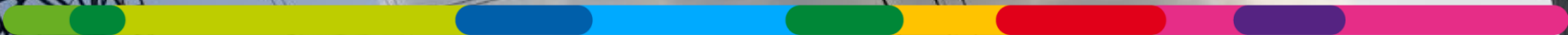




THE BELGIAN CAPACITY MARKET: NUCLEAR PHASE-OUT, RELIABILITY OPTIONS AND THE CLEAN ENERGY PACKAGE

IAEE Online Conference 7th – 9th June 2021
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Nuclear in Belgium



Belgium: 7 reactors, ~ 6GW



Source: World Nuclear Association

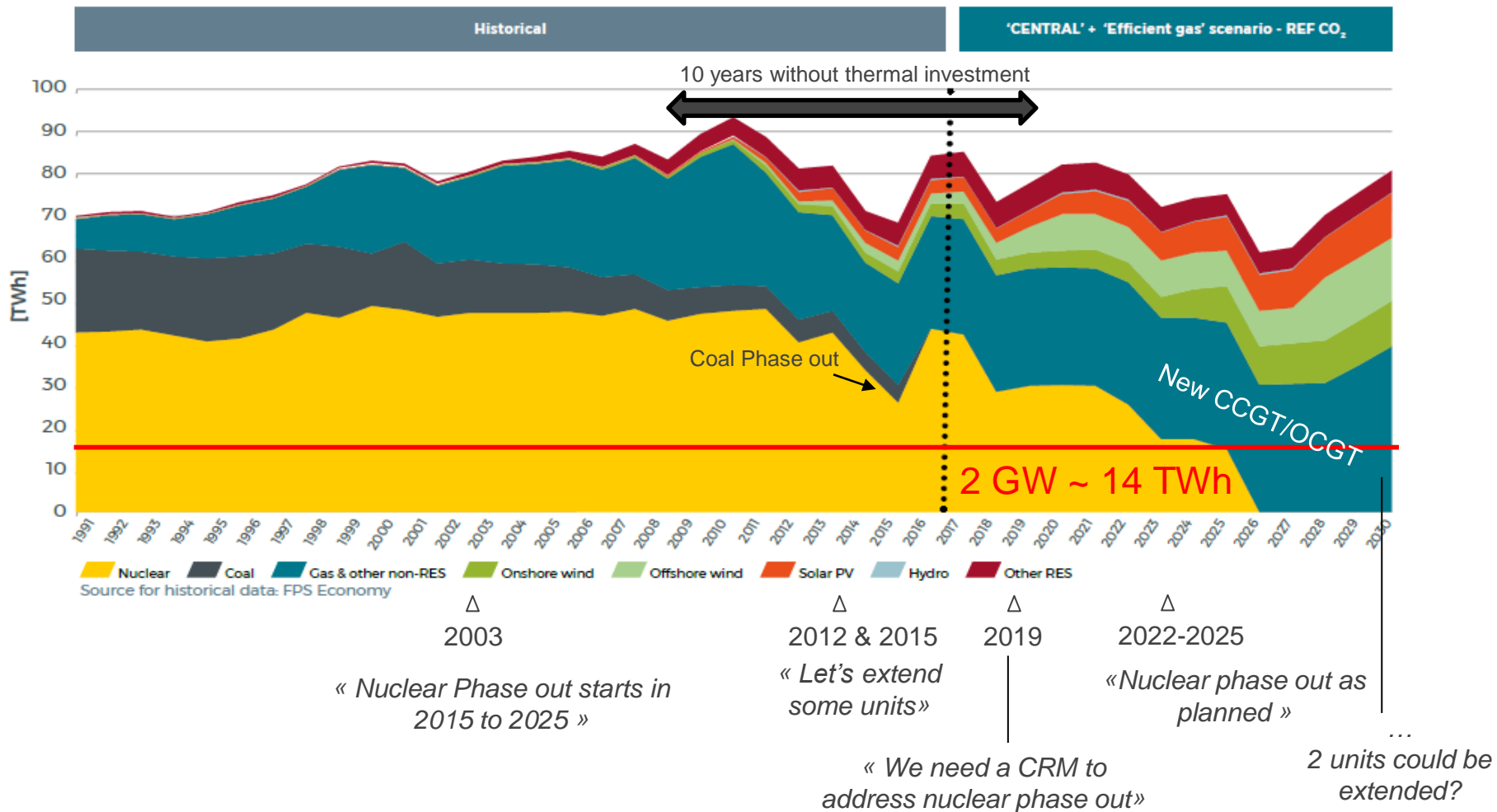
| Reactor | Net capacity (MW) | Start | Off-line | Lifetime |
|-----------|-------------------|-------|----------|----------|
| Doel 1 | 433 | 1975 | 2025 | 50 |
| Doel 2 | 433 | 1975 | 2025 | 50 |
| Doel 3 | 1 006 | 1982 | 2022 | 40 |
| Doel 4 | 1 033 | 1985 | 2025 | 40 |
| Tihange 1 | 962 | 1975 | 2025 | 50 |
| Tihange 2 | 1 008 | 1983 | 2023 | 40 |
| Tihange 3 | 1 038 | 1985 | 2025 | 40 |



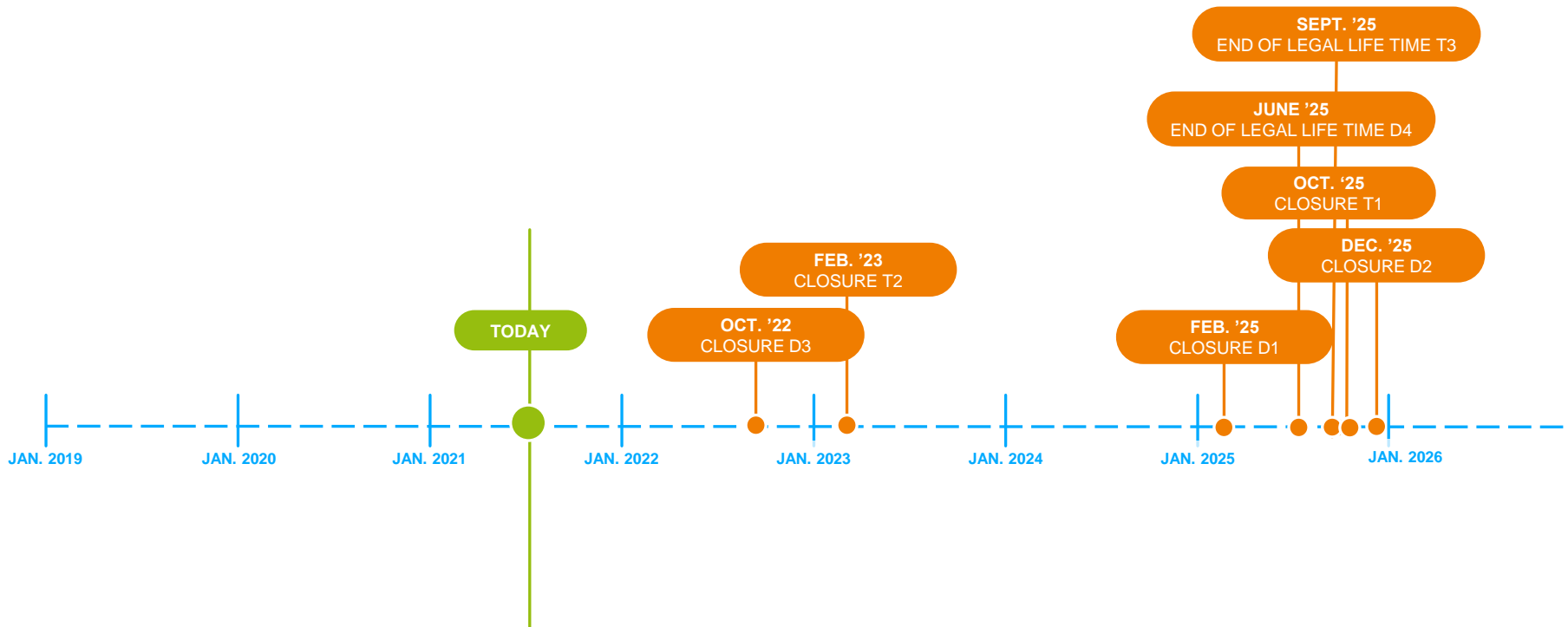
Belgium: ~ 80 TWh, 50 % Nuclear

2030: A lot of RES + Gas

ELECTRICITY GENERATION PER FUEL TYPE IN BELGIUM FOR A GIVEN FUTURE CAPACITY MIX [FIGURE 4-40]



Legal nuclear phase out scenario: 7 units to be closed by 2025



Phase out law and derogation

2003 law

“Belgium must commit to a gradual nuclear phase-out”

→ limit operating lifetime of nuclear reactors to 40 years...

→ however security of supply is the absolute priority = temporary derogations are possible

Why?

- No economic, ecological nor technical?
- Key reasons:
 - risk of nuclear accident,
 - nuclear weapon proliferation
 - waste management

Derogation to ensure Security of supply

- No comprehensive plan to replace nuclear led to 2 LTO:
 - 2012: Tihange 1
 - 2015: Doel 1 & 2
 - 2021: ???

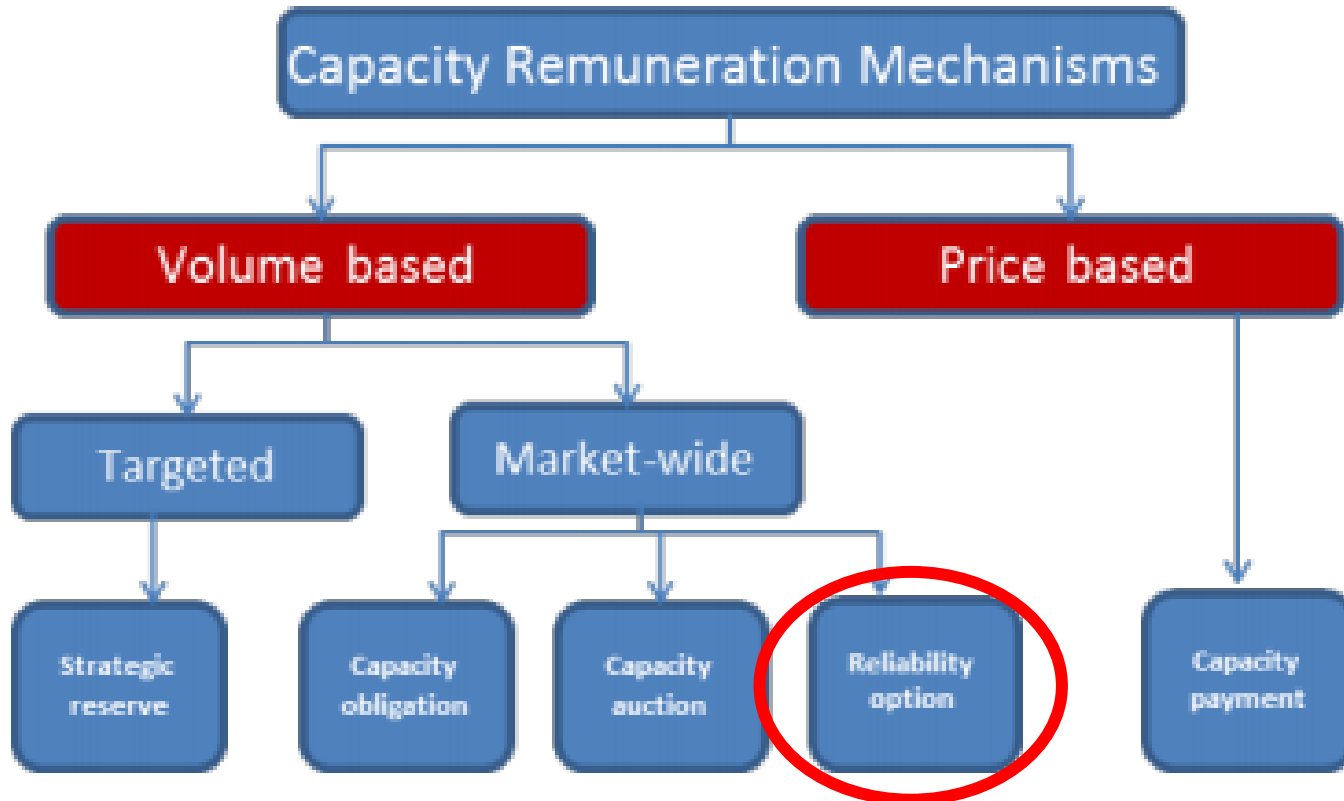
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CRM

ENGIE
Electrabel



Reliability options and CRM « taxonomy »

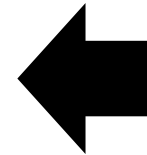


Source: Capacity remuneration mechanisms and the internal market for electricity, ACER, July 2013.

Reliability options

- Capacity remuneration scheme (MW), which is:
 - Volume-based (MW) & Market-wide
 - Technology neutral
 - Centralized
- Capacity price determined in a competitive process
- **Excessive profits are limited with a pay-back obligation**

KEY
MOTIVATION
FOR POLICY
MAKERS!



Ensuring adequacy, keeping cost under control beyond competition

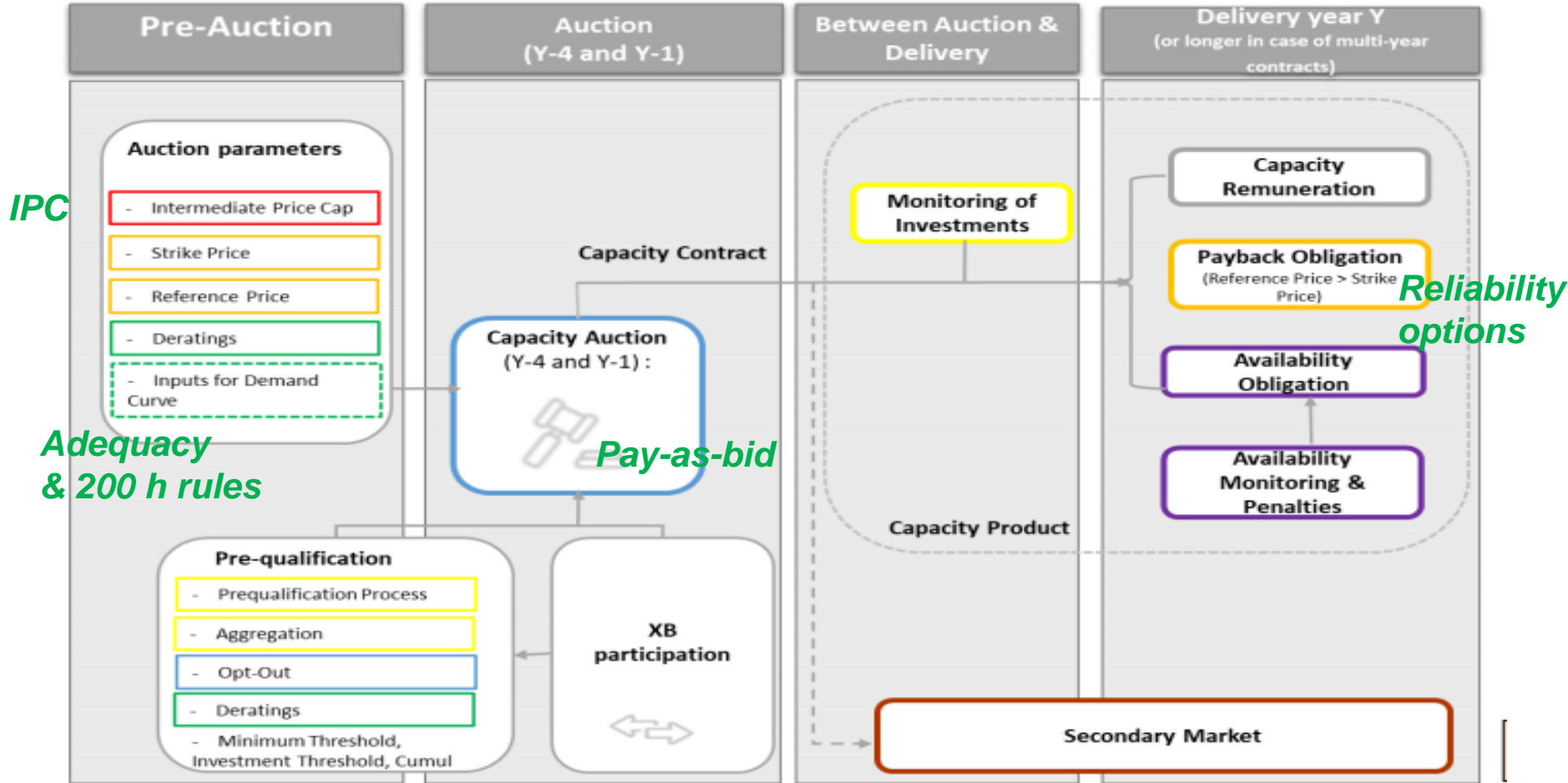


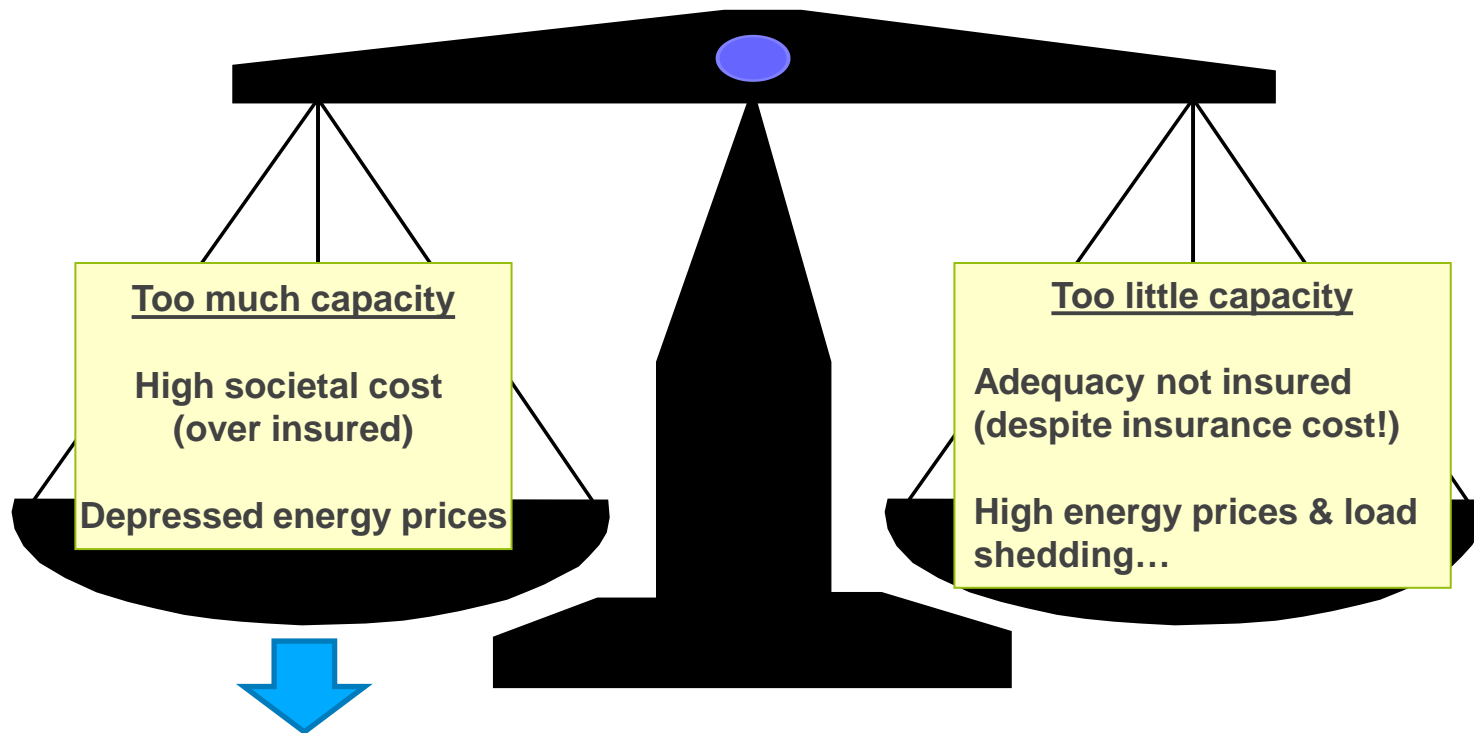
Figure 1 : Overview of the CRM process

Source: Elia

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How much volume? A difficult balance to find

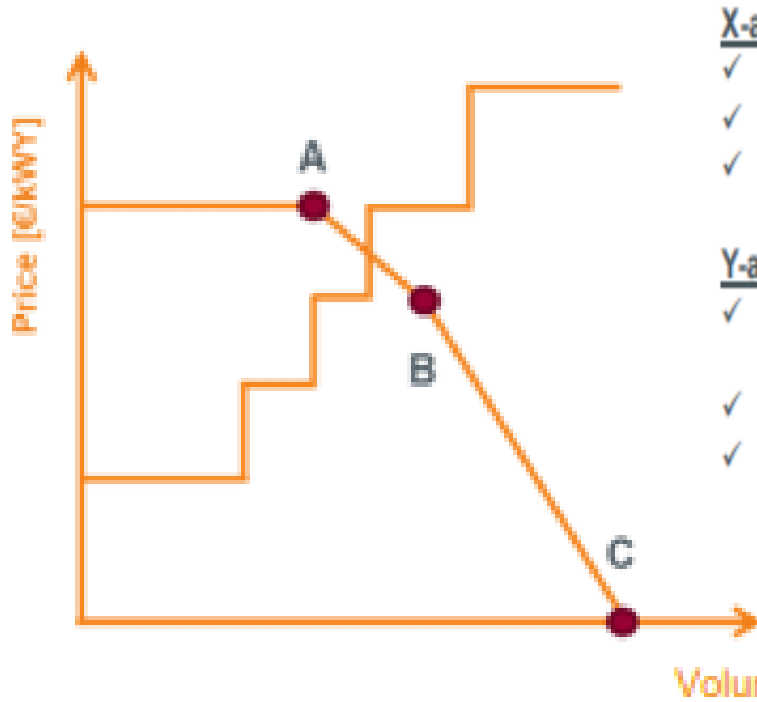
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Negative impact on CRM cost!



Volumes: Defining « ABC »...



X-axis (Volume)

- ✓ A = Minimum capacity to be cleared at price cap;
- ✓ B = Targeted procured capacity (MW needed to meet the reliability standard);
- ✓ C = Maximum procured capacity level above which extra capacity has no further value.

Y-axis (Price)

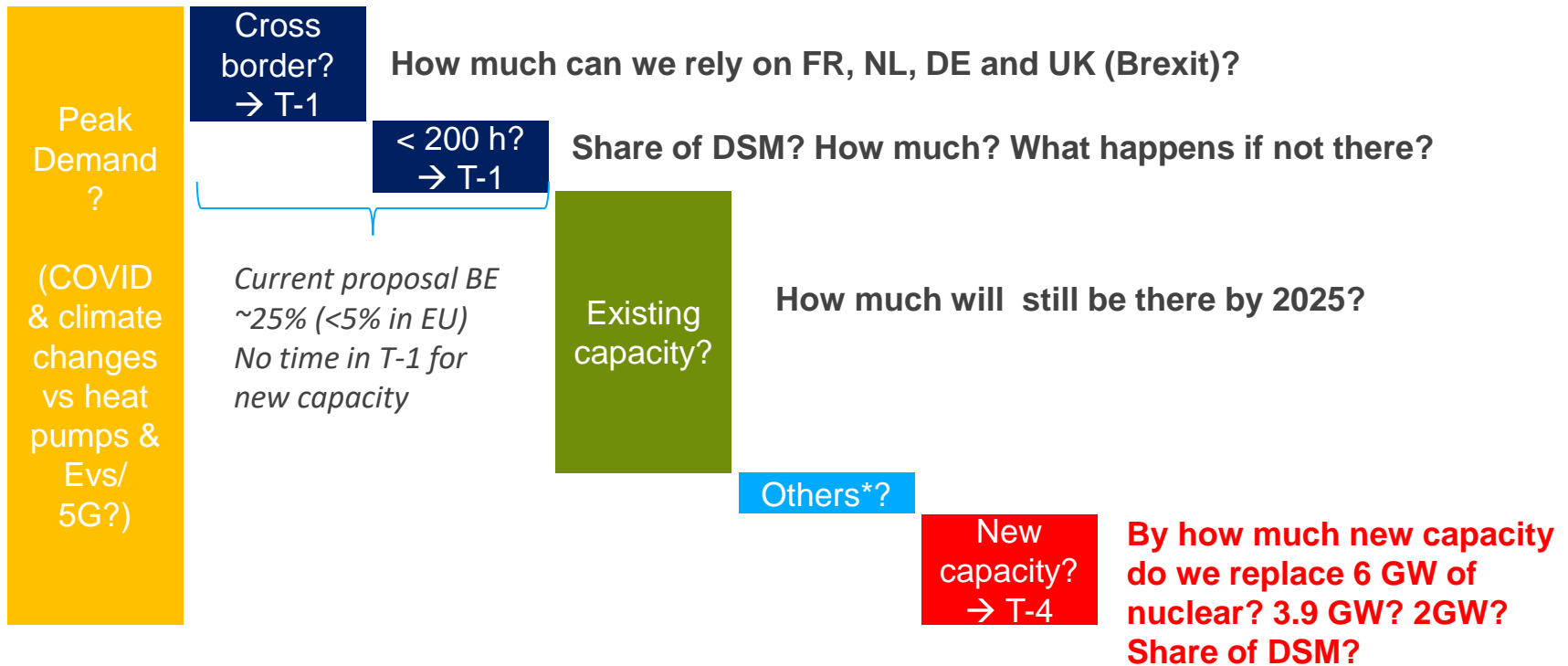
- ✓ A = Global Auction Price Cap to avoid unreasonable capacity offers and to cover for uncertainty on point B.
- ✓ B = Price offered by (i.e. missing money of) Best New Entrant;
- ✓ C = X-axis intersect (0 €/kWY).

B: Volume we need to meet “Reliability standard”

Which level? (LOLE < 3h & LOLE95 < 20h → the Belgian law)

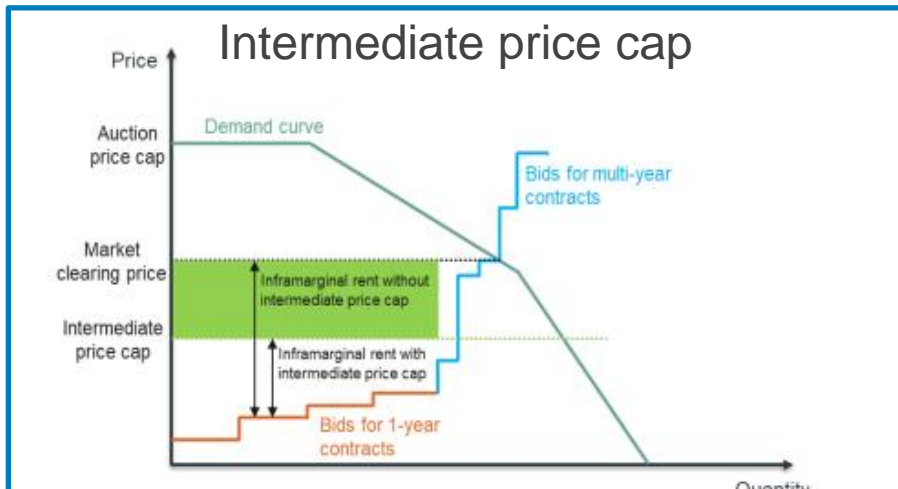
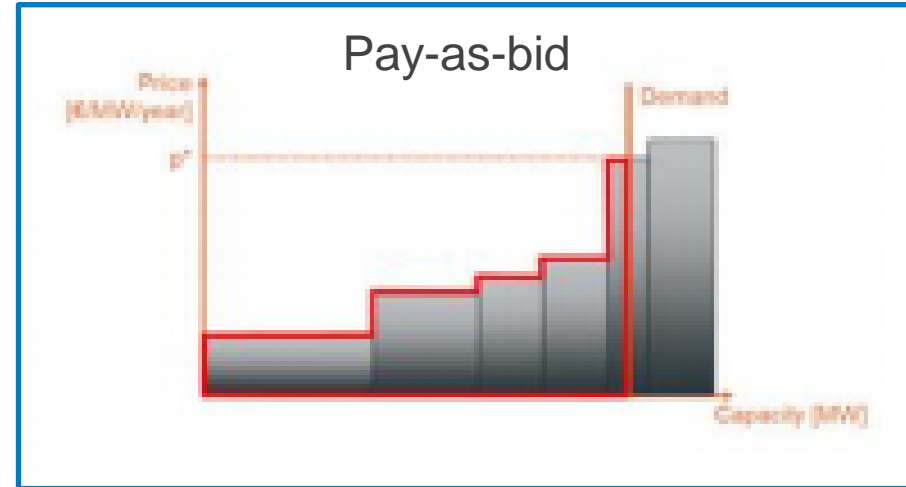
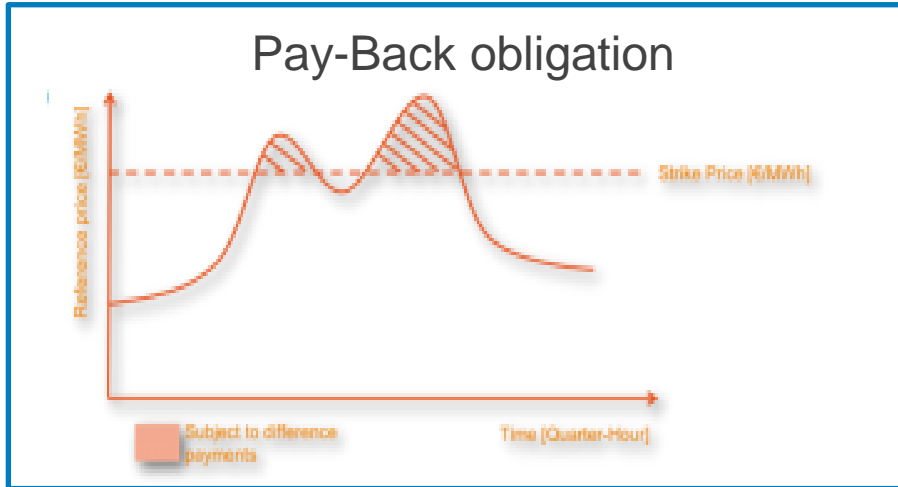
What is the Best New Entrant?

How much volume? Battle of assumptions...



* e.g. non eligible capacity (PV, wind, CHP, below 1 MW...etc)

Keep costs under control? Several design elements



200 hours

"volume to be reserved [in T-1] is at least equal to the capacity having, on average, less than 200 operating hours per year in order to cover the total peak capacity"



Auction format: Pay-as-bid



“It is proposed to apply a pay-as-bid pricing rule for the first two Auctions (Y-4 Auctions for the first two Delivery Periods) and switch towards a pay-as-cleared pricing rule afterwards as this allows to limit windfall profits”

Source: Elia

Kahn et al (2001): *“The critical assumption is that generators will bid just as they had before. They will not”.*

200h rules, when do we Auction How Much?

| 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | ... |
|----------|----------|----------|----------|---------------|---------------|---------------|---------------|
| T-4 2025 | | | T-1 2025 | Delivery 2025 | | | |
| | T-4 2026 | | | T-1 2026 | Delivery 2026 | | |
| | | T-4 2027 | | | T-1 2027 | Delivery 2027 | |
| | | | T-4 2028 | | | T-1 2028 | Delivery 2028 |

→ Simple

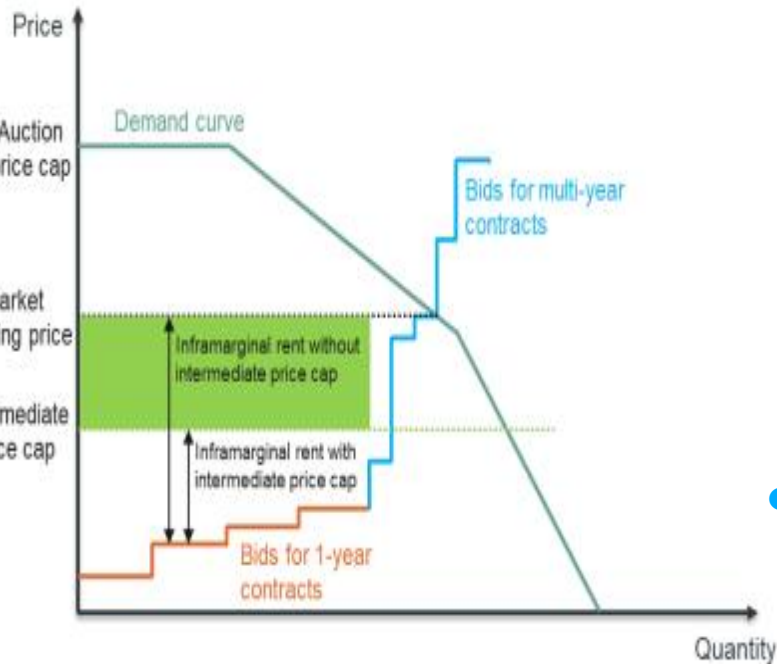
T-4 needed for new built

"volume to be reserved [in T-1] is at least equal to the capacity having, on average, less than 200 operating hours per year in order to cover the total peak capacity"

| Country | Capacity reserved for T-1 auction |
|---------|--|
| UK | 95% confidence interval around T-4 (i.e. around <u>5%</u> of T-4 auction volume) |
| IE | <u>2-5%</u> of capacity requirement |
| PL | 1.160MW out of ca. 22.000MW (i.e. approximately <u>5%</u> of main auction) |
| IT | At least <u>1%</u> of expected capacity demand |

→ ~25% in T-1 for Belgium?

Intermediate price cap- IPC



- Objective: limit the cost of the CRM
- Issues:
 - Pay-as-bid + IPC → unique
 - Reduce competition between old and new assets
 - No incentive to offer below the IPC
 - What if too low? → exit?
 - Impact investment decision taken before the CRM (state aid guideline)
- Proposal: Derogation
 - How to give derogation? Based on missing money computation? → impossible task
 - Why a rule if everyone apply for derogation?
 - If you one can compute the missing money in the first place- Why A CRM: simply regulate!

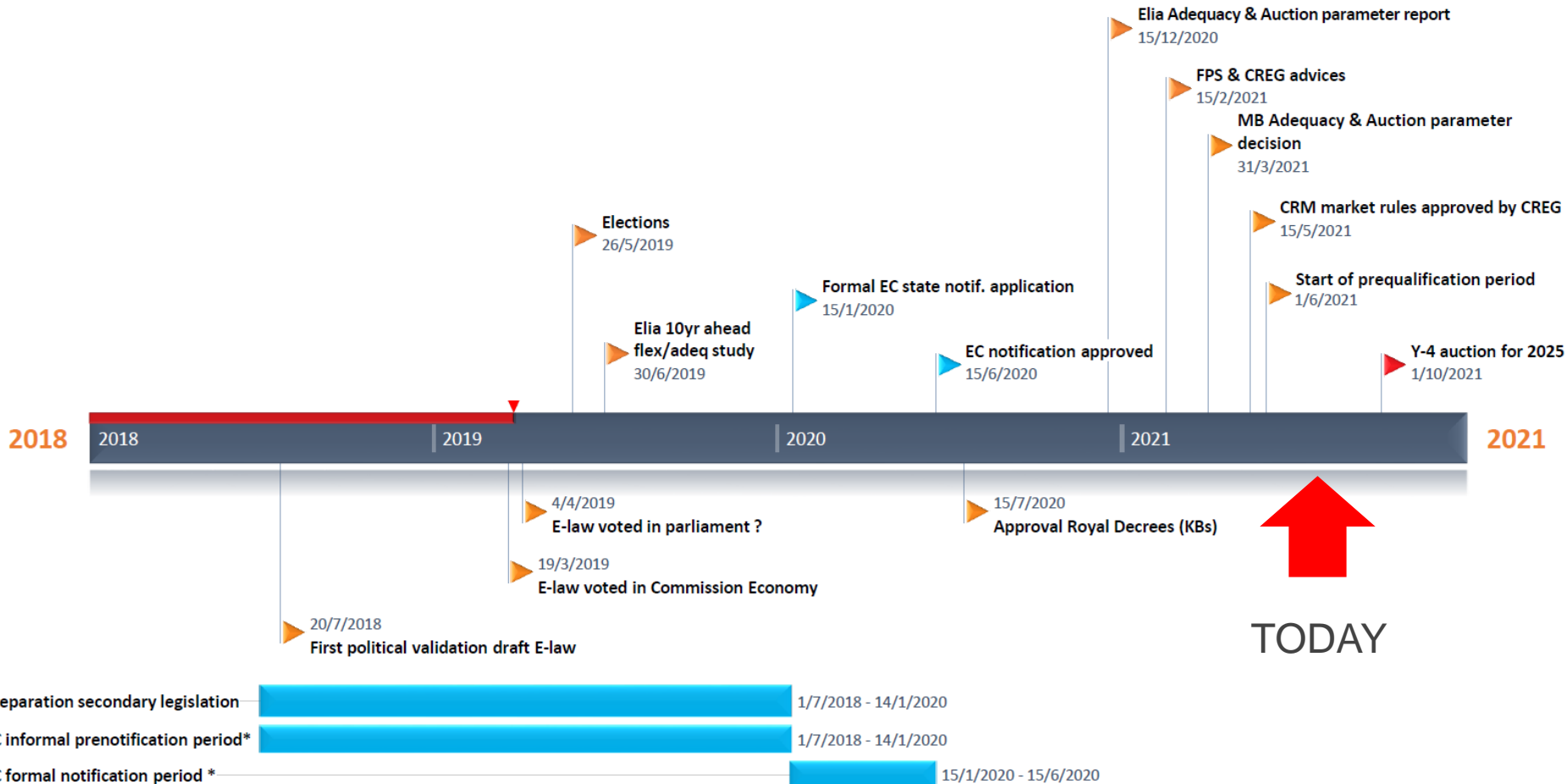
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Conclusion

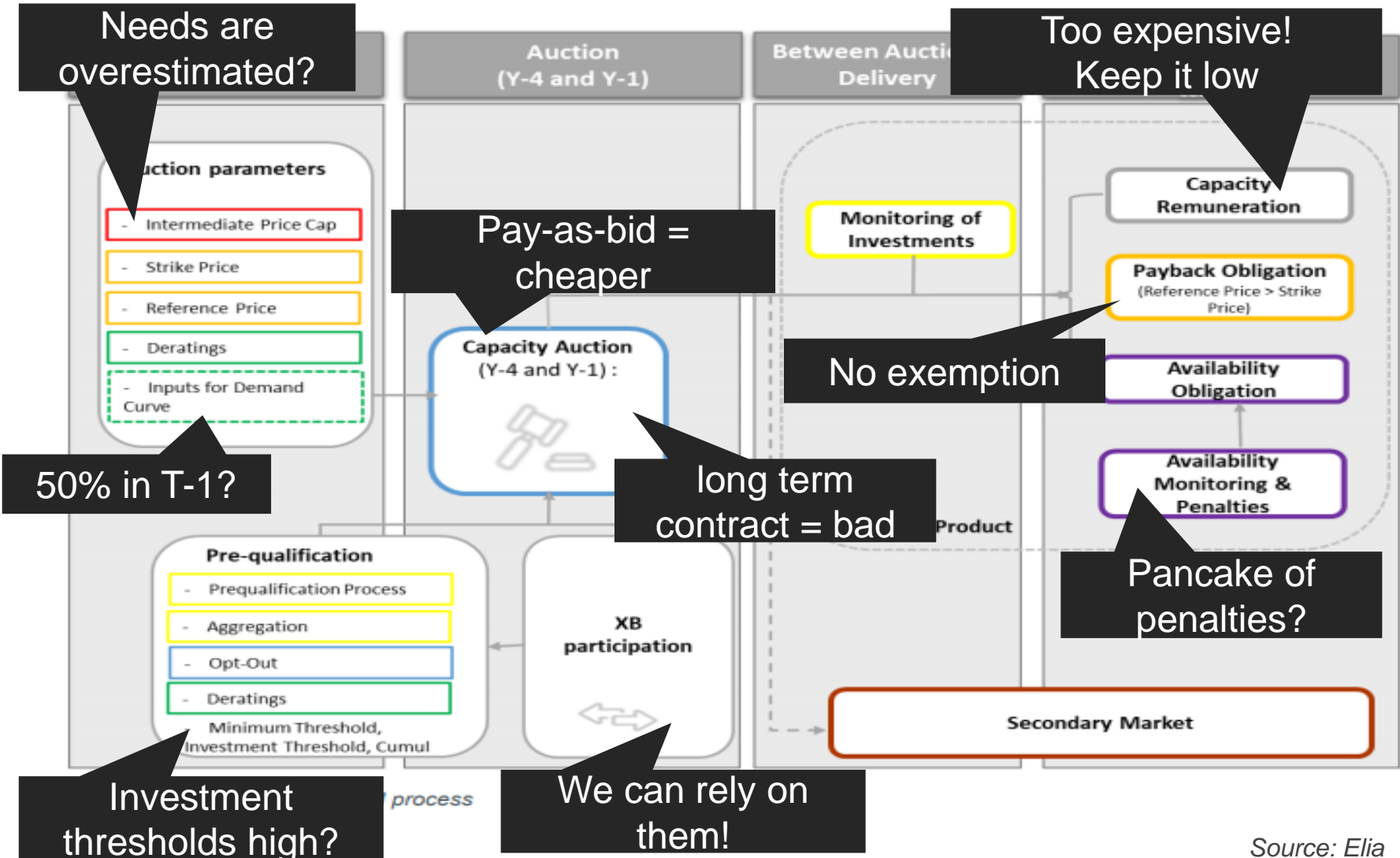


An ambitious planning

- The CRM is behind schedule...5 months before the auction (Oct 2021), a lot remains to be done...



A lot of debates in the Belgium CRM



Source: Elia

Lessons? next?

Some early lessons?

- Nuclear phase out needs a comprehensive replacement plan
- A CRM should be a competitive, clear and transparent mechanism: additional rules to “control” competition can hamper competition?
- Decarbonization creates an additional challenge
- Clean Energy package provides a rather robust framework but no standard market design
- Careful monitoring of the first results needed to address potential flaws

Next?

Optimistic scenario: DG comp approve the CRM, players able to compete on a level playing field, sufficient capacity at the lowest cost, CO2 emissions under control.

Pessimistic scenario: Delayed DG comp approval, the nuclear option re-open (feasibility?), several players bring to court legal actions against the CRM, further delay implementation security of supply 2025 at risk....





Thanks you