Challenges in CCP Management in Europe

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ABSTRACT

The continuous adaptation of the energy strategies of the European Commission requires CO_2 reduction, increased production by renewables and energy savings. Each member state has its own answer for CO_2 savings due to dependencies in coal-fired generation and partly own coal mining activities. Also energy security has to be considered starting with fuel availability, economics in production and grid stability. But for most of the member states meanwhile phase-out dates have been published. Much more ambitious climate actions are presented in the Commission work program for 2021, the revisions and initiatives linked to the European Green Deal climate actions and in particular the climate target plan's 55 % net reduction target under the Fit for 55 package.

As coal still plays a role in European power generation changes in regional availability of CCPs as raw and construction materials are observed. This leads to increased re-use from stock when available and also to imports from other countries to serve existing markets. But also markets are changing due to climate neutrality aims by 2050. For construction products and constructions the use of secondary, recovered and recycled materials as waste or by-product is of increasing importance.

The report gives an update on the diverging developments of market needs and options by CCPs.

INTRDUCTION

Over the last years the power industry is under continuous pressure to meet stricter emission limit values (ELVs) resulting in recent implementation of the BAT-based ELVs. In addition, the constantly developed energy efficiency strategies of the European Commission (EC) including CO_2 reduction results in using less coal for energy production and in 2020 the production by renewables was first time higher than that of coal. The renewables are mainly wind and solar but also hydro and biomass for co-

combustion in coal-fired power plants and pure biomass in FBC- and converted dry-bottom boilers. In addition, the EU proposed the European Green Deal (EGD) in 2019 which consists of a set of 50 actions for the coming five years across all sectors to prepare the EU economy for climate neutrality by 2050.

Along with all scenarios on reduced power production and significant changes on power production in single member states the production of Coal Combustion Products in Europe still sums up to more than 123 million tons, about 27 million tonnes of this amount in EU15 member states demonstrating the drop of more than 30 % in EU15 but also drops in EU.

Since decades, CCPs serves as raw materials in the building material industry, in civil engineering, in road construction, for construction work in underground coal mining as well as for recultivation and restoration purposes in open cast mines. The use of CCPs is not only essential for the performance of building material, especially on long-term durability, but also important for the sustainability of materials and constructions established. Availability is a major problem in regions and member states which resulted in re-use from stock and also imports. The management of CCPs meeting market needs is a major task for power producers and marketers.

ENERGY STRATEGIES AND FIT-FOR-55

Over the last years the European Commission (EC) agreed on energy strategies with a vision for coal phase-out in 2050 with the Green Deal and the Fit-for-55 initiative. In 2008, the European Parliament and the Council agreed upon the so-called “Climate and Energy Package”, which entered into force in 2009[1]. The legislative package put in place what is collectively known as the EU-20-20-20 targets to be met by 2020:

- Reduction of greenhouse gas emissions of at least 20 % below 1990 level,
- Increasing the share of renewable energy to 20%, and
- Improving the EU’s energy efficiency by 20%.

With this package additional legislation was installed for promotion of the use of renewable energy (RES), geological storage of carbon dioxide and a revised Trading Scheme for greenhouse gases (GHG). Since that time the installed capacity of renewable power has increased but the geological storage of separated CO_2 faced technical and economic problems. The European Trading System (ETS) for CO_2 was installed and expected to serve for more emission reduction but was not effective.

In 2014, EU countries have further agreed to meet at least a 40% reduction in greenhouse gas emissions, a binding target of at least 27% of renewable energy in the EU and an increase in energy efficiency increase of at least 27% by 2030[2]. To reach this the completion of the internal energy market by reaching an electricity interconnection target of 15% between EU countries by 2030, and pushing forward important infrastructure projects have been agreed. The progress of the proposals and associated regulations are reported regularly to the EC.

In November 2016, the Commission released draft legislative proposals designed to help achieve the set targets with measures including proposals on electricity market design, renewables and energy efficiency. The EU aims to achieve an 80% to 95% reduction in greenhouse gasses compared to 1990 levels by 2050. Its Energy Roadmap 2050 analyses a series of scenarios on how to meet this target[3].

In 2019, the EU overhauled its energy policy framework to move away from fossil fuels towards cleaner energy - and, more specifically, to deliver on the EU's Paris Agreement commitments for reducing greenhouse gas emissions. The agreement on this new energy rulebook – called the Clean Energy for all Europeans Package – marked a significant step towards implementing the Energy Union Strategy, published in 2015[4]. Based on Commission proposals, the package consists of 4 Directives and 4 Regulations published in 2018 and 2918 (see table 1).

- *Energy Performance in Buildings Directive (EU) 2018/844* which sets specific provisions for better and more energy–efficient buildings
- *Renewable Energy Directive (EU) 2018/2001* which sets a binding target of 32% for renewable energy sources (RES) in the EU's energy mix by 2030
- *Energy Efficiency Directive (EU) 2018/2002* which sets a target of 32.5% for energy efficiency for 2030, compared to a baseline scenario established in 2007
- *Governance of the Energy Union Regulation (EU) 2018/1999* which sets a new governance system for the Energy Union. Member States have to establish an integrated 10-year National Energy and Climate Plan (NECP) for 2021 to 2030, with a longer-term view towards 2050.
- *Electricity Regulation (EU) 2019/943* which sets principles for the internal EU electricity market. It focuses mainly on the wholesale market as well as network operation
- *Electricity Directive (EU) 2019/944* which sets rules for the generation, transmission, distribution, supply and storage of electricity. It also includes consumer empowerment and protection aspects
- *Risk Preparedness Regulation (EU) 2019/941* which requires the Member States to prepare plans on how to deal with potential future electricity crises.
- *ACER Regulation (EU) 2019/942* which updates the role and functioning of the European Union Agency for the Cooperation of Energy Regulators (ACER)

Tab. 1 Directives and Regulations published within the Clean Energy for all Europeans Package

In its communication (COM 2019/640)[5] of 11th December 2019, the Commission presented the "European Green Deal" which sets out a detailed vision to make Europe the first climate-neutral continent by 2050, safeguard biodiversity, establish a circular economy and eliminate pollution, while boosting the competitiveness of European industry and ensuring a just transition for the regions and workers affected. In its Climate Target Plan, the Commission proposed to raise the Union's ambition on

reducing greenhouse gas emissions to at least 55% below 1990 levels by 2030, which is a substantial increase compared to the existing 40% target.
To implement this, the European Commission 2021 Work Programme announced a 'Fit for 55' package to reduce GHG emissions by at least 55% by 2030, and achieve a climate-neutral Europe by 2050. This package will cover a wide range of policy areas including energy efficiency, renewables, land use, energy taxation, effort sharing and emissions trading. e European Union's target for 2030 towards 55% in a responsible way.

In June 2021, the Council adopted its position at first reading on the European climate law, ending the adoption procedure and setting into legislation the objective of a climate-neutral EU by 2050. This follows a political agreement reached with the European Parliament on 21 April and the Parliament's adoption of its position at first reading on 24 June. In addition to the goal of climate neutrality and an aspirational goal for the Union to strive to achieve negative emissions after 2050, the European climate law sets a binding Union climate target of a reduction of net greenhouse gas emissions (emissions after deduction of removals) by at least 55% by 2030 compared to 1990. In order to ensure that sufficient efforts to reduce and prevent emissions are deployed until 2030, the climate law introduces a limit of 225 Mt of CO_2 equivalent to the contribution of removals to that target. The Union will also aim to achieve a higher volume of carbon net sink by 2030[6].

As a consequence of the all the initiatives member states have announced coal phase-out deadlines which are already corrected for some countries. An over view of the situation with phase-out decisions is given in Figure 1.

INDUSTRIAL EMISSIONS DIRECTIVE

Aside from all the discussions on climate neutrality, the power industry is also under continuous pressure to improve the environmental performance of their operations. The most important Directive for emissions from coal-fired power plants is the Industrial Emissions Directive (IED)[8] which is the successor of the IPPC Directive[9] and the main EU instrument regulating pollutant emissions from industrial installations.

Since 1st January 2016, the IED also supersedes the Large Combustion Plant Directive[10] which aimed to reduce acidification, ground level ozone and particulates by controlling the emissions of sulphur dioxide, oxides of nitrogen and dust from large combustion plants (i.e. plants with a rated thermal input of equal to or greater than 50 MW_{th}). All combustion plants built after 1987 had to comply with the emission limits in the LCPD and were either closed or retrofitted with more effective flue gas cleaning devices for de-dusting, de-nitrification (de-NOx) and de-sulphurisation (de-SOx). By this, the closure of power plants observed today is not only due to climate targets but are also consequences on decisions for plant retrofits.

Fig. 1 Coal phase-out in Europe (based on updated information by [7])

The IED aims to achieve a high level of protection of human health and the environment taken as a whole by reducing harmful industrial emissions across the EU, in particular through better application of Best Available Techniques (BAT) which have been revised by 2016 and which were published as the “Commission implementing decision establishing the Best Available Techniques (BAT) conclusions for Large Combustion Plants”[11] in the Official Journal of the European Union on 17th August 2017. The BAT Conclusions will provide stricter emission limit values for e.g. Hg and NOx which may also have an impact on the quality of CCPs. Examples discussed over the last years are e.g. FGD gypsum (Hg content) and NH_3 injection installations due to the revised IED. By 17th August 2021, member states have to implement the conclusions and power producers have to meet the new emission limit values.

Around 50,000 installations undertaking the industrial activities listed in Annex I of the IED are required to operate in accordance with a permit (granted by the authorities in the Member States). The IED is based on several pillars, in particular an integrated approach, the use of best available techniques, flexibility, inspections and public participation. The integrated approach means that the permits must take into account the whole environmental performance of the plant, covering e.g. emissions to air, water and land, generation of waste, use of raw materials, energy efficiency, noise, prevention of accidents, and restoration of the site upon closure. To fulfill the approach also other Directives as the Waste Directive[12] for utilisation of waste and REACH Regulation[13] and several product standards and requirements for the use as products have to

considered. It is a continuous task of ECOBA and its members to highlight that CCPs are valuable resources which can be and which are used as replacement for natural materials in several applications and to inform about related regulations.

It has to be noted that in January 2021, the European Court of Justice ruled that the existing limit values remain valid due to an formally inadequate voting procedure[14]. The case was initiated in October 2017 by the government of Poland, supported by Hungary and Bulgaria. The Court has now annulled the standards on a procedural ground while confirming that they will remain valid until new standards are voted, as “the annulment of the contested decision with immediate effect would run counter to the objectives of ensuring a high level of environmental protection and the improvement of environmental quality’. The European Commission has 12 months to submit a new draft of the standards to member states for a second vote, while the deadline for operators to comply with the air pollution rules included in the Large Combustion Plants Best Available Techniques Reference Document (LCP BREF) is still set to 17th August 2021 the latest.

COAL COMBUSTION PRODUCT AS RESOURCES

Following the requirements of the Waste Directive[12] with the implemented waste hierarchy starting with avoidance via i.a. utilisation and processing for use before disposal of waste the use of CCPs as raw or construction materials developed over time and they are considered by-products in many cases and have consequently been registered under REACH[13]. The utilisation of CCPs quality and availability are important parameters for the construction market for improving technical performance of construction materials and construction but serve for environmental benefits and the sustainability.

In 2019, about 27 million tonnes of CCPs have been produced which are mainly utilised in the building material industry, in civil engineering, in road construction, for construction work in underground coal mining as well as for recultivation and restoration purposes in open cast mines. About 50% of the total CCPs are used in the construction industry, in civil engineering and as construction materials in underground mining and about 45% for restoration of open cast mines, quarries and pits and about 4 % were disposed of (see figures 2 and 3)[15].

The quality is defined by technical and environmental requirements in standards and regulations which have to be met all the time. A continuous quality management including auto and third-party control is required. The standards and requirements are subject of regular updates to meet regulatory as well as market needs.
In addition to quality, availability is important to serve construction projects especially in member states with existing markets. Forecasting of production to serve market needs cause more efforts in CCP management today as for some applications a regular availability is needed. Stock management whether in silo or on site as well as beneficiation for fresh produced or stockpiled ash are tools together with cross border transport as options for safeguarding availability of CCPs.

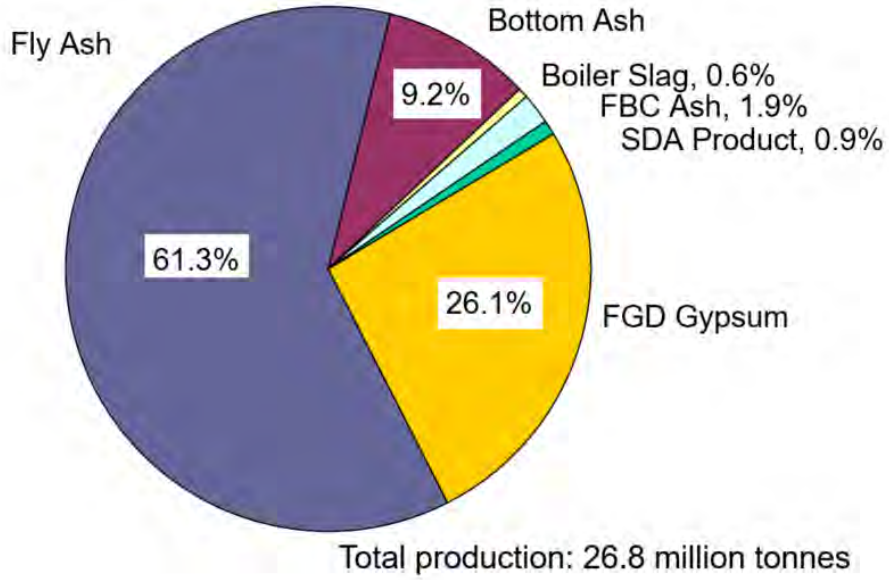

Fig 2 CCP production in Europe (EU15) in 2019[15]

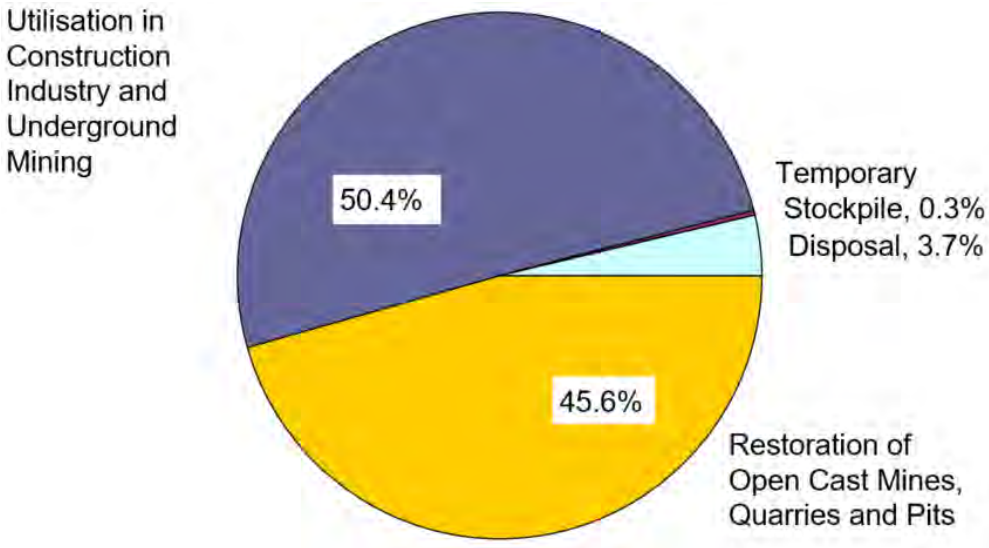

Fig 3 Utilisation and Disposal of CCPs in Europe (EU 15) in 2019[15]

The figures for production and use in EU15/EU28/EU are given in table 2. The total production of CCPs in the EU more than 123 million tonnes, that in EU28 member states to more than 80 million tonnes. A regular statistic is compiled by ECOBA members annually and published as EU15 statistics /15/. Beside the production also the utilization data for the coal combustion products are compiled. The utilization rate for CCPs used as or in raw material and construction materials and for reclamation is 96%.

	EU15	EU28*	EU*
Production	[mill.t]		
CCPs total	27	>80	>123
Ashes	20	>62	>103
desulph. Products	7	>17	>18
utilisation rate			
construction ind.	50%	**	**
constr. + reclam.	96%	**	**

* data + calculations based on coal comsumption
** information on utilisation only partly available

Table 2: Production and utilisation of CCPs in Europe 2019 (EU15, EU28, EU)[16]

To serve the existing markets for CCPs as construction materials and to meet the increasing demand due to requirements for sustainable construction materials and construction beside the fresh production the utilisation from short- and long-term stock by either direct use or processing and the import of ashes have to be considered.

In countries with available stocks the re-use of ashes for different applications is possible and practised on regular term. In e.g. France, the re-use from stock is practised regularly over the last 50 years[17]. In Denmark, a complete ash stock was removed and used for cement production to prepare extension areas for constructions. In May 2015, the Hénâ project was started in Awirs, Belgium. From 1952 to 1972 about 1.7 million m³ of fly ash produced by the combustion of coal at the Awirs power plant were deposited. The ash is now removed and used for cement production in a nearby cement plant[18]. In the UK ashes on longterm stockpile are considered a strategic secondary mineral resource which are referenced in the latest National Planning Policy Framework Document[19]. The EP UK Investments Ltd is proposing to extract up to 1 million tonnes of ash per annum from the Gale Common Ash Disposal Site in North Yorkshire over a 25-year period[20].

In addition to fresh production from coal-fired power generation also import/export of ashes is practised. About 2-3 million tonnes of ashes are transported cross border each year to serve the existing markets (see figure 4).

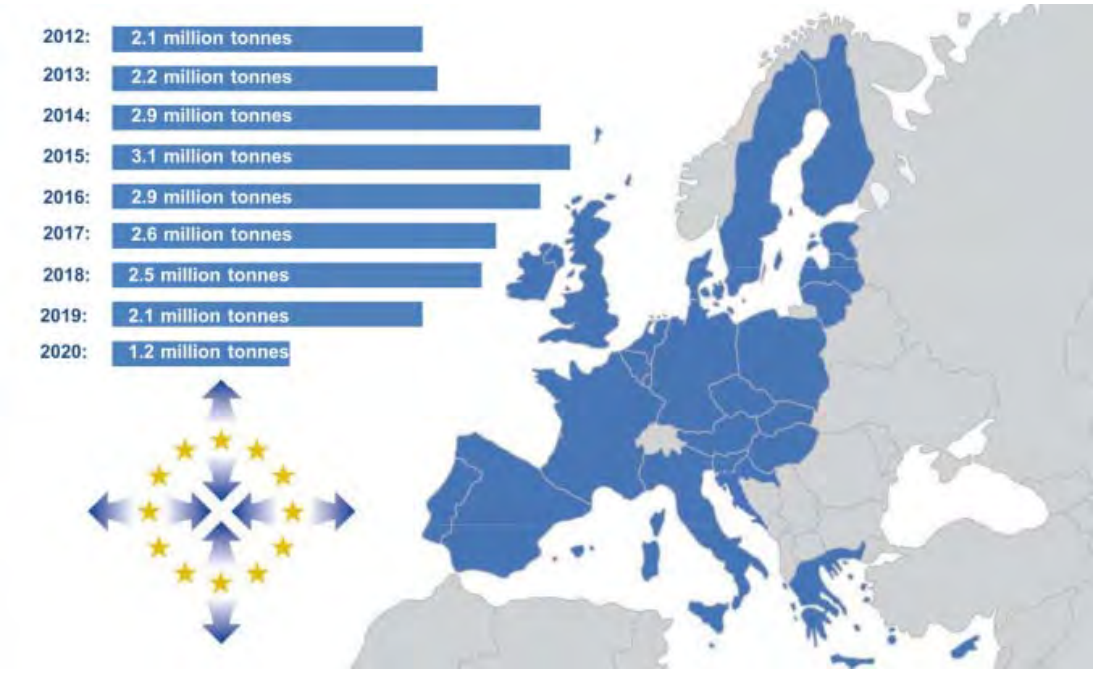

Figure 4 Cross Border transport of ashes in Europe[21]

CONCLUSIONS/OUTLOOK

Due to different situations in energy production sources and Regulations and Directives on reduced CO_2 emission aiming in climate neutrality by 2050 coal-fired power production was reduced over the years. In some countries coal was phased-out or is announced and only in few countries no phase-out is announced.

In existing markets the demand for CCPs as raw and construction is high as also the construction industry has to save CO_2 and become climate neutral. Therefore, beside production in power plants also re-use from stock and imports from other countries are used to serve existing markets. The use of CCPs serve not only for better performance but also to the sustainability of construction materials and constructions.

The management of CCPs from coal-fired power plant operation - whether from fresh production or from stock - as raw and construction materials remains is a continuous challenge!

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