SDD – Strategic Deployment Document

BELLONA

Demonstration projects

- We need to initiate the immediate large-scale deployment of CCS technology, starting with the implementation of 10-12 full-scale commercial demonstration projects
- Any R&D requirements are to enable wider implementation and economies of scale which, although important, are no barrier to deployment.
- Technologies required for CO_2 capture and storage are already well proven - especially in EOR

SDD – Strategic Deployment Document

BELLONA

Regulatory framework

- Yet the true potential of CCS has still not been realised due to lack of long-term fiscal incentives and a regulatory framework
- Industry is not willing to commit the significant upfront investment required until they have confidence in the long-term future and commercial value of CCS. Even for EOR projects, incentives are needed to ensure rates of return are high enough to attract capital.
- Without clarity on the financial risks and rewards - including a stable regulatory framework - investors will not have the long-term certainty they need to commit their funds
- Liability is a very important issue that has to be addressed to clarify the ownership of CO2 during transport and storage

SDD – Strategic Deployment Document

BELLONA

Regulatory framework

- It is essential that CO_2 used for CCS projects is fully accredited under EU ETS, as well as the Clean Development Mechanism (CDM).
- Long-term regulations must to be in place to govern the EU ETS beyond 2012. There must also be consistency with the stimulation of other parallel developments in clean energy/fuels, such as the mechanism for green certificates
- Laws and treaties regulating the economics involved when CO_2 crosses country borders must be consistent and compatible within all countries taking part in a CO_2 infrastructure
- A clear risk management strategy needs to be developed. Every CCS project must include risk management using LCA or SEA/EIA as assessment tools.

SDD – Strategic Deployment Document

Public acceptance

- It is essential that we maintain an open dialogue with the public on *all* aspects of CCS technology. CCS and renewable energy are *complementary*, not competing strategies, with the latter still our ultimate, long-term solution. However, we must act *now* if we are to avoid further climate changes
- The challenge is to get the key messages out early so that the public are reassured that their lives will not be affected adversely in any way. On the contrary, if we do not develop CCS technology, their lives will almost certainly be affected adversely by climate change.

SDD – Strategic Deployment Document

Kick starting the CO_2 value chain

- One way to kick-start the development of CO_2 infrastructure is to identify ***niche markets*** where the cost and income are at acceptable levels. This will motivate stakeholders to act on a commercial basis, even without proper framework conditions. Examples: use of CO2 in ***EOR, EGR, NGS***, ***CBMR***
- The starting point for the development of a European CO_2 infrastructure is the identification and transfer of technology, know-how and experience from other parts of the world

BELLONA

SRA – Strategic Research Agenda

- Public Acceptance
  - "The complexity of beliefs, values and concerns that affect the perception and attitudes toward risk technologies makes it necessary to develop more precise and sensitive to the specific context methods"

BELLONA

SRA – Strategic Research Agenda

Plant design

- The pathway to zero emissions can only be achieved effectively by addressing the issues of improved energy efficiency of fossil fuel power plants together with the development and adoption of CO_2 capture technologies
- The development of highly efficient steam power plants (> 50%) is particularly related to the technical control over high steam temperatures.
- The next generation of gas turbine combined cycles should attain efficiency above 60%. Moreover there is a demand of longer lifetime in combination with cost-efficient operation. The materials should show an improved capacity to withstand increased mechanical-thermal load

BELLONA

SRA – Strategic Research Agenda

Post combustion

- In a post-combustion capture system, the major components of the system are well established in existing power generation plants
- The next decisive R&D step on the road towards a zero-CO2 IGCC/IRCC power plant is the construction of a complete demonstration plant on an industrial scale.

Pre combustion

- Further process studies are needed to evaluate the various schemes needed to provide oxygen at high pressure upstream the gasifiers
- Further developments are required for designing large single train gasifiers within a power range of 1200-1500MWth, H-class gas turbines capable of burning H2 rich gases at same GT inlet temperatures as natural gas fired GTs. and high temperature water steam cycles

BELLONA

SRA – Strategic Research Agenda

Oxyfuel

- Flue gas recycle rates have to be optimised
- Existing boiler design models have to be adapted for oxyfuel combustion and validated by experimental data. New burner designs have to be developed in order to minimise emissions and provide a stable combustion.
- Material has to be selected for new flue gas environment
- Adequate control systems have to be defined
- the basic thermodynamic cycle for oxyfuel combustion needs to be further developed.
- Development of new large-scale oxygen production concepts based on ceramic ion transport membranes or the CAR technology may lead to an alternative to the future advanced distillation technology

BELLONA

SRA – Strategic Research Agenda

Transport

- The corrosive behaviour of CO_2 is well known, but further research is necessary
- Existing pipelines originally designed for other flow systems than CO_2 may be converted to CO_2 pipelines. In such the ability for the pipelines to transport CO_2 has to be identified
- Concepts for carrying large volumes of CO_2 by ships have been theoretically developed, but no ships in the size needed to move large CO_2 volumes have yet been built.
- It is necessary to to develop accurate and verifiable monitoring systems in order to detect potential infrastructure leakages.

BELLONA

SRA – Strategic Research Agenda

Storage

- More work is needed to prove the trapping concept in more geological settings.
- Study of rock/fluid interactions from reservoirs
- Exploration of seal integrity
- Systematic development of dynamic models of CO2 lifetime
- Cap rock integrity
- It is necessary to model possible escape profiles

Environmental impacts

- *Poorly covered in the SRA*