LOCATION ??, Oslo March 2011

CCS projects in the EU

NER 300

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What is the NER 300?

- World's largest CCS funding mechanism.
  - 300 million emission unit allowances (EUAs)
    - Today's value app. €4.5bn –allocated by two calls for proposals for large-scale demonstration projects of CCS and innovative renewable projects through this mechanism. **(6 - 8 CCS and 34 RES)**
  - **1st call (200 million EUA):** Application to MS by the February 9th. MS to European Investment Bank and European Commission by May 9th, 2011.
  - **2nd call** (100 million EUA): 2012 (selection: late 2013)

NER 300 Overview

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- Total projects 22 CCS and 131 RES, according to the European Commission:

- Power generation: pre-combustion 250 MW = 6 projects
- Power generation: post combustion 250 MW= 8 projects
- Power generation: oxyfuel 250 MW = 4 projects

- Industrial applications = 4 projects

- Refineries, with 500 kt/y stored CO_2 from one or more sources within the refinery
- Cement kiln, with 500 kt/y stored CO_2
- Primary production routes in iron and steel production with 500 kt/y stored CO_2
- Primary production routes in aluminium production with 500 kt/y stored CO_2

NER 300 requirements

- Eligibility criteria:
- Full chain project: capture, transport and storage
- Capture rate: >85% of CO_2 in flue gases
- Operational by 2016
- Knowledge sharing & Research Centre for each project

- NER 300 grant= Max. 50% of CCS relevant costs

- Role of the EIB: ranking against the cost per unit performance (CPUP) " amount of CO_2 captured and stored per € granted"

- Other Requirements
- Will be selected at least 3 projects in saline aquifer and 3 in depleted oil-gas fields
- Full funding if 75% of the projected total amount of CO_2 stored in a 10 year period after the entry of the project

Projects per country

- **9 in the UK** (5 pre-combustion projects, 3 post-combustion projects, 1 oxyfuel project)
- **4 in the Netherlands** (1 oxyfuel, 1 pre-combustion, 1 post-combustion, 1 industrial)
- **1 in Spain** (oxyfuel)
- **1 in Italy** (post-combustion)
- **1 in France** (industrial)
- **1 in Poland** (post-combustion)
- **1 in Germany** (oxyfuel)
- **1 in Romania** (post-combustion)

NER 300 CCS Projects in the UK

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- 5 pre-combustion projects:

Eston Grange (Progressive Energy)
Lynemouth project (Alcan, Progressive Energy)
Killingholme, (C gen)
Two projects in Hatfield (Powerfuel Power Limited)

- 3 post-combustion projects:

Longannet (Scottish Power)
Peterhead (Scottish and Southern Energy)
Hunterston (AP Ayrshire Power Limited)

- 1 oxyfuel project:

Drax project in Selby

E.ON, RWE, EDF Energy say did not enter UK bids

UK - Eston Grange

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- Teesside, North-East England

- Project: **new 850 MW IGCC power plant**

- Capture technology: **Pre-combustion**: Around 85% of CO_2 emissions
- Storage: **Offshore** approximately 7.5 million tonnes CO_2 North Sea.

- Consortium: **Coastal Energy Ltd**, a joint venture between Centrica (British Gas) and Progressive Energy Ltd.

- Project will store CO_2 from other power plants and industrial processes in Teesside and the North East.
- Network developed by COOTS Ltd: joint venture between Centrica and Progressive Energy Ltd- pipeline to account for CO_2 from other sources

UK - Lynemouth project

- Northumberland, North England

- Retrofit the Lynemouth **biomass and coal-fired power station (420MW) on one of three units (**Most thermally efficient coal-fired power station in the UK).

- Assumed capture technology: **Pre-combustion**.
- Storage: **Off shore** – salient acquifer – North Sea

- Project partners: **Rio Tinto Alcan's and Progressive Energy –** may share the CO_2 transport pipeline and storage site with Eston Grange

- Part of the North East network, being developed with One North East, Project: clusterred with the Eston Grange project Tees Valley Unlimited (TVU), the North East Process Industry Cluster (NEPIC), the Association of North East Councils, RENEW, and major firms including Sabic, Growhow, Lucite International, Rio Tinto Alcan and Progressive Energy

UK - Killingholme

- South of Hamber, North Lincolnshire.
- Killingholme, **C Gen** (Belgian company)
- **IGCC plant up to 430MW** in size in Killingholme's "clean gas project"

- Capture technology: **Pre-combustion**
- Storage: North Sea ?

- The **Humber region** is seen as a prime spot to test CCS with its abundance of power plants, oil refineries and steelworks.
- 4 out of 9 UK bids are from Hamber

UK - Hatfield #1

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- **Hatfield, Hertfordshire, England**

- **900MW IGCC plant - new coal power plant**

- Capture technology: **Pre-combustion,**
- Offshore storage: 5 million tonnes per annun (Mta) of CO_2, in saline aquifers or depleted reservoirs beneath North Sea

- Consortium: Powerfuel Power Limited, Shell, Russia's Kuzbassrazrezugol and National Grid, which has responsibility for the transportation and storage elements.

- The companies Powerfuel Power Ltd, B9 Coal Ltd and AFC Energy Plc have now signed a Letter of Intent to install up to 300 megawatts (MW) of AFC Energy's alkaline fuel cell technology at Hatfield.

UK - Hatfield #2

BELLONA

- **Hatfield, Hertfordshire, England**

- 450MW **gas fired** Endex NGCC plant in Hatfield

- Capture technology: pre-combustion ”Endex Reactor technology” , with zero primary energy penalty
- 10MW pilot project, expected to be up and running in 2011
- Commercial scale by the end of 2015.
- Storage technology:

- Joint venture: **Powerfuel Power Limited** and Australian firm **Calix**
- Announced in November 2010

- → Powerfuel PL, the energy company, entered two bids for plants at Hatfield near Doncaster.

UK - Longannet

- **Longannet, Scotland**
- Capture technology: retrofit with **post-combustion** capture technology on two of the 600 MW units of the 2400 MW coal/biomass turbine. Emission reduction : 90%
- **Offshore Storage**: 2 Mta CO_2 captured, stored in the North Sea
- The pilot involves a Mobile Test Unit (MTU), **Aker Clean Carbon**. App. 1MW in size, processing 1,000m3 of flue gas per hour and can capture up to **200 kg of CO_2 per hour.**
- Consortium: Scottish Power and brings in other companies as part of a consortium, including National Grid for the transport aspect, Shell U.K Limited (storage) and Aker Clean Carbon (capture). The consortium is also investigating using a rock formation under the North Sea to store the captured CO_2 .

UK - Peterhead

- **Peterhead, Scotland**

- New gas fired Peterhead power station
- Capture technology: **Post-combustion project** on one 385 MW combined cycle gas turbine unit
- 1Mta of CO_2 captured
- Offshore Storage: existing gas reservoir in the North Sea, operated by Shell
- First project was cancelled
- Current consortium: **Scottish and Southern Energy (SSE)** and **Shell and** CO_2 DeepStore (offshore transport and storage elements)

UK - Hunterston

- **Hunterston, North Ayrshire, Scotland**

- New co-fired coal and biomass power plant at Hunterston, approx. 1700MW capacity.

- Capture technology: **Post-combustion**. Approx. 100,000tpa of CO_2 captured
- **Offshore Storage**: East Irish Sea

- In December 2010, AP Ayrshire Power Limited announced consortium with Doosan Power Systems (capture), Fluor Limited and Petrofac (storage).

UK - Drax Power project in Selby

- **Sulby, Northamptonshire, England**

- **New 426MW** CCS demonstration project, on or near the site of the 4,000MW coal power station.
- Capture Technology: **oxyfuel**
- **Offshore storage**: North sea

- Bid partners: **Drax Power, Alstom UK, National Grid**

- National Grid will provide the transportation element of the chain with an experienced offshore partner.

NER300 CCS projects in the Netherlands

- There are 4 tenders to the NER 300 in the Netherlands:

- **1 Post-combustion** project in Eemshaven
- **1 Pre-combustion** project in Buggenum, Rotterdam
- **1 Oxyfuel** Corus' CO_2 -project
- **1 Industrial** project on a hydrogen Refinery, Air Liquide

- Storage site undecided yet.

- Other projects: ROAD in Rotterdam have not applied

NL - Eemshaven

- Northern seaport of **Eemshaven** in Groningen
- **1600 MW coal-fired** power plant in - based on 10% biomass
- Capture technology: **post-combustion** CO_2 capture R&D unit. 200,000 ton per year of CO_2 (equivalent to 35 MW).
- Storage site: undecided
- Operating demo 10 MW plant in Germany (Niederaussem)
- Project partners: **Essent/RWE Power**
- Plans to become operational **in 2015.**

NL - Buggenum Project

- **Buggenum** in the Dutch province of Limburg

- Capture technology: **Pre-combustion** process on a biomass/coal fired plant
- Willem Alexander IGCC power plant (**233MW,**) in operation since February 2011
- Buggenum pilot plant in preparation of **Magnum:** 1200 MW multi-fuel (coal, biomass, natural gas) power plant based on coal gasification technology
- Storage: undecided
- Consortium: **Nuon, Vattenfall -** working together with leading parties such as ECN, KEMA TNO and Delft University of Technology.

NL - Corus CO2-project

- Location of the capture plant undefined
- Project: **Oxyfuel technology**. Was planned on steel manufacture but may have changed.

- Not many details on this new project, what we know:
- Along with HISARNA technology, partially funded through the Ultra-Low CO_2 Steelmaking (ULCOS) initiative
- Storage was planned in **Ljmuiden**
- The consortium leader: **Corus**

NL - Air Liquide Refinery

- **Botlek area, Rotterdam**
- **Industrial project: New hydrogen plant.** Capture fitted on to new hydrogen units or retrofitted onto existing units
- Capture technology: Carbon capture unit called cryogenic purification unit (CPU) that could capture up to **0.55Mta** CO_2
- **Air Liquide** in co-operation with the Rotterdam Climate Initiative, Air Liquide is also a partner in the joint venture with Vopak, Anthony Veder and Gasunie, for the carbon dioxide hub in Rotterdam

NER 300 CCS projects in FRANCE

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- **Florange, Northern France**

- **industrial project**
- The **Florange steelworks project** which is part of the ULCOS project in Northern France
- Capture technology: Retrofit**: post-combustion technology** on a steel plant to capture carbon dioxide. Construction could commence 2012/2013.
- **500,000 t** CO_2 **/y to be captured**
- Onshore Storage: Injection could ideally start by 2015, in deep **saline formations**

- Consortium: **ArcelorMittal & ULCOS** (Ultra-Low- CO_2 -Steel)

- Other ongoing CCS projects:
  - CCS demonstration on a gas power plant in Lacq: oxyfuel capture process & storage in depleted natural gas reservoir,Total

NER 300 CCS projects in GERMANY

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- **Jänschwalde, Brandenburg in East Germany**

- **Oxyfuel project**

- Capture technology: combination of **oxyfuel** and post-combustion capture technologies on two of the six 250MW boilers units of the **lignite fired power plant**

- **NER300 project: 250 MW Oxyfuel boiler** – Oxyfuel was chosen for its superior capture rates and is the best option to retrofit existing power plants
- Onshore storage: route undecided

- **Vattenfall** should start operations in 2015

The Jänschwalde power plant

The Jänschwalde project applied to the NER300, it has already received 180mn€, provided by European Union Economic Recovery Package

NER 300 CCS projects in ITALY

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- Porto Tolle, Northern Italy

- **Capture technology: post-combustion Retrofitting a 660MW coal-fired power-generation with post-combustion technology.**
- **1 Mt/y of** CO_2
- Offshore storage: into an off-shore saline aquifer.

- Consortium: **ENEL - Eni S.p.a**. (co-operatioon agreement aimed at developing an integrated pilot CCS project and a feasibility study for the construction of a large-scale integrated demo plant at the Porto Tolle power plant); IFP Energies Nouvelles for the capture (MoU to test the first generation post-combustion capture process developed by IFP, on the capture pilot plant in Brindisi)

- Other ongoing project: ENEL has inaugurated the CCS pilot plant on the Federico II coal plant in Brindisi, early 2011.

NER 300 CCS projects in POLAND

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- **Belchatow, central Poland**

- 858 MW new unit of the existing 4,440 MW lignite-fired power plant

- Capture technology: Post-combustion: Carbon Capture Plant (CCP) of equivalent power of >250MW, integrated with the 858 MW unit.
- CO_2 capture efficiency of >80% (Advanced Amine Process (AAP)
- Onshore storage: saline formations. approx.1.8Mta of CO_2 captured

- Consortium: **PGE Group** (larger power sector company in Poland) and **Alstom** (lignite-fired unit currently being built by Alstom for PGE Elektrownia Bełchatów)

- The other project on a coal power plant in Kedzierzyn-Kozle has not applied

Belchatow power station

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The largest thermal power station in Europe,
the second largest fossil fuel power station in the world.

NER 300 CCS projects in SPAIN

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- Compostilla, North West Spain
- ENDESA power station **Compostilla OXYCFB300**

- Capture technology: **Oxy-combustion plant:** 300 MWe Circulating Fluidised Bed (CFB) technology.
- Tested first on a new 30 MWth Technology Development Plant (TDP), in Cubillos del Sil.
- **1.1Mta** CO_2 **captured**, transported approximately 120km by onshore pipeline.
- **Onshore Storage**: proposed in saline formations.

- Consortium **ENDESA, CIUDEN and Foster Wheeler Energia** for the for its CO_2 Capture Technology Development Plant

Compostilla OXYCFB300

NER 300 CCS projects in ROMANIA

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- **Turceni,** South West Romania

- Capture technology: **Post-combustion** on a newly modernised lignite-fired unit of 330MW
- 1,5Mta of captured CO_2
- 85% removal efficiency from flue gases.
- **Onshore storage:** deep saline aquifers in the area

- Consortium: **ISPE** as the manager of the CCS project together with *Turceni* Power Plant.
- Got funds from the Norwegian Grants Agreement.

Turceni power station

The largest electricity producer in Romania, with an installed capacity of 2310MW.

Thank you !