

TF CRM

Full-cycle examples

22/10/2019 | Elmo Van Thielen

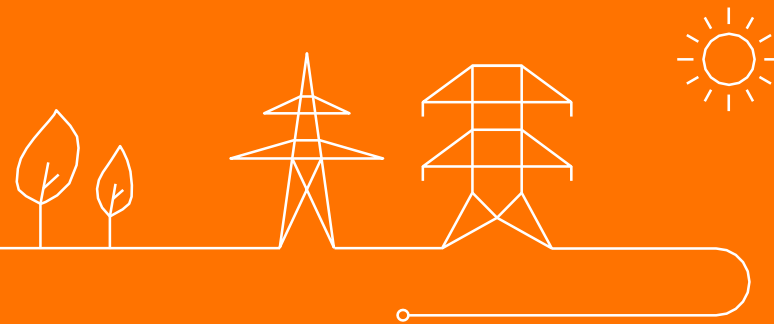
Three theoretical CMU's are used for the full-cycle example:

CMU 1 Large-scale CCGT	CMU 2 Demand Side Response	CMU 3 Partial opt-out OCGT
Nominal Reference Power:	Nominal Reference Power:	Nominal Reference Power:
300 MW	25 MW	200 MW
New/existing:	New/existing:	New/existing:
New	New	Existing
Y-4/Y-1:	Y-4/Y-1:	Y-4/Y-1:
Y-4	Y-4	Y-1
Constraints	Constraints	Constraints
NA	2 hours/day	NA

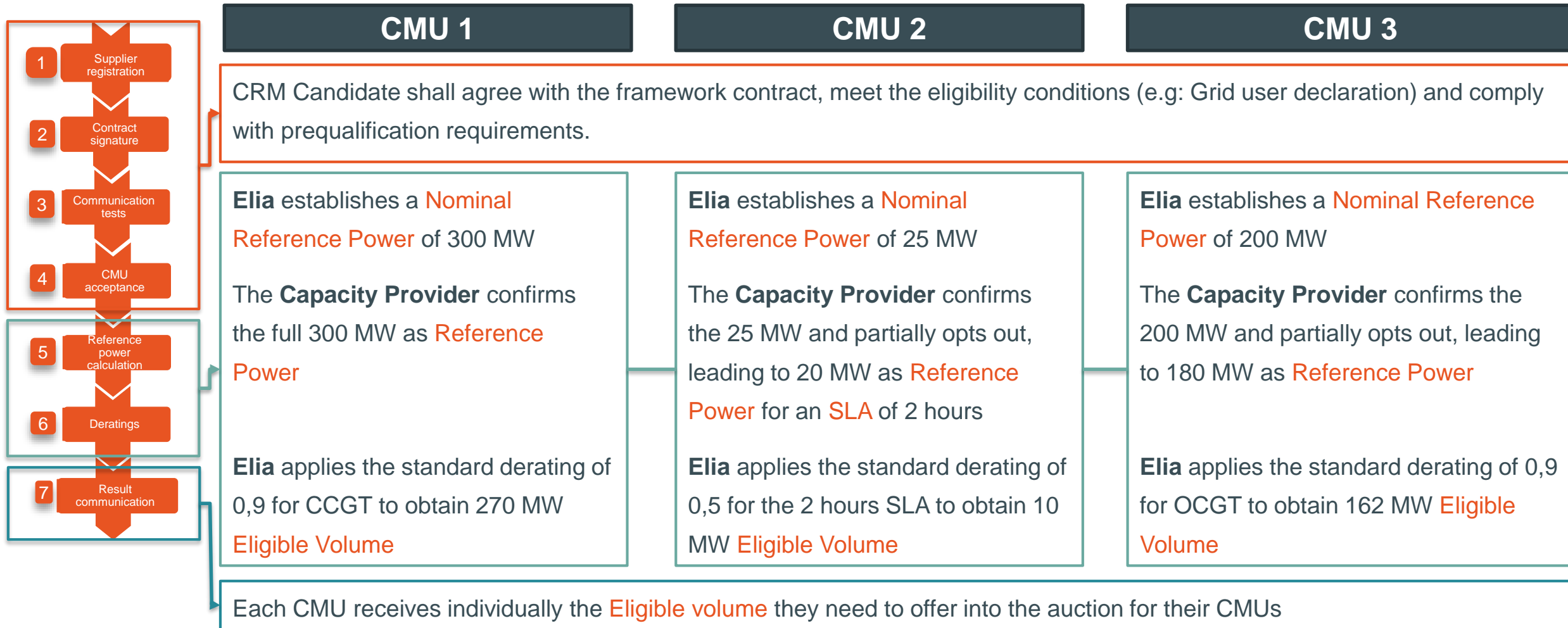
All CMU's will go through the different steps of the life cycle of the Capacity Product in the remainder of the presentation.

DISCLAIMER: numbers associated with and behavior exhibited by the CMU's in these examples are purely illustrative and do not represent expectations of or limitations on real CMU's participating to the CRM, other than those referring to and enforced in the relevant legal framework.

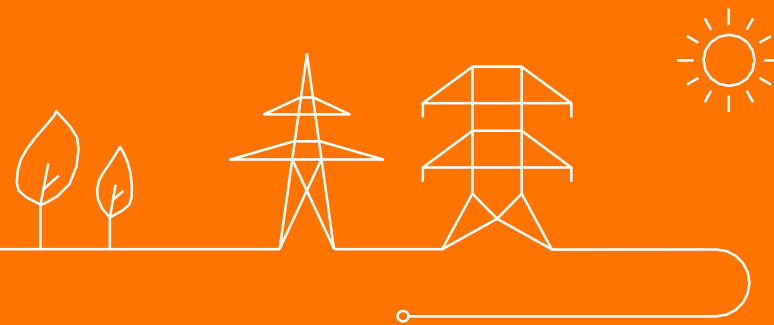
Prequalification



A CRM Candidate is required to successfully pass the prequalification process with at least one CMU to bid in the CRM Auction



Capacity Auction & contracting



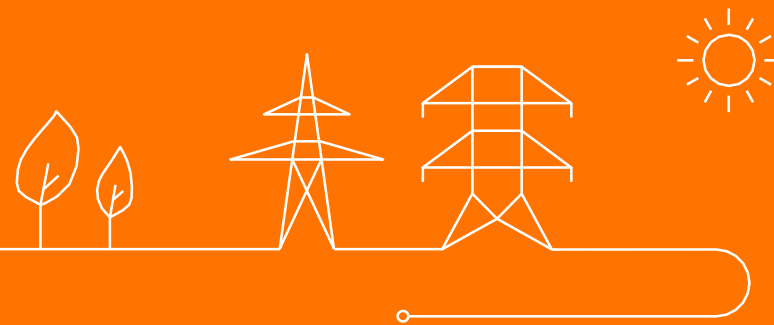
A competitive Capacity Auction will determine if a Capacity Provider is awarded with a capacity on its CMU(s)

Y-4 Auction	General	CMU 1	CMU 2
	Strike Price: 500 €/MWh Weighted average bid price: 25 €/kW Interm. PC: 20 €/kW	Eligible Volume: 270 MW Awarded contract price and length: 50 €/kW/y for 8 years* Monitoring type: Full schedule Reference Market for Reference Price: EPEX spot	Eligible Volume: 10 MW Awarded contract price and length: 20 €/kW/y for 1 year Monitoring type: Declared Market Price (DMP), with reference value in contract 250 €/MWh Reference Market for Reference Price: EPEX spot
Y-1 Auction	General	CMU 3	
	Strike Price: 520 €/MWh Weighted average bid price: 20 €/kW Interm. PC: 20 €/kW	Eligible Volume: 162 MW Awarded contract price and length: 20 €/kW/y for 1 year Monitoring type: Full schedule Reference Market for Reference Price: Nordpool spot	

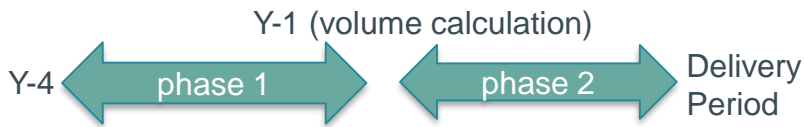
The weighted average bid price of both auctions is relevant for Secondary Market. To avoid making assumptions on volume, a 50/50 distribution of volume between both auctions is assumed (i.e. 22,5 €/ kW)

*: requires award of max contract duration by CREG during prequalification

Pre-Delivery Period Monitoring



Examples of possible penalties during pre-delivery period monitoring



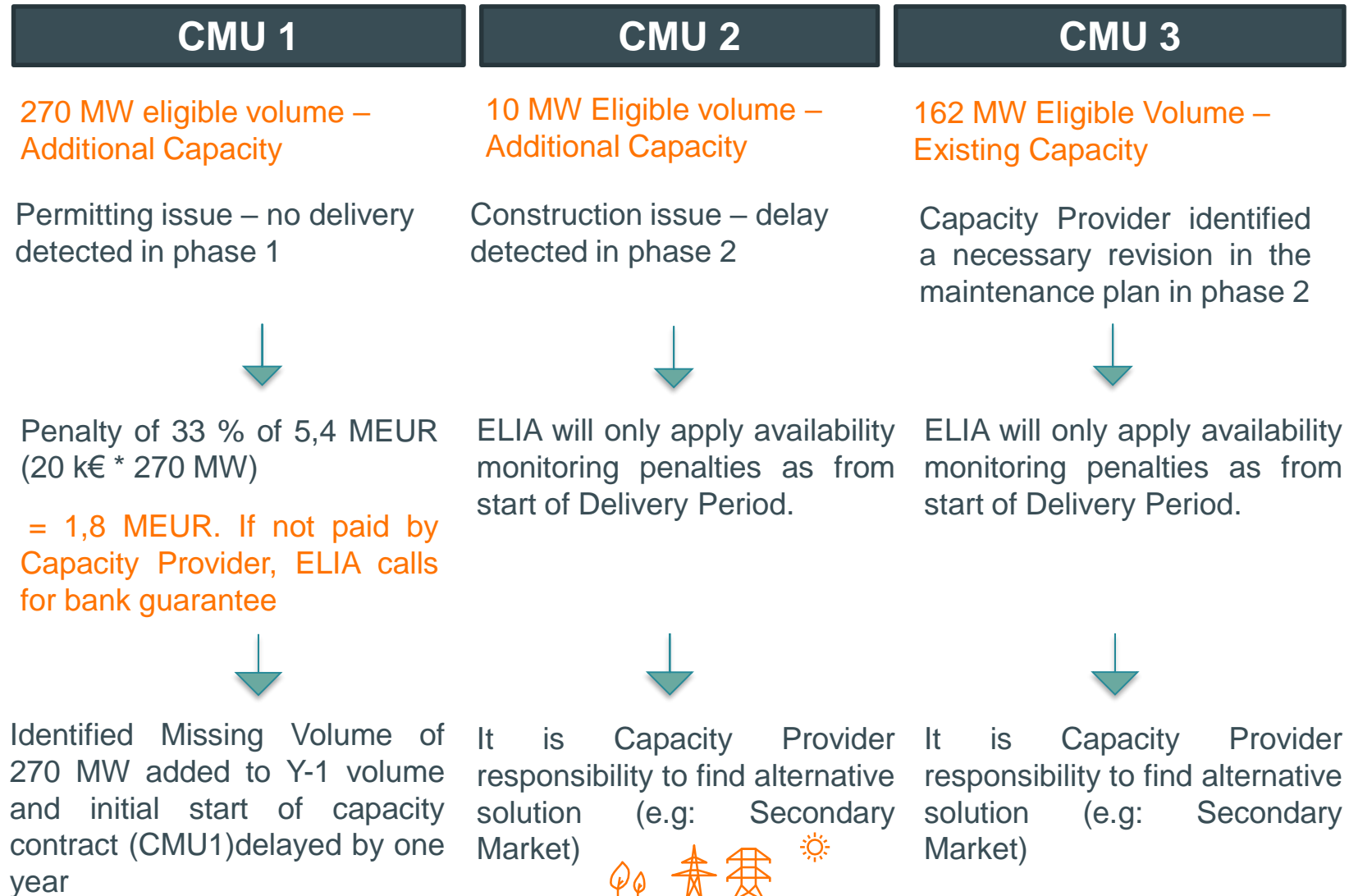
Existing capacity → Verify – closer to delivery period – **the prequalified Nominal Reference Power**

Additional capacity → Follow up project evolution to timely detect potential delays (e.g: related to permits, commissioning...)

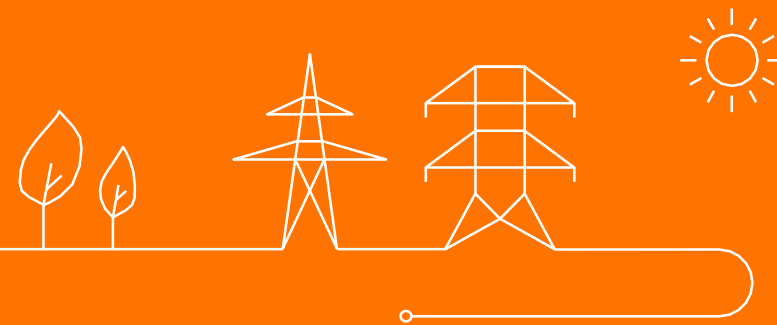
Related penalties may have an impact on:

- Capacity Contract duration ;
- Contracted Capacity (volume);
- Ultimately via bank guarantee

Assumed that CMU's incur no such penalties or revisions



Availability Monitoring

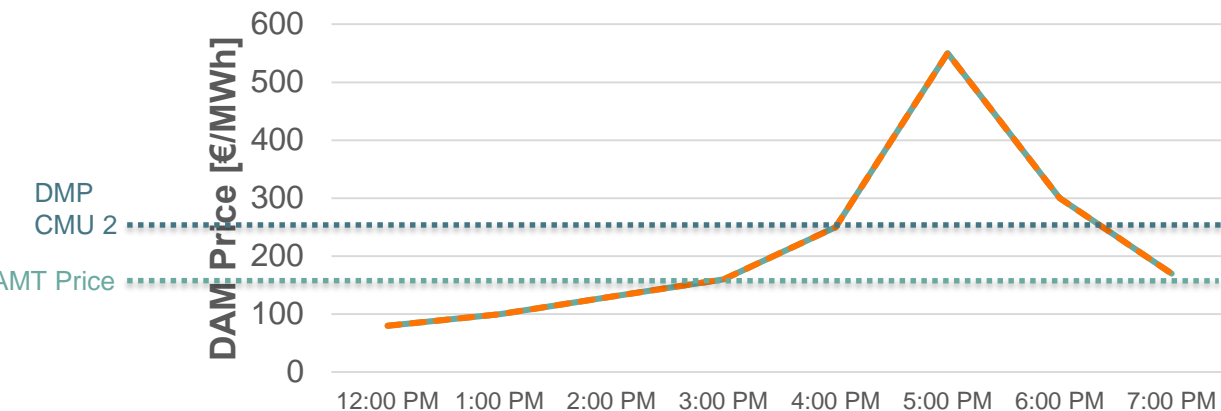


During the Delivery Period, CMUs will be monitored on their availability during AMT Hours

The **AMT Price** is published after the Y-1 Auction to be 150 €/MWh

=> AMT Hours from 3:00 PM to 7:00 PM

Results of Availability Monitoring (Proven Availability in **green**, missing capacity in **red**):



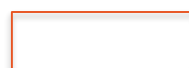
— Nordpool - - - EPEX



CMU Type	Not Reserved in AS	
	Above DMP	Below DMP
Generation/storage with full schedule	$P_{available} = P_{max.Nominated}$	
Aggregation/DSR	$P_{available} = P_{baseline} - P_{measured}$	$P_{available} = P_{measured} - UM$

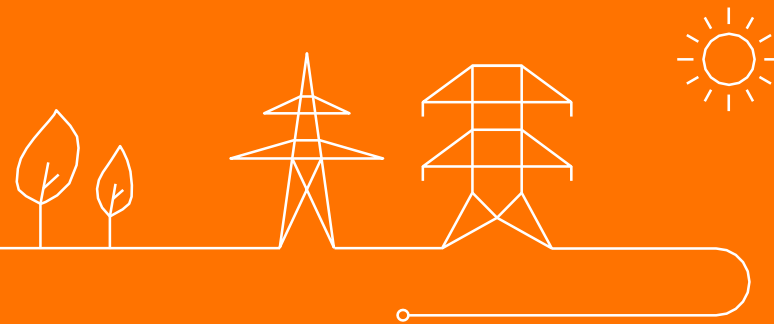


Hour	CMU 1		CMU 2		CMU 3	
	Obligated	Available	Obligated	Available	Obligated	Available
12:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
1:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
2:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
3:00 PM	270 MW	300 MW	0 MW	0 MW	162 MW	200 MW
4:00 PM	270 MW	300 MW	0 MW	0 MW	162 MW	200 MW
5:00 PM	270 MW	300 MW	20 MW	26 MW	162 MW	0 MW
6:00 PM	270 MW	300 MW	20 MW	16 MW	162 MW	0 MW
7:00 PM	270 MW	300 MW	0 MW	8 MW	162 MW	0 MW



SLA Hours

Secondary Market



CMUs can cover exposed Missing Capacity on the Secondary Market

	CMU 1	CMU 2	CMU 3
Prequalification determines ex ante tradeable volume:	300 MW – 270 MW = 30 MW	(25 MW – 20 MW)*0,5 = 2,5 MW	200 MW – 162 MW = 38 MW
Monitoring results determine ex-post tradeable volume:	Proven Available Capacity – Obligated Capacity	Proven Available Capacity - Obligated Capacity	Proven Available Capacity – Obligated Capacity

Hour	CMU 1		CMU 2		CMU 3	
	Obligated	Available	Obligated	Available	Obligated	Available
12:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
1:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
2:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
3:00 PM	270 MW	300 MW	0 MW	0 MW	162 MW	200 MW
4:00 PM	270 MW	300 MW	0 MW	0 MW	162 MW	200 MW
5:00 PM	270 MW	300 MW	20 MW	26 MW	162 MW	0 MW
6:00 PM	270 MW	300 MW	20 MW	16 MW	162 MW	0 MW
7:00 PM	270 MW	300 MW	0 MW	8 MW	162 MW	0 MW

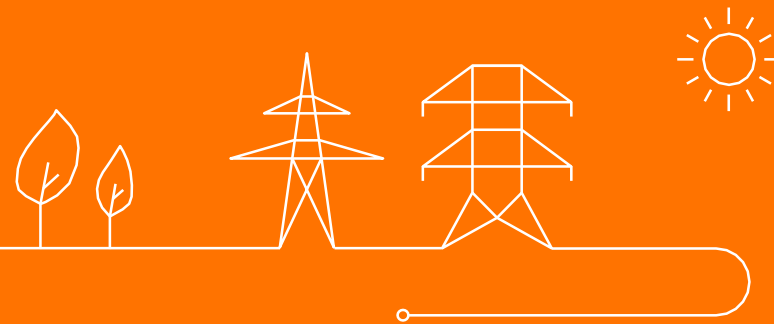
Positions after
Secondary Market trades



Hour	CMU 1		CMU 2		CMU 3	
	Obligated	Available	Obligated	Available	Obligated	Available
12:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
1:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
2:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
3:00 PM	270 MW	300 MW	0 MW	0 MW	200 MW	200 MW
4:00 PM	300 MW	300 MW	0 MW	0 MW	200 MW	200 MW
5:00 PM	300 MW	300 MW	26 MW	26 MW	100 MW	0 MW
6:00 PM	300 MW	300 MW	20 MW	16 MW	200 MW	0 MW
7:00 PM	300 MW	300 MW	8 MW	8 MW	0 MW	0 MW

SLA Hours

Availability Penalties



Once the Secondary Market is closed, the final positions are known and Availability Penalties can be issued

$$Penalty = (1 + X) * \frac{P_{Obligated} - P_{Available}}{UP} * \text{Yearly Contract Value per MW}$$

For the sake of this example, **UP = 12**

Hour	CMU 1		CMU 2		CMU 3	
	Obligated	Available	Obligated	Available	Obligated	Available
12:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
1:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
2:00 PM	0 MW	NA	0 MW	NA	0 MW	NA
3:00 PM	270 MW	300 MW	0 MW	0 MW	200 MW	200 MW
4:00 PM	300 MW	300 MW	0 MW	0 MW	200 MW	200 MW
5:00 PM	300 MW	300 MW	26 MW	26 MW	100 MW	0 MW
6:00 PM	300 MW	300 MW	20 MW	16 MW	200 MW	0 MW
7:00 PM	300 MW	300 MW	8 MW	8 MW	0 MW	0 MW

SLA Hours

CMU 2:

Had a missing capacity of **4 MW** spread out over 2 hours => **2 MW** average shortage

This was unannounced => **X = 1**

$$Penalty = 2 * \frac{2 \text{ MW}}{12} * 20.000 \frac{\text{€}}{\text{MW}} = 6.667 \text{ €}$$

CMU 3:

Was in Forced Outage, but still liable to Availability Penalties

Had a primary missing capacity of **224 MW** spread out over 5 hours => **44,8 MW** average shortage

This was unannounced => **X = 1**

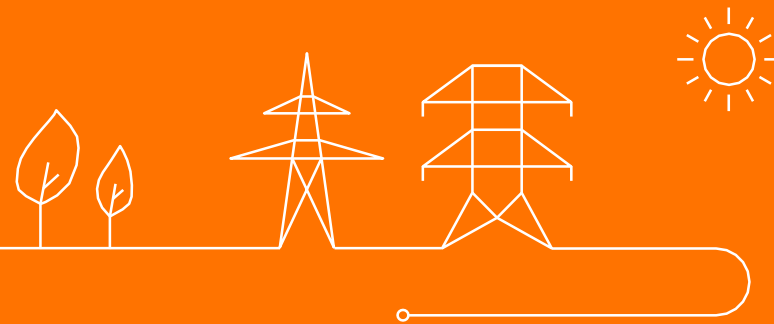
$$Penalty = 2 * \frac{44,8 \text{ MW}}{12} * 20.000 \frac{\text{€}}{\text{MW}} = 149.333 \text{ €}$$

Had a secondary missing capacity of **76 MW** spread out over 5 hours => **15,2 MW** average shortage

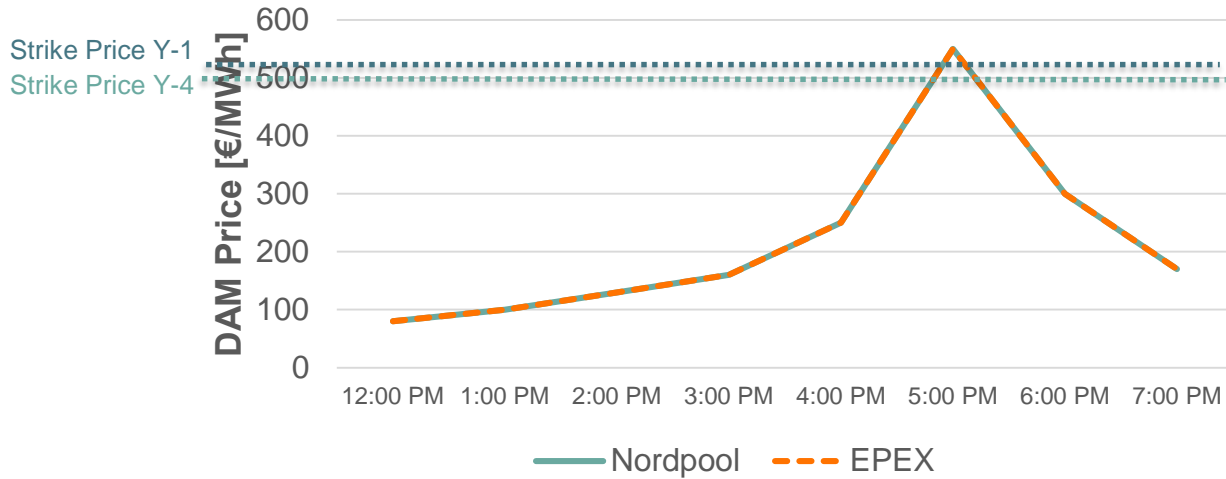
This was unannounced => **X = 1**

$$Penalty = 2 * \frac{15,2 \text{ MW}}{12} * 22.500 \frac{\text{€}}{\text{MW}} = 57.000 \text{ €}$$

Payback Obligation



When a CMU's Reference Price surpasses the Strike Price, it is liable to a pay-back obligation.



At 5:00 PM, the price is **550 €/MWh** and surpasses both strike prices 500 €/MWh and 520 €/MWh

The (ex-ante determined) **Reference Load** was determined at 14 GW

The current **Total load** is 12,6 GW

As a result the **Load Following Factor** is 0,9

CMU 1:

$$\text{Primary Payback Obligation} = \text{MAX}(0; \text{LFF} * \text{Contracted Capacity} * 1\text{h} * (\text{Reference Price} - \text{Strike Price})) = \text{MAX}(0; 0,9 * 270 \text{ MWh} * \left(\frac{550\text{€}}{\text{MWh}} - \frac{500\text{€}}{\text{MWh}}\right)) = 12.150 \text{ €}$$

$$\text{Secondary Payback Obligation} = \text{MAX}(0; \text{LFF} * \text{Secondary Market Capacity} * 1\text{h} * (\text{Reference Price} - \text{Strike Price})) = \text{MAX}(0; 0,9 * 30\text{MWh} * \left(\frac{550\text{€}}{\text{MWh}} - \frac{520\text{€}}{\text{MWh}}\right)) = 810 \text{ €}$$

CMU 2:

$$\text{Primary Payback Obligation} = \text{MAX}\left(0; \text{LFR} * \frac{\text{Contracted Capacity}}{\text{Derating Factor}} * 1\text{h} * (\text{Reference Price} - \text{Strike Price})\right) = \text{MAX}(0; 0,9 * \frac{10}{0,5} \text{ MWh} * \left(\frac{550\text{€}}{\text{MWh}} - \frac{500\text{€}}{\text{MWh}}\right)) = 900 \text{ €}$$

$$\text{Primary Payback Obligation} = \text{MAX}(0; \text{LFR} * \text{Secondary Market Capacity} * 1\text{h} * (\text{Reference Price} - \text{Strike Price})) = \text{MAX}(0; 0,9 * 6 \text{ MWh} * \left(\frac{550\text{€}}{\text{MWh}} - \frac{520\text{€}}{\text{MWh}}\right)) = 162 \text{ €}$$

CMU 3 is exempted from the Payback Obligation for this hour, as it was in Forced Outage