

A photograph of an offshore wind farm at sunset. The sky is a mix of orange, yellow, and blue. In the foreground, a large, illuminated platform or substation is visible, supported by several legs in the water. Numerous wind turbines are scattered across the horizon, their silhouettes against the bright sky. The water is dark blue with some whitecaps.

# The impact of new-built nuclear on the future Dutch electricity system

Tim Gaßmann  
TenneT NL | Energy System Planning

Nuclear Innovation Conference (NIC)

# Introduction

## Speakers overview

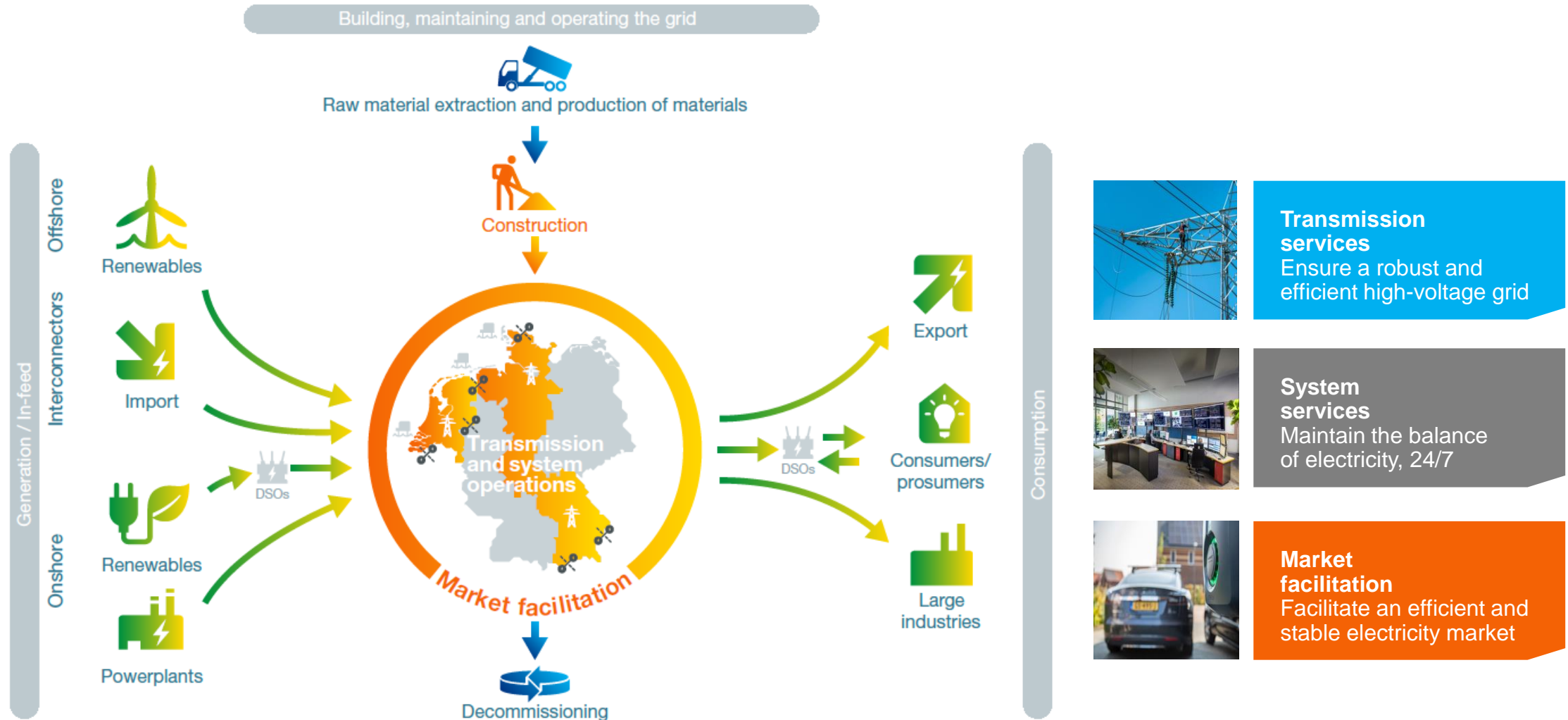


- ❖ **Tim Gaßmann**
- ❖ Msc. Electrical engineering & business administration (RWTH Aachen)
- ❖ Since 2013: Working enthusiastic on the energy transition at TenneT
- ❖ Current position: **Energy system scenario developer** in TenneT's business unit energy system planning focussing on scenario development, market- & adequacy analyses
- ❖ **Recent projects:** Investment plan 2024, Integrated Infrastructure outlook 2030-2050, Target Grid, Monitor Leveringszekerheid 2024
- ❖ **Contact:** [tim.gassmann@tennet.eu](mailto:tim.gassmann@tennet.eu)



# Introduction

## TenneT: At the centre of the energy transition



# Agenda

What I would like to discuss today...

**Main drivers of the Dutch energy system transition**

**General considerations: Impact of nuclear power plants**

**Case study: Market & grid impact of new nuclear power plants in the Netherlands**

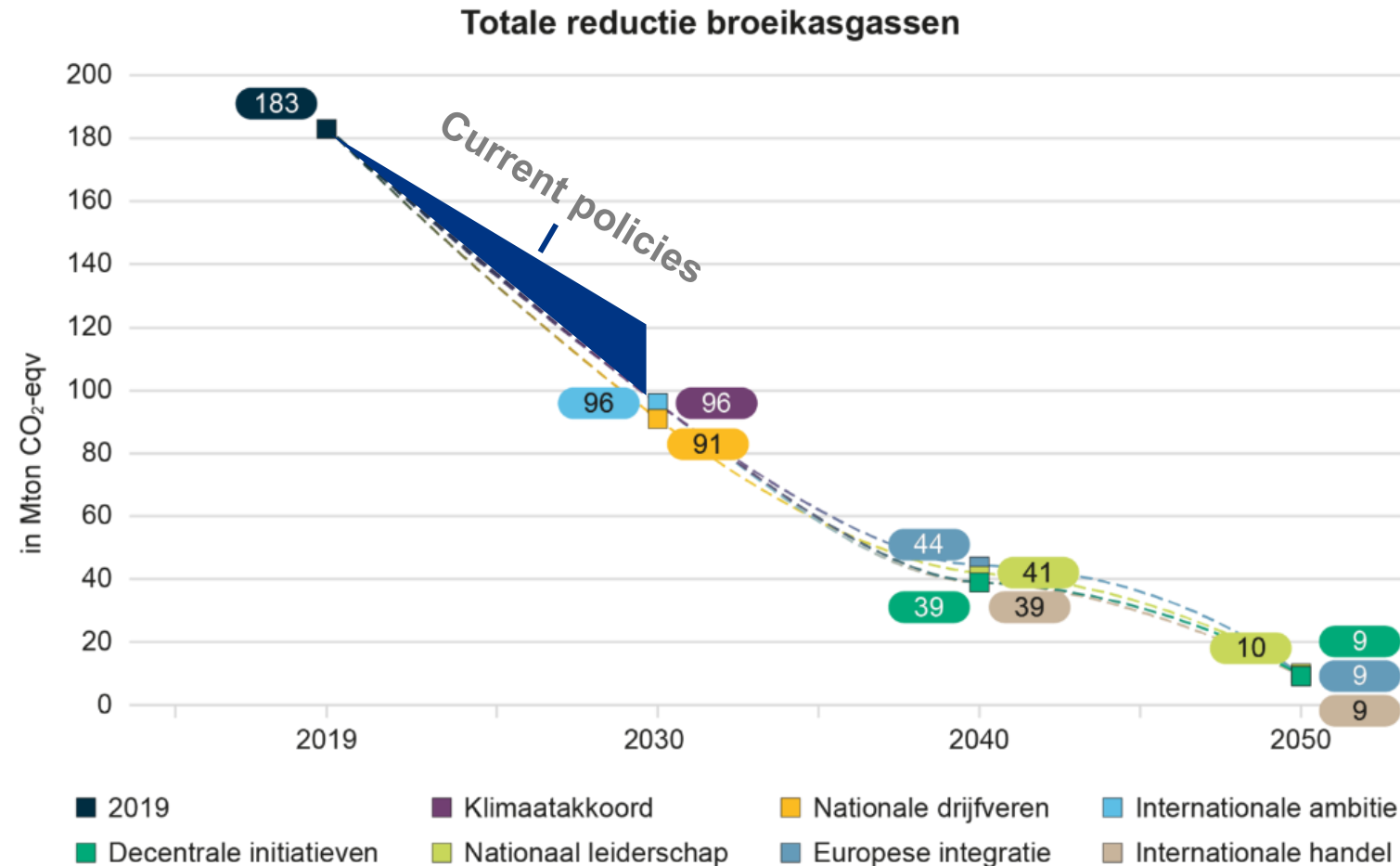
**Summary**

# What is driving the transition?

# The Dutch energy system

## What is driving the transition?

**An ambitious emission reduction pathway will be required to comply to the climate targets.**

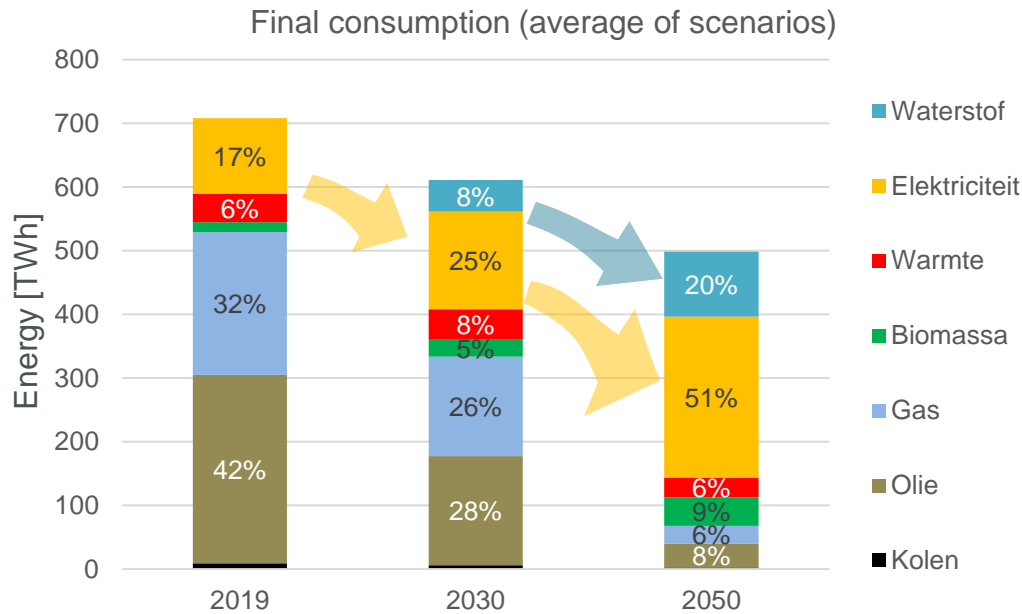


- Considering current policies, the NL are expected to reach 46-57% emission reduction until 2030\*. The legally binding target of 55% is in reach.
- However to eventually reach a climate neutral energy system in 2050, high efforts will still be required.
- With energy system scenarios we investigate different pathways to get there.

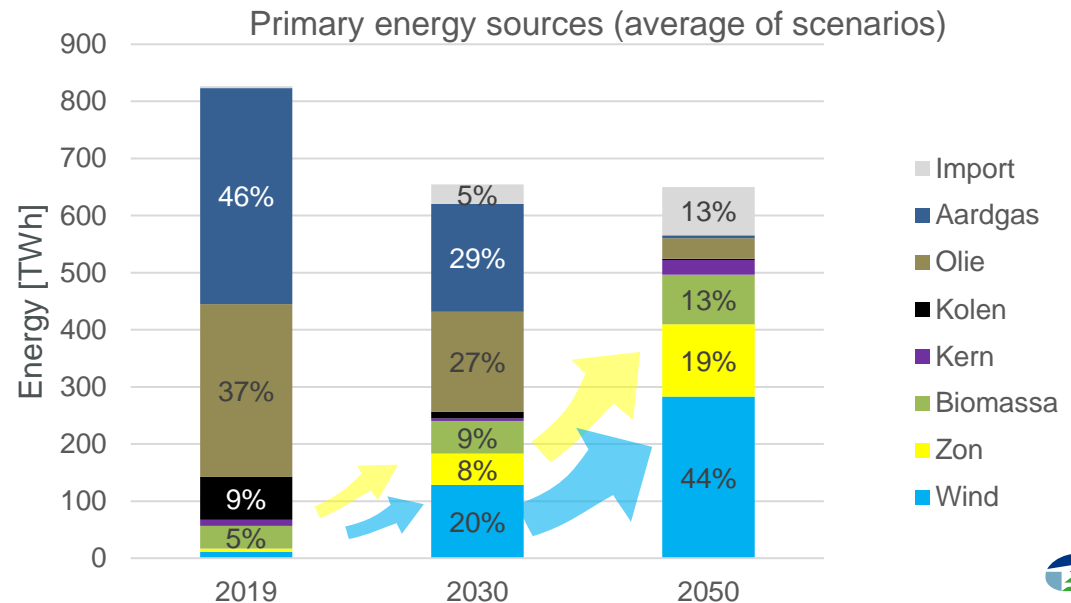
# The Dutch energy system

## What is driving the transition?

**The energy system will have to transform drastically, both on supply & demand side.**



- **Electrification of final energy demand** is key to substitute fossil energy carriers & use energy more efficiently. Green molecules like hydrogen & biomass will play a role in sectors which are hard to electrify.
- The supply mix must match this demand, while being sourced from **sustainable (zero-emission) energy sources** like wind & solar. **Nuclear can also play a role.**



# General considerations: Impact of nuclear power plants



# Nuclear power

## System impact: Some general considerations...

Building new nuclear power plants will have **impact on the energy system as a whole**, in particular:



**Market impact:** Nuclear capacity **will impact the behaviour** (dispatch, market bids etc.) of market participants and potentially also their business cases, not only in the Netherlands but also in other European countries. While this primarily impacts the electricity market & system, it has also a broader impact on other parts of the energy system (sectors, energy carriers).



**Grid impact:** Nuclear will require **large grid connections and sufficient “infrastructure space”** to be able to transport supply to demand. Since the lead times of new built of nuclear and infrastructure are comparable, TenneT should be able to realize these grid connections on time. **However, this requires that we can plan timely ahead.**

- The concrete impact will strongly depend on:
  - **Capacity** of the nuclear power plants: *Small or large?*
  - **Locations:** *Central or decentral?*
  - **Operational regime:** *Must-run or flexible?*
- TenneT is investigating these questions in different studies, for example the **recently published study report “Analyse netinpassing kerncentrales” (2024)**

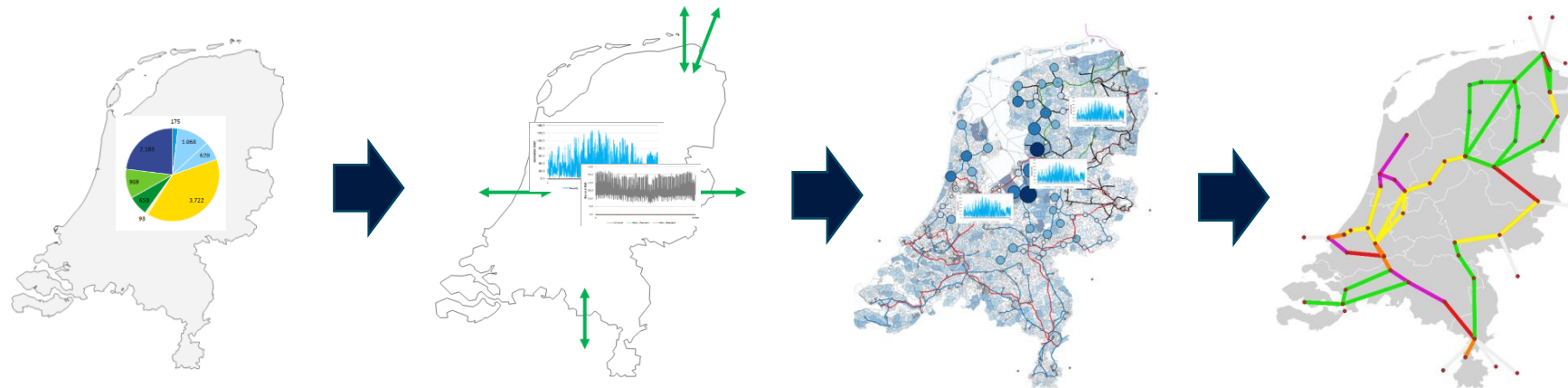
# Case study: Market & grid impact of new nuclear power plants in the Netherlands

# Nuclear power

## Case study: What did we investigate?

**Study question:** *What would be the impact of commissioning new nuclear power plants until 2035 on the electricity system & grid infrastructure of TenneT?*

**Approach:** Based on two 2035 scenarios from [TenneT's investment plan 2024](#) (Climate Ambition, National Driver), European electricity market simulations & grid analyses conducted with varying amounts of nuclear capacity



### Scenarios (2035)

- Climate ambition & National driver
- **Sensitivities on nuclear capacity:**
  - Base case **0.5 GW** (Borssele)
  - Additional capacity of **1.6 GW**
  - Additional capacity of **3.2 GW**

### Market analyses

- Hourly simulation of European electricity market & cross-border market exchanges
- According to today's market (energy-only)

### Regionalization

- Determine locations of supply, demand & flexibility
- **Variation of new nuclear power plant locations** (Borssele & Maasvlakte)

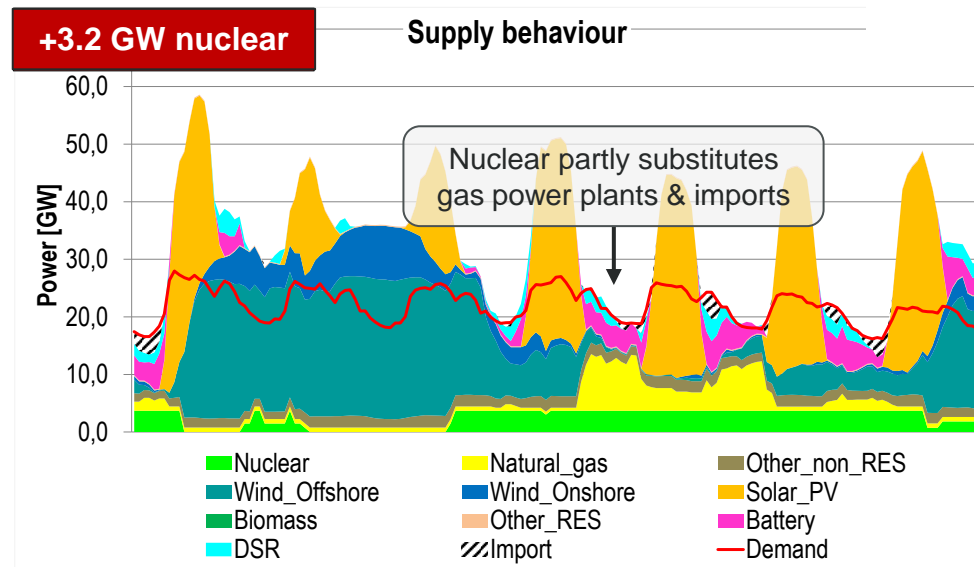
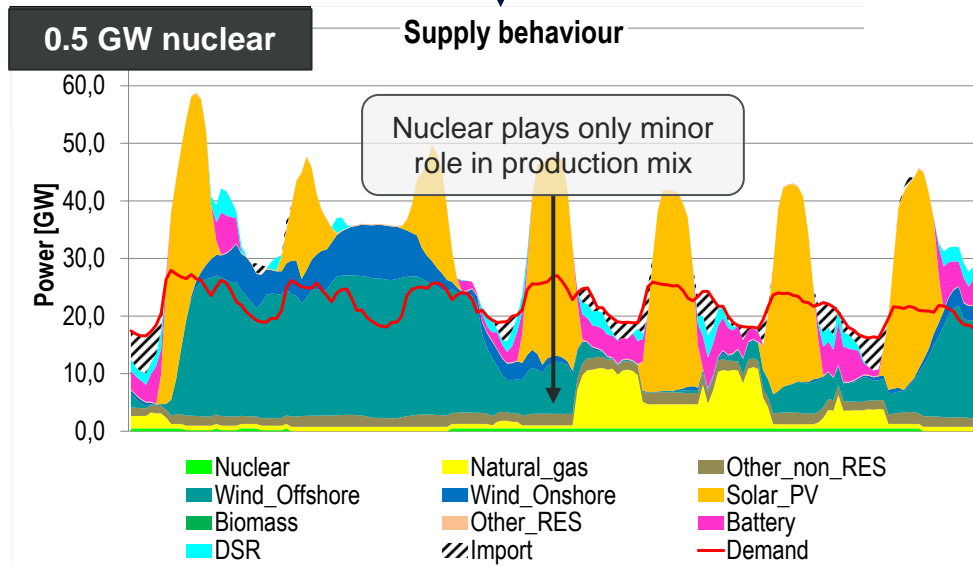
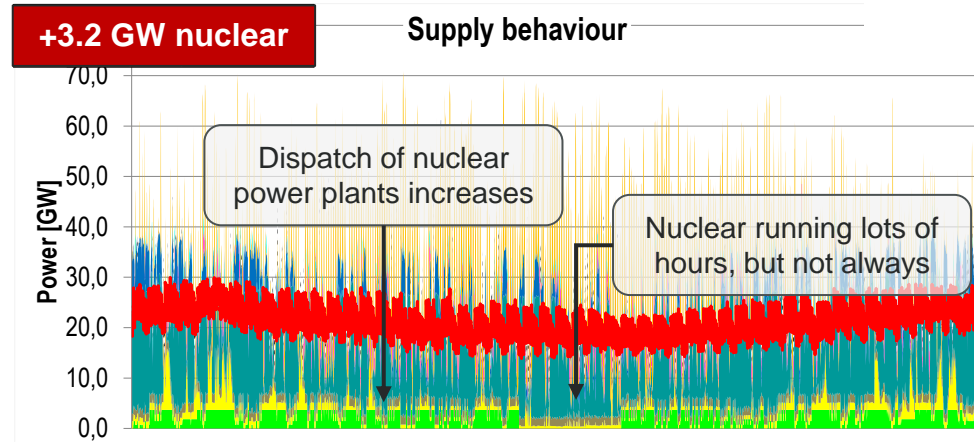
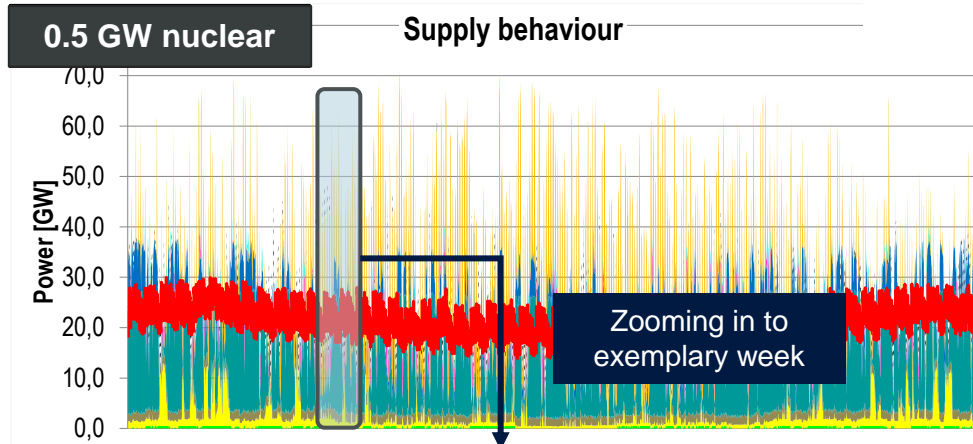
### Grid analyses

- Simulation of grid power flows & identification of structural bottlenecks
- Driver & impact assessment

# Nuclear power

## Case study: Impact on electricity market

**Nuclear power plants impact the dispatch of other price-driven units in the Dutch electricity market.**

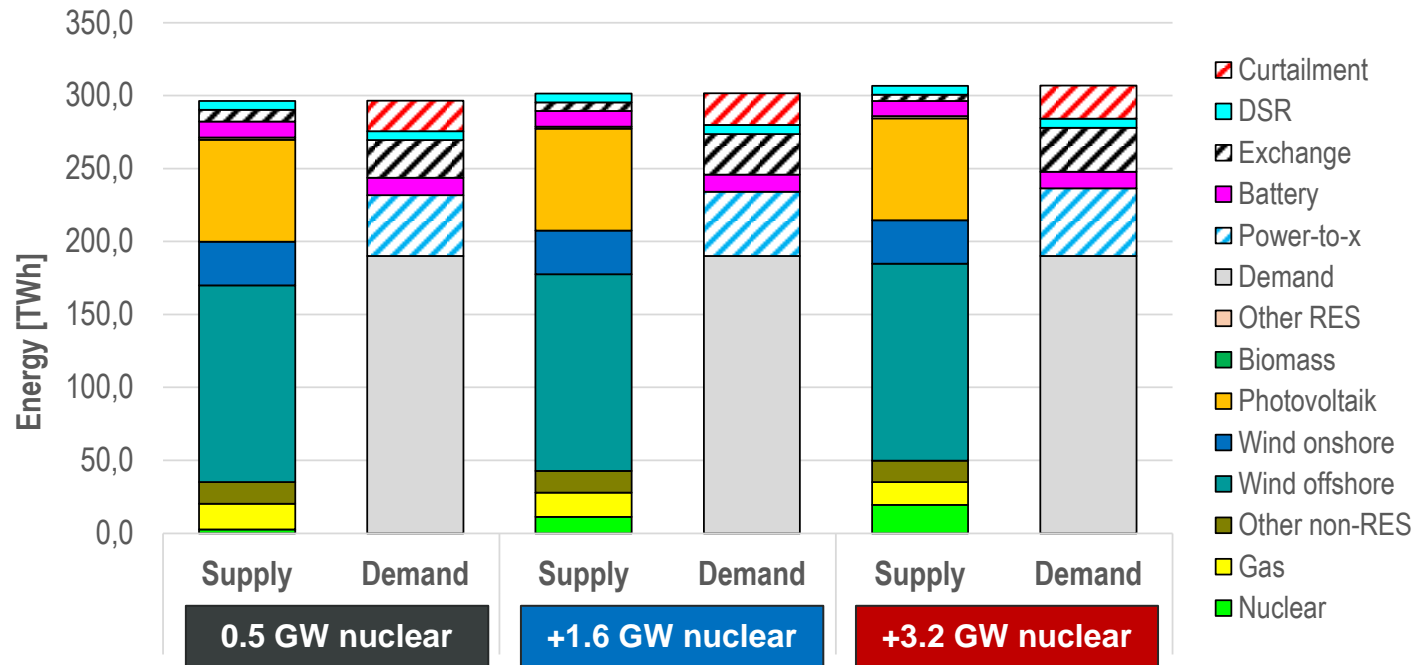


# Nuclear power

## Case study: Impact on electricity market

**Nuclear power plants impact the dispatch of other price-driven units in the Dutch electricity market.**

This effect is also visible on a yearly energy volume basis...

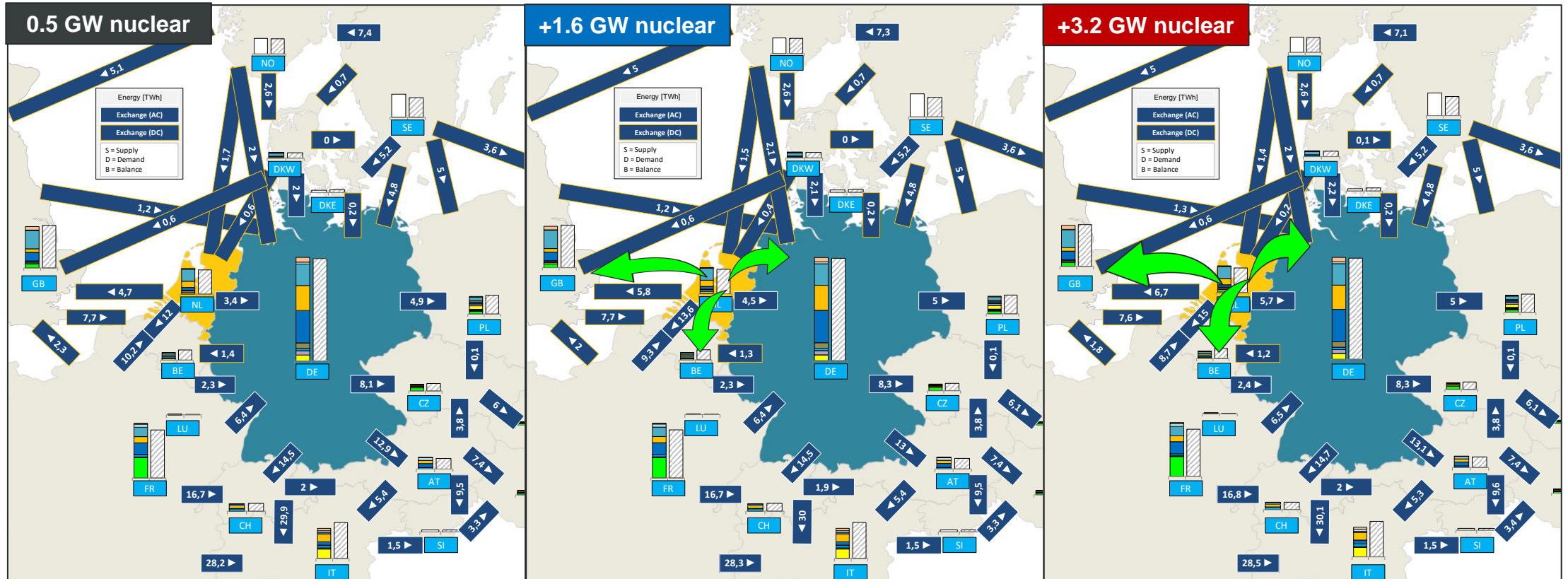


- Nuclear electricity production increases
- Gas-fired electricity production slightly decreases, but limited effect since mostly role as backup-capacities
- Lower electricity imports & higher exports due to addition of relatively cheap electricity production
- Limited increase of power-to-x use & curtailment, mostly due to more situations with excess supply from renewables

# Nuclear power

## Case study: Impact on electricity market

New nuclear power plants also impact the European electricity market & exchange between countries.

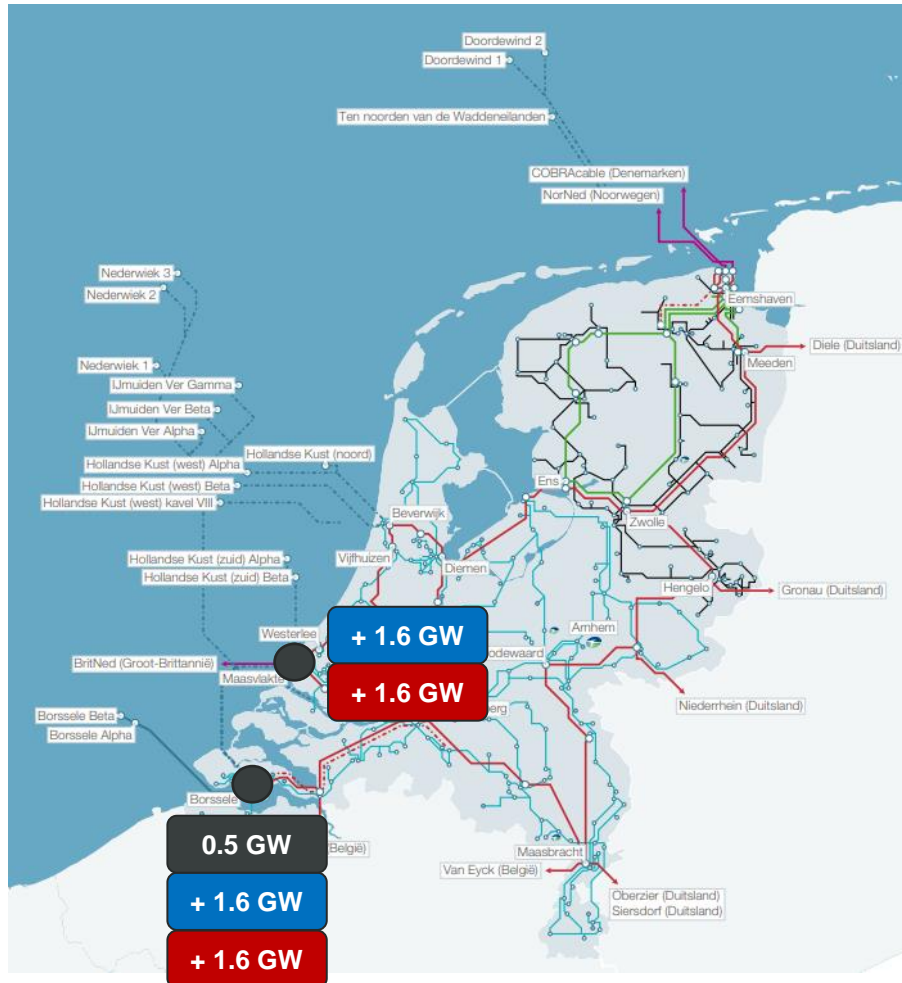


New nuclear power plants will not only serve domestic electricity demand, but also export their generation to other countries and substitute other forms of supply in Europe. With increasing amounts this effect becomes stronger.

# Nuclear power

## Case study: Impact on electricity grid

**Integrating new nuclear power plants has a significant impact on the required electricity grid.**



The market simulation results & assumed future locations of supply, demand and flexibility were input for the grid analyses.

Different **locational variants** investigated:

- ❖ Base case: Existing nuclear power plant in Borssele (0.5 GW)
- ❖ One additional power plant in Borssele (+ 1.6 GW)
- ❖ Two additional power plants in Borsseele (+ 3.2 GW)
- ❖ One additional power plant in Maasvlakte (+ 1.6 GW)
- ❖ Two additional power plants in Maasvlakte (+ 3.2 GW)

**Observations:**

- Under the study assumptions and in the investigated cases, **integrating new nuclear power plants would lead to infrastructural bottlenecks** and require additional measures
- However, **this outcome is dependent on factors** like the regional amount of renewables (especially wind offshore), regional electricity demand and the degree of its flexibility
- More detailed background about the study assumptions and results can be found in the [published report](#)

# Nuclear power

## Summary

- To achieve our energy and climate targets, **the energy system will have to change drastically**: A phase-out of fossil fuels, the availability of green energy sources, a more efficient use of energy, flexible resources to balance energy supply & demand and of course a robust infrastructure that can connect these elements are key for a successful transition.
- Nuclear power plants could be one of the (long-term) solutions to ensure sufficient green supply of electricity. **New-built of nuclear in the Netherlands is a political choice that requires balancing of societal, technological and economical questions.**
- **The potential market & grid infrastructure impact of new-built nuclear power plants is big.** Therefore it is important to carefully investigate under which circumstances new nuclear power plants in the Netherlands fit into the energy system. Relevant questions for TenneT concern size, locations and market behaviour of these plants.
- From first impact analyses we can conclude, that additional infrastructure measures are likely to be necessary to fit in nuclear power plants into the high voltage grid of TenneT in the time horizon until 2035. Further impact analyses (e.g. for later years) with varying assumptions are needed to gain more clarity.
- **Early clarity on the Dutch nuclear plans and a coordinated approach will help TenneT to realize the required infrastructure on time.**



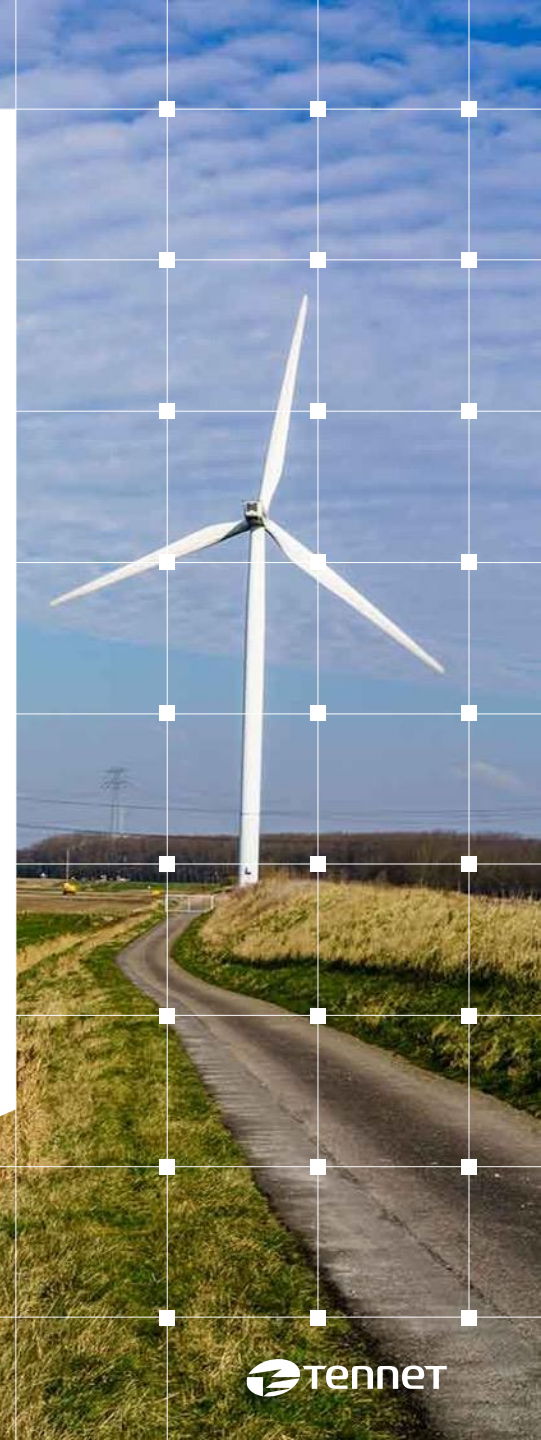
**Thanks for your attention!**

**Any more questions?**



TenneT is a leading European grid operator. We are committed to providing a secure and reliable supply of electricity 24 hours a day, 365 days a year, while helping to drive the energy transition in our pursuit of a brighter energy future – more sustainable, reliable and affordable than ever before. In our role as the first cross-border Transmission System Operator (TSO) we design, build, maintain and operate 25,000 kilometres of high-voltage electricity grid in the Netherlands and large parts of Germany, and facilitate the European energy market through our 17 interconnectors to neighbouring countries. We are one of the largest investors in national and international onshore and offshore electricity grids, with a turnover of EUR 9.8 billion and a total asset value of EUR 41 billion. Every day our 7,400 employees take ownership, show courage and make and maintain connections to ensure that the supply and demand of electricity is balanced for over 43 million people.

Lighting the way ahead together



# Disclaimer

This PowerPoint presentation is offered to you by TenneT TSO B.V. ('TenneT'). The content of the presentation – including all Teksts, images and audio fragments – is protected by copyright laws. No part of the content of the PowerPoint presentation may be copied, unless TenneT has expressly offered possibilities to do so, and no changes whatsoever may be made to the content. TenneT endeavours to ensure the provision of correct and up-to-date information, but makes no representations regarding correctness, accuracy or completeness.

TenneT declines any and all liability for any (alleged) damage arising from this PowerPoint presentation and for any consequences of activities undertaken on the strength of data or information contained therein.