Tendances Carbone
The Monthly Bulletin on the European Carbon Market
cdc climat research
A newsletter of CDC Climat Research in partnership with CLIMPACT metnext

Methodology – Tendances carbone

CDC Climat Research publishes Tendances Carbone, the monthly bulletin on the European carbon market (EU ETS). The objective of this publication is to provide our readers with analysis and information on the development of the European carbon price and its fundamentals.

This paper provides further details on the indicators used in Tendances Carbone and their calculation.

Each month, the bulletin presents six groups of indicators:

1. EU carbon market: monthly summary
2. Energy
3. Production
4. Impact of temperature
5. Institutional environment
6. Carbon markets dashboard

The data and methodology used to calculate each of these groups of indicators is discussed below.

1. EU ETS: monthly summary

▪ Monthly trading volumes of EUA and CER

The monthly trading volume is the total of all the daily transactions on the exchanges and OTC markets. We use Thomson Reuters to get the data from NordPool, EEX and GreenX, whereas for ICE Futures Europe we use data provided on its website.

▪ Prices of EUA and CER: Futures dec.13

Daily settlement prices for dec.13 contracts are provided by ICE Futures Europe.

▪ EUA – CER price spreads

Daily price spreads between EUA and CER is calculated from ICE Futures Europe data on dec.13 contract.

2. Energy

The purpose of this indicator is to evaluate changes in production costs of electricity generation due to variations in primary energy prices and therefore to give and indication of economic incentives to shift production capacity to modes of production which emit less CO_2.

The “Energy prices” indicators correspond to the monthly average of the daily closing price of this following energy source (Thomson Reuters)

- the prices of coal API#2 CIF ARA Month Ahead in USD/t;
- the prices of natural gas NBP and TTF in €/MWh;

- the prices of Brent in USD/b;
- the prices of base load German electricity, spot and Calendar 2013 in €/MWh
- the prices of base load UK electricity, spot and next season in €/MWh

From this, CDC Climat Research calculates:

- two specific spread indicators based on the price of CO_2, which refer to the marginal profitability of using coal-fired generation ("clean dark spread") as well as using gas-fired generation plants ("clean spark spread").
- the implied "fuel switching price", i.e. the price of CO_2 which would be required to equalize the returns to coal and gas and beyond which arbitrage opportunities toward the use of gas are possible.

These indicators are calculated for Germany and the United Kingdom, which represent the main areas of arbitrage opportunity in the EU ETS. These following parameters are used for the calculation:

For Germany

- Net thermal Efficiency of a conventional coal-fired plant : 36 %
- Net thermal Efficiency of a conventional gas-fired plant : 50 %
- Emissions factor (CO_2/MWh) of a conventional coal-fired plant: 0, 96 tCO_2/MWh
- Emissions factor (CO_2/MWh) of a conventional gas-fired plant: 0, 37 tCO_2/MWh

For UK

- Net thermal Efficiency of a conventional coal-fired plant : 35 %
- Net thermal Efficiency of a conventional gas-fired plant : 49,13 %
- Emissions factor (CO_2/MWh) of a conventional coal-fired plant: 0, 98 tCO_2/MWh
- Emissions factor (CO_2/MWh) of a conventional gas-fired plant: 0, 38 tCO_2/MWh

▪ Calculation of clean dark spread

The clean dark spread, expressed in €/MWh, represents the difference between the price of electricity and the price of coal used to generate that electricity, corrected for the energy output of the coal plant.

We calculate dark spreads by dividing the coal price per MWh in the chosen currency by the coal plant efficiency rate expressed as a percentage (CO_2 impact is not included). Then, we subtract the result from the electricity futures contract price.

Dark spread = Power price - (Coal price per MWh / Coal plant efficiency rate)

Our clean dark spreads are calculated by subtracting the carbon emission costs (adjusted with the impact of CO_2 gas) from the dark spreads:

It is calculated for each day as follows:

Clean dark spread = Dirty dark spread – Carbon price × coal CO2 emissions factor

The monthly clean dark spread published in Tendances Carbone corresponds to the monthly average of daily clean dark spreads.

▪ Calculation of clean spark spread

The Clean spark spread, expressed in €/MWh, represents the difference between the price of electricity and the price of natural gas used to generate that electricity, corrected for the energy output of the gas-fired plant.

We calculate spark spreads by dividing the natural gas price per MWh in the chosen currency by the natural gas plant efficient rate expressed as a percentage (CO_2 impact is not included). Then, we subtract the result from the electricity futures contract price.

Spark spread = Power Price - (Natural gas price per MWh / Natural gas energy efficiency factor)

We calculate our clean spark spread by subtracting carbon emission costs (CO_2-adjusted) from spark spread.

It is calculated, for each day, as follows:

Clean spark spread = Dirty spark spread – Carbon price × gas CO2 emissions factor

The monthly clean spark spread published in *Tendances Carbone* corresponds to the monthly average of daily clean spark spreads.

▪ Calculation of the CO_2 allowance switching price

The "switching price" is an indicative CO_2 allowance price which indicates when a switch from coal to natural gas or from natural gas to coal is economically advantageous to an electric power producer.

Mathematically, this indicator is the fictional daily price of CO_2 that would establish equality between the clean dark spread and the clean spark spread.

In the short term, it is advantageous to switch from:

- coal to natural gas, when the daily CO_2 price is above carbon switch
- natural gas to coal, when the daily CO_2 price is below carbon switch

It is calculated for each day as follows:

$$Switching\ Price = \frac{\cos t(gas)/MWh - \cos t(coal)/MWh}{tCO_2(coal)/MWh - tCO_2(gas)/MWh}$$

With:

Cost (gas): Production cost of one MWh of electricity on base of net CO_2 emissions of gas in €/MWh

Cost (coal): Production cost of one MWh of electricity on base of net CO_2 emissions of coal in €/MWh

tCO_2 (coal): Emissions factor (CO_2/MWh) of a conventional coal-fired plant: 0, 96 tCO_2/MWh

tCO_2 (gas): Emissions factor (CO_2/MWh) of a conventional gas-fired plant: 0, 37 tCO_2/MWh

The price of the monthly switch price published in *Tendances Carbone* corresponds to the monthly average of daily switch prices.

3. Production

The objective of this indicator is to analyze firstly the evolution of electricity generation in Europe by energy sources (fossil fuels, nuclear, hydro and renewables), and secondly, changes in production in other industrial EU ETS sectors

▪ European electricity production

This indicator is compiled from monthly data published each month by the International Energy Agency (IEA) in its "*monthly electricity survey*" bulletin. The data are aggregated for 20 European countries which are involved in the EU ETS. It includes only the European OECD countries and does

not include Romania, Bulgaria, Slovenia, Latvia, Lithuania, Cyprus, Malta, Liechtenstein, Estonia. These data are provided with a delay of three months.

▪ European industry production index

The European industrial production indicator shows the monthly index (base 100 =2005) of industrial production excluding construction provided by Eurostat. Data are seasonally adjusted. The "European industrial production index" indicator published in *Tendances Carbone* corresponds to the index of production of all industries for the month "M – 2" for the EU-27. For instance, in March 2011, Eurostat publish January index.

4. Climpact Metnext Weather Index

▪ European temperature index

Climpact Metnext provides the *Metnext Weather* indices for the following 18 countries: Austria, Belgium, Germany, Denmark, Spain, Finland, France, United-Kingdom, Hungary, Ireland, Italia, the Netherlands, Norway, Poland, Portugal, Sweden, Slovakia and Slovenia.

This national business-climate index is defined as the average daily temperature of the regions making up the country, weighted by the population of these regions, which gives a good approximation of the weight of regional economic activity.

This index Θ, expressed in ℃, is calculated for each country a s follows:

$$\theta = \frac{\sum_{i=1}^{N} p_i \times \theta_i}{\sum_{i=1}^{N} p_i}$$

With:

N : Number of regions in the country under consideration;

p_i : Population of region i;

θ_i : Average temperature of region i during the month under consideration, in ℃.

Calculation of the Tendances Carbone *European temperature index:*

The European temperature index is equal to the average of the national temperature indices θ for the 18 countries, weighted by the weight of each country in the total volume of distributed allowances.

This European temperature index is calculated as follows:

$$T = \frac{\sum_{j=1}^{4} Q_j \times \theta_j}{\sum_{j=1}^{4} Q_j}$$

With:

Q_j : Number of allowances allocated by the NAP in country j;

θ_j : National temperature index of country j.

Source: European Commission

The monthly index is the average of the daily indices during the month.

▪ Impact of the temperature on European electricity production

The aim of the indicator, calculated by Climpact Metnext, is to determine the impact (expressed in %) of the temperature on the European electricity production compared with a 10 year average (2000-2009). An index greater than 1 % expresses a positive impact of the weather on electricity generation, if not negative and neutral if the indicator is equal or very close to 0.

Climapct Metnext calculate the impact factor from a modeling of European electricity generation. Model features are detailed below:

Data

- EU 27 electricity production index (D35) provided by Eurostat. These data are seasonally adjusted and are adjusted by working days;
- Eurostat unemployment rate;
- Indices of business confidence published by the European Commission.

Perimeter

- Analysis at the Europe 27 level
- Analysis for 8 specific countries (Czech Republic, Germany, Spain, France, Italy, Netherlands, Poland, and United Kingdom)

Modelling

The statistical model is introduced to represent the index of electricity production based on weather and macro-economic variables. The model produces a forecast of production indices in different weather conditions.

- Simulation of production indices with observed temperature
- Simulation of production indices with normal seasonality (clim 10 years, 2000-2009)

The impact factor, expressed in percentage, is defined as the ratio between both simulations.

5. Institutional environment

▪ Supply of European carbon allowances

The indicators on the institutional environment, on national registries, the allocation of CO_2 allowances and the compliance of facilities are based on public information provided by the European Commission and Member states. The main database is the European registry CITL.

The supply of allowances auctioned correspond to the sum of the allowances offered by the various states. Sources are trading platforms that make these sales, such as EEX on behalf of the German states, and national organizations, such as the UK Debt Management Office on behalf of the United-Kingdom.

▪ Supply of international credits

The number of CDM and JI projects and the volume of credits issued are derived from the operation of the database CDM/JI Pipeline, published by the UNEP-Risoe data are collected on a monthly basis directly through UNEP Risoe website: www.cdmpipeline.org. The reported volume of credits issued that is published in Tendances Carbone is aggregated absolute value.

CDC Climat Research also provides a forecast estimation of the volume of CERs expected by May 1st 2013. This indicator, “CER 2012”, evaluates the supply of credits we forecast will be generated by Clean Development Mechanism (CDM) projects by the end of the first Kyoto commitment period and the second phase of the EU ETS (2008-2012).

Calculation of CDC Climat CER $_{2013}$ indicator:

- For every month of the period from January 1st, 2000 to April 30th, 2013, the amount of CERs expected from a given project is evaluated from the estimated annual quantity of CERs in the PDD. If the crediting period is 7 years then it is supposed to be automatically renewed and that there will be generated as much emission reductions as in the previous period.

- Two discount factors are applied to these monthly amount of CERs:

1. The first one reflects the (historically observed) probability of a given approved project of being validated for a given country. It is denoted $\alpha_{country.}$
2. The second factor reflects the expected amount of credits, given the methodology used, for a project already registered by the Executive Board. It is denoted $\alpha_{method.}$

The amount of CERs generated monthly by all the projects, until April 30th 2013 – the date of compliance of the second EU ETS phase – is summed in order to obtain CDC Climat indicator. CDC Climat indicator is thus the estimation of the amount of emission reductions expected from all CDM projects at the development stage.

$$CER_{CDC\ Climat\ Recherche} = \sum_{j=1}^{N} \alpha_{country\ p} * \alpha_{methodo\ m} * ER_{2012\ j} \text{ with :}$$

$$\alpha_{country\ p} = \frac{\sum_{j=1}^{V} ERvalidated_{2012\ j}}{\sum_{j=1}^{A} ERapprouved_{2012\ j}}$$

$$\alpha_{methodo\ m} = \frac{\sum_{j=1}^{G} ER_{Annual\ j} * \pi_{issuance\ j}}{\sum_{j=1}^{G} ER_{Annual\ j}}$$

Where :

- **ER_{2012}** : for a given project, emission reductions realized until April 30th,2013 and estimated from the annual emissions reductions in the PDD
- **N** : number of projects in the pipeline,
- **A** :for a given host country, number of approved projects
- **V**: for a given host country, number of validated projects among approved projects.
- **G** : for a given methodology, number of projects which has already generated CERs,
- **ER_{Annual}**: for a given project, annual emission reductions estimated in the PDD.
- **$\Pi_{issuance}$** : for a given project, issuance rate, that is the ratio of generated credits and expected credits.