# Report from the 1st ACT knowledge sharing workshop

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691712

**Project title:**
ACT – Accelerating CCS Technologies

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# What ACT is about

Since the industrial era the level of carbon dioxide ($CO_2$) released into the atmosphere has increased significantly, and it is well documented that burning fossil fuels emits $CO_2$ with serious and negative impact on the climate. Carbon Capture and Storage (CCS) is part of a portfolio of technologies to combat climate change. CCS can help mitigate $CO_2$ emissions from electricity production and is a prerequisite for reducing $CO_2$ emissions from heavy industry such as steel, cement, chemicals and petrochemical refining.

ACT will be **A**ccelerating **C**CS **T**echnologies by making available funds for transnational research and innovation activities. CCS will have an important role to play in order to make the European transition to a low-carbon economy happen.

The CCS technology involves **capturing** $CO_2$ from large $CO_2$ emission point sources, such as fossil fuelled power plants and large, energy intensive industrial plants, compressing it for **transportation** and then injecting it deep into a rock formation at a carefully selected and safe site, where it is permanently **stored**. In addition CCUS projects where innovative and cost reducing **utilisation** of $CO_2$ is also in scope for ACT.


***Figure 1: Geological storage of CO2***

ACT is a collaboration of research and innovation funding organisations from nine European countries. Their collaboration takes the shape of an ERA NET Cofund under the Horizon 2020 program of the European Commission (EC).

The main activity of ACT will be to establish joint transnational calls for CCS research and development projects.

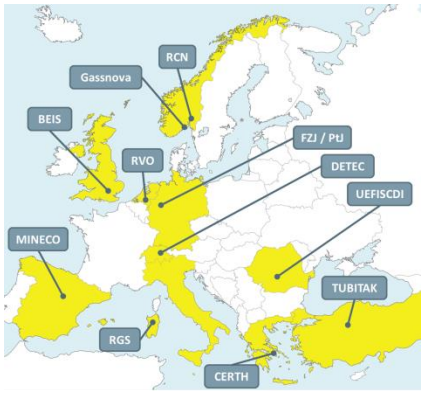


***Figure 2: Partners of ACT***

Ten partners from nine countries (Norway , Germany, Switzerland, Romania, The Netherlands, Turkey, Spain, Greece and the United Kingdom, have agreed to work together to develop the first call for projects later in 2016; ACT is led by Norway who is managing the budget of close to 41 million Euros.

The ACT calls ask for RD&D projects that can lead to deployment of CCS in Europe. Project proposals with high industrial relevance and industrial involvement will be prioritised.

Besides the organisations of joint calls, ACT cooperates closely with other CCS initiatives, primarily in Europe, but also in other parts of the world.



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## Executive summary

The ERA-NET ACT consortium met on 14 November 2016 in a one-day workshop in Lausanne (Switzerland) with their US-American Department of Energy, Australian (ANLEC R&D) and Canadian (NRCan) counterparts to discuss and share good practices in devising and managing funding schemes for CCS research and innovation projects.

The stage was set by the IEAGHG Technology Collaboration Program recommending processes to define the funding program's objective and evaluation criteria, and the high added value derived from large-scale CCS projects. Importantly, even for high Technology Readiness Level projects, there is a continued need for underlying applied R&D.

Funding agencies adopt variable approaches to funding CCS research built on a clear understanding of the research and innovation space and the regional needs to advance CCS. Fit-for-purpose funding vehicles range from governmental research programs to not-for-profit companies. Programming can range from highly specific to very broad coverage. The duration of funding programs ranges from annually adjustable to multi-year thematic programs.

Technical readiness assessments provide a solid foundation to enable well-defined topical calls. If funding programs are driven by a portfolio of demonstration projects, the solicitation and selection process may be highly targeted. The submission and evaluation process can be tailored to individual projects or range up to highly structured two-stage processes. Proposals are not only evaluated on the scientific and technical merit, but also along organizational criteria and organizational capability.

Cooperative/contribution agreements are the norm for projects that are characterized address technology readiness levels TRL of $\geq 4$; grants are rarely given. Agreements are subject to close review and assessment of technical, managerial and financial performance, often with go/no go decisions. TRL drives also the level of monitoring. Project reporting typically involves regular updates of progress and expenses incurred, and may extend to an additional 5 years of reporting beyond project end date. Contracts pay special attention to the protection of the independence of researchers. Intellectual property rights are owned by the researcher and licensed to a project.

Dissemination and exploitation of results requires the consideration of the system's readiness (framed as a reference performance level) in addition to advances in technology readiness. Exploitable results are of particularly high quality if there is a «line-of-sight» to (competitively developed) technology.

Results may also find immediate applications in other fields using similar technologies. Facing the research community, there is heavy emphasis on disseminating results via the learned literature such as journals, webinars and conferences. Post-project assessments and lessons learned feature strongly; multi-lateral joint activities with other funding organizations range from participation as reviewers to coordinated planning and release of solicitations.



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**Key lessons**:

1. A solid understanding of the research and innovation space in Europe helps focus on application-driven research needs by an emerging commercial sector. An ERA NET ACT–like institution needs to be a highly efficient catalyst for funding opportunities and to match industry needs with research & innovation capabilities.
2. All funding schemes emphasize the value of a deep knowledge of the research and innovation space of CCS technologies. Positioning of the funding mechanism will define the level of collaborative/cooperative versus targeted solicitation of the research & innovation community.
3. Contracts are multi-faceted and require time to formulate and execute. Reporting is «manifold» and commensurate with TRL's.
4. The provision of a platform (annual reviews) for dissemination is highly effective, also to engage outside-of-Europe stakeholders.

# 1. Introduction and scope

On the margins of GHGT-13 (the biannually held CCS conference series of the IEAGHG, the International Energy Agency's (IEA) Greenhouse Gas R&D Technology Collaboration Program), the ERA NET ACT consortium met on 14 November 2016 in a one-day workshop at the Swiss Tech Convention Center in Lausanne (Switzerland).

The topic of the workshop was: *Joint programming and joint calls, selection, funding and monitoring of pilot and demonstration projects: sharing and collaborating with other regions.*

The ERA-NET ACT consortium met with their US-American, Australian and Canadian counterparts to discuss and share good practices in devising and managing funding schemes for CCS research and innovation projects. The counterparts were representatives from the US DoE's Office of Fossil Energy, from the Australian National Low Emissions Coal Research and Development ANLEC R&D funding program, from Canada's National Research Council NRCan. All these organisations are either program owners or program managers for research and innovation in the area of CCS. In addition to the ACT consortium members and the above mentioned counterparties in US, Canada and Australia, the nominated external experts to ACT-projects evaluation were also invited to the workshop.

The workshop was structured along 4 themes:

**THEME 1**: Setting the stage (overall funding schemes in the regions; why do they exist and so on; organizational set-ups);

**Theme 2**: Formulation, set up of calls, proposals and their evaluation, and selection process of projects – based on a call, funding opportunity announcement, solicitation;

**Theme 3**: Execution of projects (contracting; monitoring; quality assurance and control);

**Theme 4**: Dissemination, exploitation of project results – what are minimum expectations; what constitutes success and how does it impact future joint programming and additional joint calls, funding opportunities;



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Each theme saw input presentations from the US DoE's Office of Fossil Energy, from the Australian National Low Emissions Coal Research and Development ANLEC R&D funding program, from Canada's National Research Council NRCan as well as the ERA-NET ACT.

The stage was set by IEAGHG, an IEA Technology Collaboration Program (TCP) of the International Energy Agency's Energy Technology Network (IEA ETN). A number of the ERA-NET countries and the EC participate in this global technology collaboration program. Key recommendations of IEAGHG included a thorough and carefully thought-out process to define the funding program's objective (in advance), focus on criteria for the evaluation of projects, the value derived from large-scale and complex CCS projects also in terms of benefits from international collaboration and sharing of experiences and learnings. While the focus on large-scale and complex projects is valuable, there is a continued need for ongoing underlying applied R&D – especially as this need arises when executing large and complex CCS projects.

## 2. Setting the stage (overview of funding schemes in the regions)

The represented funding agencies adopt variable approaches to funding CCS research. Strategically, Australia has created ANLEC R&D a not-for-profit private company, which acts as a private-public-partnership and funded by the Australian Government Department Industry, Innovation and Science through the National Low Emissions Coal Initiative, and by the ACA Low Emissions Technologies Ltd. (ACALET) through the COAL21 Fund. About AUS$ 150 million are available for application oriented research to support deployment of commercial scale low emissions power generation from coal. An very lean organization of very few capable members of staff within a framework of an extremely clear vision, mission and strategy connects the needs of commercial applications with the skills of the research and innovation community.

The Clean Coal & Carbon Management of the U.S. DOE's Office of Fossil Energy in contrast to ANLEC has a broad vision and mission, which against a backdrop of a well-defined remit to address advanced energy systems, carbon capture, carbon storage and cross-cutting research allows for the definition of program research areas. Funding levels are in excess of US$ 350 million and benefit from strong parliamentary steers as to the funding levels and programmatic areas of research.

The National Resources Canada branch of the Government of Canada has also a proven track record of world-class CCS research and innovation and has demonstrated its capabilities through 3 commercial projects in operation; by pursuing innovative cutting-edge CCS R&D and next generation technologies in carbon capture and$CO_2$ utilization and by engaging in various international collaborations to advance CCS. The Government sets up dedicated funding program by establishing priorities and scope via internal and external consultations and subsequently engaging in a well-established administrative process. Examples are the Clean Energy Fund (starting 2009) - supported a number of large scale CCS demo's with leveraging support from provinces and industries, the 2016 Oil & Gas Clean Tech Program ($50M over 2 years) – demo projects, FEED studies or testing of pre-commercial technologies leading to demo's (including CCUS) and the 2016 Clean Energy Innovation Program ($25M in 2017-18).

**Lesson for ACT:** No detailed description of the ERA-NET ACT is given here, but some of the key observations are drawn to inspire trends in future ERA-NET ACT collaborations; a solid understanding of the research and innovation space in Europe may help focus on application driven research needs



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by an emerging commercial sector. If there were a European portfolio of large-scale industry-driven CCS demonstration projects, an ERA-NET ACT–like institution may be a highly efficient catalyst for funding opportunities and for matching industry needs and research & innovation capabilities. The latter in particular is a strong European asset. In a well-developed European research and innovation space characterized by a high level of alignment and trust, even the extremely efficient, low overhead and focused Australian approach might work very well.

## 3. Formulation/set up of calls, proposals (evaluation and selection)

Technical Readiness Assessments represent the foundation which shapes the **US DoE's** solicitations. Programs are developed in wide consultation with stakeholders including Congress (both parliamentary chambers, Senate and House of Representatives). The relationship between the US DoE and recipient of funding is (preferably) governed by cooperative agreements for pilot-scale and demonstrations facilities, grants for small scale R&D and contracts for procuring R&D assets/services. Proposals are highly structured in sections to enable harmonized evaluation of: merit of technical ideas and scientific basis; demonstrated ability of proposer to manage a complex project; expertise available to conduct work and to mitigate against risk; and financial and projects management plan. A well-established process (single stage) governs the solicitation, evaluation, decision, and later the evaluation of the results.

**NRCan** publicly launches "Call for Proposals" with proposals reviewed, selected and applicants notified per criteria outlined in the "applicants' guide". Successful applicants are subject to a due diligence assessment including project finances, technical risk and team risk.

**ANLEC's** set-up is a sharply defined targeted initiative, based on a clear positioning within the innovation space; the focus is on «initiative» research, not on fundamental or commercial research, bridging the outcomes of collaborative/cooperative research and the competitive activity of technology development. Hence, there is a strong focus on communication, in the sense of linking science and technology. This frames the interaction between CCS demonstration proponents and the science community. Demo projects have embedded demo technology managers who via ANLEC R&D funding scheme sets up R&D projects with the research and innovation community where knowledge management is a key component. ANLEC R&D has an understanding of the principal technology cost drivers. Together with a focus on demonstrating enabling services (e.g. technical risk and regulatory risk reduction) of 1st generation technologies and focus on cost reduction constrains the application space. ANLEC R&D emphasizes quality control and insists on «science» quality research, and manages the solicitation and evaluation process very tightly with embedded technology mangers (of the CCS demo proponents.

**Lesson for ACT:** All funding schemes emphasize the value of a deep knowledge of the research and innovation space of CCS technologies (e.g. technology readiness assessments, detailed identification of technology cost drivers). Depending on the closeness with the principal beneficiaries of outcomes, calls/solicitations/invited proposals are drawn from a wide to very narrow pools of applicants. Hence, well-developed and carefully thought-out positioning of the funding mechanism is required to justify the level of collaborative/cooperative versus targeted solicitation of the research & innovation community.



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# 4. Execution of projects (contracting; monitoring; quality assurance and control)

The **US DoE's** Office of Fossil Energy uses grants (typically for TRL's 1-4) when there is no need for substantial involvement between the recipient and agency during performance of the grant. Cooperative agreements are used when substantial involvement is needed between the recipient and agency during performance. They are subject to close review and assessment of technical, managerial and financial performance, often with go/no go decisions. The TRL drives also the level of monitoring. When project costs are significant; government cost share is often loaded toward the front of the project (for example, design and procurement of specific components while construction and operating costs may be the responsibility of the project team). Project management tools track completion or achievement of project value (earned value for example).

**NRCan's** projects establish a «contribution agreement» outlining funding level & schedule, review and assessment process. Project reporting to monitor progress is in accordance with signed contribution agreement typically involving regular updates of progress and expenses incurred. Natural Resources Canada requires an additional 5 years of reporting beyond project end date.

**ANLEC R&D's** (business oriented) contracting strategy and implementation builds on an in-depth analysis of the needs of funders, users and research service providers. Contracts pay special attention to protect the independence of researchers. Demonstration proponents may provide advice. Intellectual property rights are owned by the researcher and licensed to the demonstration project. Material must eventually be published with demonstration projects having fixed time to respond with feedback to publications, or authorization is by default. Monitoring is embedded by systematic communication at the governance level, project management level and user level. Quality is controlled and monitored for science quality through peer review, application and relevance by target customer, and project leadership and execution by ANLEC's management.

**Lesson for ACT:** Contracts may be quite complex and will require time to formulate and execute (note e.g. IP rights vested in the scientist). Reporting will be «manifold» and also require time; to what extent it can be harmonized per ACT's ideas will have to be seen in practice. Again, the amount of reporting seems also to be commensurate with TRL's of the projects.

# 5. Dissemination, exploitation of project results

The **US DoE's** experience suggests that considering the system readiness in addition to technology readiness is essential to evaluate the dissemination of results. One approach is to evaluate the development of a specific technology in terms of a performance model provided/offered as reference to be used in evaluating financial benefits of technology being developed (the approach is the Quality Guide Energy System Studies – QGESS and here for a presentation). The publications of peer reviews also support the exploitation and serve as input future R&D. Similarly, post-project assessments and lessons learned feature strongly. Results from a group of projects can define readiness for commercialization or for new work, and finally individual components or results may find immediate applications in other fields using similar technologies (i.e., novel membranes). The US DoE also sees substantial benefit in multi-lateral joint activities such as participation as reviewers, coordinated



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planning and release of solicitations, the development of novel opportunities for cost-sharing, and co-funding work on bench-marking projects

**ANLEC R&D's** ability to have «exploitable» results builds on funding research that has a «line-of-sight» to (competitively developed) technology. One aspect of exploitation is «customer facing», i.e. th CCS demonstration proponents who anticipate and value research results. One can there expect immediate exploitation with a tangible impact leading to improved decisions. Facing the research community, there is also heavy emphasis on disseminating results via the learned literature such as journals, webinars and conferences

**NRCan's** method also benefits from the tight integration of the research & innovation community with the industry (and hence an immediate drive for implementation of results obtained).

**Lesson for ACT:** Providing a platform for dissemination (e.g. annual peer reviews in conference style) strongly supports such efforts. ACT should encourage outside-of-Europe engagement to increase visibility and dissemination.

# 6. Summary

Funding agencies adopt variable approaches to funding CCS research. Underlying is a clear understanding of the research and innovation space and the regional needs to advance CCS. Fit-for-purpose funding vehicles range from governmental research programs to not-for-profit companies. Programming is driven by needs and can range from highly specific to very broad coverage. The duration of funding programs ranges from annually adjustable to multi-year thematic programs.

Technical readiness assessments provide a solid foundation to enable well-defined topical calls. If funding programs are driven by a portfolio of demonstration projects, the solicitation and selection process may be highly targeted. The submission and evaluation process can be tailored to individual projects or range up to highly structured two-stage processes. Proposals are not only evaluated on the scientific and technical merit, but also along organizational criteria and organizational capability.

Cooperative/contribution agreements are the norm for projects that are characterized address technology readiness levels TRL of 4 or higher; grants are rarely given. Agreements are subject to close review and assessment of technical, managerial and financial performance, often with go/no go decisions. TRL drives also the level of monitoring. Project reporting typically involves regular updates of progress and expenses incurred, and may extend to an additional 5 years of reporting beyond project end date. Contracts pay special attention to the protection of the independence of researchers. Intellectual property rights are owned by the researcher and licensed to project.

Dissemination and exploitation of results requires the consideration of the system's readiness (framed as a reference performance level) in addition to advances in technology readiness. Exploitable results are of particularly high quality from funded research that has a «line-of-sight» to (competitively developed) technology. Results may also find immediate applications in other fields using similar technologies. Facing the research community, there is also heavy emphasis on disseminating results via the learned literature such as journals, webinars and conferences. Post-project assessments and lessons learned feature strongly; multi-lateral joint activities with other funding organizations range from participation as reviewers to coordinated planning and release of solicitations.



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**Key lessons:**

1. A solid understanding of the research and innovation space in Europe helps focus on application-driven research needs by an emerging commercial sector. An ERA-NET ACT–like institution needs to be a highly efficient catalyst for funding opportunities and to match industry needs with research & innovation capabilities.
2. All funding schemes emphasize the value of a deep knowledge of the research and innovation space of CCS technologies. Positioning of the funding mechanism will define the level of collaborative/cooperative versus targeted solicitation of the research & innovation community.
3. Contracts are multi-faceted and require time to formulate and execute. Reporting is «manifold» and commensurate with TRL's.
4. The provision of a platform (annual reviews) for dissemination is highly effective, also to engage outside-of-Europe stakeholders.

## 7. Acknowledgements

*This workshop has been subsidized by the Swiss Federal Office of Energy under contract SI/501'162-01 and has been planned and executed in cooperation with ERA NET ACT's national research and innovation program owners and managers.*

*We express our sincere gratitude to the US Department of Energy's Office of Fossil Energy, to the Australian National Low Emissions Coal Research and Development ANLEC R&D funding program and to Canada's National Research Council NRCan. They have selflessly and in the spirit of international cooperation made their time and resources available to participate in this workshop.*



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# Annex 1: List of national contacts for ACT

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# Annex 2: Agenda for the workshop

**Date: 14 November 2016, 8 am to 3 pm**

**Venue**: Meeting Room in the Swiss Tech Convention Center / GHGT-13 conference site.

**Topic**: Joint programming and joint calls, selection, funding and monitoring of pilot and demonstration projects: sharing and collaborating with other regions.

**Perspective**: solely that of funding agencies.

**Target audience**: program owners and managers from ACT (and other European) countries, North America, East Asia and Australasia; international research organizations that fund pilot and demonstration projects research.

**Purpose**: This workshops seeks to identify and share good practices in selecting, funding and monitoring CCS pilot and demonstration projects – from the viewpoint of funding agencies.

| | |
|---|---|
| **THEME 1: Setting the stage (overall funding schemes in the regions; why do they exist and so on; organizational set-ups)** | |
| Welcome (Gunter) | Gunter |
| Introduction to the European Research Area Network **ERANET** Accelerating CCS Technologies **ACT** | Ragnhild / Nicoleta |
| IEA Technology Collaboration Program (IEAGHG) : observations of an external reviewer of large scale CCS project | Tim |
| US DoE -- CCS research and innovation program(s) | John |
| Australia - CCS research and innovation programs | Dick |
| NRCan / Canadian Provinces - Overview CCS reserach and innovation programs / covering all aspects | Eddy |
| | |
| **10:00 - 10:30 Tea Break** | |
| | |
| **Theme 2: Formulation, set up of calls, proposals and their evaluation, and selection process of projects** – based on a call, funding opportunity announcement, solicitation. This part of the workshop aims to identify learnings and good practices | |
| ERANET ACT | Annette / Brian |
| US DoE -- CCS research and innovation program(s) | John |
| Australia - CCS research and innovation programs | Noel |
| Discussion | All |
| | |
| **11:45 - 12:30 Lunch** | |
| | |
| **Theme 3: Execution of projects (contracting; monitoring; quality assurance and control)** | |
| ERANET ACT | Gerdi / Harry |
| US DoE -- CCS research and innovation program(s) | John |
| Australia - CCS research and innovation programs | Noel |
| Discussion | All |
| | |
| **Theme 4: Dissemination, exploitation of project results –** what are minimum expectations; what constitutes success and how does it impact future joint programming and additional joint calls, funding opportunties | |
| ERANET ACT | Ragnhild / Aage |
| US DoE -- CCS research and innovation program(s) | John |
| Australia - CCS research and innovation programs | Noel |
| Discussion | All |



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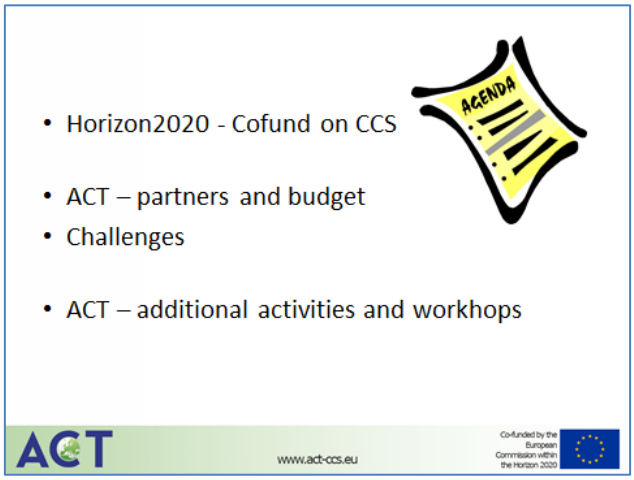
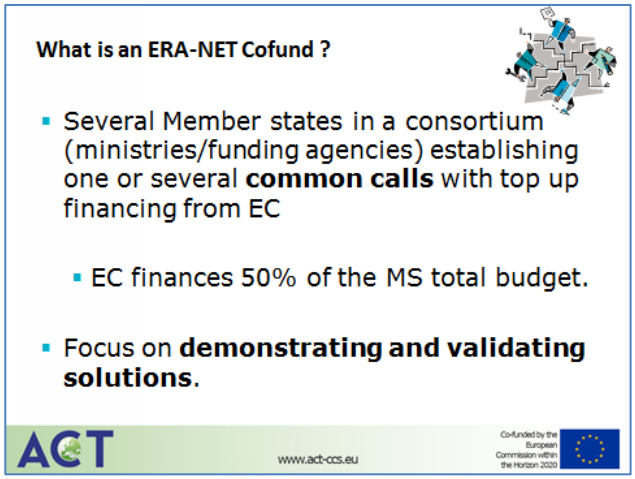
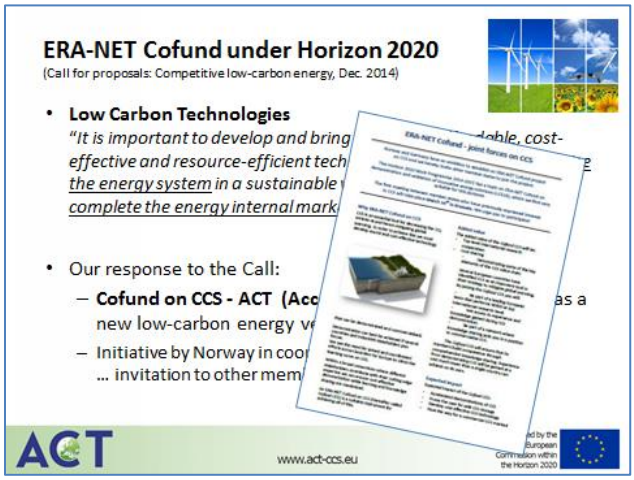
# Annex 3: Presentations

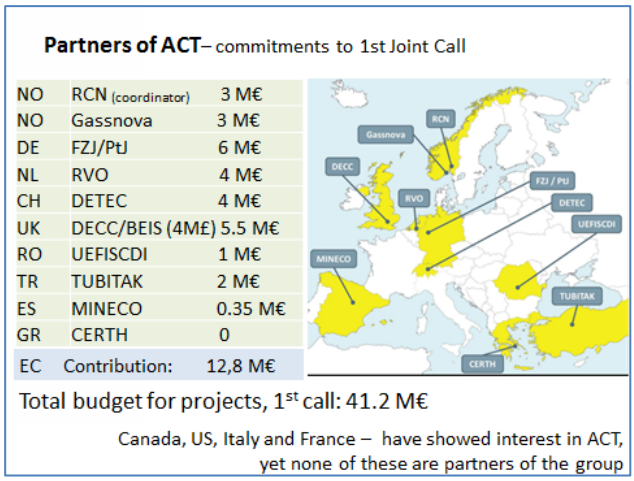
## Presentation 1: Introduction to the ERANET Accelerating CCS Technologies ACT.

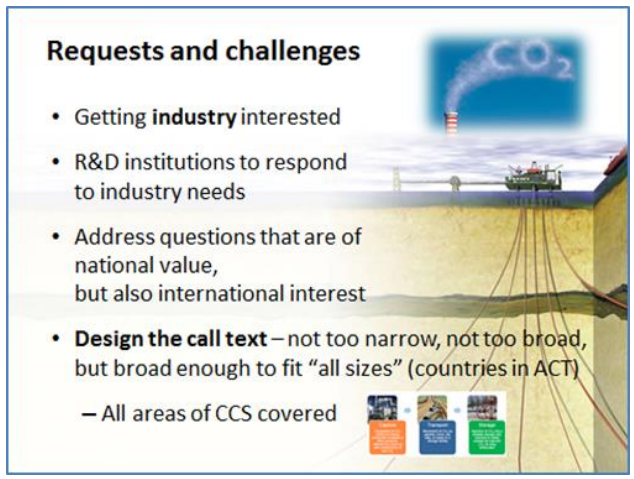
This presentation was given by Ragnhild Rønneberg (RCN) and Nicoleta Dumitrache (UEFISCDI).

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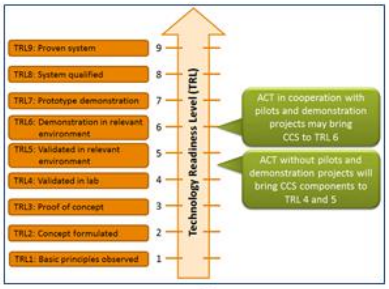
## ACT has asked for projects in cooperation with pilots



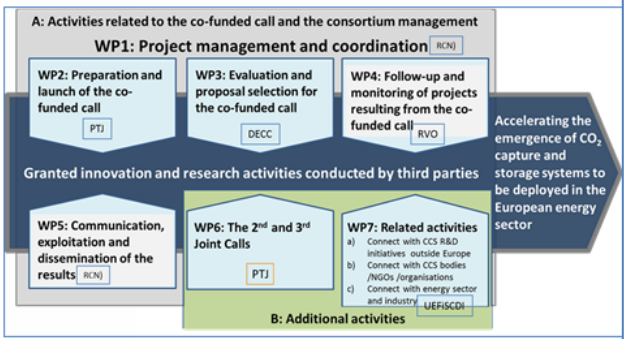




Big project – higher TRL
Smaller projects – lower TRL

Relevant to industry



## Workpachages






## WP 7 – additional activities (lead by UEFICDI)

- Alignment with European CCS RD&D activities outside ACT
- Collaboration with European CCS initiatives, through common workshops
- Strengthen R&D collaboration with key stakeholders outside Europe
- Closer cooperation with the energy sector and industry



## Related activities (WP7)

- Build and intensify a close collaboration with other European CCS Initiatives (*both networks and pilot/demonstration projects*) in order to increase knowledge sharing and accelerate deployment of CCS;
- Knowledge obtained in EU-funded projects will be shared



## 5 Knowledge sharing workshops

- **Why?**
  - Best platform to disseminate results from ACT funded projects;
  - Stimulate cooperation between academics and industry;
  - Place for policy makers to assimilate the latest news about transnational CCS-progress in Europe;
- **When?**
  - Annual basis: 10, 24, 36, 48 and 60 months.
- **Where?**
  - Switzerland, Romania, Spain, Netherlands, UK (or Europe)



## Summing up


- **ACT is here** - Ambitious partners
- Good projects/tough competition
- CCS is a part of the solutions to combat global warming – and international collaboration is needed
- Horizon2020 – new call for proposals in 2018
- **ACT - new calls in 2018 and 2020 (or ACT-2)**

**You are welcome to join !**



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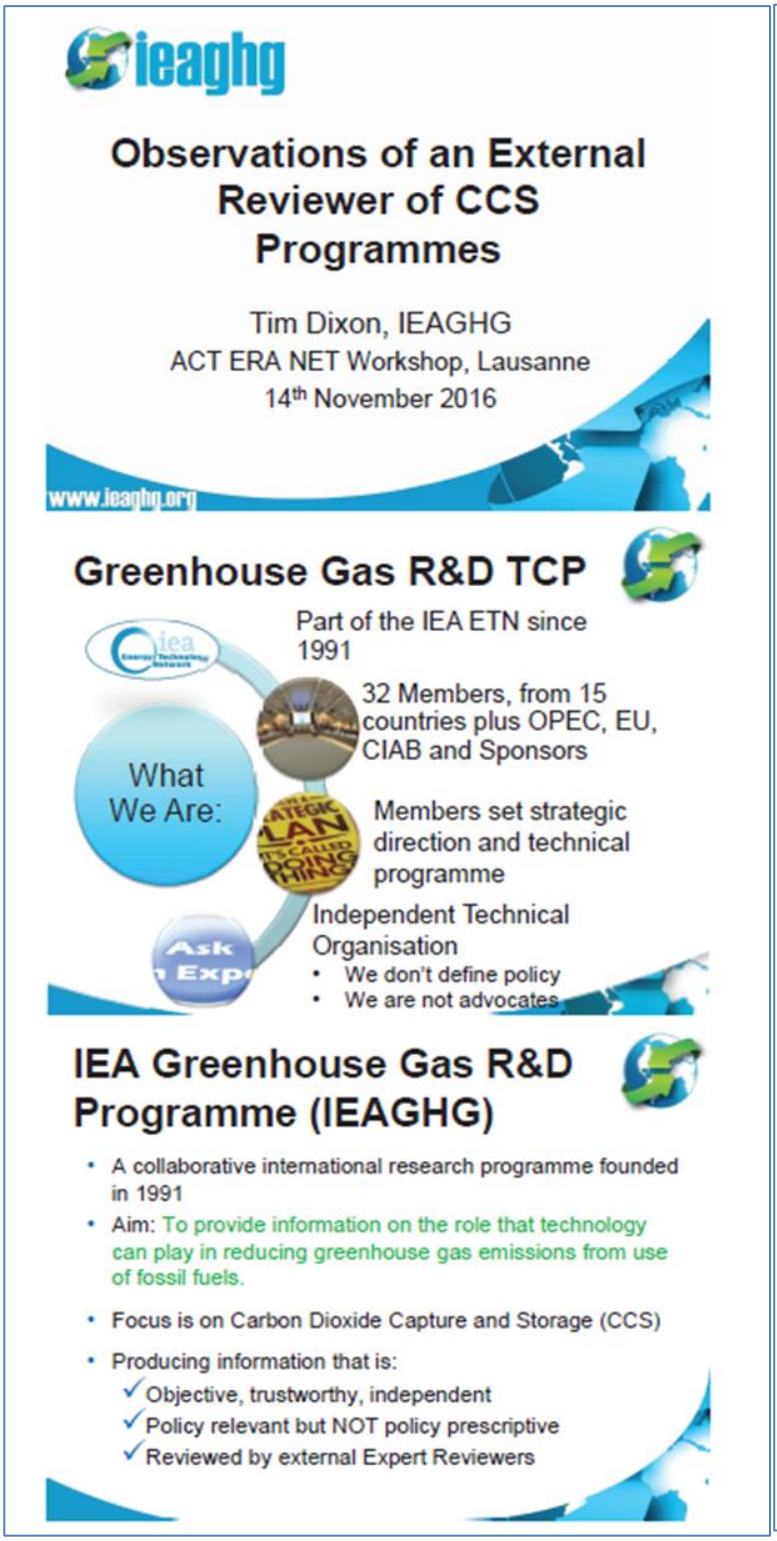
## Presentation 2: IEAGHG – Observations of an external reviewer of CCS programs.

This presentation was given by Tim Dixon.







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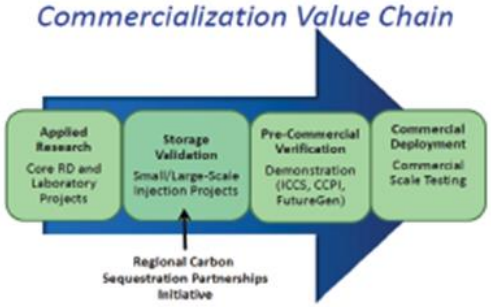
## Programme peer reviews by IEAGHG

- Battelle's Carbon Management Initiative (2001 - 2004), USA. Chairmanship of the annual technical review.
- IEAGHG Weyburn Monitoring Project Phase 1, 2003, Canada. Technical review
- RECOPOL Project Technical review of proposed $CO_2$ injection work programme, 2005, Netherlands. Chairmanship
- IEAGHG Weyburn - Midale Monitoring Project Final Phase, 2006, Canada. Technical review
- CO2CRC Otway Pilot Project Technical Review, 2006, Australia. Organisation and chairmanship.
- US EPA Vulnerability Evaluation Framework peer review, 2008, USA. Organisation
- CO2CRC Otway Pilot Project Monitoring Review, 2009, Australia. Organisation and chairmanship.
- US RCSP Phase III, 2008, USA. Peer Review organisation and chairmanship.
- US RCSP Phase III, 2011, USA. Peer Review organisation.
- US RCSP Phase III, 2013, USA. Peer Review organisation and chairmanship.
- US Carbon Storage R&D Program, 2015, USA. Peer Review organisation.
- US RCSP Phase III, 2017, USA. Peer Review organisation.

## Geologic Storage
### *Commercialization Value Chain*




*Advancing CCS through an Integrated Value Chain fromResearch to Commercial Deployment*

## Example of review aims: US RCSP

- The aim of the Review is to:
  - Follow up progress addressing the recommendations of the 2nd review in 2011; overall RCSP and individual regional partnerships Phase III projects
  - Assess progress on individual Phase III projects
    - Does each proposed technical program achieve goals (individual / overall RCSP)
    - Identification of Gaps or necessary modifications to work programmes
  - Assess results and key findings from Phase III tests across the RCSP as they relate to the DOE Program goals
  - Assess overall technical integration of RCSP initiative, address synergies between the Phase III projects, how they complement each other and will collectively provide a basis for future commercial scale projects in USA
  - Assess how RCSP compares/ compliments/ contrasts with similar projects underway worldwide and how international knowledge base on CCS can be built.

## IEAGHG Observations

- Differing objectives of programmes:
  - larger-scale demonstrations and pilots (more prescriptive objectives, less frequent calls), vs
  - R&D (can be less prescriptive more open calls, more frequent, more responsive)
- **need different programme mechanisms and procedures.**
- **Impact**:- generally relates to: project success; outputs; use and dissemination of results and learnings; management; and $ magnitude.
- Peer reviews can be useful – assurance, re-justification, re-alignment, technical audit. Need evaluation criteria.

## Some Recommendations

- Well-defined programme objectives in advance
- Clear evaluation criteria for programme assessment
- Larger-scale and complexity of CCS brings benefits from international collaboration and sharing of experiences and learnings from programmes and projects.
- Need for ongoing underlying applied R&D - for many reasons including to be responsive to issues arising – eg UK DTI, UKCCSRC, EU CO2ReMove, US DOE R&D, IEAGHG

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## Thank you

## Any Questions?

www.ieaghg.org



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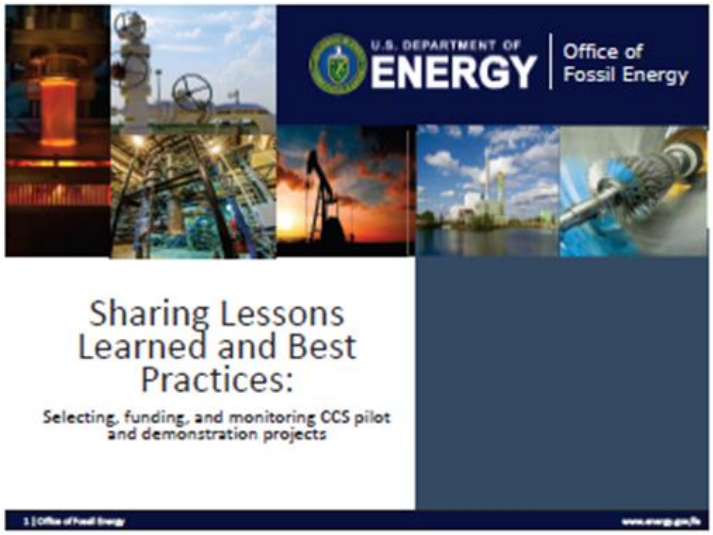
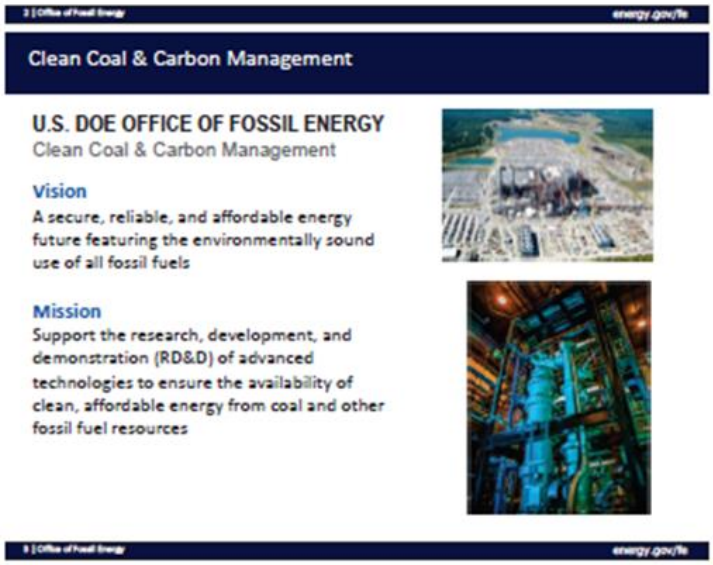
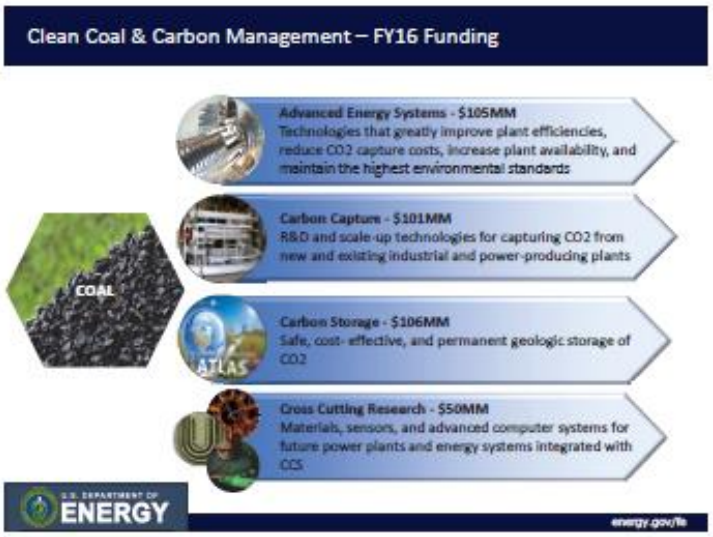
## Presentation 3: CCS research and innovation programs in US.

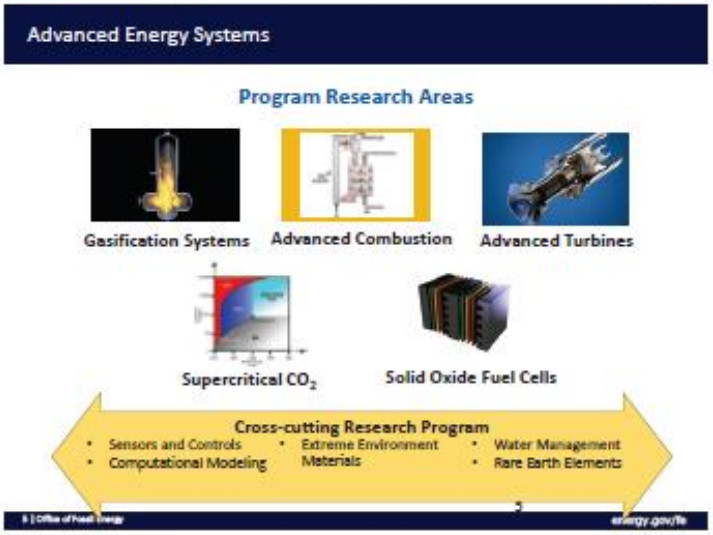
This presentation was given by John Litynski, US-DoE

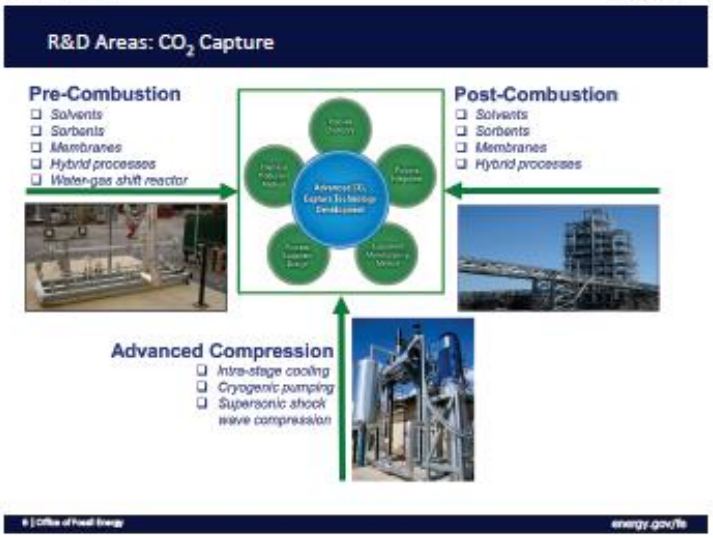






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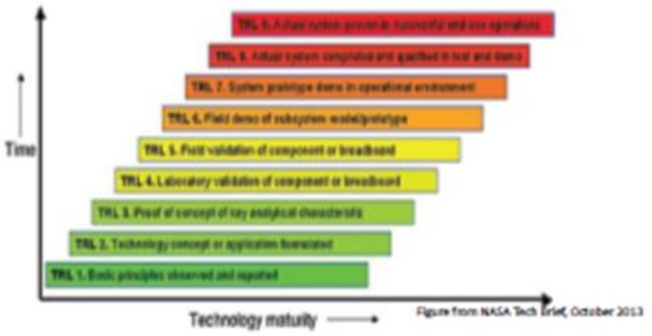
## Carbon Storage Programmatic Structure and Technical Priorities

- Predicting and monitoring $CO_2$ plume and brine pressure front movement, stabilization, and impacts.
- Optimization of reservoirs for $CO_2$ storage capacity.
- Developing and validating risk-assessment strategies.
- Mitigating risks, such as leakage from old wells and induced seismicity.
- Carrying out field tests (CarbonSAFE, BEST, Fit for Purpose) for different storage types and depositional environments.


7 | Office of Fossil Energy energy.gov/fe

## Technical Readiness Assessment shapes solicitations and nature of funding mechanism

- **Funding for R,D,D & D activities can involve a variety of funding mechanisms.**




- **DOE/FE uses cooperative agreements for work at TRL levels 5 -8 (single component demonstrations can occur for lower TRLs)**

8 | Office of Fossil Energy energy.gov/fe



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## Presentation 4: Australia - CCS research and innovation programs.

This presentation was given by Richard Wells, Australian National Low Emissions Coal Research & Development ANLEC R&D.

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Australian National Low Emissions Coal Research and Development

### Australian Perspective

Richard Wells
Chairman – ANLEC R&D

### Content

- ✓ National Low Emissions Strategy
- ✓ Initiatives and Council Recommendations
- ✓ Energy Policy & Low Emissions Status Today
- ✓ National Research Strategy
- ✓ The National Research Space
- ✓ Australian National Low Emissions Coal R&D (ANLEC R&D)

anlecr&d

### Low Emissions Energy Strategy

#### Intent and Objectives

- Maintain Competitiveness – Low Cost Energy
- Protect Revenues – Export Energy Resources
- Respond to Climate Science – Responsible Citizenship
- Deliver Policy Certainty
  - Manage Energy Asset Portfolio Transition

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### Various Initiatives

History

2004 – Low Emissions Technology Demonstration Fund

2006 – Coal 21 Fund

2008 – Carbon Storage Taskforce Reported

2009 – National Low Emissions Coal Initiative

– Coal Strategy

2010 – National CCS Council (includes Gas Industry)

2012 – Coal Strategy Updated

2014 – Industry led Round Table replaces Council

2016 – CCS Road Map (imminent)

anlecr&d

### National Low Emissions Councils

#### Council Recommendations

***Highest priority - Storage Reservoirs***

– Identification and assessment

– Additional investment to prove-up

***Research, Development and Demonstration***

– Funding be maintained to support deployment

– Increase funding for Demonstration projects

– Extend target deployment date – no drivers

– Include Gas and Industrial emissions

anlecr&d

### National Low Emissions Councils

***Supportive regulatory framework***

– Nationally consistent CCS policy/regulation

– Liability, easements, standards, approvals

– CCS Ready Standard for new build coal, gas & industrial

***Transitional Financial Support***

– Capital grants; performance based subsidies and exploration incentives

– Funding be non-taxable

– Demonstration and CCS Ready investments exempt from future carbon pricing

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## National Low Emissions Councils

*Communication & Community Acceptance*

- Government to supply public information and ensure consultation on energy policy
- gives due regard to the contribution of CCS
- reports Australia's GHG targets & performance

**Skills Development**

- review and assess requirements for emergent CCS development and deployment

## Status Today

### Low Emissions Commitment

Lower GHG Emissions acknowledged in Energy White Papers of both C'wth Governments to date

**Current Commitment:** 26-28% below 2005 levels by 2030

State Govs also set aggressive and aspirational targets

**Qld** – 50% RE by 2030
**Vic** – 25% RE by 2020
40% RE by 2025
**SA** – @ 40% RE

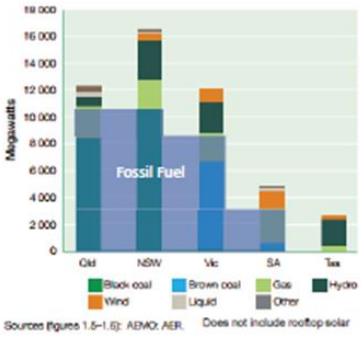
Renewable Energy Target (RET) is well established since 2001

Accelerated penetration of subsidised wind and (domestic) solar assets

**RET Cert price (2015):**
Small Scale: $38/kWh
Large Scale: $66/kWh

## The Australian Reality

### Electricity Generation Dominated by fossil fuel




(East Coast NEM only)

70% Coal

9.3% Gas

79% Fossil Fuel

7.0% Hydro

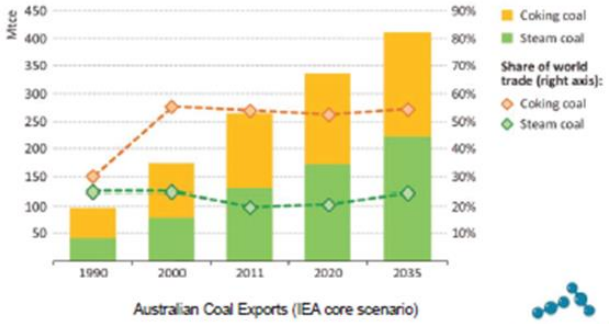
4.7% Wind

6.8% Solar

2.5% Other

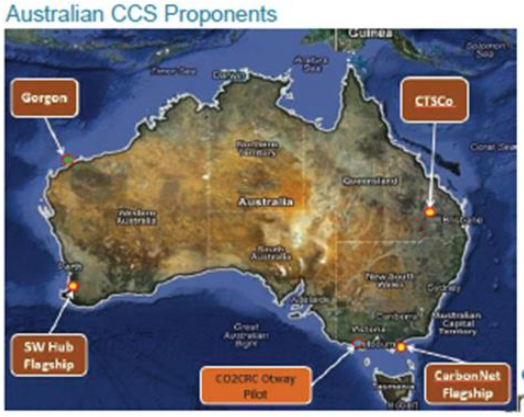
## The Australian Reality

### Export demand will be sustained




## CCS must take up its role

### Australian CCS Proponents




## Research Strategy

### National Council - Low emissions research strategy

- A targeted research initiative
- Support & accelerate deployment
- Reduce investment risk
- Support low emissions flagships (CCS)
- Focus on $CO_2$ Storage
- Recognise Australia is a technology taker for Capture
  - Adapt technologies for Australian conditions
  - Underpin permitting and regulation



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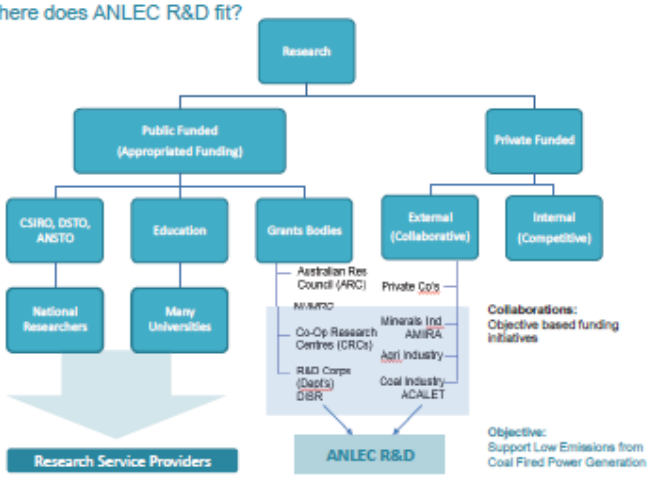
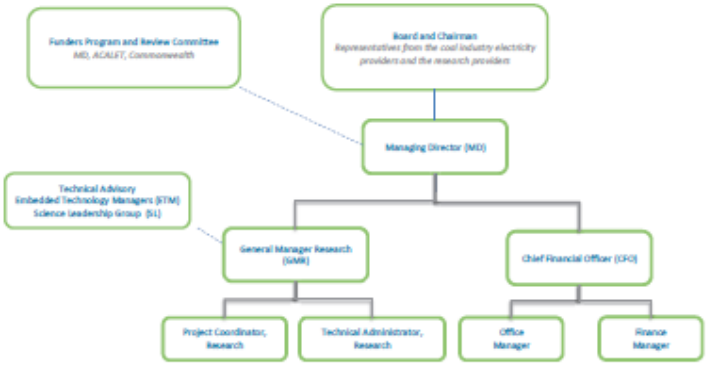
## National Research Space

Where does ANLEC R&D fit?




## Governance

- ANLEC R&D is a Private company with a Board of Independent Directors
- It operates under 2 separate but complementary Funding Agreements with the Australian Government and its Coal Industry



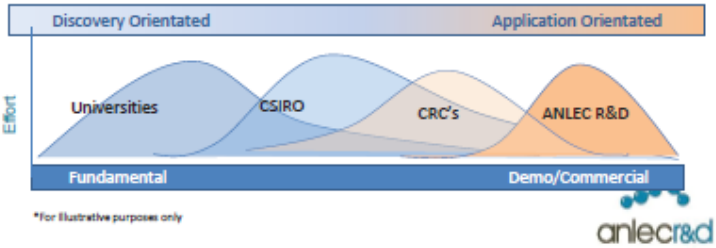

## Deployment Orientated Research

### Types of Research

**Fundamental Research:** Capability Maintenance Eg: ARC

**Initiative Research:** Targeted Objective Eg: Cancer, Genome

**Internal Research** : Corporate IP - Generation & Exploitation




*For illustrative purposes only

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## A National Initiative


## Summary

- ANLEC R&D is a National Research Initiative
- Established 2009 and will continue to 2020
- It is a partnership between the Australian Commonwealth and the Australian Coal Industry
- It delivers total cash funding of up to AUD150,000,000 for research to support deployment of commercial scale low emissions power generation from coal
- There is a catalogue of results to date – for your information
- MD will present on Governance, Processes and Operation

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## Presentation 5: NRCan / Canadian Provinces - Overview CCS reserach and innovation programs

This presentation was given by Eddy Chui, CanmetENERGY, Natural Resources Canada, and the presentation covers all aspects of the workshops topics.





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## Execution of Funding Programs

- Publicly launched "Call for Proposals"
- Proposal review, selection and applicant notification per criteria outlined in the "applicants' guide"
- Project review – successful applicants subject to a due diligence assessment including project finances, technical risk and team risk
- Establishment of "contribution agreement" outlining funding level & schedule, review and assessment process
- Project Reporting to monitor progress – in accordance with signed contribution agreement typically involving regular updates of progress and expenses incurred. Natural Resources Canada requires an additional 5 years of reporting beyond project end date

Canada

## Case Study 1 - Boundary Dam CCUS Project

- Led by SaskPower, a crown-owned utility
- $CO_2$ capture occurs at Unit 3 at Boundary Dam power plant in province of Saskatchewan
- Online since October 2014
- First commercial CCS project globally at a coal-fired power plant
- Ability to capture 90% of its $CO_2$ emissions annually (up to 1 million tonnes)

Canada

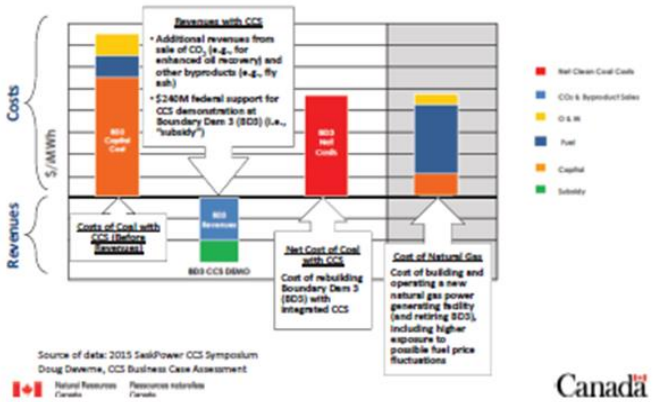
## Components of Boundary Dam's Business Case

- Federal funding of $240 million
- Value from sale of by-products (e.g. CO2, sulphuric acid, and fly ash) to offset project cost
- Realizing continued value from original power unit investment
- Anticipation of federal GHG emissions regulations
- Continue to generate power from price-stable, long-term fuel supply


Source: IEAGHG, "Integrated Carbon Capture and Storage Project at SaskPower's Boundary Dam Power Station", 2015/06 , August 2015

Canada

## Investment Decision for Boundary Dam (2010)




Source of data: 2015 SaskPower CCS Symposium
Doug Devenne, CCS Business Case Assessment

Canada

## Environmental & Commercial Results

- Captured over one million tonnes of CO2 (as of August 2016)
- Through SaskPower's unique experience, it has identified significant lessons learned that will allow it to reduce costs by up to 30% on future CCS projects

Summary of Boundary Dam Project Air Emissions Improvements*

| CONSTITUENT | PRE-CCS | POST-CCS* | CHANGE |
|---|---|---|---|
| Power | 139 MW | 120 MW | 13.6% |
| $CO_2$ | 3604 tonnes/day | 354 tonnes/day | 90% |
| $NO_x$ | 7 tonnes/day | 0 tonnes/day | 100% |
| $NO_2$ | 2.4 tonnes/day | 1.05 tonnes/day | 56% |
| $PM_{10}$ | 190 kg/day | 15 kg/day | 92% |
| $PM_{2.5}$ | 65 kg/day | 7 kg/day | 70% |

* Based on Design Performance

Canada

## Learn more from the Project Experts


International CCS Knowledge Centre
Contact: Michael Monea, President
Email: mmonea@CCSKnowledge.com

Monthly performance updates
http://www.saskpower.com/about-us/blog/bd3-status-update-august-2016/

Take the Tour
http://www.saskpowerccs.com/tour

Canada



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## Case Study 2 – Shell Quest Project

- Joint Venture among Shell (60%); Chevron (20%); and Marathon (20%)
- Located ~50 km from city of Edmonton in province of Alberta at an oil sands upgrader (refinery)
- Online in November 2015
- Quest captures $CO_2$ from 3 hydrogen manufacturing units at the upgrader
- Project has capacity to capture and store more up to 1.2 million tonnes of $CO_2$ emissions annually

Canada

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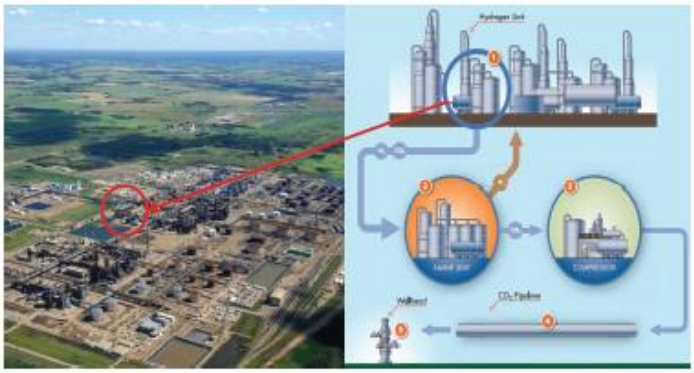
## Quest Overview



Canada

15

## Modular Construction – 69 Modules

Canada

16

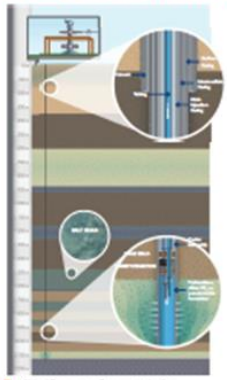
## $CO_2$ Transport

- 65-km pipeline from the upgrader to 3 injection wells


Canada

17

## $CO_2$ Storage – Measurement, Monitoring, and Verification (MMV)



- Establishment of robust MMV program for the stored CO2
- Ensure Containment
- Demonstrate 'security' of $CO_2$ storage
- Detect early warning signs of unexpected loss of containment
- Trigger of additional safeguards
- Annual outcomes of program submitted to regulator and government

Canada

18

## Components of the Quest Project's Business Case

- Combined funding of $865 million from federal and Alberta provincial government to support construction and operation
- The project has carbon credit arrangement with Alberta province for each tonne sequestered.
- Anticipation of future carbon pricing to make projects like Quest more economic
- CO2 mitigation and improving environmental performance in heavy oil operations

Canada



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## GHG Mitigation and Commercial Results

- Captured over one million tonnes of $CO_2$
- $CO_2$ capture efficiency and $CO_2$ storage reservoir performance have been better than expected
- Through operation, areas are being identified in which contingencies in design could be reduced
- Through construction, it became clear that cost can be further reduced with scale



Natural Resources Canada / Ressources naturelles Canada

Canada

## Learn more from the Quest Project Experts

**For more information:**
Contact: Tim Wiwchar, Shell (Canada)
Email: tim.wiwchar@shell.com

**Knowledge-sharing reports on Quest's learnings and best practices:**
- lower-cost design and construction
- technology and regulations
- state-of-the-art MMV program

http://www.shell.ca/can/en_ca/about-us/projects-and-sites/quest-carbon-capture-and-storage-project.html

http://www.energy.alberta.ca/CCS/3848.asp




Natural Resources Canada / Ressources naturelles Canada

Canada



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## Presentation 6: ERANET ACT- formulation of calls and evaluation procedures.

This presentation was given by Annette Weiss (PtJ) and Brian Alison (BEIS)

Accelerating CCS Technologies

The ACT Project So Far

Annette Weiss (WP2) & Brian Allison (WP3)

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### ACT Preparation of the call (1)

**Task 2.1: Definition of the call text**

- Evaluation of the state-of-the-art and identification of knowledge gaps for an accelerated implementation of CCS
- Assessment of scientific development trends and specification of cutting-edge technologies
- Alignment of the tentative topics with the Horizon 2020 Work Programme (relevance, complementarity)
- Prediction of challenges and expected impacts of the identified topics
- Assumption of required funding

⬇

List of plausible topics presented to the Policy Board
Basis for call text and evaluation criteria

ACT www.act-ccs.eu

### ACT Preparation of the call (2)

**Task 2.2: Ensuring funds for the call**

- Clarification of the available national budget for ACT by all involved funding agencies
- Common approach towards the funding mode and the split of the EC top up
- Consented procedure for project selection via eligibility requirements (also considering national criteria)
- Discussion of principles for monitoring of granted transnational projects

⬇

Smooth and efficient allocation of the required funding

ACT www.act-ccs.eu

### ACT Preparation of the call (3)

**Task 2.3: Launch of the first joint call**

- Test of the corresponding electronic submission system
- Advices to the target group of the call concerning the eligibility requirements and specific national funding rules
- Pre-announcement of the call (by direct contact to the CCS societies, video-conferences / meetings (in Norway), web-announcement and press release)
- Information of the EC 30 days in advance of launching

⬇

Publication of the call via the ACT Website

ACT www.act-ccs.eu

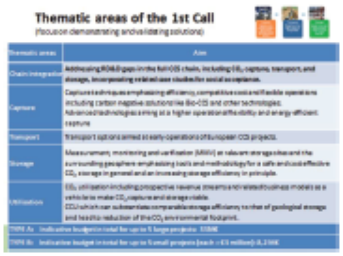
### Results from evaluation of pre-proposals

- ACT received 38 preproposals by 7 Sept 2016
- 20 pre-proposals are invited to submit full proposals, requested funding ~77M€
- **5 large projects** (5 – 16 M€)
- **15 smaller projects** (0,2M€ – 3M€)

ACT www.act-ccs.eu

### Thematic areas of the 20 projects

- 9 projects on Capture
- 4 Storage
- 2 Utilisation
- 2 Full chain
- 1 Storage EOR
- 1 Utilisation EOR
- 1 on Full chain CCU




- 13 projects with power/industry participation
- Partners from Canada, Australia, India, France and Sweden

ACT www.act-ccs.eu



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## ACT Evaluation Process (1)

### Task 3.1: First-stage evaluation

For first-stage proposals, the checking of eligibility and relevance will be made by all members of the Consortium and the Call Secretariat. The purpose is:

- Check that proposals comply with national funding requirements
- Assessing the eligibility and relevance of all proposals
- Preparation of a brief evaluation report for each proposal
- Compile a list of project consortia to be invited to submit a full proposal for Stage 2 evaluation
- The Call Secretariat will inform applicants of the outcome of the eligibility process



## ACT Evaluation Process (2)

### Task 3.2: Second-stage evaluation

- Evaluation panel will include members nominated by the Consortium partners. The panel will be selected for impartiality, to be free from conflicts and under confidentiality agreements. Selection of the independent experts will be in accordance with relevant H2020 guidance
- Identify Chair for the evaluation panel from Advisory Board, to report on the overall process
- Identify a separate independent observer to monitor the Stage 2 evaluation process and to deliver a report on the Stage 2 evaluation to the Commission. Kept informed during Stage 1
- Allocate full proposals to an appropriate selection of between 3 & 5 independent experts
- Manage H2020 compliant evaluation of proposals, including organisation of a final evaluation meeting where the independent expert panel will be asked to reach consensus agreement on the scores for each of the applicant projects and to produce a final and binding ranking list(s) of fundable projects
- Provide an Evaluation Summary Report to all applicants
- The Call Secretariat will notify applicants of the results of the Stage 2 evaluation
- Prepare a Transnational Project Selection Report describing the call process and procedures
- Coordinate the announcement of the results of the evaluation across the Member States



## ACT Evaluation Process (3)

| Deliverables | | |
|---|---|---|
| Del. no. | Deliverable name | Delivery date (month) |
| D3.1 | List of Independent Experts for Stage 2 Evaluation | 5 |
| D3.2 | List of Stage 1 Successful Projects | 8 |
| D3.3 | Stage 1 Applicant Notification | 8 |
| D3.4 | Transnational Project Selection Summary Report | 12 |
| D3.5 | Stage 2 Applicant Notification, including evaluation reports | 12 |
| D3.6 | Ranking list | 12 |
| D3.7 | List of projects to be funded | 15 |
| D3.8 | Observers report on the evaluation | 15 |
| D3.9 | Commitment letters for funding the projects | 15 |
| D3.10 | Evaluation Report (Compulsory Deliverable) | 17 |

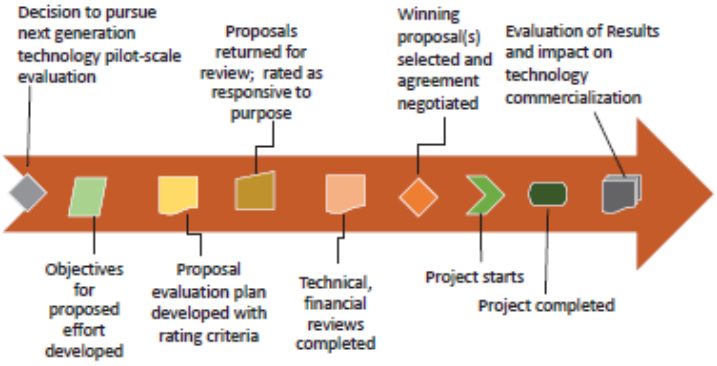
## Presentation 7: Calls and selection of projects by US-DoE

Presentation given by John Litynski, US-DoE

### Theme 2
### Formulations, Setup of Call, Proposals, Evaluation, and Selection Process



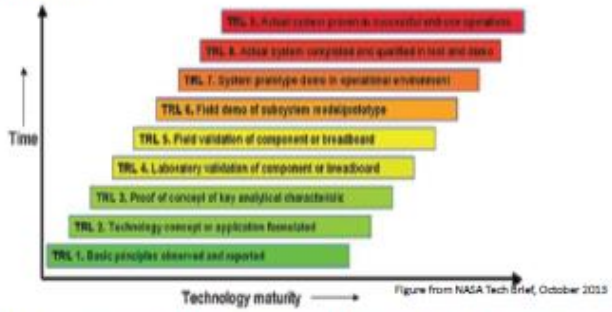
### Notational timeline






### Technical Readiness Assessment shapes solicitations and nature of funding mechanism

- Funding for R,D,D & D activities can involve a variety of funding mechanisms.




- DOE/FE uses cooperative agreements for work at TRL levels 5 -8 (single component demonstrations can occur for lower TRLs)



### Program Planning based on use of expert opinion, analysis, and Congressional guidance

- Congressional Budget Appropriations and Guidance
- Administration budget request
- System Analyses
- External Input
  - Conference proceedings
  - Literature Reviews
  - Targeted stakeholder workshops
  - Expert Studies – National Academies, Advisory Boards, etc
- Workshops convened by DOE and in conjunction with other organizations and funding sources – may include multi-national agreements.



### Theme 2: Formulation, calls, proposal guidelines, proposal evaluations, and the selection process

- Full and open competition process preferred
- Determination of Non Competitive Financial Assistance
- Pathways for Technology Procurement considers
  - Nature of R&D
  - Level of DOE involvement
  - Level of risk
- Cooperative agreements - Pilot-scale and demonstrations facilities
- Grants – Small scale R&D
- Contracts – Procuring R&D assets/services



### Proposal design and evaluation criteria linked

- Sections of proposal structured to allow experts to review and judge:
  1) Merit of technical ideas and scientific basis;
  2) Demonstrated ability of proposer to manage a complex project;
  3) Expertise available to conduct work and to mitigate against risk; and
  4) Financial and projects management plan.
- Proposal evaluations align with required sections in proposal:
  - Technical evaluation focuses on scientific merit, project management plan, qualified lead investigators and expertise of project manager;
  - Financial review qualifies budget plan to ensure adequate control and ability to make go/no go decisions





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## Presentation 8: Australia - Calls and selection of projects

Presentation given by Noel Simento, Australian National Low Emissions Coal Research & Development ANLEC R&D

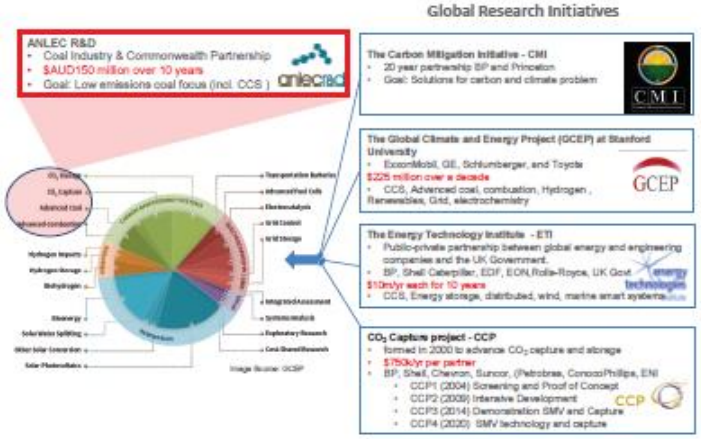
anlecr&d

Australian National Low Emissions Coal Research and Development

### Formulation, Evaluation and Selection

Noel Simento
Managing Director

### Among the largest industry partnerships worldwide




### Content

- ✓ Defining the Innovation Space
- ✓ Focus on Value
  - ➢ To Funders
  - ➢ To Customers
  - ➢ To Service Providers
- ✓ Defining the application space
- ✓ Focus on due diligence

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### Defining the Innovation Space

Types of Research

1. **Fundamental Research:**
   Discovery, Capability Maintenance - e.g. ARC
2. **Initiative Research:**
   Targeted Objective - e.g. Cancer, Genome
3. **Commercial Research :**
   IP – Generation/Exploitation - e.g. Pharmaceuticals

***ANLEC R&D is an initiative designed for a purpose***

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### Focus of Innovation Effort

| | *Research* (Co-operative activity) | *Technology* (Competitive activity) | |
|---|---|---|---|
| **Purpose:** | Knowledge Creation | Knowledge Application | |
| **Pre-requisite:** | Know the Science | Know the Business | |
| **Who:** | *Scientists* | *Employees (Technologists)* Invisible (IP closed) Effectiveness: Good | *Contractors (Consultants)* Visible (IP Open) Weak |
| **Best Result:** | Tools for Innovation | Measurable commercial benefit | |
| **Req. Activity** | Communication | Implementation | |

Fundamental Research | Initiative Research | Commercial Research

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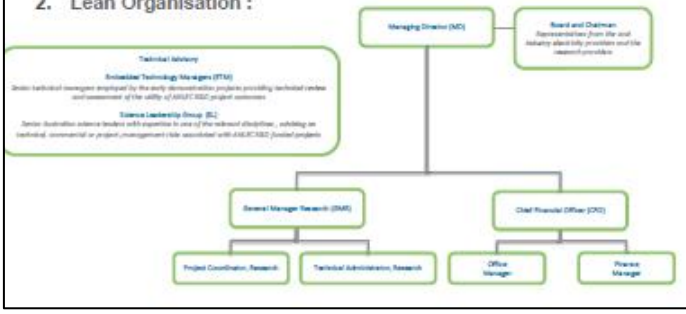
### Governance Lessons

1. **Targeted Initiative (not necessarily collaborative)**
   - Empowered Executive Management
   - Avoids conflicted interests
   - Embeds due diligence
2. **Lean Organisation :**





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## Value – to Customers

Strategy Lesson 1:

- *Initiative must be driven by a technology objective:*
  **Lower emissions from coal fired power generation**

Strategy Lesson 2:

- *Research is a SERVICE to a customer (Science relevance)*
  **Demonstration Proponents of Low Emission Coal Technology**

Demonstration proponent
- "Knows the business"
- Drives research needs
- Embedded in research project selection process
- Embedded in systematic technology review process

Customer is clear:
Research Impact is immediate & assured

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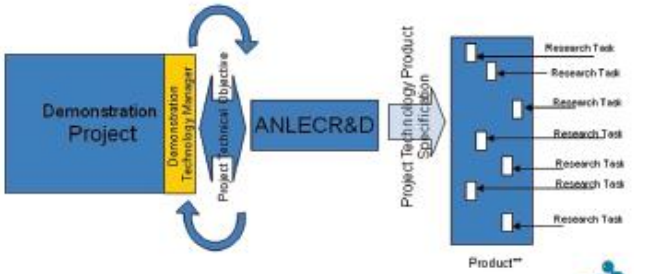
## Australian CCS Proponents


## Formulation
### by
### Embedded Technology & Knowledge Management




**Note: There will be several products for each flagship Project

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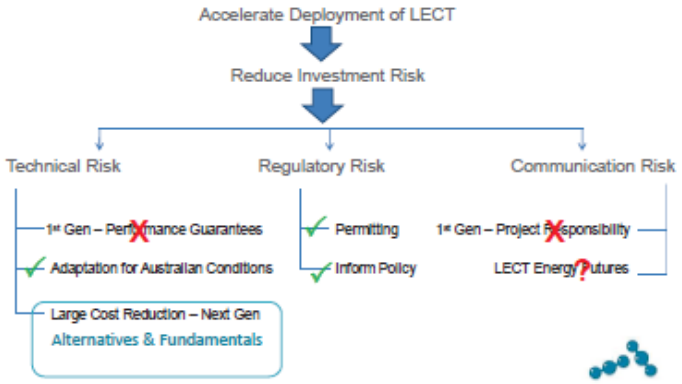
## Defining the Application Space

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## Locating the Australian Research Effort

1st Generation – Demonstration Enabling Service

- Enable Permitting
- Validate design and scale-up
- Adapt to Australian conditions e.g. water conservation
- Accelerate subsurface storage characterisation
- Reduce subsurface storage risk (MMV)

Nth Generation – Reducing Cost (Discovery Service)

- Capital - Capture
- Operating – Fuel/Efficiency
- Licence - Monitoring

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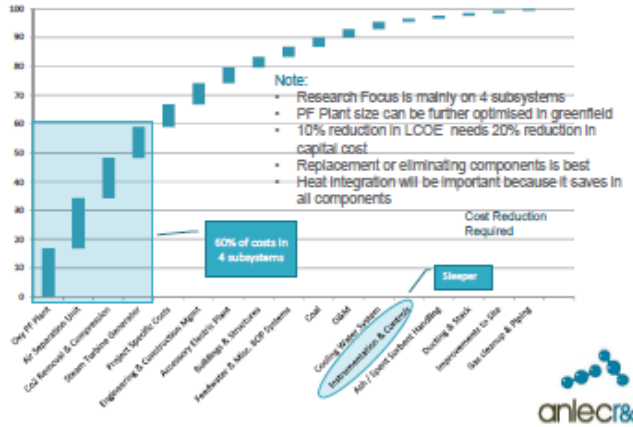
## Know the Research Space
### The Oxy-Fuel Technology Costs

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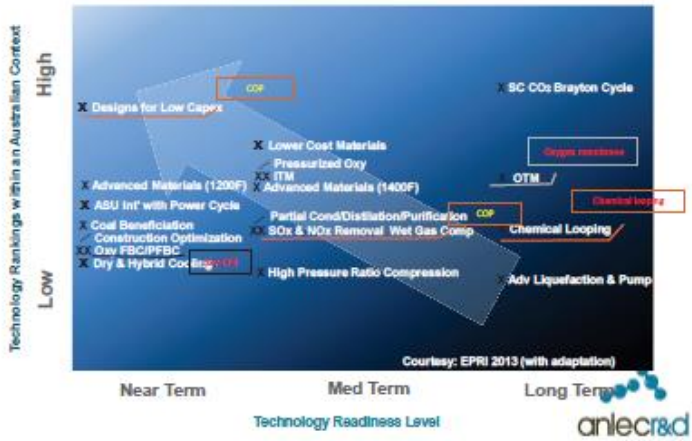
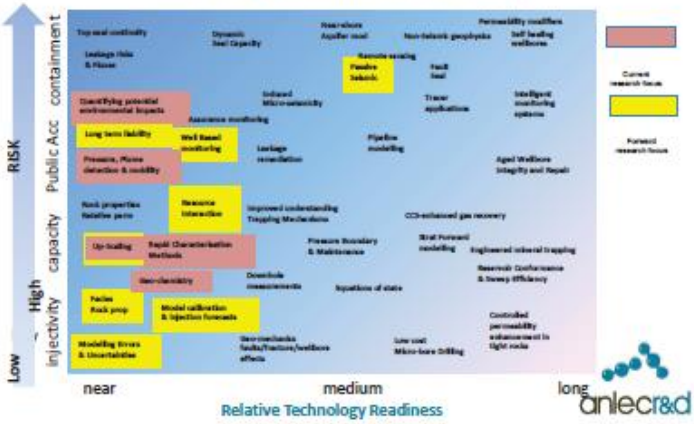
## Oxy- Fuel R&D Selection




## Know the Research Space

$CO_2$ Storage Research Selection - CTSCo




## Value – to Service Providers

Strategy Lesson 3:

- *Research must be credible (Science quality)*

**Quality control assurance**

Research proponents

- Validate science & quality independently
- Respond with their expertise/strength
- Retain intellectual property
- Protect their reputation

ANLEC R&D does not build a brand: researchers report under their own brand.

## Due Diligence: Evaluation

Research need is derived from Demonstration proponent

Scope to expand science to take opportunity with independent peer science review

Project priority set by Demonstration schedule


## Summary

- ✓ Targeted Initiative
- ✓ Empowered Management
- ✓ Embedded Customer Focus
- ✓ Science Leadership
- ✓ Diligent Project Development & Management

Defined Australian contribution in an international low emissions R&D context

**THANK YOU**

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Managing Director

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## Presentation 9: ERANET ACT – execution of projects and monitoring.

This presentation was given by Gerdi Breembroek (RVO)

Accelerating CCS Technologies

Contracting and Monitoring in ACT

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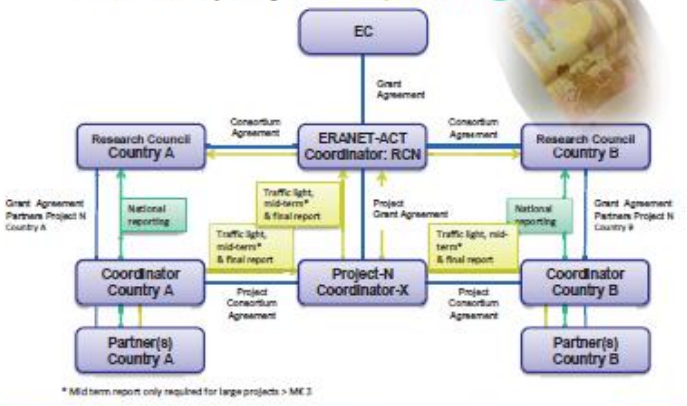
Gerdi Breembroek, Harry Schreurs
Netherlands Enterprise Agency
Leaders of monitoring work package

### Funded project reporting flows

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### ACT projects are fun!

- Funding from nine countries plus EC
  - Various funding regimes
- At least three partners from at least two countries
  - And up to 30 partners
- Strict timeline
- Minimum administration

ACT www.act-ccs.eu

### General principles

- One-to-one contact:
  - Coordinator of funded project and ACT Country contact
- Projects: no delays are possible
  - Early remediation in case of deviation from plan obligatory
    - Project level: 3-monthly "traffic light" progress monitoring
- Project Coordinator reports
  - Traffic light reports
  - Mid term review (large projects)
  - ACT knowledge sharing meetings
  - Final report

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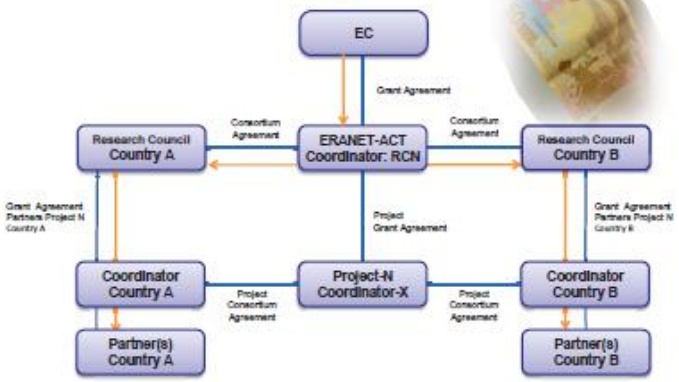
### Money flows

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### Traffic light report – 3 monthly (- calender)

Project coordinator to Call secretariat:

1. Identification of the project
2. Traffic light monitoring

| Progress | | | | |
|---|---|---|---|---|
| WP1 | [WP title] | | | |
| WP2 | [WP title] | | | |
| -- | | | | |
| Critical path | | | | |
| Financial | | | | |
| HSE | | | | |

3. Brief explanation of deviations and corrective actions

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## Knowledge sharing meetings
### & regular meetings

- Funded projects should be present at the annual knowledge sharing meetings:
  - With coordinator and task leaders as a minimum
  - The aim here is to share contents..
  - Focus is on the projects as a whole
  - ACT shall plan the dates well in advance. The meetings are linked to the workshops
- Regular ACT meetings:
  - ACT representatives bring an oral report (< 3 min) of projects coordinated from their country to the ACT meeting

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## Mid-term Review (large projects)

- Progress and financial review
- Only for the large projects
- After 18 months
- Identify strengths and weaknesses – inspire the projects to be excellent in their results
- Commission: ACT management team and Scientific Advisory Group
- Planned ahead, at least half a day per project - February 2019
- Policy Board meeting just after review

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## Simple as that!

- Thank you for your attention…
- Any questions?

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## Presentation 10: Execution of CCS projects and monitoring in US

Presentation given by John John Litynski, US-DoE

Theme 3
Execution of Projects
Contracting, monitoring, and QA/QC

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### Theme 3: Project execution, monitoring, and quality assurance

- DOE/FE uses financial assistance vehicles which support and stimulate R&D for a public purpose.
- Grants are used when there is no need for substantial involvement between the recipient and agency during performance of the grant. This is typically restricted to lower TRL's ( 1 to 4)
- Cooperative agreements are used when substantial involvement is needed between the recipient and agency during performance.
- Cooperative agreements are subject to close review and assessment of technical, managerial and financial performance.
- One or more intermediate go/no go decisions are often required to allow careful stewardship of Federal investment.

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### Project monitoring and QA/QC

- TRL drives level of monitoring
- Project costs are significant; government cost share is often loaded toward the front of the project (for example, design and procurement of specific components while construction and operating costs may be the responsibility of the project team).
- Project management tools track completion or achievement of project value (earned value for example).

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### Go/No Go Decision Points

- Budget Periods and continuation applications
- Go/No Go decision points
- Peer review – Internal and External
- Financial Reviews
- Pre FEED and FEED study results (pilots and demos)
- Techno economic assessments – Pre and Post
  - Quality Guidelines for Energy System Studies - FE/NETL
  - https://www.netl.doe.gov/research/energy-analysis/quality-guidelines

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### Quality Guide Energy System Studies - QGESS

- Techno Economic
- Process Modeling Design Parameters
- Retrofit Difficulty Factors
- Carbon Dioxide Transport and Storage Costs
- Capital Cost Scaling Factors
- Fuel Specifications and Prices for Selected Feedstocks

http://www.netl.doe.gov/research/energy-analysis/search-publications/vuesearch?search=netl&id=17&value=quality%20guidelines

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## Presentation 11: Australia – execution of projects and monitoring aspects

Presentation given by Noel Simento, ANLEC R&D

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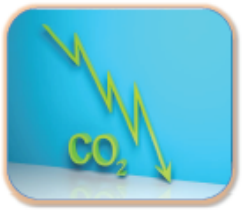
Australian National Low Emissions Coal Research and Development

### Contracting, Monitoring & Quality

Noel Simento
Managing Director

### Content

- ✓ Research Contracting Context
- ✓ Unique Drivers
- ✓ Implementation
- ✓ Monitoring
- ✓ Quality




**Note:**

All contracts are with ANLEC R&D act in the interest of the Demonstration Proponents

### Contracting Context: National Research Initiative

Partnership between the Australian Commonwealth and the Australian Coal Industry.

Objective:

*Research to support and enable demonstration of low emissions coal technology.*

Strategic Common Interest – Commonwealth & Coal Co's

- Maintain Competitiveness – Low Cost Energy
- Protect Revenues – Export Energy Resources
- Respond to Climate Science – Responsible Citizenship
- Deliver Policy Certainty
  - Manage Energy Asset Portfolio Transition

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### Contracting Context: Unique Drivers

- Funders will risk larger investment in Demonstration
- Research IP resulting targeted to reduce investment risk
- (Funders unlikely to use IP directly in core business)
- Consultant Contractor approach to contracting risk
  - embedded rights to terminate for convenience

Contracts must:

- Deliver research IP for Demonstrations
- Protect Demonstration Proponents relationships
- Protect researchers independence
- Deliver IP to public domain for maximum utility and benefit of low emissions coal technologies

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### Contracting Implementation

- Common Template developed.
- Negotiated with Research organisations as a group.
- IP Deed Poll accompanies every contract
  - ➢ maintains contract relationship between Researcher and Funder after ANLEC R&D.
- Exceptions are treated on merit.


Project Agreement
(Fuel Development)

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### Contracting Implementation

Deliver to Demonstrations

- Systematic communication and review with Demonstration Embedded Technology Manager
- Demonstration review of output
- Royalty free right to use/apply research IP in Demonstration
- Final payment is 25% of project value

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## Contracting Implementation

### Controlled Communication

- Protect Demonstration Proponents relationships
- Demonstration can embargo results for a limited period.
- Confidential information is specified by both parties.
- Demonstration has right of input/advice in publications.


## Contracting Implementation

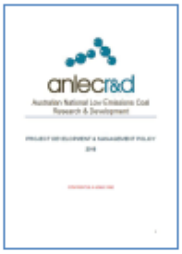
### Protect Researchers Independence

- Review by the Demonstration is limited to "advice only".
- IP is owned by the researcher and licenced to the Demonstration.
- Demonstration has fixed time to respond with feedback to publications, or authorisation is by default.
- Material must eventually be published.

## Monitoring

### Responsibility of General Manager Research

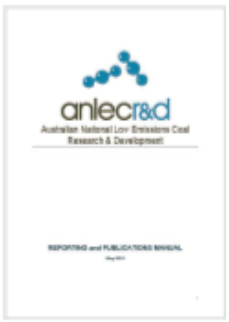
- Dedicated Project Co-ordinator and support.
- Automated milestone communication.
- Systematic project review by Demonstration.
- Project Management Policy;
  - Sets delegation of authorities & limits.
  - Sets procedures and deadlines.
- Quarterly financial reporting to Board of Directors
- Six Monthly Report to Funders



## Research Quality

### Systematic Review

- Weekly management review by exception.
- Demonstration review of project progress and quality twice a year.
- Scientific peer review for research publication quality.
- ETM review for scientific relevance and utility.
- Independent Science Leadership.
- Executive approval required for milestone completion and publication.



## Summary

### Lessons Learned

- Private Funding Agency – effective business model
- Contracts must balance the needs of Funders, Users and Research Service Providers
- Clarity of the "target customer" makes for easier contract negotiation
- Monitoring is embedded by systematic communication at
  - Governance level
  - Project Management Level
  - User Level
- Quality is controlled and monitored for
  - Science quality through peer review
  - Application and relevance by target customer
  - Project leadership and execution by Management

## THANK YOU

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## Presentation 12: ERANET ACT – Dissemination, exploitation of project results

Presentation given by Aage Stangeland (RCN)

# Accelerating CCS Technologies

ACT Workshop, Lausanne, 14 November 2016

Dissemination and exploitation of project results

Dr. Aage Stangeland
The Research Council of Norway

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## Communication – the key to success

Public survey performed for the European Commission 2011:

1. Have you heard about CCS?
   - Yes
   - No
   - Don't know

2. Do you think CCS is a good idea to combat global warming?
   - Yes
   - No
   - Don't know



## Communication – the key to success

Results:

- 10 % said they had heard of CCS
- 70 % had an opinion about CCS
  - 47 % agree that CCS could help combat climate change
  - 23 % did not agree

Reference: Special Eurobarometer 364, May 2011

- People often have an opinion about something they have not heard about
- People tend to listen more to NGOs than researchers, politicians and industrial stakeholders



## Promoting ACT

- Website
- Dialogue with researchers
- Presenting ACT at conferences and seminars
- Meeting with applicants between Phase 1 and Phase 2 of the ACT Call




## WP5 Communication

| Deliverable Number [14] | Deliverable Title | WP number [9] | Lead beneficiary | Type [15] | Dissemination level [16] | Due Date (in months) [17] |
|---|---|---|---|---|---|---|
| D5.1 | ACT Website | WP5 | 1 - RCN | Websites, patents filling, etc. | Public | 3 |
| D5.2 | Database with ACT results | WP5 | 1 - RCN | Websites, patents filling, etc. | Public | 24 |
| D5.3 | Evaluation report on results of communication and dissemination | WP5 | 1 - RCN | Report | Public | 60 |
| D5.4 | Communication plan | WP5 | 1 - RCN | Report | Public | 3 |
| D5.5 | Plan for knowledge sharing workhops | WP5 | 1 - RCN | Report | Confidential, only for members of the consortium (including the Commission Services) | 6 |



## Communication plan

- Announcing the ACT calls
- Marketing the call to ensure that good project proposals are submitted
- Knowledge sharing to all relevant stakeholders
  - Example: today's workshop
- Public relations
  - Reach out to researcher community
  - Target the public
  - Ensure engagement by governmental authorities

## Tools

- Annual knowledge sharing workshops
- Cooperation with relevant organisations
- Link to national programs and H2020
- Newsletters



## Dissemination by ACT projects

- Publications in top level journals
- Case studies on social acceptance
- Workshops
- Target end users
- Public outreach
- Dissemination is part of the Impact criteria when evaluating proposals



## Conclusions

- Ensure that the ACT consortium and ACT funding projects make a difference

PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

## Presentation 13: Dissemination, exploitation of project results by US-DoE

Presentation given by John Litynski, US-DoE

### Theme 4
### Dissemination, exploitation or Project Results

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### Technical Readiness Scale – What else marks commercialization threshold?

- Aside from the TRL scale, other criteria at the system level form an essential part of a commercialization plan.
- Additional steps may be needed beyond demonstrating readiness of a single component or of a large subsystem.
- System readiness level and the integration readiness level
- Real-world operation of a complex technology when it is fully integrated into an even larger system – such as a utility plant that is part of the electric grid.

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### Definition of success built into Call and Proposal

- Solicitation identifies the criteria for success
- DOE performance goals explicit in call for proposals
- Final reports to include data and evaluation focused on advancing technology or technology components toward commercialization
- Performance model provided or offered as reference to be used in evaluating financial benefits of technology being developed QGESS
- DOE Baselines for PC, NGCC, and IGCC facilities

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### Learning the key lessons from project results

- Peer reviewed published and considered for future R&D.
- Post-project assessments and lessons learned
- Results from a group of projects can define readiness for commercialization or for new work
- Individual components or results may find immediate applications in other fields using similar technologies (i.e., novel membranes)

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### Multi-lateral cooperation

- Joint activities may involve:
  - Participation as reviewers,
  - Coordinated planning and release of solicitations
  - Novel opportunities for cost-sharing, and
  - Co-funding work one bench-mark projects
- DOE procurement rules limit cost share for international projects to 25%
  - Share can be raised in special cases such as large pilots (50%)

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## Presentation 14: Australia - Dissemination, exploitation of project results

Presentation given by Noel Simento, ANLEC R&D

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Australian National Low Emissions Coal Research and Development

### Dissemination, Impact and Exploitation

Noel Simento
Managing Director

### Content

- ✓ Impact and Exploitation Context
- ✓ Case Study 1 – South West Hub
- ✓ Case Study 2 – CTSCo
- ✓ Case Study 3 – Callide Oxy-fuel
- ✓ Summary

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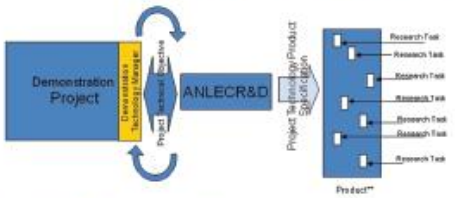
### Context: Impact & Exploitation




Embedded Technology & Knowledge Management

- Research is targeted to highest risk elements
- Exploitation is immediate (keen recipient of results)
- Impact is tangible and assessable - improved decisions
- Takes science out of the Lab for validation in the field
- Rewarding for researchers

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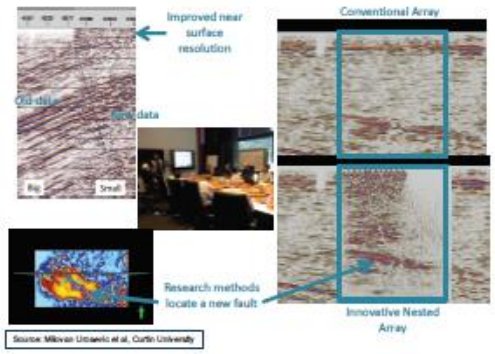
### Case Study 1: Advanced Processing for SW Hub




Delivers improved detail of geological structure

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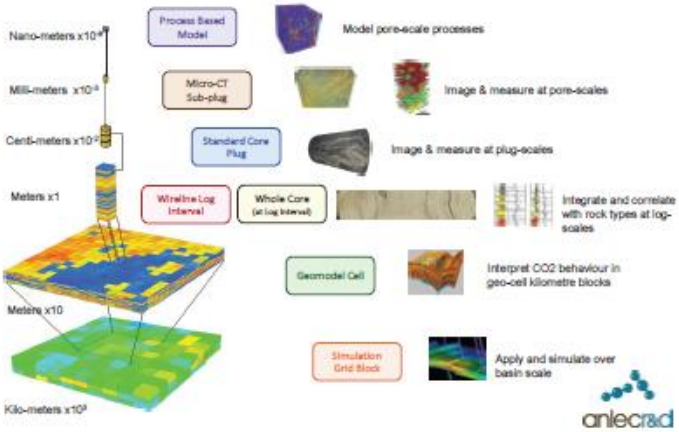
### Case Study 2: CTSCo

**Objective: Faster Reservoir Characterisation**

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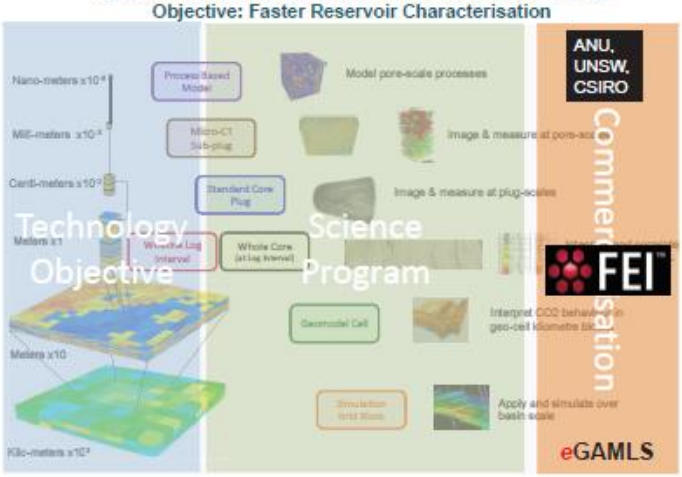
### Auditable Up-scaling for Reservoir Characterisation – CTSCo

**Objective: Faster Reservoir Characterisation**



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## Project Status

### Outcomes to date

- Project Reviewed by: Statoil Norway, Imperial College, U of Calgary, CSIRO
- Panel classifies technology progress as "world leading"
- Leadership embedded in hardware design and development
- Close partnership with Technology Vendor
- Technology has gone through 3 increasingly large corporate acquisitions since project commenced

### Outlook

- Make digital data open access to encourage innovation
- Continue and refine development
- Validate results in-field at CTSCo and Otway

## Case Study 3: Callide Oxyfuel Project

***Important to establish the capital costs for gas clean-up equipment necessary to allow CO2 storage.***

When this largest Demo commenced unknowns included:

- Potentially unsuitable $CO_2$ flue gas quality for corrosion tolerance of $CO_2$ compression unit operations, transport & storage
- Size of additional efficiency penalty - High levels of $SO_x$ in recirculated flue gas will result in a higher temperature dew point in the boiler, require a higher FGET and lower efficiency
- Redundancy of de-NOx equipment
- Cost of impacts of mercury gases in $CO_2$:
  - higher concentrations in flue gas requiring high cost of HEX materials in $CO_2$ compression
  - necessity or otherwise for additional Hg capture equipment either in power plant or in $CO_2$ compression

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## Research Results for Callide Oxy-fuel

Low cost de-SOx is viable, even for standard Australian power plants without FGDs

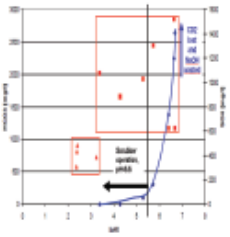
- NaOH scrubber will reduce SOx levels in flue gas
- 4<pH<5.5 is recommended as control regime to avoid caustic waste and for high removal extent
- Caustic consumption and disposal costs are material to the process

Separate de-NOx not required

- NOx and Mercury reactions coupled and synergistic
- Significant $Hg^0$ & NOx captured during compression process -100% Hg, ~90% NOx

Additional mercury capture not required

- Mercury removal can be achieved via ash disposal and liquid waste streams from compression



## Summary

### Lessons Learned

- Research funding must define "line-of-sight" to Technology
- Technology Deployment discriminates Research Priorities

### For ANLEC R&D

- Demonstration Proponents are "customers"
- Research results are anticipated and valued
- Exploitation is immediate
- Impact is tangible and assessable - improved decisions
- Dissemination
  - Short term through systematic communication
  - Long term by learned literature: Journals, Webinars, conference

### THANK YOU

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