Projects Interaction and Review Team (PIRT) Meeting

Clinton Foster

Chair, Australia

15 June 2015
Regina, Saskatchewan, Canada

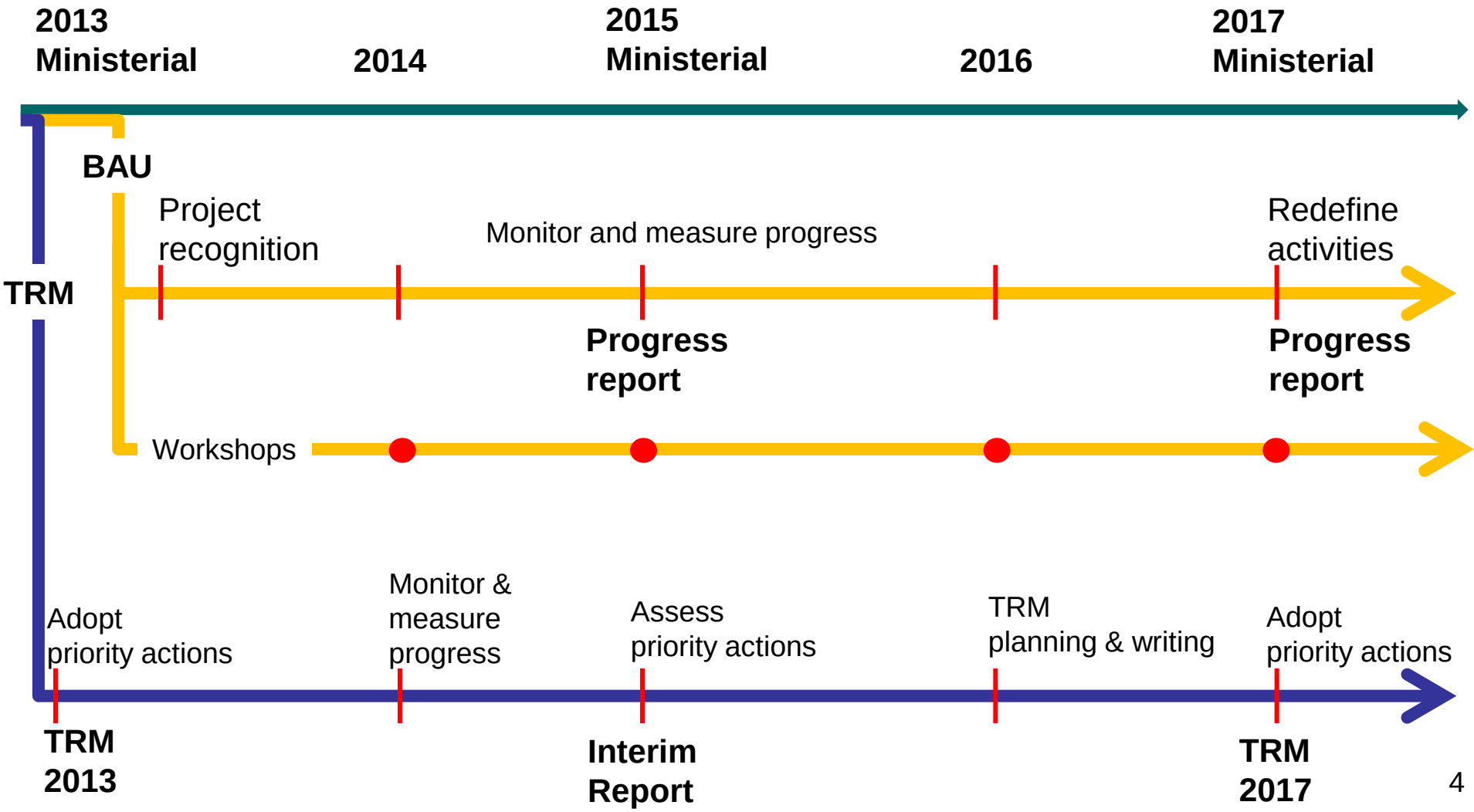
WELCOME

PIRT - two functions (from Seoul meeting 2014)

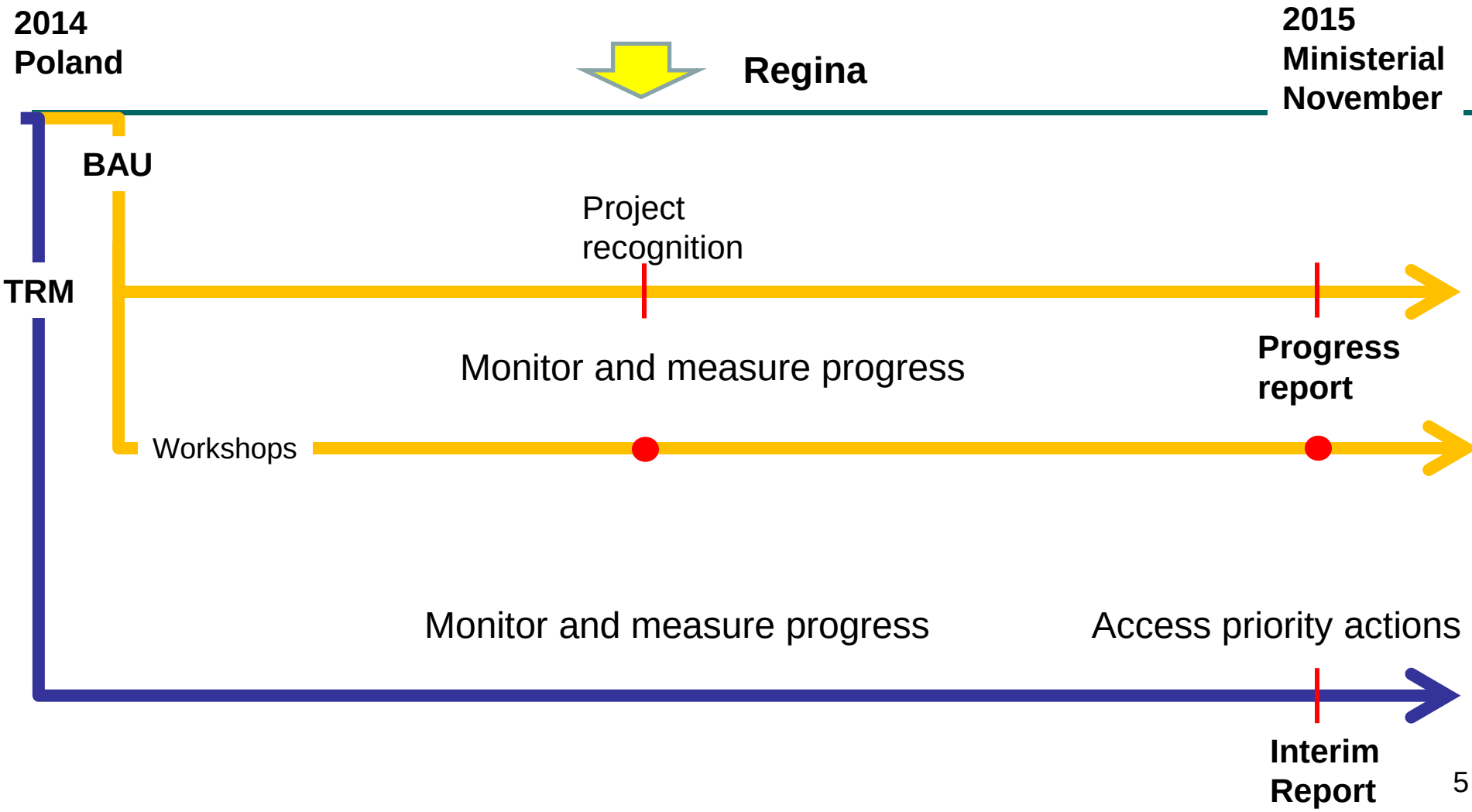
Business as Usual	New Activities from Technical Roadmap (TRM)

• Project recognition
• Project monitoring
  • Workshop
	• Collaboration with CCS organisations
	• Monitoring TRM priority actions
	  • Summarise CCS progress
	• TRM publication

PIRT Action Time Line



PIRT Action Time Line - detail



Operation and Procedures of the PIRT

Project Recognition

- Project proposals should be circulated to Active Members by the CSLF Secretariat.
- No later than ten days prior to PIRT meetings, Members are asked to submit a free-text comment, either supporting or identifying issues for discussion on each project nominated for CSLF recognition.

Operation and Procedures of the PIRT

- At PIRT meetings or via proxy through the PIRT Chair, individual country representatives will be required to comment on projects nominated for CSLF recognition .

- Recommendations of the PIRT should be reached by consensus with one vote per member country only.

Agenda Item 3
Approval of Summary of the Warsaw PIRT meeting

- **Summary of Consensuses**
  - The PIRT recommends approval by the Technical Group for the Norcem CO2 Capture Project.

- **Summary of Action Items –** *Item 4 this Agenda*

Agenda Item 5

Discussion of Draft of Interim report – on screen

Agenda Item 7
Future PIRT Activities

7.1 TRM Progress reports – ***comments and review from Items 4,5***

7.2 Future Technology Road Map – ***for which stakeholders?***

7.3 Technology Workshops – ***future topics***

Agenda Item 7.2
Future TRM for which stakeholders?

Carbon Sequestration leadership forum
www.cslforum.org

GOVERNMENT

Any technical gaps
Progress
Business as usual
2030 1 Gtonne

INDUSTRY

Agrees same gaps
Active

PUBLIC

Confidence
in technique

Agenda Item 7.2 continued

- Is it still a TRM or does the document take on a new role

  - ***Technology status report update (TSR)***
  - ***Technology update to CCS/CCUS***
  - ***Technology progress to CCS/CCUS***

Storage or Disposal

Project Dashboard

Summary

- On target.
- Small resource issues

KPI Status

By Project Area

- Workstream 1 – on target
- Workstream 2 – on target
- Workstream 3 – Budget required
- Workstream 4 – Resource issue
- Workstream 5 – on target

RISKS	ASSUMPTIONS	ISSUES	DEPENDENCIES
• New Competitors [owner: Howard] • Supply chain [owner: Jane]	• Finance will continue to 2013	• Resource in Workstream 4 • Signoff needed for Widget plan	• Widget supplier is going out of business - must source new supplier

23-Jun-13 www.Business-Docs.co.uk 2

https://business-docs.co.uk/downloads/powerpoint-project-dashboard-with-status-template/

Agenda Item 7.2 continued

- The proposition is that the principle stakeholder is GOVERNMENT
- Both Industry and Public need to be informed – because Government will not proceed without the agreement/approval/knowledge of both other partners
- For CSLF it means new format – and other options

Agenda Item 7.3 WORKSHOPS

- Shipping CO2?
- Engineering integration?
- ?

Norcem CO_2 Capture Project

PIRT Members' Recommendations

PIRT Member	Recommendation	Supporting Comments
Australia (Foster)	Approve	"Australia welcomes the application to this industrial process."
European Commission (Schuppers)	Approve	"...the approach to test 4 different capture technologies on emissions from the cement industry strikes me as innovative and of wider interest."
France (Bonijoly)	Approve	"...all the members of the European Cement Research Academy ... see this project as an important step towards the overall reduction in CO_2 emissions for the cement industry. … They are convinced of the benefits of this project for their industry. "
Japan (Tanaka)	Approve	

PIRT Members' Recommendations

PIRT Member	Recommendation	Supporting Comments
Saudi Arabia (Aleidan)	Approve	"Capturing CO_2 from fixed sources (e.g cement industry) is relevant to Saudi Arabia research interests. Even though the project is investigating mature technologies, the benchmarking will offer valuable insights."
United Kingdom (Sharman)	Approve	"…an excellent project addressing important CO_2 capture aspects of industrial CCS. … The Benchmarking Study is particularly relevant [and] the dissemination activities … look comprehensive."
United States (Litynski)	Approve	"…technologies being tested … are of significant interest to DOE and we look forward to leveraging the international collaboration to learn more about the flexibility of these capture technologies."

Best Practices and Standards for Geologic Storage and Monitoring of CO_2

- Content
  - Summary
    - For a high level summary with indications of which storage topics are included in the documents, click her
  - Standards general
    - CSA: Z741-12 - Geological storage of carbon dioxide
    - ISO/TC 265 "Carbon dioxide capture, transportation, and geological storage" – work in progress
  - Guidelines
    - Australia
    - European Commission
    - Alberta, Canada
      Summary Report of the Regulatory Framework Assessment
    - London Convention and Protocol
    - OSPAR
    - Site screening, characterization and selection
    - US EPA
    - World Resources Institute (WRI): Guidelines for CCS
  - Best Practice Manuals
    - General
    - Simulation and modelling
    - Well construction and integrity
    - Monitoring and verification
    - Risk assessment and management
    - Operation
    - Closure

OSPAR

- The OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic has issued Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations
- http://www.ospar.org/html_documents/ospar/html/ospar_convention_e_updated_text_2007.pdf
- http://www.google.no/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCQQFjAA&url=http%3A%2F%2Fwww.ospar.org%2Fdocuments%2Fdbase%2Fdecrecs%2Fagreements%2F07-12e_co2%2520gl%2520and%2520fram.doc&ei=yvBAVOq0CYWxaeSpgPgL&usg=AFQjCNF2Gwg_5zwO-SWZyOZ3zVgaTOdHVA&bvm=bv.77648437,d.d2s

- The Convention is accompanied by Guidelines for Risk Assessment and Management of Storage of CO_2 Streams in Geological Formations
- The Guidelines provide generic guidance for Contracting Parties when considering applications for permits to store CO_2 in geological formations under the seabed. The Guidelines have four Annexes, whereof Annex 1 – Framework for Risk Assessment and management of Storage of CO_2 Streams in Geological Formations (FRAM) – is relevant for this overview. It addresses:
- Problem formulation
- Site selection and characterization
- Exposure assessment
- Effects assessment
- Risk characterization
- Risk management

Agenda Item 7, TRM 2017 - confirmation

From the Minutes Seoul, following responsibilities were assigned:

Area #1: CO2 Capture Technologies in Power Generation (Norway)

Area #2: CO2 Capture in Industrial Sector (South Africa & UK)

Area #3: CO2 Transport (Australia)

Area #4: Large-Scale CO2 Storage (Japan and France)

Area #5a: Monitoring (United States & France)

Area #5b: Mitigation / Remediation (European Commission)

Area #6: Understanding the Storage Reservoirs (United Kingdom – to be confirmed)

Area #7: Infrastructure (United Kingdom – to be confirmed)

Area #8a: CO2 Utilization, non-EOR (France, M. David Savary, Solvay)

Area #8b: CO2 Utilization, EOR (Saudi Arabia)

Agenda Item 9

Closing Comments / Adjourn

Agenda Item 4 TRM Progress

TRM Progress Report

- 2013 CSLF Technology Roadmap (TRM) was launched at 5th CSLF Ministerial Meeting in November 2013.
- An objective of 2013 TRM was to answer three key questions:
  - What is the current status of CCS technology and deployment, particularly in CSLF member countries?
  - Where should CCS be by 2020 and beyond?
  - What is needed to get from point a) to point b), while also addressing the different circumstances of developed and developing countries?

TRM Progress Report

- At 2014 Technical Group Meeting (in Seoul), PIRT began the process for producing a Progress Report on the 2013 TRM.
- Template was developed by Secretariat, approved by PIRT Chair, for gathering information about ten technology needs areas identified in 2013 TRM.

TRM Progress Report

Technology Needs Areas:

a) CO_2 capture in power generation
b) CO_2 capture in the industrial sector
c) CO_2 transport
d) Large-scale CO_2 storage
e) Monitoring stored CO_2
f) Mitigation / remediation procedures
g) Understanding storage reservoirs
h) Infrastructure and the integrated CCS chain (capture to storage)
i) CO_2 utilization, non-EOR
j) CO_2 utilization, EOR

TRM Progress Report

- Technical Group delegates sent template to representatives of organizations within their countries which are working on CCS.
- As of October, total of 13 completed templates have been returned.
  - Norway (4)
  - USA (3)
  - Canada, China, EC, Japan, Saudi Arabia, Australia (1 each)

TRM Progress Report

- TRM Progress Report includes responses received as of September 29.
- Additional completed templates were received after this date will be included in next version of Progress Report.

TRM Progress Report

TRM Progress Report – Global Trends

Technology Needs Area	1st Generation Technologies – Progress toward 2020	2nd – 3rd Gen. Technologies – Progress toward 2020	What kinds of barriers exist?		
			Economic	Policy	Technology
a) CO_2 Capture in Power Generation	Moderate	Very Slowly to Moderate	Yes	Yes	Yes
b) CO_2 Capture in Industrial Sector	Very Slowly to Moderate	Very Slowly	Yes	Yes	Yes
c) CO_2 Transport	Very Slowly to Moderate	Very Slowly to Moderate	Yes	Yes	
d) Large-Scale CO_2 Storage	Very Slowly to Moderate	Very Slowly to Moderate	Yes	Yes	
e) Monitoring Stored CO_2	Moderate	Very Slowly to Moderate	Yes	Yes	Yes
f) Mitigation / Remediation Procedures	Moderate	Very Slowly to Moderate	Yes	Yes	Yes
g) Understanding Storage Reservoirs	Very Slowly to Moderate	Very Slowly to Moderate	Yes	Yes	Yes
h) Infrastructure and the Integrated CCS Chain (capture to storage)	Very Slowly	Very Slowly	Yes	Yes	
i) CO_2 Utilization, non-EOR	Very Slowly	Very Slowly	Yes	Yes	Yes
j) CO_2 Utilization, EOR	Moderate	Very Slowly	Yes	Yes	Yes

TRM Progress Report

PRELIMINARY RESULTS:

- Not enough information yet to definitively describe global status of CCS. Some trends are evident.
- For 1st generation technologies, **none** of the 10 technology needs areas were perceived as "fast moving".

TRM Progress Report

PRELIMINARY RESULTS:

- Progress in most areas perceived as mixed opinion of “very slow” and “moderate”.
- Geographic bias in responses received: North American responders were, in general, more pessimistic.
- Results for 2nd & 3rd generation technologies were similar, but many more “no opinion” responses were received.

TRM Progress Report

PRELIMINARY RESULTS:

- No clear-cut singling-out of specific barriers (or drivers). All types of barriers (economic, policy, technology) perceived to exist for most technology needs areas.
- Individual country results gave wide range of responses. Issues surrounding CCS are viewed in different ways in different countries.

TRM Progress Report

CONCLUSIONS AND RECOMMENDATIONS:

- 2013 TRM is still reasonably accurate in its depiction and portrayal of the status and barriers/drivers for development and deployment of CCS technologies.
- There is still a need for progress in **all** of the technology needs areas, some more than others.

TRM Progress Report

CONCLUSIONS AND RECOMMENDATIONS:

- Results confirm that worldwide, CCS is not a “one size fits all” collection of technologies.
- There is a great need for individualized country-specific technology roadmaps.
- **This is only an interim progress report**. An updated version is recommended for the next CSLF meeting.

DETAILS

4.1.1. Recommendation 1: CO2 Capture Technologies in Power Generation

Towards 2020: Implement a sufficient number of large-scale capture plants and sizeable pilots to:

- Increase understanding of the scale-up risks. Lessons learned will be used to generate new understanding and concepts complying with 2nd generation CCS.
- Gain experience in the integration of CO2 capture systems with the power or processing plant, including heat integration and other environmental control systems (SOx, NOx).
- Gain experience in part-load operations and daily cycling flexibility, as well as in the impacts of CO2 composition and impurities.
- Gain experience in the integration of power plants with CCS into electricity grids utilizing renewable energy sources.

Towards 2030:

- Develop 2nd generation CO2 capture technologies with energy penalties and avoidance costs well below that of 1st generation technologies. Possible targets for 2nd generation capture technology for power generation and industrial applications are a 30% reduction of the each of the following the energy penalty, normalized capital cost, and normalized operational and maintenance (O&M) costs (fixed and non-fuel variable costs) compared to 1st generation technologies.

Towards 2050:

- Possible targets for 3rd generation CO2 capture technology for power generation and industrial applications are a 50% reduction of each of the following: the energy penalty, normalized capital cost, and normalized O&M costs (fixed and non-fuel variable costs) compared to 1st generation technologies.

4.1.2. Recommendation 2: CO2 Capture in the Industrial Sector

Towards 2020:

- Further develop CO2 capture technologies for industrial applications and implement pilot-plants and demonstrations for these.

Towards 2030:

- Implement the full-scale CCS chain in cement, iron and steel and other industrial plants.

4.2.1. Recommendation 3: CO2 Transport

Towards 2020:

- Acquire data for, and understand the effects of, impurities on the thermodynamics of CO2 streams and on pipeline materials, and establish and validate flow models that include such effects.
- Establish and validate dispersion models for the impact assessment of incidents pursuant to leakage of CO2 from the CO2 transport system (pipelines, ships, rail and trucks).
- Develop common specifications for pipelines and the CO2 stream and its components.
- Qualify pipeline materials for use in CO2 pipes with impurities.

4.3.1. Recommendation 4: Large-Scale CO2 Storage

Towards 2020:

- Demonstrate CO2 storage in a wide range of sizes and geological settings, including deep saline formations, depleted oil and gas fields and producing oil and gas fields (EOR and EGR) around the world.
- Improve the understanding of the effects of impurities in the CO2 stream, including their phase behaviour, on the capacity and integrity of the CO2 storage site, with emphasis on well facilities.

Towards 2030:

- Qualify CO2 storage sites for safe and long-term storage in the scale of tens of millions of tonnes of CO2 annually per storage site from clusters of CO2 transport systems.

Towards 2050:

- Have stored over 120 GtCO2 in geological storage sites around the world.

4.3.2. Recommendation 5: Monitoring and Mitigation/Remediation

Towards 2020:

- Further testing, validation and commercialization of monitoring technologies in large-scale CO2 storage projects, onshore and offshore, to prove that monitoring works and leaks can be prevented or detected, and to make monitoring cost-efficient.
- Develop mitigation and remediation methods for leakage, including well leakage, and test in small-scale, controlled settings.
- Validate mitigation technologies on a large scale, including well leakage.
- Demonstrate safe and long-term CO2 storage.

Towards 2030:

- Develop a complete set of monitoring and mitigation technologies to commercial availability.

4.3.3 Recommendation 6: Understanding the Storage Reservoirs

Towards 2020:

- Further advance the simulation tools.
- Develop and agree on consistent methods for determining CO2 storage capacity reserves at various scales (as opposed to storage resources) and global distribution of this capacity (important for policy makers).

4.4.1. Recommendation 7: Infrastructure

- Towards 2020:
- Design large-scale CO2 transport networks that integrate capture, transport and storage, including matching of sources and sinks, particularly in non-OECD countries.
- Map the competing demands for steel and pipes and secure the manufacturing capacity for the required pipe volumes and other transport items.
- Develop systems for metering and monitoring CO2 from different sources with varying purity and composition that feed into a common collection and distribution system.
- Start the identification, characterization and qualification of CO2 storage sites for the large-scale systems.

Towards 2030:

- Implement large-scale CO2 transport networks that integrate CO2 capture, transport and storage, including matching of sources and sinks, particularly in non-OECD countries.

4.5.1. Recommendation 8: CO2 Utilization

Towards 2020:

- Resolve technical challenges for the transition from CO2-EOR operations to CO2 storage operations.
- Establish methods and standards that will increase and prove the permanent storage of CO2 in EGR, ECBM, EGHR and other geological applications if CO2 injection becomes more prevalent in these applications.
- Research, evaluate and demonstrate carbonation approaches, in particular for mining residue carbonation and concrete curing, but also other carbonate mineralization that may lead to useful products (e.g. secondary construction materials), including environmental barriers such as the consequences of large mining operations and the disposal of carbonates.
- Map opportunities, conduct technology readiness assessments and resolve main barriers for the implementation of the CO2 utilization family of technologies including life-cycle assessments and CO2 and energy balances.
- Increase the understanding of CO2 energy balances for each potential CO2 re-use pathways and the energy requirement of each technology using technological modelling.
- Address policy and regulatory issues related to CO2 utilization, particularly in enhanced hydrocarbon recovery.

TRM Priority Actions

- Towards 2020 nations should work together to:
  - Maintain and increase commitment to CCS as a viable greenhouse gas (GHG) mitigation option
  - Establish international networks, test centres and comprehensive RD&D programmes to verify, qualify and facilitate demonstration of CCS technologies
  - Gain experience with 1st generation CO2 capture technologies and their integration into power plants
  - Encourage and support the first industrial demonstration plants for CO2 capture
  - Develop sizeable pilot-scale projects for storage
  - Design large-scale, regional CO2 transport networks and infrastructure
  - Agree on common standards, best practices and specifications for all parts of the CCS chain
  - Map regional opportunities for CO2 utilization, addressing the different priorities, technical developments and needs of developed and developing countries.

TRM Priority Actions

- Towards 2030 nations should work together to:
  - Move 2nd generation CO2 capture technologies for power generation and industrial applications through demonstration and commercialisation, with possible targets of 30% reduction of energy
  - penalty, normalized capital cost, and normalized operational and maintenance (O&M) costs compared to 1st generation technologies
  - Implement large-scale national and international CO2 transport networks and infrastructure
  - Demonstrate safe, large-scale CO2 storage and monitoring
  - Qualify regional, and potentially cross-border, clusters of CO2 storage reservoirs with sufficient capacity
  - Ensure sufficient resource capacity for a large-scale CCS industry
  - Scale-up and demonstrate non-EOR CO2 utilization options.

TRM Priority Actions

- Towards 2050 nations should work together to:
  - Develop and progress to commercialisation 3rd generation CO2 capture technologies with energy penalties and avoidance costs well below that of 1st generation technologies. Possible targets for 3rd generation CO2 capture technology for power generation and industrial applications are a 50% reduction from 1st generation levels of each of the following: the energy penalty, capital cost, and O&M costs (fixed and non-fuel variable costs) compared to 2013 first generation technologies costs.