CCS – Status Report

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BEST

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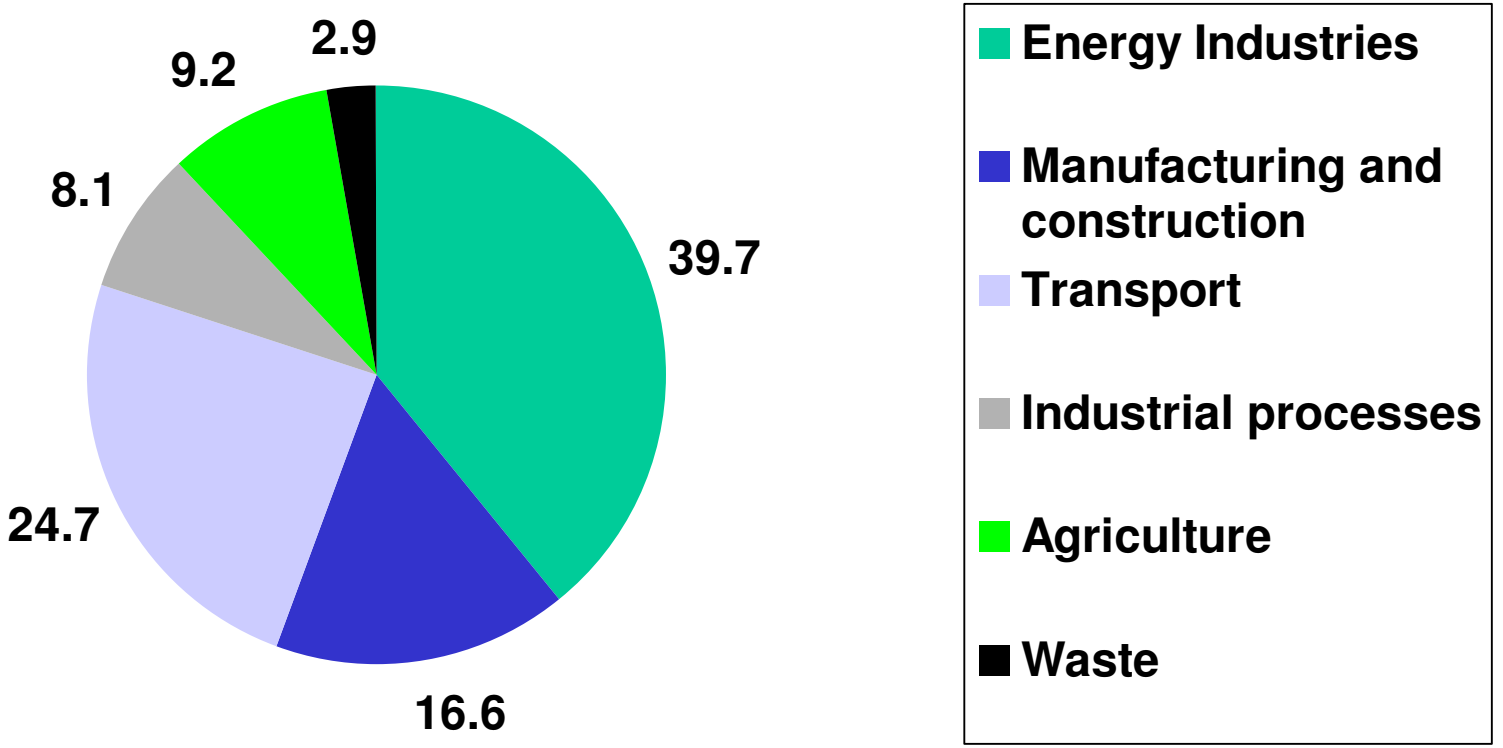
EU - Core Policy Objective

The core objective of the energy and environment policy is:

- *A **20%** reduction of the greenhouse gas emissions that energy produces by **2020***
- ***This is a « must do » target!***

EU's GHG emissions

in million tonnes CO_2 equivalent

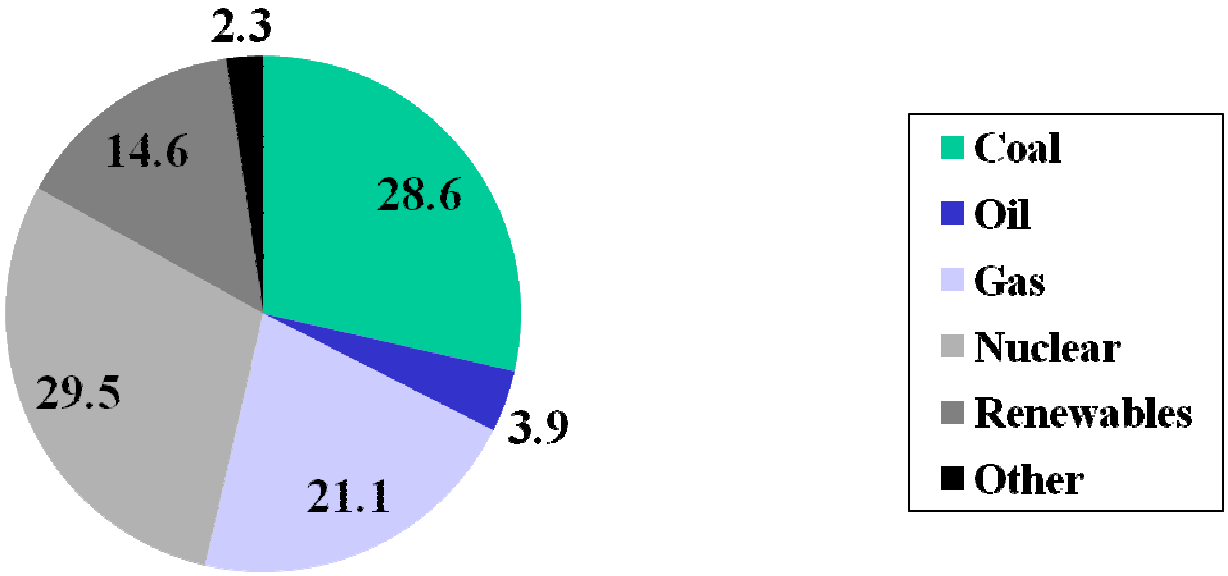


Total energy is responsible for 80% of EU's GHG emissions

Sources of CO_2 in the EU

- CO_2 emissions in the EU total 4260 MT/yr
- Energy use accounts for 3962 MT/yr
- Electricity accounts for 1380 MT/yr
  - Close to one-third of all emissions
  - ***The large majority of this is from burning coal***

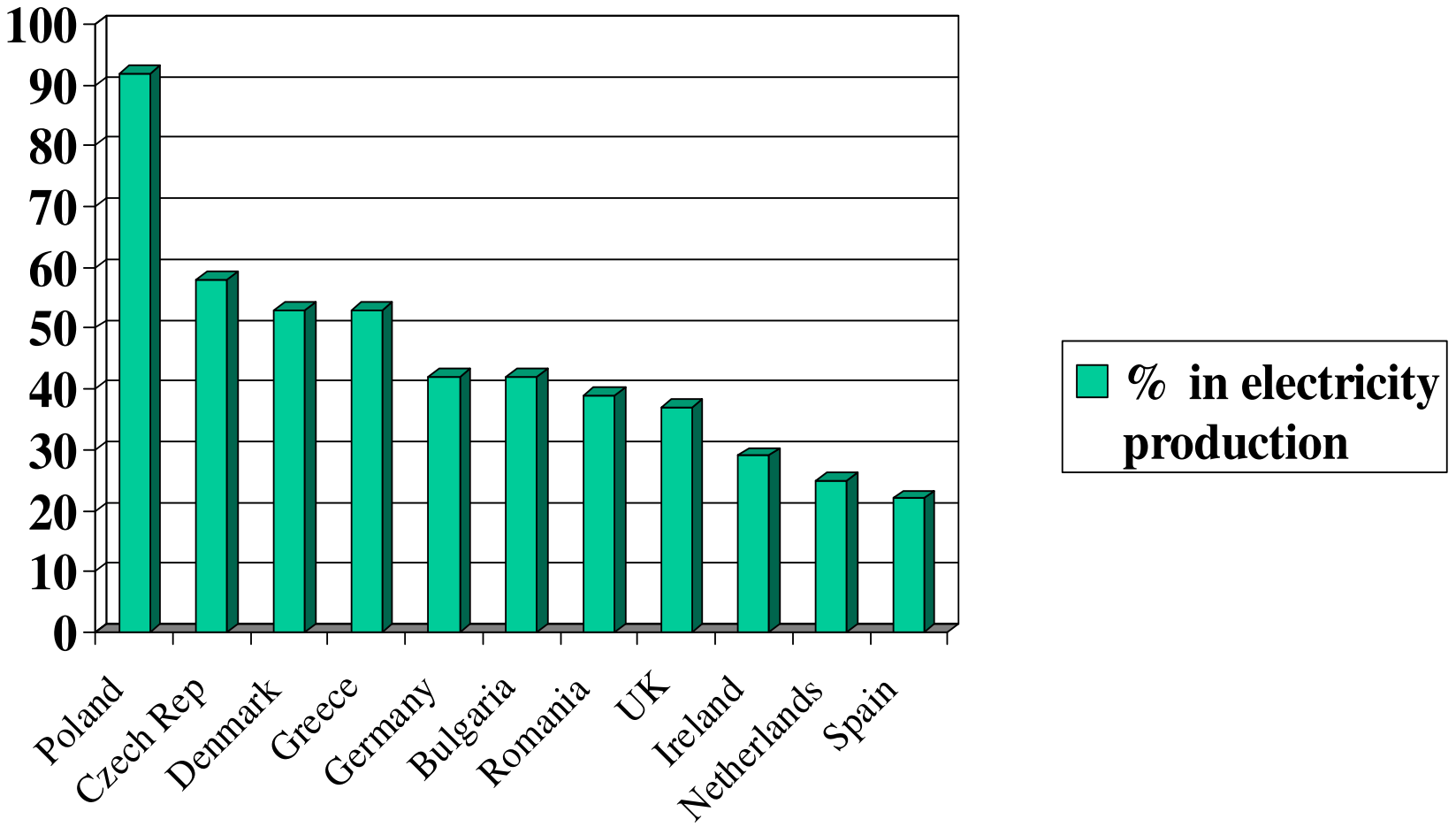
EU Gross Electricity Generation



The Role of Coal

- Most countries in the Developed World and many in the Developing World rely heavily – or even very heavily - on coal for their supply of energy. (The USA, China and India all rely very heavily on coal).
- In the European Union (EU) around 30% of all our electricity comes from coal
- In some European countries a majority of electricity is generated from burning coal (the highest dependence on coal is in Poland with over 90% of electricity being from coal-fired generation)

Who depends on coal in the EU?



World Coal Reserves

- The World's proven reserves of coal total **826001 million tonnes** (BP Statistical Review 2010)
- This equates to close to **120 years** of future supply at our present rate of consumption
- Additional coal reserves and resources are, of course, much higher and could be further explored and developed depending on future markets

World Coal production

- Every year for the last 10 years world coal production has increased to meet growing demand.
- Over a 10 year period, production has increased by around 50% - from 2225 Mtoe in 1999 to 3409 Mtoe in 2009).
- Nearly all of this increase has been in Emerging Market Economies[1] where production has more than doubled (from 1025 Mtoe to 2200 Mtoe)

[1] *EMEs – excluding Former Soviet Union*

World Coal consumption

- World coal consumption in 2009 showed no significant increase over the previous year – due to the impact of the economic recession in OECD countries and the FSU and lower gas prices.
- Elsewhere in the world it continued to grow (7.4% higher than in 2008).
- **At 29.4%, coal's share of primary energy consumption was the highest it has been for 40 years**

Coal is important, secure and affordable…

- Coal is:
  - A very important source of energy for the EU
  - Because of the EU's high reserves to production ratio and the diversity of external suppliers, coal is seen as increasing the EU's security of supply (*in spite of high level of imports*)
  - Using inextensive coal to produce electricity is seen as maintaining the competitiveness of EU industry
- ***But* ……..**

European Council - March 2007

- In March 2007 the European Council finally addressed the closely linked issues of Energy Policy and Climate Change.
- They agreed a new policy – which has now passed into **European law** – of a 20% reduction in CO2 emission in the EU by 2020
- In addition the European Council agreed that***: the burning of coal to produce electricity has no future unless it can very significantly reduce – to "near zero"– the amount of CO_2 emitted per unit of energy produced***

A few facts about gas

- World gas reserves in 2009 were higher than at any time in the past – 187.5 trillion cubic metres
- The Reserves to Production ratio is 63
- World consumption actually declined by over 2% in 2009 (to 2940 billion cubic metres). The gas consumption in the EU declined by close to 6%.
- There have been some calls to replace coal-fired power generation by gas-fired generation by oil companies....

Driver for emission reduction

- The EU has taken a number of major steps to promote the reduction of CO_2 emissions
- The main driver for this is the Emission Trading System (ETS)
  - This is a “cap and trade” system for CO_2 emissions
  - Large stationary CO2 emitting facilities must purchase “allowances” to cover the total quantity of CO2 that they emit.
  - The number of allowances available reduces each year to achieve the legally binding reductions agreed by the European Council

Reducing CO_2

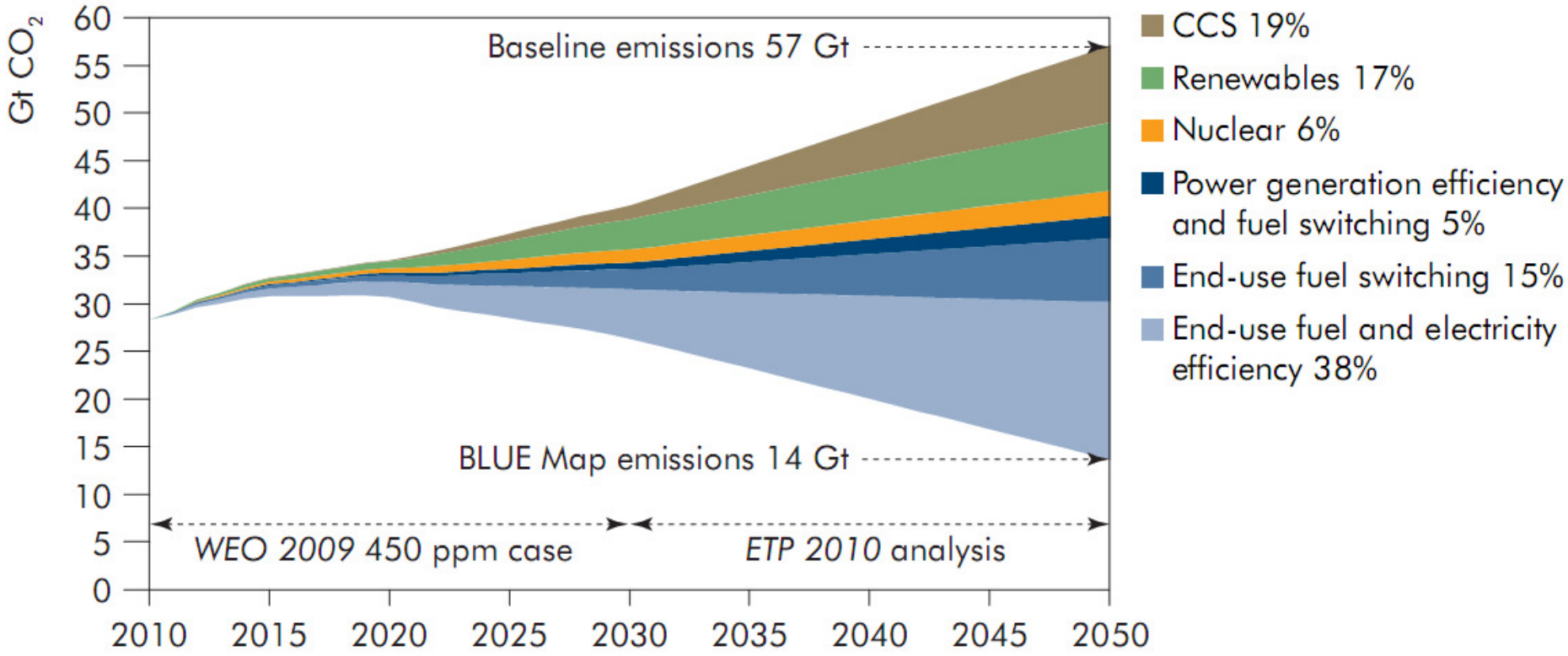
- The Emission Trading System will put ever increasing pressure on utilities to reduce their carbon emissions – and coal is largest carbon emitter.
- Many utilities with plans to build new coal-fired power plants are meeting resistance from the public.
- All new coal-fired power plant in the EU must – in future – be "***carbon capture and storage ready"***

A very short “aside”

- Like a growing number of people – including, I believe, a number of former EU Commission colleagues – I have my doubts over the short to medium term effectiveness of the ETS to bring about the necessary technology shift needed to achieve the required longer term emission reductions.
- Personally I would strongly support the early introduction of ***emission performance standards*** (EPS)

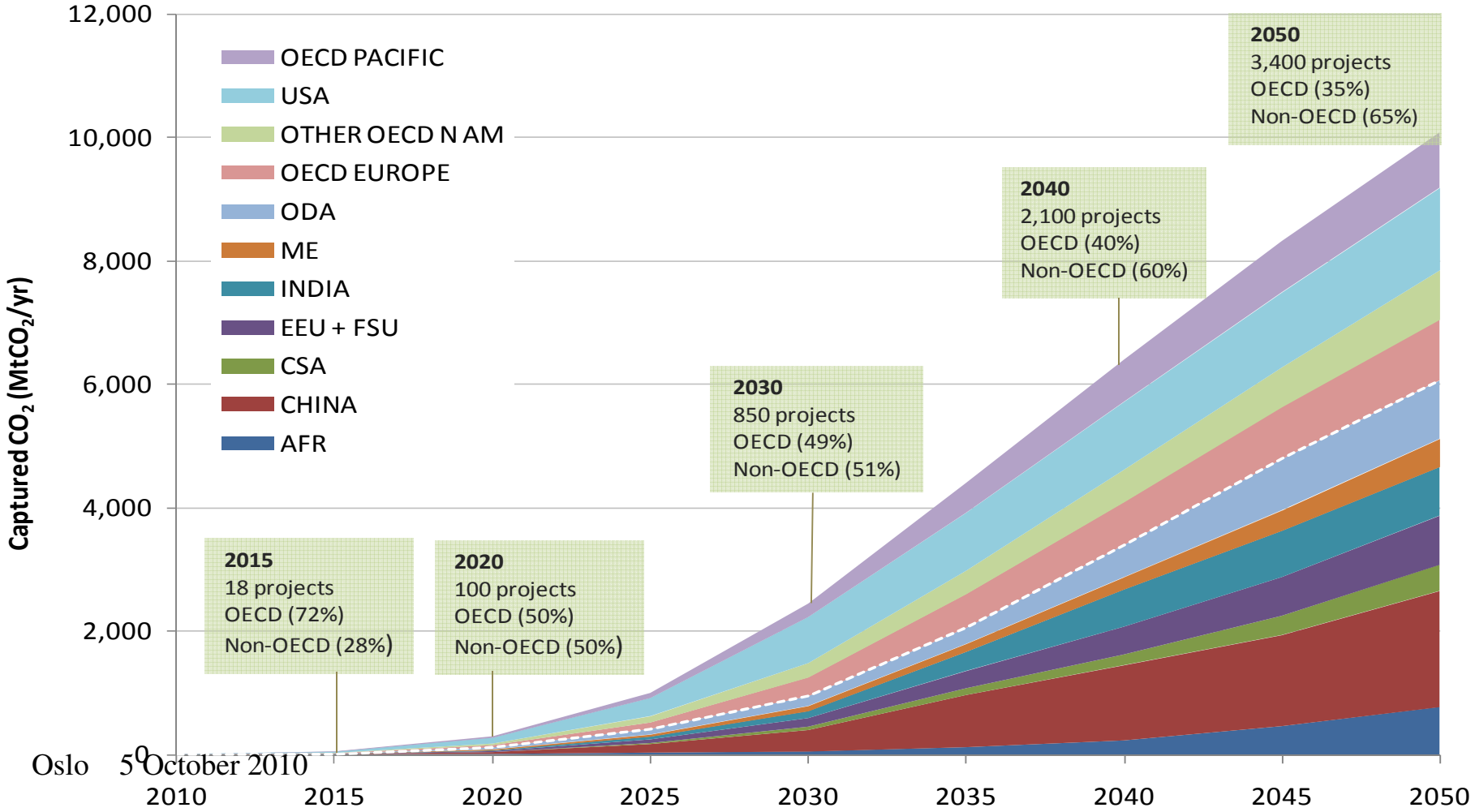
The IEA's Blue Map Scenario

CCS can provide up to 20% of CO_2 reduction by 2050



[1] **IEA BLUE MAP SCENARIO:** THIS SCENARIO IS CONSISTENT WITH STABILISING CO_2 CONCENTRATIONS AT 450PPM, WITH AN ASSOCIATED GLOBAL RISE IN TEMPERATURE OF TWO TO THREE DEGREES CELSIUS, BUT ONLY IF THE REDUCTION IN ENERGY-RELATED CO_2 EMISSIONS IS COMBINED WITH DEEP CUTS OF GREENHOUSE GAS EMISSIONS FROM NON-ENERGY SOURCES. **SOURCE:** INTERNATIONAL ENERGY AGENCY 2008, ENERGY TECHNOLOGY PERSPECTIVES: SCENARIOS AND STRATEGIES TO 2050.

To achieve the IEA's Blue Map scenario: we must be capturing and storing 10 Gigatonnes/year by 2050



EU actions on CCS

- The EU has taken a number of major steps to promote the reduction of CO_2 emissions
- At the moment, the main driver for this is the Emission Trading System (ETS) – though there is ***growing interest in Emission Performance Standards (EPS)***
- Facilitating legislation has been adopted. This includes the CCS Directive – that will permit the environmentally safe storage of CO_2 in geological strata
- There are also a number of financial incentives, including in the "Recovery Plan" (EERP) and use of the 300 million CO2 allowances from the ETS's "New Entrants Reserve" (NER300) as well as through support to R&D

CCS Funding under EERP

Award Decision taken in Dec 2009 for 6 projects

- » Jaenschwalde, Germany (€180M)
- » Rotterdam, The Netherlands (€180M)
- » Porto Tolle, Italy (€100M)
- » Compostilla, Spain (€180M)
- » Hatfield, UK (€180M)
- » Belchatow, Poland (€180M)

The “NER300” the biggest game in town at the moment

- "NER300" is the name of a financing instrument managed jointly by the European Commission, European Investment Bank and Member States
- It contains the provision to set aside 300 million allowances (rights to emit one tonne of carbon dioxide) in the New Entrants’ Reserve of the European Emissions Trading Scheme for subsidising installations of innovative renewable energy technology and carbon capture and storage (CCS).
- The allowances will be sold on the carbon market and the money raised - which would be around €4.5 billion if each allowance is sold for €15 - will be made available to projects as they operate.
- The money will be divided between CCS and RES projects.

CCS demonstration projects rules

- - Each project has to implement the full chain (capture, transport, storage);
- - Each demonstration project must implement heat integration for the capture component of the process;
- - The capture rate has to be at least 85% of CO_2 from the flue gases to which capture is applied;
- - Each project has to contain an independent research block related to safety of storage sites and improvement of monitoring technologies especially in the field of brine migration, its possible pathways and impacts.
- Must be in commercial operation by 31 December 2015

Project Categories - CCS

- power generation: pre-combustion 250 MW;
- power generation: post-combustion 250 MW;
- power generation: oxyfuel 250 MW;
- industrial applications implementing (a) CCS on refineries with 500kt/y stored CO_2 from one or more sources within the refinery; (b) CCS application to cement kiln with 500kt/y stored $CO_{2;}$ (c) CCS application for primary production routes in iron and steel production with 500kt/y stored CO_2; or (d) CCS application for primary production routes in aluminium production with 500kt/y stored CO_2 - project sub-categories;

  CCS power thresholds are expressed as gross electrical output before capture.

Project selection – CCS projects

- For CCS demonstration projects, the highest ranked projects shall be selected in order of their ranking, provided the following criteria are met:
- (1) at least one project and at most three projects are selected in each project category;
- (2) at least three projects are selected with hydrocarbon reservoir storage; and
- (3) at least three projects are selected with saline aquifer storage.
- Where selecting a project would mean that the criteria referred to under (1) to (3) would not be met, the project in question shall not be selected, and the next highest ranked project shall be considered for selection. This process shall be continued until eight projects have been selected;

Information to be provided in proposals for NER300 Funding

- the relevant costs, in euro, referred to in Article 2(3);
- the total request for public funding in euro, which is the relevant costs, minus any contribution to those costs from the operator;
- the best estimate of the net present value of additional benefits resulting from support schemes as calculated according to Article 3(5);
- for the CCS demonstration projects, the total projected amount of CO_2 stored in the first ten years of operation, as well as, for the RES demonstration projects, the total projected amount of energy produced in the first five years of operation.

Demonstrating CCS

- The G8/G20 has agreed that there needs to be 20 large scale CCS demonstration plants by 2020
- The EU has its own target of “up to 12” large scale demonstration plants by 2015
- However, the IEA Blue Map scenario calls for 100 commercial CCS plants by 2020 (with half of these outside the OECD countries)
- ***There is a very long way to go in a very short time!***

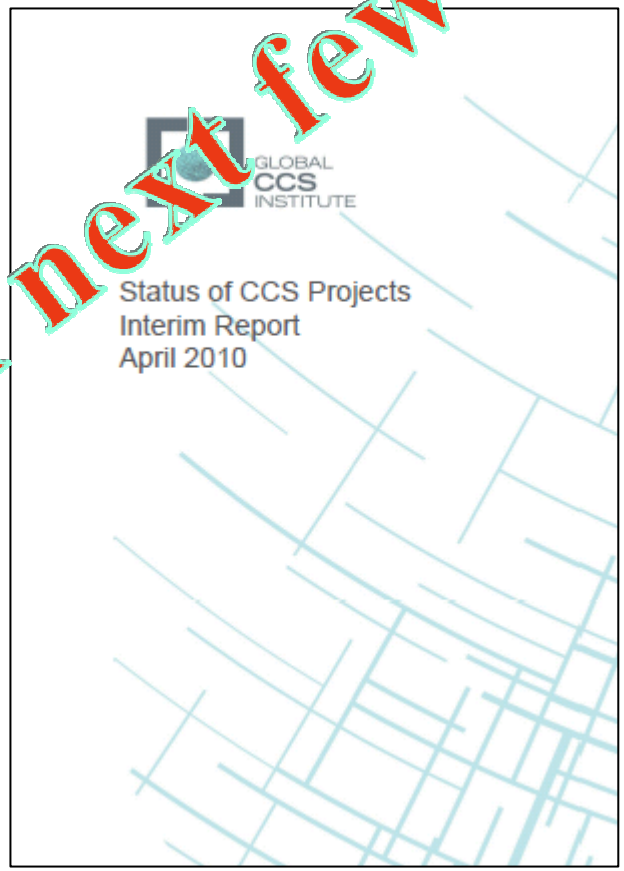
The need for CCS deployment ....grows ..... and grows ..... and grows

Year	Projects	Share
2015	18	OECD – 72%
2020	100	OECD – 50%
2030	850	OECD – 49%
2040	2100	OECD – 40%
2050	3400	OECD – 35%

Source: IEA

GCCSI's Interim Project Status April 2010

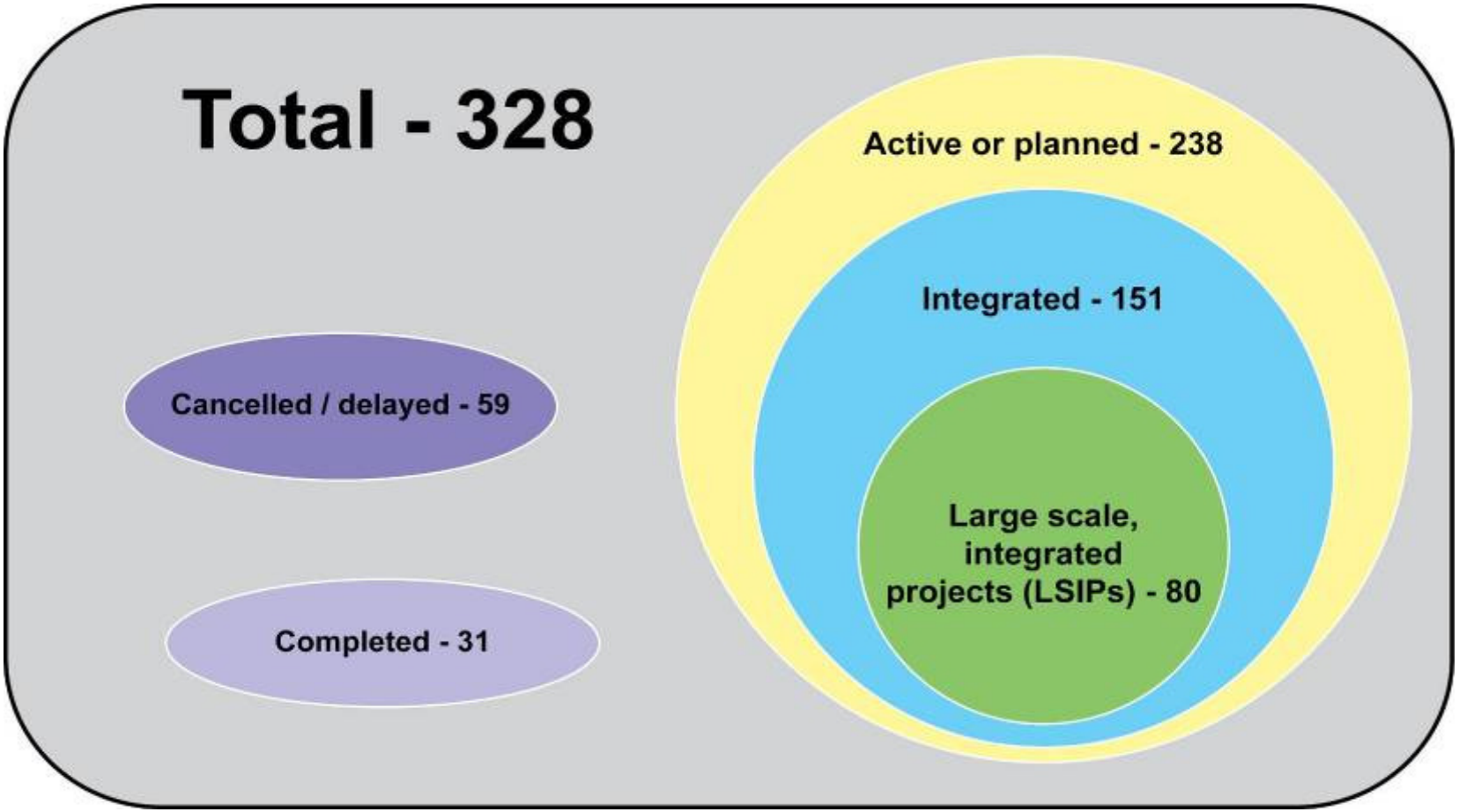
- **A companion report to G8 Report covering the global status of CCS projects**
- **More comprehensive report to be developed in October**
- **Includes analysis on the G8 criteria**



To be updated in next few days

The Global CCS Institute has identified 328 projects worldwide in 2010

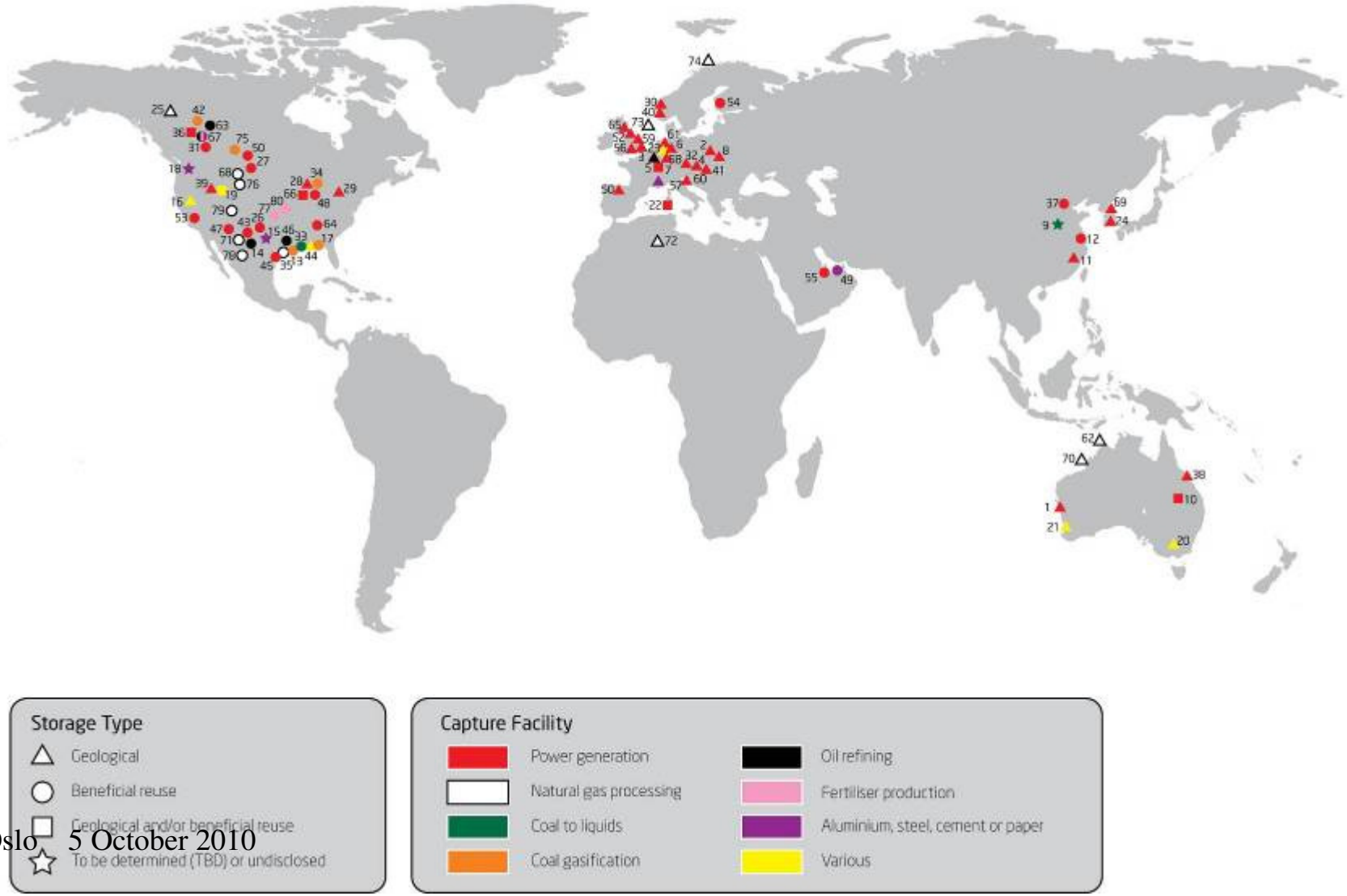
Of these 80 are "***large-scale integrated projects***"



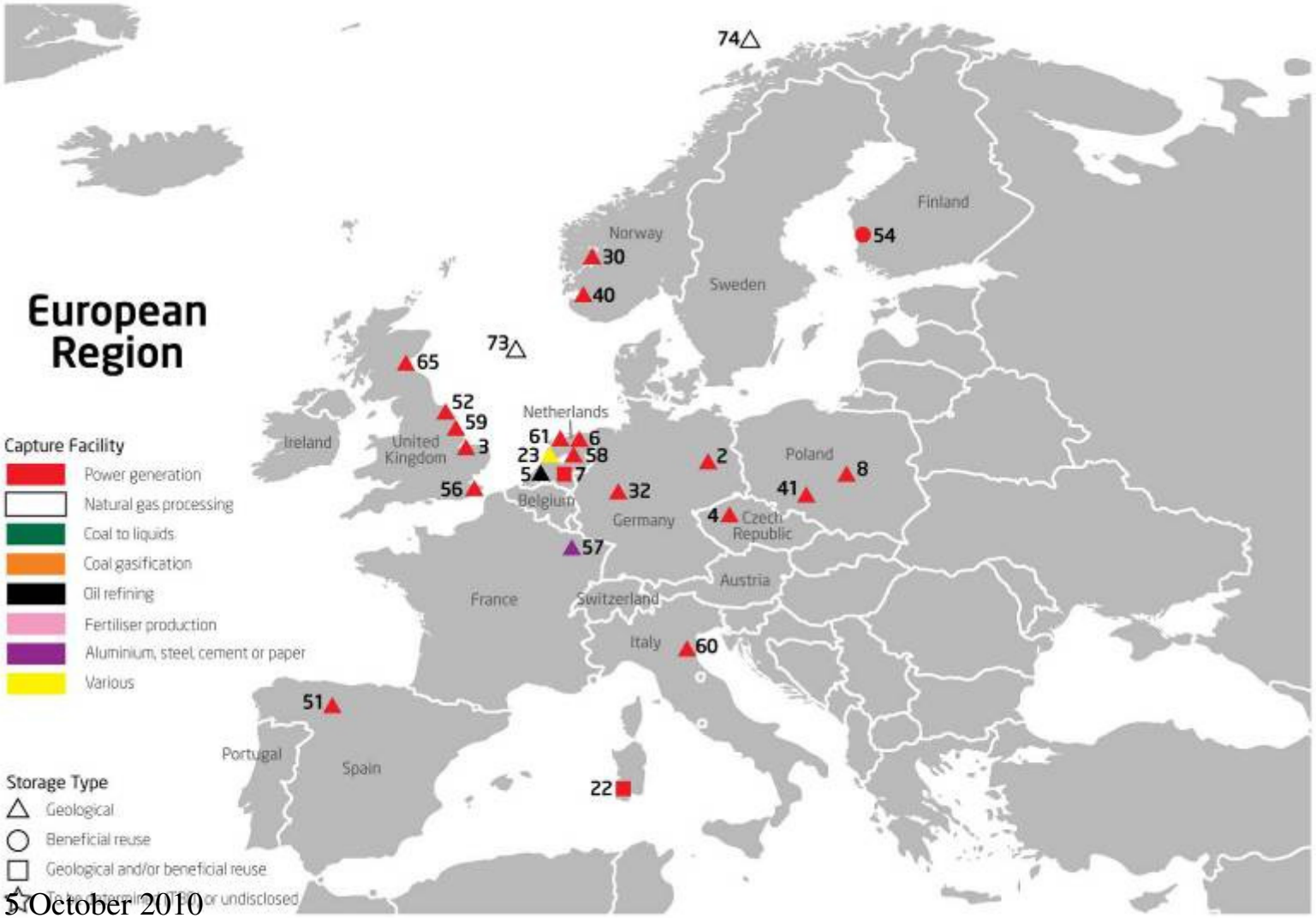
"LSIPs"

- To be an "LSIP" a coal-fired power plant must aim to process at least 1 million tonnes of CO_2/year and capture and store at least 80% of this gas.
- North America and Europe contain the vast majority of active or planned LSIPs. This is likely to be a function of the funding available in these regions and the relatively large economies and industrial sectors of countries within these regions.
- Specifically, U.S. and Europe account for 31 and 22 projects respectively, or 66 percent of all LSIPs, followed by Canada (8 projects), Australia (7 projects), and China (4 projects).

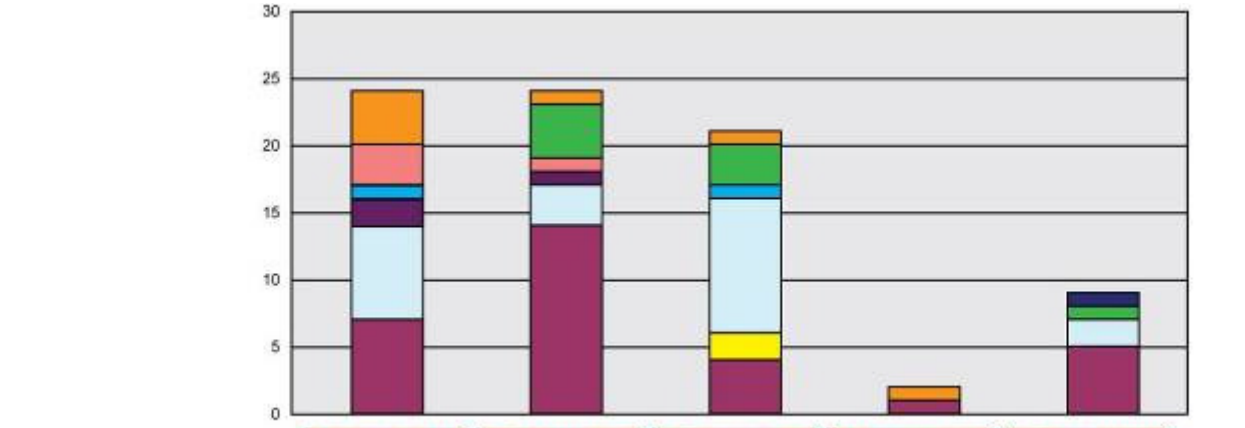
Global representation of LSIPs



LSIPs in Europe



Active or planned LSIPs by region and asset lifecycle stage



Region	1 IDENTIFY	2 EVALUATE	3 DEFINE	4 EXECUTE	5 OPERATE	Total
Africa					1	1
Australia and New Zealand	4	1	1	1		7
Canada		4	3		1	8
China	3	1				4
East Asia (excl. Japan)	1		1			2
Eastern Europe	2	1				3
Europe Area	7	3	10		2	22
Middle East			2			2
USA	7	14	4	1	5	31
TOTAL (2010)	24	24	21	2	9	80
TOTAL (2009)	20	21	14	3	9	67

European projects – "***Identify***" stage

• ***Jänschwalde***	***Brandenburg, Germany***
• Immingham CCS Project	Lincolnshire, England, UK
• NW Bohemia Clean Coal Project	North Bohemia, Czech Republic
• Barendrecht Shell	Rotterdam, Netherlands
• Eemshaven RWE	Groningen, Netherlands
• Rotterdam CGEN	Rotterdam, Netherlands
• ***Belchatow CCS project***	***Łódź Voivodeship, Poland***
• Integrated Project Carbon Mine Sulcis	Carbonia-Iglesias, Italy
• Rotterdam CCS Network	Rotterdam, Netherlands

European projects – "***Evaluate***" stage

• Mongstad	Hordaland, Norway
• RWE Goldenbergwerk	North Rhine Westphalia, Germany
• Karsto Full Scale	Rogaland, Norway
• Kedzierzyn	Opolskie, Poland

European projects – "*Define*" stage

• Compostilla Project	Leon, Spain
• North East CCS Cluster (Teesside)	England, UK
• FINNCAP - Meri Pori CCS Project	Pori, Finland
• Kingsnorth Demo Plant	Kent, England, UK
• ULCOS Florange	Lorraine, France
• Rotterdam Afvang en Opslag Demo	Zuid-Holland, Netherlands
• Hatfield Power Park	South Yorkshire, England, UK
• Porto Tolle	Rovigo, Italy
• Eemshaven NUON (Nuon Magnum)	Groningen, Netherlands
• Longannet Clean Coal Power Station	Fife, Scotland, UK

European projects – "***Operate***" stage

- Sleipner CO_2 Injection — North Sea, Norway
- SnØhvit CO_2 Injection — North Sea, Norway

Key Conclusions from project stock take

- Significant project development activity especially for CCS in coal-fired power generation – but too little gas!
- Other large stationary emissions sources such as steel and cement production significantly under-represented.
- **Clusters of projects** in Nth America, Europe and Australia.
- In terms of a "balanced portfolio"- significant under-representation in developing countries.
- **Key challenges remain** – financing, policy uncertainty, public acceptance.

Adequacy of effort

- While there are many and growing – activities working towards the demonstration of CCS in the world, they are probably inadequate to achieve even the low target set by the G8/G20 - and could fall a very long way short of what the IEA tell us is required by 2020.
- However, as long as there are a sufficient number of projects to adequately develop and demonstrate CCS is a viable technology, then a shortfall in 2020 should not necessarily delay full deployment after that date.
- While the rates of deployment in the period 2020 to 2050 are high, they are definitely achievable – with the right technology and, of course, public and political support.

Main data source

- Most of the information used in this presentation can be found on the websites of the European Commission's (Europa), the ***Bellona Foundation*** (Bellona CCS Web) and the ***Global CCS Institute***.
- In addition, statistical data on EU energy:

➢ **http://ec.europa.eu/energy/publications/statistics/doc/2010_energy_transport_figures.pdf**

- Or contact: *derek@bellona.org*