



Coal as a raw material in a sustainable energy system – how do we make it possible?

NOG-seminar 14th April 2010

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2010-04-22

Foreword

The Electricity in Europe today is to a large extent produced from Coal and Natural gas. In order to meet the current climate goals, new solutions are required to reduce emissions from these sources.

Extensive research is being carried out to develop methods to use coal and other fossil fuels in a sustainable way in order to minimize the release of emissions into the atmosphere.

Clean Coal Technologies, such as Carbon Capture and Storage are one of the interesting solutions that could be used to meet the environmental targets.

The NOG seminar addressed the problem of how coal can be used as fuel in a sustainable energy system in the future. Some of the aspects that the seminar highlighted were:

- Present coal resources and utilization, how large are the resources and where are they located?
- New technologies, identification of Clean Coal Technologies in Sweden, Europe and the world
- The role of Coal in the future energy system

Speakers:

Torbjörn Wahlborg

Head of Vattenfall Nordic

John Topper

Managing Director, IEA Clean Coal Centre

Kalliopi Kalesi

Programme Manager, CCS, European Commission

Moderator:

Tomas Bruce

Managing Director of the Swedish Coal Institute

This abstract is a summary of the seminar written by the secretariat of NOG.

Tomas Bruce, Managing Director of the Swedish Coal Institute

Tomas Bruce is CEO of the Swedish Coal Institute, and special adviser to the Swedish Government on Energy Efficiency. He has worked for many years within the Swedish energy sector, and has been CEO at Skellefteå Kraft, Stockholm Energi and Birka Energi. He has also been a board member at Capital Cooling Europe, Euroheat & Power and Svenska Kraftnät.

Tomas Bruce was the moderator of the seminar, and he held an opening speech titled *Supply and use of coal in an international perspective*.

The speech started with a presentation of the Swedish Coal Institute, which is an interest group for the use of coal in Sweden. Their aim is to work for a use of coal that is responsible from an environmental perspective, and to inform about the role of coal in the Swedish as well as the global energy consumption. The organization has members from energy companies, industries, fuel traders as well as research institutions.

Tomas Bruce showed statistics of the use of coal on different regional levels. Coal constitutes 26 percent of all energy being used in the world, and 40 percent of the energy being used for electricity. For Europe the numbers are somewhat smaller, with 18 percent of the total energy being used and 30 percent of the energy used for electricity. This situation has been stable during the last decades. Sweden differs from most of the world, having only 0.3 percent of the electricity originating from coal. Of total energy being used in Sweden coal constitute about 5 percent, mostly because of the coal being used within larger industries.

China is the biggest coal supplier, followed by USA, which has a supply that is only one third of Chinas. India is the third biggest supplier. Only 15 percent of the coal is exported from the country where it is mined. China, USA and India were therefore also the three largest coal users in 2008. Australia, followed by Indonesia and Russia, were the biggest coal exporters in 2008. Most important coal importers are Japan, South Korea and Taiwan. However, China has an increasing import of coal and according to Tomas Bruce it is likely that China is second to Australia at this moment.

A review of the current reserves of coal and lignite shows that coal is likely to last for more than hundred years, assuming that the technology and consumption does not change. The resources however are even bigger. Tomas Bruce concludes that coal is today used more than ever in a global perspective, and he therefore believes that it will be an important energy source for the coming centuries. Sweden is however thought to stay as a low-coal economy.

John Topper, Managing Director, IEA Clean Coal Centre

John Topper is a chemical engineer who started working in the coal industry in 1975. He is currently the Managing Director of the IEA Clean Coal Centre, located in London. Earlier in his career John Topper was executive director of a private energy and environment consulting company, and he has also worked for the British Coal Corporation, the UN Industrial Development Organisation and the IEA Environmental Projects Ltd.

John Topper held a presentation titled *Coal Use World-Wide; why it will continue and the Challenges it must meet*. The focus of the presentation was to describe the usage of coal in a global perspective and to present forecasts of the future development, as well as presenting the progress of burning technologies and decarbonization of fossil fuels.

The IEA Clean Coal Centre aims at providing information about the sustainable use of coal world-wide. The organization has member countries as well as private sponsors from all over the world.

Forecasts made by the IEA predict that the energy demand will increase with 45 percent from now until 2030. According to the IEA this scenario is far from sustainable since fossil fuels are expected to account for most of the increase. More than one third of the overall rise in energy use would be coming from coal, which is also the energy source for which the demand is increasing most rapidly. It is mainly the non OECD-countries with China and India in the front that are suspected to increase their demand, of energy in general and coal in particular. The OECD-countries are believed to stay at a stable level.

IEA has also made a forecast of the division of different energy sources if the share of carbon dioxide is to be halted at 450 ppm by year 2030. This would require about 40 percent renewable sources for the electricity generation. Coal would however still be used in substantial amounts. John Topper points out that 1.5 billion people are lacking electricity today, and that mitigating carbon dioxide is not the only important task on the agenda.

John Topper continued by presenting the state-of-the-art and the current development within coal fired power plants, based on a recent global investigation. Nordjylland 3 in Denmark is given as an example of a highly efficient coal-fired plant, operating at a net efficiency of 47 percent. For lignite the German plant Niederaussem K operates with a net efficiency of 43.2 percent. E.ON is building a new plant in Wilhelmshaven that is hoped to be the first coal fired plant ever to reach a net efficiency of 50 percent. John Topper also mentions a Japanese plant, the Isogo New Unit 1, which has managed to get their emissions of nitrogen oxides and sulphur oxides to be lower than what can be found in the European countries. This has been achieved by using the latest techniques.

According to John Topper there is a great potential to reduce the carbon dioxide emissions by upgrading old coal fired power plants. However, it is his opinion that Carbon Capture and Storage (CCS) is necessary to make the emission reductions that are needed for the future. This is the only possibility if we are to continue using fossil fuels.

John Topper finished his presentation by giving a review of the current situation and future challenges for Carbon Capture and Storage. The Vattenfall pilot plant at Schwarze Pumpe was mentioned as the leading example of capturing carbon, having been running for about one year. A lot of research is done within the field of CCS but there are still many question marks to address.

China is developing capture technologies with some assistance and co-operation from western organisations and aims to own its own Intellectual Property and supply its own market in due course.

John Topper believes that the efficiency of power plants have the potential to increase until the year 2030 so that when adding systems for CCS the total efficiency will be about the same as the current standards. To have an effect however CSS must be installed in all parts of the world and both within power production and industries. A big challenge is also for CCS to get accepted by the public opinion, which so far has been rather difficult.

Torbjörn Wahlborg, Head of Vattenfall Nordic

Torbjörn Wahlborg is head of the Vattenfall Business Group Nordic and Senior Executive Vice President of Vattenfall. Torbjörn holds an engineering degree from Chalmers University of Technology and has worked at Vattenfall for about fifteen years. During these years Torbjörn has worked at a number of the company's facilities, and he has until lately been Country Manager for Vattenfall in Poland.

Torbjörn Wahlborg held a presentation titled *Clean coal from a Vattenfall perspective*, with the objective to explain how Vattenfall look at coal and the role that it will have in the future. Torbjörn Wahlborg started his presentation by giving a brief presentation of Vattenfall. Vattenfall is the fifth largest generator of electricity in Europe and the largest producer of heat. The company is operating in seven countries and has a total of six million costumers. In total Vattenfall have more than 40,000 employees, whereof less than one forth are located in Sweden.

Vattenfall owns coal fired power plants in Denmark, Netherlands, Germany and Poland. Their total annual consumption of hard coal is 11.5 million tons. The company does not own any coal mines. According to Torbjörn Wahlborg there have been several offers to invest in coal mines, but due to lack of knowledge within mining they have always turned down those offers.

The long time goal of Vattenfall is to be climate neutral by year 2050. In the Nordic countries the goal is to be so by year 2030. One of the strategies to reach this goal is to invest in renewable energy sources, and Torbjörn Wahlborg mentions that wave-power is one of the areas where they are very active. Other activities that they are planning are to replace fossil fuel with electricity where this is possible, upgrade nuclear power plants and install carbon capture and storage.

Torbjörn Wahlborg believes that there is a big potential in CCS. However, there must be a functioning global trading system for greenhouse gases for CCS to be carried out in full scale. With the current development it is likely that a fully developed commercial concept for CCS will be in place by year 2025. Before the COP 15 meeting in Copenhagen it was estimated that a commercial concept would be in place by 2020, but according to Torbjörn Wahlborg the failure in Copenhagen it likely to delayed the progress with a few years. Currently there are pilot plants running, though the next step to develop a demonstration plant is still a few years ahead. Torbjörn Wahlborg believes that this will be realized at the earliest in year 2015.

There are three different methods for capturing carbon dioxide in power plants. Vattenfall has focused on oxyfuel combustion, but are hoping for all technologies to be developed. Their main project at the moment is the oxyfuel pilot plant in Schwarze Pumpe, Germany, which has been running for little more than one year. For the next step in the development Vattenfall is planning a demonstration plant for CCS in Jämschwalde, Germany. The plant is believed to be ready about year 2015, but there are still some critical issues that must be solved. Getting public acceptance for storing carbon dioxide below ground is one of the biggest challenges.

According to Torbjörn Whalborg CCS is a necessary step if Vattenfall is to succeed with the goal of being carbon dioxide neutral in the Nordic countries by year 2030. If combining CCS with combustion of biofuels there is even a possibility to create a carbon dioxide sink. Torbjörn Wahlborg concludes his presentation by saying that “there is a future for coal in Europe, but not for carbon dioxide”.

Kalliopi Kalesi, Programme Manager, CCS, European Commission

Kalliopi Kalesi currently works in the Coal and Oil Unit of the European Union's Directorate General for Energy. Prior to joining the DG for Energy, she was policy officer in the European Commission's Directorate- General for Research, where she was responsible for policy development on the financing of strategic energy technologies, including CCS. Earlier, in her role as European parliamentary assistant, she helped draft and negotiate the European Parliament's report on the EU's CCS Directive. She has previously worked as a public affairs consultant in climate and energy, and has experience in international relations in energy, multilateral negotiations in the UN system, and the liberalization of energy markets.

Kalliopi Kalesi, Programme Manager for CCS at the European Commission, held a presentation titled *European perspective on clean coal technologies-CCS policy*. The presentation focused on policy making, finance and deployment.

As a background to the work that the EU commission is doing within the field of CCS, Kalliopi Kalesi mentioned the EU climate strategy 20-20-20. The aim of this directive is to reduce greenhouse gas emissions by 20% (compared with 1990 emission levels), reduce energy consumption with 20% and increase usage of renewable energy with 20% until year 2020. CCS is included in this package, even though the CCS is not likely to be commercially available before 2020.

The EU adopted in April 2009 a directive for CCS and safe storage of carbon dioxide. The member states who wish to pursue CCS in their territory have until June 2011 to transpose this directive into their national law. This will make it possible for companies to apply for constructing a CCS facility, provided that it can be shown that there are sufficient storage sites for the carbon dioxide and that the CO₂ can be safely stored. The EU supports this development and has a program with a budget of 1.05 billion EUR for demonstration projects of CCS.

Kalliopi Kalesi presented a forecast, based on Eurostat data, implying that the share of coal in Europe's energy supply will still be substantial in year 2030. On a global scale the usage is even assumed to be rising. Based on these forecasts Kalliopi Kalesi states that to stabilize the share of carbon dioxide in the atmosphere at 450 ppm 19 percent of the emission reductions must be coming from CCS.

However, CCS still has a long way to go before being commercially available. Kalliopi Kalesi presented a list of the major challenges, not including the technical aspects. The economic aspect of CCS is an important issue, since the technique is expensive and requires a functioning emissions trading system. Since there are no economic advantages for performing CCS today there is also a challenge to finance large scale industrial CCS demonstration projects. The public awareness is also mentioned as one of the most important factors. CCS is still a new phenomenon for most people and if not properly communicated public support may be hard to ensure.

Kalliopi Kalesi points out that the price of carbon dioxide in the EU-ETS is today too low for CCS to be profitable. In combination with rising prices, and the costs of CCS going down, there are good possibilities for CCS to be profitable in the future. This will however require an international cooperation, both regarding knowledge and financing.