property boundaries of the facility. This will put any planned development to the west of the proposed Jordan Cove facility, including the above proposed wind turbine development, at risk.

The Oregon International Port of Coos Bay says its proposed Marine Terminal Slip is being designed for the Jordan Cove LNG docking facility and other potential marine uses on the west side berth. But the Marine Slip will not likely be usable for purposes other than those associated with and/or controlled by the Jordan Cove Energy Project. At a recent site tour held on March 27, 2012, that was sponsored by the Jordan Cove Energy Project, Bob Braddock from Jordan Cove stated that the current proposed Marine Terminal Slip was only designed to handle one vessel. Presumably this is due to Jordan Cove's thermal radiation and vapor dispersion exclusion

[31] October 8, 2010 letter requesting Jordan Cove Energy Project, L.P. provide the informing described in Enclosure 3 to assist the FERC in their review re the PHMSA Interpretations on the Part 193 Exclusion Zone Regulations under CP07-444. http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20101008-3036

zones referenced above and also the Coast Guard safety and security hazard zones proposed for the LNG facility and berth that will preclude the use of the berth for other purposes.

The safety and security hazard zones the Coast Guard has proposed to impose will encompass the LNG vessel both while the vessel is moored and even when the LNG vessel is not moored. When the LNG vessel is at the docking facility there will be a 150 yard security zone around the vessel to include the entire terminal slip and when there is no LNG vessel moored, the security zone shall cover the entire terminal slip and extend 25-yards in the waterway. (CG-WSA page 2)[32] In addition, the Coast Guard has also set a moving safety/security zone for the LNG tanker ship that extends 500-yards around the vessel but ends at the shoreline. No vessel may enter the safety /security zone without first obtaining permission from the Coast Guard Captain of the Port who resides in the Portland, OR office.[32]

As a result of the above safety zones, the Port's proposed Marine slip can realistically serve only LNG terminal purposes.

In addition, the ECONorthwest study assumes there will be only 80 - 90 shipments per year and not the more realistic number of between 186 - 232 LNG vessel harbor disruptions that would include LNG vessels both coming and leaving the lower Coos Bay during high slack tides. (See Exhibit J)

Detailed issues concerning Pollution, Noise, Visual Impacts, Security, LNG Hazards, Natural Hazards and Emergency Response were filed with the Federal Energy Regulatory Commission for the Jordan Cove LNG Import / Pacific Connector Docket numbers CP07-444-000 and CP07-441-000. Most of these issues were never fully addressed and would apply whether you were importing or exporting LNG.[33]

FERC's Order[34] that was recently pulled had 128 Conditions of Approval, many highly unlikely that Jordan Cove would ever be able to meet. The impacts of these issues and the true negative effects of the Jordan Cove LNG proposal on jobs in tourism, recreation, real estate, fishing, clamming, crabbing, oyster harvesting, timber, etc, were not addressed or considered fully in any economic study.

10. The proposed project will not provide tax revenue to local government

The Jordan Cove LNG facility will not increase the tax base of Coos County. The facility will sit in an Enterprise Zone and will be exempt from paying taxes for 3 or more years. The facility

---

[32] Coast Guard - LOR / WSR / WSA for Port of Coos Bay / Jordan Cove Energy Project: http://homeport.uscg.mil/mycg/portal/ep/contentView.do?contentTypeId=2&contentId=63626&programId=12590&pageTypeId=16440&BV

[33] January 15, 2010, letter to FERC with detailed information on LNG Hazard information and studies; http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20100115-5057

[34] December 17, 2009, FERC Order on the Jordan Cove / Pacific Connector LNG Import Project - Dockets CP07-441-000; CP07-444-000 et al: http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20091217-3076

also will sit in an Urban Renewal District for the North Spit, which is administered by the Oregon International Port of Coos Bay. Money received is to go to Urban Renewal for the North Spit. The Oregon International Port of Coos Bay has already announced at Port meetings how they plan on spending this money. It will not go into the County general fund for roads, schools, sheriffs, and other necessary county expenditures.

11. Jordan Cove proposed LNG export facility would create substantial risks to public safety

Building an LNG import-export terminal on dredging spoils located on a sand spit (an unstable sand dune area) directly across the bay from an airport runway, in the flight path of the runway, in an extreme tsunami inundation zone, in an earthquake subduction zone, in an area known for high winds and ship disasters, less than a mile from a highly populated city not only violates multiple safety codes and regulations but is not in the public interest.

The Jordan Cove LNG facility is not following gas industry recommended guidelines for the safe siting of LNG Ports and jetties, putting thousands of people in the Coos Bay area at risk.

11.1 Tsunami and Earthquake Hazards

The Jordan Cove Energy Project has never complied with FERC's request to show that that their facility which will be located on dredging spoils on a sand spit in a natural hazard zone has met engineering designs in order to withstand a Cascadia subduction 9.0 earthquake event and/or a tsunami.[35] Since it is not a matter of "if" but a matter of "when" a Cascadia subduction event will occur off of our Pacific West Coast, placing a hazardous LNG facility in these natural hazard zones would not be in the public interest.[36] (See Exhibit H)

It is estimated to take 90 minutes to 2 hours for an LNG tanker to transit from K Buoy to the marine slip dock. It is also estimated that it will take around 15-20 minutes from the time of a Cascadia subduction earthquake event until a tsunami would come ashore in the Coos Bay. A new study from Oregon State University says that the South Coast has a 40 percent chance of experiencing a major earthquake and resulting tsunami sometime in the next 50 years. The study further suggests that that tsunami could have a greater impact on the South Coast — around Coos

---

[35] December 17, 2009, FERC Order - pages 79-84, Conditions 52-65,70,74: http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20091217-3076

[36] The World, Coos Bay – **"***Not a matter of 'if' It's a matter of when. What will the South Coast look like after a major disaster?*" Stories by Jessica Musicar, Nia Towne, Andy Rossback and Nate Traylor. Illustrations by Jeff Trionfante, Benjamin Brayfield and Andy Rossback The World | Posted: Saturday, August 7, 2010 http://theworldlink.com/news/local/not-a-matter-of-if/article_d4b8e520-a1f3-11df-89f5-001cc4c03286.html

● *"Oregon geology: 'The next 'Big One' is imminent'":* Story Published: Oct 16, 2009; *Courtesy OSU News & Communications*; http://www.kval.com/news/tech/64534977.html: *"...The release of pressure between two overlapping tectonic plates along the subduction zone regularly generates massive 9.0 magnitude earthquakes – including five over the last 1,400 years," Corcoran said. "The last 'Big One' was 309 years ago. We are in a geologic time when we can expect another 'Big One,'... ... "Prudence dictates that we overcome our human tendencies to ignore this inevitability," he added…".*

● Visit www.oregontsunami.org for more information on current tsunami maps and hazards in the vicinity of the Jordan Cove Energy LNG project.

Bay — than other areas of the west coast.[37] According to the study's authors, the clock is ticking fast. There is no consideration for this LNG ship transit hazard in the FERC FEIS or the Coast Guard Letter of Recommendation (LOR) or Water Suitability Assessment (WSA) or Jordan Cove's 3/31/09 Emergency Response Memorandum of Understanding (MOU). There is no Emergency Response plan that encompasses this and/or other safety issues in regard to transiting LNG tanker ships, floating objects, adrift vessels, barges, etc. Effects of tectonic subsidence (prolonged changes in tidal elevation inherent in the earthquake source scenarios used for tsunami generation) were also not considered in the FERC FEIS.

11.2 LNG Safety and Security Hazard Guidelines and Impacts

Industry SIGTTO Guidelines,[38] Sandia National Laboratory Guidelines,[39] GAO Report Guidelines[40] and the most recent U.S. Department of Energy report to Congress, "Liquefied Natural Gas Safety Research"[41] are not being considered or followed. The FERC Final EIS did not address the project's notable departures from **industry standards or comments to them on those departures.**[38] It is not in the public interest to proceed with this proposed project until these issues are fully addressed.

If the Jordan Cove LNG project should proceed, LNG tanker ships will be transiting our Coos Bay harbor carrying around 39 million gallons of LNG. If only about 3 million gallons of LNG was to spill onto the water from an LNG tanker ship, flammable vapors from the spill could travel up to three miles[42]. If a pool fire was to develop, people up to a mile away would be at risk of 2nd degree burns in 30 seconds.[39/40/41]

---

[37] *Study: Coos Bay region in danger of megaquake*" By KATU.com Staff, Published: Aug 1, 2012 http://www.kpic.com/news/local/Study-Coos-Bay-region-in-danger-of-megaquake-164645456.html
● Oregon State University - "*13-Year Cascadia Study Complete – and Earthquake Risk Looms Large*" 8-1-12 - http://oregonstate.edu/ua/ncs/archives/2012/jul/13-year-cascadia-study-complete-%E2%80%93-and-earthquake-risk-looms-large

[38] "*Site Selection & Design for LNG Ports & Jetties – Information Paper No. 14*" - Published by Society of International Gas Tanker and Terminal Operators Ltd / 1997 http://www.dma.dk/themes/LNGinfrastructureproject/Documents/Risk%20analyses/sigtto-site%20selection%20and%20design%20lng%20ports%20jetties.pdf

[39] SANDIA REPORT "*Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water"*; Mike Hightower, Louis Gritzo, Anay Luketa-Hanlin, John Covan, Sheldon Tieszen, Gerry Wellman, Mike Irwin, Mike Kaneshige, Brian Melof, Charles Morrow, Don Ragland; SAND2004-6258; Unlimited Release; Printed December 2004; http://www.fossil.energy.gov/programs/oilgas/storage/lng/sandia_lng_1204.pdf

[40] United States Government Accountability Office, Report to Congressional Requesters, Maritime Security; "*Public Safety Consequences of a Terrorist Attack on a Tanker Carrying Liquefied Natural Gas Need Clarification*", February 2007; GAO-07-316: http://www.gao.gov/new.items/d07316.pdf

[41] U.S. Department of Energy report to Congress, "*Liquefied Natural Gas Safety Research*" ; May 2012 : http://www.fossil.energy.gov/programs/oilgas/storage/publications/DOE_LNG_Safety_Research_Report_To_Congre.pdf [NOTE: Based on the data collected from the large-scale LNG pool fire tests conducted, thermal (fire) hazard distances to the public from a large LNG pool fire will decrease by at least 2 to 7 percent compared to results obtained from previous studies. In spite of this slight decrease, people up to a mile away are still at risk of receiving 2nd degree burns in 30 seconds should a LNG pool fire develop due to a medium to large scale LNG breach event.]

[42] "*LNG and Public Safety Issues – Summarizing Current Knowledge about Potential Worst Case Consequences of LNG spills onto water*". Jerry Havens, Coast Guard Journal Proceedings, Fall 2005

11.3 Airport Issues and Hazards

The proposed Jordan Cove LNG facility and South Dune Power Plant and liquefaction facility are directly across the Bay in close proximity to the Southwest Oregon Regional Airport in North Bend. Airport airspace and hazard issues were not addressed properly in the FERC FEIS. LNG Tank Heights clearly violate Title 14 Code of Federal Regulations (CFR) Part 77, Objects Affecting Navigable Airspace. Many issues concerning this and other airport hazards were raised in comments to FERC (Docket # CP07-444-000 and CP07-441-000)[43] The airport will clearly be impacted negatively in order for LNG vessels to safely transit our Coos Bay harbor. This would greatly affect many businesses in the area including the Bandon Dunes World Renowned Golf Course. Currently, there are no plans to prevent this impact and protect citizens in this area and that is not in the public interest. Issues involving LNG tanker passage and air space issues were also not addressed in the Coast Guard's LOR, WSA or considered in Jordan Cove's economic analysis.

11.4 Inadequate Emergency Response Resources

Emergency Response is inadequate with most Emergency Responders located in the Hazard Zones of Concern of the facility and LNG tanker transit. See Hazard Zone maps on FEIS pages 4.7-3,-7,-15.[44] The Coast Guard WSA is not in line with the Gas Industry SIGTTO guidelines and recommendations nor the Sandia National Laboratories guidelines and recommendations. The Coast Guard did not account for many LNG potential hazards in the waterway, air and shoreline and they failed to consider or mention hazard issues listed in the Coos County Natural Hazards Mitigation Plan. They underestimated the number of annual vessel calls and included no plans for handling tsunamis and earthquakes in their reports.

"*Once ignited, as is very likely when the spill is initiated by a chemical explosion, the floating LNG pool will burn vigorously…Like the attack on the World Trade Center in New York City,* ***there exists no relevant industrial experience with fires of this scale from which to project measures for securing public safety***." – Statement by Professor James Fay, Massachusetts Institute of Technology

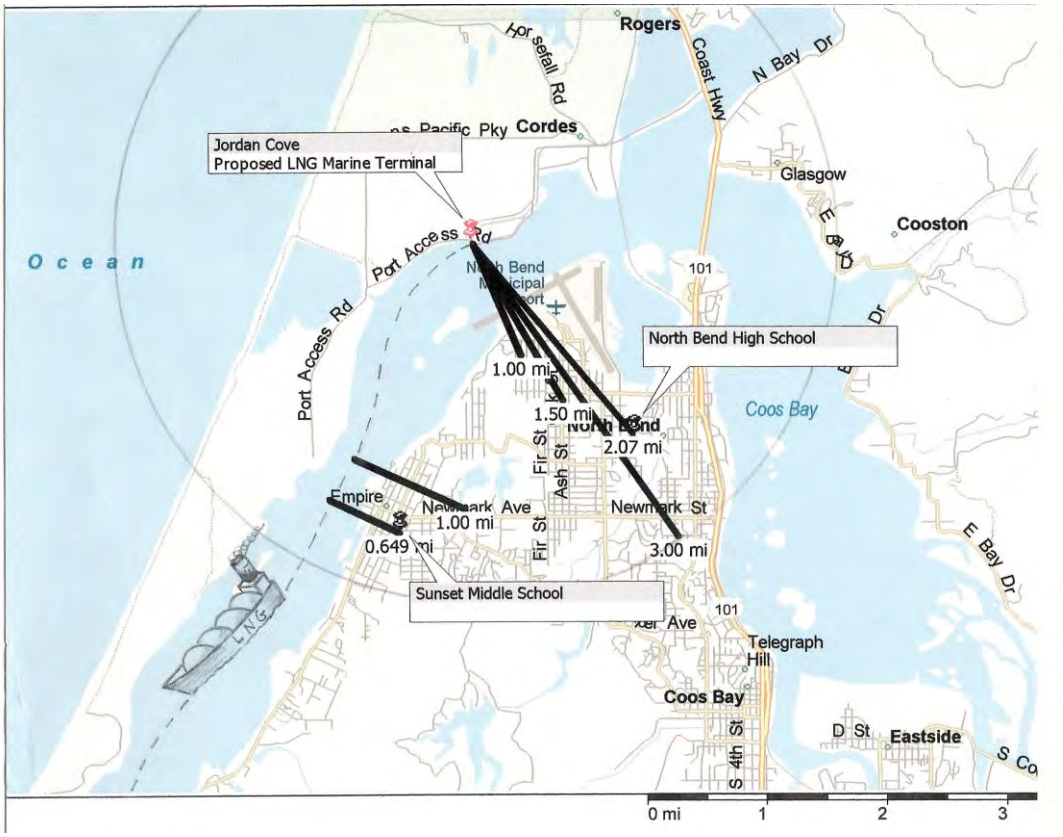
Sandia Laboratory's Dec 2004 Report; "*Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water",* states on page 83; "*... The distance from the fire to an object at which the radiant flux is 5 kW/m2 is 1.9 km"* (1.181 miles).

To clearly understand this one must understand that 5 kW/m2 is the heat flux level that can cause 2nd degree burns on exposed human skin in 30 seconds.

---

[43] March 31, 2009 comment letter to FERC addressing Safety and Security issues / Airport Hazards / Tsunami and Earthquake hazards:
http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20090331-5160 - &
http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20090401-5170

[44] FERC Final EIS for Jordan Cove / Pacific Connector http://www.ferc.gov/industries/gas/enviro/eis/2009/05-01-09-eis.asp Pages 4.7-3,-7,-15



The FERC Jordan Cove Energy (Import) Project Final Environmental Impact Statement (FEIS) - Section 4-7, pages 4.7-3 and 4.7-15, has maps with diagrams of the structures that are within the LNG Ship Transit Route Hazard Zones of Concern.[45] (See Exhibit I) <u>According to the FERC Final Environmental Impact Statement for Jordan Cove (FEIS page 4.8-2), 16,922 people live in these hazard zones along the waterway and yet there is little concern given for their safety</u>. Trees and burnable scrub brush cover our area. Secondary fires will be paramount should an LNG accident occur. The FERC FEIS ignored comments on these dangers. The Coos Bay area has one hospital; it does not have a "Burn Unit." Neither the FEIS nor any public communication from Jordan Cove Energy Project, Inc. ("JCEP") has suggested how the medical response to even a minor LNG hazardous event could be handled in light of our area's obvious insufficiency of appropriate medical facilities and personnel.

Many of the guidelines for safety that are suggested in the gas industries "Society of International Gas Tanker & Terminal Operators" (SIGTTO)[46] Information Paper No. 14 have been completely ignored in this terminal siting, including the following:

1) **Approach Channels**. Harbor channels should be of uniform cross-sectional depth and have a minimum width, equal to five time the beam of the largest ship

[45] FERC Jordan Cove LNG Import FEIS pages 4.7-3 and 4.7-15: http://www.ferc.gov/industries/gas/enviro/eis/2009/05-01-09-eis.asp

[46] **Site Selection & Design for LNG Ports & Jetties – Information Paper No. 14 -** Published by *Society of International Gas Tanker and Terminal Operators Ltd* / 1997

2) **Turning Circles**. Turning circles should have a minimum diameter of twice the overall length of the largest ship, where current effect is minimal. Where turning circles are located in areas of current, diameters should be increased by the anticipated drift.
3) **Tug Power**. Available tug power, expressed in terms of effective bollard pull, should be sufficient to overcome the maximum wind force generated on the largest ship using the terminal, under the maximum wind speed permitted for harbor maneuvers and with the LNG carrier's engines out of action.
4) **Site selection process** should remove as many risk as possible by placing LNG terminals in sheltered locations remote from other port users. Suggest port designers construct jetties handling hazardous cargoes in remote areas where ships do not pose a (collision) risk and where any gas escaped cannot affect local populations. Site selection should limit the risk of ship strikings, limiting interactive effects from passing ships and reducing the risk of dynamic wave forces within mooring lines.
5) **Building the LNG terminal on the outside of a river bend** is considered unsuitable due to fact that a passing ship may strike the berthed carrier if the maneuver is not properly executed.
6) **SIGTTO Examples given for reducing risk factors** beyond normal operations of ship/shore interface include LNG terminal patrols of the perimeter of the offshore safety zones with guard boats and to declare the air-space over an LNG terminal as being a restricted zone where no aircraft is allowed to fly without written permission.
7) **Restriction of the speed of large ships passing** close to berthed LNG carriers.

Also ignored were some of the safety guideline preventative measures in the Sandi National Laboratories Report – "Guidance on Risk Analysis and Safety Implications of Large Liquefied Natural Gas (LNG) Spill Over Water" – Dec 04:[47]

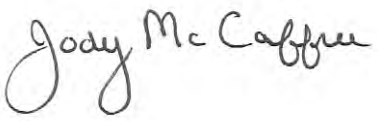
1) Appropriate off-shore LNG ship interdiction and inspections for explosives, hazardous materials, and proper operation of safety systems;
2) Appropriate monitoring and control of LNG ships when entering U.S. waters and **protection of harbor pilots and crews**;
3) Enhanced safety zones around LNG vessels (safety halo) that can be enforced;
4) **Appropriate control of airspace over LNG ships**; and
5) Appropriate inspection and protection of terminal areas, tug operations prior to delivery and unloading operations.

[47] Without an emergency response plan to review it is hard to know if some of these recommendations have been met. Page 4.8-9 of FEIS states, "The Coos County Airport District, which operates the airport, has stated that the airport would not have to stop operations while an LNG carrier was transiting in the waterway past the airport." "…and the Coos Bay Pilots Association foresees no delays for airplanes using the airport resulting from LNG marine traffic in the waterway." This clearly violates Sandia's safety guideline preventative measure recommendations.

Conclusion

It may be in the financial interest of some Canadian energy company to export domestic natural gas across the United States and across Oregon landowner's private property. But it is contrary to the public interest. Exporting Canadian and domestic natural gas from Jordan Cove will (1) put Coos Bay area residents at risk in the event of a Magnitude 9 earthquake and tsunami; (2) deprive many landowners of the full use of their private property; (3) negatively impact Oregon forests and waterways; (4) increase the costs for residential, commercial, and industrial natural gas users; and (5) negatively impact businesses and industries in Oregon and in other parts of the United States. The DOE should not grant such a permit for Jordan Cove to export LNG to non-free trade agreement nations when it is clearly not in "*the public interest*" both nationally and locally to do so.

Sincerely,



Jody McCaffree
Executive Director,
Citizens Against LNG Inc

Citizens Against LNG
Index for Exhibits

Exhibit A - Coos Watershed Association, May 13, 2010, comment letter on Pacific Connector Gas Pipeline Coos County CUP #HBCU-10-01.

Exhibit B - Declaration of Russell R Lyon on Pacific Connector Gas Pipeline Case No. CV-10-6279-HO

Exhibit C - Williams / Metcalf, May 13, 2012, comment letter on Pacific Connector Gas Pipeline Coos County CUP #HBCU-10-01.

Exhibit D – McCauley, May 11, 2012, comment letter on Pacific Connector Gas Pipeline Coos County CUP #HBCU-10-01.

Exhibit E - Clausen Oyster, May 13, 2010, comment letter on Pacific Connector Gas Pipeline Coos County CUP #HBCU-10-01.

Exhibit F - Messerle and Sons, June 10, 2010, comment letter on Pacific Connector Gas Pipeline Coos County CUP #HBCU-10-01.

Exhibit G - Yankee Creek Forestry/Jake Robinson, June 7, 2010, comment letter on Pacific Connector Gas Pipeline Coos County CUP #HBCU-10-01

Exhibit H - Current 2012 Tsunami Evacuation Map of Jordan Cove Project area

Exhibit I - Jordan Cove LNG Tanker Hazard Zones from FERC Final EIS page 4.7-3

Exhibit J - Calculation of the approximate number of LNG Ship Transits needed to liquefy .8 and 1 billion cubic feet of gas per day and transport using 148,000 cubic meter ships.

Exhibit H

Exhibit H

Current 2012 Tsunami Evacuation Map of Jordan Cove Project area

Orange – Distant Tsunami evacuation zone

Yellow – Local Cascadia Earthquake and Tsunami evacuation zone

Full Tsunami Evacuation Map for Coos Bay Area available at: http://www.oregongeology.org/pubs/tsubrochures/CoosBayEvac.pdf (4.03 MB)

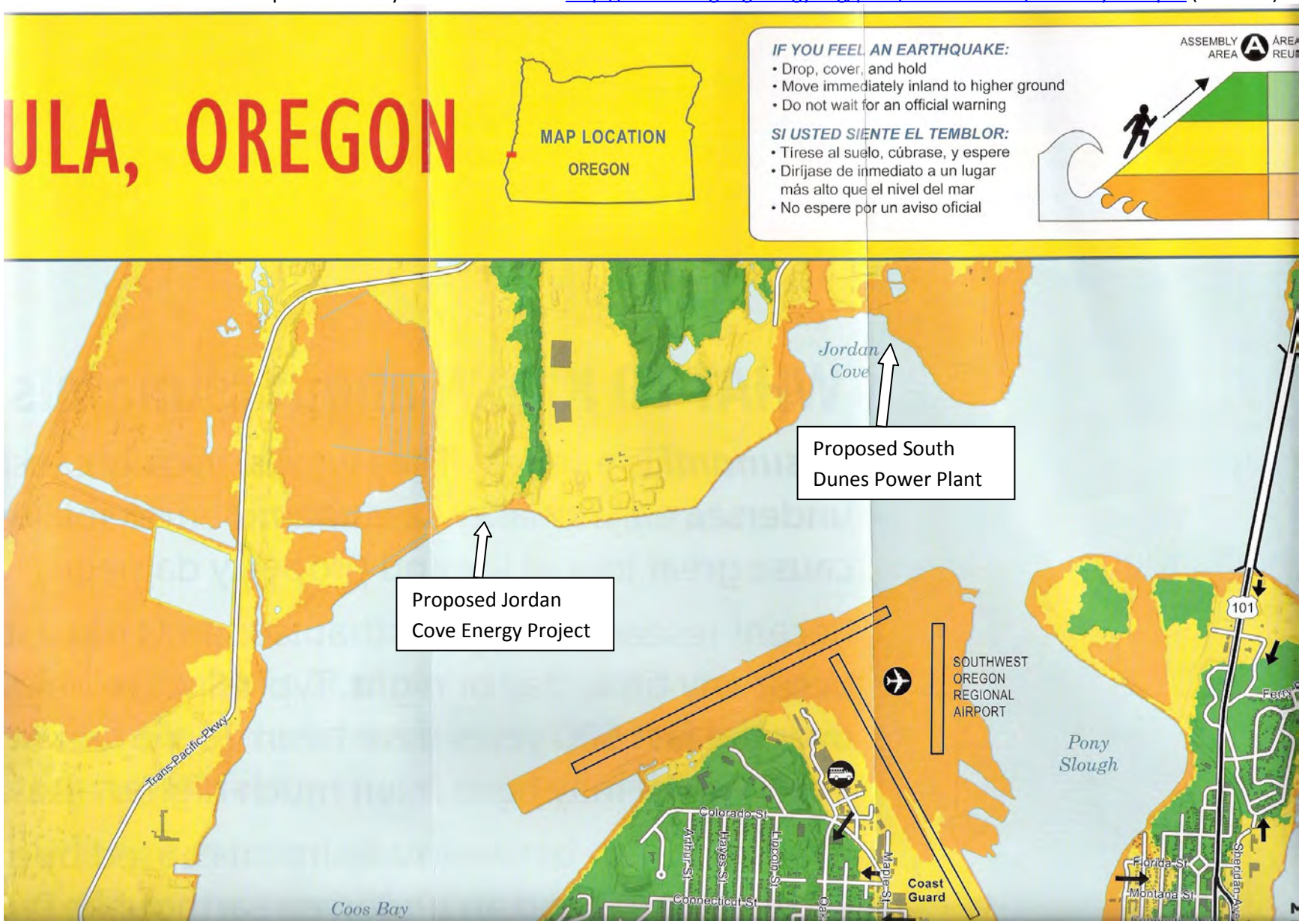


Exhibit I

Jordan Cove LNG Tanker Hazard Zones (FEIS Page 4.7-3)

No one is expected to survive in Zone 1 (yellow) - Structures will self ignite in this zone just from the heat. People in Zone 2 (green) will be at risk of receiving 2nd degree burns in 30 seconds on exposed skin. People in Zone 3 are still at risk of burns if they don't seek shelter but exposure time is longer than in Zone 2. Map does not include the hazard zones for the South Dunes Power Plant.

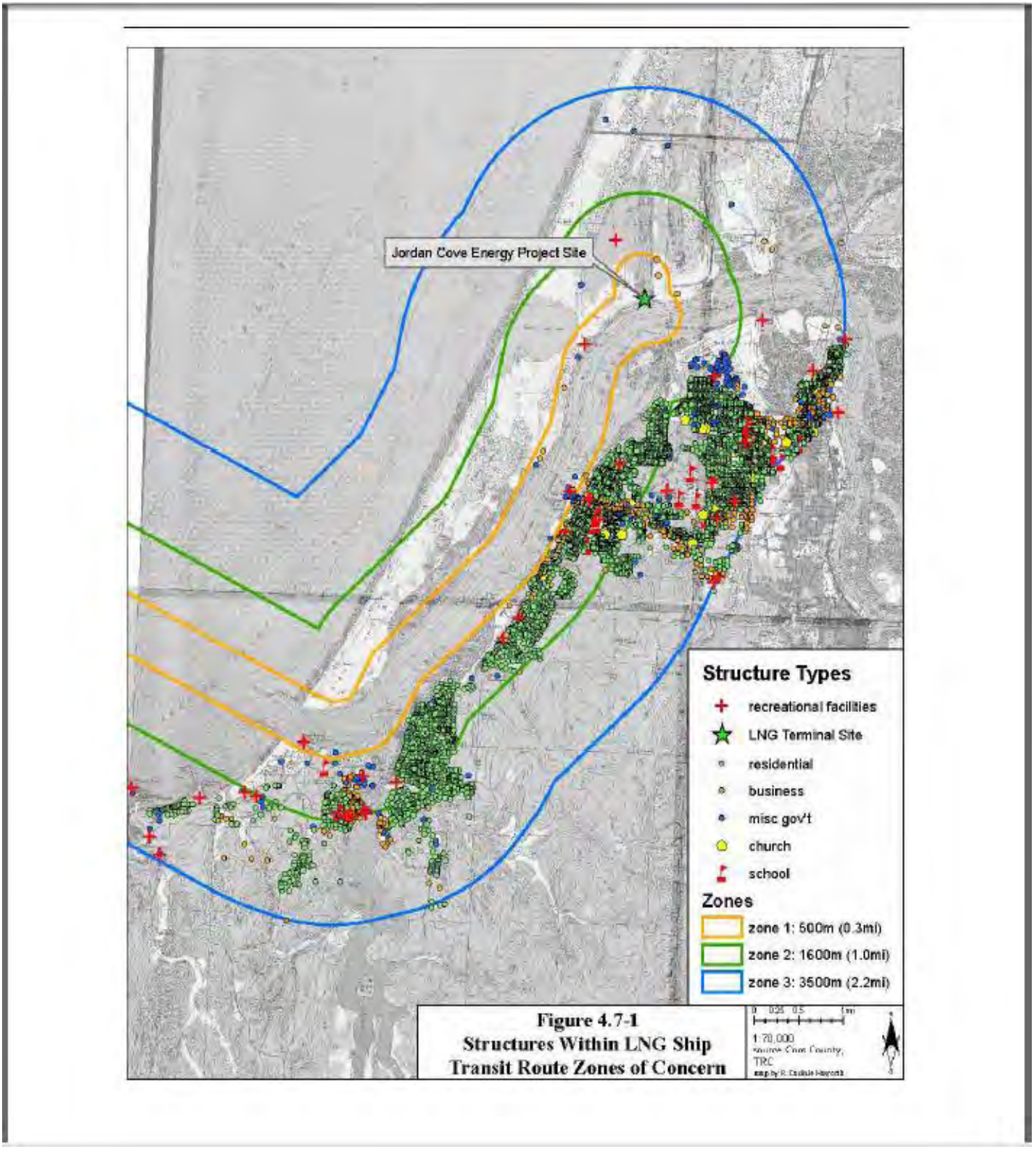


Exhibit J

EXHIBIT J

Calculating 148,000 cubic meter LNG ship at –
600 to 1 and 610 to 1 conversion from Natural Gas and how many shipments that would mean:

148,000 cubic meters LNG = 5,226,570.675 cubic feet LNG

5,226,570.675 X **600** = 3,135,942,405 cubic feet of natural gas

292,000,000,000 cubic feet of gas (yearly) :/: 3,135,942,405 cubic feet of gas per shipload = **93 shipments needed per year = 186 harbor disruptions at high slack tide.**

[**Note:** Jordan Cove non-FTA Application page one says JCEP will export 292 billion cubic feet (Bcf) per year (.8 Bcf/d); Page 13 states .9 Bcf/d beginning in 2017; ECONorthwest Construction Impact Study page 3 states; " The PCGP would have a nameplate capacity of 1.1 billion cubic feet of natural gas per day (Bcfd). At a 90 percent capacity factor, throughput would average 0.99 Bcfd." Page 5 states; "A single natural gas compressor station at Malin will allow the PCGP to transport 1.1 Bcfd to JCEP terminus in Coos County."]

****

148,000 cubic meters LNG = 5,226,570.675 cubic feet LNG

5,226,570.675 X **600** = 3,135,942,405 cubic feet of natural gas

365,000,000,000 cubic feet of gas (yearly) :/: 3,135,942,405 cubic feet of gas per shipload = **116 shipments needed per year = 232 harbor disruptions at high slack tide**

****

148,000 cubic meters LNG = 5,226,570.675 cubic feet of LNG

5,226,570.675 X **610** = 3,188,208,111.75 cubic feet of natural gas

365,000,000,000 cubic feet of gas (yearly) :/: 3,188,208,111.75 cubic feet of gas per shipload = **114 shipments needed per year = 228 harbor disruptions at high slack tide**

****

116 shipments: /: 12 (months) = Ten shipments per month (roughly) A shipment every 2 – 3 days. Some of the LNG is left in the ship to keep the containers cold and there is also LNG lost to boil off (about 15 % per shipment by some estimates) that has not been figured into these estimates.

Who's to say that the minute the DOE and FERC would approve this, Jordan Cove Energy Project would submit another application to increase their export capacity?

Another good question would be what is the pollution impact of having all these smaller ships? Right now most of the newer ships being built are much larger than 148,000 cubic meters - www.coltoncompany.com

Exhibit 8

United States Government Accountability Office

GAO

Report to Congressional Requesters

September 2012

OIL AND GAS

Information on Shale Resources, Development, and Environmental and Public Health Risks

GAO-12-732

September 2012

OIL AND GAS

Information on Shale Resources, Development, and Environmental and Public Health Risks

GAO Accountability * Integrity * Reliability

Highlights

Highlights of GAO-12-732, a report to congressional requesters

Why GAO Did This Study

New applications of horizontal drilling techniques and hydraulic fracturing—in which water, sand, and chemical additives are injected under high pressure to create and maintain fractures in underground formations—allow oil and natural gas from shale formations (known as "shale oil" and "shale gas") to be developed. As exploration and development of shale oil and gas have increased—including in areas of the country without a history of oil and natural gas development—questions have been raised about the estimates of the size of these resources, as well as the processes used to extract them.

GAO was asked to determine what is known about the (1) size of shale oil and gas resources and the amount produced from 2007 through 2011 and (2) environmental and public health risks associated with the development of shale oil and gas. GAO reviewed estimates and data from federal and nongovernmental organizations on the size and production of shale oil and gas resources. GAO also interviewed federal and state regulatory officials, representatives from industry and environmental organizations, oil and gas operators, and researchers from academic institutions.

GAO is not making any recommendations in this report. We provided a draft of this report to the Department of Energy, the Department of the Interior, and the Environmental Protection Agency for review. The Department of the Interior and the Environmental Protection Agency provided technical comments, which we incorporated as appropriate. The Department of Energy did not provide comments.

View GAO-12-732. For more information, contact Frank Rusco at (202) 512-3841 or ruscof@gao.gov.

What GAO Found

Estimates of the size of shale oil and gas resources in the United States by the Energy Information Administration (EIA), U.S. Geological Survey (USGS), and the Potential Gas Committee—three organizations that estimate the size of these resources—have increased over the last 5 years, which could mean an increase in the nation's energy portfolio. For example, in 2012, EIA estimated that the amount of technically recoverable shale gas in the United States was 482 trillion cubic feet—an increase of 280 percent from EIA's 2008 estimate. However, according to EIA and USGS officials, estimates of the size of shale oil and gas resources in the United States are highly dependent on the data, methodologies, model structures, and assumptions used to develop them. In addition, less is known about the amount of technically recoverable shale oil than shale gas, in part because large-scale production of shale oil has been under way for only the past few years. Estimates are based on data available at a given point in time and will change as additional information becomes available. In addition, domestic shale oil and gas production has experienced substantial growth; shale oil production increased more than fivefold from 2007 to 2011, and shale gas production increased more than fourfold from 2007 to 2011.

Oil and gas development, whether conventional or shale oil and gas, pose inherent environmental and public health risks, but the extent of these risks associated with shale oil and gas development is unknown, in part, because the studies GAO reviewed do not generally take into account the potential long-term, cumulative effects. For example, according to a number of studies and publications GAO reviewed, shale oil and gas development poses risks to air quality, generally as the result of (1) engine exhaust from increased truck traffic, (2) emissions from diesel-powered pumps used to power equipment, (3) gas that is flared (burned) or vented (released directly into the atmosphere) for operational reasons, and (4) unintentional emissions of pollutants from faulty equipment or impoundments—temporary storage areas. Similarly, a number of studies and publications GAO reviewed indicate that shale oil and gas development poses risks to water quality from contamination of surface water and groundwater as a result of erosion from ground disturbances, spills and releases of chemicals and other fluids, or underground migration of gases and chemicals. For example, tanks storing toxic chemicals or hoses and pipes used to convey wastes to the tanks could leak, or impoundments containing wastes could overflow as a result of extensive rainfall. According to the New York Department of Environmental Conservation's 2011 Supplemental Generic Environmental Impact Statement, spilled, leaked, or released chemicals or wastes could flow to a surface water body or infiltrate the ground, reaching and contaminating subsurface soils and aquifers. In addition, shale oil and gas development poses a risk to land resources and wildlife habitat as a result of constructing, operating, and maintaining the infrastructure necessary to develop oil and gas; using toxic chemicals; and injecting fluids underground. However, the extent of these risks is unknown. For example, the studies and publications GAO reviewed on air quality conditions provide information for a specific site at a specific time but do not provide the information needed to determine the overall cumulative effects that shale oil and gas activities may have on air quality. Further, the extent and severity of environmental and public health risks identified in the studies and publications GAO reviewed may vary significantly across shale basins and also within basins because of location- and process-specific factors, including the location and rate of development; geological characteristics, such as permeability, thickness, and porosity of the formations; climatic conditions; business practices; and regulatory and enforcement activities.

Contents

Abbreviations

BLM	Bureau of Land Management
Btu	British thermal unit
DOE	Department of Energy
EIA	Energy Information Administration
EPA	Environmental Protection Agency
NORM	naturally occurring radioactive materials
Tcf	technically recoverable gas
USGS	U.S. Geological Survey

GAO
Accountability * Integrity * Reliability

United States Government Accountability Office
Washington, DC 20548

September 5, 2012

Congressional Requesters

For decades, the United States has relied on imports of oil and natural gas to meet domestic needs. As recently as 2007, the expectation was that the nation would increasingly rely on imports of natural gas to meet its growing demand. However, recent improvements in technology have allowed companies that develop petroleum resources to extract oil and natural gas from shale formations,[1] known as "shale oil" and "shale gas," respectively, which were previously inaccessible because traditional techniques did not yield sufficient amounts for economically viable production. In particular, as we reported in January 2012, new applications of horizontal drilling techniques and hydraulic fracturing—a process that injects a combination of water, sand, and chemical additives under high pressure to create and maintain fractures in underground rock formations that allow oil and natural gas to flow—have prompted a boom in shale oil and gas production.[2] According to the Department of Energy (DOE), America's shale gas resource base is abundant, and development of this resource could have beneficial effects for the nation, such as job creation.[3] According to a report by the Baker Institute, domestic shale gas development could limit the need for expensive imports of these resources—helping to reduce the U.S. trade deficit.[4] In addition, replacing older coal burning power generation with new natural gas-fired generators could reduce greenhouse gas emissions and result in fewer air pollutants

[1]Shale oil differs from "oil shale." Shale is a sedimentary rock that is predominantly composed of consolidated clay-sized particles. Oil shale requires a different process to extract. Specifically, to extract the oil from oil shale, the rock needs to be heated to very high temperatures—ranging from about 650 to 1,000 degrees Fahrenheit—in a process known as retorting. Oil shale is not currently economically viable to produce. For additional information on oil shale, see GAO, *Energy-Water Nexus: A Better and Coordinated Understanding of Water Resources Could Help Mitigate the Impacts of Potential Oil Shale Development*, GAO-11-35 (Washington, D.C.: Oct. 29, 2010).

[2]GAO, *Energy-Water Nexus: Information on the Quantity, Quality, and Management of Water Produced during Oil and Gas Production*, GAO-12-156 (Washington, D.C.: Jan. 9, 2012).

[3]EIA is a statistical agency within DOE that provides independent data, forecasts, and analyses.

[4]The Baker Institute is a public policy think tank located on the Rice University campus.

for the same amount of electric power generated.[5] Early drilling activity in shale formations was centered primarily on natural gas, but with the falling price of natural gas companies switched their focus to oil and natural gas liquids, which are a more valuable product.[6]

As exploration and development of shale oil and gas have increased in recent years—including in areas of the country without a history of oil and natural gas activities—questions have been raised about the estimates of the size of domestic shale oil and gas resources, as well as the processes used to extract them.[7] For example, some organizations have questioned the accuracy of the estimates of the shale gas supply. In particular, some news organizations have reported concerns that such estimates may be inflated. In addition, concerns about environmental and public health effects of the increased use of horizontal drilling and hydraulic fracturing, particularly on air quality and water resources, have garnered extensive public attention. According to the International Energy Agency, some questions also exist about whether switching from coal to natural gas will lead to a reduction in greenhouse gas emissions—based, in part, on uncertainty about additional emissions from the development of shale gas. These concerns and other considerations have led some communities and certain states to impose restrictions or moratoriums on drilling operations to allow time to study and better understand the potential risks associated with these practices.

In this context, you asked us to provide information on shale oil and gas. This report describes what is known about (1) the size of shale oil and gas resources in the United States and the amount produced from 2007 through 2011—the years for which data were available—and (2) the environmental and public health risks associated with development of shale oil and gas.[8]

[5]EIA reported that using natural gas over coal would lower emissions in the United States, but some researchers have reported that greater reliance on natural gas would fail to significantly slow climate change.

[6]The natural gas liquids include propane, butane, and ethane, and are separated from the produced gas at the surface in lease separators, field facilities, or gas processing plants.

[7]For the purposes of this report, resources represent all oil or natural gas contained within a formation and can be divided into resources and reserves.

[8]For the purposes of this report, we refer to risk as a threat or vulnerability that has potential to cause harm.

To determine what is known about the size of shale oil and gas resources and the amount of shale oil and gas produced, we collected data from federal agencies, state agencies, private industry, and academic organizations. Specifically, to determine what is known about the size of these resources, we obtained information for technically recoverable and proved reserves estimates for shale oil and gas from the EIA, the U.S. Geological Survey (USGS), and the Potential Gas Committee—a nongovernmental organization composed of academics and industry representatives. We interviewed key officials from these agencies and the committee about the assumptions and methodologies used to estimate the resource size. Estimates of proved reserves of shale oil and gas are based on data provided to EIA by operators—companies that develop petroleum resources to extract oil and natural gas.[9] To determine what is known about the amount of shale oil and gas produced from 2007 through 2011, we obtained data from EIA—which is responsible for estimating and reporting this and other energy information. To assess the reliability of these data, we examined EIA's published methodology for collecting this information and interviewed key EIA officials regarding the agency's data collection efforts. We also met with officials from states, representatives from private industry, and researchers from academic institutions who are familiar with these data and EIA's methodology. We discussed the sources and reliability of the data with these officials and found the data sufficiently reliable for the purposes of this report. For all estimates we report, we reviewed the methodologies used to derive them and also found them sufficiently reliable for the purposes of this report.

To determine what is known about the environmental and public health risks associated with the development of shale oil and gas,[10] we reviewed studies and other publications from federal agencies and laboratories, state agencies, local governments, the petroleum industry, academic institutions, environmental and public health groups, and other nongovernmental associations. We identified these studies by conducting

[9]Proved reserves refer to the amount of oil and gas that have been discovered and defined.

[10]Operators may use hydraulic fracturing to develop oil and natural gas from formations other than shale, but for the purposes of this report we focused on development of shale formations. Specifically, coalbed methane and tight sandstone formations may rely on these practices and some studies and publications we reviewed identified risks that can apply to these formations. However, many of the studies and publications we identified and reviewed focused primarily on shale formations.

a literature search, and by asking for recommendations during interviews with federal, state, and tribal officials; representatives from industry, trade organizations, environmental, and other nongovernmental groups; and researchers from academic institutions. For a number of studies, we interviewed the author or authors to discuss the study's findings and limitations, if any. We believe we have identified the key studies through our literature review and interviews, and that the studies included in our review have accurately identified currently known potential risks for shale oil and gas development. However, it is possible that we may not have identified all of the studies with findings relevant to our objectives, and the risks we present may not be the only issues of concern.

The risks identified in the studies and publications we reviewed cannot, at present, be quantified, and the magnitude of potential adverse affects or likelihood of occurrence cannot be determined for several reasons. First, it is difficult to predict how many or where shale oil and gas wells may be constructed. Second, the extent to which operators use effective best management practices to mitigate risk may vary. Third, based on the studies we reviewed, there are relatively few studies that are based on comparing predevelopment conditions to postdevelopment conditions—making it difficult to detect or attribute adverse conditions to shale oil and gas development. In addition, changes to the federal, state, and local regulatory environments and the effectiveness of implementing and enforcing regulations will affect operators' future activities and, therefore, the level of risk associated with future development of oil and gas resources. Moreover, risks of adverse events, such as spills or accidents, may vary according to business practices which, in turn, may vary across oil and gas companies, making it difficult to distinguish between risks associated with the process to develop shale oil and gas from risks that are specific to particular business practices. To obtain additional perspectives on issues related to environmental and public health risks, we interviewed federal officials from DOE's National Energy Technical Laboratory, the Department of the Interior's Bureau of Land Management (BLM) and Bureau of Indian Affairs, and the Environmental Protection Agency (EPA); state regulatory officials from Arkansas, Colorado, Louisiana, North Dakota, Ohio, Oklahoma, Pennsylvania, and Texas;[11] tribal officials from the Osage Nation; shale oil and gas operators;

[11]We selected these states because they are involved with shale oil and gas development.

representatives from environmental and public health organizations; and other knowledgeable parties with experience related to shale oil and gas development, such as researchers from the Colorado School of Mines, the University of Texas, Oklahoma University, and Stanford University. Appendix I provides additional information on our scope and methodology.

We conducted this performance audit from November 2011 to September 2012 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

This section includes (1) an overview of oil and natural gas, (2) the shale oil and gas development process, (3) the regulatory framework, (4) the location of shale oil and gas in the United States, and (5) information on estimating the size of these resources.

Overview

Oil and natural gas are found in a variety of geologic formations. Conventional oil and natural gas are found in deep, porous rock or reservoirs and can flow under natural pressure to the surface after drilling. In contrast to the free-flowing resources found in conventional formations, the low permeability of some formations, including shale, means that oil and gas trapped in the formation cannot move easily within the rock. On one extreme—oil shale, for example—the hydrocarbon trapped in the shale will not reach a liquid form without first being heated to very high temperatures—ranging from about 650 to 1,000 degrees Fahrenheit—in a process known as retorting. In contrast, to extract shale oil and gas from the rock, fluids and proppants (usually sand or ceramic beads used to hold fractures open in the formation) are injected under high pressure to create and maintain fractures to increase permeability, thus allowing oil or gas to be extracted. Other formations, such as coalbed methane

formations and tight sandstone formations,[12] may also require stimulation to allow oil or gas to be extracted.[13]

Most of the energy used in the United States comes from fossil fuels such as oil and natural gas. Oil supplies more than 35 percent of all the energy the country consumes, and almost the entire U.S. transportation fleet—cars, trucks, trains, and airplanes—depends on fuels made from oil. Natural gas is an important energy source to heat buildings, power the industrial sector, and generate electricity. Natural gas provides more than 20 percent of the energy used in the United States,[14] supplying nearly half of all the energy used for cooking, heating, and powering other home appliances, and generating almost one-quarter of U.S. electricity supplies.

The Shale Oil and Gas Development Process

The process to develop shale oil and gas is similar to the process for conventional onshore oil and gas, but shale formations may rely on the use of horizontal drilling and hydraulic fracturing—which may or may not be used on conventional wells. Horizontal drilling and hydraulic fracturing are not new technologies, as seen in figure 1, but advancements, refinements, and new uses of these technologies have greatly expanded oil and gas operators' abilities to use these processes to economically develop shale oil and gas resources. For example, the use of multistage hydraulic fracturing within a horizontal well has only been widely used in the last decade.[15]

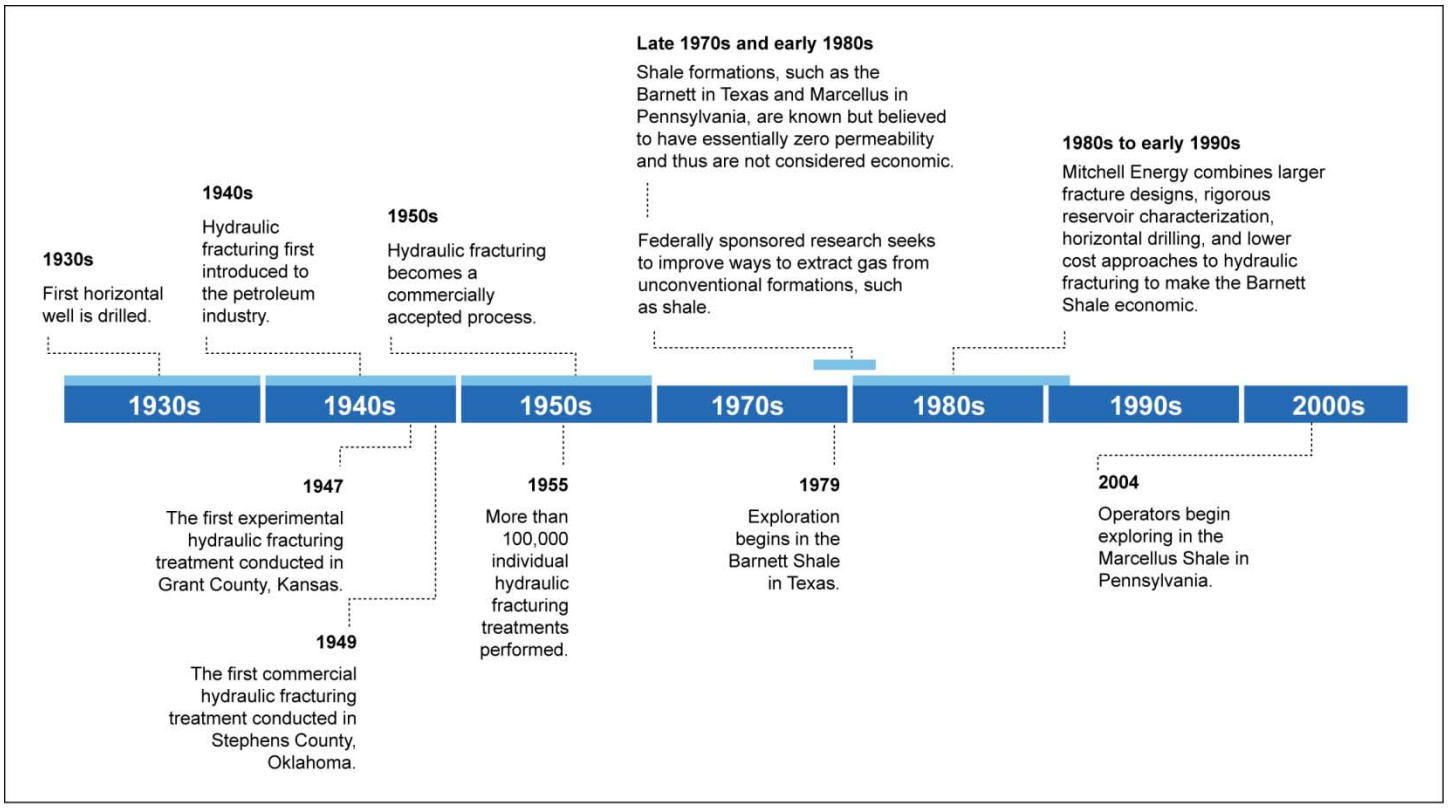
[12]Conventional sandstone has well-connected pores, but tight sandstone has irregularly distributed and poorly connected pores. Due to this low connectivity or permeability, gas trapped within tight sandstone is not easily produced.

[13]For coalbed methane formations, the reduction in pressure needed to extract gas is achieved through dewatering. As water is pumped out of the coal seams, reservoir pressure decreases, allowing the natural gas to release (desorb) from the surface of the coal and flow through natural fracture networks into the well.

[14]Ground Water Protection Council and ALL Consulting, *Modern Shale Gas Development in the United States: A Primer*, a special report prepared at the request of the Department of Energy (Washington, D.C.: April 2009).

[15]Hydraulic fracturing is often conducted in stages. Each stage focuses on a limited linear section and may be repeated numerous times.

Figure 1: History of Horizontal Drilling and Hydraulic Fracturing



Source: GAO.

First, operators locate suitable shale oil and gas targets using seismic methods of exploration,[16] negotiate contracts or leases that allow mineral development, identify a specific location for drilling, and obtain necessary permits; then, they undertake a number of activities to develop shale oil and gas. The specific activities and steps taken to extract shale oil and gas vary based on the characteristics of the formation, but the development phase generally involves the following stages: (1) well pad

[16]The seismic method of exploration introduces energy into the subsurface through explosions in shallow "shot holes" by striking the ground forcefully (with a truck-mounted thumper), or by vibration methods. A portion of the energy returns to the surface after being reflected from the subsurface strata. This energy is detected by surface instruments, called geophones, and the information carried by the energy is processed by computers to interpret subsurface conditions.

preparation and construction, (2) drilling and well construction, and (3) hydraulic fracturing.[17]

Well Pad Preparation and Construction

The first stage in the development process is to prepare and construct the well pad site. Typically, operators must clear and level surface vegetation to make room for numerous vehicles and heavy equipment—such as the drilling rig—and to build infrastructure—such as roads—needed to access the site.[18] Then operators must transport the equipment that mixes the additives, water, and sand needed for hydraulic fracturing to the site—tanks, water pumps, and blender pumps, as well as water and sand storage tanks, monitoring equipment, and additive storage containers . Based on the geological characteristics of the formation and climatic conditions, operators may (1) excavate a pit or impoundment to store freshwater, drilling fluids, or drill cuttings—rock cuttings generated during drilling; (2) use tanks to store materials; or (3) build temporary transfer pipes to transport materials to and from an off-site location.

Drilling and Well Construction

The next stage in the development process is drilling and well construction. Operators drill a hole (referred to as the wellbore) into the earth through a combination of vertical and horizontal drilling techniques. At several points in the drilling process, the drill string and bit are removed from the wellbore so that casing and cement may be inserted. Casing is a metal pipe that is inserted inside the wellbore to prevent high-pressure fluids outside the formation from entering the well and to prevent drilling mud inside the well from fracturing fragile sections of the wellbore. As drilling progresses with depth, casings that are of a smaller diameter than the hole created by the drill bit are inserted into the wellbore and bonded in place with cement, sealing the wellbore from the surrounding formation.

Drilling mud (a lubricant also known as drilling fluid) is pumped through the wellbore at different densities to balance the pressure inside the wellbore and bring rock particles and other matter cut from the formation back to the rig. A blowout preventer is installed over the well as a safety measure to prevent any uncontrolled release of oil or gas and help

[17]The specific order of activities and steps may vary.

[18]According to the New York Department of Environmental Conservation's 2011 Supplemental Generic Environmental Impact Statement, the average size of a well pad is 3.5 acres.

maintain control over pressures in the well. Drill cuttings, which are made up of ground rock coated with a layer of drilling mud or fluid, are brought to the surface. Mud pits provide a reservoir for mixing and holding the drilling mud. At the completion of drilling, the drilling mud may be recycled for use at another drilling operation.

Instruments guide drilling operators to the "kickoff point"—the point that drilling starts to turn at a slight angle and continues turning until it nears the shale formation and extends horizontally. Production casing and cement are then inserted to extend the length of the borehole to maintain wellbore integrity and prevent any communication between the formation fluids and the wellbore. After the casing is set and cemented, the drilling operator may run a cement evaluation log by lowering an electric probe into the well to measure the quality and placement of the cement. The purpose of the cement evaluation log is to confirm that the cement has the proper strength to function as designed—preventing well fluids from migrating outside the casing and infiltrating overlying formations. After vertical drilling is complete, horizontal drilling is conducted by slowly angling the drill bit until it is drilling horizontally. Horizontal stretches of the well typically range from 2,000 to 6,000 feet long but can be as long as 12,000 feet long, in some cases.

Throughout the drilling process, operators may vent or flare some natural gas, often intermittently, in response to maintenance needs or equipment failures. This natural gas is either released directly into the atmosphere (vented) or burned (flared). In October 2010, we reported on venting and flaring of natural gas on public lands.[19] We reported that vented and flared gas on public lands represents potential lost royalties for the federal government and contributes to greenhouse gas emissions. Specifically, venting releases methane and volatile organic compounds, and flaring emits carbon dioxide, both greenhouse gases that contribute to global climate change. Methane is a particular concern since it is a more potent greenhouse gas than carbon dioxide.

Hydraulic Fracturing

The next stage in the development process is stimulation of the shale formation using hydraulic fracturing. Before operators or service companies perform a hydraulic fracture treatment of a well, a series of

[19]GAO, *Federal Oil and Gas Leases: Opportunities Exist to Capture Vented and Flared Natural Gas, Which Would Increase Royalty Payments and Reduce Greenhouse Gases*, GAO-11-34 (Washington, D.C.: Oct. 29, 2010).

tests may be conducted to ensure that the well, wellhead equipment, and fracturing equipment can safely withstand the high pressures associated with the fracturing process. Minimum requirements for equipment pressure testing can be determined by state regulatory agencies for operations on state or private lands. In addition, fracturing is conducted below the surface of the earth, sometimes several thousand feet below, and can only be indirectly observed. Therefore, operators may collect subsurface data—such as information on rock stresses[20] and natural fault structures—needed to develop models that predict fracture height, length, and orientation prior to drilling a well. The purpose of modeling is to design a fracturing treatment that optimizes the location and size of induced fractures and maximizes oil or gas production.

To prepare a well to be hydraulically fractured, a perforating tool may be inserted into the casing and used to create holes in the casing and cement. Through these holes, fracturing fluid—that is injected under high pressures—can flow into the shale (fig. 2 shows a used perforating tool).

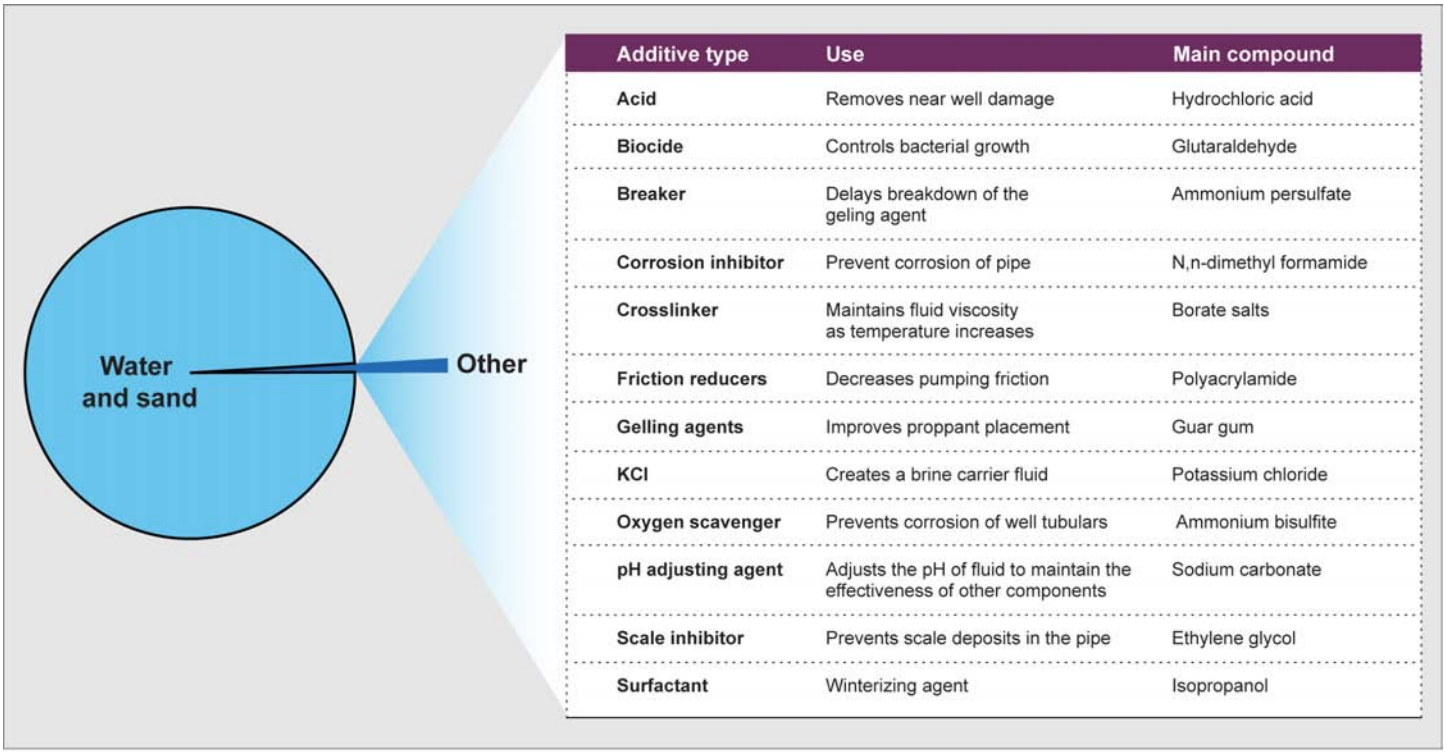
[20]Stresses in the formation generally define a maximum and minimum stress direction that influence the direction a fracture will grow.

Figure 2: Perforating Tool

Source: GAO.

Fracturing fluids are tailored to site specific conditions, such as shale thickness, stress, compressibility, and rigidity. As such, the chemical additives used in a fracture treatment vary. Operators may use computer models that consider local conditions to design site-specific hydraulic fluids. The water, chemicals, and proppant used in fracturing fluid are typically stored on-site in separate tanks and blended just before they are injected into the well. Figure 3 provides greater detail about some chemicals commonly used in fracturing.

Figure 3: Examples of Common Ingredients Found in Fracturing Fluid



Additive type	Use	Main compound
Acid	Removes near well damage	Hydrochloric acid
Biocide	Controls bacterial growth	Glutaraldehyde
Breaker	Delays breakdown of the geling agent	Ammonium persulfate
Corrosion inhibitor	Prevent corrosion of pipe	N,n-dimethyl formamide
Crosslinker	Maintains fluid viscosity as temperature increases	Borate salts
Friction reducers	Decreases pumping friction	Polyacrylamide
Gelling agents	Improves proppant placement	Guar gum
KCl	Creates a brine carrier fluid	Potassium chloride
Oxygen scavenger	Prevents corrosion of well tubulars	Ammonium bisulfite
pH adjusting agent	Adjusts the pH of fluid to maintain the effectiveness of other components	Sodium carbonate
Scale inhibitor	Prevents scale deposits in the pipe	Ethylene glycol
Surfactant	Winterizing agent	Isopropanol

Sources: Department of Energy and Groundwater Protection Council.

The operator pumps the fracturing fluid into the wellbore at pressures high enough to force the fluid through the perforations into the surrounding formation—which can be shale, coalbeds, or tight sandstone—expanding existing fractures and creating new ones in the process. After the fractures are created, the operator reduces the pressure. The proppant stays in the formation to hold open the fractures and allow the release of oil and gas. Some of the fracturing fluid that was injected into the well will return to the surface (commonly referred to as flowback) along with water that occurs naturally in the oil- or gas-bearing formation—collectively referred to as produced water. The produced water is brought to the surface and collected by the operator, where it can be stored on-site in impoundments, injected into underground wells, transported to a wastewater treatment plant, or reused by the operator in

other ways.[21] Given the length of horizontal wells, hydraulic fracturing is often conducted in stages, where each stage focuses on a limited linear section and may be repeated numerous times.

Once a well is producing oil or natural gas, equipment and temporary infrastructure associated with drilling and hydraulic fracturing operations is no longer needed and may be removed, leaving only the parts of the infrastructure required to collect and process the oil or gas and ongoing produced water. Operators may begin to reclaim the part of the site that will not be used by restoring the area to predevelopment conditions. Throughout the producing life of an oil or gas well, the operator may find it necessary to periodically restimulate the flow of oil or gas by repeating the hydraulic fracturing process. The frequency of such activity depends on the characteristics of the geologic formation and the economics of the individual well. If the hydraulic fracturing process is repeated, the site and surrounding area will be further affected by the required infrastructure, truck transport, and other activity associated with this process.

Regulatory Framework

Shale oil and gas development, like conventional onshore oil and gas production, is governed by a framework of federal, state, and local laws and regulations. Most shale development in the near future is expected to occur on nonfederal lands and, therefore, states will typically take the lead in regulatory activities. However, in some cases, federal agencies oversee shale oil and gas development. For example, BLM oversees shale oil and gas development on federal lands. In large part, the federal laws, regulations, and permit requirements that apply to conventional onshore oil and gas exploration and production activities also apply to shale oil and gas development.

- *Federal*. A number of federal agencies administer laws and regulations that apply to various phases of shale oil and gas development. For example, BLM manages federal lands and approximately 700 million acres of federal subsurface minerals, also known as the federal mineral estate. EPA administers and enforces key federal laws, such as the Safe Drinking Water Act, to protect

[21]Underground injection is the predominant practice for disposing of produced water. In addition to underground injection, a limited amount of produced water is managed by discharging it to surface water, storing it in surface impoundments, and reusing it for irrigation or hydraulic fracturing.

human health and the environment. Other federal land management agencies, such as the U.S. Department of Agriculture's Forest Service and the Department of the Interior's Fish and Wildlife Service, also manage federal lands, including shale oil and gas development on those lands.

- *State.* State agencies implement and enforce many of the federal environmental regulations and may also have their own set of state laws covering shale oil and gas development.

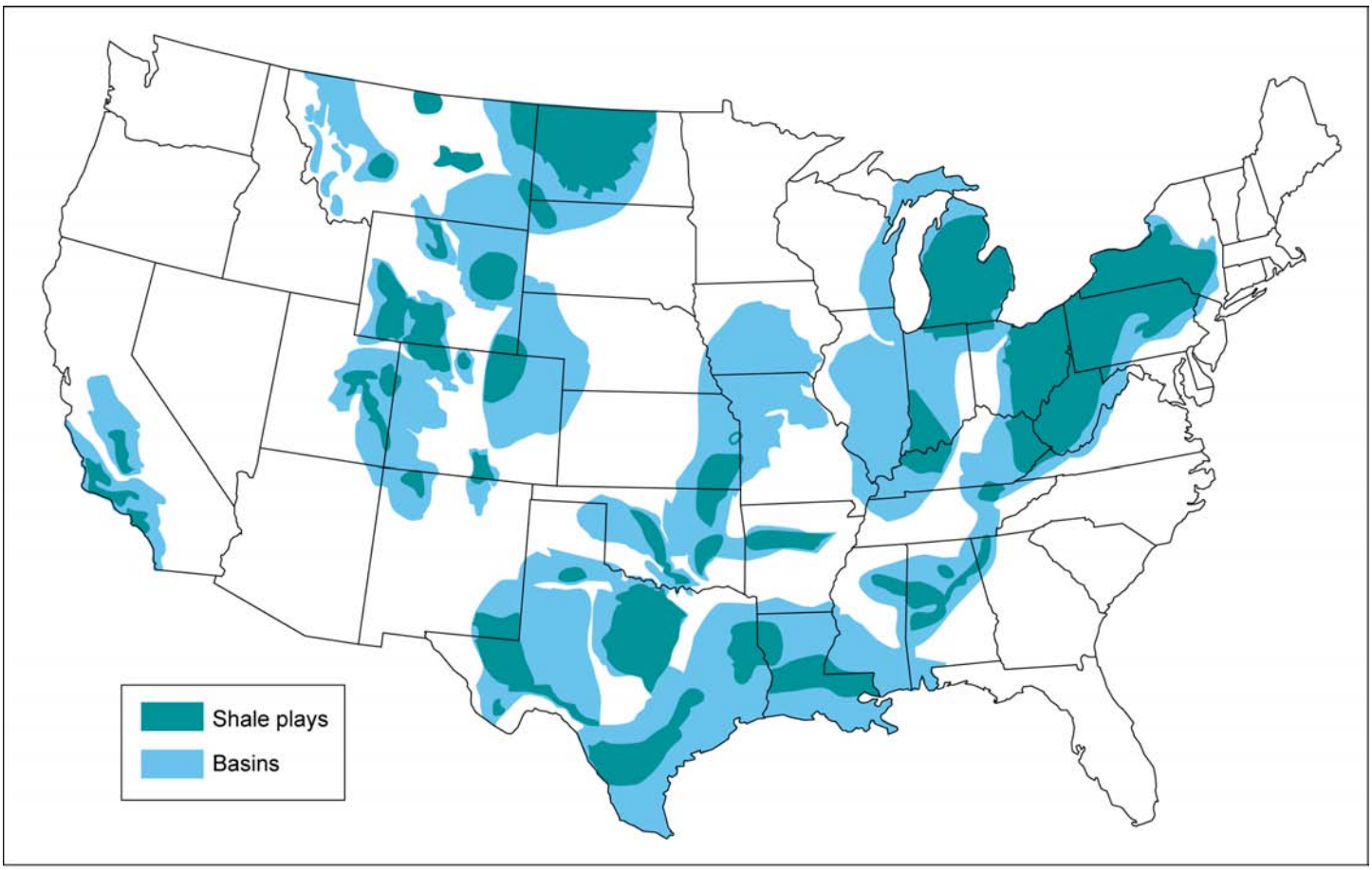
- *Other.* Additional requirements regarding shale oil and gas operations may be imposed by various levels of government for specific locations. Entities such as cities, counties, tribes, and regional water authorities may set additional requirements that affect the location and operation of wells.

GAO is conducting a separate and more detailed review of the federal and state laws and regulations that apply to unconventional oil and gas development, including shale oil and gas.

Location of Shale Oil and Gas in the United States

Shale oil and gas are found in shale plays—a set of discovered or undiscovered oil and natural gas accumulations or prospects that exhibit similar geological characteristics—on private, state-owned, and federal lands across the United States. Shale plays are located within basins, which are large-scale geological depressions, often hundreds of miles across, that also may contain other oil and gas resources. Figure 4 shows the location of shale plays and basins in the contiguous 48 states.

Figure 4: Shale Plays and Basins in the Contiguous 48 States



Sources: Energy Information Administration (shale location data); (map) copyright © Corel Corp., all rights reserved.

A shale play can be developed for oil, natural gas, or both. In addition, a shale gas play may contain “dry” or “wet” natural gas. Dry natural gas is a mixture of hydrocarbon compounds that exists as a gas both underground in the reservoir and during production under standard temperature and pressure conditions. Wet natural gas contains natural gas liquids, or the portion of the hydrocarbon resource that exists as a gas when in natural underground reservoir conditions but that is liquid at surface conditions. The natural gas liquids are typically propane, butane, and ethane and are separated from the produced gas at the surface in lease separators, field facilities, or gas processing plants. Operators may then sell the natural gas liquids, which may give wet shale gas plays an economic advantage over dry gas plays. Another advantage of liquid petroleum and natural

gas liquids is that they can be transported more easily than natural gas. This is because, to bring natural gas to markets and consumers, companies must build an extensive network of gas pipelines. In areas where gas pipelines are not extensive, natural gas produced along with liquids is often vented or flared.

Estimating the Size of Shale Oil and Gas Resources

Estimating the size of shale oil and gas resources serves a variety of needs for consumers, policymakers, land and resource managers, investors, regulators, industry planners, and others. For example, federal and state governments may use resource estimates to estimate future revenues and establish energy, fiscal, and national security policies. The petroleum industry and the financial community use resource estimates to establish corporate strategies and make investment decisions.

A clear understanding of some common terms used to generally describe the size and scope of oil and gas resources is needed to determine the relevance of a given estimate. For an illustration of how such terms describe the size and scope of shale oil and gas, see figure 5.

The most inclusive term is in-place resource. The in-place resource represents all oil or natural gas contained in a formation without regard to technical or economic recoverability. In-place resource estimates are sometimes very large numbers, but often only a small proportion of the total amount of oil or natural gas in a formation may ever be recovered. Oil and gas resources that are in-place, but not technically recoverable at this time may, in the future, become technically recoverable.

Technically recoverable resources are a subset of in-place resources that include oil or gas, including shale oil and gas that is producible given available technology. Technically recoverable resources include those that are economically producible and those that are not. Estimates of technically recoverable resources are dynamic, changing to reflect the potential of extraction technology and knowledge about the geology and composition of geologic formations. According to the National Petroleum Council,[22] technically recoverable resource estimates usually increase

[22]The National Petroleum Council is a federally chartered and privately funded advisory committee that advises, informs, and makes recommendations to the Secretary of Energy on oil and natural gas matters.

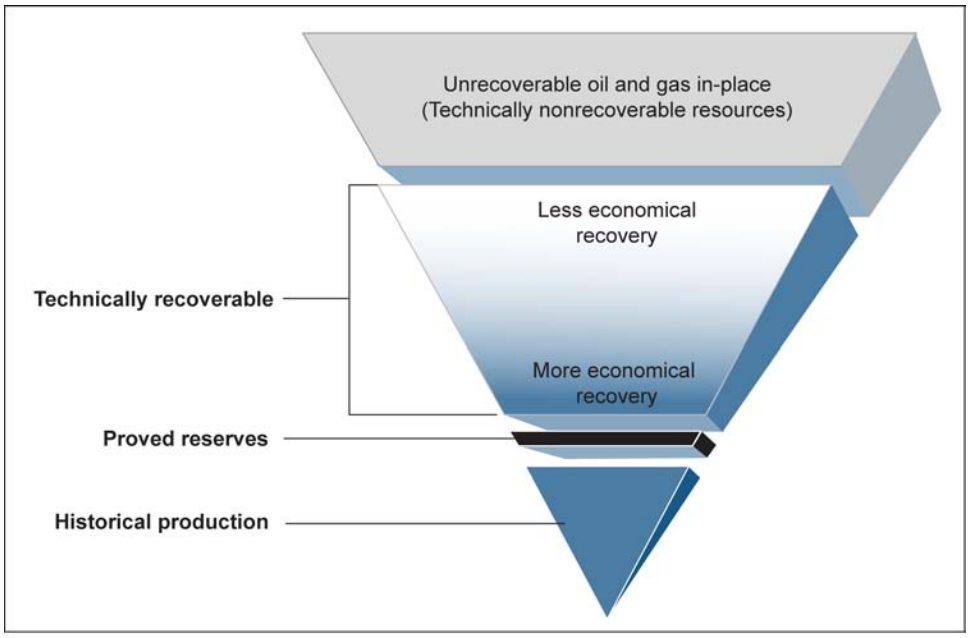
over time because of the availability of more and better data, or knowledge of how to develop a new play type (such as shale formations).

Proved reserve estimates are more precise than technically recoverable resources and represent the amount of oil and gas that have been discovered and defined, typically by drilling wells or other exploratory measures, and which can be economically recovered within a relatively short time frame. Proved reserves may be thought of as the "inventory" that operators hold and define the quantity of oil and gas that operators estimate can be recovered under current economic conditions, operating methods, and government regulations. Estimates of proved reserves increase as oil and gas companies make new discoveries and report them to the government; oil and gas companies can increase their reserves as they develop already-discovered fields and improve production technology. Reserves decline as oil and gas reserves are produced and sold. In addition, reserves can change as prices and technologies change. For example, technology improvements that enable operators to extract more oil or gas from existing fields can increase proved reserves. Likewise, higher prices for oil and gas may increase the amount of proved reserves because more resources become financially viable to extract.[23] Conversely, lower prices may diminish the amount of resources likely to be produced, reducing proved reserves.

Historical production refers to the total amount of oil and gas that has been produced up to the present. Because these volumes of oil and gas have been measured historically, this is the most precise information available as it represents actual production amounts.

[23]For example, secondary recovery operations can be costly (such as using a well to inject water into an oil reservoir and push any remaining oil to operating wells), but the costs may be justified if prices are high enough.

Figure 5: Common Terminology to Describe the Size and Scope of Shale Oil and Gas



Sources: GAO; based on illustration by the Congressional Research Service.

Note: This illustration is not necessarily to scale because all volumes, except historical production, are subject to significant uncertainty.

Certain federal agencies have statutory responsibility for collecting and publishing authoritative statistical information on various types of energy sources in the United States. EIA collects, analyzes, and disseminates independent and impartial energy information, including data on shale oil and gas resources. Under the Energy Policy and Conservation Act of 2000, as amended, USGS estimates onshore undiscovered technically recoverable oil and gas resources in the United States.[24] USGS has conducted a number of national estimates of undiscovered technically recoverable oil and natural gas resources over several decades. USGS geologists and other experts estimate undiscovered oil and gas—that is, oil and gas that has not been proven to be present by oil and gas companies—based on geological survey data and other information about

[24]Pub. L. No. 106-469 § 604 (2000), 114 Stat. 2029, 2041-42, codified, as amended, at 42 U.S.C. § 6217.

the location and size of different geological formations across the United States. In addition to EIA and USGS, experts from industry, academia, federal advisory committees, private consulting firms, and professional societies also estimate the size of the resource.

Domestic Shale Oil and Gas Estimates and Production

Estimates of the size of shale oil and gas resources in the United States have increased over time as has the amount of such resources produced from 2007 through 2011. Specifically, over the last 5 years, estimates of (1) technically recoverable shale oil and gas and (2) proved reserves of shale oil and gas have increased, as technology has advanced and more shale has been drilled. In addition, domestic shale oil and gas production has experienced substantial growth in recent years.

Estimates of Technically Recoverable Shale Oil and Gas Resources

EIA, USGS, and the Potential Gas Committee have increased their estimates of the amount of technically recoverable shale oil and gas over the last 5 years, which could mean an increase in the nation's energy portfolio; however, less is known about the amount of technically recoverable shale oil than shale gas, in part because large-scale production of shale oil has been under way for only the past few years. The estimates are from different organizations and vary somewhat because they were developed at different times and using different data, methods, and assumptions, but estimates from all of these organizations have increased over time, indicating that the nation's shale oil and gas resources may be substantial. For example, according to estimates and reports we reviewed, assuming current consumption levels without consideration of a specific market price for future gas supplies, the amount of domestic technically recoverable shale gas could provide enough natural gas to supply the nation for the next 14 to 100 years. The increases in estimates can largely be attributed to improved geological information about the resources, greater understanding of production levels, and technological advancements.

Estimates of Technically Recoverable Shale Oil Resources

In the last 2 years, EIA and USGS provided estimates of technically recoverable shale oil.[25] Each of these estimates increased in recent years as follows:

- In 2012, EIA estimated that the United States possesses 33 billion barrels of technically recoverable shale oil,[26] mostly located in four shale formations—the Bakken in Montana and North Dakota; Eagle Ford in Texas; Niobrara in Colorado, Kansas, Nebraska, and Wyoming; and the Monterey in California.

- In 2011, USGS estimated that the United States possesses just over 7 billion barrels of technically recoverable oil in shale and tight sandstone formations. The estimate represents a more than threefold increase from the agency's estimate in 2006. However, there are several shale plays that USGS has not evaluated for shale oil because interest in these plays is relatively new. According to USGS officials, these shale plays have shown potential for production in recent years and may contain additional shale oil resources. Table 1 shows USGS' 2006 and 2011 estimates and EIA's 2011 and 2012 estimates.

Table 1: USGS and EIA Estimates of Total Remaining Technically Recoverable U.S. Oil Resources

Barrels of oil in billions				
	USGS		**EIA**	
	2006	**2011**	**2011**	**2012**
Estimated technically recoverable shale oil and tight sandstone resources	2	7	32	33
Estimated technically recoverable oil resources other than shale[a]	142	133	187	201

Source: GAO analysis of EIA and USGS data.

[25]As noted previously, for the purposes of this report, we use the term "shale oil" to refer to oil from shale and other tight formations, which is recoverable by hydraulic fracturing and horizontal drilling techniques and is described by others as "tight oil." Shale oil and tight oil are extracted in the same way, but differ from "oil shale." Oil shale is a sedimentary rock containing solid organic material that converts into a type of crude oil only when heated.

[26]Comparatively, the United States currently consumes about 7 billion barrels of oil per year, about half of which are imported from foreign sources.

[a]Includes estimates for conventional offshore oil and gas, as well as natural gas liquids. In addition, the USGS estimates for 2006 and 2011 include a 2006 estimate of technically recoverable offshore conventional oil resources totaling 86 billion barrels of oil and natural gas liquids from the former Minerals Management Service, which has since been reorganized into the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement.

Overall, estimates of the size of technically recoverable shale oil resources in the United States are imperfect and highly dependent on the data, methodologies, model structures, and assumptions used. As these estimates are based on data available at a given point in time, they may change as additional information becomes available. Also these estimates depend on historical production data as a key component for modeling future supply. Because large-scale production of oil in shale formations is a relatively recent activity, their long-term productivity is largely unknown. For example, EIA estimated that the Monterey Shale in California may possess about 15.4 billion barrels of technically recoverable oil. However, without a longer history of production, the estimate has greater uncertainty than estimates based on more historical production data. At this time, USGS has not yet evaluated the Monterey Shale play.

Estimates of Technically Recoverable Shale Gas Resources

The amount of technically recoverable shale gas resources in the United States has been estimated by a number of organizations, including EIA, USGS, and the Potential Gas Committee (see fig. 6). Their estimates were as follows:

- In 2012, EIA estimated the amount of technically recoverable shale gas in the United States at 482 trillion cubic feet.[27] This represents an increase of 280 percent from EIA's 2008 estimate.
- In 2011, USGS reported that the total of its estimates for the shale formations the agency evaluated in all previous years[28] shows the

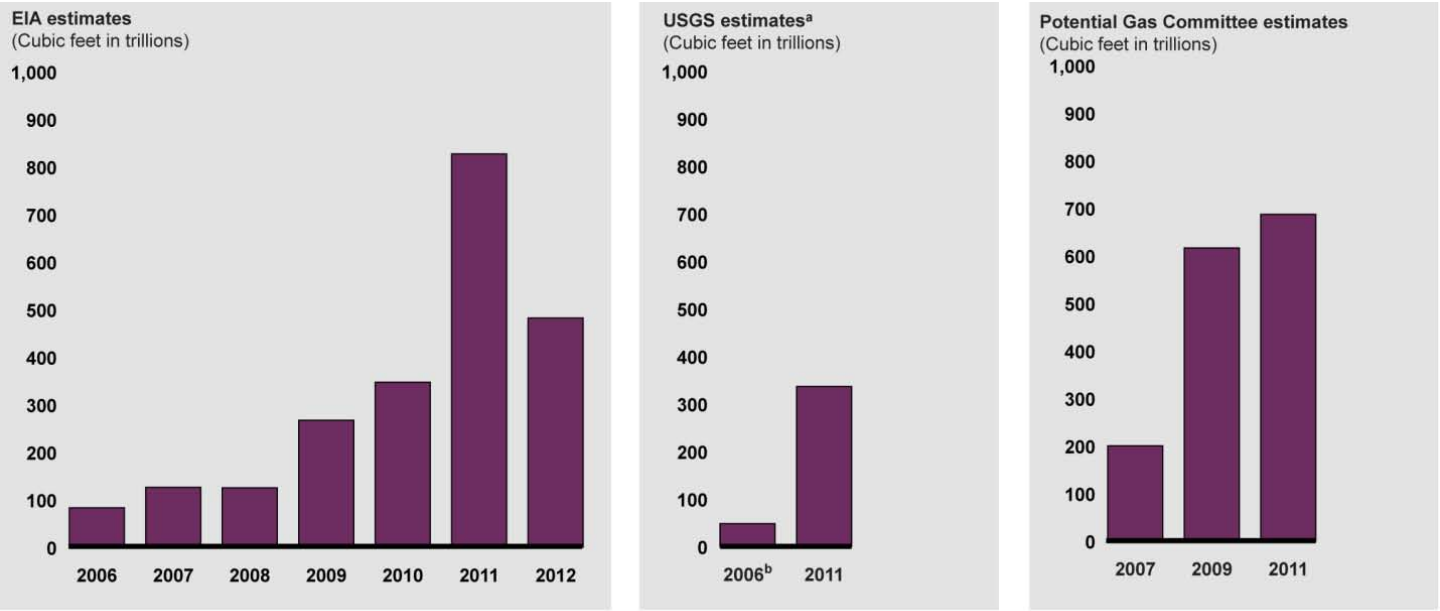
[27]EIA estimates are based on natural gas production data from 2 years prior to the reporting year; for example, EIA's 2012 estimate is based on 2010 data; the date cited here reflects the fact that EIA reported this latest estimate in 2012.

[28]USGS estimates are based on updated data in a few—but not all—individual geological areas, combined with data from other areas from all previous years. Each year USGS estimates new information for a few individual geological areas. For example, the 2011 USGS estimate includes updated 2011 data for the Appalachian Basin, the Anadarko Basin, and the Gulf Coast, combined with estimates for all other areas developed before 2011. See appendix III for additional information on USGS estimates. The date cited here reflects the fact that USGS reported this latest estimate in 2011.

amount of technically recoverable shale gas in the United States at about 336 trillion cubic feet. This represents an increase of about 600 percent from the agency's 2006 estimate.

- In 2011, the Potential Gas Committee estimated the amount of technically recoverable shale gas in the United States at about 687 trillion cubic feet.[29] This represents an increase of 240 percent from the committee's 2007 estimate.

Figure 6: Estimates of Technically Recoverable Shale Gas from EIA, USGS, and the Potential Gas Committee (2006 through 2012)



Sources: GAO analysis of EIA, Potential Gas Commitee, and USGS estimates.

Notes: Natural gas is generally priced and sold in thousand cubic feet (abbreviated Mcf, using the Roman numeral for 1,000). Units of a trillion cubic feet (Tcf) are often used to measure large quantities, as in resources or reserves in the ground, or annual national energy consumption. One Tcf is enough natural gas to heat 15 million homes for 1 year or fuel 12 million natural gas-fired vehicles for 1 year. In 2012, EIA reduced its estimate of technically recoverable shale gas in the Marcellus Shale by about 67 percent. According to EIA officials, the decision to revise the estimate was based primarily on the availability of new production data, which was highlighted by the release of the USGS

[29]Potential Gas Committee estimates are based on natural gas production data from the previous year; for example, committee's 2011 estimate is based on 2010 data. The date cited here reflects the fact that the Potential Gas Committee reported this latest estimate in 2011.

estimate. In 2011, EIA used data from a contractor to estimate that the Marcellus Shale possessed about 410 trillion cubic feet of technically recoverable gas. After EIA released its estimates in 2011, USGS released its first estimate of technically recoverable gas in the Marcellus in almost 10 years. USGS estimated that there were 84 trillion cubic feet of natural gas in the Marcellus—which was 40 times more than its previous estimate reported in 2002 but significantly less than EIA's estimate. In 2012, EIA announced that it was revising its estimate of the technically recoverable gas in the Marcellus Shale from 410 to 141 trillion cubic feet. EIA reported additional details about its methodology and data in June 2012. See U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2012, With Projections to 2035 (DOE/EIA-0383 [2012], Washington, D.C., June 25, 2012).

[a]The 2006 USGS estimate of about 54 trillion cubic feet represents those assessments that had been done up to the end of 2006. As such, the estimate is partially dependent on how the agency scheduled basin studies and assessments from 2000 through 2006, rather than purely on changes in USGS views of resource potential since 2006.

[b]The Potential Gas Committee did not report separate estimates of shale gas until 2007 and has updated this estimate every 2 years since then.

In addition to the estimates from the three organizations we reviewed, operators and energy forecasting consultants prepare their own estimates of technically recoverable shale gas to plan operations or for future investment. In September 2011, the National Petroleum Council aggregated data on shale gas resources from over 130 industry, government, and academic groups and estimated that approximately 1,000 trillion cubic feet of shale gas is available for production domestically. In addition, private firms that supply information to the oil and gas industry conduct assessments of the total amount of technically recoverable natural gas. For example, ICF International, a consulting firm that provides information to public- and private-sector clients, estimated in March 2012 that the United States possesses about 1,960 trillion cubic feet of technically recoverable shale gas.

Based on estimates from EIA, USGS, and the Potential Gas Committee, five shale plays—the Barnett, Haynesville, Fayetteville, Marcellus, and Woodford—are estimated to possess about two-thirds of the total estimated technically recoverable gas in the United States (see table 2).

Table 2: Estimated Technically Recoverable Shale Gas Resources, by Play

Shale play	Location	Technically recoverable gas, in trillion cubic feet (Tcf)
Barnett	North Texas	43-53
Fayetteville	Arkansas	13-110
Haynesville	Louisiana and East Texas	66-110
Marcellus	Northeast United States	84-227[a]
Woodford	Oklahoma	11-27

Sources: GAO analysis of EIA, USGS, and Potential Gas Committee data.

Note: The estimated technically recoverable gas shown here represents the range of estimates for these plays determined by EIA, USGS, and the Potential Gas Committee.

[a]This estimate of the Marcellus also includes estimated shale gas from other nearby lands in the Appalachian area; but, according to an official for the estimating organization, the Marcellus Shale is the predominant source of gas in the basin.

As with estimates for technically recoverable shale oil, estimates of the size of technically recoverable shale gas resources in the United States are also highly dependent on the data, methodologies, model structures, and assumptions used and may change as additional information becomes available. These estimates also depend on historical production data as a key component for modeling future supply. Because most shale gas wells generally were not in place until the last few years, their long-term productivity is untested. According to a February 2012 report released by the Sustainable Investments Institute and the Investor Responsibility Research Center Institute, production in emerging shale plays has been concentrated in areas with the highest known gas production rates, and many shale plays are so large that most of the play has not been extensively tested.[30] As a result, production rates achieved to date may not be representative of future production rates across the formation. EIA reports that experience to date shows production rates from neighboring shale gas wells can vary by as much as a factor of 3 and that production rates for different wells in the same formation can vary by as much as a factor of 10. Most gas companies estimate that production in a given well will drop sharply after the first few years and

[30]The Sustainable Investments Institute (Si2) is a nonprofit membership organization founded in 2010 to conduct research and publish reports on organized efforts to influence corporate behavior. The Investor Responsibility Research Center Institute is a nonprofit organization established in 2006 that provides information to investors.

then level off, continuing to produce gas for decades, according to the Sustainable Investments Institute and the Investor Responsibility Research Center Institute.

Estimates of Proved Reserves of Shale Oil and Gas

Estimates of proved reserves of shale oil and gas increased from 2007 to 2009. Operators determine the size of proved reserves based on information collected from drilling, geological and geophysical tests, and historical production trends. These are also the resources operators believe they will develop in the short term—generally within the next 5 years—and assume technological and economic conditions will remain unchanged.

Estimates of proved reserves of shale oil. EIA does not report proved reserves of shale oil separately from other oil reserves; however, EIA and others have noted an increase in the proved reserves of oil in the nation, and federal officials attribute the increase, in part, to oil from shale and tight sandstone formations. For example, EIA reported in 2009 that the Bakken Shale in North Dakota and Montana drove increases in oil reserves, noting that North Dakota proved reserves increased over 80 percent from 2008 through 2009.

Estimates of proved reserves of shale gas. According to data EIA collects from about 1,200 operators, proved reserves of shale gas have grown from 23 trillion cubic feet in 2007 to 61 trillion cubic feet in 2009, or an increase of 160 percent.[31] More than 75 percent of the proved shale gas reserves are located in three shale plays—the Barnett, Fayetteville, and the Haynesville.

Shale Oil and Gas Production

From 2007 through 2011, annual production of shale oil and gas has experienced significant growth. Specifically, shale oil production increased more than fivefold, from 39 to about 217 million barrels over this 5-year period, and shale gas production increased approximately fourfold, from 1.6 to about 7.2 trillion cubic feet, over the same period. To

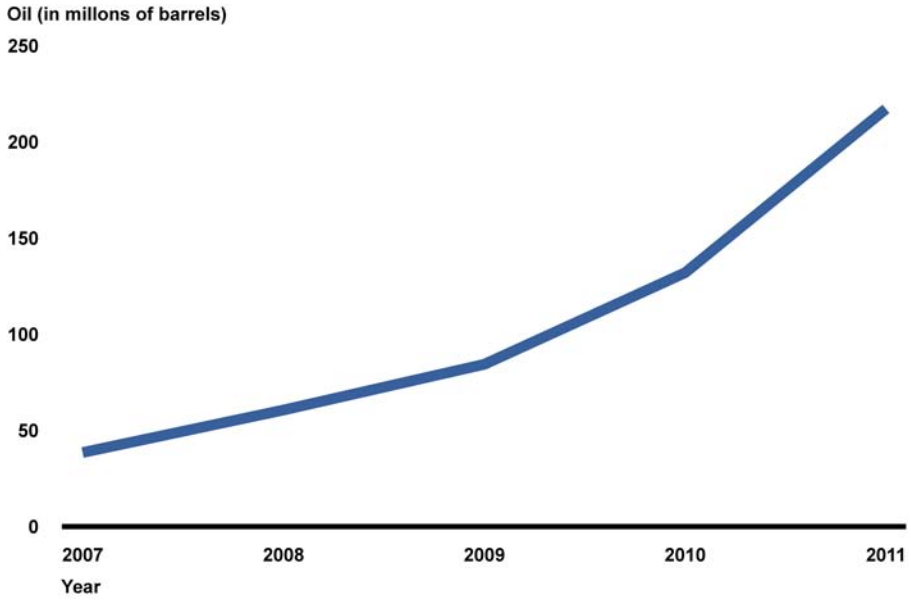
[31]Reserves are key information for assessing the net worth of an operator. Oil and gas companies traded on the U.S. stock exchange are required to report their reserves to the Securities and Exchange Commission. According to an EIA official, EIA reports a more complete measure of oil and gas reserves because it receives reports of proved reserves from both private and publically held companies.

put this shale production into context, the annual domestic consumption of oil in 2011 was about 6,875 million barrels of oil, and the annual consumption of natural gas was about 24 trillion cubic feet. The increased shale oil and gas production was driven primarily by technological advances in horizontal drilling and hydraulic fracturing that made more shale oil and gas development economically viable.

Shale Oil Production

Annual shale oil production in the United States increased more than fivefold, from about 39 million barrels in 2007 to about 217 million barrels in 2011, according to data from EIA (see fig. 7).[32] This is because new technologies allowed more oil to be produced economically, and because of recent increases in the price for liquid petroleum that have led to increased investment in shale oil development.

Figure 7: Estimated Production of Shale Oil from 2007 through 2011 (in millions of barrels of oil)



Source: GAO analysis of EIA data.

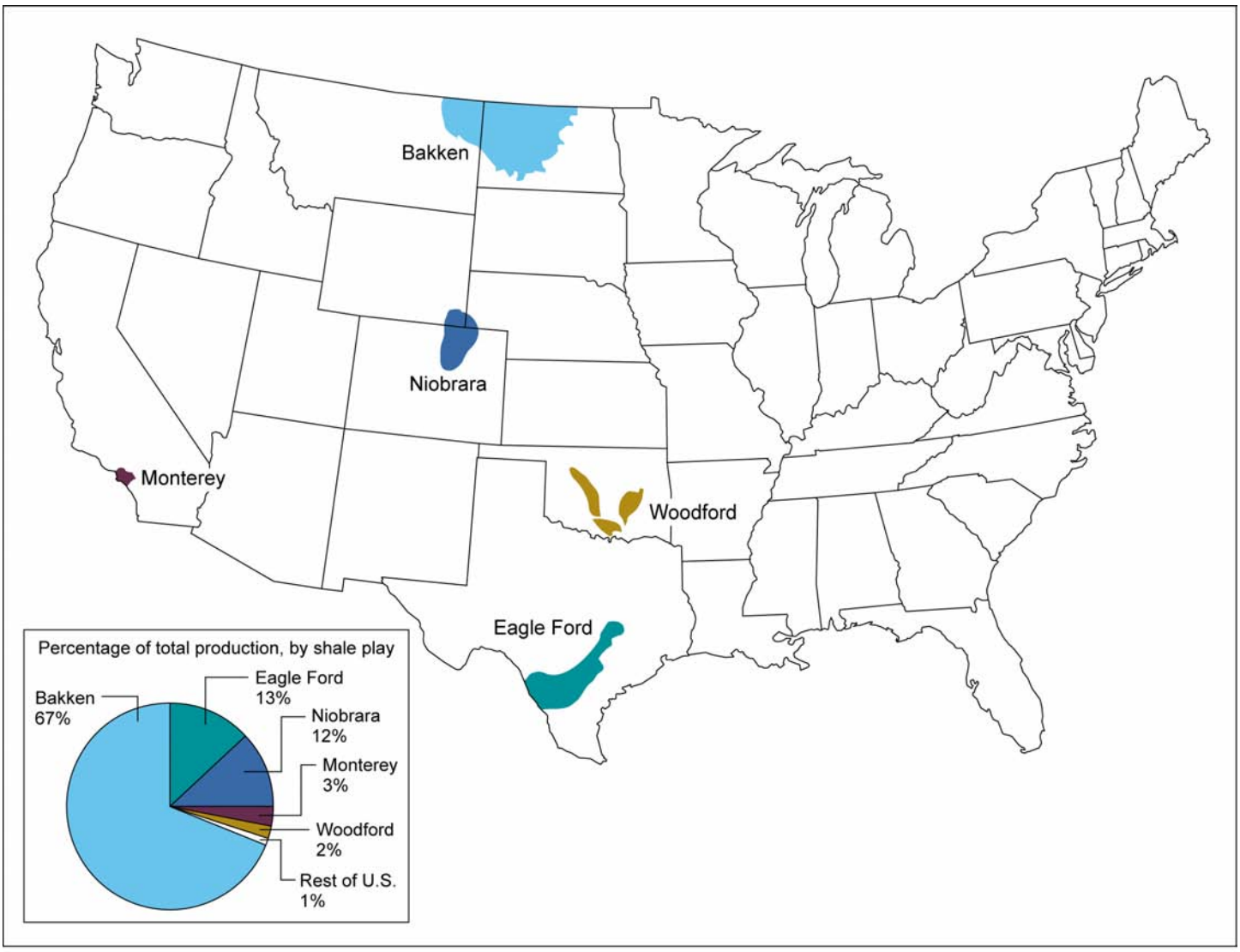
[32]As noted previously, for the purposes of this report, we use the term "shale oil" to refer to oil from shale and other tight formations, which is recovered by hydraulic fracturing and horizontal drilling and is described by others as "tight oil." Shale oil and tight oil are extracted in the same way, but differ from "oil shale." Oil shale is a sedimentary rock containing solid organic material that converts into a type of crude oil only when heated.

In total, during this period, about 533 million barrels of shale oil was produced. More than 65 percent of the oil was produced in the Bakken Shale (368 million barrels; see fig. 8).[33] The remainder was produced in the Niobrara (62 million barrels), Eagle Ford (68 million barrels), Monterey (18 million barrels), and the Woodford (9 million barrels). To put this in context, shale oil production from these plays in 2011 constituted about 8 percent of U.S. domestic oil consumption, according to EIA data.[34]

[33]EIA provided us with estimated shale oil production data from a contractor, HPDI LLC., for 2007 through 2011. EIA uses these data for the purposes of estimating recent shale oil production. EIA has not routinely reported shale oil production data separately from oil production.

[34]In addition to production from these shale oil plays, EIA officials told us that oil was produced from "tight oil" plays such as the Austin Chalk. The technology for producing tight oil is the same as for shale oil, and EIA uses the term "tight oil" to encompass both shale oil and tight oil that are developed with the same type of technology. In addition, EIA officials added that the shale oil data presented here is approximate because the data comes from a sample of similar plays. Overtime, this production data will become more precise as more data becomes available to EIA.

Figure 8: Shale Oil Production, by Shale Play (from 2007 through 2011)

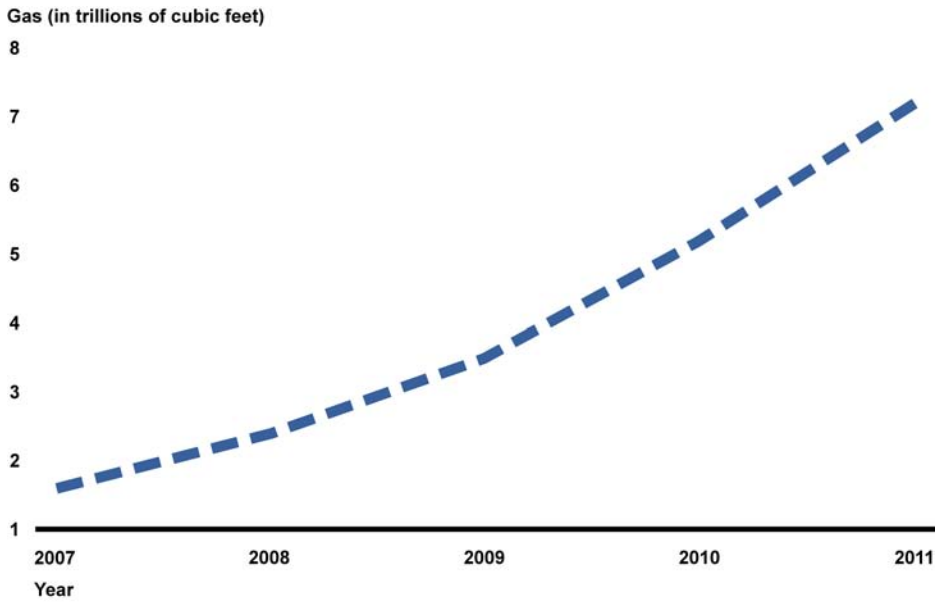


Sources: GAO analysis of EIA data; (map) copyright © Corel Corp., all rights reserved.

Shale Gas Production

Shale gas production in the United States increased more than fourfold, from about 1.6 trillion cubic feet in 2007 to about 7.2 trillion cubic feet in 2011, according to estimated data from EIA (see fig. 9).[35]

Figure 9: Estimated Production of Shale Gas from 2007 through 2011 (in trillions of cubic feet)



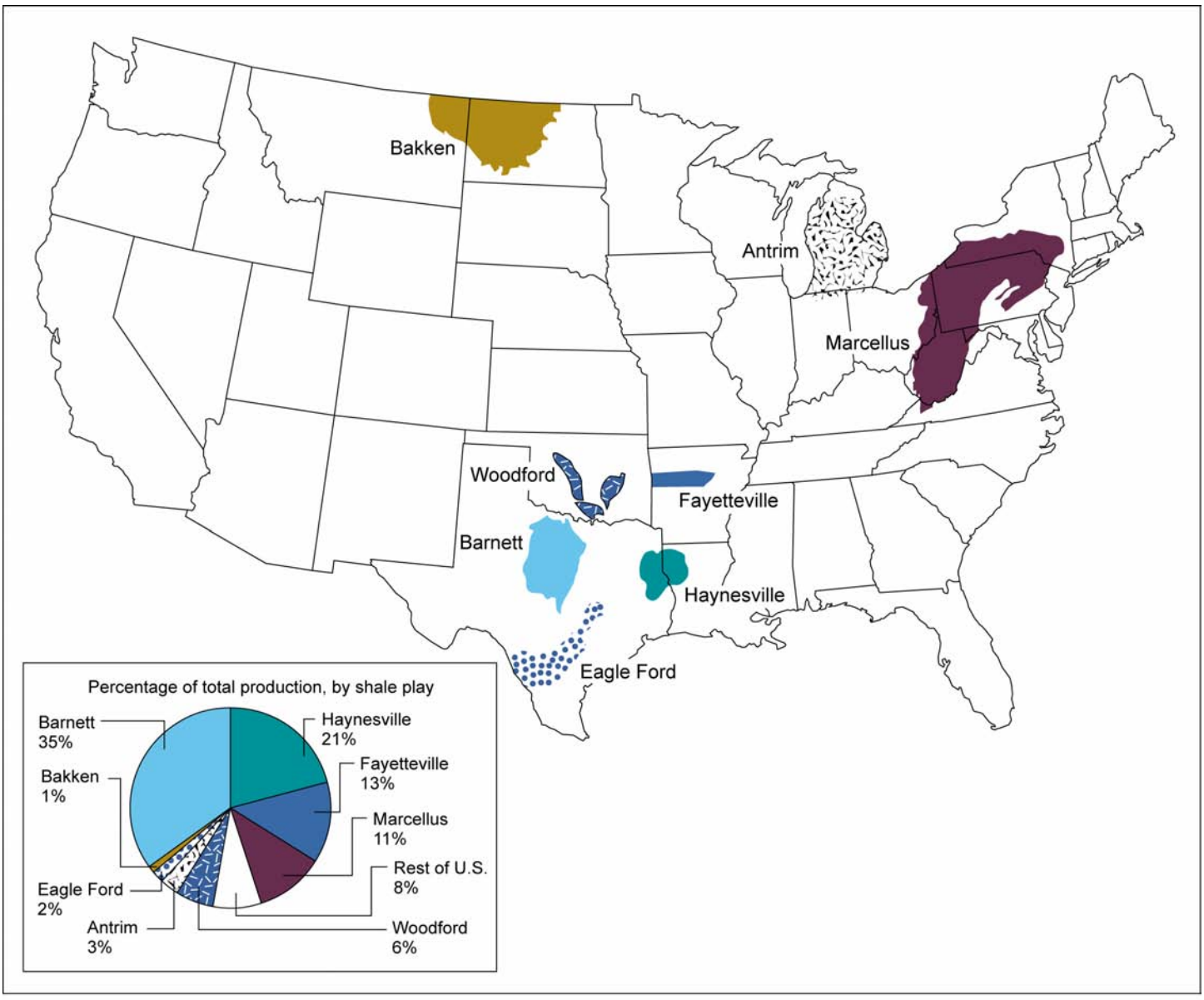
Source: GAO analysis of EIA data.

In total, during this period, about 20 trillion cubic feet of shale gas was produced—representing about 300 days of U.S. consumption, based on 2011 consumption rates. More than 75 percent of the gas was produced in four shale plays—the Barnett, Marcellus, Fayetteville, and Haynesville (see fig.10). From 2007 through 2011, shale gas' contribution to the nation's total natural gas supply grew from about 6 percent in 2007 to approximately 25 percent in 2011 and is projected, under certain assumptions, to increase to 49 percent by 2035, according to an EIA report. Overall production of shale gas increased from calendar years 2007 through 2011, but production of natural gas on federal and tribal

[35]EIA provided us with estimated shale gas production data from a contractor, Lippman Consulting, Inc., for 2007 through 2011. EIA uses these data for the purposes of estimating recent shale gas production. EIA has separately reported shale gas production data using reports from states for the years 2008 and 2009.

lands—including shale gas and natural gas from all other sources—decreased by about 17 percent, according to an EIA report. EIA attributes this decrease to several factors, including the location of shale formations—which, according to an EIA official, appear to be predominately on nonfederal lands.

Figure 10: Shale Gas Production, by Shale Play (from 2007 through 2011)



Sources: GAO analysis of EIA data; (map) copyright © Corel Corp., all rights reserved.

The growth in production of shale gas has increased the overall supply of natural gas in the U.S. energy market. Since 2007, increased shale gas

production has contributed to lower prices for consumers, according to EIA and others.[36] These lower prices create incentives for wider use of natural gas in other industries. For example, several reports by government, industry, and others have observed that if natural gas prices remain low, natural gas is more likely to be used to power cars and trucks in the future. In addition, electric utilities may build additional natural gas-fired generating plants as older coal plants are retired. At the same time, some groups have expressed concern that greater reliance on natural gas may reduce interest in developing renewable energy.

The greater availability of domestic shale gas has also decreased the need for natural gas imports. For example, EIA has noted that volumes of natural gas imported into the United States have fallen in recent years—in 2007, the nation imported 16 percent of the natural gas consumed and in 2010, the nation imported 11 percent—as domestic shale gas production has increased. This trend is also illustrated by an increase in applications for exporting liquefied natural gas to other countries. In its 2012 annual energy outlook, EIA predicted that, under certain scenarios, the United States will become a net exporter of natural gas by about 2022.[37]

Development of Wet Gas

EIA reported that operators have recently moved away from the development of shale plays that are primarily dry gas in favor of developing plays with higher concentrations of natural gas liquids. At current natural gas prices, natural gas liquids are a much more valuable product than dry gas. This is because the end products and byproducts of natural gas liquids contain more energy per unit of volume and have uses beyond heating and power generation and may be converted into products that can be more easily transported and traded in the global market. Shale plays with significant natural gas liquids include the Eagle Ford and Marcellus.

Shale Oil and Gas Development Pose Environmental and Public Health Risks, but the Extent is Unknown and Depends on Many Factors

Developing oil and gas resources—whether conventional or from shale formations—poses inherent environmental and public health risks, but the extent of risks associated with shale oil and gas development is unknown, in part, because the studies we reviewed do not generally take into account potential long-term, cumulative effects. In addition, the severity of adverse effects depend on various location- and process-specific factors, including the location of future shale oil and gas development and the rate at which it occurs, geology, climate, business practices, and regulatory and enforcement activities.

[36]According to a 2012 report from the Bipartisan Policy Center, natural gas prices declined roughly 37 percent from February 2008 to January 2010.

[37]Department of Energy, Energy Information Administration, *Annual Energy Outlook 2012, With Projections to 2035*, DOE/EIA-0383 (Washington, D.C.: June 25, 2012).

Shale Oil and Gas Development Pose Risks to Air, Water, Land and Wildlife

Oil and gas development, which includes development from shale formations, poses inherent risks to air quality, water quantity, water quality, and land and wildlife.

Air Quality

According to a number of studies and publications we reviewed, shale oil and gas development pose risks to air quality. These risks are generally the result of engine exhaust from increased truck traffic, emissions from diesel-powered pumps used to power equipment, intentional flaring or venting of gas for operational reasons, and unintentional emissions of pollutants from faulty equipment or impoundments.

Construction of the well pad, access road, and other drilling facilities requires substantial truck traffic, which degrades air quality. According to a 2008 National Park Service report, an average well, with multistage fracturing, can require 320 to 1,365 truck loads to transport the water, chemicals, sand, and other equipment—including heavy machinery like bulldozers and graders—needed for drilling and fracturing. The increased traffic creates a risk to air quality as engine exhaust that contains air pollutants such as nitrogen oxides and particulate matter that affect public health and the environment are released into the atmosphere.[38] Air quality may also be degraded as fleets of trucks traveling on newly graded or unpaved roads increase the amount of dust released into the air—which can contribute to the formation of regional haze.[39] In addition to the dust, silica sand (see fig. 11)—commonly used as proppant in the hydraulic fracturing process—may pose a risk to human health, if not properly handled. According to a federal researcher from the Department of Health and Human Services, uncontained sand particles and dust pose threats to workers at hydraulic fracturing well sites. The official stated that particles from the sand, if not properly contained by dust control mechanisms, can lodge in the lungs and potentially cause silicosis.[40]

[38]Nitrogen oxides are regulated pollutants commonly known as NOx that, among other things, contribute to the formation of ozone and have been linked to respiratory illness, decreased lung function, and premature death. Particulate matter is a ubiquitous form of air pollution commonly referred to as soot. GAO, *Diesel Pollution: Fragmented Federal Programs That Reduce Mobile Source Emissions Could Be Improved*, GAO-12-261 (Washington, D.C.: Feb. 7, 2012).

[39]T. Colborn, C. Kwiatkowski, K. Schultz, and M. Bachran, "Natural Gas Operations From a Public Health Perspective," *International Journal of Human & Ecological Risk Assessment* 17, no. 5 (2011).

[40]Silicosis is an incurable lung disease caused by inhaling fine dusts of silica sand.

The researcher expects to publish the results of research on public health risks from proppant later in 2012.

Figure 11: Silica Sand Proppant

Source: GAO.

Use of diesel engines to supply power to drilling sites also degrades air quality. Shale oil and gas drilling rigs require substantial power to drill and case wellbores to the depths of shale formations. This power is typically provided by transportable diesel engines, which generate exhaust from the burning of diesel fuel. After the wellbore is drilled to the target formation, additional power is needed to operate the pumps that move large quantities of water, sand, or chemicals into the target formation at high pressure to hydraulically fracture the shale—generating additional exhaust. In addition, other equipment used during operations—including pneumatic valves and dehydrators—contribute to air emissions. For example, natural gas powers switches that turn valves on and off in the production system. Each time a valve turns on or off, it "bleeds" a small amount of gas into the air. Some of these pneumatic valves vent gas

continuously. A dehydrator circulates the chemical glycol to absorb moisture in the gas but also absorbs small volumes of gas. The absorbed gas vents to the atmosphere when the water vapor is released from the glycol.[41]

Releases of natural gas during the development process also degrade air quality. As part of the process to develop shale oil and gas resources, operators flare or vent natural gas for a number of operational reasons, including lowering the pressure to ensure safety or when operators purge water or hydrocarbon liquids that collect in wellbores to maintain proper well function. Flaring emits carbon dioxide, and venting releases methane and volatile organic compounds. Venting and flaring are often a necessary part of the development process but contribute to greenhouse gas emissions.[42] According to EPA analysis, natural gas well completions involving hydraulic fracturing vent approximately 230 times more natural gas and volatile organic compounds than natural gas well completions that do not involve hydraulic fracturing.[43] As we reported in July 2004, in addition to the operational reasons for flaring and venting, in areas where the primary purpose of drilling is to produce oil, operators flare or vent associated natural gas because no local market exists for the gas and transporting to a market may not be economically feasible.[44] For example, according to EIA, in 2011, approximately 30 percent of North Dakota's natural gas production from the Bakken Shale was flared by operators due to insufficient natural gas gathering pipelines, processing plants, and transporting pipelines. The percentage of flared gas in North Dakota is considerably higher than the national average; EIA reported that, in 2009,

[41]GAO-11-34.

[42]Methane and other chemical compounds found in the earth's atmosphere create a greenhouse effect. Under normal conditions, when sunlight strikes the earth's surface, some of it is reflected back toward space as infrared radiation or heat. Greenhouse gases such as carbon dioxide and methane impede this reflection by trapping heat in the atmosphere. While these gases occur naturally on earth and are emitted into the atmosphere, the expanded industrialization of the world over the last 150 years has increased the amount of emissions from human activity (known as anthropogenic emissions) beyond the level that the earth's natural processes can handle.

[43]EPA, Regulatory Impact Analysis: Final New Source Performance Standards and Amendments to the National Emissions Standards for Hazardous Air Pollutants for the Oil and Natural Gas industry (Research Triangle Park, NC: April 2012).

[44]GAO, *Natural Gas Flaring and Venting: Opportunities to Improve Data and Reduce Emissions*, GAO-04-809 (Washington, D.C.: July 14, 2004).

less than 1 percent of natural gas produced in the United States was vented or flared.

Storing fracturing fluid and produced water in impoundments may also pose a risk to air quality as evaporation of the fluids have the potential to release contaminants into the atmosphere. According to the New York Department of Environmental Conservation's 2011 Supplemental Generic Environmental Impact Statement, analysis of air emission rates of some of the compounds used in the fracturing fluids in the Marcellus Shale reveals the potential for emissions of hazardous air pollutants, in particular methanol, from the fluids stored in impoundments.

As with conventional oil and gas development, emissions can also occur as faulty equipment or accidents, such as leaks or blowouts, release concentrations of methane and other gases into the atmosphere. For example, corrosion in pipelines or improperly tightened valves or seals can be sources of emissions. In addition, according to EPA officials, storage vessels for crude oil, condensate, or produced water are significant sources of methane, volatile organic compounds and hazardous air pollutant emissions.

A number of studies we reviewed evaluated air quality at shale gas development sites. However, these studies are generally anecdotal, short-term, and focused on a particular site or geographic location. For example, in 2010, the Pennsylvania Department of Environmental Protection conducted short-term sampling of ambient air concentrations in north central Pennsylvania. The sampling detected concentrations of natural gas constituents including methane, ethane, propane, and butane in the air near Marcellus Shale drilling operations, but according to this state agency, the concentration levels were not considered significant enough to cause adverse health effects.[45]

The studies and publications we reviewed provide information on air quality conditions at a specific site at a specific time but do not provide the information needed to determine the overall cumulative effect that

[45]Methane emissions represent a waste of resources and a fractional contribution to greenhouse gas levels.

shale oil and gas activities have on air quality.[46] The cumulative effect shale oil and gas activities have on air quality will be largely determined by the amount of development and the rate at which it occurs, and the ability to measure this will depend on the availability of accurate information on emission levels. However, the number of wells that will ultimately be drilled cannot be known in advance—in part because the productivity of any particular formation at any given location and depth is not known until drilling occurs. In addition, as we reported in 2010, data on the severity or amount of pollutants released by oil and gas development, including the amount of fugitive emissions, are limited.

Water Quantity

According to a number of studies and publications we reviewed, shale oil and gas development poses a risk to surface water and groundwater because withdrawing water from streams, lakes, and aquifers for drilling and hydraulic fracturing could adversely affect water sources.[47] Operators use water for drilling, where a mixture of clay and water (drilling mud) is used to carry rock cuttings to the surface, as well as to cool and lubricate the drill bit. Water is also the primary component of fracturing fluid. Table 3 shows the average amount of freshwater used to drill and fracture a shale oil or gas well.

Table 3: Average Freshwater Use per Well for Drilling and Hydraulic Fracturing

	Average freshwater used (in gallons)	
Shale play	**For drilling**	**For hydraulic fracturing**
Barnett	250,000	4,600,000
Eagle Ford	125,000	5,000,000
Haynesville	600,000	5,000,000
Marcellus	85,000	5,600,000
Niobrara	300,000	3,000,000

Source: GAO analysis of data reported by George King, Apache Corporation (2011).

Note: The amount of water required to hydraulically fracture a single well varies considerably as fracturing of shale oil and gas becomes dominated by more complex, multistaged fracturing activities.

[46]According to a 2008 National Park Service report, on a site-by-site basis, emissions may not be significant but on a regional basis may prove significant as states and parks manage regional ozone transport.

[47]An aquifer is an underground layer of rock or unconsolidated sand, gravel, or silt that will yield groundwater to a well or spring.

According to a 2012 University of Texas study,[48] water for these activities is likely to come from surface water (rivers, lakes, ponds), groundwater aquifers, municipal supplies, reused wastewater from industry or water treatment plants, and recycling water from earlier fracturing operations.[49] As we reported in October 2010, withdrawing water from nearby streams and rivers could decrease flows downstream, making the streams and rivers more susceptible to temperature changes—increases in the summer and decreases in the winter. Elevated temperatures could adversely affect aquatic life because many fish and invertebrates need specific temperatures for reproduction and proper development. Further, decreased flows could damage or destroy riparian vegetation. Similarly, withdrawing water from shallow aquifers—an alternative water source—could temporarily affect groundwater resources. Withdrawals could lower water levels within these shallow aquifers and the nearby streams and springs to which they are connected. Extensive withdrawals could reduce groundwater discharge to connected streams and springs, which in turn could damage or remove riparian vegetation and aquatic life. Withdrawing water from deeper aquifers could have longer-term effects on groundwater and connected streams and springs because replenishing deeper aquifers with precipitation generally takes longer.[50] Further, groundwater withdrawal could affect the amount of water available for other uses, including public and private water supplies.

Freshwater is a limited resource in some arid and semiarid regions of the country where an expanding population is placing additional demands on water. The potential demand for water is further complicated by years of drought in some parts of the country and projections of a warming climate. According to a 2011 Massachusetts Institute of Technology study,[51] the amount of water used for shale gas development is small in

[48]Charles G. Groat, Ph.D. and Thomas W. Grimshaw, Ph.D., *Fact-Based Regulation for Environmental Protection in Shale Gas Development* (Austin, Texas: The Energy Institute, The University of Texas at Austin, February, 2012).

[49]Operators are pursuing a variety of techniques and technologies to reduce freshwater demand, such as recycling their own produced water and hydraulic fracturing fluids. We recently reported that some shale gas operators have begun reusing produced water for hydraulic fracturing of additional wells (see GAO-12-156).

[50]GAO-11-35.

[51]Massachusetts Institute of Technology, *The Future of Natural Gas: An Interdisciplinary MIT Study* (2011) (web.mit.edu/mitei/research/studies/report-natural-gas.pdf).

comparison to other water uses, such as agriculture and other industrial purposes. However, the cumulative effects of using surface water or groundwater at multiple oil and gas development sites can be significant at the local level, particularly in areas experiencing drought conditions.

Similar to shale oil and gas development, development of gas from coalbed methane formations poses a risk of aquifer depletion. To develop natural gas from such formations, water from the coal bed is withdrawn to lower the reservoir pressure and allow the methane to desorb from the coal. According to a 2001 USGS report, dewatering coalbed methane formations in the Powder River Basin in Wyoming can lower the groundwater table and reduce water available for other uses, such as livestock and irrigation.[52]

The key issue for water quantity is whether the total amount of water consumed for the development of shale oil and gas will result in a significant long-term loss of water resources within a region, according to a 2012 University of Texas study. This is because water used in shale oil and gas development is largely a consumptive use and can be permanently removed from the hydrologic cycle, according to EPA and Interior officials. However, it is difficult to determine the long-term effect on water resources because the scale and location of future shale oil and gas development operations remains largely uncertain. Similarly, the total volume that operators will withdraw from surface water and aquifers for drilling and hydraulic fracturing is not known until operators submit applications to the appropriate regulatory agency. As a result, the cumulative amount of water consumed over the lifetime of the activity—key information needed to assess the effects of water withdrawals—remains largely unknown.

Water Quality

According to a number of studies and publications we reviewed, shale oil and gas development pose risks to water quality from contamination of surface water and groundwater as a result of spills and releases of produced water, chemicals, and drill cuttings; erosion from ground disturbances; or underground migration of gases and chemicals.

[52]USGS, *A Field Conference On Impacts of Coalbed Methane Development in the Powder River Basin, Wyoming,* Open-File Report 01-126 (Denver, CO: 2001).

Spills and Releases

Shale oil and gas development poses a risk to water quality from spills or releases of toxic chemicals and waste that can occur as a result of tank ruptures, blowouts, equipment or impoundment failures, overfills, vandalism, accidents (including vehicle collisions), ground fires, or operational errors. For example, tanks storing toxic chemicals or hoses and pipes used to convey wastes to the tanks could leak, or impoundments containing wastes could overflow as a result of extensive rainfall. According to New York Department of Environmental Conservation's 2011 Supplemental Generic Environmental Impact Statement, spilled, leaked, or released chemicals or wastes could flow to a surface water body or infiltrate the ground, reaching and contaminating subsurface soils and aquifers. In August 2003, we reported that damage from oil and gas related spills on National Wildlife Refuges varied widely in severity, ranging from infrequent small spills with no known effect on wildlife to large spills causing wildlife death and long-term water and soil contamination.[53]

Drill cuttings, if improperly managed, also pose a risk to water quality. Drill cuttings brought to the surface during oil and gas development may contain naturally occurring radioactive materials (NORM),[54] along with other decay elements (radium-226 and radium-228), according to an industry report presented at the Society of Petroleum Engineers Annual Technical Conference and Exhibition.[55] According to the report, drill cuttings are stored and transported through steel pipes and tanks—which the radiation cannot penetrate. However, improper transport and handling of drill cuttings could result in water contamination. For example, NORM

[53]GAO, *National Wildlife Refuges: Opportunities to Improve the Management and Oversight of Oil and Gas Activities on Federal Lands*, GAO-03-517 (Washington, D.C.: Aug. 28, 2003).

[54]Naturally occurring radioactive materials (NORM) are present at varying degrees in virtually all environmental media, including rocks and soils. According to a DOE report, human exposure to radiation comes from a variety of sources, including naturally occurring radiation from space, medical sources, consumer products, and industrial sources. Normal disturbances of NORM-bearing rock formations by activities such as drilling do not generally pose a threat to workers, the general public or the environment, according to studies and publications we reviewed.

[55]J. Daniel Arthur, Brian Bohm, David Cornue. "Environmental Considerations of Modern Shale Gas Development" (presented at the Society of Petroleum Engineers Annual Technical Conference and Exhibition, New Orleans, Louisiana, October 2009).

concentrations can build up in pipes and tanks, if not properly disposed, and the general public or water could come into contact with them, according to an EPA fact sheet.[56]

The chemical additives in fracturing fluid, if not properly handled, also poses a risk to water quality if they come into contact with surface water or groundwater. Some additives used in fracturing fluid are known to be toxic, but data are limited for other additives. For example, according to reports we reviewed, operators may include diesel fuel—a refinery product that consists of several components, possibly including some toxic impurities such as benzene and other aromatics—as a solvent and dispersant in fracturing fluid. While some additives are known to be toxic, less is known about potential adverse effects on human health in the event that a drinking water aquifer was contaminated as a result of a spill or release of fracturing fluid, according to the 2011 New York Department of Environmental Conservation's Supplemental Generic Environmental Impact Statement. This is largely because the overall risk of human health effects occurring from hydraulic fracturing fluid would depend on whether human exposure occurs, the specific chemical additives being used, and site-specific information about exposure pathways and environmental contaminant levels.

The produced water and fracturing fluids returned during the flowback process contain a wide range of contaminants and pose a risk to water quality, if not properly managed.[57] Most of the contaminants occur naturally, but some are added through the process of drilling and hydraulic fracturing. In January 2012, we reported that the range of contaminants found in produced water can include,[58] but is not limited to

- salts, which include chlorides, bromides, and sulfides of calcium, magnesium, and sodium;

[56]EPA, *Radioactive Waste from Oil and Gas Drilling*, EPA 402-F-06-038 (Washington, D.C.: April 2006).

[57]A 2009 report from DOE and the Groundwater Protection Council—a nonprofit organization whose members consist of state ground water regulatory agencies—estimates that from 30 percent to 70 percent of the original fluid injected returns to the surface.

[58]GAO-12-156.

- metals, which include barium, manganese, iron, and strontium, among others;
- oil, grease, and dissolved organics, which include benzene and toluene, among others;
- NORM; and
- production chemicals, which may include friction reducers to help with water flow, biocides to prevent growth of microorganisms, and additives to prevent corrosion, among others.

At high levels, exposure to some of the contaminants in produced water could adversely affect human health and the environment. For example, in January 2012, we reported that, according to EPA, a potential human health risk from exposure to high levels of barium is increased blood pressure.[59] From an environmental standpoint, research indicates that elevated levels of salts can inhibit crop growth by hindering a plant's ability to absorb water from the soil. Additionally, exposure to elevated levels of metals and production chemicals, such as biocides, can contribute to increased mortality among livestock and wildlife.

Operators must transport or store produced water prior to disposal. According to a 2012 University of Texas report, produced water temporarily stored in tanks (see fig. 12) or impoundments prior to treatment or disposal may be a source of leaks or spills, if not properly managed. The risk of a leak or spill is particularly a concern for surface impoundments as improper liners can tear, and impoundments can overflow.[60] For example, according to state regulators in North Dakota, in 2010 and 2011, impoundments overflowed during the spring melt season because operators did not move fluids from the impoundments—which

[59]GAO-12-156.

[60]The composition of pit lining depends on regulatory requirements, which vary from state to state.

were to be used for temporary storage—to a proper disposal site before the spring thaw.[61]

Figure 12: Storage Tank for Produced Water in the Barnett Shale

Source: GAO.

Unlike shale oil and gas formations, water permeates coalbed methane formations, and its pressure traps natural gas within the coal. To produce natural gas from coalbed methane formations, water must be extracted to lower the pressure in the formation so the natural gas can flow out of the coal and to the wellbore. In 2000, USGS reported that water extracted from coalbed methane formations is commonly saline and, if not treated

[61]In response, the state passed a new law that will significantly reduce the number of pits. Under the new law, operators can use pits for temporary storage of fluid from the flowback process but must drain and reclaim the pits no more than 72 hours after hydraulic fracturing is complete.

and disposed of properly, could adversely affect streams and threaten fish and aquatic resources.

According to several reports, handling and transporting toxic fluids or contaminants poses a risk of environmental contamination for all industries, not just oil and gas development; however, the large volume of fluids and contaminants—fracturing fluid, drill cuttings, and produced water—that is associated with the development of shale oil and gas poses an increased risk for a release to the environment and the potential for greater effects should a release occur in areas that might not otherwise be exposed to these chemicals.

Erosion

Oil and gas development, whether conventional or shale oil and gas, can contribute to erosion, which could carry sediments and pollutants into surface waters. Shale oil and gas development require operators to undertake a number of earth-disturbing activities, such as clearing, grading, and excavating land to create a pad to support the drilling equipment. If necessary, operators may also construct access roads to transport equipment and other materials to the site. As we reported in February 2005, as with other construction activities, if sufficient erosion controls to contain or divert sediment away from surface water are not established then surfaces are exposed to precipitation and runoff could carry sediment and other harmful pollutants into nearby rivers, lakes, and streams.[62] For example, in 2012, the Pennsylvania Department of Environmental Protection concluded that an operator in the Marcellus Shale did not provide sufficient erosion controls when heavy rainfall in the area caused significant erosion and contamination of a nearby stream from large amounts of sediment.[63] As we reported in February 2005, sediment clouds water, decreases photosynthetic activity, and destroys organisms and their habitat.

[62]GAO, *Storm Water Pollution: Information Needed on the Implications of Permitting Oil and Gas Construction Activities*, GAO-05-240 (Washington, D.C.: Feb. 9, 2005).

[63]In response, the state required the operator to install silt fences, silt socks, gravel surfacing of the access road, and a storm water capture ditch.

Underground Migration

According to a number of studies and publications we reviewed, underground migration of gases and chemicals poses a risk of contamination to water quality.[64] Underground migration can occur as a result of improper casing and cementing of the wellbore as well as the intersection of induced fractures with natural fractures, faults, or improperly plugged dry or abandoned wells. Moreover, there are concerns that induced fractures can grow over time and intersect with drinking water aquifers. Specifically:

Improper casing and cementing. A well that is not properly isolated through proper casing and cementing could allow gas or other fluids to contaminate aquifers as a result of inadequate depth of casing,[65] inadequate cement in the annular space around the surface casing, and ineffective cement that cracks or breaks down under the stress of high pressures. For example, according to a 2008 report by the Ohio Department of Natural Resources, a gas well in Bainbridge, Ohio, was not properly isolated because of faulty sealing, allowing natural gas to build up in the space around the production casing and migrate upward over about 30 days into the local aquifer and infiltrating drinking water wells.[66] The risk of contamination from improper casing and cementing is not unique to the development of shale formations. Casing and cementing practices also apply to conventional oil and gas development. However, wells that are hydraulically fractured have some unique aspects. For example, hydraulically fractured wells are commonly exposed to higher pressures than wells that are not hydraulically fractured. In addition, hydraulically fractured wells are exposed to high pressures over a longer period of time as fracturing is conducted in multiple stages, and wells may be refractured multiple times—primarily to extend the economic life of the well when production declines significantly or falls below the estimated reservoir potential.

[64]Methane can occur naturally in shallow bedrock and unconsolidated sediments and has been known to naturally seep to the surface and contaminate water supplies, including water wells. Methane is a colorless, odorless gas and is generally considered nontoxic, but there could be an explosive hazard if gas is present in significant volumes and the water well is not properly vented.

[65]The depth for casing and cementing may be determined by state regulations.

[66]Ohio Department of Natural Resources, *Report on the Investigation of the Natural Gas Invasion of Aquifers in Bainbridge Township of Geauga County, Ohio* (September 2008).

Natural fractures, faults, and abandoned wells. If shale oil and gas development activities result in connections being established with natural fractures, faults, or improperly plugged dry or abandoned wells, a pathway for gas or contaminants to migrate underground could be created—posing a risk to water quality. These connections could be established through either induced fractures intersecting directly with natural fractures, faults, or improperly plugged dry or abandoned wells or as a result of improper casing and cementing that allow gas or other contaminants to make such connections. In 2011, the New York State Department of Environmental Conservation reported that operators generally avoid development around known faults because natural faults could allow gas to escape, which reduces the optimal recovery of gas and the economic viability of a well. However, data on subsurface conditions in some areas are limited. Several studies we reviewed report that some states are unaware of the location or condition of many old wells. As a result, operators may not be fully aware of the location of abandoned wells and natural fractures or faults.

Fracture growth. A number of such studies and publications we reviewed report that the risk of induced fractures extending out of the target formation into an aquifer—allowing gas or other fluids to contaminate water—may depend, in part, on the depth separating the fractured formation and the aquifer. For example, according to a 2012 Bipartisan Policy Center report, [67] the fracturing process itself is unlikely to directly affect freshwater aquifers because fracturing typically takes place at a depth of 6,000 to 10,000 feet, while drinking water tables are typically less than 1,000 feet deep.[68] Fractures created during the hydraulic fracturing process are generally unable to span the distance between the targeted shale formation and freshwater bearing zones. According to a 2011 industry report, fracture growth is stopped by natural subsurface barriers

[67]Bipartisan Policy Center, *Shale Gas: New Opportunities, New Challenges* (Washington, D.C.: January 2012).

[68]Some coalbed methane formations are much closer to drinking water aquifers than are shale formations. In 2004, EPA reviewed incidents of drinking water well contamination believed to be associated with hydraulic fracturing in coalbed methane formations. EPA found no confirmed cases linked to the injection of fracturing fluid or subsequent underground movement of fracturing fluids. The report states that, although thousands of coalbed methane formations are fractured annually, EPA did not find confirmed evidence that drinking water wells had been contaminated by the hydraulic fracturing process.

and the loss of hydraulic fracturing fluid.[69] When a fracture grows, it conforms to a general direction set by the stresses in the rock, following what is called fracture direction or orientation. The fractures are most commonly vertical and may extend laterally several hundred feet away from the well, usually growing upward until they intersect with a rock of different structure, texture, or strength. These are referred to as seals or barriers and stop the fracture's upward or downward growth. In addition, as the fracturing fluid contacts the formation or invades natural fractures, part of the fluid is lost to the formation. The loss of fluids will eventually stop fracture growth according to this industry report.

From 2001 through 2010, an industry consulting firm monitored the upper and lower limits of hydraulically induced fractures relative to the position of drinking water aquifers in the Barnett and Eagle Ford Shale, the Marcellus Shale, and the Woodford Shale.[70] In 2011, the firm reported that the results of the monitoring show that even the highest fracture point is several thousand feet below the depth of the deepest drinking water aquifer. For example, for over 200 fractures in the Woodford Shale, the typical distance between the drinking water aquifer and the top of the fracture was 7,500 feet, with the highest fracture recorded at 4,000 feet from the aquifer. In another example, for the 3,000 fractures performed in the Barnett Shale, the typical distance from the drinking water aquifer and the top of the fracture was 4,800 feet, and the fracture with the closest distance to the aquifer was still separated by 2,800 feet of rock. Table 4 shows the relationship between shale formations and the depth of treatable water in five shale gas plays currently being developed.

[69]George E. King, Apache Corporation, "Explaining and Estimating Fracture Risk: Improving Fracture Performance in Unconventional Gas and Oil Wells" (presented at the Society of Petroleum Engineers Hydraulic Fracturing Conference, The Woodlands, Texas, February 2012).

[70]Kevin Fisher, Norm Warpinski, Pinnacle—A Haliburton Service, "Hydraulic Fracture-Height Growth: Real Data" (presented at the Society of Petroleum Engineers Technical Conference and Exhibition, Denver, Colorado, October 2011).

Table 4: Shale Formation and Treatable Water Depth

Distance in feet			
Shale play	**Depth to shale**	**Depth to base of treatable water**	**Distance between shale and base of treatable water**
Barnett	6,500- 8,500	1,200	5,300- 7,300
Fayetteville	1,000- 7,000	500	500- 6,500
Haynesville	10,500- 13,500	400	10,100- 13,100
Marcellus	4,000- 8,500	850	2,125- 7,650
Woodford	6,000- 11,000	400	5,600- 10,600

Source: GAO analysis of data presented in a report prepared at the request of the DOE.

Note: Depths to base of treatable water are approximate. According to the report, the depth to base of treatable water was based on data from state oil and gas agencies and state geological survey data.

Several government, academic, and nonprofit organizations evaluated water quality conditions or groundwater contamination incidents in areas experiencing shale oil and gas development. Among the studies and publications we reviewed that discuss the potential contamination of drinking water from the hydraulic fracturing process in shale formations are the following:

- In 2011, the Center for Rural Pennsylvania analyzed water samples taken from 48 private water wells located within about 2,500 feet of a shale gas well in the Marcellus Shale.[71] The analysis compared predrilling samples to postdrilling samples to identify any changes to water quality. The analysis showed that there were no statistically significant increases in pollutants prominent in drilling waste fluids—such as total dissolved solids, chloride, sodium, sulfate, barium, and strontium—and no statistically significant increases in methane. The study concluded that gas well drilling had not had a significant effect on the water quality of nearby drinking water wells.

- In 2011, researchers from Duke University studied shale gas drilling and hydraulic fracturing and the potential effects on shallow groundwater systems near the Marcellus Shale in Pennsylvania and the Utica Shale in New York. Sixty drinking water samples were collected in Pennsylvania and New York from bedrock aquifers that

[71]The Center for Rural Pennsylvania, *The Impact of Marcellus Gas Drilling on Rural Drinking Water Supplies* (Harrisburg, Pennsylvania: October 2011).

overlie the Marcellus or Utica Shale formations—some from areas with shale gas development and some from areas with no shale gas development.[72] The study found that methane concentrations were detected generally in 51 drinking water wells across the region—regardless of whether shale gas drilling occurred in the area—but that concentrations of methane were substantially higher closer to shale gas wells. However, the researchers reported that a source of the contamination could not be determined. Further, the researchers reported that they found no evidence of fracturing fluid in any of the samples.

- In 2011, the Ground Water Protection Council evaluated state agency groundwater investigation findings in Texas and categorized the determinations regarding causes of groundwater contamination resulting from the oil and gas industry.[73] During the study period—from 1993 through 2008—multistaged hydraulic fracturing stimulations were performed in over 16,000 horizontal shale gas wells. The evaluation of the state investigations found that there were no incidents of groundwater contamination caused by hydraulic fracturing.

In addition, regulatory officials we met with from eight states—Arkansas, Colorado, Louisiana, North Dakota, Ohio, Oklahoma, Pennsylvania, and Texas—told us that, based on state investigations, the hydraulic fracturing process has not been identified as a cause of groundwater contamination within their states.

A number of studies discuss the potential contamination of water from the hydraulic fracturing process in shale formations. However, according to several studies we reviewed, there are insufficient data for predevelopment (or baseline) conditions for groundwater. Without data to compare predrilling conditions to postdrilling conditions, it is difficult to determine if adverse effects were the result of oil and gas development, natural occurrences, or other activities. In addition, while researchers

[72]Stephen G. Osborn, Avner Vengosh, Nathaniel R. Warner, and Robert B. Jackson, "Methane Contamination of Drinking Water Accompanying Gas-well Drilling and Hydraulic Fracturing," *Proceedings of the National Academy of Science* 108, no. 20 (2011).

[73]Ground Water Protection Council, *State Oil and Gas Agency Groundwater Investigations And Their Role in Advancing Regulatory Reforms: A Two-State Review: Ohio and Texas* (Oklahoma City, Oklahoma: August 2011).

have evaluated fracture growth, the widespread development of shale oil and gas is relatively new. As such, little data exist on (1) fracture growth in shale formations following multistage hydraulic fracturing over an extended time period, (2) the frequency with which refracturing of horizontal wells may occur, (3) the effect of refracturing on fracture growth over time,[74] and (4) the likelihood of adverse effects on drinking water aquifers from a large number of hydraulically fractured wells in close proximity to each other.

Ongoing Studies Related to Water Quality

Ongoing studies by federal agencies, industry groups, and academic institutions are evaluating the effects of hydraulic fracturing on water resources so that, over time, better data and information about these effects should become available to policymakers and the public. For example, EPA's Office of Research and Development initiated a study in January 2010 to examine the potential effects of hydraulic fracturing on drinking water resources. According to agency officials, the agency anticipates issuing a progress report in 2012 and a final report in 2014. EPA is also conducting an investigation to determine the presence of groundwater contamination within a tight sandstone formation being developed for natural gas near Pavillion, Wyoming, and, to the extent possible, identify the source of the contamination. In December 2011, EPA released a draft report outlining findings from the investigation. The report is not finalized, but the agency indicated that it had identified certain constituents in groundwater above the production zone of the Pavillion natural gas wells that are consistent with some of the constituents used in natural gas well operations, including the process of hydraulic fracturing. DOE researchers are also testing the vertical growth of fractures during hydraulic fracturing to determine whether fluids can travel thousands of feet through geologic faults into water aquifers close to the surface.

Land and Wildlife

Oil and gas development, whether conventional or shale oil and gas, poses a risk to land resources and wildlife habitat as a result of constructing, operating, and maintaining the infrastructure necessary to develop oil and gas; using toxic chemicals; and injecting waste products underground.

[74]According to research presented in the New York Department of Environmental Conservation's Supplemental Generic Environmental Impact Statement, refracturing can restore the original fracture height and length, and can often extend the fracture length beyond the original fracture dimensions.

Habitat Degradation

According to studies and publications we reviewed, development of oil and gas, whether conventional or shale oil and gas, poses a risk to habitat from construction activities. Specifically, clearing land of vegetation and leveling the site to allow access to the resource, as well as construction of roads, pipelines, storage tanks, and other infrastructure needed to extract and transport the resource can fragment habitats.[75] In August 2003, we reported that oil and gas infrastructure on federal wildlife refuges can reduce the quality of habitat by fragmenting it.[76] Fragmentation increases disturbances from human activities, provides pathways for predators, and helps spread nonnative plant species.

In addition, spills of oil, gas, or other toxic chemicals have harmed wildlife and habitat. Oil and gas can injure or kill wildlife by destroying the insulating capacity of feathers and fur, depleting oxygen available in water, or exposing wildlife to toxic substances. Long-term effects of oil and gas contamination on wildlife are difficult to determine, but studies suggest that effects of exposure include reduced fertility, kidney and liver damage, immune suppression, and cancer. In August 2003, we reported that even small spills may contaminate soil and sediments if they occur frequently.[77] Further, noise and the presence of new infrastructure associated with shale gas development may also affect wildlife. A study by the Houston Advanced Research Center and the Nature Conservancy investigated the effects of noise associated with gas development on the Attwater's Prairie Chicken—an endangered species. The study explored how surface disruptions, particularly construction of a rig and noise from diesel generators would affect the animal's movement and habitat.[78] The results of the study found that the chickens were not adversely affected by the diesel engine generator's noise but that the presence of the rig caused the animals to temporarily disperse and avoid the area.

[75]Habitat fragmentation occurs when a network of roads and other infrastructure is constructed in previously undeveloped areas.

[76]GAO-03-517.

[77]GAO-03-517.

[78]James F. Bergan, Richard Haut, Jared Judy, and Liz Price. "Living In Harmony—Gas Production and the Attwater's Prairie Chicken" (presented at the Society of Professional Engineers Annual Technical Conference, Florence, Italy, September 2010).

A number of studies we reviewed identified risks to habitat and wildlife as a result of shale oil and gas activities. However, because shale oil and gas development is relatively new in some areas, the long-term effects—after operators are to have restored portions of the land to predevelopment conditions—have not been evaluated. Without these data, the cumulative effects of shale oil and gas development on habitat and wildlife are largely unknown.

Induced Seismicity

According to several studies and publications we reviewed, the hydraulic fracturing process releases energy deep beneath the surface to break rock but the energy released is not large enough to trigger a seismic event that could be felt on the surface. However, a process commonly used by operators to dispose of waste fluids—underground injection—has been associated with earthquakes in some locations. For example, a 2011 Oklahoma Geological Survey study reported that underground injection can induce seismicity. In March 2012, the Ohio Department of Natural Resources reported that "there is a compelling argument" that the injection of produced water into underground injection wells was the cause of the 2011 earthquakes near Youngstown, Ohio. In addition, the National Academy of Sciences released a study in June 2012 that concluded that underground injection of wastes poses some risk for induced seismicity, but that very few events have been documented over the past several decades relative to the large number of disposal wells in operation.

The available research does not identify a direct link between hydraulic fracturing and increased seismicity, but there could be an indirect effect to the extent that increased use of hydraulic fracturing produces increased amounts of water that is disposed of through underground injection. In addition, according to the National Academy of Science's 2012 report, accurately predicting magnitude or occurrence of seismic events is generally not possible, in part, because of a lack of comprehensive data on the complex natural rock systems at energy development sites.

Extent of Risks Is Unknown and Depends on Many Factors

The extent and severity of environmental and public health risks identified in the studies and publications we reviewed may vary significantly across shale basins and also within basins because of location- and process-specific factors, including the location and rate of development; geological characteristics, such as permeability, thickness, and porosity of the

formations in the basin; climatic conditions; business practices; and regulatory and enforcement activities.

Location and rate of development. The location of oil and gas operations and the rate of development can affect the extent and severity of environmental and public health risks. For example, as we reported in October 2010, while much of the natural gas that is vented and flared is considered to be unavoidably lost, certain technologies and practices can be applied throughout the production process to capture some of this gas, according to the oil and gas industry and EPA. The technologies' technical and economic feasibility varies and sometimes depends on the location of operations. For example, some technologies require a substantial amount of electricity, which may be less feasible for remote production sites that are not on the electrical grid. In addition, the extent and severity of environmental risks may vary based on the location of oil and gas wells. For example, in areas with high population density that are already experiencing challenges adhering to federal air quality limits, increases in ozone levels because of emissions from oil and gas development may compound the problem.

Geological characteristics. Geological characteristics can affect the extent and severity of environmental and public health risks associated with shale oil and gas development. For example, geological differences between tight sandstone and shale formations are important because, unlike shale, tight sandstone has enough permeability to transmit groundwater to water wells in the region. In a sense, the tight sandstone formation acts as a reservoir for both natural gas and for groundwater. In contrast, shale formations are typically not permeable enough to transmit water and are not reservoirs for groundwater. According to EPA officials, hydraulic fracturing in a tight sandstone formation that is a reservoir for both natural gas and groundwater poses a greater risk of contamination than the same activity in a deep shale formation.

Climatic conditions. Climatic factors, such as annual rainfall and surface temperatures, can also affect the environmental risks for a specific region or area. For example, according to a 2007 study funded by DOE, average rainfall amounts can be directly related to soil erosion.[79] Specifically,

[79]ALL Consulting and the Interstate Oil and Gas Compact Commission, *Improving Access to Onshore Oil and Gas Resources on Federal Lands* (a special report prepared at the request of the U.S. Department of Energy National Energy and Technology Laboratory, March 2007).

areas with higher precipitation levels may be more susceptible to soil compaction and rutting during the well pad construction phase. In another example, risk of adverse effects from exposures to toxic air contaminants can vary substantially between drilling sites, in part, because of the specific mix of emissions and climatic conditions that affect the transport and dispersion of emissions. Specifically, wind speed and direction, temperature, as well as other climatic conditions, can influence exposure levels of toxic air contaminants. For example, according to a 2012 study from the Sustainable Investments Institute and the Investor Responsibility Research Center Institute, the combination of air emissions from gas operations, snow on the ground, bright sunshine, and temperature inversions during winter months have contributed to ozone creation in Sublette County, Wyoming.[80]

Business practices. A number of studies we reviewed indicate that some adverse effects from shale oil and gas development can be mitigated through the use of technologies and best practices. For example, according to standards and guidelines issued jointly by the Departments of the Interior and Agriculture, mitigation techniques, such as fencing and covers, should be used around impoundments to prevent livestock or wildlife from accessing fluids stored in the impoundments.[81] In another example, EPA's Natural Gas STAR program has identified over 80 technologies and practices that can cost effectively reduce methane emissions, a potent greenhouse gas, during oil and gas development. However, the use of these technologies and business practices are typically voluntary and rely on responsible operators to ensure that necessary actions are taken to prevent environmental contamination. Further, the extent to which operators use these mitigating practices is unknown and could be particularly challenging to identify given the significant increase in recent years in the development of shale oil and gas by a variety of operators, both large and small.

Regulatory and enforcement activities. Potential changes to the federal, state, and local regulatory environment will affect operators' future

[80]Susan Williams, "Discovering Shale Gas: An Investor Guide to Hydraulic Fracturing," Sustainable Investments Institute and Investor Responsibility Research Center Institute (New York, NY: February 2012).

[81]United States Department of the Interior and United States Department of Agriculture. *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development*. BLM/WO/ST-06/021+3071/REV 07 (Denver, CO: 2007).

activities and can therefore affect the risks or level of risks associated with shale oil and gas development. Shale oil and gas development is regulated by multiple levels of government—including federal, state, and local. Many of the laws and regulations applicable to shale oil and gas development were put in place before the increase in operations that has occurred in the last few years, and various levels of government are evaluating and, in some cases, revising laws and regulations to respond to the increase in shale oil and gas development. For example, in April 2012, EPA promulgated New Source Performance Standards for the oil and gas industry that, when fully phased-in by 2015, will require emissions reductions at new or modified oil and gas well sites, including wells using hydraulic fracturing. Specifically, these new standards, in part, focus on reducing the venting of natural gas and volatile organic compounds during the flowback process. In addition, areas without prior experience with oil and gas development are just now developing new regulations. These governments' effectiveness in implementing and enforcing this framework will affect future activities and the level of associated risk.

Agency Comments

We provided a draft of this report to the Department of Energy, the Department of the Interior, and the Environmental Protection Agency for review and comment. We received technical comments from Interior's Assistant Secretary, Policy, Management, and Budget, and from Environmental Protection Agency officials, which we have incorporated as appropriate. In an e-mail received August 27, 2012, the Department of Energy liaison stated the agency had no comments on the report.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the appropriate congressional committees, the Secretary of Energy, the Secretary of the Interior, the EPA Administrator, and other interested parties. In addition, the report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or ruscof@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix IV.

Frank Rusco
Director, Natural Resources and Environment

List of Requesters

The Honorable Barbara Boxer
Chairman
Committee on Environment and Public Works
United States Senate

The Honorable Sheldon Whitehouse
Chairman
Subcommittee on Oversight
Committee on Environment and Public Works
United States Senate

The Honorable Benjamin L. Cardin
Chairman
Subcommittee on Water and Wildlife
Committee on Environment and Public Works
United States Senate

The Honorable Henry A. Waxman
Ranking Member
Committee on Energy and Commerce
House of Representatives

The Honorable Edward J. Markey
Ranking Member
Committee on Natural Resources
House of Representatives

The Honorable Diana DeGette
Ranking Member
Subcommittee on Oversight and Investigations
Committee on Energy and Commerce
House of Representatives

The Honorable Robert P. Casey, Jr.
United States Senate

Appendix I: Scope and Methodology

Our objectives for this review were to determine what is known about (1) the size of shale oil and gas resources in the United States and the amount produced from 2007 through 2011—the years for which data were available—and (2) the environmental and public health risks associated with development of shale oil and gas.

To determine what is known about the size of shale oil and gas resources, we collected data from federal agencies, state agencies, private industry, and academic organizations. Specifically, to determine what is known about the size of these resources, we obtained information for technically recoverable and proved reserves estimates for shale oil and gas from the Energy Information Administration (EIA), the U.S. Geological Survey (USGS), and the Potential Gas Committee—a nongovernmental organization composed of academic and industry officials. We interviewed key officials about the assumptions and methodologies used to estimate the resource size. Estimates of proved reserves of shale oil and gas are based on data provided to EIA by operators. In addition to the estimates provided by these three organizations, we also obtained and presented technically recoverable shale oil and gas estimates from two private organizations—IHS Inc., and ICF International—and one national advisory committee representing the views of the oil and gas industry and other stakeholders—the National Petroleum Council. For all estimates we report, we conducted a review of the methodologies used in these estimates for fatal flaws; we did not find any fatal flaws in these methodologies.

To determine what is known about the amount of produced shale oil and gas from 2007 through 2011, we obtained data from EIA—the federal agency responsible for estimating and reporting this and other energy information. EIA officials provided us with estimated oil and gas production data, including data estimating shale oil and gas estimates from states and two private firms—HPDI, LLC and Lippman Consulting, Inc. To assess the reliability of these data, we examined EIA's published methodology for collecting this information and interviewed key EIA officials regarding the agency's data collection and validation efforts. We also interviewed officials from three state agencies, representatives from five private companies, and researchers from three academic institutions who are familiar with these data and EIA's methodology and discussed the sources and reliability of the data. We determined that these data were sufficiently reliable for the purposes of this report.

To determine what is known about the environmental and public health risks associated with the development of shale oil and gas[1], we identified and reviewed more than 90 studies and other publications from federal agencies and laboratories, state agencies, local governments, the petroleum industry, academic institutions, environmental and public health groups, and other nongovernmental associations. The studies and publications we reviewed included scientific and industry periodicals, government-sponsored research, reports or other publications from nongovernmental organizations, and presentation materials. We identified these studies by conducting a literature search and by asking for recommendations during our interviews with stakeholders. For a number of studies, we interviewed the author or authors to discuss the study's findings and limitations, if any. We believe we have identified the key studies through our literature review and interviews, and that the studies included in our review have accurately identified potential risks for shale oil and gas development. However, given our methodology, it is possible that we may not have identified all of the studies with findings relevant to our objectives, and the risks we present may not be the only issues of concern. The widespread use of horizontal drilling and hydraulic fracturing to develop shale oil and gas is relatively new. Studying the effects of an activity and completing a formal peer-review process can take numerous months or years. Because of the relative short time frame for operations and the lengthy time frame for studying effects, we did not limit the review to peer-reviewed publications.

The risks identified in the studies and publications we reviewed cannot, at present, be quantified, and the magnitude of potential adverse affects or likelihood of occurrence cannot be determined for several reasons. First, it is difficult to predict how many or where shale oil and gas drilling operations may be constructed. Second, operators' use of effective best practices to mitigate risk may vary. Third, based on the studies we reviewed, there are relatively few that are based on evaluating predevelopment conditions to postdevelopment conditions—making it difficult to detect or attribute adverse changes to shale oil and gas development. In addition, changes to the federal, state, and local

[1]Operators may use hydraulic fracturing to develop oil and natural gas from formations other than shale. Specifically, coalbed and tight sand formations may rely on these practices, and some studies and publications we reviewed identified risks that can apply to these formations. However, many of the studies and publications we identified and reviewed focused primarily on the development of shale formations.

regulatory environment and the effectiveness in implementation and enforcement will affect operators' future activities. Moreover, risks of adverse events, such as spills or accidents, may vary according to business practices, which in turn, may vary across oil and gas companies making it difficult to distinguish between risks that are inherent to the development of shale oil and gas from risks that are specific to particular business practices.

To obtain additional perspectives on issues related to environmental and public health risks, we interviewed a nonprobability sample of stakeholders representing numerous agencies and organizations. (See app. II for a list of agencies and organizations contacted.) We selected these agencies and organizations to be broadly representative of differing perspectives regarding environmental and public health risks. In particular, we obtained views and information from federal officials from the Department of Energy's National Energy Technical Laboratory, the Department of the Interior's Bureau of Land Management and Bureau of Indian Affairs, and the Environmental Protection Agency; state regulatory officials from Arkansas, Colorado, Louisiana, North Dakota, Ohio, Oklahoma, Pennsylvania, and Texas; tribal officials from the Osage Nation; shale oil and gas operators; representatives from environmental and public health organizations; and other knowledgeable parties with experience related to shale oil and gas development, such as researchers from the Colorado School of Mines, the University of Texas, Oklahoma University, and Stanford University. The findings from our interviews with stakeholders and officials cannot be generalized to those we did not speak with.

We conducted this performance audit from November 2011 to September 2012 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: List of Agencies and Organizations Contacted

Federal Agencies	Congressional Research Service Department of Energy's National Energy Technology Laboratory Department of Health and Human Services Department of the Interior's Bureau of Indian Affairs Department of the Interior's Bureau of Land Management Department of the Interior's U.S. Geological Survey Environmental Protection Agency
State Agencies	Arkansas Department of Environmental Quality Arkansas Oil and Gas Commission Colorado Oil and Gas Conservation Commission Louisiana Department of Natural Resources North Dakota Industrial Commission Ohio Department of Natural Resources Ohio Environmental Protection Agency Oklahoma Geological Survey Oklahoma Corporation Commission Texas Railroad Commission
Academic Institutions	Colorado School of Mines Oklahoma University Stanford University University of Texas at Arlington University of Texas Energy Center and Bureau of Economic Geology
Environmental Organizations	Clean Water Action Pennsylvania Earthworks Oil and Gas Accountability Project Environmental Defense Fund Subra Consulting Western Resource Advocates
Public Health Organizations	The Endocrine Disruption Exchange National Association of County and City Health Officials Southwest Pennsylvania Environmental Health Project
Industry	ALL Consulting American Exploration and Production Council American Petroleum Institute Apache Corporation

	Chesapeake Energy
	Colorado Oil and Gas Association
	Devon Energy
	Powell Shale Digest
Others	Ground Water Protection Council
	Martin Consulting
	Red River Watershed Management Institute
	Osage Tribal Nation

Appendix III: Additional Information on USGS Estimates

The USGS estimates potential oil and gas resources in about 60 geological areas (called “provinces”) in the United States. Since 1995, USGS has conducted oil and gas estimates at least once in all of these provinces; about half of these estimates have been updated since the year 2000 (see table 5). USGS estimates for an area are updated once every 5 years or more, depending on factors such as the importance of an area.

Table 5: USGS Estimates

Name of USGS province	Most recent assessment year
Northern Alaska	2006
Central Alaska	2004
Southern Alaska	2011
Western Oregon-Wash.	2009
Eastern Oregon-Wash.	2006
Northern Coastal	1995
Sonoma-Livermore	1995
Sacramento Basin	2006
San Joaquin Basin	2004
Central Coastal	1995
Santa Maria Basin	1995
Ventura Basin	1995
Los Angeles Basin	1995
Idaho-Snake River Downwarp	1995
Western Great Basin	1995
Eastern Great Basin	2004
Uinta-Piceance Basin	2002
Paradox Basin	1995
San Juan Basin	2002
Albuquerque-Sante Fe Rift	1995
Northern Arizona	1995
S. Ariz.-S.W. New Mexico	1995
South-Central New Mexico	1995
Montana Thrust Belt	2002
Central Montana	2001
Southwest Montana	1995
Hanna, Laramie, Shirley	2005

Name of USGS province	Most recent assessment year
Williston Basin (includes Bakken Shale Formation)	2008
Powder River Basin	2006
Big Horn Basin	2008
Wind River Basin	2005
Wyoming Thrust Belt	2004
Southwestern Wyoming	2002
Park Basins	1995
Denver Basin	2003
Las Animas Arch	1995
Raton Basin-Sierra Grande Uplift	2005
Palo Duro Basin	1995
Permian Basin (includes Barnett Shale)	2007
Bend Arch-Ft. Worth Basin	2004
Marathon Thrust Belt	1995
Western Gulf Coast (includes Eagle Ford Shale)	2011
East Texas Basin Province	2011
Louisiana-Mississippi Salt Basins Province	2011
Florida Peninsula	2000
Superior	1995
Cambridge Arch-Central Kansas	1995
Nemaha Uplift	1995
Forest City Basin	1995
Anadarko Basin	2011
Sedgwick Basin/Salina Basin	1995
Cherokee Platform	1995
Southern Oklahoma	1995
Arkoma Basin	2010
Michigan Basin	2005
Illinois Basin	2007
Black Warrior Basin	2002
Cincinnati Arch	1995
Appalachian Basin (includes Marcellus Shale)	2011
Blue Ridge Thrust Belt	1995
Piedmont	1995

Source: USGS.

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

Frank Rusco, (202) 512-3841 or ruscof@gao.gov

Staff Acknowledgments

In addition to the contact named above, Christine Kehr, Assistant Director; Lee Carroll; Nirmal Chaudhary; Cindy Gilbert; Alison O'Neill; Marietta Revesz, Dan C. Royer; Jay Spaan; Kiki Theodoropoulos; and Barbara Timmerman made key contributions to this report.

Exhibit 9

LOOK BEFORE THE LNG LEAP:

Why Policymakers and the Public Need Fair Disclosure Before Exports of Fracked Gas Start

BEYOND NATURAL GAS

SIERRA CLUB
FOUNDED 1892

LOOK BEFORE THE LNG LEAP:

Why Policymakers and the Public Need Fair Disclosure Before Exports of Fracked Gas Start

By **Craig Segall,** Staff Attorney, Sierra Club Environmental Law Program. Thanks to legal fellow **Philip Goo** for very helpful research assistance.

EXECUTIVE SUMMARY

Exporting American natural gas to the world market would spur unconventional natural gas production across the country, increasing pollution and disrupting landscapes and communities. Deciding whether to move forward is among the most pressing environmental and energy policy decisions facing the nation. Yet, as the Department of Energy (DOE) considers whether to greenlight gas exports of as much as 45% of current U.S. gas production — more gas than the entire domestic power industry burns in a year — it has refused to disclose, or even acknowledge, the environmental consequences of its decisions. In fact, DOE has not even acknowledged that its own National Energy Modeling System can be used to help develop much of this information, instead preferring to turn a blind eye to the problem. DOE needs to change course. Even much smaller volumes of export have substantial environmental implications and exporting a large percentage of the total volume proposed would greatly affect the communities and ecosystems across America. The public and policymakers deserve, and are legally entitled to, a full accounting of these impacts.

Gas exports are only possible because of the unconventional natural gas boom which hydraulic fracturing ("fracking") has unlocked. DOE's own advisory board has warned of the boom's serious environmental impacts. DOE is charged with determining whether such exports are in the public interest despite the damage that would result. To do that, it needs a full accounting of the environmental impacts of increasing gas production significantly to support exports.

These environmental considerations include significant threats to air and water quality from the industry's wastes, and the industrialization of entire landscapes. Gas production is associated with significant volumes of highly-contaminated wastewater and the risk of groundwater contamination; it has also brought persistent smog problems to entire regions, along with notable increases in toxic and carcinogenic air pollutants. Regulatory measures to address these impacts have been inadequate, meaning that increased production very likely means increased environmental harm. Natural gas exports also have important climate policy implications on several fronts: Even if exported gas substitutes for coal abroad (which it may or may not do), it will not produce emissions reductions sufficient to stabilize the climate, and gas exports will increase our investment in fossil fuels. Moreover, the gas export process is particularly carbon-intensive, and gas exports will likely raise gas prices domestically, increasing the market share of dirty coal power, meaning that perceived climate benefits may be quite limited if they exist at all. The upshot is that increasing gas production comes with significant domestic costs.

The National Environmental Policy Act (NEPA) process is designed to generate just such an analysis. NEPA analyses, properly done, provide full, fair, descriptions of a project's environmental implications, remaining uncertainties, and alternatives that could avoid environmental damage. A full NEPA environmental impact statement looking programmatically at export would help DOE and the public fairly weigh these proposals' costs and benefits, and to work with policymakers at the federal, state, and local levels to address any problems. In fact, the U.S. Environmental Protection Agency has repeatedly called for just such an analysis.Without one, America risks committing itself to a permanent role as a gas supplier to the world without determining whether it can do so safely while protecting important domestic interests.

Equally troublingly, even as DOE has thus far failed to fulfill its obligation to protect the public interest

by weighing environmental impacts, it risks losing its authority altogether. A drafting quirk in the export licensing statute intended to speed gas imports from Canada means that DOE must grant licenses for gas exports to nations with which the United States has signed a free trade agreement which includes national treatment of natural gas. This rubber-stamp applies even if the proposed exports would not otherwise be in the public interest. As the U.S. negotiates a massive trade agreement which may include nations hungry for U.S. exports, the Trans-Pacific Partnership, this mandatory rubber-stamp risks undercutting DOE's ability to protect the public.

The bottom line is that before committing to massive gas exports, federal decisionmakers need to ensure that they, and the public, have the environmental information they need to make a fair decision, and the authority to do so. That means ensuring that a full environmental impact statement discloses exports' impacts and develops alternatives to reduce them. It also means defending DOE's prerogatives against the unintended effects of trade pacts. Congress and the U.S. trade negotiators must ensure that agreements like the Trans-Pacific Partnership are designed to maintain DOE's vital public interest inquiry.

Gas exports would transform the energy landscape and communities across the country. We owe ourselves an open national conversation to test whether they are in the public interest. We need to look before we leap.

I. Introduction

For the first time ever, the United States has the ability to become a major natural gas exporter, but that possibility comes with substantial economic and environmental risks. The huge volumes of natural gas proposed for export as liquefied natural gas (LNG) would raise domestic energy prices and require a significant expansion of unconventional gas production using hydraulic fracturing ("fracking").

This shift in the energy landscape raises serious questions: What will export-induced production mean for people living in the gas fields? What will it mean for utilities weighing coal and gas prices as they chart the future of their generation fleets? What it will mean for environmental regulators seeking to manage risk? What will it mean for our air and water quality? What will it mean for climate policy if we increase the extraction and use of this fossil fuel? In the end, are exports worth higher prices and more pollution from fracked gas?

The policy debate continues, but without crucial information: Incredibly, neither the Department of Energy ("DOE")'s Office of Fossil Energy nor the Federal Energy Regulatory Commission ("FERC"), which share responsibility over LNG export proposals under the Natural Gas Act, have completed a full assessment of the environmental risks associated with export and the expanded gas production needed to support it. The agencies could do so using publicly available information and modeling systems, but have so far refused, implausibly insisting that it is impossible to predict *any* upstream impacts from expanded LNG exports.

For more than forty years, Congress has directed federal agencies to use the National Environmental Policy Act (NEPA)'s environmental impact statement process to address environmental decisions like this one. The NEPA process allows agencies to generate comprehensive data, weigh alternatives, and expose assumptions to public scrutiny, so they can base decisions on a fully developed analysis of the impacts of a proposed activity. Amidst the ongoing raucous public debate on export, the information NEPA can provide is not just legally required, but sorely needed.

DOE and FERC have failed to provide this critical analysis. Only one LNG export proposal, for a terminal at Sabine Pass on the Louisiana-Texas border, has moved most of the way through the federal licensing process. FERC, which focuses largely on terminal siting, refused to consider any of the upstream consequences of Sabine Pass's plan to export 2.2 billion cubic feet of gas every day.[2] It did so even though Sabine Pass's export application trumpets that the project intends to "play an influential role in contributing to the growth of natural gas production in the U.S." and relies substantially on this point to argue that the project is in the public interest.[3] DOE followed suit, adopting FERC's analysis to support its own public interest determination, while maintaining that the induced gas production necessary to support export is not

[2] FERC, *Order Granting Section 3 Authorization [to Sabine Pass]*, 139 FERC ¶ 61,039 (Apr. 16, 2012).
[3] Sabine Pass Export Application at 56, DOE/FE Docket 10-111-LNG (Sept. 7, 2010).

"reasonably foreseeable," and so warrants no consideration.[4] DOE recently announced that it would take time to consider whether to stand by this decision, but it has not yet reversed course.[5]

Thus, even while authorizing a proposal which, on its own, would increase U.S. gas exports by more than 50% annually,[6] and which explicitly relies on increased natural gas production to support itself, the federal decisionmakers charged with protecting the public interest were asleep at the switch. Even though export proponents themselves advertise that their projects will drive unconventional natural gas production, DOE and FERC are willfully blind to this major impact. This position is particularly untenable because the National Energy Modeling System (NEMS) which the Energy Information Administration ("EIA") within DOE administers, is designed to project changes in gas production caused by new demand, and could therefore predict precisely the production-level impacts which DOE and FERC insist cannot be foreseen at all.[7]

Instead, applications to export more than ten times the gas which was authorized in the Sabine Pass matter are moving forward in a piecemeal terminal-by-terminal licensing process which has not provided any meaningful analysis of the national and regional environmental challenges linked to export. This ongoing legal and policy failure warrants immediate correction.

Not only have DOE and FERC failed to provide a proper accounting, they may lose even their authority to do so if a controversial trade agreement now under negotiation is finalized. That deal, the Trans-Pacific Partnership ("TPP"), could further liberalize trade with much of the Pacific Rim, including major natural gas importers like Japan. Thanks to a little-known provision of the Natural Gas Act, it could also remove federal oversight of LNG exports. Twenty years ago, in an effort to speed Canadian gas *imports*, Congress provided that LNG shipments between countries with which the U.S. has a free trade agreement were to be automatically granted. Although Congress never anticipated massive LNG exports, that same provision could nonetheless remove DOE and FERC's discretion to weigh whether huge volumes of export are in the public interest, or to meaningfully regulate the process. Yet neither agency has insisted that TPP negotiators protect this critical federal authority.

For communities across the country, therefore, the future is in real question. If LNG export goes forward, they will experience a surge of unconventional new gas production, along with all

---

[4] DOE, *Final Opinion and Order Granting Long-Term Authorization to Export Liquefied Natural Gas from Sabine Pass LNG Terminal to Non-Free Trade Agreement Nations*, FE Docket No. 10-111-LNG (Aug. 7, 2012).

[5] *See* DOE, *Order Granting Rehearing for Further Consideration*, FE Docket No. 10-111-LNG (Oct. 5, 2012).

[6] *See* EIA, *U.S. Natural Gas Imports & Exports 2011* (July 18, 2012). The U.S. now exports about 1,500 billion cubic feet "bcf" of natural gas annually, with the vast majority travelling by pipeline to Mexico and Canada. Sabine Pass would export 2.2 bcf/day, or 803 bcf annually.

[7] *See, e.g.*, EIA, *The National Energy Modeling System: An Overview* (2009) at 54-55 (explaining that NEMS contains "play-level" production models for each unconventional natural gas play and projects production based on demand); 59-62 (transmission and distribution module of NEMS allocates demand based through modeling the transmission network and can account for imports and exports).

the environmental burdens of the boom that are outlined below. If DOE and FERC do not analyze and disclose these impacts, neither they or state and local governments can weigh whether they are in the public interest, or take action to lessen them. And if the TPP and pacts like it are signed without due reflection and before a full NEPA environmental impact statement is available, the U.S. will be locked into a future of gas export without ever having considered the cost.

It is not yet too late to change course. DOE has committed not to release any more export licenses until an economic study has been finalized, which will not occur until this winter. Negotiations for the TPP have not concluded. FERC has not sited any more new terminals. So, although the United States has begun to edge into exports, that future has not yet been chosen. Cooler heads can still prevail, and decisionmakers can develop the information we and they so clearly need.

II. The Magnitude of the Export Boom

Even if only some of the 19 export projects now before DOE are approved, they would, once operational, transform the domestic energy market and greatly increase unconventional natural gas production. There is no domestic precedent for changes of the magnitude which DOE is now considering.

Before the shale gas boom began, the U.S. exported almost no gas beyond Canada and Mexico, and even those North American exports were not very large. In 2006, for instance, the U.S. exported a total of 723.9 bcf per year of natural gas, with 663 of that by pipeline.[8] Only the remaining approximately 60 bcf per year are exported as LNG, essentially all of it going to Japan from a single Alaskan terminal, with a few bcf to Mexico by truck.[9] Policymakers largely assumed that this pattern would continue, urging that the U.S. develop gas *import* capacity to accommodate growing domestic demand.[10]

The situation now is very different. Projections of abundant domestic natural gas from unconventional, largely shale, plays has dropped domestic gas prices to record lows while prices abroad remain high. As a result, U.S. pipeline exports have risen, pushing total exports over 1,500 bcf per year (or about 4 bcf per day), and investors have flooded DOE with an ever-growing number of export proposals. As of late October 2012, the 19 different export projects before DOE proposed to export as much as 28.39 bcf *per day* of LNG.[11] Of this, 23.71 bcf per day was proposed for export to countries with which the U.S. has not signed a free trade

[8] EIA, U.S. Natural Gas Exports by Country, *available at*: http://www.eia.gov/dnav/ng/ng_move_expc_s1_a.htm.
[9] *See id.*
[10] *See, e.g.*, National Petroleum Council, *Balancing Natural Gas Policy: Fueling the Demands of a Growing Economy* at 36-40 (2003)
[11] Department of Energy Office of Fossil Energy, *Applications Received by DOE/FE to Export Domestically Produced LNG from the Lower-48 States (as of October 26, 2012)*, available at http://www.fossil.energy.gov/programs/gasregulation/reports/Long_Term_LNG_Export_10-26-12.pdf. Other proposals to export at least 2.5 bcf/d of LNG have also been reported, but have not yet been filed with DOE.

agreement providing for national treatment of natural gas; DOE has clear authority to disapprove such proposals if they are not in the public interest.

How much gas is 28.39 bcf per day? It is equivalent to 10,362 bcf per year. By comparison, the entire country produced just 23,000 bcf in 2011, meaning that exports equivalent to about 45% of domestic production are now before DOE.[13] Exporting this much gas would be bound to strongly affect domestic gas production and consumption patterns. For example, the country consumed 24,316 bcf of gas last year – slightly more than it produced, with imports making up much of the difference.[14] Dedicating forty percent of U.S. gas production to export would, therefore, cause big shifts in the domestic market. The amount of gas slated for export is considerably more than the 7,602 bcf that the entire electric power sector used last year, and nearly twice as much gas as was used for electricity by every home in the country.[15] If this amount of gas is exported, the United States must produce more gas, use less, or do both.

The Energy Information Administration ("EIA") has come to just that conclusion in a DOE-commissioned January 2012 report, which estimated that about two-thirds (63%) of export demand will be met by increased production, rather than by decreases in gas consumption elsewhere in the economy.[16] That new production, in turn, will come almost entirely (93%) from unconventional gas plays, and so will be produced by fracking. [17]

Thus, if the DOE authorizes all of the 10,362 bcf of exports now before it, about 63% of that exported gas, or 6,5282 bcf, would likely be from new production, and 6,397 bcf of that new production would be fracked gas. Total domestic gas production would increase by 27%.

To be sure, there are legitimate questions as to the real scope of the export boom. The global LNG market may be hungry for U.S. gas, but limits on near-term demand and regasification capacity may mean that not every export terminal will be built, or operate at capacity. On the other hand, the scramble for export licenses shows no signs of diminishing. In fact, the pace and intensity of this export boom seems to have caught decisionmakers by surprise. In January 2012, DOE and the EIA assumed that exports of 12 bcf/d were at the high end of possible export futures.[18] Export applications for more than double that volume have now been lodged with DOE. The "high end" scenario now looks decidedly mid-range compared to pending applications.[19]

---

[13] EIA, Natural Gas Monthly November 2012, Table 1 (volume reported is dry gas).
[14] *Id.*, Table 2.
[15] *Id.* (electric power sector gas use in 2011 was 7,602 bcf; residential use was 4,730 bcf).
[16] EIA, *Effects of Increased Natural Gas Exports on Domestic Energy Markets* (Jan. 2012) at 6, 10-11.
[17] *Id.* at 11.
[18] EIA, *Effects of Increased Natural Gas Exports on Domestic Energy Markets* at 1.
[19] In its Annual Energy Outlook for 2012, EIA very conservatively projects that only 2.2 bcf/d of LNG will be exported by 2035, noting that this projection is subject to considerable regulatory uncertainty. *See* EIA, *Annual Energy Outlook* (2012) at 94. This amount would correspond to about a 470 bcf annual increase in unconventional natural gas production – about a 2% national increase. Notably, the 2.2 bcf of annual LNG export EIA conservatively projects are equivalent to the export proposed by the Sabine Pass facility which DOE has already all

Moreover, even a much smaller gas export increase would still mean major changes in the U.S. gas market. If only one-quarter of the proposed projects move forward, about 6 bcf/d of gas would still be exported – the equivalent of 2,190 bcf annually. That demand would, in turn, be accompanied by about 1,172 bcf of new unconventional gas production if the EIA is correct, increasing U.S. gas production overall by 5%.

Proposed export terminal sites are on all three U.S. sea coasts. Most applications are focused on the Gulf Coast, but applicants have also filed to export from Atlantic coastal sites in Maryland and Georgia and from Pacific coastal sites in Oregon. Between the terminals themselves, the pipelines required to feed them with gas, the barge traffic they will engender and, of course, the fracking boom they will support and extend, few regions of the United States will be untouched by LNG export.

III. Environmental Implications of Export

Producing and exporting large volumes of natural gas will have significant environmental implications that are best evaluated in the NEPA process with an Environmental Impact Statement. The urgency of a comprehensive look is clear from an examination of a subset of those effects: impacts associated directly with increasing gas production, impacts from changes in the gas market associated with export, and impacts associated with export itself, particularly its implications for climate change.

A. The Environmental Impacts of Increased Unconventional Gas Production

While the DOE's Office of Fossil Energy continues to consider pending export applications, the Secretary of Energy Advisory Board has been sounding the alarm about the fracking process on which export depends. Its Shale Gas Production Subcommittee issued a detailed set of recommendations in late 2011, emphasizing that a substantially enhanced regulatory and research effort is needed to ensure that unconventional natural gas production can move forward safely.

The Subcommittee, composed of nationally-regarded independent experts, wrote that it "believes that if action is not taken to reduce the environmental impact accompanying the very considerable expansion of shale gas production expected across the country – perhaps as many as 100,000 wells over the next several decades – there is a real risk of serious environmental consequences causing a loss of public confidence that could delay or stop this activity."[20] As of late 2011, the Subcommittee warned that "progress to date is less than the Subcommittee

---

but approved. The EIA projection thus functionally assumes that *none* of the other projects now before DOE are built. While that might occur, it is obviously prudent to consider the impacts of other projects.

[20] Secretary of Energy Advisory Board Shale Gas Production Subcommittee ("SEAB"), *Second-Ninety Day Report* (Nov. 18, 2011) at 10.

hoped."[21] It cautioned that "some concerted and sustained action is needed to avoid excessive environmental impacts of shale gas production and the consequent risk of public opposition to its continuation and expansion."[22]

As the Subcommittee recognized, the impacts of unconventional gas production stretch across multiple mediums and contexts. Its recommendations identify areas for improvement in managing air pollution, water pollution, subsurface contamination, land use, and community impacts.[23] The Subcommittee also issued an urgent call for improved transparency and disclosure throughout the process, and for greatly enhanced research and development to better understand and improve production processes.[24]

Significant environmental impacts associated with unconventional natural gas production, and hence with export, include the following:

Air Pollution

Natural gas production has significant air quality impacts. As the DOE's Shale Gas Subcommittee summarized the matter last August:

> Shale gas production, including exploration, drilling, venting/flaring, equipment operation, gathering, accompanying vehicular traffic, results in the emission of ozone precursors (volatile organic compounds (VOCs), and nitrogen oxides), particulates from diesel exhaust, toxic air pollutants and greenhouse gases (GHG), such as methane.
>
> As shale gas operations expand across the nation these air emissions have become an increasing matter of concern at the local, regional and national level. Significant air quality impacts from oil and gas operations in Wyoming, Colorado, Utah and Texas are well documented, and air quality issues are of increasing concern in the Marcellus region (in parts of Ohio, Pennsylvania, West Virginia and New York).[25]

The tight link between gas production and ground-level ozone, or smog, is a particularly pressing problem. The gas industry is a major source of two major ozone precursors: VOCs and NO_x.[26] Smog harms the respiratory system and has been linked to premature death, heart

---

[21] *Id.*
[22] *Id.*
[23] *Id.* at Annex C.
[24] *Id.*
[25] SEAB, *First Ninety Day Report* (August 18, 2011) at 15.
[26] *See, e.g.,* Al Armendariz, *Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements* (Jan. 26, 2009), *available at* http://www.edf.org/documents/9235_Barnett_Shale_Report.pdf (hereinafter "Barnett Shale Report").

failure, chronic respiratory damage, and premature aging of the lungs.[27] Smog may also exacerbate existing respiratory illnesses, such as asthma and emphysema, or cause chest pain, coughing, throat irritation and congestion. Children, the elderly, and people with existing respiratory conditions are the most at risk from ozone pollution.[28]

As a result of significant VOC and NO_x emissions associated with oil and gas development, numerous areas of the country with heavy concentrations of drilling are now suffering from serious ozone problems. For example, the Dallas Fort Worth area in Texas is home to substantial oil and gas development. Within the Barnett shale region, as of July 2012, there were 16,213 gas wells and another 2,764 wells permitted.[29] Of the nine counties surrounding the Dallas Fort Worth area that EPA has designated as in "nonattainment" with national air quality standards for ozone, five contain significant oil and gas development.[30] A 2009 study found that summertime emissions of smog-forming pollutants from gas production in these counties were roughly comparable to emissions from all the cars in those same areas.[31] These nonattainment designations are particularly striking because the current ozone standard is set below the level EPA's own scientific advisors recommend as adequate to protect public health.[32] That gas production emissions can cause violations even of this relatively *lax* standard underlines their severity.

Oil and gas development has also brought serious ozone pollution problems to rural areas, such as western Wyoming.[33] On March 12, 2009, the governor of Wyoming recommended that EPA designate Wyoming's Upper Green River Basin as an ozone nonattainment area under EPA's current ozone.[34] The Wyoming Department of Environmental Quality conducted an extended assessment of the ozone pollution problem and found that it was "primarily due to local emissions from oil and gas . . . development activities: drilling, production, storage, transport, and treating."[35] In the winter of 2010-2011, the residents of Sublette County suffered thirteen

---

[27] *See, e.g.*, Jerrett *et al.*, *Long-Term Ozone Exposure and Mortality*, New England Journal of Medicine (Mar. 12, 2009), *available at* http://www.nejm.org/doi/full/10.1056/NEJMoa0803894#t=articleTop.

[28] *See* EPA, *Ground-Level Ozone, Health Effects*, *available at* http://www.epa.gov/glo/health.html; EPA, Nitrogen Dioxide, Health, available at http://www.epa.gov/air/nitrogenoxides/health.html.

[29] Texas Railroad Commission, http://www.rrc.state.tx.us/data/fielddata/barnettshale.pdf (Accessed Sept. 25, 2012).

[30] Barnett Shale Report at 1, 3.

[31] *Id.* at 1, 25-26.

[32] *See,e.g.*, Elizabeth Shogren, NPR, *EPA Seeks to Tighten Ozone Standards* (July 24, 2011) (when EPA set the current standards it "ignored the advice of its own panel of outside scientific advisers"). EPA has since opted not to immediately update the out-dated standards, but revisions may be forthcoming next year.

[33] Schnell, R.C, et al. (2009), "Rapid photochemical production of ozone at high concentrations in a rural site during winter," *Nature Geosci.* 2 (120 – 122). DOI: 10.1038/NGEO415.

[34] *See* Letter from Wyoming Governor Dave Freudenthal to Carol Rushin, Acting Regional Administrator, USEPA Region 8, (Mar. 12, 2009) ("Wyoming 8-Hour Ozone Designation Recommendations"), *available at* http://deq.state.wy.us/out/downloads/Rushin%20Ozone.pdf; Wyoming Department of Environmental Quality, Technical Support Document I for Recommended 8-hour Ozone Designation of the Upper Green River Basin (March 26, 2009) ("Wyoming Nonattainment Analysis"), at vi-viii, 23-26, 94-05, *available at* http://deq.state.wy.us/out/downloads/Ozone%20TSD_final_rev%203-30-09_jl.pdf.

[35] Wyoming Nonattainment Analysis at viii.

days with ozone concentrations considered "unhealthy" under EPA's current air-quality index, including days when the ozone levels exceeded the worst days of smog pollution in Los Angeles.[36]

As oil and gas production moves into new areas ozone problems are likely to follow. For example, regional air quality models predict that gas development in the Haynesville shale will increase ozone pollution in northeast Texas and northwest Louisiana and may lead to violations of ozone air quality standards.[37] Experts also anticipate air quality problems associated with development of the Marcellus shale in the Mid-Atlantic region.[38]

Ozone pollution is not the only danger associated with natural gas production, however. Toxic air emissions are also a significant concern. Emissions from gas fields contain carcinogenic compounds, including benzene, which are associated with significant increases in cancer risk. In fact, Colorado researchers sampling the air near a field there recently determined that residents living within half a mile of from wells were at increased risk of cancer, compared to those living further away, due to long-term exposure to toxic leaks.[39] As the industry expands, this toxic problem will come with it.

In addition to these serious problems, the industry poses a significant threat to the global climate. The natural gas industry is also among the very largest sources of methane pollution in the country. Methane is a potent greenhouse gas, and these emissions rank the industry as the second largest industrial greenhouse gas source, second only to power production.[40] Because fracking operations tend to produce substantially more methane, and are also supporting new well development across the country, unconventional natural gas production is increasing these emissions. EPA has recently estimated annual industry methane emissions as the equivalent of 328 million metric tons of CO_2.[41]

This pollution will remain a serious danger even though EPA has recently finalized its first attempt at comprehensive air pollution controls for the industry.[42] While these standards will

---

[36] EPA, *Daily Ozone AQI Levels in 2011 for Sublette County, Wyoming*, *available at* http://www.epa.gov/cgi-bin/broker?msaorcountyName=countycode&msaorcountyValue=56035&poll=44201&county=56035&msa=-1&sy=2011&flag=Y&_debug=2&_service=data&_program=dataprog.trend_tile_dm.sas.; *see also* Wendy Koch, *Wyoming's Smog Exceeds Los Angeles' Due to Gas Drilling*, USA Today, *available at* http://content.usatoday.com/communities/greenhouse/post/2011/03/wyomings-smog-exceeds-los-angeles-due-to-gas-drilling/1.

[37] *See* Kemball-Cook et al., *Ozone Impacts of Natural Gas development in the Haynesville Shale* 44 Environ. Sci. Technol. 9357, 9362 (Nov. 18, 2010).

[38] Elizabeth Shogren, *Air Quality Concerns Threaten Natural Gas's Image*, National Public Radio (June 21, 2011), *available at* http://www.npr.org/2011/06/21/137197991/air-quality-concerns-threaten-natural-gas-image.

[39] *See generally* Lisa McKenzie *et al.*, *Human health risk assessment of air emissions from development of unconventional natural gas resources*, Sci. Total Environment (May 2012), *abstract available at*: http://www.ncbi.nlm.nih.gov/pubmed/22444058.

[40] *See* EPA, Inventory of US Greenhouse Gas Emissions and Sinks 1990-2010 (2012).

[41] *See* 74 Fed. Reg. 52,738, 52,756 (Aug. 23, 2011).

[42] *See* 77 Fed. Reg. 49,490 (Aug. 16, 2012).

play a significant role in reducing air pollution from new infrastructure, many new sources and existing infrastructure escape regulation. Moreover, the standards do not regulate methane directly. As a result, air pollution from production will continue to be a serious problem, despite this important first regulatory effort.

Water Pollution

Much public concern over expanded fracking operations has focused on water pollution, and with good reason. Significant water resource impacts can occur throughout the production process.

Fracking requires large volumes of water per well. While operators have sought to reduce their water demands in some areas, numerous sources indicate that fracturing a single well requires at least 1 to 5 million gallons of water.[43] Water withdrawals can harm aquatic ecosystems and human communities by reducing instream flows—especially in small headwaters streams -- and by harming aquatic organisms at water intake structures.[44] Where water is withdrawn from aquifers rather than surface sources, withdrawal risks permanent depletion.[45] Withdrawals for fracking pose a greater risk than other withdrawals, because fracking is a consumptive use. Fluid injected during the fracking process is ideally deposited below freshwater aquifers and into sealed formations, so much of it never returns to the surface.

The well-site management of fracking fluid and wastes, including flowback water, poses water quality risks throughout the process. Spills at the surface, leaks through well casings, and contaminant migration from the fracking site itself can all contaminate ground and surface water.

Fracturing fluid itself contains many chemicals that present health risks. Diesel fuel and similar compounds pose particularly pressing risks. The DOE Subcommittee singled out diesel for its harmful effects and recommended that it be banned from use as a fracturing fluid additive.[46] The minority staff of the House Committee on Energy and Commerce determined that despite diesel's risks, between 2005 and 2009, "oil and gas service companies injected 32.2 million gallons of diesel fuel or hydraulic fracturing fluids containing diesel fuel in wells in 19 states."[47]

Fracking fluids are not the only source of potential contamination.[48] Fluid naturally occurring in the target formation "may include brine, gases (e.g. methane, ethane), trace metals, naturally occurring radioactive elements (e.g. radium, uranium) and organic compounds." [49] Inadequate

[43] *See, e.g.*, SEAB, *First Ninety-Day Report* at 19; NY RDSGEIS 6-10.
[44] NY RDSGEIS at 6-3, 6-4.
[45] *Id.* 6-5; SEAB, *First Ninety Day report* at 19 ("[I]n some regions and localities there are significant concerns about consumptive water use for shale gas development.").
[46] *Id.* at 25.
[47] Letter from Reps. Waxman, Markey, and DeGette to EPA Administrator Lisa Jackson (Jan. 31, 2011) at 1.
[48] NY RDSGEIS at 5-75 to 5-78
[49] SEAB *First Ninety-Day Report* at 21.

well cementing, among other faults, can allow these substances to contaminate groundwater resources.[50] Storage, transport, and treatment of produced water on the surface create risks of spills and inadequate disposal, providing another vector for contamination of surface and groundwater resources.[51]

Properly treating these waste products, and other production waste, is essential to protecting water quality. Limited treatment capacity and the challenges of safely using underground injection as an alternative disposal method for large volumes of waste are pressing problems. Treating and discharging extremely salty, highly-contaminated wastewater is energy-intensive and technically difficult, and can put surface streams at risk. Meanwhile, injection also faces challenges, as not all regions have substantial injection capacity and injection wells themselves have been associated with earthquakes of up to 4.0 on the Richter scale.[52]

Finally, sediment contamination associated with the significant land disturbance and construction activities needed to construct and manage a well field is a persistent challenge. Run-off from production sites can readily contaminate streams without careful management.

Incidents of water contamination from various phases of the production process have been widely reported. Although EPA, other federal agencies and some states have begun to move forward with regulatory responses, many of these challenges remain unresolved. Thus, increased gas production for export will be accompanied by increasing risks of water pollution.

Land and Community Impacts

Intense gas production can transform entire regions. The gas boom means hundreds of thousands of new wells, along with the vast infrastructure of roads, pipelines, and support facilities they require. This landscape-level industrialization can transform formerly rural areas into vast construction sites, with thousands of trucks moving down an expanding webwork of gravel roads. This landscape change, too, is a significant environmental impact of increasing gas production.

The scope of potential change is great. Each well pad alone occupies roughly 3 acres, and associated infrastructure (roads, water impoundments, and pipelines) more than doubles this figure.[53] Many of these acres remain disturbed through the life of the well, estimated to be 20 to 40 years.[54] This directly disturbed land is generally no longer suitable as wildlife habitat. *Id.* at 6-68. In addition to this direct disturbance, indirect habitat loss occurs as areas around the directly disturbed land lose essential habitat characteristics. As New York regulators, for

[50] *Id.* at 20.
[51] *See* NY RDSGEIS at 1-12 (describing risks of fluid containment at the well pad).
[52] *See, e.g.*, Columbia University, Lamont-Doherty Earth Observatory, *Ohio Quakes Probably Triggered by Waste Disposal Well, Say Seismologists* (Jan. 6, 2012); Alexis Flynn, *Study Ties Fracking to Quakes in England*, Wall Street Journal (Nov. 3, 2011).
[53] NY RDSGEIS at 5-5.
[54] *Id.* at 6-13.

instance, report, "[r]esearch has shown measureable impacts often extend at least 330 feet (100 meters) into forest adjacent to an edge."[55]

These effects will harm rural economies and decrease property values, as major gas infrastructure transforms and distorts the existing landscape. United States Geological Survey researchers, reviewing recent patterns of unconventional gas extraction, combined with coalbed methane projects, report that these activities create "potentially serious patterns of disturbance on the landscape."[56]

Pennsylvania presents a particularly striking example of the many ways in which gas production can transform a landscape. A recent state study of drilling in Pennsylvania's hitherto relatively undisturbed forest lands found that the forests have been so thoroughly fragmented and disrupted by the influx of gas activity that "zero" remaining acres of the state forests are suitable for further leasing with surface disturbing activities.[57]

Increased gas production for export can be expected to intensify and extend these impacts to new regions as drilling continues to meet increased demand.

Summary

The environmental impacts of increasing gas production of course extend well beyond those captured by this short summary. There are real environmental risks inherent in every phase of gas's life-cycle, from site preparation to drilling to waste disposal. Greatly increasing gas demand will increase the scope and intensity of these risks. The DOE's Shale Gas Subcommittee has already found that our regulatory infrastructure is not adequate to manage these risks at their current level of intensity. The United States is even less prepared for a greater and more rapid expansion of natural gas extraction.

B. Environmental Impacts Due to Fuel Market Shifts

Increasing demand for gas will necessarily raise gas and energy prices. These price effects have important environmental impacts as well because changing gas prices and availability affects the domestic fuel market. If natural gas is relatively more expensive, utilities, in particular, may be more likely to use competing fuels and generation technologies, each of which has its own environmental implications.

The prospect that LNG exports could incentivize domestic coal-fired generation is particularly important to understand. Coal-fired generation is a major source of many air pollutants,

[55] *Id.* at 6-75.
[56] E.T. Slonecker *et al.*, USGS, *Landscape Consequences of Natural Gas Extraction in Bradford and Washington Counties, Pennsylvania, 2004–2010* (2012) at 1.
[57] PA DCNR, *Impacts of Leasing Additional State Forest for Natural Gas Development* (2011).

including asthma-inducing SO_2, and among the very largest sources of combustion-related CO_2. Thus, LNG-induced market changes could have important implications for domestic air quality.

The EIA has modeled this fuel-shifting effect for gas exports of up to 12 bcf/d.[58] It reports that as exports rise, domestic gas consumption falls. Utilities largely switch to coal, while also making up a bit of the displaced gas generation with energy efficiency and renewable energy.[59] On balance, this shift results in increased emissions because the bulk of the new energy (72% of the total) comes from coal generation.[60]

More coal generation means greater carbon dioxide emissions from combustion, which are more than sufficient to balance out any emissions savings from greater use of efficiency and renewable energy in most of the scenarios that the EIA considered.[61] In fact, even in the few scenarios where the EIA predicted a larger market share for low carbon sources, LNG exports still resulted in a net increase in CO_2 emissions nationally, once emissions from the liquefaction process itself were accounted for.[62] The size of this increase depends upon the volume and size of exports, and the baseline price of gas and coal under various scenarios, so the EIA analysis estimates it within a broad range of 187 to 1,587 million metric tons of CO_2 over the next twenty years. These are large amounts. Even at the low end, 187 million metric tons is equivalent to the CO_2 emitted in a year by roughly 44 coal-fired power plants.[63] These emissions have the potential to increase as more LNG is exported with commensurate impacts on the market. They would be accompanied by corresponding increases in other coal-generation-related air pollutants, like SO_2.

This market-linked pollution effect could work to disrupt important policy work at the national and local level. Many utilities, public service commissions, and environmental regulators increasingly assume that coal generation's market share will steadily fall, in favor of gas, renewable energy, and energy efficiency. These entities are planning accordingly. Indeed, the EPA's recent proposed carbon pollution standards for fossil-fired generation are premised on EPA's understanding that "in light of a number of economic factors, including the increased availability and significantly lower price of natural gas … few, if any, new coal-fired power plants will be built in the foreseeable future."[64] As policymakers adapt to a world of more readily-available natural gas, export's tendency to make gas *less* available and more expensive will have important environmental implications throughout the country.

C. Impacts from Export Itself: Focus on Climate

[58] EIA, *Effects of Increased Natural Gas Exports on Domestic Energy Markets* at 17-19.
[59] *Id.*
[60] *Id.* at 18.
[61] *See id.* at 18-19.
[62] *Id.*
[63] Calculated with EPA's *Greenhouse Gas Equivalencies Calculator*, available at http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results.
[64] *See* 77 Fed. Reg. 22,392, 22,399 (Apr. 13, 2012).

Finally, exports themselves have substantial environmental impacts.

Export terminals are large industrial sites. The liquefaction facilities needed to chill natural gas until it condenses into a liquid well below zero are energy-intensive and can produce substantial amounts of air and water pollution. Likewise, the pipeline and compressor networks needed to transport gas to the terminal, and the international shipping system needed to carry it onward all have significant impacts on the environments they traverse. The highly explosive nature of LNG means that carefully mapping out the potential for serious accidents around terminals and ships is an ongoing and important exercise in worst-case scenario analysis.

Looking more broadly, the use of LNG itself has environmental impacts, both positive and negative. Examining the climate implications of LNG is particularly important because LNG proponents have touted the fuel for its supposed potential to substantially reduce greenhouse gas pollution by displacing coal.

This claim is not well-supported. Because of the energy used to liquefy, transport, and re-gasify LNG, its life-cycle climate footprint is greater than that of most gas sources. Indeed, at least one peer-reviewed study has found LNG's life-cycle greenhouse gas emissions approach the low-end of coal life-cycle emissions.[65] Notably, that study was based on emissions from conventionally-produced natural gas, which are considerably lower than those from unconventional gas. Other studies, though concluding that LNG emissions are still lower than those of coal, have likewise documented that LNG life-cycle emissions are on the order of 30% greater than those of ordinary gas.[66] Whichever figures ultimately turn out to be correct, it is clear that LNG is among the most carbon-intensive forms of natural gas.

Further, whether or not LNG produces as much greenhouse gas pollution as coal, increased use of *any* fossil fuel is not consistent with preventing dangerous climate change. Recent climate studies show that increased natural gas use (from whatever source), without aggressive additional carbon control efforts, will not prevent dangerous increases in global temperature. The International Energy Agency, for instance, recently considered a future in which global gas use (including LNG use) sharply increases because of the unconventional gas boom.[67] In this scenario, despite gas's presumed life-cycle emissions advantage over coal, atmospheric CO_2 concentrations nonetheless rise on a trajectory towards 650 ppm, up from near 400 ppm today, pushing towards a 3.5°C temperature increase.[68] As a result, even if LNG emits less greenhouse gas pollution than coal, and even if it displaces some amount of coal power (which may or may not occur), it will not put on a path towards safe climate.

---

[65] Jaramillo et al., *Comparative Life-Cycle Air Emissions of Coal, Domestic Natural Gas, LNG, and SNG for Electricity Generation*, 41 Environ. Sci. Technol. 6,290, 6,295 (2007).

[66] *See* European Commission Joint Research Centre, *Liquefied Natural Gas for Europe – Some Important Issues for Consideration* (2009) at 16-17; European Commission Joint Research Centre, *Climate impact of potential shale gas production in the European Union* (2012).

[67] International Energy Agency, *Golden Rules for a Golden Age of Gas* (2012).

[68] *Id.* at 91.

We can only avoid the worst impacts of climate change if emissions fall sharply. As IEA explains, "reaching the international goal of limiting the long-term increase in global mean temperature to 2°C above pre-industrial levels cannot be accomplished through greater reliance on natural gas alone."[69] Thus, expanded natural gas exports may, at best, very slightly slow the pace of warming. In the worst case, they will maintain the status quo, while deepening a national and global investment in climate-disrupting fossil fuels and delaying the transition to renewable energy sources.

D. Conclusions on Environmental Impacts

In sum, the environmental impact of LNG export is large, and stretches from local effects near individual gas wells to significant cumulative impacts on the country as gas production increases and gas prices rise to significant shifts in the international energy market. Some of these impacts are better understood than others, but all are worthy of careful analysis.

That analysis has not been forthcoming. DOE and FERC have prepared no environmental reports studying the impacts of export and, worse, have so far declined to do so, as is explained below. Export proponents, who generally trumpet production increases as a central benefit of their projects, are silent on the environmental costs of these production shifts.

The policy community has not yet seriously engaged these questions either. Two much-discussed recent LNG export papers, which generally favor exports, devote almost no attention to the environmental impacts of exports and the increased gas production that would accompany them. A report from the Brookings Institution, titled *Liquid Markets*, cites the DOE's Shale Gas Subcommittee's serious concerns and reviews ongoing regulatory initiatives, but makes no effort to quantify the likely environmental impacts of increased production.[70] Instead, it settles for predicting only that the "current regulatory environment" – the one which DOE has judged to be inadequate – should not put any insuperable hurdles in the way of new drilling.[71]

A second report, from Michael Levi of the Council on Foreign Relations and the Hamilton Project, also lacks a detailed treatment of these issues.[72] The environmental portion of that analysis also largely considers whether public backlash over environmental damage will be sufficient to derail exports, warning that the EIA projects "that a large part of increased production spurred by export demand would be in the Northeast, where opposition to shale gas development has been strongest."[73] Levi views this possibility as an argument for improved regulation, such as the DOE has called for. He implies, however, that because LNG exports will

---

[69] *Id.* at 100.
[70] Brookings Energy Security Initiative, *Liquid Markets: Assessing the Case for U.S. exports of Liquefied Natural Gas* (May 2012) at 6-12.
[71] *Id.* at 11.
[72] Michael Levi, The Hamilton Project, *A Strategy for U.S. Natural Gas Exports* (June 2012).
[73] *Id.* at 20-21.

not commence "for several years," there will be time to put the necessary rules in place before hand.[74] Suffice to say that this is back-to-front thinking: There is no guarantee that rules will be in place to manage a wave of increased fracking. On the contrary, with billions of dollars sunk into export terminals, one might expect export proponents to oppose new regulation.

These two recent reports are representative: There has been a great deal of discussion of the economic potential of LNG exports, but the environmental discussion has lagged dangerously behind. Mere assertions that environmental impacts will not be sufficiently disturbing as to cause a massive public backlash, or that regulations will doubtless be in place by the time exports occur, are not enough to support careful consideration of these transformative changes. The decision to allow substantial LNG exports requires a thorough accounting of the likely impacts and how they can best be managed.

To be sure, a great deal of useful information is being developed on the environmental impacts of unconventional gas production generally, as state and federal regulators grapple with the implications of the boom. That information, however, has not been integrated into an analysis of the impacts of LNG exports or used to inform export decisions. If DOE or FERC began that study, they would find a rich and developing literature to draw upon and synthesize. The export licensing system, supported by the NEPA process, should produce just an analysis. That information is long overdue.

IV. The Regulatory Infrastructure

The Natural Gas Act and NEPA provide a framework under which DOE and FERC must weigh the environmental impacts of export, and then ensure that exports, if any, are regulated to protect the public interest. Thus far, this fundamental oversight machinery has not been fully used.

Natural gas imports and exports have been regulated under the Natural Gas Act since the late 1930s. Until very recently, however, large-scale exports of LNG were not in the picture. The two core regulatory bodies, DOE's Office of Fossil Energy, and FERC, dealt largely with pipeline shipments to Canada and Mexico and with LNG import terminals. Although they occasionally handled periodic permit renewals for a sole, small, LNG export terminal in Alaska that has served the Asian market off and on since the 1960s, this minor project does not remotely compare to the enormous export proposals now before them. This striking shift underlines the importance of proceeding carefully now.

A. The Public Interest Determination and Siting Process

The Natural Gas Act provides that "no person" may export or import natural gas without a license.[75] Such a license will be granted unless the proposal "will not be consistent with the

[74] *See id.* at 21.
[75] 15 U.S.C. § 717b(a).

public interest."[76] This public interest standard is broad and invites careful analysis. Among other points, it includes "the authority to consider conservation, environmental, and antitrust questions."[77] The Supreme Court has made clear that environmental considerations, in particular, are due close attention in this analysis.[78] DOE has recently affirmed that it is required to examine a "wide range of criteria" to best understand the public interest, "including… U.S. energy security… [i]mpact on the U.S. economy… [e]nvironmental considerations… [and] [o]ther issues raised by commenters and/or interveners deemed relevant to the proceeding."[79]

DOE and FERC share responsibility for Natural Gas Act determinations, with DOE taking, in many ways, the more fundamental role. Under their current division of authority, FERC is charged with location-specific concerns: Its primary responsibility is to investigate how to safely site and operate export and import terminals themselves.[80] DOE, by contrast, is charged with more broadly considering whether the project should move forward at all: It must make the public interest determination, and so must survey the information before it in order to discern how a given export or import proposal will affect the many considerations relevant to the public interest.[81] Although DOE reads its governing statute to afford export applicants a rebuttable presumption that their project is in the public interest, this presumption is not dispositive and a detailed public interest analysis is required in each case.[82]

NEPA analysis supports this public interest determination by providing the environmental information which DOE must weigh under the Natural Gas Act. The NEPA process, described in detail below, is the joint responsibility of DOE and FERC, and must be completed before either one issues a final order. Since 2005, FERC has been charged by statute as the "lead" agency for NEPA compliance, meaning that it coordinates the environmental assessment process.[83] DOE, however, must contribute to and review the documents which FERC prepares, and must independently determine whether they are sufficient to support its public interest determination, or whether more analysis is needed.[84] Only once DOE determines that it has NEPA documents which fully analyze the environmental impacts of the decision before it does it weigh those impacts and make its final public interest decision.

This process applies to all the export applications now before FERC and DOE with one important exception, which is discussed in more detail in the final section of this paper. In the 1992

---

[76] *Id.*
[77] *Nat'l Ass'n for the Advancement of Colored People v. Federal Power Commission*, 425 U.S. 662, 670 n.4 & n.6 (1976).
[78] *See Udall v. Federal Power Comm'n*, 387 U.S. 428, 450 (1967).
[79] Testimony of Christopher Smith, Deputy Assistant Secretary of Oil and Gas Before the Senate Committee on Energy and Natural Resources (Nov. 8, 2011).
[80] Department of Energy Delegation Order No. 00-004.00A § 1.21 (May 16, 2006).
[81] *See* Department of Energy Redelegation Order No. 00-002.04E § 1.3 (Apr. 29, 2011).
[82] *See Panhandle Producers and Royalty Owners Ass'n v. Economic Regulatory Administration*, 822 F.2d 1105, 1110-1111 (D.C. Cir. 1987).
[83] *See* 15 U.S.C. § 717n.
[84] *See* 40 C.F.R. § 1501.6.

Energy Policy Act, Congress amended DOE's Natural Gas Act authority to provide that DOE *must* grant applications for export to (or import from) nations with which the United States has signed a free trade agreement providing for national treatment in natural gas.[85] In those cases, FERC still oversees terminal siting, but DOE loses its broad oversight role as to whether export is wise in the first place. This loophole was created to support natural gas imports from Canada – rather than massive LNG *exports* from the U.S. – but it has been relatively unimportant until recently. Significant export projects generally must go through the usual public interest process because the United States does not have free trade agreements with most major LNG importers. The 2010 free trade agreement with South Korea, a large LNG importer, changed this picture somewhat, but the South Korean market is still relatively limited and the free-trade "loophole" has not short-circuited DOE's usual process in most cases. That situation highlights, however, the importance of maintaining the public interest determination process as trade negotiations continue with other importers.

Accordingly, though most exporters do secure the "free" license to export to free-trade-agreement nations, the license to export to non-free-trade-act nations remains more valuable, and is often essential to doing business. Of the 19 projects now before DOE, only 4 rely exclusively on a free-trade-agreement license.[86] The remaining proposals are proceeding through the full public interest determination process.

B. The NEPA Process

The NEPA phase of this process must provide DOE and the public with a full and fair understanding of the environmental implications of export.

NEPA is our bedrock environmental statute.[87] It is rooted in democratic decisionmaking informed by excellent information. NEPA directs federal agencies to look before they leap: by requiring the preparation of environmental impact statements (EISs) for major federal actions, it helps ensure sound decisions before bulldozers roll. Policymakers have a pressing need for the information the NEPA process can provide as they consider whether and how to permit LNG export. NEPA analysis, accordingly, is not just a legal mandate but a prudent measure.

NEPA requires all federal agencies to "utilize a systematic, interdisciplinary approach" to make decisions, ensuring that their decisions are fully informed before they act with a goal of maintaining "the environment for succeeding generations."[88] The core of this obligation is the EIS, which must be prepared for every major Federal action which could significantly affect "the quality of the human environment."[89]

---

[85] *See* 15 U.S.C. 717b(c).
[86] Those four are the SB Power Solutions, Golden Pass Productions, Main Pass Energy Hub, and Waller LNG Services proposals.
[87] It is codified at 42 U.S.C. §§ 4321 *et seq.*
[88] 42 U.S.C. §§ 4332(A) & 4331(b)(1).
[89] 42 U.S.C. § 4332(C).

An EIS is designed to develop information describing the environmental impact of a proposed action, alternatives to the proposal, and the relationship between the short-term proposal and "the maintenance and enhancement of long-term [environmental] productivity."[90] NEPA, in other words, helps prompt agencies to look more broadly than the immediate matter at hand, to understand how their actions fit within a larger environmental context. As the first court to review the statute explained, "NEPA, first of all, makes environmental protection a part of the mandate of every federal agency and department."[91]

This is not a paper exercise. The Council on Environmental Quality, the high-level body which administers NEPA across the government, explains in its regulations that "[u]ltimately, of course, it is not better documents but better decisions that count. NEPA's purpose is not to generate paperwork--even excellent paperwork--but to foster excellent action."[92] This means that "[t]he NEPA process is intended to help public officials make decisions that are based on an understanding of environmental consequences, and take actions that protect, restore, and enhance the environment."[93]

This process proceeds in several steps, designed to build a strong platform for the final decision. It is to begin as early as possible in order to ensure that the EIS can "serve practically as an important contribution to the decisionmaking process and will not be used to rationalize or justify decisions already made."[94] After an initial "scoping" phase during which the agency gathers comments from stakeholders to identify key issues,[95] the agency prepares a draft and then a final EIS.

The "heart of the environmental impact statement" is a careful discussion of the proposal and all relevant alternatives, "sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public."[96] With regard to each option, the agency must develop a careful description of its environmental consequences.[97]

These consequences are generally divided between direct, indirect, and cumulative impacts.[98] Direct impacts are simply those immediately caused by the action at issue; indirect impacts are those which may occur a bit further afield, but which are still causally linked to the federal action.[99] The agency must cast a wide net, analyzing all "reasonabl[y] foreseeable" impacts, including those "induced" by its action – think, for instance, of the "growth inducing" impacts of building a highway, or, for that matter, an export terminal inducing drilling with its attendant

[90] *Id.*
[91] *Calvert Cliffs' Coordinating Committee, Inc. v. U.S. Atomic Energy Comm'n*, 449 F.2d 1109, 1112 (D.C. Cir. 1971).
[92] 40 C.F.R. § 1500.1(c).
[93] *Id.*
[94] 40 C.F.R. § 1502.5.
[95] 40 C.F.R. § 1501.7.
[96] 40 C.F.R. § 1502.14.
[97] 40 C.F.R. § 1502.16.
[98] 40 C.F.R. §§ 1508.7 & 1508.8.
[99] 40 C.F.R. § 1508.8.

effects on "air and water and other natural systems."[100] The analysis must also include the "cumulative" impacts of federal action – the "incremental impact of the action when added to other past, present, and reasonably foreseeable future actions."[101] For instance, in the LNG context, the cumulative production inducing effects of all relevant LNG terminals should be considered together. It would also make sense to consider the cumulative impact of new production from export along with the impact of existing gas production.

The EIS, in short, ultimately presents a full accounting of all the reasonably foreseeable impacts of the agency's proposed course of action, along with alternatives to that course of action. It is designed to bring information to light and to generate syntheses of formerly scattered information.

Congress recognized, in this regard, that some uncertainty will always be present in any prediction of environmental impacts. Such uncertainty does not excuse agencies from complying with NEPA – if it did, NEPA analyses would never succeed in developing the new research agencies need to inform their decisions. Rather, the NEPA process is designed to limit uncertainty, while carefully characterizing remaining questions. Where information is incomplete, the agency must gather it (expending reasonable funds to do so) to fill in key aspects of the picture.[102] If costs are truly exorbitant, or it is very difficult to generate a particular piece of information, an agency must still do its best, providing a careful description of what it believes to be missing from its evaluation, a "summary of existing credible scientific evidence" relevant to its problem, and the agency's best "evaluation" of the impacts before it based upon what it knows.[103] In all cases, the goal is to develop the best-informed analysis possible, advancing the public's understanding, even of uncertainties, before the final decision is made.

Uncertainties can also be managed by beginning at a higher level of generality with a special form of EIS known as a "programmatic" environmental impact statement, and then filling in more specific information down the road as individual projects are considered. As the name suggests, programmatic EISs are intended to provide a broad overview of entire programs, or classes of activity.[104] Such documents are particularly useful as road maps. They provide an overview of how a class of decisions – such as granting many different export applications – will affect the environment. As the D.C. Circuit Court of Appeals has explained, this process has "a number of advantages" which recommend it here:[105] A programmatic EIS, the court explained, "provides an occasion for a more exhaustive consideration of effects and alternatives than would be practicable in a statement on an individual action. It ensures consideration of

[100] *See id.*
[101] 40 C.F.R. § 1508.7.
[102] 40 C.F.R. § 1502.22(a).
[103] 40 C.F.R. § 1502.22(b)(1).
[104] *See* 40 C.F.R. § 1502.14(b)-(c).
[105] *Scientists' Institute for Public Information, Inc. v. Atomic Energy Comm'n*, 481 F.2d 1079, 1087 (D.C. Cir. 1973).

cumulative impacts that might be slighted in a case-by-case analysis. And it avoids duplicative reconsideration of basic policy questions."[106]

To facilitate this broad overview, the NEPA regulations in turn explain that agencies can structure programmatic EISs by looking, for instance, geographically at "actions occurring in the same general location"; generically, by looking at actions with, for instance, "common timing, impacts, alternatives, methods of implementation, media, or subject matter"; or even by "stage of technical development" as processes and technologies mature.[107] Once such an overview is in hand, an agency is free to rely upon it to guide more specific analyses of particular projects, thereby saving work and time down the road.[108]

Whether an EIS is programmatic or project-specific, as the Supreme Court has explained, by ensuring that agencies take a "hard look" at the environmental consequences of their decisions, NEPA is "almost certain to affect the agency's substantive decision."[109] In this sense, NEPA reflects a fundamentally democratic approach to decisionmaking, a faith that putting the best information forward transparently will help policymakers and the public navigate uncertainty and make difficult choices. The Supreme Court identifies these two purposes this way:

> First, [NEPA] ensures that the agency, in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts. Second, it guarantees that the relevant information will be made available to the larger audience that may also play a role in both the decisionmaking process and the implementation of that decision.[110]

With this process in place, the goal is that "the most intelligent, optimally beneficial decision will ultimately be made."[111]

There is a pressing need for such careful, deliberate, decisionmaking in the LNG export context.

V. Applying NEPA to LNG Exports

DOE affirms in its governing regulations that it will "follow the letter and spirit of NEPA" and will "apply the NEPA review process early in the planning stages" of its projects.[112] These rules are clear that DOE must base its final decisions on matters with significant environmental impacts on a carefully developed environmental impact statement.[113] But DOE has refused to prepare

---

[106] *Id.* (internal quotations and citation omitted).
[107] 40 C.F.R. § 1502.14(c)(1)-(3).
[108] *See, e.g.*, 40 C.F.R. § 1502.20
[109] *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 (1989).
[110] *Dep't of Transp. v. Public Citizen*, 541 U.S. 752, 767 (2004) (internal quotations omitted).
[111] *Calvert Cliffs*, 449 F.2d at 1114.
[112] 10 C.F.R. § 1021.102.
[113] *See, e.g.*, 10 C.F.R. §§ 1021.210 (affirming that DOE will complete NEPA review "before making a decision"); 1021.214 (affirming that this standard applies for adjudicatory proceedings, such as licensing processes).

an environmental impact statement to help it wrestle with the weighty export decisions now before it. Worse, it has refused even to acknowledge that it has the tools to do so, even though its own modeling system could go far to help answer the vital questions now before it.

DOE *should* have approached NEPA compliance in a far more considered way. It should have begun by preparing a national programmatic environmental impact statement – either on its own or as a partner with FERC, the usual NEPA lead agency -- that would have considered the cumulative effect of the export proposals before it and ways to mitigate those effects. Such an analysis would be a natural counterpart to a national economic study it is now preparing. In fact, the U.S. Environmental Protection Agency (EPA) has now twice filed formal comments making clear that just such an analysis is necessary.[114] With both such studies in hand, DOE and FERC could then have developed shorter, subsidiary studies for each proposal before it, considering their particular circumstances in the context of its comprehensive public disclosures.

The unwise course the agencies have thus far taken in the environmental arena contrasts sharply with DOE's far wiser commitment to consider national economic impacts before moving forward on any further export applications. These two approaches are irreconcilable. DOE must undertake a full EIS for LNG export, including the effects of increased gas production, if it is to make prudent decisions and satisfy its legal mandates.

A. DOE's Failure to Properly Apply NEPA Thus Far

DOE has assured Congress that it recognizes that the cumulative impact of "future LNG export authorizations could affect the public interest."[115] Unfortunately, though DOE is attempting to better understand some of the economic implications of LNG export, it has thus far actively refused to consider the environmental implications.

The only nearly-complete example of DOE's deliberative process thus far is its handling of the Sabine Pass LNG export project proposed for southern Louisiana. Sabine Pass was the first LNG export application filed in the current wave of proposals, and proposed to export 803 bcf of gas annually. This volume of export, alone, would increase *total* U.S. gas exports by more than 50%.[116] One might have expected DOE to analyze this historic application in detail, but it did not.

Instead, applying the rebuttable presumption-based approach to export, DOE did not develop significant independent analyses when considering the application. It relied almost entirely on Sabine Pass's own assertions. In spring 2011, it "conditionally" approved the Sabine Pass's request to export up to 2.2 bcf/d of natural gas, largely on the ground that no opposing party

[114] Letter from Christine B, Reichgott, EPA Region 10 to FERC (Oct. 29, 2012) at 12-13; Letter from Jeffrey D. Lapp, EP Region 3 to FERC (Nov. 15, 2012) at 2.
[115] Letter from Christopher Smith, Deputy Assistant Secretary of Oil and Gas to Representative Edward Markey (Feb. 24, 2012) at 3.
[116] *See* n. 3, *supra*.

had shown that the project was *not* in the public interest.[117] DOE thus approved the beginning of the export boom largely on the export proponents' say-so, without preparing its own analysis.

The "conditional" part of the approval referred in large part to DOE's decision to defer its consideration of environmental matters pending FERC's work on NEPA documents for Sabine Pass as the lead agency for NEPA compliance. Because FERC had not yet prepared an environmental analysis or environmental impact statement, DOE opted not to weigh any environmental factors in its public interest analysis. Instead, it stated that FERC, with DOE's cooperation, would undertake the environmental study for both agencies as part of FERC's facility siting process.[118] DOE stated that it would review FERC's final product before finally signing off on Sabine Pass.

But FERC did not prepare an EIS for Sabine Pass and did not consider the national implications of the application, including its implications for production. FERC recognized that Sabine Pass itself identified the purpose and need of the facility as to "provide a market solution to allow the further development of unconventional (particularly shale gas-bearing formation) sources in the United States."[119] Nonetheless, it instead prepared only a more limited document called an environmental assessment (an "EA"), which focused only on the environmental impacts of the facility siting decision before it.[120]

FERC justified this decision on the grounds that the impacts from increased gas development were not "reasonably foreseeable" because "no specific shale-gas play is identified."[121] It did so even though Sabine Pass itself affirmed that the "most likely" sources of supply for its project were "the historically prolific Gulf Coast Texas and Louisiana onshore gas fields, the gas fields in the Permian, Anadarko, and Hugoton basins, and the emerging unconventional gas fields in the Barnett, Fayetteville, Woodford, and Bossier basins."[122] FERC apparently felt that the applicant's own assurances that export would spur production, and would likely do so in specific places, provided no ground for analysis. Because FERC believed that it could not identify precisely where Sabine Pass would catalyze gas production, it refused to consider these impacts at all.[123]

But NEPA analyses are not dependent on this sort of location-specific analysis. Instead, a programmatic EIS, for instance, could readily have presented the environmental choices before DOE on a national level, with particular attention to potential production patterns in prolific shale plays. Even a project-specific EIS could have addressed pressing environmental issues directly. FERC could have evaluated the sorts of pollution risks and ecosystem threats

[117] DOE, Order 2961 (May 20, 2011) at 42.
[118] *Id.* at 40-41.
[119] *Id.* at 1-10.
[120] *See* FERC, *Environmental Assessment for the Sabine Pass Liquefaction Project* (December 2011).
[121] FERC, Order Granting Section 3 Authorization, 139 FERC ¶ 61,039 at ¶¶ 96-97 (Apr. 16, 2012).
[122] Sabine Pass Export Application (Sept. 7, 2010) at 16.
[123] *Id.* at ¶¶ 98-100.

associated with increased fracking. It could have described the likely cumulative impacts of the many proposed LNG projects, including those at Sabine Pass, and could have estimated the scale of environmental disruption that they may cause. Instead, FERC provided none of this information. Perversely, because it concluded that Sabine Pass might promote gas production "in any of the numerous shale plays that exist in most of the eastern United States," and hence could have nationwide impacts, FERC decided that these impacts swept too broadly to be analyzed.[124]

DOE did not have to accept this blinkered view, but it nonetheless did so, declaring, on its review of FERC's EA, that FERC had "examined all reasonably foreseeable impacts" of the project.[125] DOE therefore accepted FERC's EA as a "complete picture for purposes of meeting DOE's NEPA responsibilities and fulfilling its duty to examine environmental factors as a public interest consideration under the [Natural Gas Act]."[126] In doing so, DOE also accepted FERC's reasoning that because it was "impossible" to know precisely how much new production Sabine Pass would cause, or exactly where this production would occur, there was no way to discuss these impacts at all.[127]

Thus, though DOE affirmed that it was "fully aware of concerns of the environmental effects of shale gas production," it insisted that it could not provide a "meaningful analysis" of Sabine Pass – or of the cumulative impacts of LNG export as a whole.[128] Sierra Club petitioned for rehearing of this decision, and DOE has announced that it continues to consider whether its decision was correct.[129]

DOE has not moved forward on any other LNG export applications (with the exception of licenses for export to countries with which the U.S. has a free trade agreement, discussed below), so the Sabine Pass order stands as its current word on the subject. If DOE does not change course, huge volumes of natural gas will be produced and exported without any consideration of how this massive production increase will affect communities across the country. Far from working to protect the public interest, DOE will not acknowledge, much less address, the challenge before it.

B. How NEPA Should Be Applied to LNG Exports

The Sabine Pass decisions made a bad beginning, but they need not determine the rest of the story. DOE may yet reconsider its Sabine Pass order. Moreover, many other LNG export applications have been filed with DOE and, as it considers them, it may still treat this environmental challenge with the seriousness it deserves. Before granting any further licenses,

---

[124] FERC, Order Denying Rehearing and Stay, 140 FERC ¶ 61,076 at ¶ 12 (July 26, 2012).
[125] DOE, Order 2961-A (Aug. 7, 2012) at 27.
[126] *Id.*
[127] *Id.* at 28.
[128] *Id.*
[129] DOE, *Order Granting Rehearing for Further Consideration*, FE Docket No. 10-111-LNG (Oct. 5, 2012).

DOE should ensure that the NEPA process develops the information it needs to make a sound public interest determination.

For purposes of this discussion, DOE or FERC could undertake the tasks described below. FERC would be the most likely coordinator, given its lead agency role under the Natural Gas Act, but it is ultimately DOE's responsibility to ensure that the final NEPA analysis is sufficient to support a careful public interest determination, whether it is prepared entirely by FERC or later supplemented by DOE. For ease of reference, this section therefore refers to "DOE" as conducting the analysis, though FERC would play an important coordinating role.

In this context, a programmatic EIS makes a great deal of sense. By looking first at the common questions inherent in export, DOE could help develop a fundamental shared understanding of their impacts before turning to the particular impacts of specific proposals.

i. Determining Foreseeable Production Associated with Export

The most important first question for DOE is to determine a "reasonably foreseeable" range of natural gas which may be exported and the corresponding range of reasonably foreseeable increases in production. So far, DOE and FERC have insisted that *no* production impacts are reasonably foreseeable, as the Sabine Pass decisions state. This conclusion is simply wrong. The DOE's own NEMS program can forecast these production impacts. DOE's failure to develop such projections is unjustifiable.

NEMS is a very well-established modeling system designed to model the economy's energy use through a series of interlocking "modules" that represent different energy sectors on regional and national levels.[130] Relevant here, NEMS has an "Oil and Gas Supply Module"[131] and a "Natural Gas Transmission and Distribute Module."[132] Rhese modules jointly represent the entire domestic natural gas sector, and describe how production responds to demand across the country. They can be used, therefore, to model the effects of increased export demand on gas production. In fact, they *have* been used for this purpose by DOE already: The January 2012 EIA special report on LNG, which included production forecasts, relies on NEMS, as does the summer 2012 Annual Energy Outlook, which contains LNG projections.[133]

EIA's formal documentation for NEMS is available online, and thoroughly describes the system. That documentation demonstrates that DOE/FE is in error when it states that the implications of LNG export demand for the production and supply of domestic gas are not foreseeable. In fact, NEMS's natural gas sub-models are explicitly designed to project how supply will respond to demand on a national and a regional basis; indeed, they *must* do so for the model to

---

[130] *See* EIA, *The National Energy Modeling System: An Overview* (2009) at 1-2 ("NEMS Overview").
[131] *See* EIA, *Documentation of the Oil and Gas Supply Module* (2012 ("OGSM Documentation").
[132] *See* EIA, *Model Documentation: Natural Gas Transmission and Distribution Module of the National Energy Modeling System* (2012) (TDM Documentation).
[133] *See, e.g.*, EIA, *Effects of Increased Natural Gas Exports on Domestic Energy Markets* at 3 (EIA used NEMS for this forecast); EIA, . *See* EIA, *Annual Energy Outlook* (2012) at App. E (describing NEMS).

generate predictions. As such, NEMS could (and in fact has) be used to project likely production increases in response to increased demand caused by LNG exports. NEMS therefore provides the analysis of "when, where, and how shale-gas development will be affected" that the DOE has so far stated it would be impossible to produce.

To begin with, the Supply Module is built on detailed state-by-state reports of gas production across the country.[134] These reports allow the EIA to develop regionally differentiated models of the costs of production in each gas field, and how readily production can be increased in those fields. As the EIA explains, "production type curves have been used to estimate the technical production from known fields" as the basis for a sophisticated "play-level model that projects the crude oil and natural gas supply from the lower 48."[135] The module reports its results for regions throughout the United States, including the Northeast, the Gulf Coast, and areas in Texas and Arkansas with large gas plays.[136] It also distinguishes coalbed methane, shale gas, and tight gas from other resources, allowing for specific predictions distinguishing unconventional gas production from conventional natural gas production.[137] The module further projects the number of wells drilled each year, and their likely production; these are important figures for estimating environmental impacts.[138]

In short, this module "includes a comprehensive assessment method for determining the relative economics of various prospects based on future financial considerations, the nature of the undiscovered and discovered resources, prevailing risk factors, and the available technologies. The model evaluates the economics of future exploration and development from the perspective of an operator making an investment decision."[139] Thus, for each play in the lower 48 states, the EIA is able to predict future production based on existing data. Importantly, the EIA makes clear that "the model design provides the flexibility to evaluate … environmental, or other policy changes in a consistent and comprehensive manner."[140] Those policy changes include permitting LNG export.

LNG export creates new demand and transmission needs. The next NEMS module, the Transmission and Distribution Module, can address these impacts. It integrates supply projections with regional and national demand to help determine how gas will flow to areas experiencing increased demand. As EIA explains, the module "represents the transmission, distribution, and pricing of natural gas" using a national module of the transmission system, which, in turn, is divided by region.[141] The module "links natural gas suppliers (including importers) and consumers in the lower 48 States and across the Mexican and Canadian borders via a natural gas transmission and distribution network, while determining the flow of natural

[134] *See* OGSM Documentation at 2-2.
[135] *Id.* at 2-3.
[136] *Id.* at 2-4.
[137] *Id.* at 2-7.
[138] *See id.* at 2-25 -2-26
[139] *Id.*
[140] *Id.*
[141] TDM Documentation at 2.

gas and the regional market clearing prices between suppliers and end-users."[142] Because the Transmission Module represents demand regionally, it can distinguish, for instance, between LNG export demand on the Gulf Coast and demand in the Northeast.[143] For each region, the module then links supply and demand annually, taking transmission costs into account, in order to project how demand will be met by the transmission system.[144] Thus, it interacts with the Supply Module to develop projections for how supply in each production region will evolve in response to demand.[145]

Importantly, the Transmission Module already is designed to model LNG imports and exports, and contains an extensive modeling apparatus to do so.[146] The Module includes import/export pipelines and the sole existing LNG export terminal in Alaska.[147] There is, thus, no technical barrier to modeling increased export demand going forward.[148] One source of demand is much like any other, so additional export terminals can simply be modeled as additional demand centers in the regions in which terminals are proposed. The Module could, for instance, readily model additional demand along the Gulf Coast or other coasts, and translate that demand back to the Supply Module. Again, this process is essentially what the EIA already did in the context of its January 2012 LNG export study, which relied on NEMS to forecast the production and price impacts of export.

In short, NEMS is already set up to do the sort of work which DOE needs to do here.[149] In response to a given demand in a particular region, it projects transmission system flows and

---

[142] *Id.*
[143] *See id.* at 12-14.
[144] *See id.* at 15-16.
[145] *See id.* at 16-20.
[146] *See id.* at 22-32.
[147] *Id.* at 3.
[148] *See id.* at 30-31.
[149] As are several models used by private consultants. For instance, the Deloitte consultancy regularly makes such predictions. *See, e.g.*, Deloitte, *Made in America: The Economic Impact of LNG Exports from the United States* (2011) at 6 (explaining that if LNG is "exported from one particular geographic point, the entire eastern part of the United States reorients production and flows and basis differentials change substantially"); *see also id.* at 6 (explaining that the reference case for the model predicts increased production in the Marcellus and Haynesville shales) & 8 (explaining that Deloitte considers how producers will "develop more reserves in anticipation of demand growth, such as LNG exports" and forecasting different prices depending on where exports occur).

According to Deloitte, its "World Gas Model" and its component "North American Gas Model" are designed precisely to provide this sort of finer-grained analysis. Deloitte explains that "[t]he North American Gas Model is designed to simulate how regional interactions of supply, transportation, and demand determine market clearing prices, flowing volumes, storage, reserve additions, and new pipelines throughout the North American natural gas market." *See* Deloitte, *Natural Gas Models.* The model "contains field size and depth distributions for every play, with a finding and development cost model included. This database connects these gas plays with other energy products such as coal, power, and emissions." *Id.* According to Deloitte, its modeling thus allow it to predict how gas production, infrastructure construction, and storage will respond to changing demand conditions, including those resulting from LNG export: "The end result is that valuing storage investments, identifying maximally effectual storage field operation, positioning, optimizing cycle times, demand following modeling, pipeline sizing and location, and analyzing the impacts of LNG has become easier and generally more accurate." *Id.* The point here is that linking exports to production is plainly possible.

production responses at the level of individual plays across the country. Thus, DOE is fully capable of analyzing the production impacts of particular levels of LNG export. Its failure to do so – and its insistence that such projections are somehow impossible to make – is inexplicable.

Given this capability, DOE should look at a range of possible export volumes and timing, just as the EIA did in the economic study that DOE commissioned. It should then consider the amount of natural gas (either produced or diverted from other uses) necessary to meet this demand, and can, using the same analysis EIA applied, predict how much of this gas is likely to come from new production.

Because NEPA is rooted in the alternatives analysis, DOE should also develop alternative approaches to the range of possible exports. It might, for instance, look at the impacts of allowing the maximum and minimum volumes of exports it thinks are plausible, along with its projection of the most likely scenario. It also makes sense to look at variations in export timing and volume driven by public interest concerns. For instance, DOE could consider permitting exports only after the environmental safeguards the Shale Gas Subcommittee identified are in place, or only permitting exports at a volume that would not cause serious price disruptions or economic harm domestically. And, of course, DOE must consider a "no action" alternative baseline, in which exports do not move forward at all. The point of the analysis, as always, is to ensure that the agency thoroughly explores the possible solution space, rather than simply pursuing its preconceived plans.

DOE, in short, has many options before it open for analysis. The only option which it simply may not pursue, however, is the one that it has picked: It cannot and must not refuse to use its *own models* to help inform the public as to the vital choices ahead.

ii. Estimating the Impacts of Production

With this array of options in mind, the next task for DOE is to identify the environmental impacts associated with each of the reasonable alternatives it has developed. EPA has twice instructed FERC (in its role as the lead agency) that just such an analysis is necessary.

EPA's formal comments put the matter well. As EPA explained in comments on a proposal to export LNG from Oregon:

> The 2012 report from the Energy Information Administration states that[] "natural gas markets in the United States balance in response to increased natural gas exports largely through increased production." That report goes on to say that about three-quarters of that increase[d] production would be from shale resources. We believe it is appropriate to consider available information about the extent to which drilling activity might be stimulated

by the construction of an LNG export facility on the west coast, and any potential environmental effects associated with that drilling expansion.[150]

EPA made a similar point in comments on another, Maryland-based, export facility. It wrote:

> We also recommend expanding the scope of analysis to include indirect effects related to gas drilling and combustion. … Th[e EIA] report also indicated that about three-quarters of that increase[d] production would be from shale gas resources and that domestic natural gas prices could rise by more than 50% if permitted to be exported. We believe it is appropriate to consider the extent to which implementation of the proposed project, combined with implementation of other similar facilities nationally, could increase the demand for domestic natural gas extraction and increase domestic nautral gas prices.[151]

EPA, in short, recognizes that the important national debate needs to be informed by careful environmental analysis. Because this analysis may best be done at the programmatic level, DOE should look at the impacts of export-linked production across the country, before applying this programmatic analysis to informed consideration of particular project proposals. The NEMS system and similar models will help DOE to project national impacts and to regionalize them. As it considers these options, it will need to answer several key questions. These include, but are certainly not limited to, the following:

What is the magnitude and timing of the increased natural gas production associated with a range of export scenarios?

This is the most fundamental question that the NEPA process should answer. The EIA has already developed models linking export to increased production. A NEPA analysis could use this starting point to investigate the magnitude of production needed to support a range of export volumes. This inquiry, on its own, would meaningfully assist decisionmakers. If they know, for instance, that permitting 1 bcf/d of export means that some dozens, hundreds, or thousands, of additional wells will need to be drilled, that consideration should be balanced transparently in the public interest analysis. Again, NEMS should be able to supply this analysis and, indeed, to do so on play-by-play and regional levels, as well as nationally.

What incremental air pollution risk is associated with increased natural gas production generally, and with increased unconventional gas production in particular?

The air pollution impacts of both conventional and unconventional gas production are serious and need to be better understood – especially if exports significantly increase production, as they are likely to do. The DOE can use the NEPA process to better describe these impacts. For instance, the Environmental Protection Agency has developed

[150] Letter from Christine B, Reichgott, EPA Region 10 to FERC (Oct. 29, 2012) at 12.
[151] Letter from Jeffrey D. Lapp, EP Region 3 to FERC (Nov. 15, 2012) at 2.

increasingly accurate emissions figures corresponding to processes through the natural gas production system, from well drilling to gas transport.[152] By estimating the amount production is likely to increase, DOE can evaluate the approximate range of new air pollution likely to be associated with increased production. Likewise, it can assess the likely emissions associated with any upgrades to pipeline transmission networks required to get natural gas to export terminals. DOE can, in other words, forecast whether a given export scenario is likely to be associated with many thousands of tons of additional air pollution, or a more limited amount.

Going further, DOE can predict where this pollution is most likely to occur. Although exported gas can be produced in many places, some natural gas basins are declining or stable, while others – such as those near the Texas Gulf coast and the Marcellus shale of the east coast -- are rapidly growing and are near proposed export terminal sites, reducing transportation costs. DOE can and should forecast the most likely targets for additional development in response to increasing gas demand; these locations are, in turn, the most likely to suffer from increased air pollution and to have to invest in appropriate control efforts. NEMS will it allow it do so.

In short, DOE can map out the air pollution control challenge ahead under various export scenarios. It can also forecast which regions are most likely to have to manage this increased pollution, and some of its likely public health and environmental impacts.

What incremental water pollution risk is associated with increased natural gas production generally, and with increased unconventional gas production in particular?

As with air pollution, water pollution risk increases with increased gas production. Here, too, an overview of pollution risk and response needs with substantially higher production will assist policymakers and the public. Although many other questions should be answered here, two areas of investigation within this general field jump out for investigation at the programmatic level.

First, increased gas production will generate a predictable amount of waste for treatment. Looking at the national scale, a proper EIS would consider the adequacy of treatment available for this increase in wastewater and other substances. Does existing treatment plant capacity correspond to the likely increased volume and can those plants properly treat all pollutants from the industry? Do injection wells appear ready to take up the slack? If not, where is waste likely to go? Before licensing exports, it makes sense to make sure that the nation is ready to handle the waste they leave behind.

Second, water *quantity* issues also deserve a close look. A substantial increase in fracking means a substantial increase in water use. Even though water use varies among gas

[152] *See generally*, EPA, *Regulatory Impact Analysis: Final New Source Performance Standards and Amendments to the National Emissions Standards for Hazardous Air Pollutants for the Oil and Natural Gas Industry* (Apr. 2012).

fields, DOE can calculate a range of water demand likely to be associated with increased gas production. That range will help to determine whether gas export will add substantially to water stress in the nation's gas fields.

DOE's task here, as in the air pollution analysis, will thus generally be to forecast the likely scope of increased threats to water quantity and quality. Because both waste and water can be transported significant distances, this analysis does not depend on knowing precisely which fields will increase their production, but such forecasts will be helpful in assessing the most likely impacts. That said, where DOE can localize these impacts, as NEMS allows, it will be able to provide extremely important information to policymakers working to protect particular watersheds and aquifers.

What degree of land and community disturbance will be associated with increased gas production for export?

A given volume of export will be associated with an approximate number of new wells, well pads, roads, and associated infrastructure. In some gas fields, this infrastructure is already causing serious conflicts and challenges for communities and for wildlife. For instance, DOE might answer questions like these: What acreage of new disturbance is necessary to meet the increased demand for gas? How many new truck trips and how many new miles of pipeline are likely to be necessary? How many people are living in areas likely to see increased production? And how able are the already disrupted communities and ecosystems in the most likely areas for new production to absorb these impacts without excessive damage? This area of inquiry should prompt DOE to think seriously about the degree of landscape transformation that export will drive.

What are the domestic energy and environmental policy implications of export?

As we have discussed above, gas exports will likely raise gas and energy prices. These market shifts have the potential to change the electrical generation mix and also have implications for domestic industry. DOE is already analyzing these economic questions and is beginning to chart their implications. EIA's initial look at shifts in CO_2 emissions from the utility sector is a good example of this analysis. DOE should extend it to consider, at a range of export volumes and timings, what changes in emissions from other sources are likely. If price increases from export, for instance, prompt increased use of highly polluting coal plants, DOE should carefully address the impacts resulting from that shift.

What are the international energy and environmental policy implications of export?

The atmosphere does not respect national boundaries. Accordingly, if LNG exports lead to changes in climate-disrupting pollution – by replacing either cleaner or dirtier energy sources or simply by increasing the load of carbon in the atmosphere – the United States will feel the effects. The country will also experience changes in transboundary transport

of other chemicals and pollutants. To the extent possible, DOE can help forecast these impacts by considering which energy sources LNG is most likely to replace, and the extent of any such replacement.

What alternatives are available to reduce these impacts?

The alternatives analysis is the heart of the EIS. Developing a range of export policies – from permitting all exports, to only a subset of exports; from giving the green light now to waiting until protective regulations are in place – will allow DOE to test these alternatives against their impacts. The EIS should produce a map of possible trade-offs, showing how export decisions affect the environment and which export plans will best protect communities and ecosystems.

With answers to these and other questions in hand, DOE will be far better placed to understand the trade-offs inherent in LNG export and to decide whether export are in the public interest (and, if so, the proper volumes and timing which can best protect the public). This information is, in fact, necessary to properly conclude that process. Moreover, if the NEPA process reveals pressing risks from LNG export, DOE will be able to address them in advance or help other federal or state agencies do so. It will also have contributed to a crucial public conversation on a matter of vital national importance. When and if DOE does license exports, in this future, it will do so with its eyes wide open and will able to develop appropriate mitigation strategies.

Not all of the questions above are easy to answer. Many of them are difficult to address with complete precision, though DOE modeling and publicly available data will provide useful projections and estimates. But residual uncertainty is not a reason to shirk the task. The alternative, after all, is not safe inaction: It is blindly permitting a major change in the nation's energy system, committing to billions of dollars in LNG export infrastructure, and licensing a major increase in fracking activity across the country without any proper analysis. That course should not be undertaken casually. The nation will discover the answers to these questions with or without NEPA compliance, but without NEPA, the answers will come directly from suffering communities and ecosystems. NEPA ensures that decision-makers instead discover them in advance, "at a stage where real environmental protection may come about [rather] than at a stage where corrective action may be so costly as to be impossible."[153]

Forecasts of this sort are thus extraordinarily helpful, even if they are not entirely precise. As the D.C. Circuit Court of Appeals explained in a seminal NEPA case, the statute is designed to help outline crucial questions and answers early on, in order to guide continued decisionmaking and inquiry:

> The agency need not foresee the unforeseeable, but by the same token neither can it avoid drafting an impact statement simply because describing the environmental effects of and alternatives to particular agency action involves some degree of forecasting. And

[153] *Calvert Cliffs*, 449 F.2d at 1129.

> one of the functions of a NEPA statement is to indicate the extent to which environmental effects are essentially unknown. *It must be remembered that the basic thrust of an agency's responsibility under NEPA is to predict the environmental effects of proposed action before the action is taken and those effects are known.*[154]

The point is not that NEPA analysis at this phase will answer every question about export definitively and completely. Instead, "[r]easonable forecasting and speculation is… implicit in NEPA."[155] What DOE can, at a minimum, do now is to map out the fundamental environmental implications of LNG export. It can identify the scope and magnitude of likely impacts, and it can point to key unknowns that warrant more research. It can underline key concerns (such as the availability of treatment capacity to manage the waste associated with increased production for export) and offer alternatives that could address them. It can consider which regions are most likely to bear the costs of export, and where the benefits are most likely to fall. It can offer the sort of well-balanced, comprehensive, projections for which NEPA is designed.

Such an analysis, at an appropriate level of generality, is plainly required. There is absolutely no serious question that increased unconventional gas production is a "reasonably foreseeable" consequence of licensing LNG exports. Export proponents themselves predict such production increases; indeed, they premise their arguments that their projects are in the public interest in large part on the economic growth which they contend will follow from increased gas production.

For instance, Sabine Pass's promoters promised that their project would "play an influential role in contributing to the growth of natural gas production in the U.S."[156] The proponents of the Freeport project, likewise affirmed their project was "positioned to provide the Gulf Coast region and the United States with significant economic benefits by increasing domestic gas production."[157] Likewise, the Lake Charles project's backers maintained that their export would "spur[] the development of new natural gas resources that might not otherwise make their way to market."[158] The Gulf Coast LNG project's supporters asserted that their project will "allow the U.S. to benefit now from the natural gas resources that may not otherwise be produced for many decades, if ever."[159]

The litany goes on: In Oregon, the investors behind the Jordan Cove project assured DOE that it would be "instrumental in providing the increased demand to spur exploration and development of gas shale assets in North America."[160] And in Maryland, the Dominion Cove Point's project's supporters proclaimed that "[t]he most basic benefit of the proposed LNG exports will be to encourage and support increased domestic production of natural gas…. The

---

[154] *Scientists' Institute*, 481 F.2d at 1092 (emphasis added).
[155] *Id.*
[156] Sabine Pass Application at 56 (Sept. 7, 2010).
[157] Freeport LNG Application at 14-15 (Dec. 19, 2011).
[158] Lake Charles Application at 20 (May 6, 2011).
[159] Gulf Coast Application at 11 (Jan. 10, 2012).
[160] Jordan Cove Application at 19 (Mar. 23, 2012).

steady new demand associated with LNG exports can spur the development of new natural gas resources that might not otherwise be developed."[161]

The bottom line is that increased domestic gas production is a necessary consequence of export. It is not just foreseeable: It is a principal *justification* for gas export projects. As such, its environmental impacts must be disclosed under NEPA and weighed in the Natural Gas Act public interest determination.[162]

Programmatic analyses of this sort are not unfamiliar to DOE. DOE, in fact, recognizes the importance of the NEPA process as a support for its decisionmaking, and has deep experience with programmatic EISs. Secretary Chu has written that he "cannot overemphasize the importance" of building NEPA compliance into DOE project management.[163] DOE has regularly done so. Over the years, the department has prepared draft and final programmatic EISs and environmental assessments for a nationwide effort to promote energy efficiency,[164] a solar energy promotion program in six western states,[165] energy "corridors" in 11 different states,[166] a global program supporting nuclear power,[167] and a national coal power research and development initiative.[168] Plainly, DOE has had no difficulty developing national-level environmental surveys of large-scale energy decisions, even when the precise location and nature of all site-specific impacts were not yet known. Instead, such broad overviews informed policy. An EIS for LNG export would fit well into this tradition and is certainly entirely possible using DOE's own modeling capacity, as is discussed above.

The courts have made clear, as well, that NEPA requires agencies to take a hard look at the upstream consequences of their decisions. In one recent decision, the Ninth Circuit Court of Appeals rejected the Surface Transportation Board's assertion that, when permitting a new train line serving a coal-producing area, it did not need to consider the coal production the line would doubtless make possible.[169] The agency insisted that such development was not "reasonably foreseeable," even though it relied on the coal production to determine that the train line would be financially viable.[170] The court rightly held that the agency could not permit an infrastructure project justified in large part on increasing fossil fuel production without considering those impacts in a NEPA analysis. The same analysis applies here. LNG export

---

[161] Dominion Cove Point Application at 35 (Oct. 3, 2011).
[162] *See also Center for Biological Diversity v. National Highway Traffic and Safety Administration*, 538 F.3d 1172, 1200 (9th Cir. 2008) (where the impact of an agency action is uncertain, agency may not simply given that impact zero weight and fail to address it).
[163] DOE Memorandum, "Improved Decisionmaking Through the Integration of Program and Project Management with [NEPA] Compliance" (June 12, 2012).
[164] *See* DOE, Programmatic Environmental Assessment for the State Energy Conservation Program (1996).
[165] *See* 77 Fed. Reg. 44,267 (July 27, 2012).
[166] *See* 73 Fed. Reg. 72,477 (Nov. 28, 2008).
[167] *See* 73 Fed. Reg. 61,845 (Oct. 17, 2008).
[168] *See* DOE, Final Programmatic Environmental Impact Statement Clean Coal Technology Demonstration Program (1996).
[169] *Northern Plains Resource Council v. Surface Transportation Board*, 668 F.3d 1067, 1081-82 (9th Cir. 2011).
[170] *Id.*

terminals will drive new gas production and, in fact, depend upon that new production to justify their existence.

In the end, it should come as no surprise that DOE's own NEPA regulations provide that large LNG export projects will "normally require EISs."[171] When a project involves either "major operational changes (such as a major increase in the quantity of liquefied natural gas imported or exported)" or the "construction of major new facilities or the significant modification of existing facilities," an EIS is appropriate.[172] These rules, which have been in place since DOE first issued its NEPA regulations,[173] set a clear course for the agency. The applications before it now uniformly involve major increases in the quantity of LNG set for export – by many times over – and also require multi-billion dollar construction projects to create new facilities to support these facilities. An EIS, in these circumstances, is plainly mandated by DOE's own regulations.

C. DOE's National Economic Analyses Demonstrate That It Can Approach Environmental Impacts On A National Level

DOE's abdication of its environmental responsibilities is illegal and unwise. It is unjustifiable based on DOE's own modeling capabilities. It is also strikingly inconsistent with DOE's own approach to the national *economic* implications of LNG export. There, DOE has invested considerable effort in developing a comprehensive general understanding of the economic implications of LNG export, including the impacts of new production. That it can generate such an analysis at a national scale demonstrates that it can pursue the same course for environmental considerations. It should do so to ensure that policymakers and the public have a balanced view of *both* the economic and environmental impacts of exports.

The national economic analysis began, as DOE has explained to Congress, with DOE's realization, after the Sabine Pass conditional approval had issued and more LNG export applications were flooding in, that LNG exports could have real effects on the public interest.[174] DOE did not attempt to avoid grappling with these impacts just because it did not know with complete certainty exactly where production would occur. But, unlike in the environmental context, DOE correctly recognized that such uncertainties were not fatal to a proper national overview.

Instead, DOE immediately and responsibly embarked on two national studies, which were intended to help bring the national economic impacts of export into sharper focus. The first of these was the EIA report discussed above. At DOE's behest, EIA modeled a range of possible export and production scenarios, exploring combinations of different exports rate and timing

[171] 10 C.F.R. Pt. 1021 App. D to Subpart D, § D8 & D9.
[172] *Id.*
[173] *See* 45 Fed. Reg. 20,694, 20,700 (Mar. 28, 1980).
[174] Letter from Christopher Smith, Deputy Assistant Secretary of Oil and Gas to Representative Edward Markey (Feb. 24, 2012) at 3.

and possible variations in gas supply and economic demand.[175] As a result, EIA was able to generate a range of well-supported impact predictions for these varying scenarios. This analysis uncovered important effects for DOE's consideration, including the prospect of sharp domestic gas and electricity price increases with some export scenarios. Rather than allowing uncertainty to defeat the analysis, EIA considered a range of reasonable outcomes to help better inform policy – just as NEPA requires in the environmental context.

The second study will build further on these results. According to DOE, it will look at sixteen different hypothetical export scenarios to investigate:

> (1) [t]he potential impacts of additional natural gas exports on domestic energy, consumption, production, and prices; (2) the cumulative impact on the U.S. economy, including the effect on gross domestic product, job creation balance of trade; and (3) the impact on the U.S. manufacturing sector (especially energy intensive manufacturing industries).[176]

Rather than dismissing this analysis as "impossible" because it involves some degree of uncertainty, DOE sensibly embraced the task of investigating likely national impacts under varying production scenarios. Although there is, of course, some uncertainty as to the precise effects a particular proposal will have on the economy, the major wave of export proposals will have a predictable effect which can be investigated despite uncertainty as to particular production patterns. Indeed, as noted above, export proponents rely upon induced gas production to help justify their projects.

It is thus not at all surprising that DOE felt it to be both possible and necessary to analyze the economic ramifications of these changes. Of course, such an analysis is appropriate. The surprising point, instead, is that DOE nonetheless has blinded itself to the environmental impacts of the very same production increases it is analyzing.

D. DOE Must Look at Environmental Impacts With the Same Rigor With Which It Examines Economic Impacts

This double-vision – with economics in sharp focus and environmental impacts blurred to invisibility – impermissibly skews the choice before DOE. Both economic impacts and environmental costs weigh in the public interest determination. If DOE is only willing to look at one side of the ledger, it cannot properly fulfill its obligations because it cannot understand the all the aspects of the public's interest which are implicated by export. Without a full NEPA analysis, it cannot make a sound final decision.

---

[175] *See* EIA, *Effects of Increased Natural Gas Exports on Domestic Energy Markets* at 1-2.

[176] Letter from Christopher Smith, Deputy Assistant Secretary of Oil and Gas to Representative Edward Markey at 4.

The courts have made this point clear. Very early in NEPA's history, the Atomic Energy Commission insisted that it could not forecast the environmental impacts of a power plant research program for which it had already developed an economic analysis.[177] The D.C. Circuit Court of Appeals held this position had a "hollow ring" given that the Commission was happy to use its economic analyses in "convincing Congress" to support its plans.[178] As the court held, if economic analyses can be prepared, then "in turn … parallel environmental forecasts would be accurate for use in planning how to cope with and minimize the detrimental effects attendant upon" the course the agency wishes to pursue, "and in evaluating the program's overall desirability."[179] Agencies cannot skew their analyses, or mask the costs of their actions, by examining only one side of a problem while refusing to consider the other.

The Ninth Circuit Court of Appeals corrected the same error in its coal train line case, discussed above. There, too, while insisting that coal mines triggered by a new train line were too speculative to analyze under NEPA, the agency nonetheless "relied on the coal mine development … to justify the financial soundness of the proposal" which it approved.[180] Once again, the court held that an agency may not rely on economic predictions while simultaneously refusing to acknowledge the environmental impacts of the economic activity it is permitting.

The same analysis applies, with great force, to DOE's situation here. The agency has proven willing and able to analyze the economic impacts of LNG export and is in the process of expending considerable funds to improve its forecasting. Further, in individual licensing proceedings, it is clearly open to relying on predictions of increased economic activity from gas production to justify the licensing export. The very same drilling and production forecasts it is now working up in that context could, and should, inform an analysis of the environmental impacts of those decisions. There is nothing inherently harder in saying that ten thousand new wells will produce *x* dollars in tax revenue or *y* tons of pollution than in predicting they will produce *z* new jobs. DOE cannot conduct one analysis while neglecting the other.

DOE cannot embrace sunny economic predictions while ignoring real environmental costs. Such a course is not only contrary to NEPA, but will render the public interest determination process fundamentally unreliable. DOE must tally up the benefits of export, but it must also count the costs.

E. The Need for NEPA

DOE has thus far refused to give any weight to the landscape-level changes large-scale LNG export would produce. This error is serious. Uncorrected, it will distort policy by masking the domestic consequences of export.

---

[177] *See Scientists' Institute*, 481 F.2d at 1096-97.
[178] *Id.* at 1097.
[179] *Id.*
[180] *Northern Plains*, 668 F.3d at 1082.

Export proponents would, of course, prefer that these consequences go unremarked. Even as they tout the large increases in fracking that their projects will support, they insist that DOE must not and cannot even begin to account for the environmental consequences of their projects. But even if DOE ignores these impacts, American communities will feel the impacts of this production as exports ramp up. Rather than proceeding blindly while locking in these future harms, NEPA charges DOE with accounting for those impacts now, and the Natural Gas Act makes clear that it must take these harms into account as it considers the public interest.

DOE has the time it needs to do the right thing. It has already committed to Congress not to issue any further export licenses for export to non-free-trade-agreement nations until its second economic study is complete.[181] (Its decision to nonetheless finalize the in-process Sabine Pass license is a disturbing anomaly). DOE has recently announced that this economic study, originally slated for release in spring 2012, will not be released until this coming winter. It is taking the time it needs to gather meaningful economic information. It can and should do the same for environmental information.

There is no statutory deadline to issue licenses, and every reason to ensure that DOE's final decisions are as well-reasoned as possible. LNG export terminals represent billions of dollars in investment capital, and export licenses often last for decades. Before committing to this near-irrevocable investment, DOE owes it to itself and the public to take the time it needs to develop as full and careful analysis as possible.

VI. Preserving DOE's Authority to Protect the Public Interest

DOE must use its authority to prepare a proper EIS for LNG export. But, thanks to ongoing trade negotiations, this is not the only challenge DOE faces in order to protect the public interest. It must also act quickly, in coordination with Congress and the Executive, to ensure that its regulatory ability to protect the public is not inadvertently destroyed.

The problem confronting DOE is an unintended consequence of Congress's 1992 decision to speed LNG imports from Canada. To protect those imports, Congress directed that DOE *must* license LNG imports *and exports* from nations with which the U.S. has signed a free trade agreement providing for national treatment of natural gas.[182] Up to this point, this rubber stamp process has not been at issue, but that may be about to change.

The proposed Trans-Pacific Partnership (TPP) is a massive trade agreement currently under negotiation between the United States and ten other Pacific Rim nations.[183] Its influence could be even broader, however. The TPP is intended to be a "docking station" for new signatories,

[181] Letter from Christopher Smith, Deputy Assistant Secretary of Oil and Gas to Representative Edward Markey at 4.
[182] *See*15 U.S.C. § 717b(c).
[183] *See* http://www.ustr.gov/tpp.

permanently open for expansion, so it could establish an ever-expanding web of countries to which LNG *must* be exported if the market can sustain the demand.

Already, several potential signatories, including Chile and Singapore, are LNG importers and so would be able to take imports from the United States without any public interest oversight. And, critically, there is a very real possibility that Japan may join the talks and the final agreement.[184] Japan is the largest LNG importer in the world.[185]

If Japan is included in the TPP, with national treatment of natural gas, DOE will lose its discretion to condition any exports to Japan on the public interest. Such exports would be automatically licensed. Because Japan has the potential to absorb large amounts of U.S. gas, the loss of DOE's ability to carefully examine the consequences of those exports before licensing them is a serious concern. Regardless of the results of the NEPA analysis we recommend here, or of the economic studies DOE is conducting, exports would be legally mandated.

This result is not what Congress intended when it inserted the free-trade-agreement exception language in 1992. At that time, LNG export from the United States was neither possible nor contemplated. Instead, Congress was focused on removing barriers to natural gas imports from Canada.

The 1992 amendments, in fact, did not even reference export when proposed. Congressman Phil Sharp (D-IN), Chairman of the House Subcommittee on Energy and Power (and H.R. 776's original sponsor) stated that the amendments' purpose was only "deregulating Canadian natural gas imports."[186] Likewise Congressman Norman Lent (R-NY), Ranking Member of the House Committee on Energy and Commerce, explained that the amendments were "vital to assuring that U.S. regulators do not interfere with the importation of natural gas to customers in the United States."[187]Congressman Edward Markey (D-OR), who is a current skeptical voice on export, strongly supported the provisions, describing them as "important new statutory assurances that U.S. regulators will not discriminate against *imported* natural gas."[188]

Language providing for automatic approval of export applications as well as import applications in the free trade context was added in the final conference on the bill, with no recorded debate. The conference report does not justify this discussion, noting only that the final bill "includes an

[184] *See, e.g.*, Paul McBeth, National Business Review, "Pressure on Japan as Canada joins TPP talks" (June 20, 2012); ICIS Heren, "Japan Warms to U.S. Liquefaction Prospects" (Mar. 12, 2012).
[185] *See* EIA Country Statistics for Japan, http://www.eia.gov/countries/country-data.cfm?fips=JA#ng.
[186] 138 Cong. Rec. 32,075 (Oct. 5, 1992).
[187] 138 Cong. Rec. 32,083 (Oct. 5, 1992)
[188] Extension of Remarks, Cong. Rec. (Oct. 9, 1992), "Concerning Gas Import Provisions in H.R. 776, The Energy Policy Act of 1992) (emphasis added).

amended section… regarding fewer restrictions on certain natural gas imports and exports."[189] Whatever the justification for this expansion, it seems very clear that large-scale LNG exports were not on Congress's mind. The debate to this point had focused on Canadian imports, and, large-scale LNG exports were, in any event, not possible at the time. Indeed, Chairman Sharp described the final amended language as concerning "exports of natural gas *to Canada* from the United States" and affirmed (despite the seemingly open-ended final language) that "as drafted, the new fast task track process would not be available for LNG exports to, for example, Pacific rim nations other than Canada."[190]

At bottom, as DOE explained in a recent letter to Congress, "Congress's attention [in 1992] was focused on North American trade, not on the potential impact of the amendment on United States trade with other countries overseas."[191] Yet, the TPP, and the prospect of other such agreements, threatens to expand this exemption into a wholesale roll-back of DOE's regulatory discretion to protect the public interest. Should this occur, both the careful NEPA process and the public interest determination themselves would be suddenly and inappropriately truncated. In essence, the U.S. would see as much fracking activity as is necessary to support exports for the Asian market, with no direct domestic oversight of these exports.

This serious unintended consequence argues for swift remedial action. Several courses could be available. It may, first, be possible for the U.S. Trade Representative to draft the TPP to include exceptions for national treatment in natural gas, which could preserve DOE's authority. Second, Congress could certainly modify the provision to remove fast track authority for exports. Third, at a minimum, agreements that would remove DOE's discretion to regulate exports certainly should not be concluded until a full environmental impact statement for export has been completed. That report will help policymakers determine how exports should be managed – critically important information for U.S. trade negotiators before they finalize any deal that would commit the nation to exports without any further oversight.

So far, however, DOE has not taken any of these steps, and neither has the U.S. Trade Representative. In meetings and phone conversations with the Sierra Club, the Trade Representative has insisted that DOE, not the Representative, must address the issue. DOE, in turn, has placed responsibility for protecting the public interest review process back on the Trade Representative. The result is that both agencies are pointing fingers at each other, and neither is taking responsibility for addressing this serious matter. Unless they change course,or Congress or the Executive act to insist that they do so, the result may be that the U.S. gives up its ability to manage LNG exports without even thinking about it.

VII. Conclusion: A Full EIS is Needed to Inform Policymakers and the Public

[189] H.R. Conf. Rep. 102-1018, 1992 USCCAN 2472, 2477 (Oct. 5, 1992); *see also* 138 Cong. Rec. 34,043 (Oct.8. 1992) (statement of conferees, explaining only that the final bill "has been expanded to include fewer restrictions on exports of natural gas to countries with which the United States has a Free Trade Agreement.").
[190] 38 Cong. Rec. 32,076 (Oct. 5, 1992) (emphasis added).
[191] Letter from Christopher Smith, Deputy Assistant Secretary of Oil and Gas to Representative Edward Markey (Feb. 24, 2012) at 1.

The United States is sleepwalking through one of the biggest energy policy decisions of our time. Even as billions of dollars in investment capital are marshaled to support an ever-growing wave of export proposals, the federal agencies in charge of protecting the public interest have failed even to consider the environmental implications of exporting a large amount of the domestic gas supply – including the intensified fracking needed to support exports. Meanwhile, trade negotiators risk stripping away DOE's discretion ever to properly manage these problems, even if it does finally analyze and disclose them.

No matter where one stands on the ultimate wisdom of LNG exports, it is clear that this sort of blind, piecemeal, decisionmaking is what NEPA was designed to prevent. For more than 40 years, NEPA has reflected a national commitment to transparent, democratic, and careful decisionmaking to protect communities and our environment. That commitment applies with great force to DOE's decisionmaking now, and the agency should honor it. The possible conversion of the United States into one of the world's largest LNG exporters is a matter of national importance and a key shift in environmental and economic policy. If a full NEPA analysis of all the consequences, upstream and downstream, of an agency's decisions were ever appropriate for any agency action, then an EIS is surely appropriate now, when the nation's energy future is profoundly implicated by DOE's decisions. It is time for a full programmatic environmental impact statement for LNG export.

DOE has the time and the duty to do the right thing and begin the open, public, environmental impact statement process it should have initiated at the outset. It must retreat from its dereliction of duty in the Sabine Pass environmental process, and instead extend its national review process from the economic studies it has already begun to the environmental studies it also plainly needs. Before issuing another license on a piecemeal basis, it should change course, acknowledge its responsibilities, and begin the national conversation we urgently need to have.

Sierra Club National
85 Second Street, 2nd Floor
San Francisco, CA 94105
(415) 977-5500

Sierra Club Legislative
50 F Street, NW, Eighth Floor
Washington, DC 20001
(202) 547-1141

www.sierraclub.org
facebook.com/SierraClub
twitter.com/sierra_club

Exhibit 10

Exhibit 10

http://www.resilience.org/stories/2012-10-22/gas-bubble-leaking-about-to-burst

Gas Bubble Leaking, About to Burst

by Richard Heinberg, originally published by Post Carbon Institute | Oct 22, 2012

For the past three or four years media sources in the U.S. trumpeted the "game-changing" new stream of natural gas coming from tight shale deposits produced with the technologies of horizontal drilling and hydrofracturing. So much gas surged from wells in Texas, Oklahoma, Louisiana, Arkansas, and Pennsylvania that the U.S. Department of Energy, presidential candidates, and the companies working in these plays all agreed: America can look forward to a hundred years of cheap, abundant gas!

Some environmental organizations declared this means utilities can now stop using polluting coal—and indeed coal consumption has plummeted as power plants switch to cheaper gas. Energy pundits even promised that Americans will soon be running their cars and trucks on natural gas, and the U.S. will be exporting the fuel to Europe via LNG tankers.

Early on in the fracking boom, oil and gas geologist Art Berman began sounding an alarm (see example). Soon geologist David Hughes joined him, authoring an extensive critical report for Post Carbon Institute ("Will Natural Gas Fuel America in the 21st Century?"), whose Foreword I was happy to contribute.

Here, one more time, is the contrarian story Berman and Hughes have been telling: The glut of recent gas production was initially driven not by new technologies or discoveries, but by high prices. In the years from 2005 through 2008, as conventional gas supplies dried up due to depletion, prices for natural gas soared to $13 per million BTU (prices had been in $2 range during the 1990s). It was these high prices that provided an incentive for using expensive technology to drill problematic reservoirs. Companies flocked to the Haynesville shale formation in Texas, bought up mineral rights, and drilled thousands of wells in short order. High per-well decline rates and high production costs were hidden behind a torrent of production—and hype. With new supplies coming on line quickly, gas prices fell below $3 MBTU, less than the actual cost of production in most cases. From this point on, gas producers had to attract ever more investment capital in order to maintain their cash flow. It was, in effect, a Ponzi scheme.

In those early days almost no one wanted to hear about problems with the shale gas boom—the need for enormous amounts of water for fracking, the high climate impacts from fugitive methane, the threats to groundwater from bad well casings or leaking containment ponds, as well as the unrealistic supply and price forecasts being issued by the industry. I recall attempting to describe the situation at the 2010 Aspen Environment Forum, in a session on the future of natural gas. I might as well have been claiming that Martians speak to me via my tooth fillings. After all,

the Authorities were all in agreement: The game has changed! Natural gas will be cheap and abundant from now on! Gas is better than coal! End of story!

These truisms were echoed in numberless press articles—none more emblematic than Clifford Krauss's New York Times piece, "There Will Be Fuel," published November 16, 2010.

Now Krauss and the Times are singing a somewhat different tune. "After the Boom in Natural Gas," co-authored with Eric Lipton and published October 21, notes that ". . . the gas rush has . . . been a money loser so far for many of the gas exploration companies and their tens of thousands of investors." Krauss and Lipton go on to quote Rex Tillerson, CEO of ExxonMobil: "We are all losing our shirts today. . . . We're making no money. It's all in the red." It seems gas producers drilled too many wells too quickly, causing gas prices to fall below the actual cost of production. Sound familiar?

The obvious implication is that one way or another the market will balance itself out. Drilling and production will decline (drilling rates have already started doing so) and prices will rise until production is once again profitable. So we will have less gas than we currently do, and gas will be more expensive. Gosh, whoda thunk?

The current Times article doesn't drill very far into the data that make Berman and Hughes pessimistic about future unconventional gas production prospects—the high per-well decline rates, and the tendency of the drillers to go after "sweet spots" first so that future production will come from ever-lower quality sites. For recent analysis that does look beyond the cash flow problems of Chesapeake and the other frackers, see "Gas Boom Goes Bust" by Jonathan Callahan, and Gail Tverberg's latest essay, "Why Natural Gas isn't Likely to be the World's Energy Savior".

David Hughes is working on a follow-up report, due to be published in January 2013, which looks at unconventional oil and gas of all types in North America. As part of this effort, he has undertaken an exhaustive analysis of 30 different shale gas plays and 21 shale/tight oil plays—over 65,000 wells altogether. It appears that the pattern of rapid declines and the over-stated ability of shale to radically grow production is true across the U.S., for both gas and oil. In the effort to maintain and grow oil and gas supply, Americans will effectively be chained to drilling rigs to offset production declines and meet demand growth, and will have to endure collateral environmental impacts of escalating drilling and fracking.

No, shale gas won't entirely go away anytime soon. But expectations of continuing low prices (which drive business plans in the power generation industry and climate strategies in mainstream environmental organizations) are about to be dashed. And notions that the U.S. will

become a major gas exporter, or that we will convert millions of cars and trucks to run on gas, now ring hollow.

One matter remains unclear: what's the energy return on the energy invested (EROEI) in producing "fracked" shale gas? There's still no reliable study. If the figure turns out to be anything like that of tight "fracked" oil from the North Dakota Bakken (6:1 or less, according to one estimate), then shale gas production will continue only as long as it can be subsidized by higher-EROEI conventional gas and oil.

In any case, it's already plain that the "resource pessimists" have once again gotten the big picture just about right. And once again we suffer the curse of Cassandra—though we're correct, no one listens. I keep hoping that if we're right often enough the curse will lift. We'll see.