Executive Summary

BACKGROUND

Although discussions about CO_2 reductions are numerous, in the Netherlands there are plans to increase the number of power plants in order to provide well for the increasing demand for energy. The environmental aspects are not limited to the CO_2 or sulfur emissions, but also dust emissions in the handling of coal are getting more important. These emissions depend on the means of storage and handling (equipment) of coal before the material is fed into the plant itself. In addition, the co-firing of biomass as 'green energy' is an important issue. Some plants have their own storage systems on-site, others use neighboring terminals with a direct feed to the plant. This literature assignment is thus to study and to make an overview of the developments in power plants in Europe including their age distributions

TRENDS IN EUROPEAN POWER GENERATION

In the past decades the awareness negative influences of greenhouse gasses such as CO_2 has led to a investments shift from coal fired power plants to gas fired power plants (figure 1). From the bars representing planned plants and plants currently under construction, it seems as gas will continue to dominate investments at least well into the next decade. Continued expansion of gas in the power sector will depend on several factors such as.

1. Concerns for security of supply
2. nuclear phase-out as announced by some member states
3. ratio of cost of generation based on gas and coal including carbon capture and storage

In order to prevent high energy dependency, European policy is focused on more 'green' and native energy sources such as biomass, hydropower and wind.

Generally however, implementation of and investments in renewable energy sources are mainly focused on wind power in which very high growth rates are seen (figure 1). Co-firing of biomass investments are limited to the countries in North West Europe and Italy. In the rest of Europe only limited testing has been performed; government incentive and coherent policy is lacking to propel implementation.

Recently there seems to be an increased confidence from utilities to invest in coal plants again and currently some 5GW coal and lignite plants are under construction while another 26GW is under planning. The reason for this is found in the fact that the existing power plants are aging and future gas supply is more susceptible to uncertainty than coal supply.

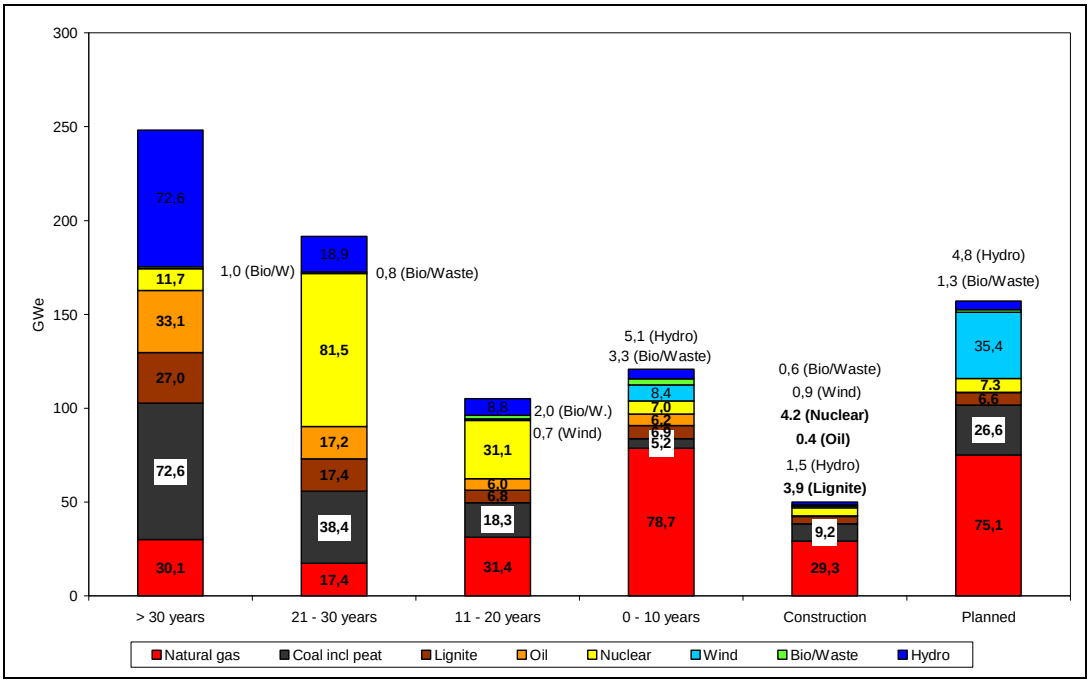

figure 1: operating and planned power plants capacity in EU-27 by fuel and age [6]

EUROPEAN LEGISLATION

Although emission limit values are very specific about stack emissions, coherent legislation for open source emissions are lacking. This is a consequence of the fact that emission from open sources (noise, dust) are more of a local nuisance and thus currently not enjoying the same amount of attention as there is for emission of green house gasses. To get all EU countries on one line with respect to environmental legislation, the European Commission has accepted a proposal which forms seven existing Directives related to industrial emissions into a single clear and coherent legislative instrument. The main thrust of the directive is to increase the use of BAT (Best Available Techniques), an IPPC-related obligation to ensure that industrial operators use the most cost-effective techniques to achieve a high level of environmental protection. A summary of the BREF (BAT reference document) is listed below.

table 1: Abatement techniques to prevent dust emissions from coal storage [7]

Type of storage	BAT
General	BAT is to apply enclosed storage where possible by using, for example, silos, bunkers, hoppers and containers
	surveying storage areas for coal and lignite with automatic systems, to detect fires, caused by self-ignition and to identify risk points

Open storage	general	having storage on sealed surfaces with drainage, drain collection and water treatment for settling out
		collecting surface run-off from coal storage areas that washes fuel particles away and treating this collected stream (settling out) before discharge
		Carry out regular or continuous visual inspections to see if dust missions occur and to check if preventive measures are in good working order.
		Following the weather forecast by, e.g., using meteorological instruments on site, will help to identify when the moistening of heaps is necessary and will prevent unnecessary use of resources for moistening the open storage.
	long-term storage	moistening the surface using durable dust-binding substances
		covering the surface, e.g. with tarpaulins
		solidification of the surface
		grassing-over of the surface
	short-term storage	moistening the surface using durable dust-binding substances
		moistening the surface with water
		covering the surface, e.g. with tarpaulins[1]
	additional measures	placing longitudinal axis of the heap parallel with the prevailing wind
		applying protective plantings, fences or mounds to lower the wind velocity
		applying one heap instead of several heaps as far as possible; with 2 heaps storing the same amount as one, the free surface increases with 26 %
		applying storage with retaining walls reduces the free surface, leading to a reduction of diffuse dust emissions
		placing retaining walls close together
Closed storage		apply proper design to provide stability and prevent the silo from collapsing
		apply proper designed ventilation and filtering systems and to keep the entrances/ exits closed
		Apply dust abatement and a BAT associated emission level of 1 – 10 mg/m^3, depending on the nature/type of substance stored. The type of abatement technique has to be decided on a case-by-case basis
		For a silo containing organic solids, BAT is to apply an explosion resistant silo equipped with a relief valve

[1] A tarpaulin or tarp is a large sheet of strong, flexible, water resistant or waterproof material

APPLIED STORAGE IN EUROPE

In order to compare different storage facilities and to be able to understand why an operator has selected a specific storage solution, it is important to know on what basis the users decide thus which factors are of importance. A basic decision model can be compiled containing the following identified decision factors:

- Quantity (throughput, buffer size)
- Supply chain configuration (chain length, reliability & redundancy)
- Properties of the material (degradability, flow-ability, particle size, moisture content)
- Site-specific factors (climate, infrastructure & site characteristics)
- Legal requirements (environmental legislation & requirements of planning authorities)
- Economical characteristics (CAPEX, OPEX, material loss)

Although economic lifetime of storage system already in place is not directly a criterion, it is very important in this context, since long lifetime of storage equipment might not allow the operator to review coal storage cost-effectively.

UNKNOWN AREA

Despite the fact that some of pre-mentioned characteristics are country-related, the total picture is too site-specific to be able to make any generalizations. In addition, literature resources regarding individual power plant sites, such as storage solutions and supply chain management, are very scarce. Due to the lack of data, no pattern with respect to storage solutions in Europe could be detected.

To gain thorough understanding of the decision factors of operators of the sites it is recommended to make use of questionnaires in addition to interviews with the responsible authorities. With the gathered insights a more profound and objective multi-criteria-analysis should be set up to be of aid when reevaluation of handling and storage. This exercise was however beyond the scope of this study.