



# Guaranteeing Energy for Europe – How can coal contribute?

## Content

- I Why coal?
- II Till 2020 — how can we achieve lower emissions with coal?
- III Beyond 2020 — will CCS deliver?
- IV Emissions Trading — fair for coal?
- V Capture ready — what does it mean?
- VI CCS Infrastructure — who takes care?
- VII Emissions Trading or “command and control”?
- VIII Coal and Renewables — partners?
- IX Combined heat and power — with coal
- X Coal — higher efficiency for biomass use

## Preface



Petr Pudil  
President of EURACOAL

The energy supply of the 21st century is more than ever shaped by coal. Almost all developing and threshold countries trust that coal is a long-term, reliable basis for the development of the economy and society. In industrialised countries, coal remains the key energy for a reliable supply of electricity and for heavy industries. According to estimates of the International Energy Agency (IEA), coal will have the same importance as oil for the world-wide supply of energy until 2030.

At the same time, coal is currently forging new alliances. Renewables need a partner providing stable prices and supply in order to complement their natural, weather-related volatility. Clean Coal is the bridge towards this partnership. If based on technology, coal can be utilised protecting both the environment and climate. The technology path leads from modern, efficient power stations to Carbon Capture and Storage.

Coal demand, increasing worldwide, is driven by the favourable situation concerning resources, moderate prices and efficient market structures. Clean Coal is a technological challenge, based on responsibility for resources and climate protection. For the European coal industry, these are two sides of the same coin, when the future of coal and of power supply is concerned.

Coal boasts three crucial advantages: security, innovation and adaptability. With these qualities, coal remains a source of energy for the future. The present publication highlights the potential of coal for Europe from different perspectives. The publication provides arguments and facts that should not be overlooked in any debate about energy or environmental policy.

Petr Pudil,  
President of EURACOAL

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# 1. Why coal?

- Hard coal and lignite represent approximately 80% of EU reserves of fossil fuels.
- As coal ensures safe, reliable, affordable and (as will be shown) sustainable energy for all, it will be very much needed in the decades to come. On a global scale coal is and will be energy No.1 for power generation.
- The EU should advocate a balanced energy mix at European and national levels, including a considerable share of coal. This has so far proven to be a winning policy.

# Why coal?

1 — Projected EU Energy Import Dependence  
Coal reduces dependence



A competitive industry is the basis of development and prosperity in Europe. Both industry and citizens need a reliable supply of energy, i.e. the guaranteed and affordable supply of electricity and primary energy without major interruptions. This is the core of all energy policy.

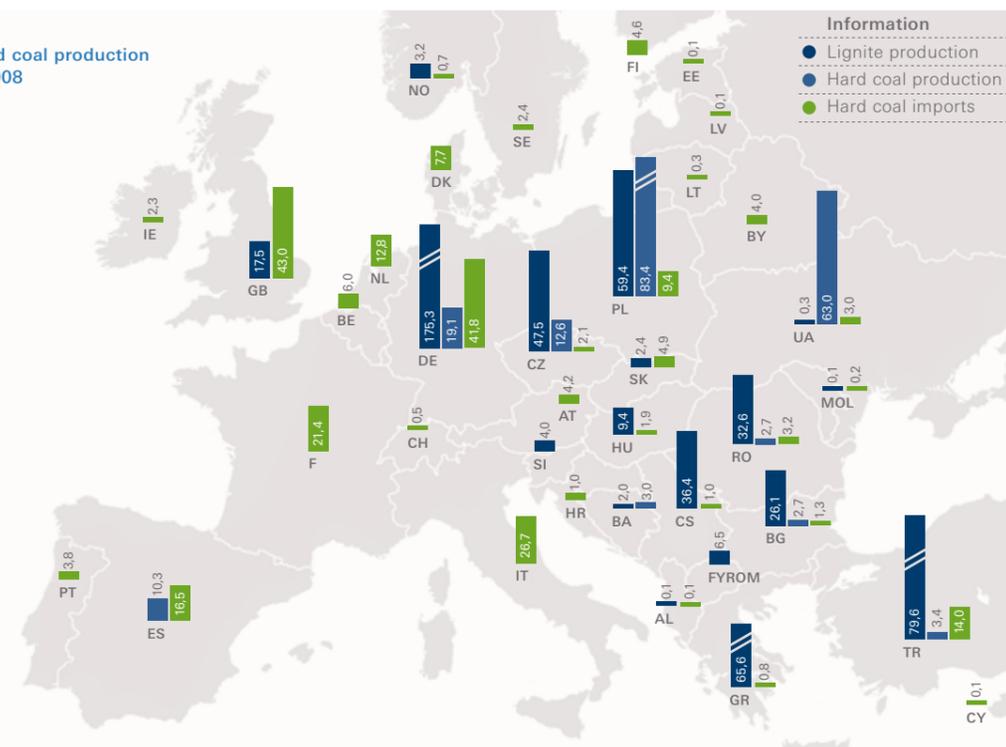
Coal, as raw material for the generation of power, the production of steel and the chemical industry, makes an important contribution, both in times of positive political and economic development as in politically challenging times. An energy mix including coal, both indigenous lignite as well as indigenous and imported hard coal, therefore belongs to the assets of a reliable EU energy policy. The coal companies are actors in the regional economy, investing considerable amounts of capital. This is often at the origin of long added value chains in the region. In 2008, the industry employed about 280.000 persons; considering indirect employment a good 700.000 jobs depend on coal production. European coal mining

technology leads the world market, with a share of more than 50%; this position can only be maintained with considerable indigenous coal production.

Fossil fuels - and if wanted by Member States, also nuclear energy - will in 2020 and 2030 cover most of the energy demand in Europe, also for power generation.

It is however generally accepted that renewables will in the medium and long terms make an increasing contribution to the supply of energy in the EU. The EU's 20% objective for renewables by 2020 is ambitious, but achievable, whether or not EU primary energy consumption is higher than today by 2020 or 2030. Even if renewables cover already 30% of energy supply by 2030, it must be clarified who will provide the remaining 70% and the reserve capacities needed as back-up. Furthermore, a substantial further development of renewables is only possible if renewables become self-sufficient despite various obstacles.

2 — Coal in Europe  
Lignite production, hard coal production and imports in Mt in 2008



## II. Till 2020 – how can we achieve lower emissions with coal?

- Coal-fired power generation technology still has substantial potential for development.
- Cost-efficient climate protection with coal is already possible today: replacing power plants with relatively low efficiencies built in the 1960s by new installations based on BAT can save one third of the CO<sub>2</sub> – with each new build, efficiency increases.
- Decision-makers should increase the potential for new coal-fired power plants by creating a stable, long-term framework.

## Till 2020 – how can we achieve lower emissions with coal?

### 1 – Clean Coal comes in three stages

**Clean Coal I**  
Retrofit and new-build in line with state of the art, increase efficiency, reduction of SO<sub>2</sub>, NO<sub>x</sub> and dust.

**Clean Coal II**  
Research and development for increase in efficiency to > 50%.

**Clean Coal III**  
CO<sub>2</sub> capture and storage.

Substantial shifts in emissions of greenhouse gases have occurred in various regions of the earth in the past years. Emissions in Europe are decreasing, both in absolute terms and also compared with other regions worldwide.

Further CO<sub>2</sub> emissions savings can be achieved in the medium term by burning coal in European power plants. The Clean Coal Concept of the European coal industry outlines the necessary steps. If new coal-fired power plants were built with Best Available Technologies, replacing relatively old fossil-fired power plants, up to a third of CO<sub>2</sub> emissions from older plants could be saved because of improved efficiency alone. This is above all a task for industry; decision-makers are however requested to create the necessary basic conditions to promote investments. Transposing the foreseen 15% rule of the 2008 Climate Protection Package for new highly efficient power stations and capture and storage-ready plants (CCS-ready) with proceeds from Emissions Trading, covering up to 15% of total investment costs is one of the measures to be taken. Nevertheless, for a long-term support of the construction of highly efficient power plants and in order to have more capture and storage ready power plants, it would be very useful to harmonise the timing of the 15%

rule with the third Emission Trading Period and prolong the 15% rule until 2020.

The continuous modernisation of coal-fired power plants is an appropriate way to prevent a “dash for gas” disrupting the energy mix as feared. Less coal-fired power generation in favour of gas would not make sense either in terms of climate policy: if — as in 2008 — a large gas supplier of the EU supplied more gas to the EU, but replacing gas by coal at home, global emissions even increase.

Efficiencies of new coal or lignite-fired power plants are expected in the medium term to increase from approximately 43% for lignite and approximately 45% for hard coal today to approximately 50%. Research and development efforts are essentially directed towards improvements concerning the steel, allowing steam temperatures of 700 °C with a pressure of 350 bar. E.ON plans, for example, to build a 400 MW demonstration power plant fuelled by hard coal, exceeding the “magic” efficiency limit of 50% in the context of the COMTES 700 project, by 2014. RWE and Vattenfall have similar projects for lignite, also including pre-drying coal. New research with ultra-supercritical materials is already looking at 60%.

### 2 – Formal Commission statement to the Council ad Article 10, paragraph 3 of the EU ETS Directive on the use of revenues generated from the auctioning of allowances

Between 2013 and 2016, Member States may also use revenues generated from the auctioning of allowances to support the construction of highly efficient power plants, including new energy power plants that are CCS-ready. For new installations exceeding the degree of efficiency of a power plant according to Annex 1 to the Commission Decision of 21 December 2006 (2007/74/EC) the Member States may support up to 15% of the total costs of the investment for a new installation that is CCS-ready.

### III. Beyond 2020 – will CCS deliver?

- Carbon Capture and Storage (CCS) is important for international climate protection policies; it is expected to deliver one fifth of very ambitious GHG reductions by 2050.
- For CCS to become commercial in the next decades, an EU CCS demonstration network has to be created in this decade.

The question to what extent human activity must reduce emissions of greenhouse gases, in order to avoid its major impact, is still disputed by scientists. Tightening the EU's 20% objective for 2020 without an equivalent participation of other developed countries is not sustainable: it would result in high costs and major competitive disadvantages for the EU - and above all for individual Member States -, without results for climate protection.

In case it is necessary to dramatically decrease GHG emissions by 2050, eminent energy think tanks as well as international organisations such as the IEA emphasise that fossil fuels can only be sustainably used with CCS; the resulting CO<sub>2</sub> to be stored in geological formations. CCS is perceived as one of the important ways forward for the

future; according to the IEA it has to contribute to one fifth of the emission reductions envisaged for 2050.

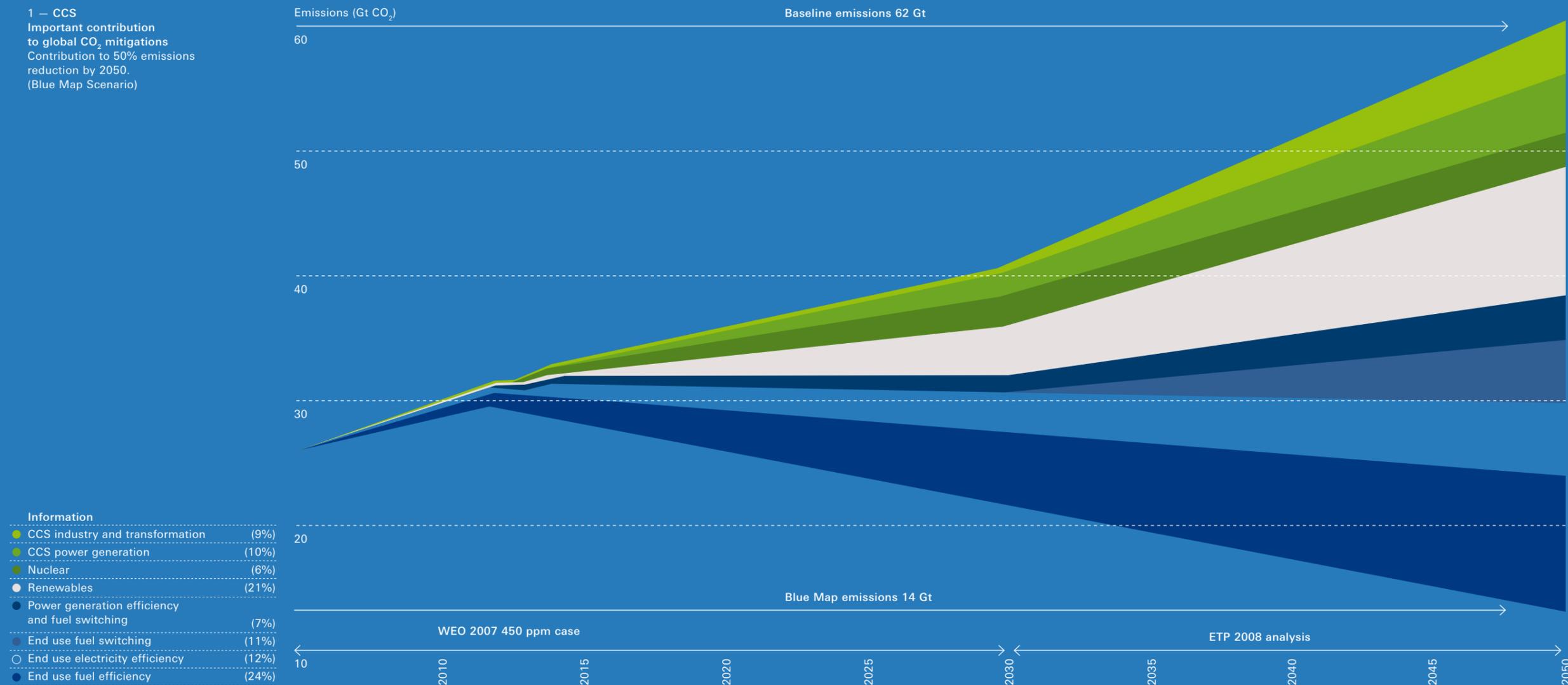
In the EU a network of CCS demonstration plants will be built by 2015, testing three of the most important CO<sub>2</sub> separation technologies (oxyfuel, IGCC and post combustion), the transport of CO<sub>2</sub> as well as the storage options in gas or oil fields and saline aquifers. On the basis of the results, CCS chains have to be developed and become available at commercial scale as soon as possible.

The separation, transport and storage of CO<sub>2</sub> are generally regarded as safe. A thorough monitoring above all of storage installations is already compulsory in the EU and is to be transposed

by Member States in their national legislation. In its "Technology Roadmap Carbon Capture and Storage", the IEA assumes "that there will be a CCS technology growth from a hand-full of large-scale projects today to over 3,000 projects by 2050."

In the coming months and years, a series of technical, financial, legal and political issues need to be clarified. The efficiency losses in power generation due to CCS must be addressed via research and development. Public acceptance of CCS in the EU is perhaps the major hurdle remaining and precondition for the technology to develop; this can be achieved only by industry, authorities and decisions makers together. Convincing demonstration projects, promoted by the state, is only one step to win over sceptics.

1 – CCS  
Important contribution to global CO<sub>2</sub> mitigations  
Contribution to 50% emissions reduction by 2050.  
(Blue Map Scenario)



IV. Emissions Trading – fair for coal?

- An appropriate climate protection policy must consider all greenhouse gas emissions. Concentrating mainly on CO<sub>2</sub> and on industrial installations – for instance power plants – is unfair to coal.
- Emissions from coal, gas and oil would differ much less if emissions occurring when oil and gas are produced were also taken into consideration.

Emissions Trading – fair for coal?

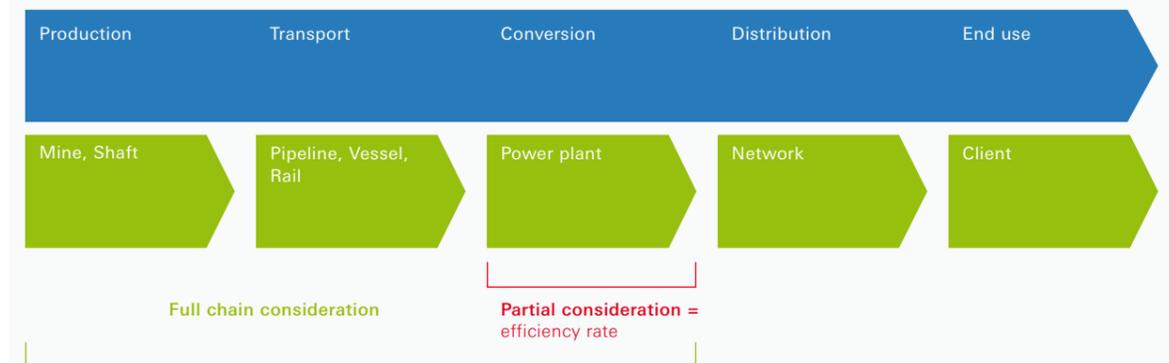
Climate protection is a global issue. For the climate it is not important which greenhouse gas occurs and where the emissions come from. It is therefore more appropriate to consider all major greenhouse gases and emitters.

When using fossil fuels, CO<sub>2</sub> emissions for example from a lignite-fired power station per kilowatt-hour are about double those from a gas-fired power station. This must be kept in mind. It is however unfair that EU legislation – for example the EU Emissions Trading Scheme till 2020 – stops here. For reasons of fairness,

the CO<sub>2</sub> emissions occurring during the production of gas and oil and during the transport of these fuels should therefore all be covered by EU legislation.

If the extraction, transport and utilisation of fuels were also looked at, i.e. the complete chain of added value, the emissions from coal, oil and gas would differ much less. This might be true even more if so-called unconventional methods of coal, oil or gas production are taken into account.

1 – Full chain consideration of environmental compatibility is unavailable



## V. Capture ready – what does it mean?

- New coal and gas-fired power plants can be built so that they can be retro-fitted with CO<sub>2</sub> capture (capture ready).
- Projects can therefore be brought in line with CCS and with future climate protection objectives, this should be further backed by EU policies.

## Capture ready – what does it mean?

1 – Power plant  
Jämschwalde Niederlausitz, (D)



Climate researchers assume that global greenhouse gas emissions must be halved by 2050. For industrialised countries, this could mean decreases of over 80% compared with 1990. Such an objective can only be reached with extraordinary investments in renewables and energy savings and if in addition to coal-fired power plants, gas-fired plants, biomass installations as well as energy-intensive industries generally also implement CCS.

Although CCS will be on the market only after 2020, industrialised countries do not have to give up the construction of new fossil-fuelled power plants today. Both new coal-fired and new gas-fired power plants can be built in such a way that later — when Carbon Capture and Storage has become state-of-the-art — a retrofit with CCS remains possible (capture ready). In this respect, it is important to understand “capture-readiness” correctly: it is crucial to foresee

the space for CO<sub>2</sub> capture and to not exclude a connection between the power plant and a CO<sub>2</sub> capture installation. Power plant operators in most regions in the EU will not be able to provide evidence about certain transport capacities or precise CO<sub>2</sub> storage sites in time when filing an application. Whoever nevertheless requires such evidence usually aims from the beginning to make the approval of the power plant impossible.

The resistance of local population to new capture-ready power plants is amazing, but not substantiated as the plants offer the potential to combine energy policy objectives in favour of climate protection, security of supply and an affordable generation of power. In this debate, industry, decision-makers and authorities should more clearly demonstrate the advantages such as fewer emissions and fewer import risks.

2 – Capture-readiness –  
Article 9a of the Large Combustion  
Plant Directive (2001/80/EC)

I. Member States shall ensure that operators of all combustion plants with a rated electrical output of 300 megawatts or more for which the original construction licence or, in the absence of such a procedure, the original operating licence is granted after the entry into force of Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide, have assessed

whether the following conditions are met: a) suitable storage sites are available b) transport facilities are technically and economically feasible c) it is technically and economically feasible to retrofit for CO<sub>2</sub> capture.

II. If the conditions in paragraph 1 are met, the competent authority shall ensure that suitable space on the installation site for the equipment necessary to capture and compress

CO<sub>2</sub> is set aside. The competent authority shall determine whether the conditions are met on the basis of the assessment referred to in paragraph 1 and other available information, particularly concerning the protection of the environment and human health.

VI. CCS Infrastructure – who takes care?

- An efficient and affordable CO<sub>2</sub> transport network can best be established at European level rather than in a national context.
- The EU should pro-actively promote the creation of a CO<sub>2</sub> infrastructure together with EU Member States; it must be included in the up-coming EU energy infrastructure package.

CCS Infrastructure – who takes care?

The importance of a network infrastructure for an effective supply of energy is obvious in the electricity and gas sectors. It reduces the number of general services and therefore makes sense economically.

To date, the importance of a CO<sub>2</sub> transport and storage infrastructure in the long term has not been sufficiently acknowledged. With climate protection objectives of - 80% emissions and more, all fossil fuels will have to be used in industrial installations only with CCS; CCS would become a general obligation for industry in Europe - progressively between 2020 and 2050.

Already at the moment there are about 400 large CO<sub>2</sub> emitters in Central Europe emitting more than 1,000 t CO<sub>2</sub>/day or 350,000 t/a. Around 80 installations are in the range of 1 Mt t/a and 10 Mt. t/a; among them there are many coal and gas-fired power plants but also about 30 industrial installations. With carbon dioxide, it cannot be expected that individual sources

and sinks work optimally in a linear fashion. By linking energy sources/ production plants and consumers to different capacities and load profiles over networks, additional value is created. Particularly for smaller installations, CCS is made possible. Linking sources and storage sites via infrastructure is economical because quadrupling transport capacity only results in about 50% more costs. The risk of high and/ or volatile CO<sub>2</sub> transport prices is reduced.

A framework must therefore be established so that an appropriate CO<sub>2</sub> infrastructure can be developed. Already today it is assumed that in many European regions this requires supra-national co-operation. The European Union can probably best find appropriate solutions to the CCS infrastructure challenge. It should therefore propose a way forward for the infrastructure package prepared for end 2010.

1 – CO<sub>2</sub>-Sources > 3 Mt t/a and potential storage areas (Data for 2004)



- Information
- CO<sub>2</sub> Storage formations
  - Oil and gas fields
  - Regional focus of CO<sub>2</sub> emissions

## VII. Emissions Trading or “command and control”?

- With the Climate Package agreed on end of 2008, the EU adopted its emission objectives and required policy instruments up to 2020. A core element is the Emissions Trading Scheme for greenhouse gases, above all the upper limit set for emissions (cap).
- The European institutions should stick to the decided objectives and instruments and not undermine the Emissions Trading Scheme with additional measures.

## Emissions Trading or “command and control”?

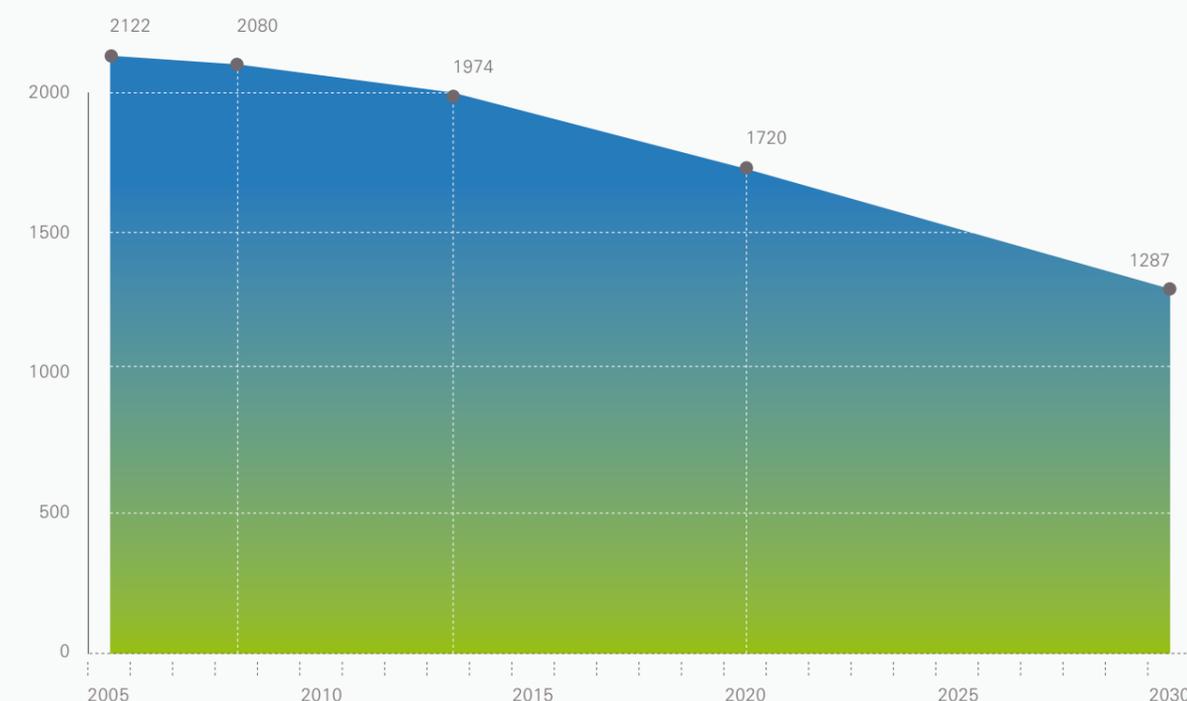
The EU decided in 2008 to prolong and step up the Emissions Trading Scheme for CO<sub>2</sub> emissions from industry for the period after 2013. Emissions Trading also concerns power generation, in fact especially affected by the regulation because of the auctioning of allowances.

The Emissions Trading Scheme has so far rather hindered, because of uncertainty surrounding CO<sub>2</sub> prices and because of burdening coal most, investments in coal-fired power generation. However, it has the huge advantage of clearly specifying global emissions in economic terms generally at a reasonable cost.

Further climate protection instruments in the Emissions Trading sectors, not included in the Package, are counter productive. They would put the functioning of Emissions Trading in question. For example,

“command and control” legislation restricting CO<sub>2</sub> emissions from power plants would go against Emissions Trading. Climate policy makers are currently discussing emission limit values, which are however often misleadingly referred to as “emission performance standards”. If such regulations foresee limit values for CO<sub>2</sub>, that coal-fired power plants without CCS could not comply with, new coal-fired power plants would not be possible at all or at least only as CCS demonstration installations. The consequences of coal being at such a disadvantage - and if the legal limit value advantaged natural gas - for security of energy supply and also for Europe as a location for industry are frequently underestimated. With Europe heading towards a dash for gas, demand for gas would increase, resulting in important price rises and supply risks.

1 – CO<sub>2</sub> cap for the ETS sector in the EU-27 without CDM in million tons CO<sub>2</sub> equivalent



## VIII. Coal and Renewables – partners?

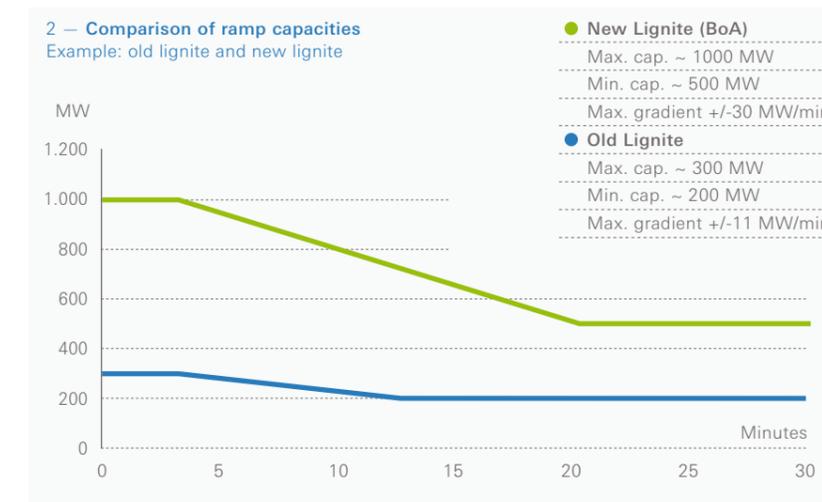
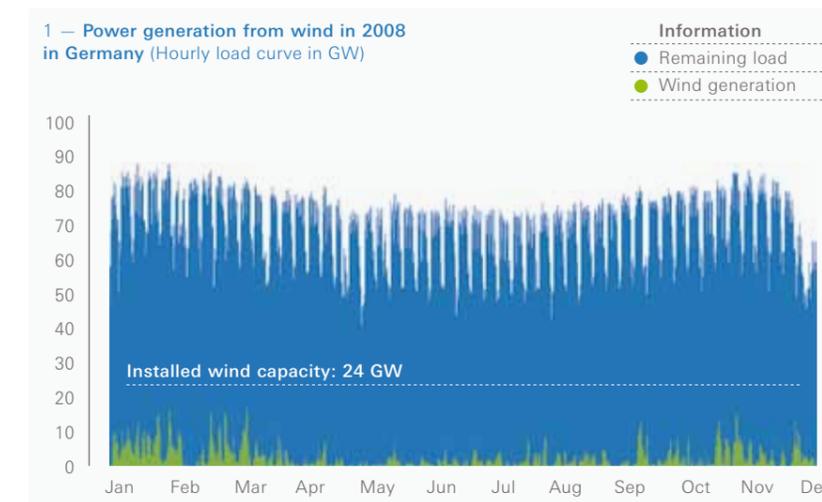
- Coal utilisation can co-exist with the development of power generation based considerably on renewables.
- Precisely new coal-fired power plants will be able to meet the variable feeding in of larger quantities of power from renewables much more flexibly and cover the gaps in supply.

## Coal and Renewables – partners?

Electricity production from renewable energies, above all wind and sun, has sharply increased in some EU Member States. As regenerative production installations depend on the weather, they deliver electricity very irregularly, both during daily and also seasonal operation. In Germany as the country with the largest renewable electricity production where in 2009 already more than 73 TWh electricity benefitted from feed-in tariffs of the aid scheme in favour of renewables, surprisingly low electricity demand and simultaneous over-production of wind-based electricity resulted several times in negative prices for electricity. In such a situation,

above all gas-fired but also coal-fired and nuclear power plants are driven down in all haste. New power plants, based on either coal or lignite, can be operated with much lower loads, e.g. 50% of nominal load, technically stable and economical. Furthermore, they reach quick load shift speeds and are therefore much more flexible than older installations, approaching gas-fired power plants, generally considered more flexible.

It therefore makes sense for new coal-fired power plants to complement the development of renewables, even in the case of an ambitious objective for renewables for 2030 or later.



## IX. Combined heat and power – with coal

- A combined heat and power plant (CHP) produces both electricity and heat, thus making maximum use of the energy obtained from the fuel.
- Especially in Eastern Europe and in Scandinavia, coal is used in combined heat and power plants. There are opportunities to further extend coal-based CHP and to foster reliable, sustainable and affordable energy production for industry and for households.

## Combined heat and power – with coal

Combined Heat and Power clearly has advantages over condensation power plants without combined heat. Combined production allows the optimal use of both the potential of heat and also of the fuel; energy and emissions are saved. CHP plants often also provide district cooling.

CHP is however not suitable without a continuous and potential stable need for heat. It is therefore not surprising that CHP is most widespread in Scandinavia and in Eastern Europe because of colder winters.

Coal is one of the fuels that can be very suitably used for combined heat and power. The fact that coal is more available as a fuel at stable prices is in favour of coal utilisation for CHP, even delivering both the advantages of CHP as well as a readily available fuel at stable prices for industry and households. The competitive advantage of coal will even increase if the assumptions that electricity prices will rise less than natural gas prices prove true.

1 — The photo shows the Vřesová CCGP co-generation plant in the Czech Republic. Capacities: Lignite 1.75 Mt/a, 370 MWe, 120 MW heat.



## X. Coal – higher efficiency for biomass use

→ The utilisation of biomass in coal-fired power plants helps reduce CO<sub>2</sub> emissions, both because less coal is used and also because of the higher efficiency of biomass use compared to dedicated biomass generation.

## Coal – higher efficiency for biomass use

1 – Amer power plant, Geertruidenberg, NL  
largest European co-firing power plant

| Information |   |
|-------------|---|
| ●           | Biomass unloading and temporary storage                               |
| ●           | Amer 9 (600 MWe, 350 MW heat)<br>600kT biomass co-firing /y≈ 1150 GWh |
| ●           | Wood gasifier (≈ 33 MWe)<br>90kT biomass /y≈ 130 GWh                  |
| ●           | Amer 8 (645 MWe, 250 MW heat)<br>300kT biomass co-firing /y≈ 525 GWh  |



Biomass is considered as increasingly important for the production of electricity. Its combustion – both in dedicated biomass plants and when co-fired with coal – produces flue gases with considerable CO<sub>2</sub> concentrations.

Biomass-based generation with CCS would create CO<sub>2</sub> sinks – CO<sub>2</sub> would be taken up from the atmosphere by the biomass when it is growing, be removed from the flue gases after combustion and finally be stored deep underground. Therefore, biomass with CCS could compensate for many small diffuse CO<sub>2</sub> emission sources such as fleets of fossil-fuel driven vehicles. Biomass with CCS could also be a cost-efficient way to reduce CO<sub>2</sub> emissions compared to, for instance, smaller gas-fired plants.

Depending on the legal situation, mainly on state aid, different trends for the use of biomass have developed throughout the European Union. Often, biomass is used in smaller plants up to 20 MWe to produce electricity. These plants are usually dedicated biomass installations, with efficiencies in a range of 20% and emitting about 1 850 g CO<sub>2</sub> /kWh. On the contrary, if biomass is used as additional fuel in highly-efficient coal-fired power plants, the specific emissions per kilowatt-hour of electricity produced by biomass can be reduced by nearly half. Biomass can thereby double its potential in favour of climate protection.

Disadvantages of firing biomass such as the costs of dedicated installations can also be reduced or avoided if the biomass is co-fired with coal. Technical issues such as the optimisation of the biomass/coal co-firing ratio can be solved, mostly by reducing the amount of biomass to be used at a specific moment.

