Royal Belgian Society for Electricians 2021

Webinar
“Balancing the future grid”

Thursday 22/04/2021

The webinar will start in a few minutes

Royal Belgian Society for Electricians 2021

Webinar
“Balancing the future grid”

Thursday 22/04/2021

in collaboration with

HORIZON 238

Introduction

Stroomprijs piekt na uitvallen Tihange 2

De Tijd - 22 Apr. 2021
Pagina 3

Introduction

KBVE/SRBE Webinar

3 sessions:

- April 22th 2021
- May 20th 2021
- June 10th 2021

Form:

- Introduction
- Philippe Monette
- Kris Poncelet
- Q&A (chat)

Introduction

Philippe Monette

-- Tractebel --

Chief Technologist Nuclear Business line

"Beyond baseload nuclear power generation"

Kris Poncelet

-- Elia --

Market Development Manager

"Balancing market design for enabling participation of demand side flexibility"

TRACTEBEL

ENGIE

Beyond base load nuclear power generation

RBSE - 22 April 2021

PUBLIC | INTERNAL | RESTRICTED | CONFIDENTIAL

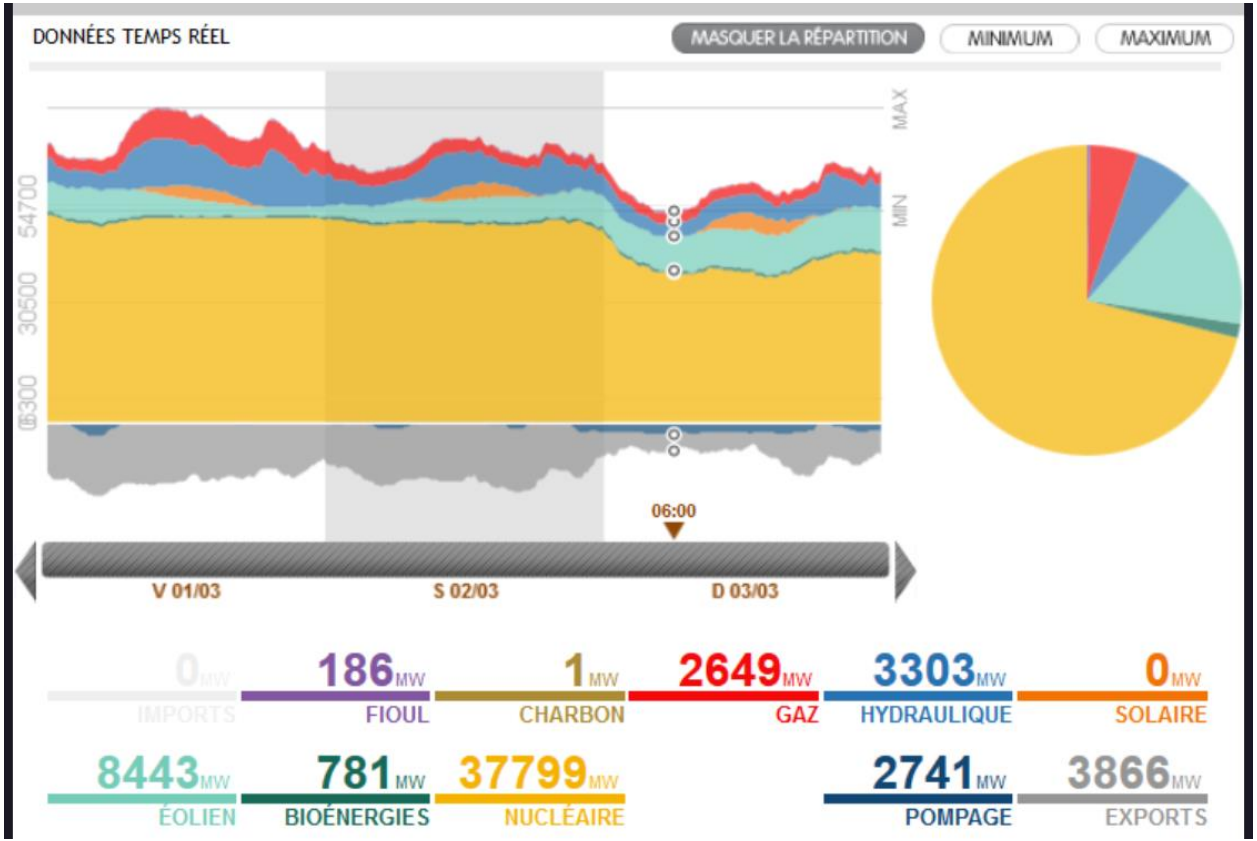
Existing nuclear fleet

- Deployed at scale in 70’s and 80’s as a result of oil crisis
- Meant to provide base load electricity generation

The French exception

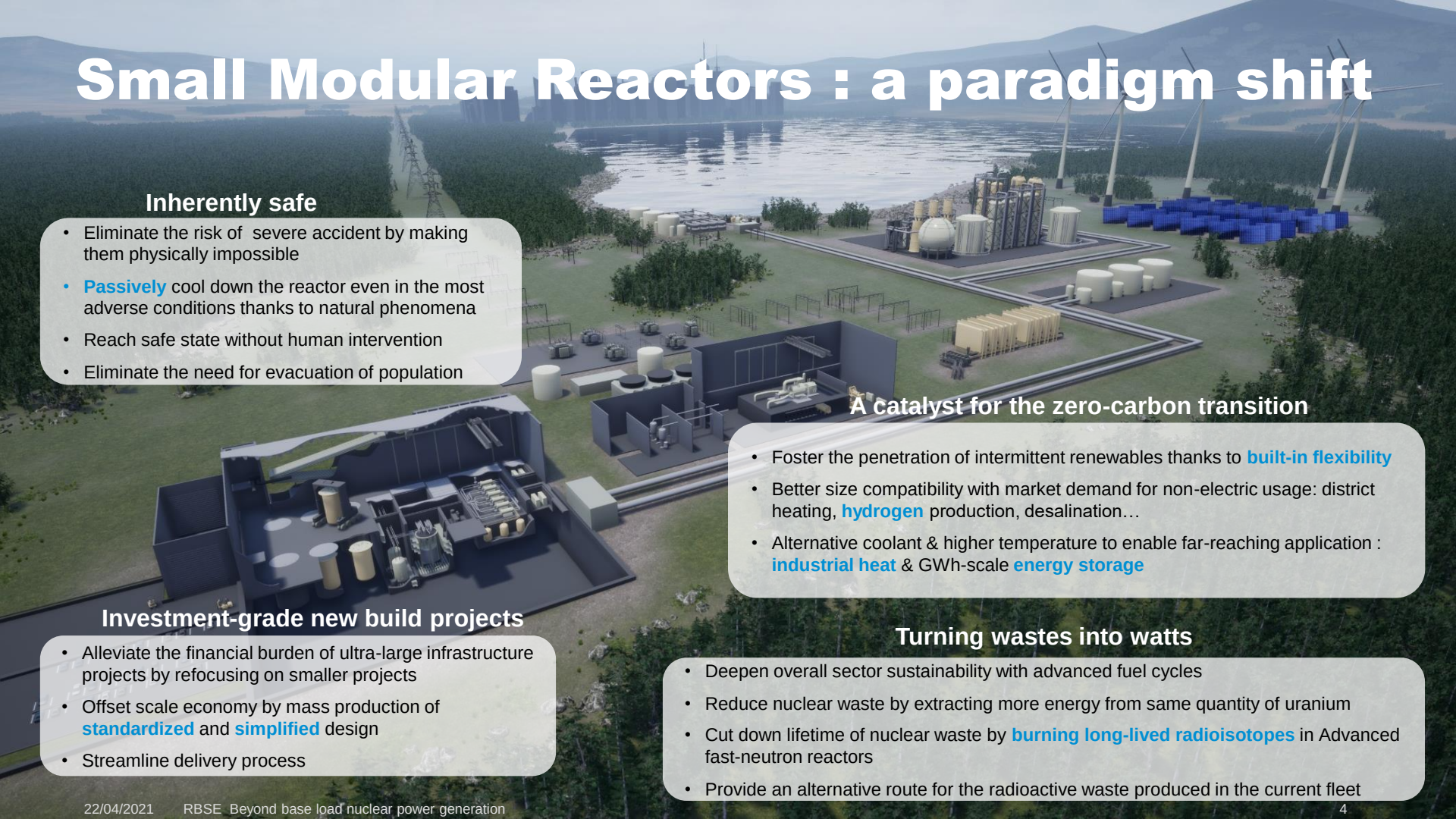
Superior load-following capability built into the design

On a windy Sunday morning…



source : https://doseequivalentbanana.home.blog/2019/06/16/suivi-de-charge-exotique-du-parc-nucleaire/

Small Modular Reactors : a paradigm shift



Inherently safe

- Eliminate the risk of severe accident by making them physically impossible
- **Passively** cool down the reactor even in the most adverse conditions thanks to natural phenomena
- Reach safe state without human intervention
- Eliminate the need for evacuation of population

A catalyst for the zero-carbon transition

- Foster the penetration of intermittent renewables thanks to **built-in flexibility**
- Better size compatibility with market demand for non-electric usage: district heating, **hydrogen** production, desalination…
- Alternative coolant & higher temperature to enable far-reaching application : **industrial heat** & GWh-scale **energy storage**

Investment-grade new build projects

- Alleviate the financial burden of ultra-large infrastructure projects by refocusing on smaller projects
- Offset scale economy by mass production of **standardized** and **simplified** design
- Streamline delivery process

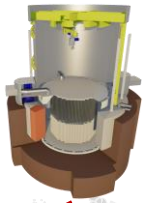
Turning wastes into watts

- Deepen overall sector sustainability with advanced fuel cycles
- Reduce nuclear waste by extracting more energy from same quantity of uranium
- Cut down lifetime of nuclear waste by **burning long-lived radioisotopes** in Advanced fast-neutron reactors
- Provide an alternative route for the radioactive waste produced in the current fleet

The vibrant international race for Advanced Nuclear

IMSR (Terrestrial) – TRL4
Thermal molten salt reactor

Image source: Terrestrial



SSR-W (Moltex) – TRL3
Waste-burner molten salt reactor

Image source: Rosatom

KLT-40S (Rosatom) – TRL8
Floating nuclear power plant

Image source: CGN

HTR-PM (CGN) – TRL7
High temperature gas cooled reactor

NuScale (Fluor) – TRL6
Multi-module Pressurized Water Reactor

Image source: NuScale

BWX-300 (GE-Hitachi) – TRL6
Boiling water reactor

Image source: General Electric - Hitachi

Key figures

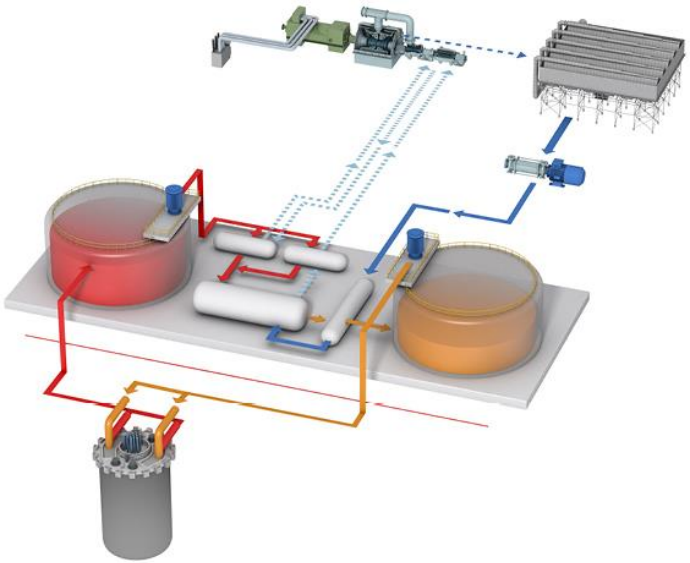
- +50 concepts of SMR under development
- +6 Technologies
- 10 countries leading development
- 2 demonstrators built

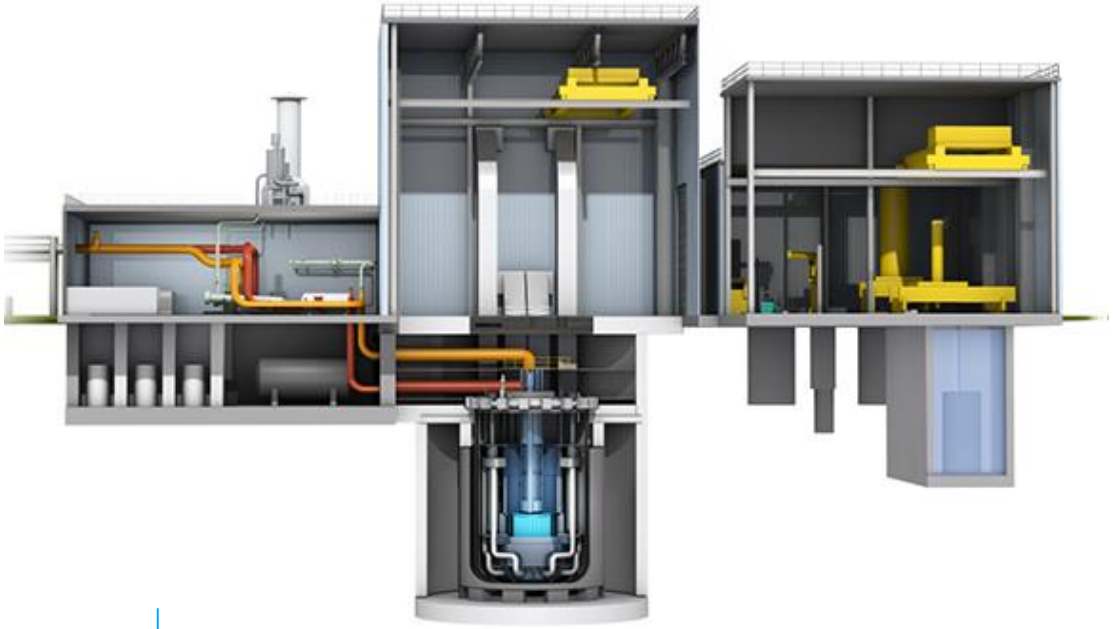
Our approach to date

- Assessed most **promising technologies**
- Engaged with vendors
- Engaged with utilities and key industry conglomerate
- Investigated promising ‘new’ uses of nuclear energy
- Conducting pilot studies

INTERNAL

Natrium – TerraPower / GEH

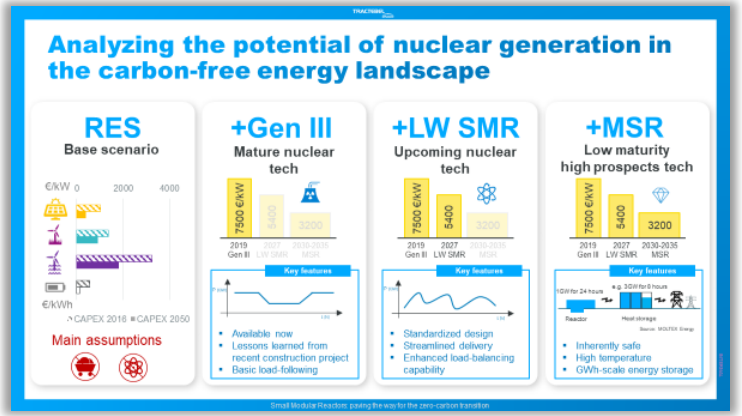


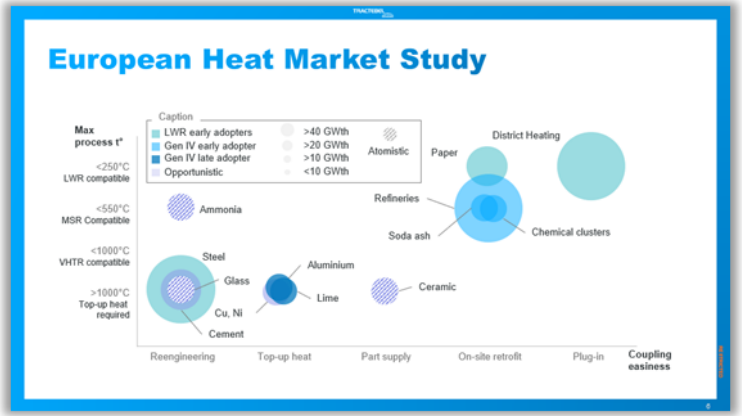


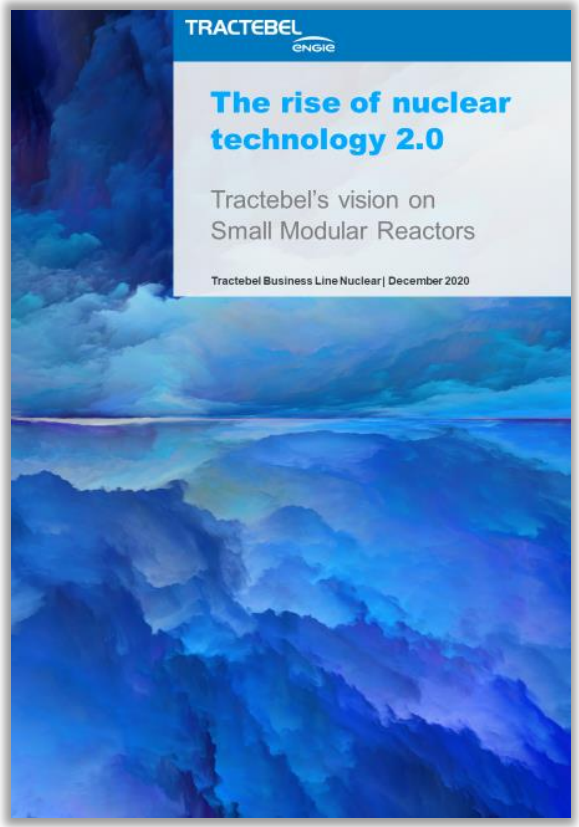
Thermal storage → variable power output

Ultrasafe reactor with small footprint

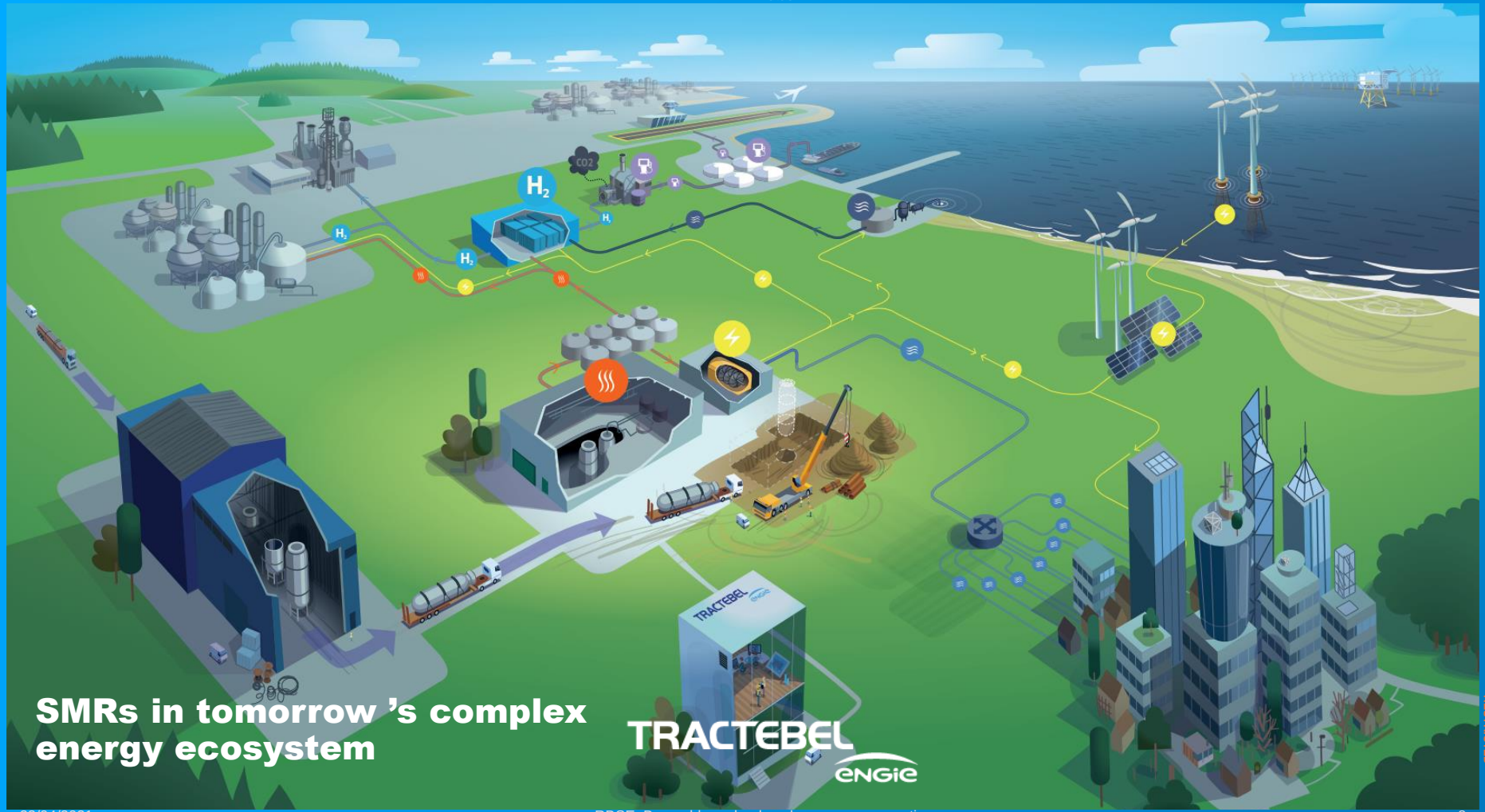
Our recent SMR white paper







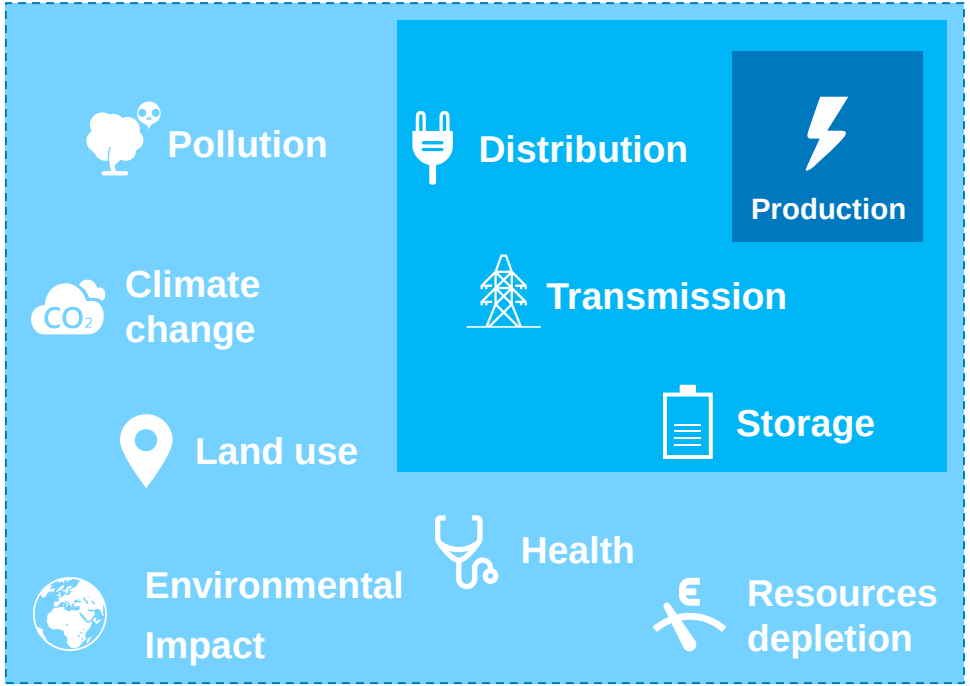
INTERNAL



SMRs in tomorrow ’s complex energy ecosystem

TRACTEBEL ENGIE

A much needed integrated view of the complex energy market



Plant-level

Production cost at market prices (LCOE)

Grid-level

System cost of the whole electricity value chain

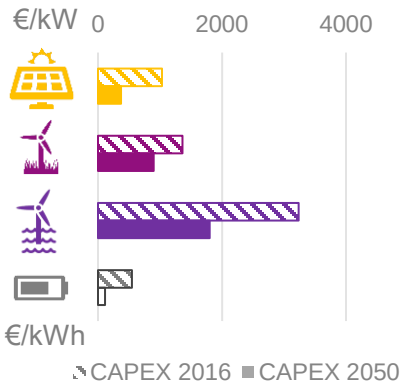
Societal-level

Full cost including external & social costs

Analyzing the potential of nuclear generation in the carbon-free energy landscape…

RES

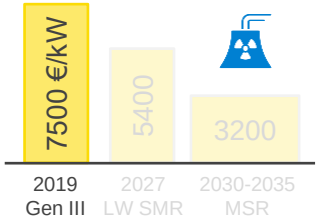
Base scenario



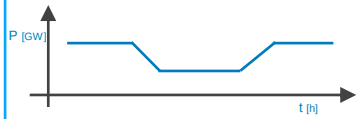
Main assumptions

+Gen III

Mature nuclear tech



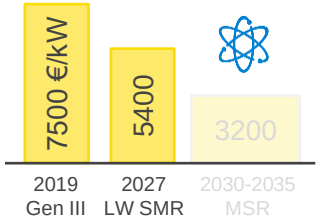
Key features



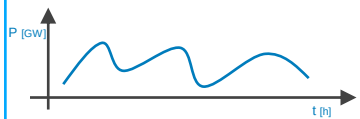
- Available now
- Lessons learned from recent construction project
- Basic load-following

+LW SMR

Near-term nuclear tech



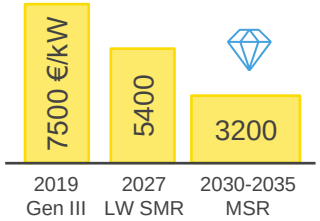
Key features



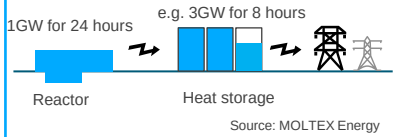
- Standardized design
- Streamlined delivery
- Enhanced load-balancing capability

+MSR

Low maturity high prospects tech



Key features

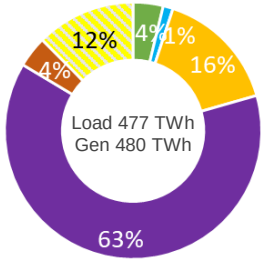


- Inherently safe
- High temperature
- GWh-scale energy storage

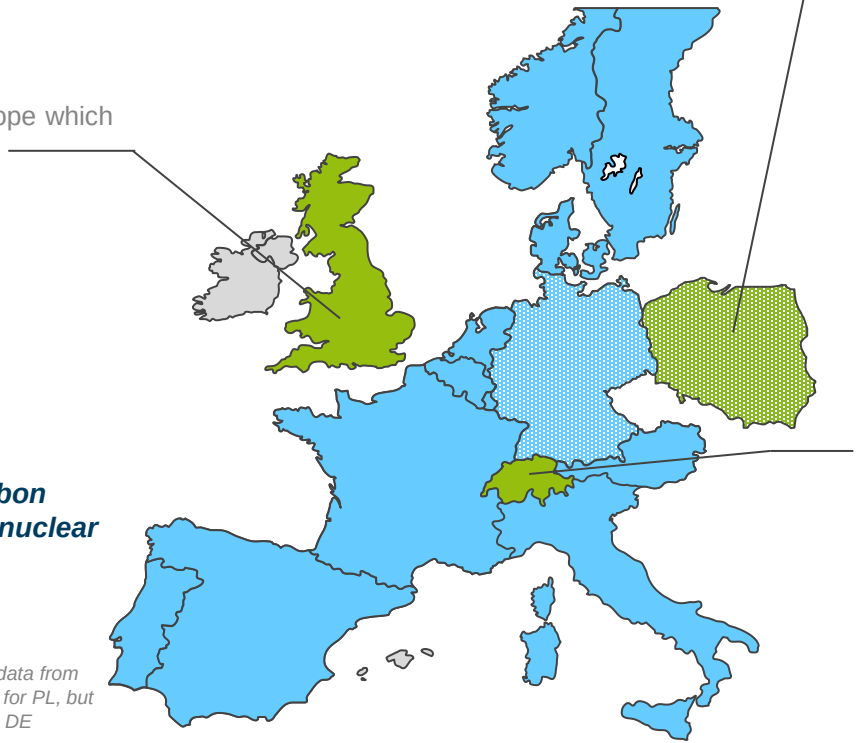
… from the perspective of countries with different profiles

Great Britain

A country in the West of Europe which has high wind potential

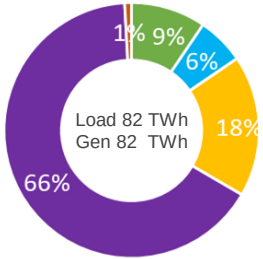


Projected 2050 Zero-Carbon Generation Mix without new nuclear



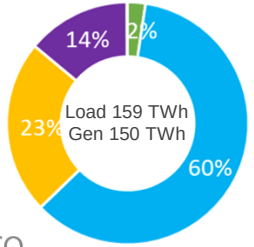
Poland*

A country in the east of Europe with a high carbon-emissions footprint



Switzerland

A country well interconnected in the middle of Europe with a lot of hydropower



(*) Poland was modelled based on surrogate data from Germany. Market potential results are shown for PL, but system impacts are measured with a modified DE

BIOGAS BIOMASS HYDRO SOLAR WIND H2 / SNG NUC New Build NUC LTO

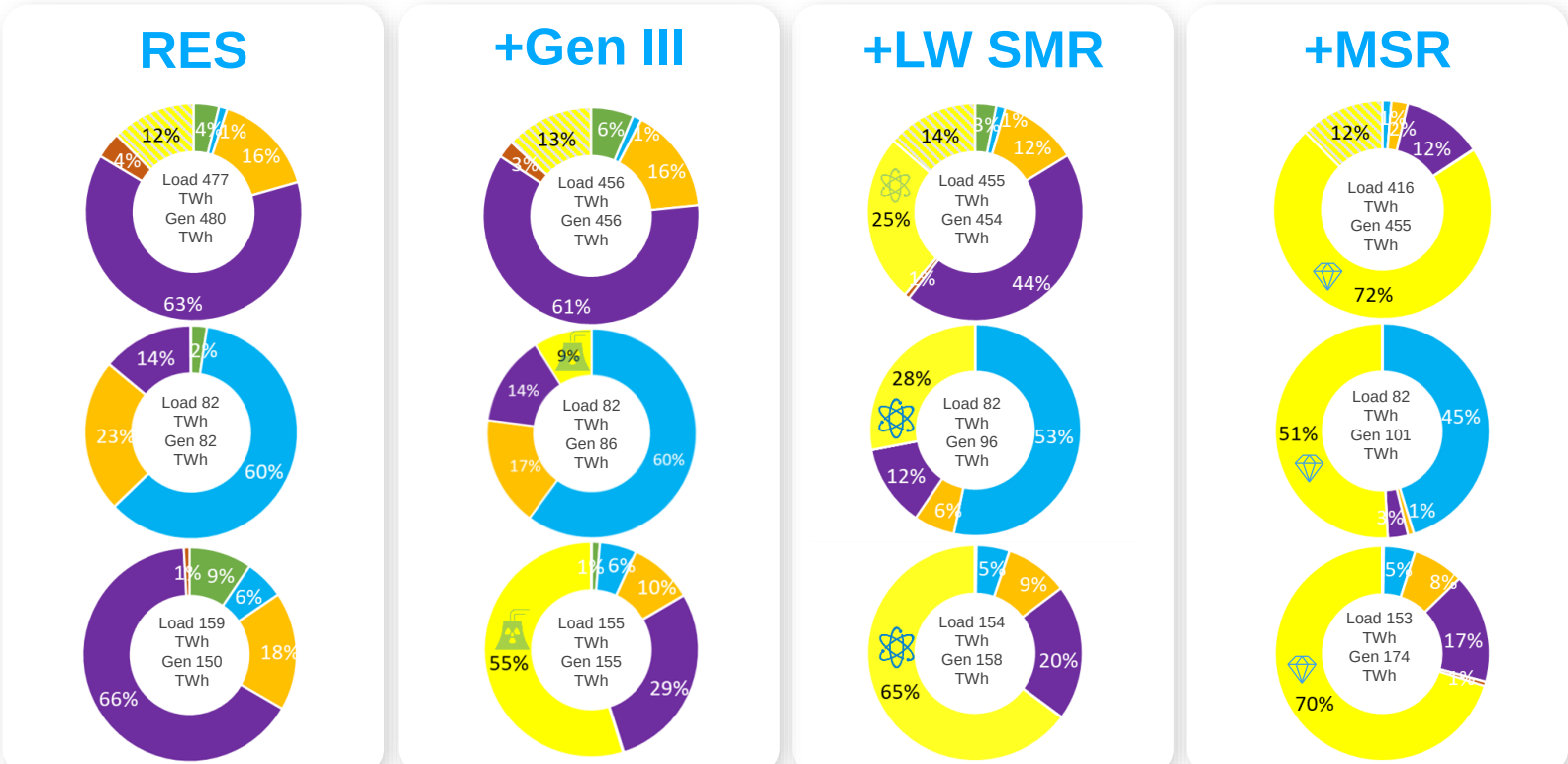
Snapshot of results for 2050

Great economic prospects for SMRs

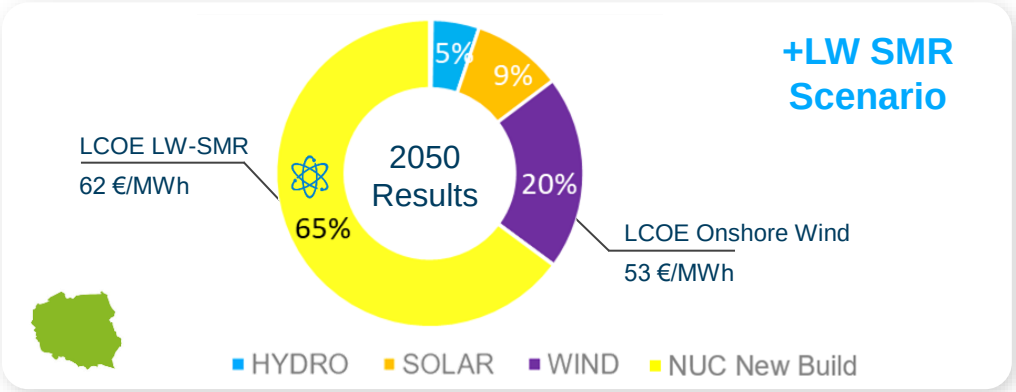
Great Britain

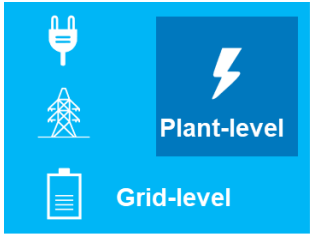
Switzerland

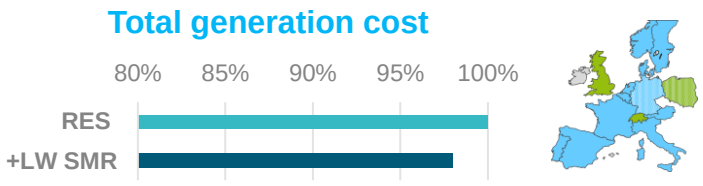
Poland

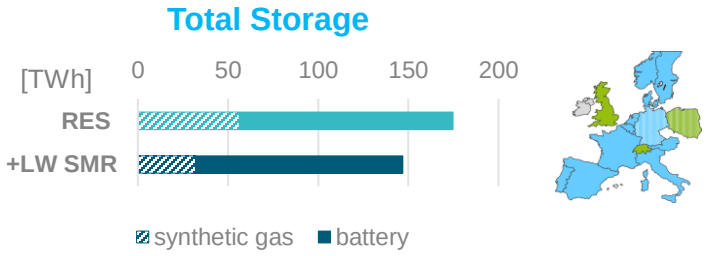


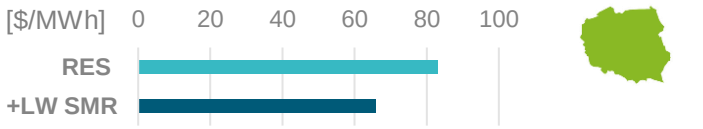
LCOE as metric is now insufficient for optimal investment decision











Key insights

- Higher penetration of NUC projected despite WIND lower **LCOE**
- **Grid-level generation cost** is lower with **NUC** than 100% **RES**
  - Lower amount of storage required
  - Lower yearly electricity price
- Lower grid infrastructural transformation (storage, T&D) with flexible nuclear

LCOE ≡ Levelized Cost Of Electricity

And we barely scratched the surface…

SMR prospects confirmed by economic modelling
Good business case even with low maturity uncertainty

LCOE is not the whole story
SMRs are synergetic with renewables through dispatchability and enhanced flexibility

Deep decarbonization
Great potential for industrial and non-electric usage

› **District heating** › **Desalination** › **Hydrogen** › **Process heat**


“The next energy miracle is nuclear energy.”
- Bill Gates


TRACTEBEL
ENGIE
Engineering
a carbon-neutral
future

Balancing market design for enabling participation of demand-side flexibility

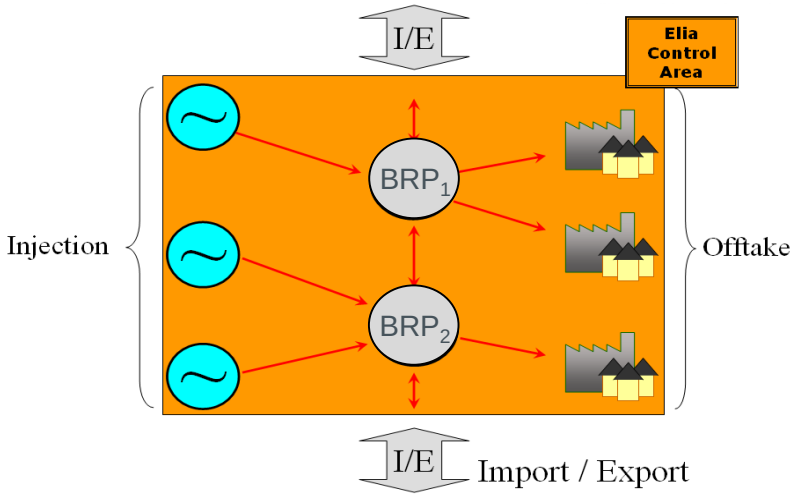
22 April 2021

Royal Belgian Society for Electricians - Seminar "Balancing the grid"

Kris Poncelet (Kris.Poncelet@elia.be)

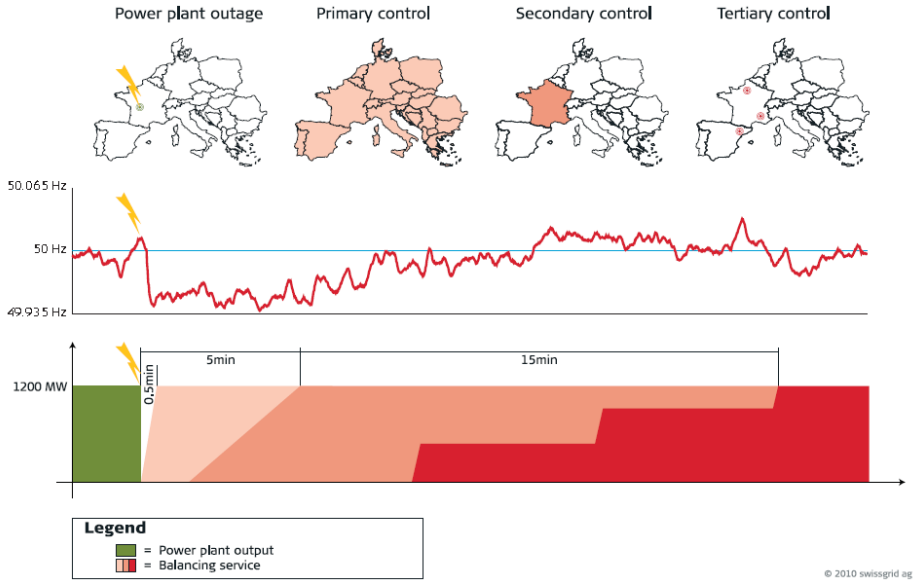
General principles of balancing

1. Balance responsible parties (BRPs):
   - are obliged to provide and deploy all reasonable sources in order to maintain the balance between total injections and total offtake within its perimeter on a quarter-hourly basis
   - Are incentivized to maintain the balance via the imbalance tariff



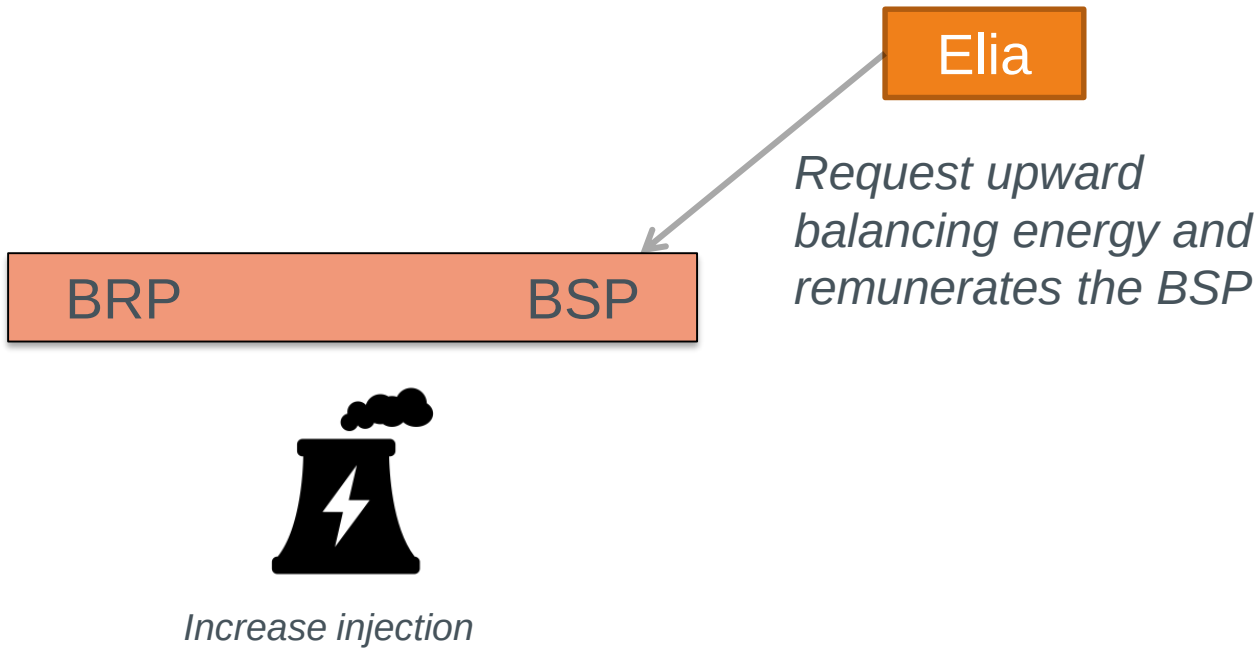
Ensure a well-functioning balancing market providing right incentives for BRPs to balance their portfolios

2. Balance service providers (BSPs):
   - Offer balancing services (FCR/aFRR/mFRR) that can be activated on request of Elia to limit and restore frequency deviations residual imbalances

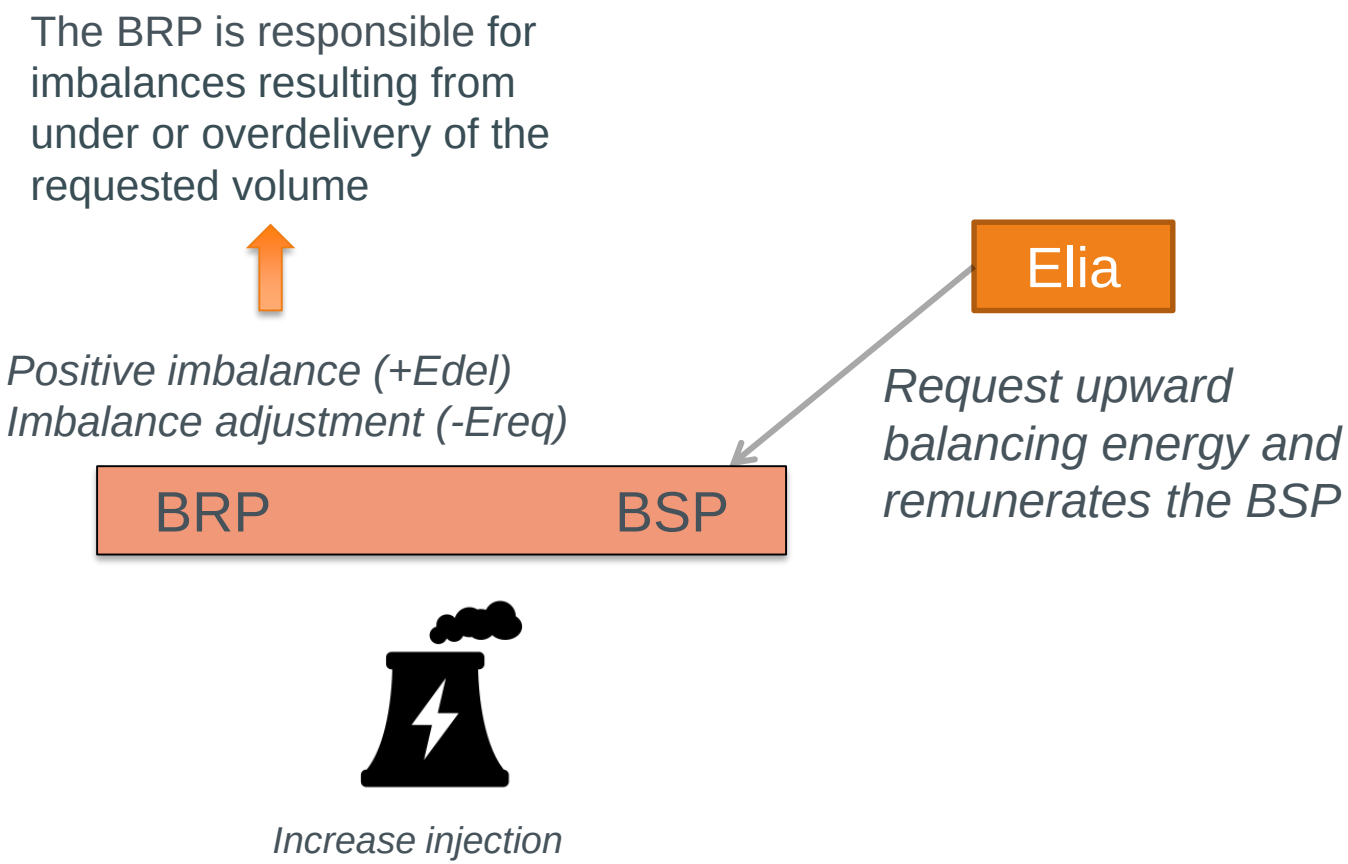


A reserve market to allow TSOs to access available flexibility "everywhere" and from "anyone" to efficiently and effectively cover residual imbalances

Historically, all balancing services were provided by large generation assets (for which BSP = BRP)



Historically, all balancing services were provided by large generation assets (for which BSP = BRP)

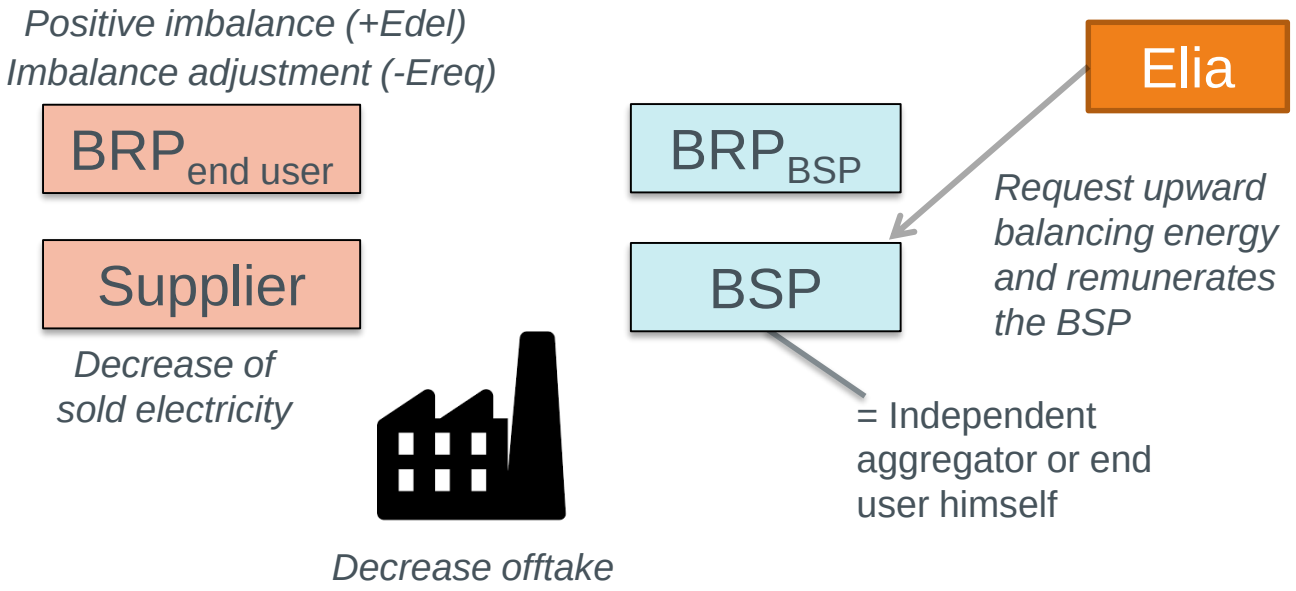


Since 2013, Elia has been gradually opening up its products to decentralized assets

- Recall: ambition to access available flexibility “everywhere” and from “anyone” => all technologies (incl. demand response, decentralized storage and generation) as well as new players (e.g., independent aggregators)
- 2017: Electricity law: Every end user has the right to valorize demand-side flexibility via his Supplier or a flexibility service provider (e.g., a BSP) of its choice

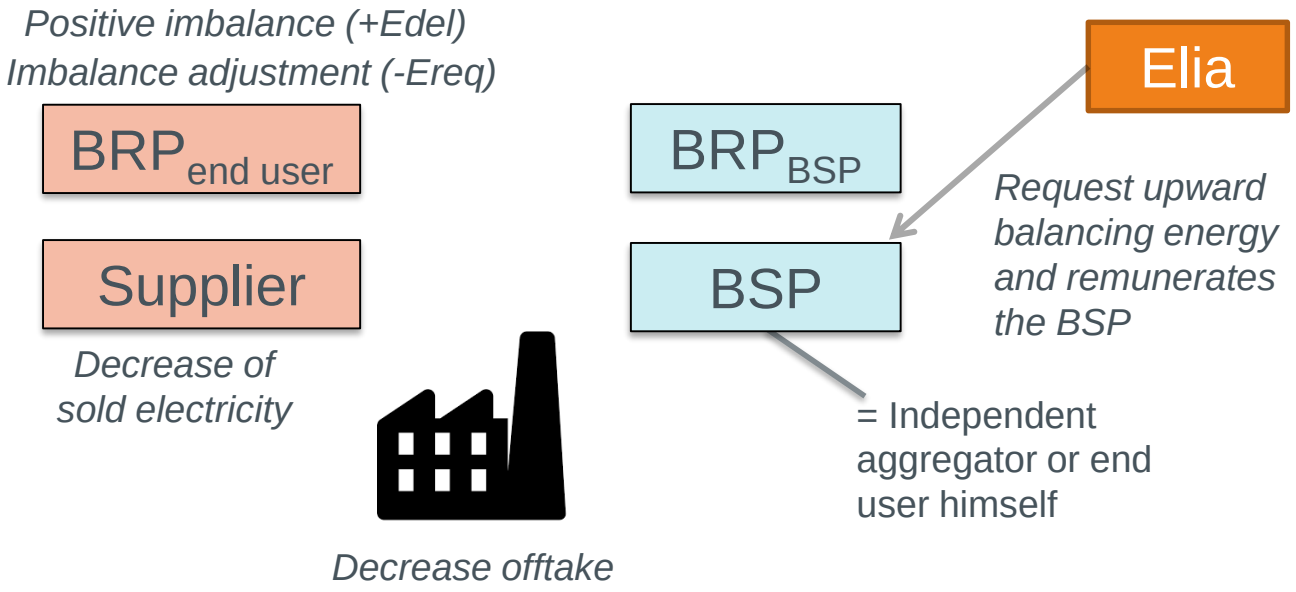
Since 2013, Elia has been gradually opening up its products to decentralized assets

- Recall: ambition to access available flexibility “everywhere” and from “anyone” => all technologies (incl. demand response, decentralized storage and generation) as well as new players (e.g., independent aggregators)
- 2017: Electricity law: Every end user has the right to valorize demand-side flexibility via his Supplier or a flexibility service provider (e.g., a BSP) of its choice



Since 2013, Elia has been gradually opening up its products to decentralized assets

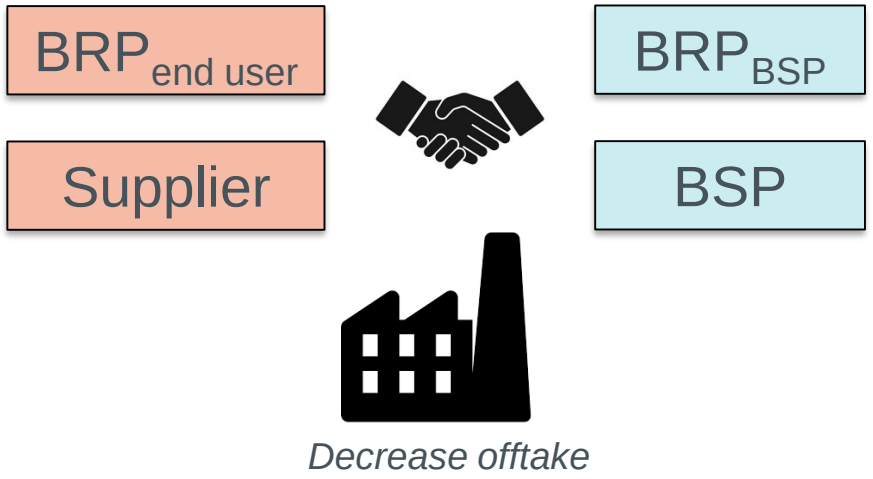
- Recall: ambition to access available flexibility “everywhere” and from “anyone” => all technologies (incl. demand response, decentralized storage and generation) as well as new players (e.g., independent aggregators)
- 2017: Electricity law: Every end user has the right to valorize demand-side flexibility via his Supplier or a flexibility service provider (e.g., a BSP) of its choice



Without a change in the market design:

1. The Supplier of the end user can be negatively impacted in case balancing energy is delivered
2. The BRP of the end user is responsible for imbalances resulting from under or overdelivery of the requested volume instead of the BRP of the BSP

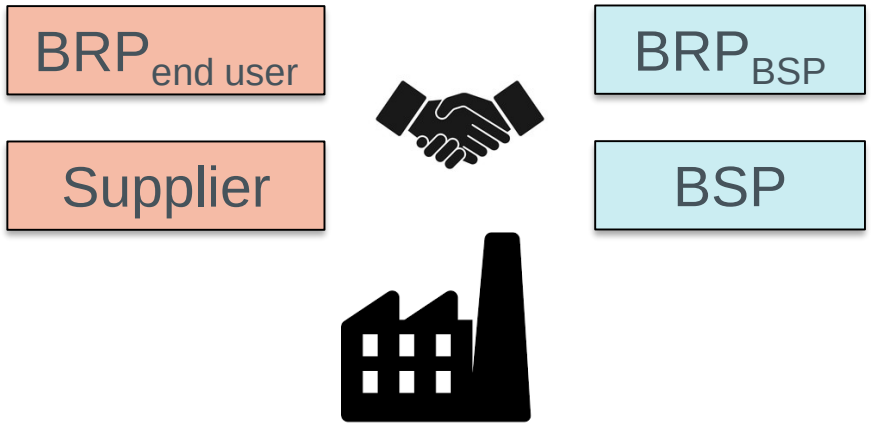
There are two complementary models

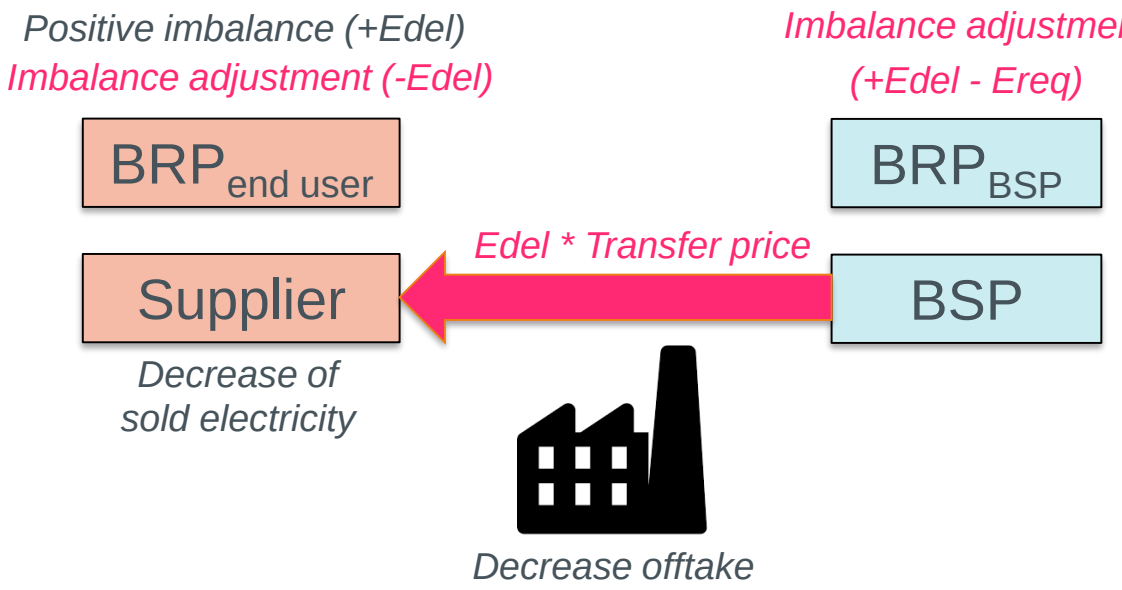


Market parties agree on the settlement and provide proof of an agreement to Elia

- Simple: only requires proof of agreement
- Supplier and/or BRP of the end user could block participation

There are two complementary models





Market parties agree on the settlement and provide proof of an agreement to Elia

- Simple: only requires proof of agreement
- Supplier and/or BRP of the end user could block participation

A centralized model to “transfer energy”

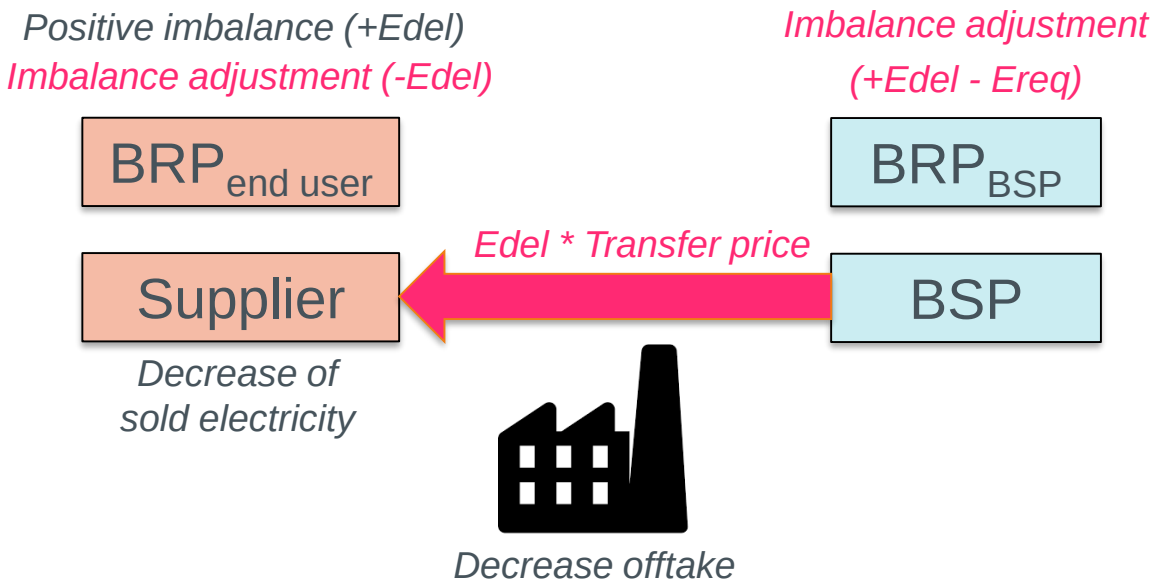
- Complex: delivered volume of energy and the transfer price need to be determined
- Valorization of flex independent of Supplier and BRP of the end user
  - Impact on Supplier and $BRP_{end\ user}$ is neutralized
  - BRP_{BSP} takes on balance responsibility for the delivery of the requested volume

Key tasks and responsibilities in the Transfer of Energy model

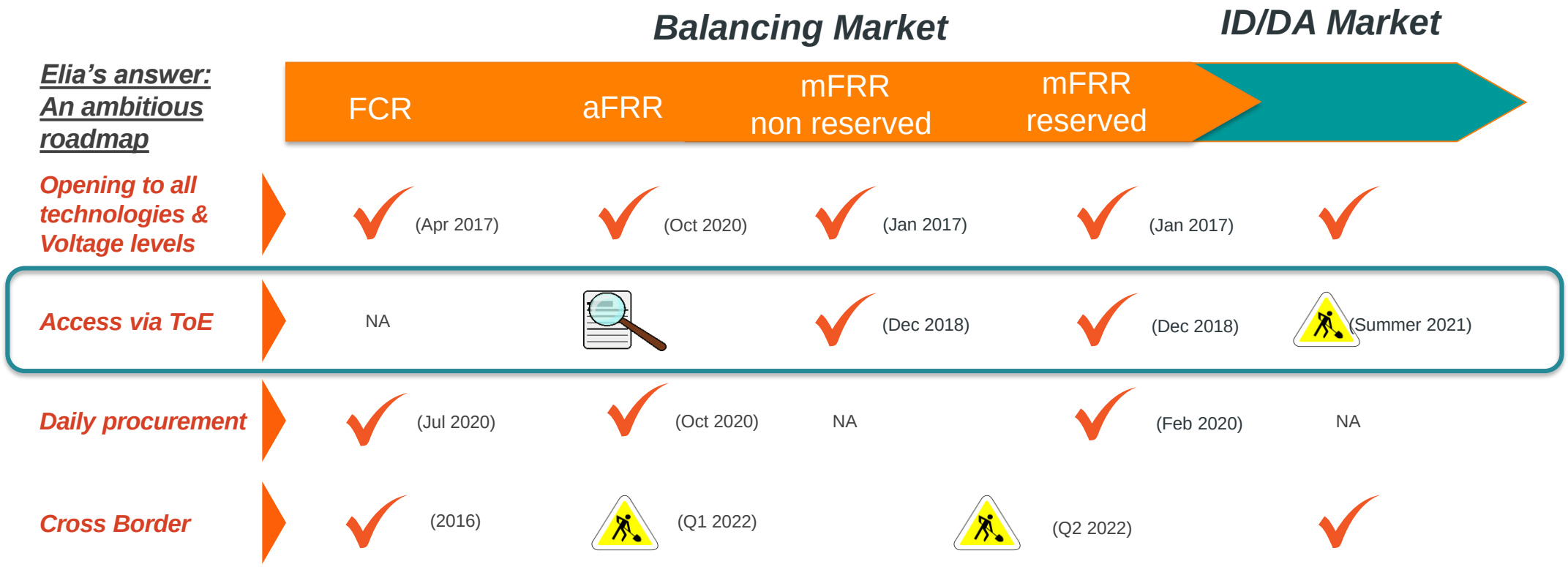
1. Calculation of the volume of energy effectively delivered:
   - Edel = Baseline – measured offtake/injection
   - Baseline: counterfactual injection/offtake if no activation of flexibility would have taken place

2. Determining the transfer price:
   - To neutralize the impact on the Supplier, the transfer price should be equal to the Supply-price
   - In absence of an agreement, the CREG calculates the transfer price as a fallback mechanism

3. Data exchange to enable the BSP and the Supplier to perform their settlement



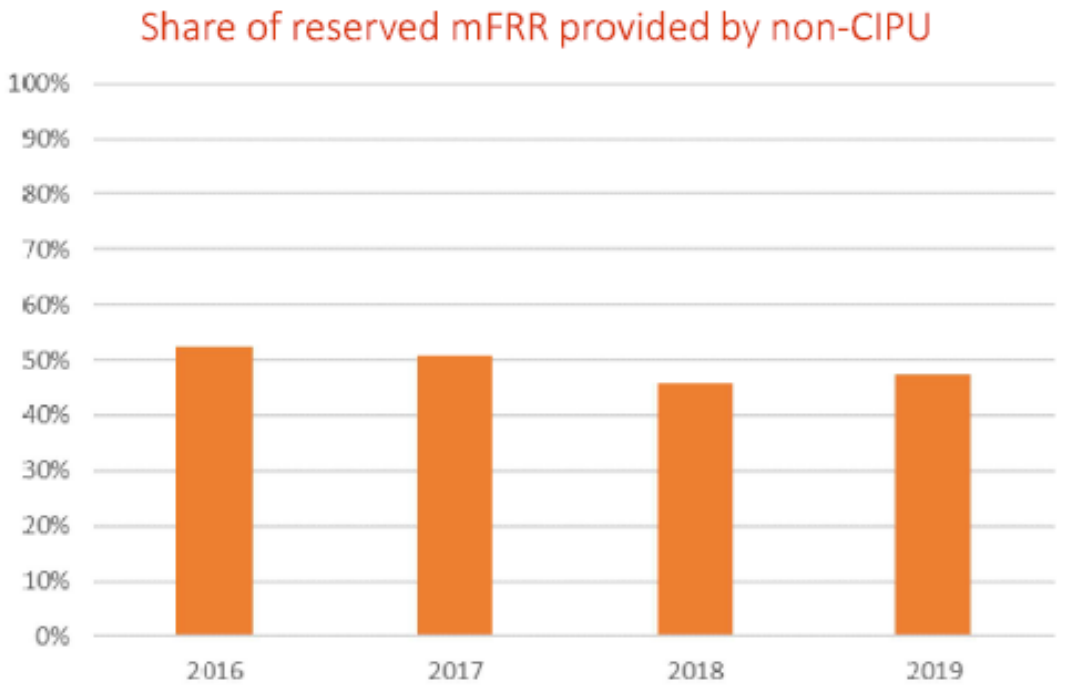
Where are we today?



Main experience from mFRR (tertiairy reserves)

- **Participation of decentralized flexibility**:
  - ~260 registered delivery points (~30% using the Transfer of energy mechanism)
  - Prequalified volume ~ 545 MW
  - Contracted volume (dec 2020) ~ 310 MW (~40%)
- Prices of mFRR energy bids of decentralized assets generally significantly higher (~1-2% of upward mFRR balancing energy)

- **“Transfer of Energy” mechanism:**
  - No big impact observed on volumes offered after go-live of the “Transfer of Energy” mechanism…
  - …but Transfer of Energy model fosters competition and is required for energy remuneration
  - Business case for decentralized flexibility providing mFRR focuses on balancing capacity remuneration => no/hardly any “free bids” submitted



We are on the verge of a new era

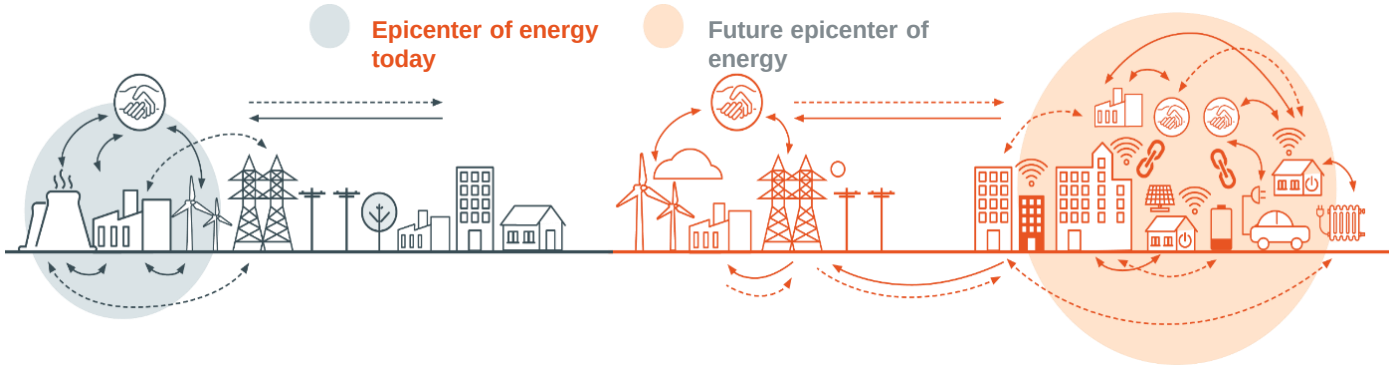
In which the energy system will be heavily transformed at its core

- Massive uptake of distributed assets
- Powered by decentralized RES generation
- Optimized locally by digital technologies

and consumers seeking for tailor-made services

- Access to new experience, fastly delivered
- Choice between different products (local, green, comfort,…)
- Control on the way to consume

Requiring a paradigm shift



Generation follows consumption → **Demand will follow generation**

Consumer expectations are changing

With new digital behaviour

Expecting tailor-made "Energy as a Service"

Willing to engage in Energy transition

With more electrification and flexibility at home

Seconded by deep technological changes

32%
of RES by 2030

RES deployment
2016 Clean Energy for all Europeans

92%
smart meter penetration by 2030

17%
Annual growth of IoT devices

Digitalisation & connectivity
EU Smart metering Benchmark

1,5 million
Electric vehicles by 2030

250,000
Heat-pumps by 2030

Electrification of uses
EU 2050 long-term strategy

EU's energy policy framework to facilitate a clean and fair energy transition

… but unlocking this potential poses challenges for the market design

- **Extending the Transfer of Energy mechanism to low-voltage poses significant challenges…**
  - Complex to collect and validate data (e.g., 4” data for aFRR) for thousands of households/assets that are needed to bring reasonable volumes to the market
  - Expect increasing divergence between supply contracts (flat tariff versus DA or RT price contracts) => complexity for the determination of the transfer price
  - Accurate calculation of delivered volumes on kW level
  - Costly submetering requirements could jeopardize the development of LV-flexibility as value per household is relatively low
  - Settlement processes between BSP and Supplier become more complex (more service points and Suppliers involved)
- **… while at the same time there is a need to enable new business models:**
  - End-consumer sells excess solar generation to his neighbors
  - Mobility as a service (e.g., leasing company acts as Supplier for the charged electricity if your EV regardless where you charge it)
  - …

… but unlocking this potential poses challenges for the market design

- **Extending the Transfer of Energy mechanism to low-voltage poses significant challenges…**
  - Complex to collect and validate data (e.g., 4” data for aFRR) for thousands of households/assets that are needed to bring reasonable volumes to the market
  - Expect increasing divergence between supply contracts (flat tariff versus DA or RT price contracts) => complexity for the determination of the transfer price
  - Accurate calculation of delivered volumes on kW level
  - Costly submetering requirements could jeopardize the development of LV-flexibility as value per household is relatively low
  - Settlement processes between BSP and Supplier become more complex (more service points and Suppliers involved)
- **… while at the same time there is a need to enable new business models:**
  - End-consumer sells excess solar generation to his neighbors
  - Mobility as a service (e.g., leasing company acts as Supplier for the charged electricity if your EV regardless where you charge it)
  - …


SO EXCITED
I CAN'T WAIT!!
imgflip.com

Thank you

Q&A

SRBE KBVE
Société Royale Belge des Electriciens
Koninklijke Belgische Vereniging der Elektrotechnici

Cybersecurity of electrical installations

Tomorrow

3.30 pm – 06.00 pm

ABB HITACHI POWER GRIDS

elia group
Elia | 50Hertz | EGI

SIEMENS energy

Registrations on www.kbve-srbe.be

Agenda

23/04

Study Day "Cybersecurity of electrical installations in industry"

22/04

Webinar "Balancing the Grid"
Session 1

20/05

Webinar "Balancing the Grid"
Session 2

04/06

Study Day "Local Communities of energy"
Session 1

10/06

Webinar "Balancing the Grid"
Session 3

11/06

Study Day "Local Communities of energy"
Session 2

18/06

Study Day "Local Communities of energy"
Session 3

Later on Q3 and Q4

- Study day *"MV & HV Substations"*
- JICABLE Conference
- Study day *"Electricity pricing"*

Thank you!