Trondheim CCS Conference 2011

The Norwegian Research Programme CLIMIT: *CCS from strategy to reality*

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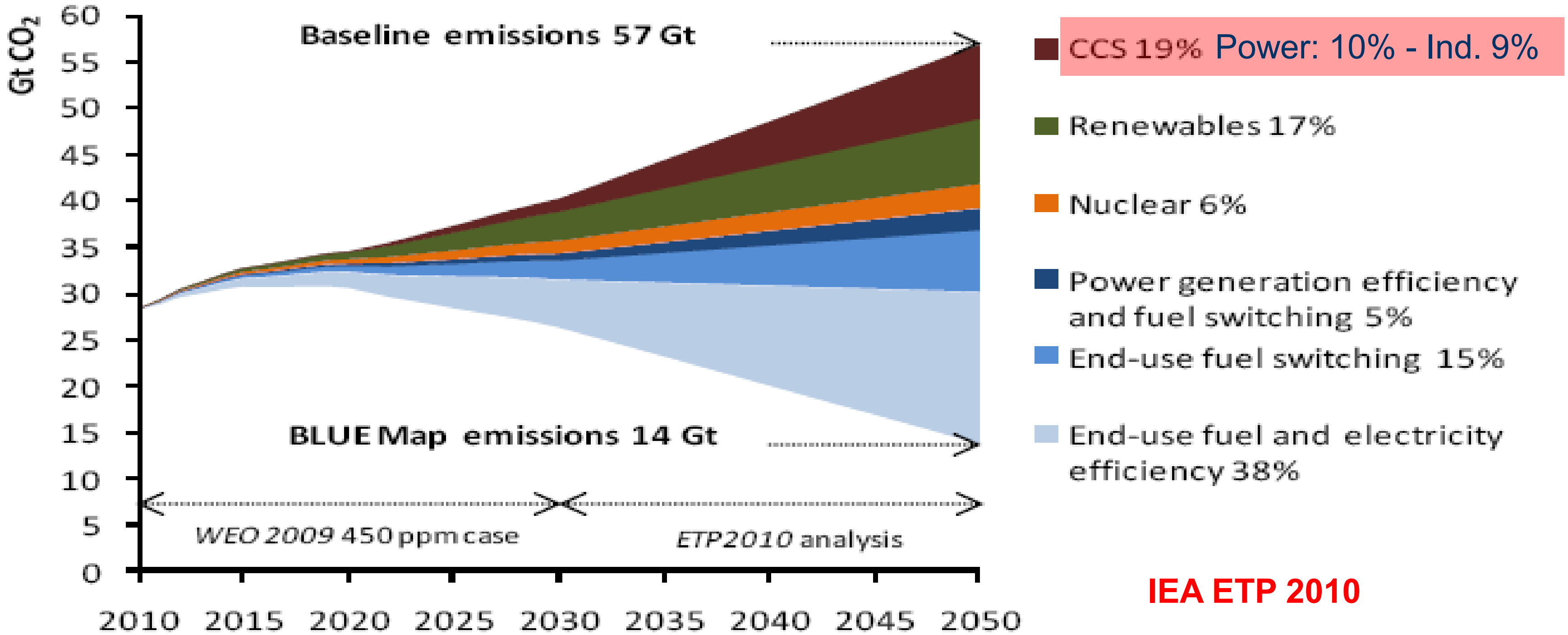
Forskningsrådet

What will it take to cut global CO_2-emissions by 50% in 2050 relative to current levels (IEA WEO 2010)?



Why CCS? Three unavoidable reasons:

- CCS provides *one* option: Not *either* renewables *or* CCS but *both-and*
- CCS may provide a transition technology from a fossil to a sustainable energy era
- CCS needed for industry emissions - is as important as for power production

Coal *and* gas power with CCS

The Challenges – What do we have to do?

1. Develop and demonstrate *competitive* technologies for mass production,
2. Deploy 2-3000 CCS power plants by 2050 *and*
3. Safely take care of 15-20bn tons of CO2 *annually*, say within 2050


Mongstad Facilities

Norwegian CCS policy

- CCS has been and still is a “hot” political issue in Norway
- Norwegian CCS policy based on Parliamentary Climate Agreement
- Objective: To achieve full scale CCS on Gas power plants and large industrial CO_2 point emission sources, *and*
- Norway should be (and has been) an “Early mover”:
  - The Offshore CO_2 Tax ⇨ Sleipner, Snøhvit CCS projects
  - Plans for several early CCS projects for EOR, Gas power

Background

Norwegian Government CCS Initiatives

- State enterprise Gassnova SF established (2005)
- The CCS RD&D Program CLIMIT established (2005)
- Technology Center Mongstad (TCM) – now being completed
- The Mongstad full scale energy plant
- Transport and subsea storage solutions and mapping of relevant sites in progress

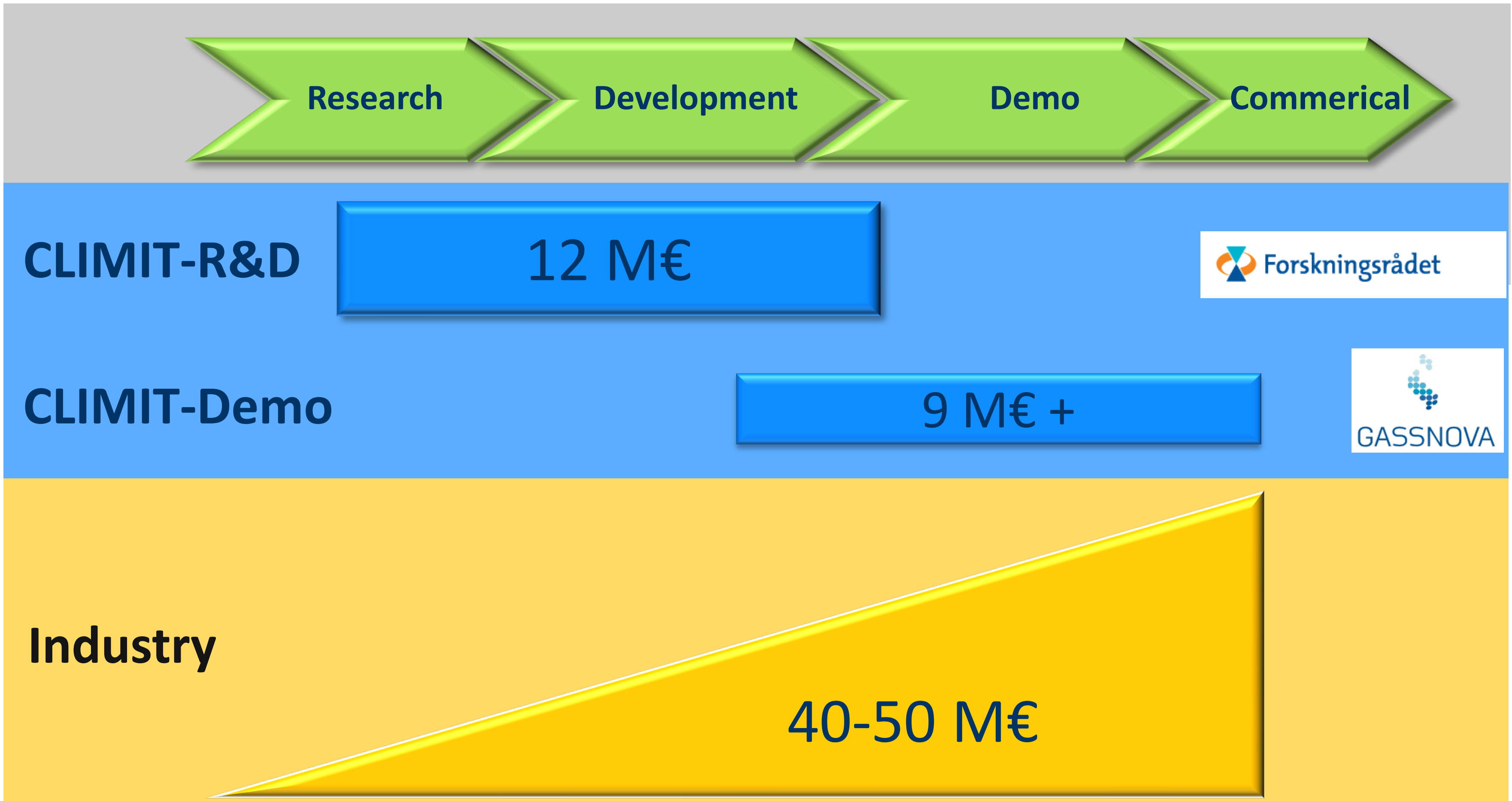
The Norwegian CCS RD&D program CLIMIT

- Vision: Accelerate commercialisation of CCS technologies by financial stimulation of RD&D
- A national collaboration between Gassnova SF and RCN
- Promotes and funds R&D and Demo CCS projects on fossil Power and large industrial point emisson sources
- Active international collaboration in CCS RD&D
- Annual budget of ~21 M€

CLIMIT Objectives – Research Challenges

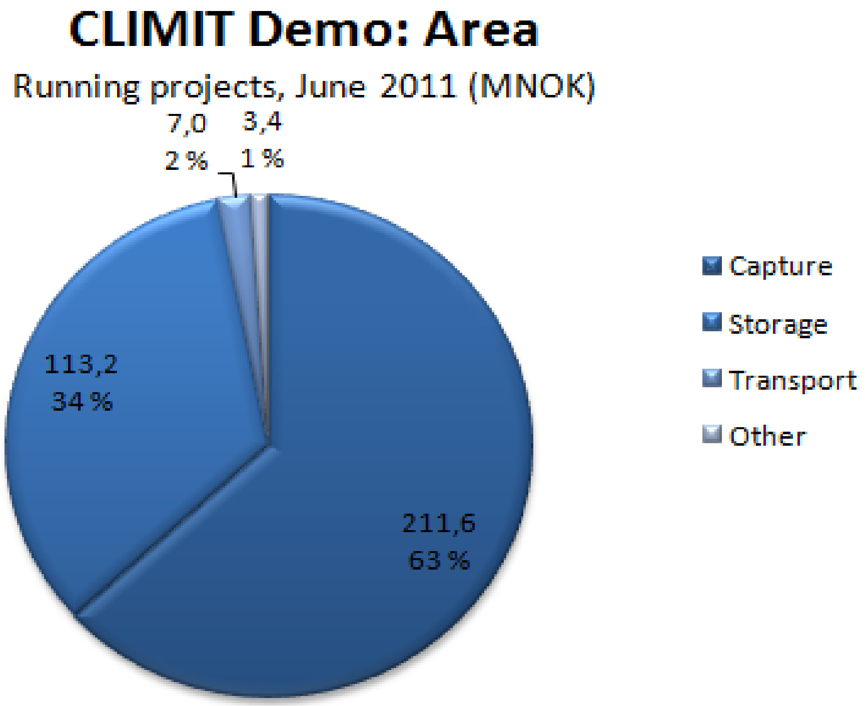
- Develop, demonstrate and verify cost and energy efficient capture processes with low environmental side effects
- Establish a significant R&D project portfolio of new, cutting edge capture technologies (with demos from 2015)
- Contribute to safe and cost efficient transport, storage and monitoring of CO2
- Establish good understanding of environmental side effects in the CO2 value chain for licensing procedures
- Contribute to identify and close technology gaps in the CCS value chain
- Support commercialization of technologies, methods and services

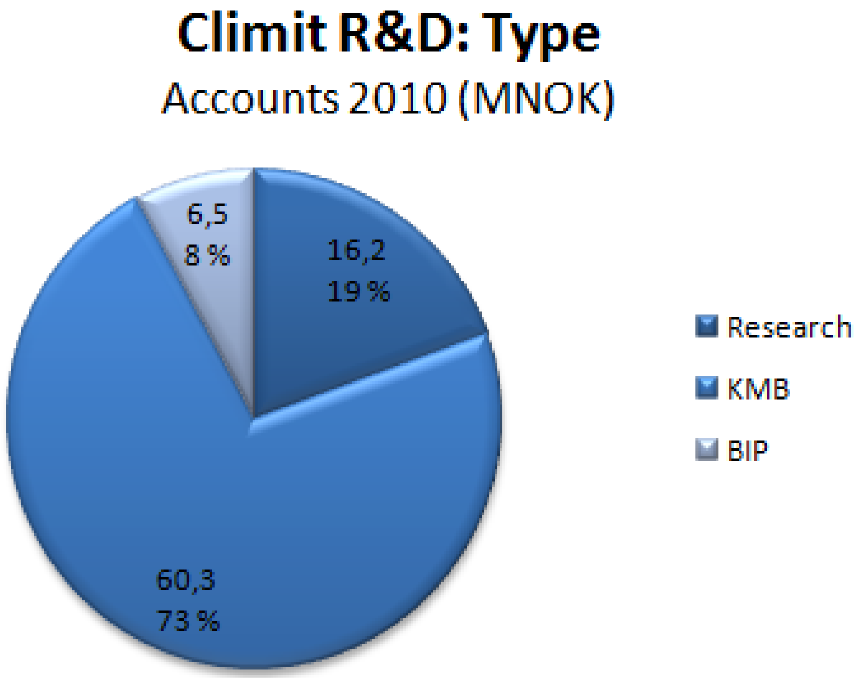
The CLIMIT Program: A Cooperation between Gassnova and RCN covering the entire value chain



CLIMIT Funding Distribution (MNOK)

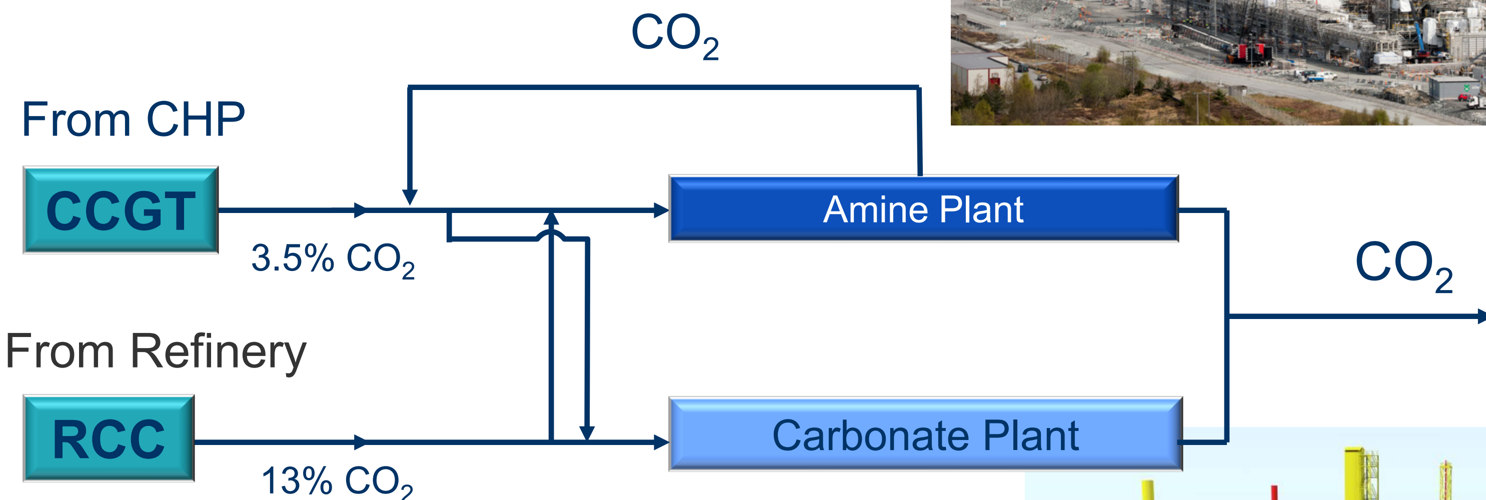
Type of Project Areas

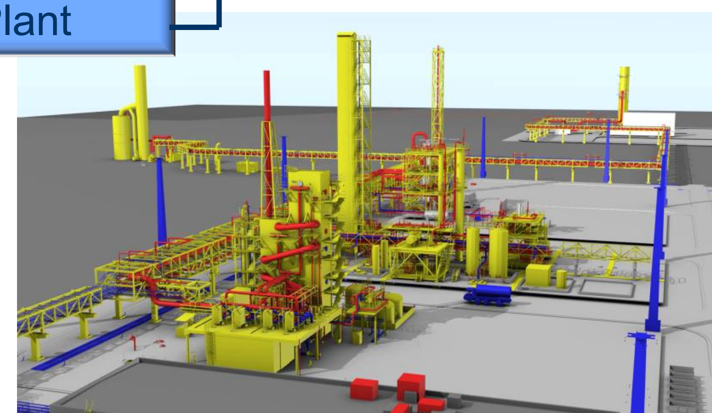




CO_2 Technology Centre Mongstad (TCM)

Two off-gas sources and
Two capture technologies:



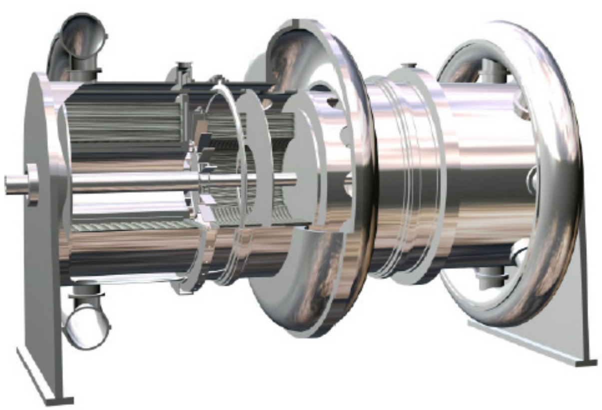


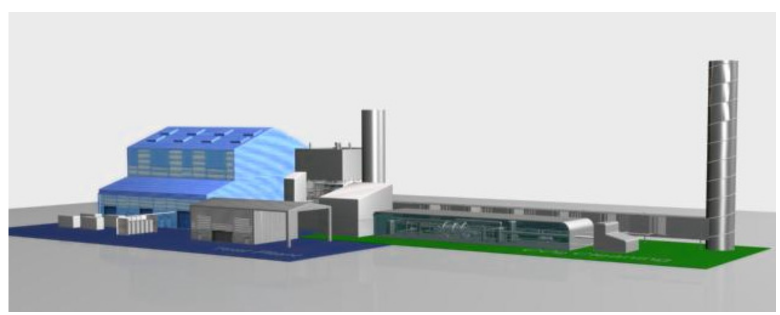
TCM Capacity: 100.000 t/yr CO_2

Examples of CLIMIT Projects

3C - Compact CO_2 Capture

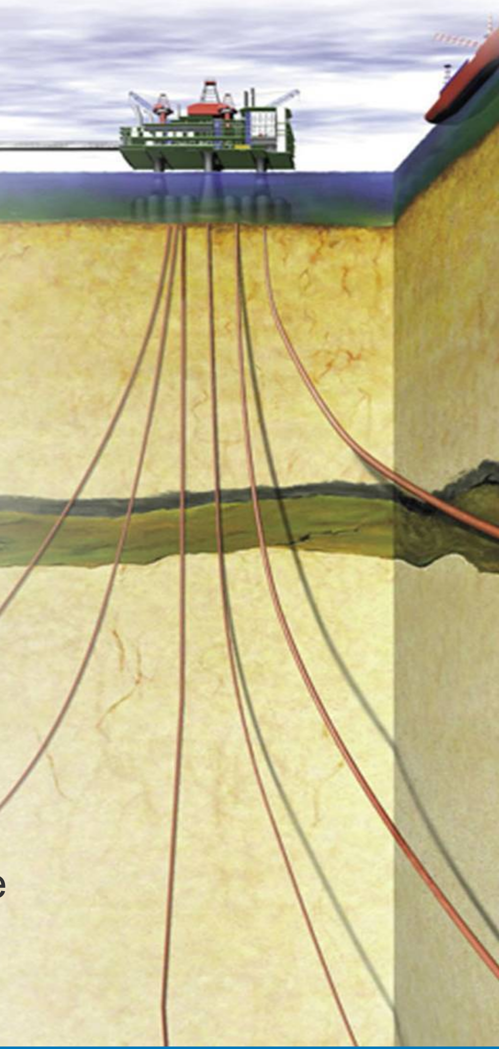
- Project Type: Industrial development (2008-2012)
- Responsible: Statoil
- Budget: 64,6 MNOK (32,2 MNOK from CLIMIT)
- Project Targets
  - Reduce CAPEX by 40-50% (Compared to BAT)
  - Reduce OPEX by 30-40%
  - Low environmental footprint capture facility





Statoil

Geological Storage of CO_2: Mathematical Modelling and Risk Assessment (Matmora)



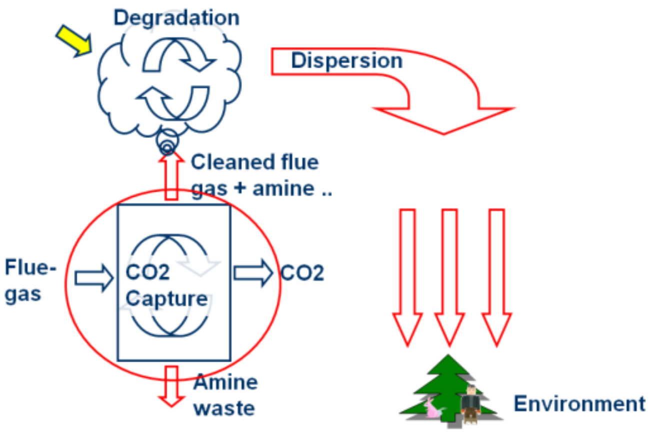
- R&D Project (KMB: 2007-2011)
  - Responsible: University of Bergen
  - Budget: 20,5 MNOK - CLIMIT Support: 16 MNOK
- Results
  - Improved understanding of storage mechanisms
    - New modelling tools show that dissolution of CO_2 in water may be a more important trapping mechanism than earlier assumed
  - Faster simulations
    - 2D-models based on vertical equilibrium show accurate results. This enables 10 to 100 times faster simulation time compared with traditional 3D models

CO_2 Field lab for monitoring and safety assessment

- Responsible: SINTEF
- Partners: NGI, BRGM, Schlumberger, Beurau Veritas, British Geological Survey, Geosciences Montpelliers, ImGeau, UiO, Ruden AS, Shell
- Site: Svelvik (south of Oslo)
- Budget: 95 MNOK (49 MNOK from CLIMIT)
- Targets
  - Injection of CO_2 into a 300m thick glacial morain
  - Study CO_2 flow and simulation of shallow leakages
  - Validation og monitoring methods
- Focus: Monitoring, public acceptance

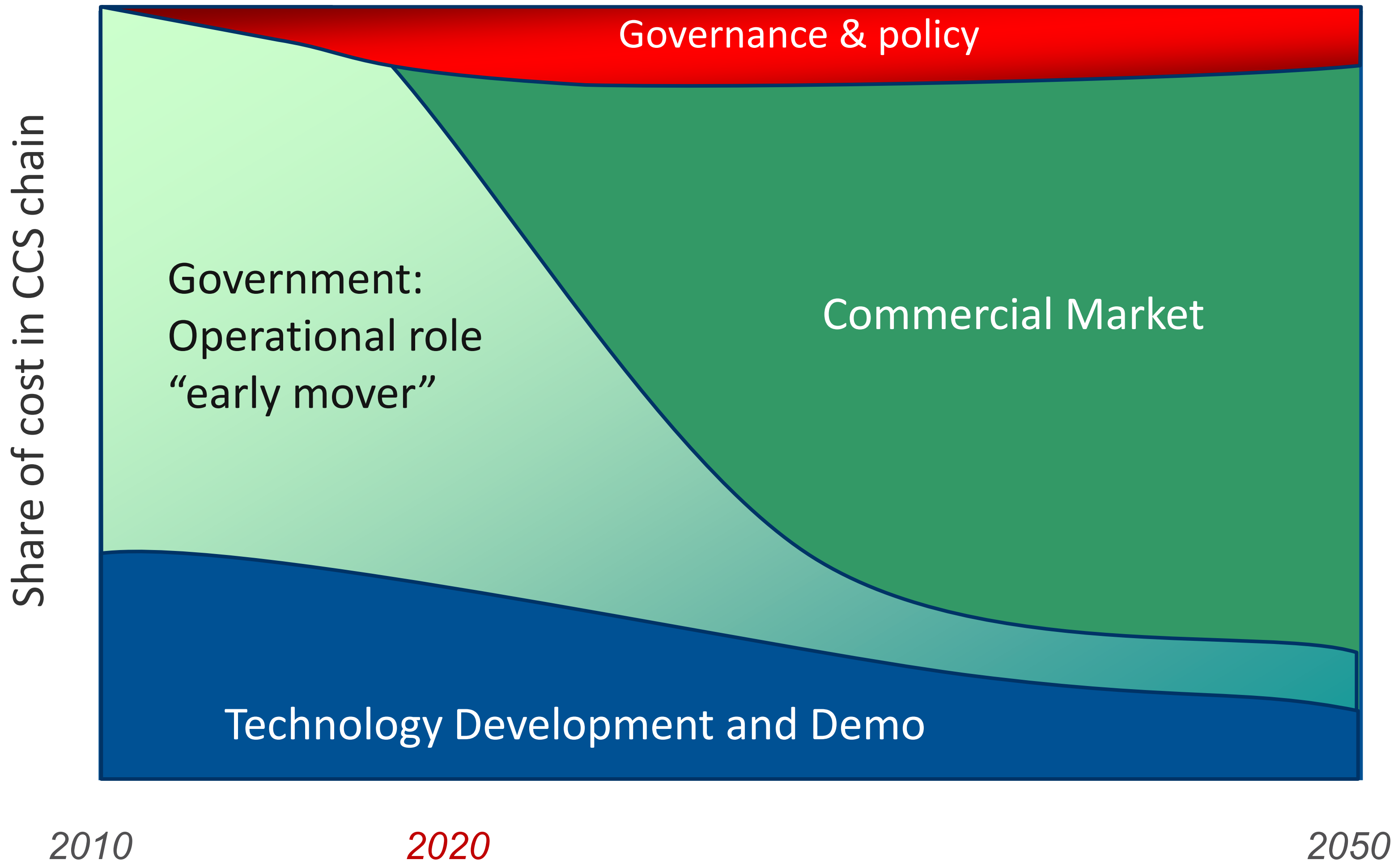
HSE related Amine emissions from Capture plants

- Several projects on Amine Emissions to Air During Carbon Capture
- Total Budget: 7M€ (since 2008)
  - Example: Atmospheric Degradation of Amines (ADA: 2008-2011)
  - Responsible: NILU and University of Oslo
- Project results
  - MEA (MonoEthanolAmine) itself is not problematic
  - MEA degradation in the atmosphere does not give nitrosamines
  - MEA degradation in atmosphere gives nitramine
    - Expected lower toxicity than nitrosamines
  - Small amounts of alkyl amines found in solvent
  - Nitrosamines has short lifetime in the atmosphere



Road map for implementation:

Government role in CCS – An optimistic view

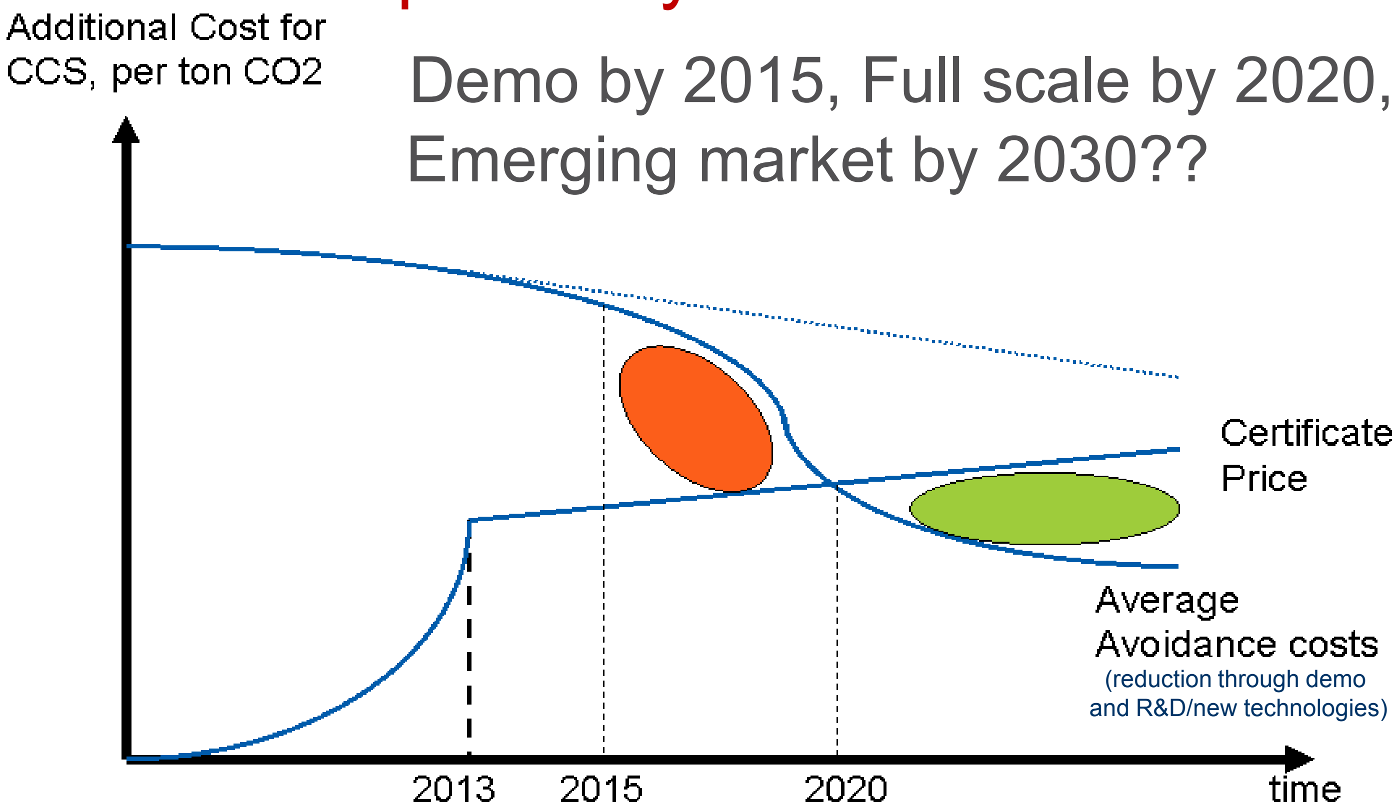


Challenges in commercialization:

EU SET Plan CCS Energy Industry Initiative

Objective: 10-12 CCS demo and full scale plants by 2020

Demo by 2015, Full scale by 2020, Emerging market by 2030??



Conclusions

- CLIMIT has a large project portfolio that covers the entire CCS development and value chains: *RD&D in Capture, Transport and Storage*
- CLIMIT Contributes to identify and close technology gaps in the CCS value chain
- CLIMIT Supports commercialization of technologies, methods and services and has “close to market” activities
- CLIMIT offers access to a professional and experienced network and secretariat
- CLIMIT provides substantial financial support to *good* projects

Thank you for your attention!

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