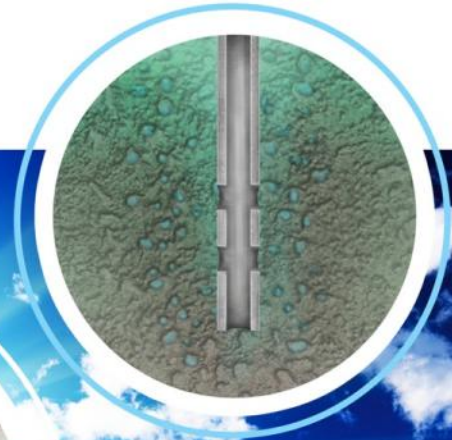


CSLF Technology Opportunities (& Gaps) Task Force



Richard Aldous

Chief Executive Officer

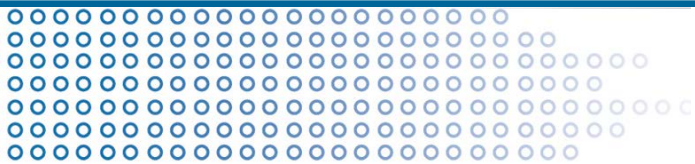
Cooperative Research Centre
for Greenhouse Gas
Technologies (CO2CRC)

Presenting to
CSLF Closing the Technology Gap Task
Force, Perth, 24th October 2012

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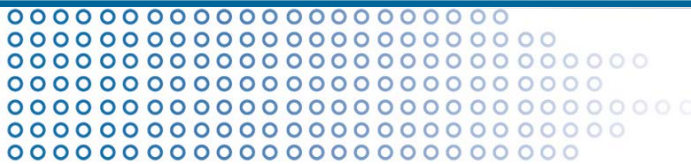
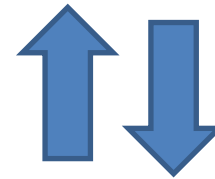
Outline of Presentation:

- Terms of Reference
- Timeline for Report
- Process for creating Report
- How have technology gaps/readiness been assessed before?



Two tasks forces : Linkages

- Technical Road Map Task Force
 - High level definition of opportunities
 - Timelines/ milestones
 - Vision and direction set
- Opportunities & Gaps Task Force
 - More detail/ granularity
 - Specific technology issues
 - Use of TRL



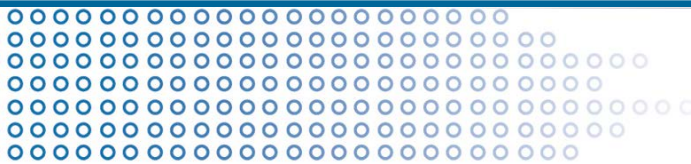
Terms of Reference:

Members:

- Australia – Richard Aldous
- USA – Darren Mollot
- Korea – Chang-Keun Yi
- Norway – Lars Ingolf Eide



- The proposed work of the TF will be to undertake a comprehensive view of the key technologies in play around CCS and CCUS with a view to identify scientific and technology gaps and opportunities which have the potential to significantly impact on CCS/CCUS demonstration and deployment.
- The reports will set out high level gaps and opportunities with recommendations on how the global technology development pathway could be sped up or enhanced to further drive down costs and enhance efficiency.

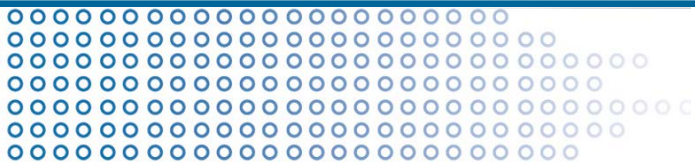


Relevant work to date – needs to be reviewed and synthesised

- Previous CSLF gaps report
- DOE reports
- Numerous GCCSI report
- TRL process happening in USA and other countries
- EU gaps analysis ECCSEL (EU initiative)
- Various technology road maps

Action:

- Review and create an outline synthesis as a starting point
- Derive a high level list of apparent gaps/opportunities & also targets
- Then dig in deeper in certain areas as required

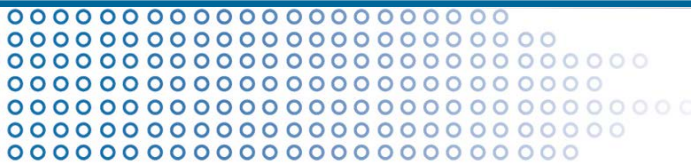


Example of CSLF Storage & Monitoring Gaps and how addressed by CO2CRC-research

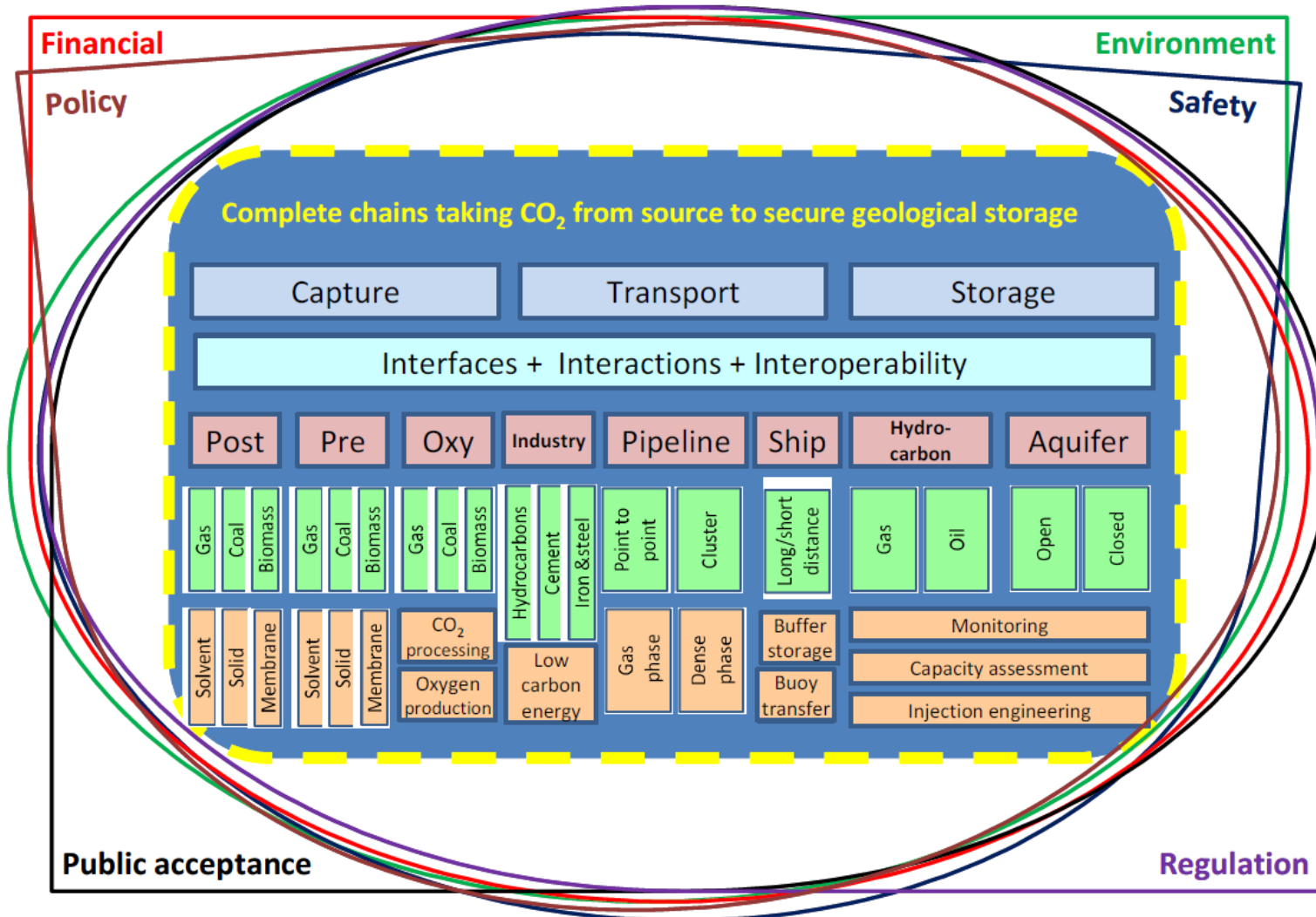
Storage Technology Theme	Number of subthemes
Injection	4 of 7
Storage Options	2 of 7
Deep Saline Formation	All 5 of 5
Depleted Oil and Gas Fields	1 of 2
Unmineable Coal Seams	0 of 2
Mineral Carbonation	3 of 4
Gaps in Uses of CO ₂ (EOR and EGR)	0 of 1
Trapping	All 2 of 2
Hydrodynamics	1 of 2
CO ₂ Properties	1 of 1
Assessments	4 of 6
Leakage	2 of 3
Economics	1 of 1
Software	2 of 3
Risk	1 of 1
Public Outreach	1 of 1

Monitoring Theme	Number of subthemes
General	0 of 2
Wellbore Integrity	3 of 4
Identification of Faults and Fractures	All 3 of 3
Subsurface Leaks	All 3 of 3
Surface and Near-Surface Leaks	5 of 7
Guideline Development	0 of 4
Gaps in Security of Geologic Storage	3 of 6
General	0 of 7
Integration	0 of 4
Cross-Cutting Issues	0 of 1

Technology Area	% by CO2CRC
Storage	60%
Monitoring	41%
Total	51%

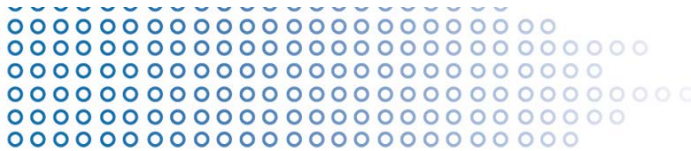


Structure of Spreadsheet:



CCS Impact Area Map based on factors influencing the deployment of CCS.

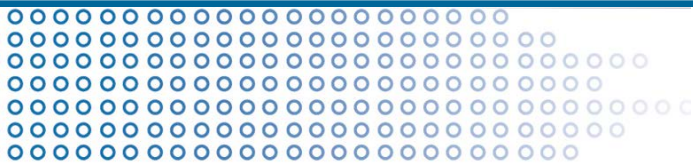
© UKCCS Research Centre



Structure of Spreadsheet:

to be used for assembling data and assessment of technologies

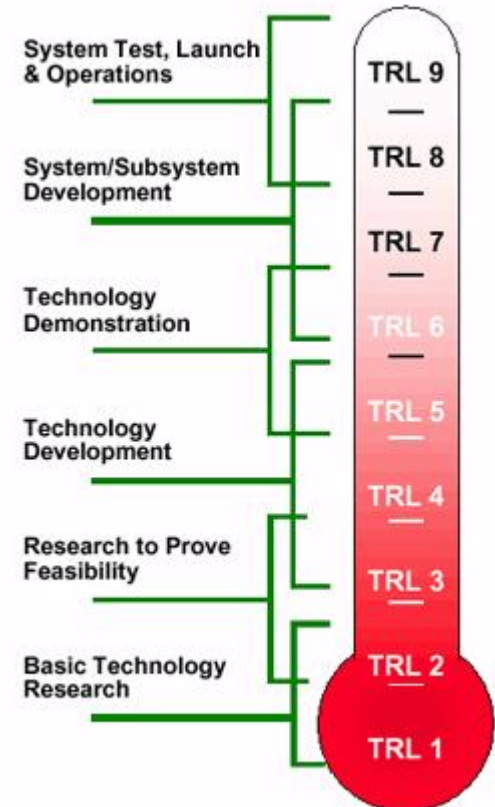
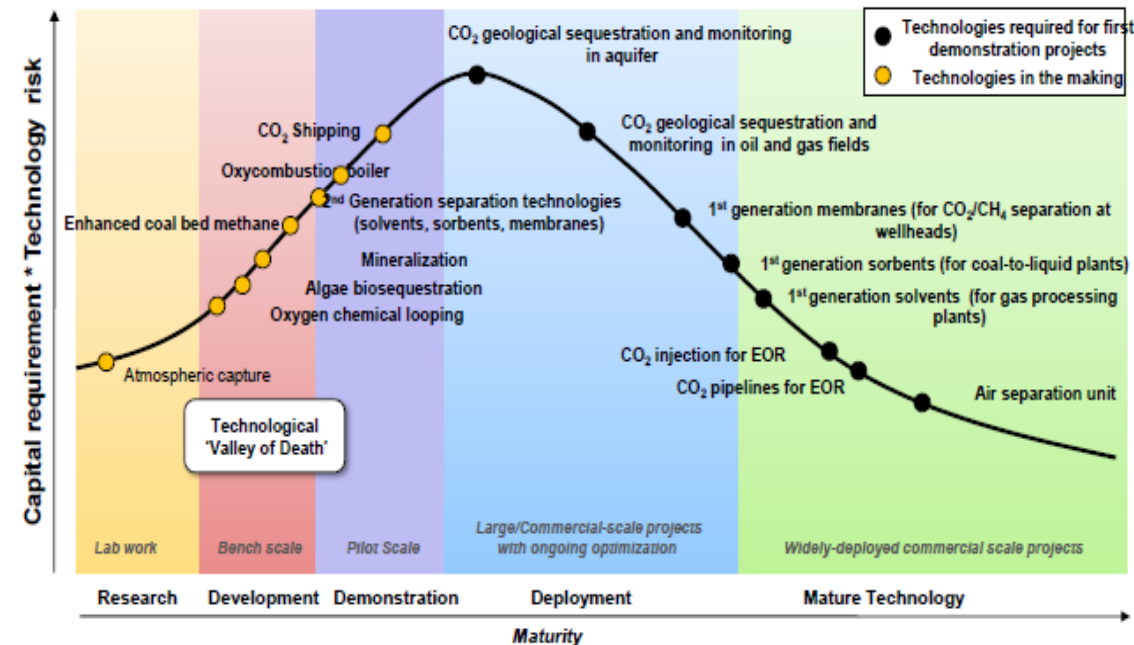
	A	B	C	D	E	F	G	H
1	Absorption process	Solvent/ description	Developer/Licensor	Source	TRL	H/M/L	COMMENTS	
2								
3	OVERALL SOVENT SYSTEMS	ranking all sovent sytems overall	synthesis of below					
4								
5	AMINE BASED SOLVENTS							
6	Physical Solvent							
7	Rectisol	Methanol	Lurgi and Linde, Gern	Gupta et al 2003	8			
8	Puisol	n-methyl-2-pyrrolidone (NMP)	Lurgi, Germany	Gupta et al 2003	8			
9	Selexol	dimethyl ethers of polyethylene glycol (DMPEG)	Union Carbide, USA	Gupta et al 2003	8			
10	Flour Solvent	Popylene carbonate	Flour, El Paso, USA	Gupta et al 2003	8			
11								
12	Chemical Solvent (organc - Amine Based)							
13								
14	MEA	2.5 n monoethanolamine and chemical inhibitors	Dow Chemical, USA	Gupta et al 2003	8			
15	Amine Guard (MEA)	5 n monoethanolamine and chemical inhibitors	Union Carbide, USA	Gupta et al 2003	8			
16	Econamine (DGA)	6 n diglycolamine	SNEA version by Soci	Gupta et al 2003	8			
17	ADIP (DIPA & MDEA)	2-4n diisopropanolamine 2 n methyl-diethanolamine	Shell, Netherlands	Gupta et al 2003	8			
18	MDEA	2 n methyl-diethanolamine	Shell, Netherlands	Gupta et al 2003	8			
19	Flexsorb/KS-1, KS-2, KS-3	Hindered amine	Exxon, USA; M.H.I	Gupta et al 2003	8			
20	AMP	2-amino-2-methyl-1-propanol		Weiland et al 2010	6			
21	Sodium Glycinate (NaGly)			Weiland et al 2010	6			
22								
23								
24								
25								
26	Physical/Chemical Solvents							
27								
28	Sulfinol-D and Sulfinol-M	Mixture of DIPA or MDEA, water and tetrahydrothiopene (DIPAM) or diethylamine	Shell, Netherlands	Gupta et al 2003	7			
29	Amisol	Mixture of methanol and MEA, DEA, diisopropylamine (DIPAM) or diethylamine	Lurgi, Germany	Gupta et al 2003	7			
30								
31								
32								



How have technology gaps/readiness been assessed before?

TRLs as used by NASA and DOE

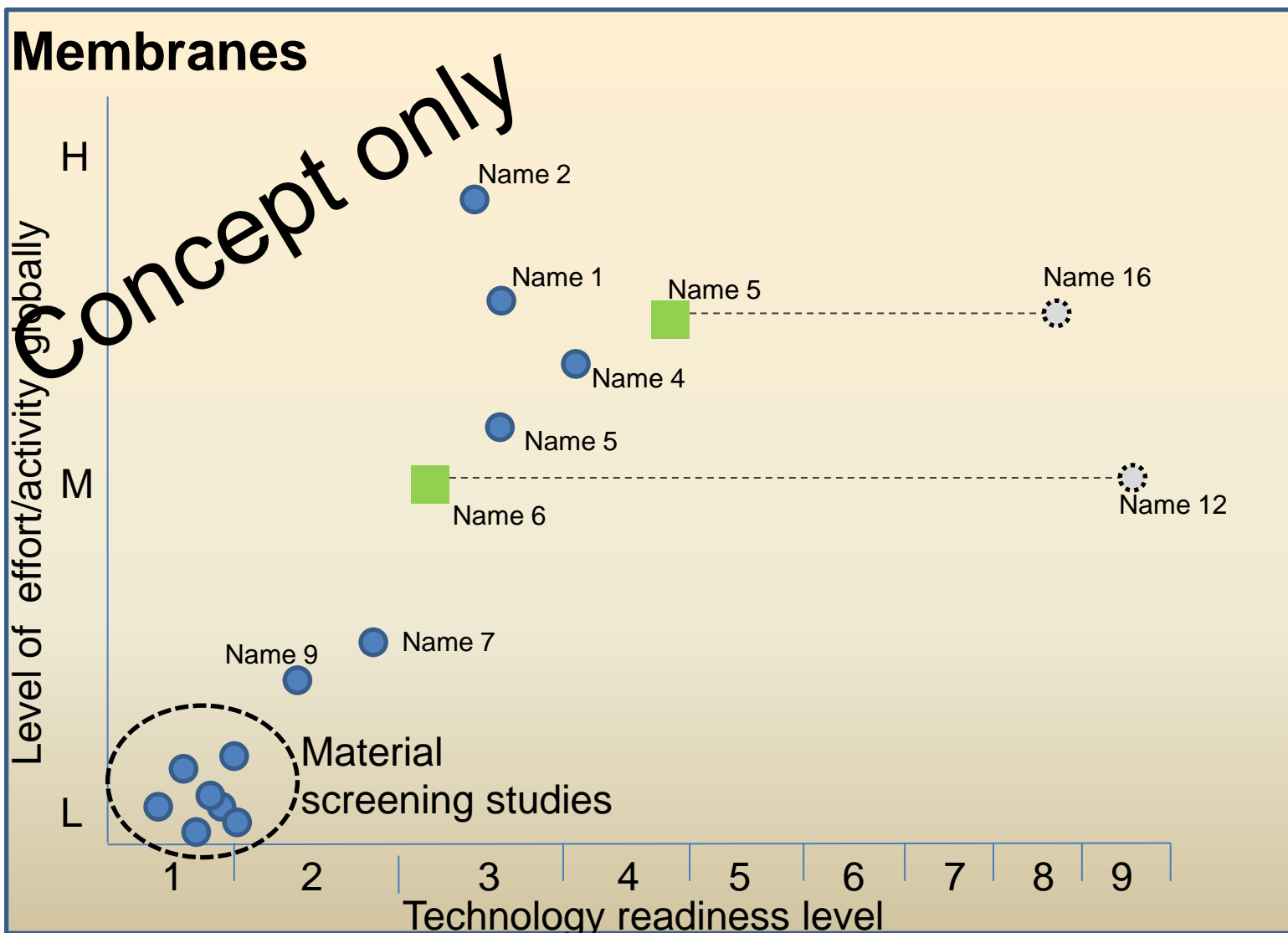
Example of CCS Technologies plotted on a generic Grubb Curve



(from "Leading the Energy Transition: Bringing Carbon Capture & Storage to Market" SBC Energy Institute 2012)

Note at the meeting Perth TF Meeting there was a suggestion that we also use the UK level of knowledge (LOK) process

Assessment of Portfolios



● CO2CRC Material (solvent membrane adsorbent)

⊛ Other material, the basis of our improvement work

■ Process improvement on or around a material

Timeline for Report

Task 1:

Agreement by the task force steering committee on the CTGTF document, including the Scope and Table of Contents. Review and finalisation **at or before the meeting in Perth in October 2012**

Task 2:

Agreement on the methodology and division of work.
December 2012

This may take more time and will follow the CSLF meeting in Perth on October 24-26, 2012. This task also includes allocation of resources necessary to perform the work with the TRM.



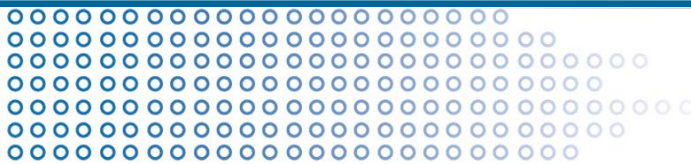
Process for creating Report

Phase 1:

- Review work to date
- Decide assessment methodology and on spreadsheet structure
- Begin to populate spreadsheet
- Identify early high level gaps and opportunities.
- Interim Report
- Recommendations

Phase 2:

- High level analysis of gaps and opportunities
- Review by panel of experts
- Synthesis and final report



Timeline for Report

Task 3:

Collection, collation and analysis of data **March 2013**

- Prepare draft report

In parallel to the above the task force will be feeding information to the Technical Road Map Process, surface ideas and technological trends that could be considered in the road map.

Task 4:

Approval. **July 2013**

This phase could include the following activities:

- Hearing round with critique, comments and validation by CSLF TG members
- Revision
- Approval at Ministerial meeting fall 2013.



Next steps

- **Send our spreadsheet and structure for feed back and initial population**
- **Send out draft list of known reports that could be useful requesting advice on additional reports that should be considered.**

