Fulfillment of economic surplus maximization in SDAC delivered via the PCR Euphemia algorithm

Rickard Nilsson

Senior Advisor on Market Design

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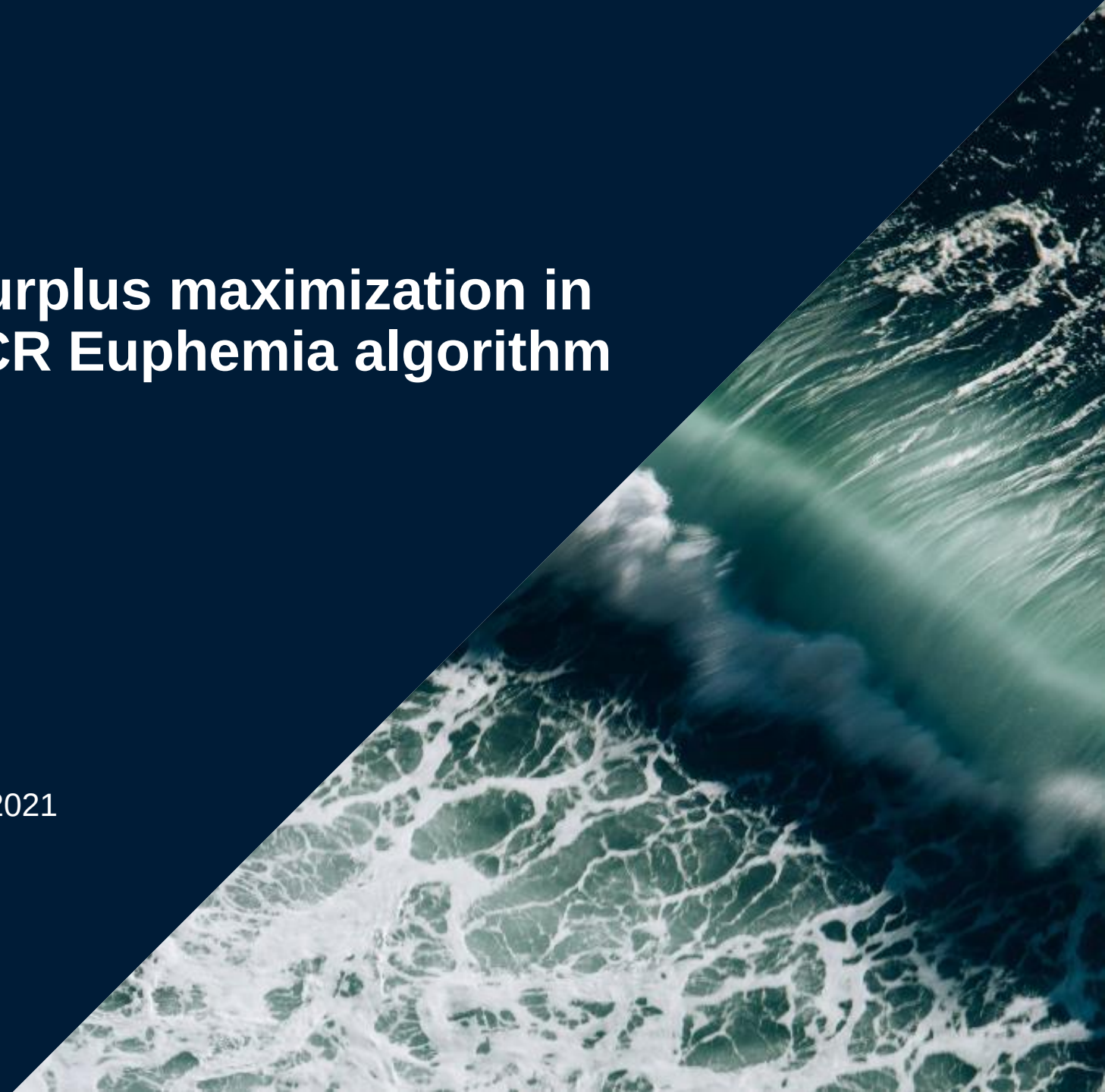


SDAC

Annual average clearing prices 2020

Compared to 2019 the "**economic dimension**" of the coupling grew slightly (+3%) to 1,531 TWh.

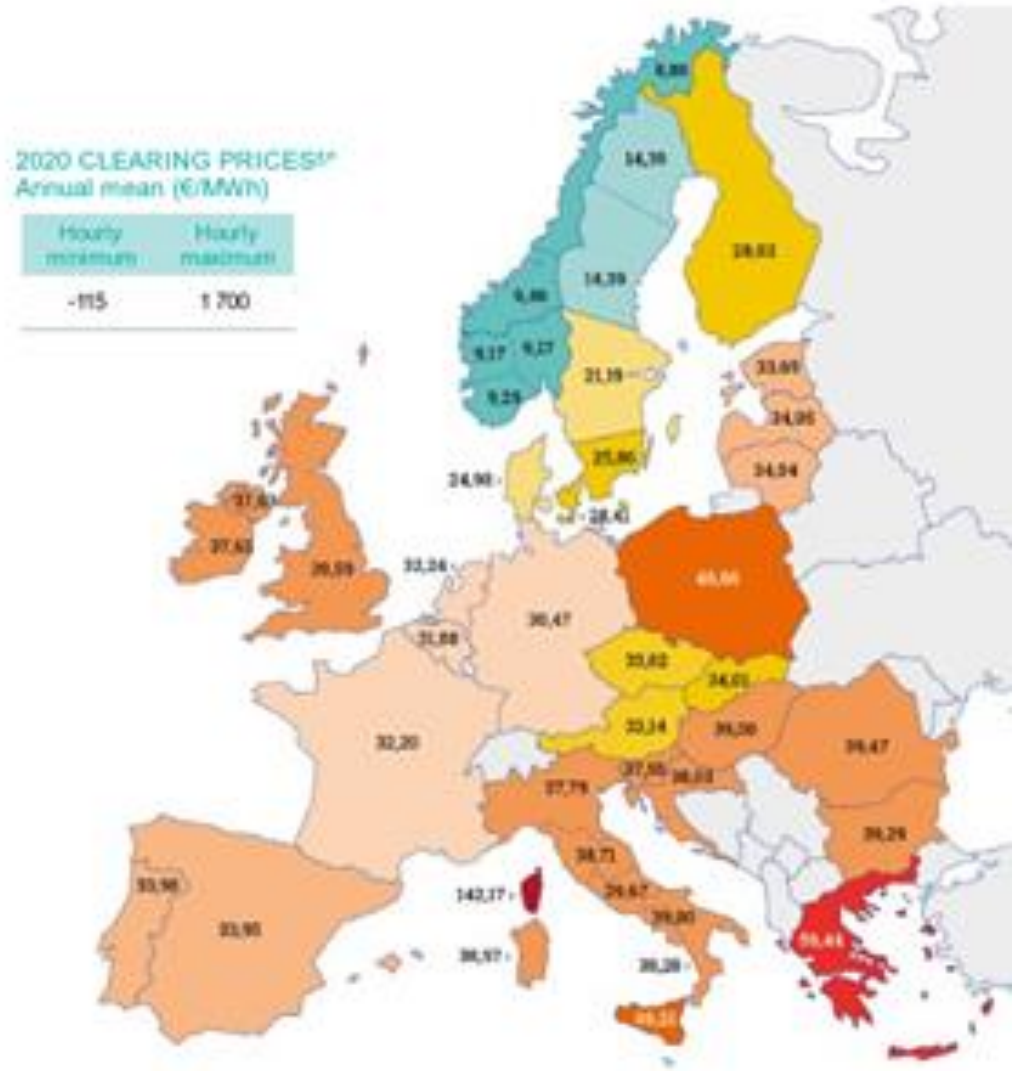
The welfare managed by the algorithm* increased up to an average of around 9B€ per session, of which 8.9B€ were from MRC and 96.4 M€ from 4MMC.

The **2020 annual average clearing prices**** declined significantly compared to 2019, mainly due to the pandemic situation.

* The "welfare managed by the algorithm" is not to be mistaken with the "social welfare" provided by the coupling of electricity markets. The "welfare managed by the algorithm" correspond to the sum of two main components, (i) the global surpluses generated by all accepted demand and supply orders (i.e., the global gains generated by these orders compared to the limit price at which they were submitted), and (ii) the global congestion rents generated over saturated interconnections (computed as the price difference between two connected areas, multiplied by the flow routing between them). It is to be regarded that "Price-Taking Orders" (being orders submitted at +3.000€ respectively –500€), largely contribute to the value of the first component (e.g., a 1MWh demand price-taking orders executed at a market price of 50€ generates 2.950€ of consumer surplus).

** Annual prices are computed as simple averages of hourly prices. Price indexes are computed excluding hourly prices in zones with no traded volume on a daily basis or in days of decoupling.

Source: CACM Annual Report 2020



NORD POOL

A common European Day Ahead Market (SDAC)

- The concept of market coupling (splitting) was originally developed and introduced by Nord Pool and has been successfully inplemented in the Nordic & Baltic market over the last 25 years.
- Efficient use of transmission capacity by trading energy across borders
- Close cooperation between TSOs, Power Exchanges (NEMOs) and National Regulators across Europe.
- EU regulation CACM 24 July 2015 – the European target model
  - Guideline on Capacity Allocation and Congestion Management
  - Nemo’s and the MCO Function
  - Single Intraday Coupling SIDC
  - Single Day-ahead coupling SDAC

NORD POOL

European market integration – day-ahead

SDAC - Single day-ahead coupling

The aim of SDAC is to create a single pan-European cross-zonal day-ahead electricity market. Single day-ahead coupling is the auction process where collected orders are matched and cross-zonal capacity is allocated simultaneously for different bidding ones in the day-ahead market.

How SDAC works

- Day-ahead market coupling requires:
  - processing bids, offers, network capacities and constraints from all involved NEMOs and TSOs
  - matching them by operating one single algorithm,
  - validating and sending matched trades, clearing prices, and scheduled exchanges to NEMOs and TSOs.
- SDAC makes use of a common price coupling algorithm, called PCR EUPHEMIA, to calculate electricity prices across Europe and to implicitly allocate auction-based cross-border capacity.
- PCR EUPHEMIA matches energy demand and supply for 24 hours simultaneously.
- This process maximises social welfare and considers price limits of orders and network constraints.

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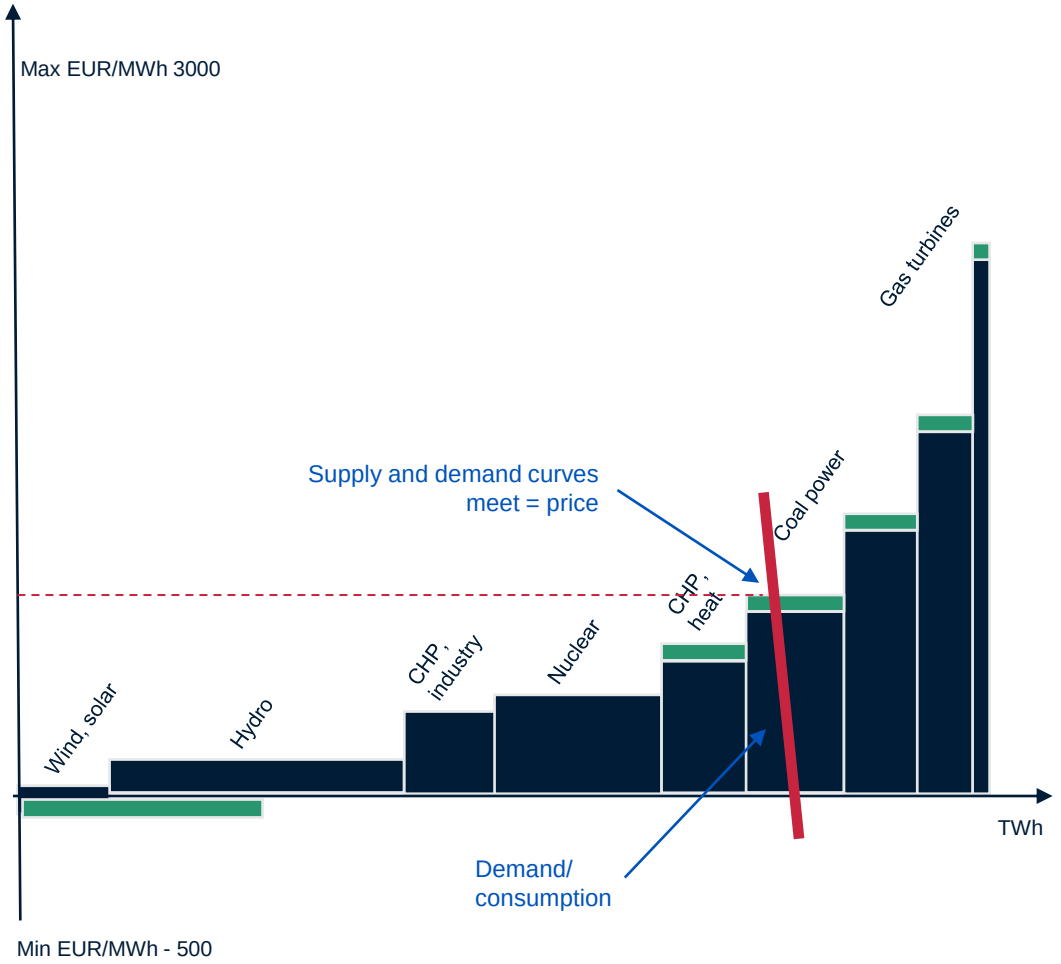
Day-ahead price formation

- Day-ahead prices are calculated using an optimization algorithm
- Optimizing social welfare
- Calculation methodology ensures that, based on the placed sell and buy orders, least-cost generation units are activated first.
- Last activated order sets the price for all production needed to meet demand.

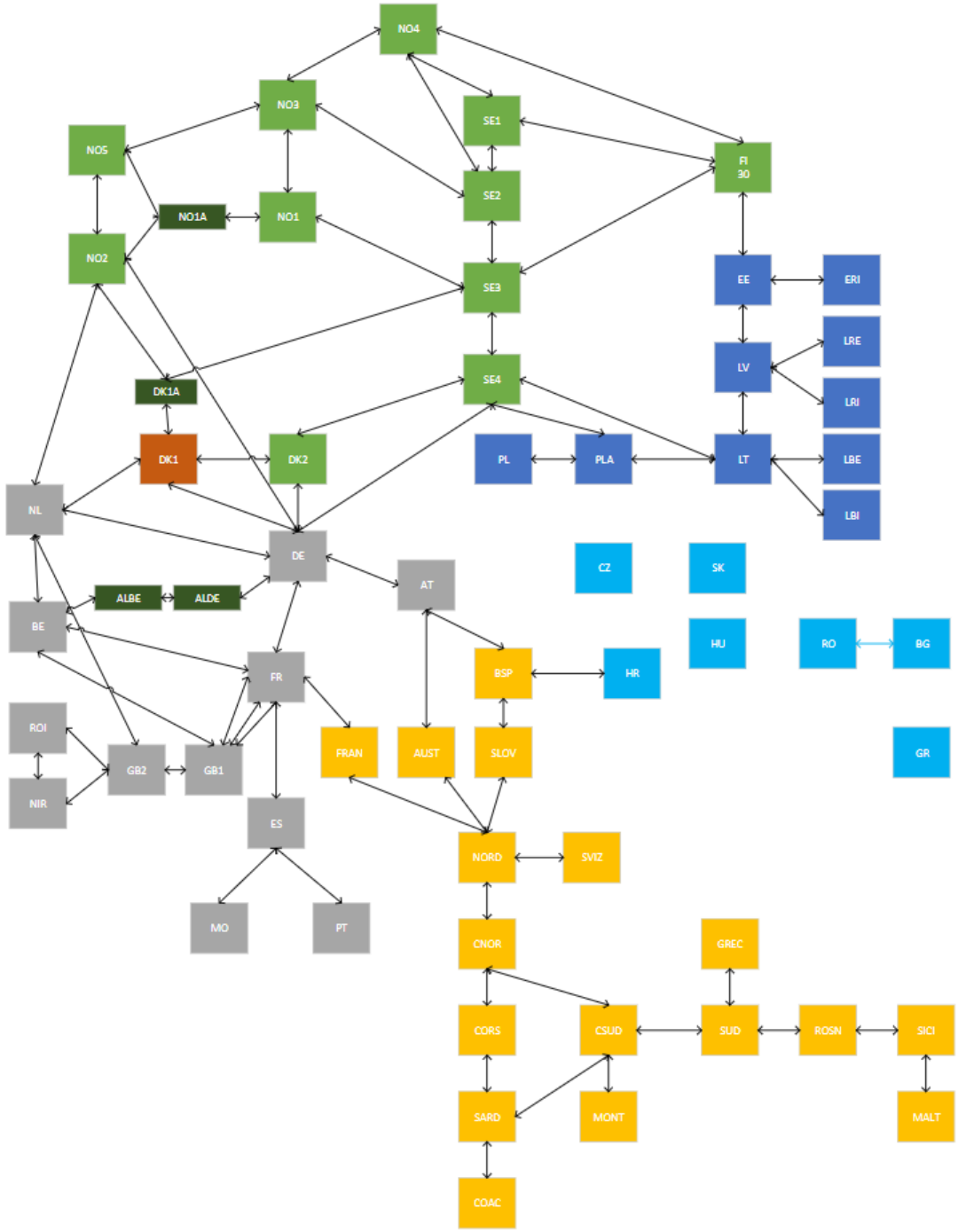


The Euphemia algorithm

EU Pan-European **H**ybrid **E**lectricity **M**arket **I**ntegration **A**lgorithm

- Algorithm currency is EURO
- Optimization time 17 min
- Price limits: min -500€ and max 3000€
- Branch and Bound technique for solving the optimization problem.

- All bidding zones are matched at the same time
- Each bidding zone can yield different price



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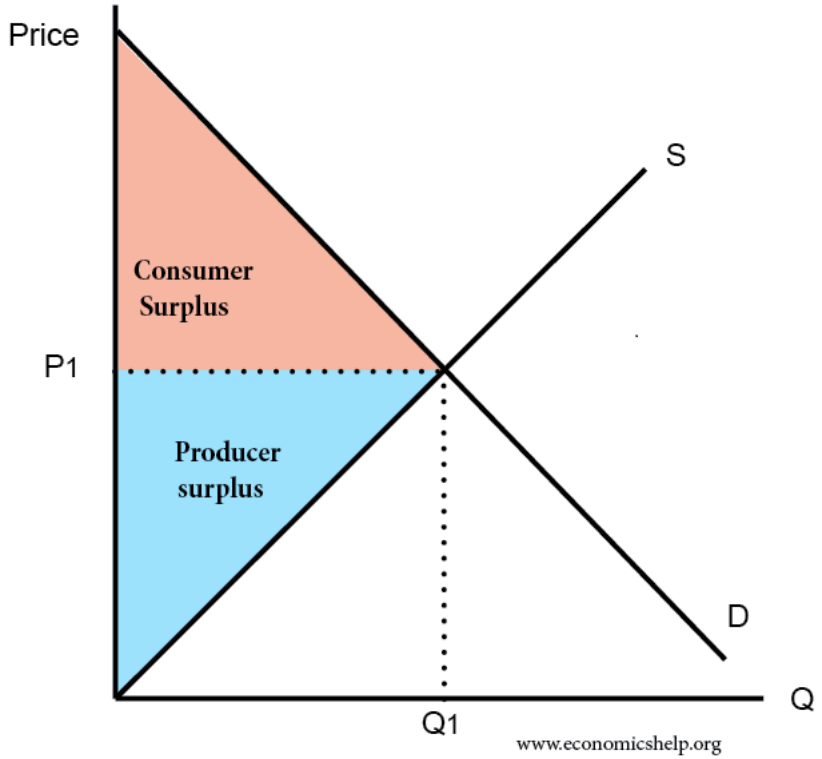
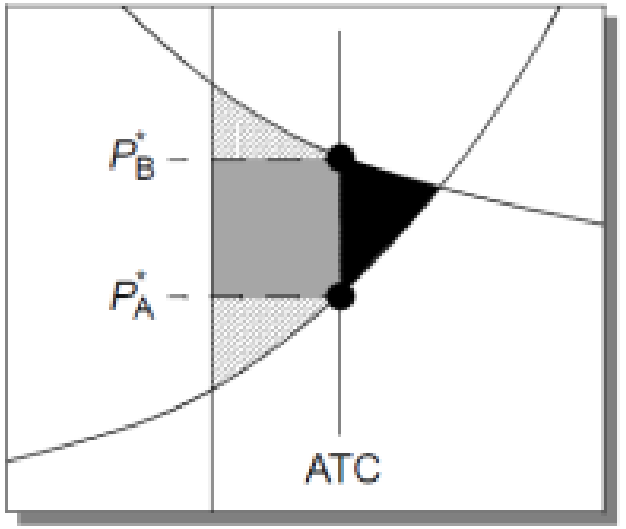
Economic Surplus (Welfare) Maximization (optimization)

It is defined as the sum of the Consumer Surplus, the Producer Surplus, and the Congestion Rent.





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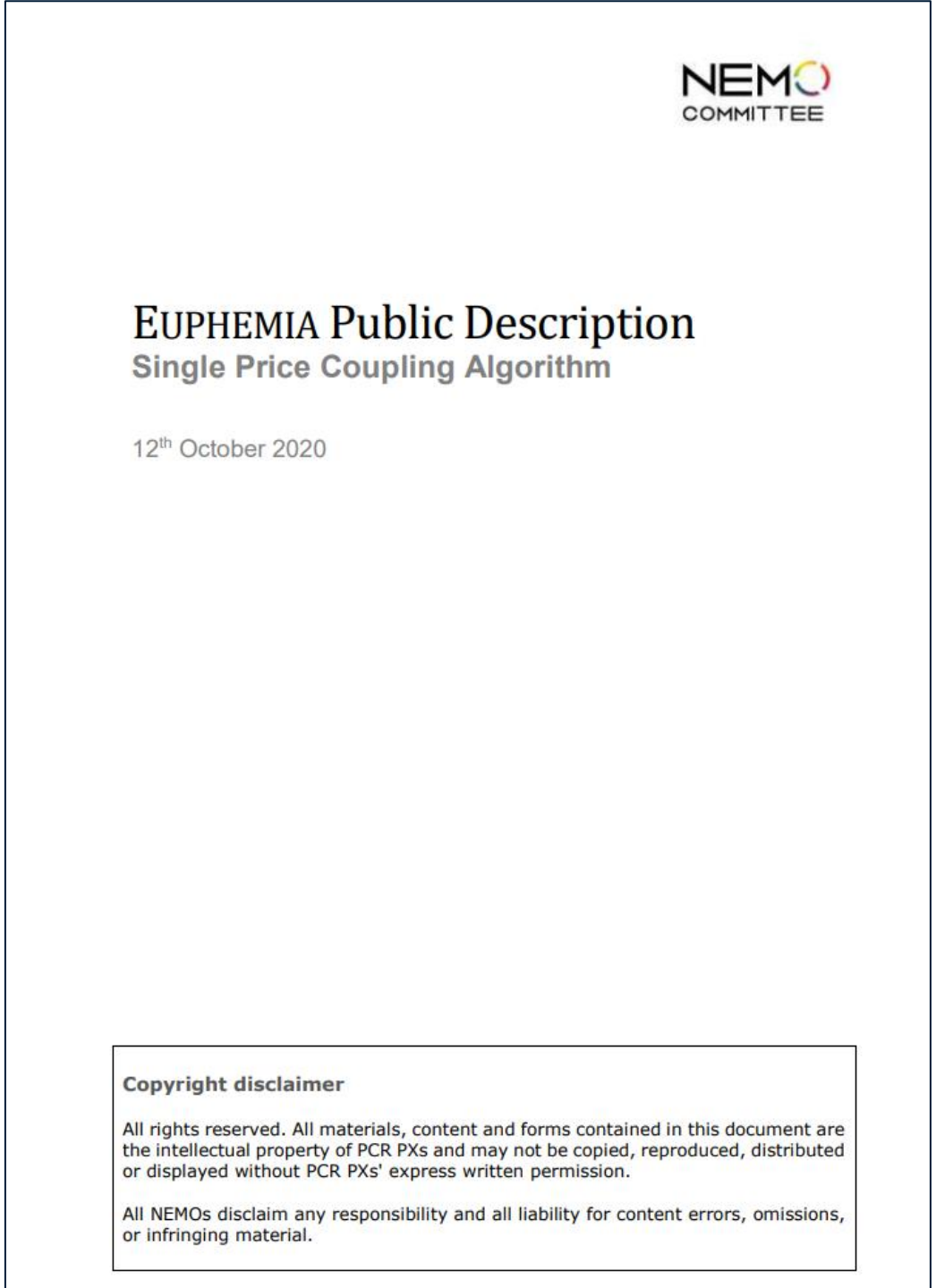
The PCR Euphemia algorithm used for SDAC

https://www.nordpoolgroup.com/492dad/globalassets/download-center/single-day-ahead-coupling/euphemia-public-description.pdf

It is also found via the all NEMO homepage:

https://www.nemo-committee.eu/assets/files/euphemia-public-description.pdf



NEMO COMMITTEE

EUPHEMIA Public Description

Single Price Coupling Algorithm

12th October 2020

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Thank You!

Questions: rickard.nilsson@nordpoolgroup.com

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