Task Force scenarios – Workshop #1 Storylines

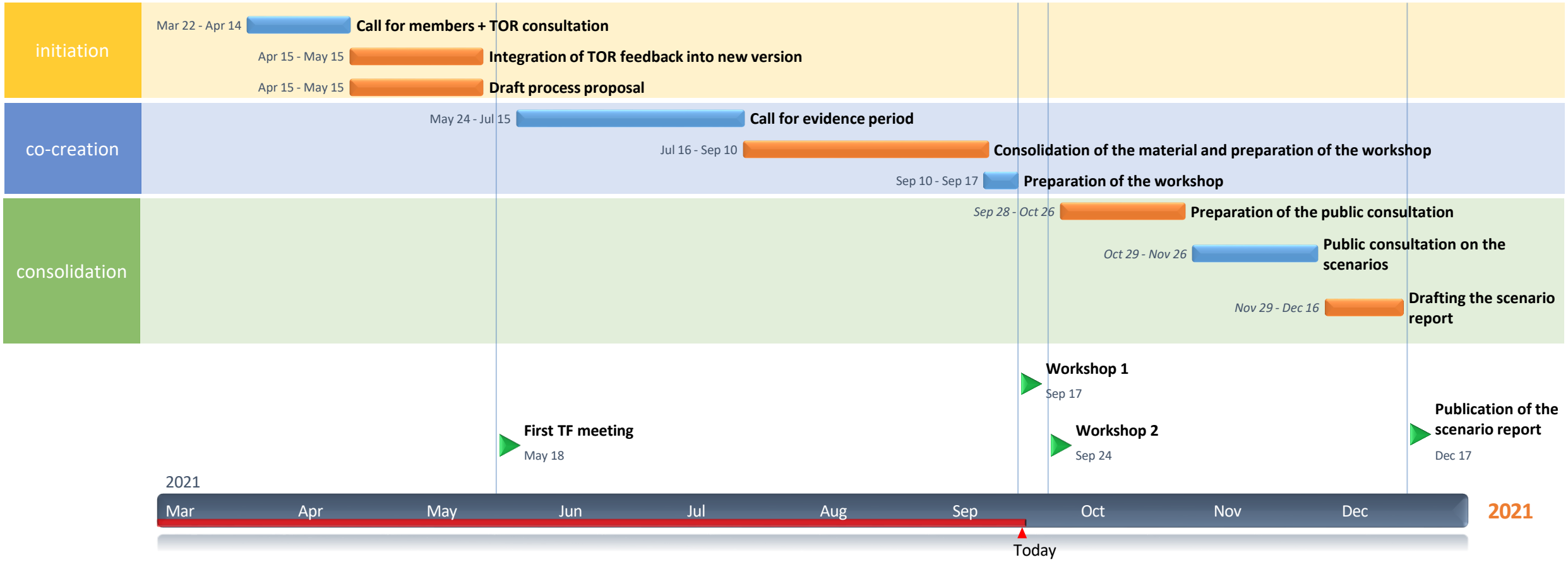
17-09-2021

Welcome to the Task Force

Agenda

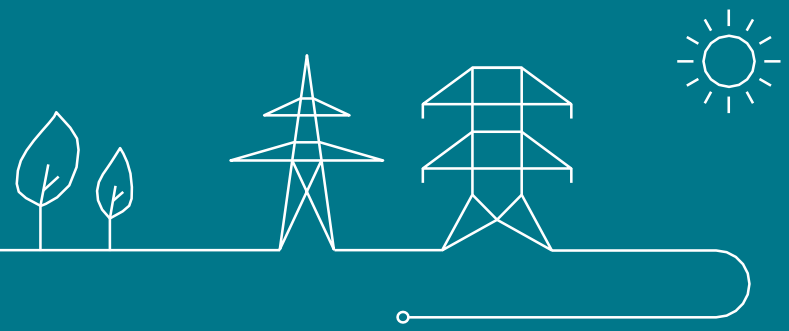
Start	End	Timing	Topic
13:00	13:10	00:10	Welcome to the workshop
13:10	13:20	00:10	Feedback Received on "call for evidence"
13:20	13:35	00:15	General methodology on storylines creation
13:35	13:55	00:20	Overview of TYNDP scenario report
13:55	14:15	00:20	Coffee break
14:15	14:30	00:15	Introduction to key questions & drivers for Belgium
14:30	15:30	01:00	Brainstorm & discussion about drivers for national sensitivities & variant storylines around the TYNDP storylines
15:30	16:00	00:30	Feedback + QA

Recap – Planning for 2021



Formal approval minutes 1805

“Call for evidence”



“Call for evidence”

Question was raised in kick-off meeting to send in other topics besides those proposed by Elia
→ no other topics proposals submitted

Call for evidence on:

- Storylines
- Flexibility in consumption

From **31/05 – 15/07**

Input received from 3 different parties:

- Fluxys – 13 documents
  - Feedback related to flexibility in electricity consumption
- FEBEG – 2 documents
  - Feedback related to storylines
- RWE – 0 documents (comments on proposed doc)

FEBEG

Concerns:

1. TYNDP storylines can be criticized for not being sufficiently substantiated (decentralized vs centralized)

2. TYNDP studies are often optimistic on the increase of capacities in Europe

3. The storylines outlined in the TYNDP studies seem only indirectly relevant for Belgium

In depth comments:

1. <u>Regarding usage of TYNDP</u>
   - TYNDP 2022 is under consideration
   - “Fit-for-55” package might give useful insights

   ⇒ Storyline should take into consideration the newly available information

FEBEG

2. Detailed remarks on TYNDP scenario storylines
   - Assumption of a more centralized (GA) or decentralized (DE) scenario are not well backed.
   - Technology is, in FEBEG opinion, the main differentiating factor in the long term.

   ⇒ Should be reflected in the scenarios

   Economic viability issues
   > Some assumptions are overly optimistic and not economically viable

   Sum of all studies results in optimistic view of available capacities
   > TYNDP is based on input from various TSO's & influenced by different political ambitions

   Gas and electricity interface
   > Gas network representation seems underdeveloped. The study does not sufficiently take into account the increased inter-dependence of gas and electricity networks

   Energy market and grid modelling
   > TYNDP should point to gaps with respect to the current target model
   f.e. today's electricity markets rely on one zone per member state. The grid is modelled with a network of 100 zone by 2040.

General Methodological Introduction

Introduction: Storylines & scenarios

Scenarios are intended to have a diversified view on long-term energy supply and demand considering trends,

policy ambitions and technological developments.

Scenarios and their **storylines** should be designed to reflect long-term EU and national policy goals and strategies.

Besides, these should also aim to consider uncertainties and strategies for the future development of the energy system with a focus on the impact for Belgium.

Within each **Storyline**, choices of technology, source and carrier will be defined as the ‘best’ strategies to cope with each corresponding future and/or level of ambition.

In order to ensure consistency with the EU approach, it is therefore proposed to use the **TYNDP scenarios** and their **storylines** as starting point.

The goal is therefore to understand what are the drivers behind the **TYNDP scenarios** and what could be other possible pathways that would be worth analyzing.

Guiding framework on storylines

Uncertainties

Technical
- Technology cost
- Fuel cost, efficiency, demand

Economic/Financial
- Economic growth
- Investors appetite

Political/Social/Environmental
- Public acceptance
- Climate policy & ambitions

Research & Development
- R&D funding
- Innovation, maturity

Example

Options / Choices

Technical
- RES potential
- NUC, COAL, GAS capacity

Economic/Financial
- Market design,
- Subsidies, Support schemes

Political/Social/Environmental
- Regulations (phase outs,..)
- Standards

Research & Development
- Offshore wind, PV,…
- V2G, P2X, Storage,..

Driver

Futures

A plausible combination of Uncertainties will create the boundaries for a possible ***Future***

Strategies

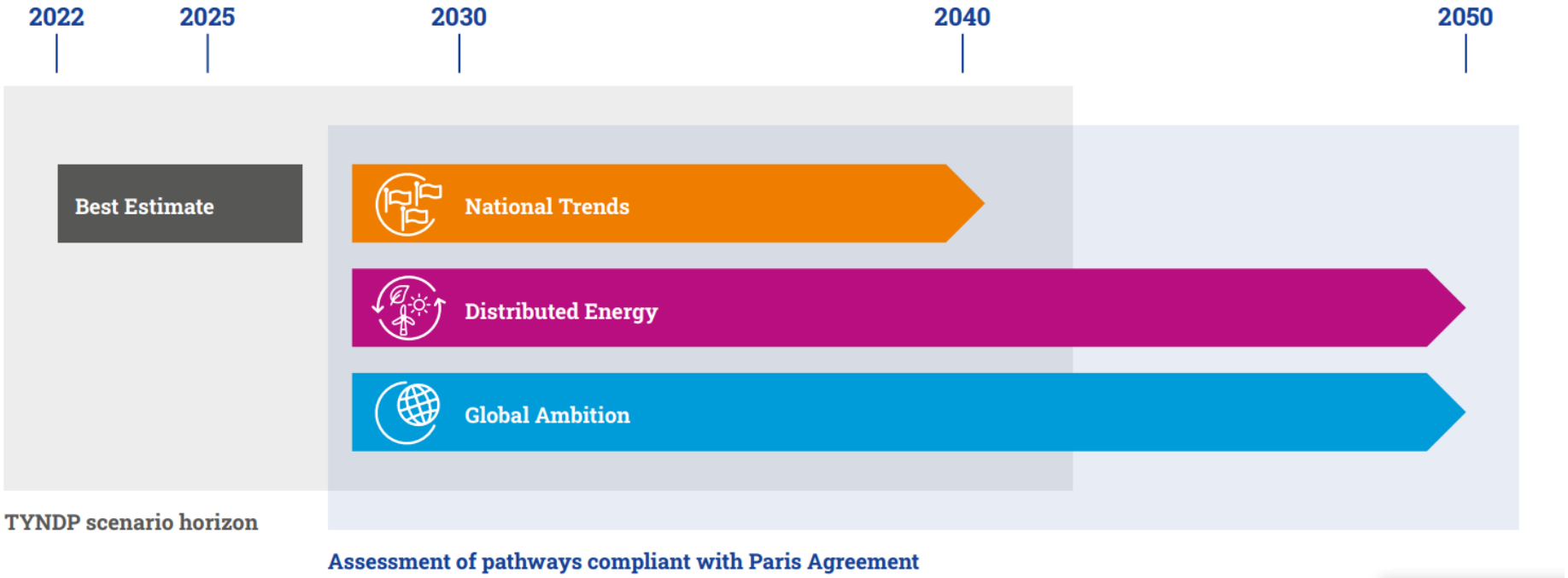
A plausible combination of Options defines the drivers for a possible ***Strategy***

Futures + **Strategies** → **Storylines**

Source: Adapted from FP7 e-HIGHWAY 2050 D1.2 deliverable

Overview of TYNDP 2022 storylines report

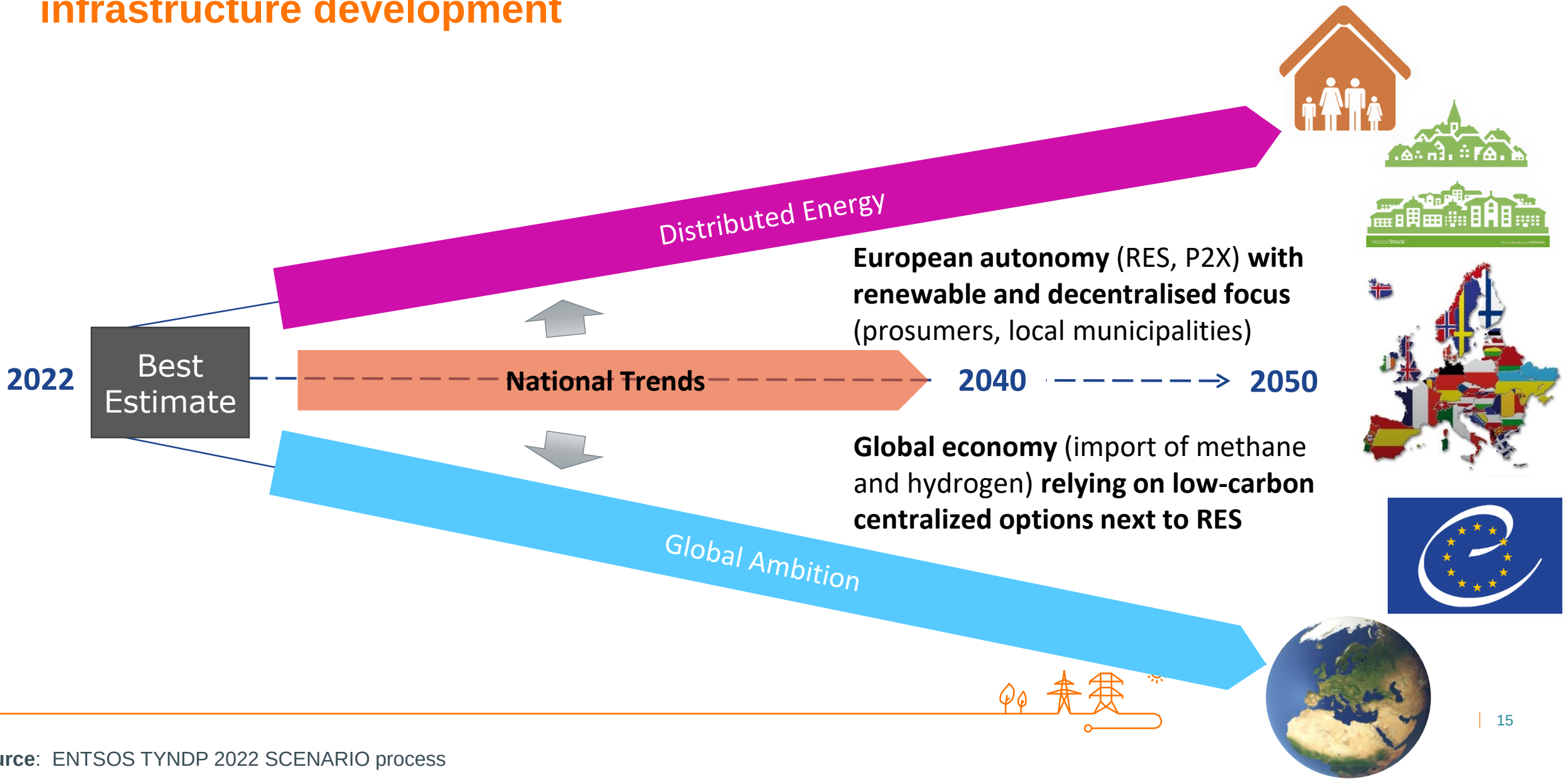
Three scenarios will be defined in the TYNDP2022



The Final TYNDP 2022 Scenario Report will ensure transparency on final scenarios description and use.

Source: ENTSOS TYNDP 2022 SCENARIOS (FINAL STORYLINE REPORT)

Scenarios aim to explore the different pathways relevant for infrastructure development



Source: ENTSOS TYNDP 2022 SCENARIO process

Drivers for the TYNDP 2022 storylines

Figure 4: High-Level Drivers of top-down scenarios

Source: ENTSOS TYNDP 2022 SCENARIOS (FINAL STORYLINE REPORT)

TYNDP 2022 Storyline Matrix (High-level drivers)

	Distributed Energy Higher European autonomy with renewable and decentralised focus	**Global Ambition** Global economy with centralised low carbon and RES options
Green Transition	At least −55 %[5] reduction in 2030, climate neutral in 2050	
Driving force of the energy transition	Transition initiated on local/national level (prosumers)	Transition initiated on a European/international level
	Aims for EU energy autonomy through maximisation of RES and smart sector integration (P2G/L)	High EU RES development supplemented with low carbon energy and imports
Energy intensity	Reduced energy demand through circularity and better energy consumption behaviour	Energy demand also declines, but priority is given to decarbonisation of energy supply
	Digitalisation driven by prosumer and variable RES management	Digitalisation and automation reinforce competitiveness of EU business
Technologies	Focus of decentralised technologies (PV, batteries, etc) and smart charging	Focus on large scale technologies (offshore wind, large storage)
	Focus on electric heat pumps and district heating	Focus on hybrid heating technology
	Higher share of EV, with e-liquids and biofuels supplementing for heavy transport	Wide range of technologies across mobility sectors (electricity, hydrogen and biofuels)
	Minimal CCS and nuclear	Integration of nuclear and CCS

Table 1: Storylines differentiation based on high-level drivers

Source: ENTSOS TYNDP 2022 SCENARIOS (FINAL STORYLINE REPORT)

TYNDP 2022 Storyline Matrix: Driver > Dimension > Characteristics

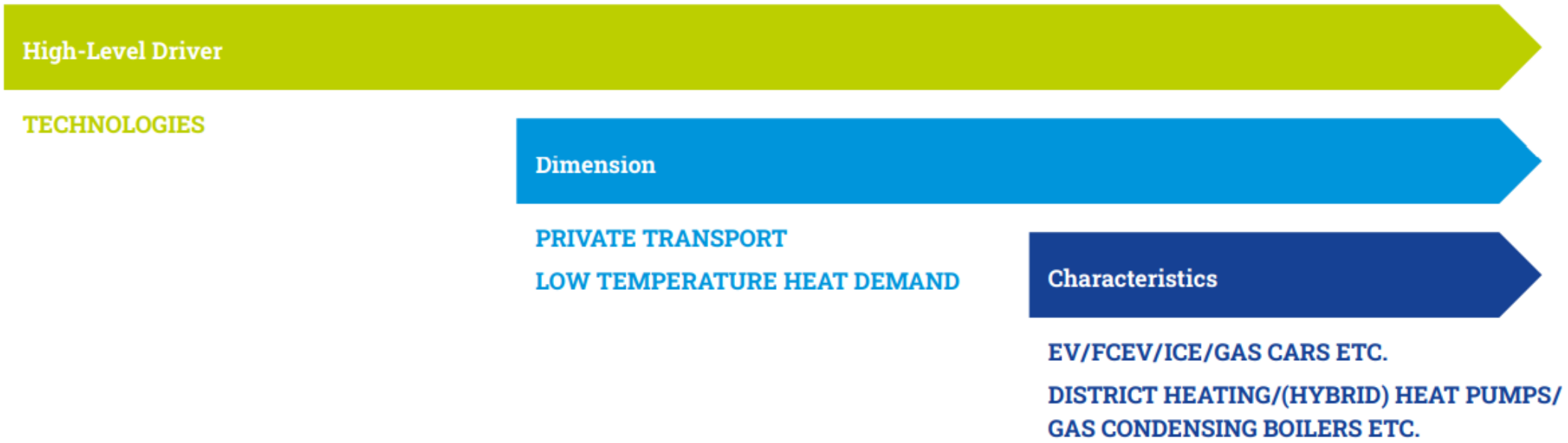


Figure 3: How to specify storyline characteristics (example)

Source: ENTSOS TYNDP 2022 SCENARIOS (FINAL STORYLINE REPORT)

TYNDP 2022 Storyline Matrix (Detailed)

High level driver	Dimension	Characteristic	Storyline 1 (DE)	Storyline 2 (GA)
Green transition	by 2030	Compliant with Green Deal (−50 − 55 % GHG emissions)	Yes	Yes
Green transition	by 2050	Reach carbon neutrality	Yes	Yes
Green transition	EU Carbon Budget	Compliant with EU strategies (LTS)	Yes	Yes
Driving force of energy transition	Initiative	Level of Decentralisation (Prosumer vs. Global)	Higher	Lower
Driving force of energy transition	Global Technology and Commodity Trade	Benefits from global synergies (sociatal acceptance and efficincies)	Lower	Higher
Driving force of energy transition	Autonomy	Share of energy autarky	Higher	Lower
Energy intensity	Residential and Tertiary	Behaviour: surface per person	Lower	Higher
Energy intensity	Residential and Tertiary	Behaviour: share of homeoffice	Higher	Lower
Energy intensity	Residential and Tertiary	Level of energy efficient consumer behaviour (lower room temperature)	Higher	Lower
Energy intensity	Residential and Tertiary	Level of energy efficient consumer behaviour (electric appliances)	Higher	Lower
Energy intensity	Residential and Tertiary	Level of renovation rate	Higher	Lower
Energy intensity	Transport	Level of public/shared transport (occupation per car)	Higher	Lower
Energy intensity	Transport	Number of traveled km per person (including vacation, trade and work)	Lower	Higher
Energy intensity	Transport	Share of autonomous vehicles	Similar	Similar
Energy intensity	Transport	Share of non-motorised transport	Higher	Lower
Energy intensity	Industry	Growth of industry (on shoring, export)	Lower	Higher
Energy intensity	Industry	Raw materials and feedstock (focus on non-energy fuels)	Lower	Higher
Energy intensity	Industry	Data centres	Similar	Similar
Technologies	Low Temperature Heat Demand	District heating (circularity)	Higher	Lower
Technologies	Low Temperature Heat Demand	Small scale gas boilers (households)	Similar	Similar
Technologies	Low Temperature Heat Demand	Small scale hybrid heat pumps (households)	Lower	Higher
Technologies	Low Temperature Heat Demand	Small scale all-electric heat pumps (households)	Higher	Lower
Technologies	Low Temperature Heat Demand	Small scale CHP incl. fuel cells (households)	Higher	Lower
Technologies	Private transport	EV	Higher	Lower
Technologies	Private transport	FCEV	Lower	Higher
Technologies	Heavy goods transport	EV	Higher	Lower
Technologies	Heavy goods transport	FCEV	Lower	Higher
Technologies	Heavy goods transport	Compressed Methane Cars	Lower	Higher
Technologies	Aviation and shipping	Liquids (methane, hydrogen, bio or synthetic fuels)	Lower	Higher
Technologies	Aviation and shipping	Electricity	Higher	Lower
Technologies	Industry: high temperature heat	Methane	Lower	Higher
Technologies	Industry: high temperature heat	Hydrogen	Lower	Higher
Technologies	Industry: high temperature heat	Electricty	Higher	Lower
Technologies	Carbon economy	CCS (all sources)	Lower	Higher
Technologies	Sector coupling	Share of P2X	Higher	Lower
Technologies	Electrictiy supply for direct electricity demand	Solar-PV	Higher	Lower
Technologies	Electrictiy supply for direct electricity demand	Onshore wind	Higher	Lower
Technologies	Electrictiy supply for direct electricity demand	Offshore wind	Lower	Higher
Technologies	Electrictiy supply for direct electricity demand	(New) nuclear	Lower	Higher
Technologies	Electrictiy supply for direct electricity demand	Small Scale CHP (including fuel cells)	Higher	Lower
Technologies	Electrictiy supply for direct electricity demand	Large Scale CHP (including fuel cells)	Lower	Higher
Technologies	Electrictiy supply for direct-electricity demand	Concentrated Solar Power	Lower	Higher
Technologies	Electricity balancing	Thermal Generation	Similar	Similar
Technologies	Electricity balancing	DSR based on Smart Metering	Higher	Lower
Technologies	Electricity balancing	Flexible power to heat	Higher	Lower
Technologies	Electricity balancing	Batteries (behind the meter)	Higher	Lower
Technologies	Electricity balancing	Large scale electricy storage	Lower	Higher
Technologies	Electricity balancing	Smart charging	Higher	Lower
Technologies	Electricity balancing	P2x	Higher	Lower

The qualitative levels refer to the storyline differentiation at the 2050 time horizon. Most of the drivers will see an evolution in the same direction when compared to the present situation.

Source: ENTSOS TYNDP 2022 SCENARIOS (FINAL STORYLINE REPORT)

TYNDP 2022 Storyline Matrix (Example on Technologies)

Technologies	Low Temperature Heat Demand	District heating (circularity)	Higher	Lower
Technologies	Low Temperature Heat Demand	Small scale gas boilers (households)	Similar	Similar
Technologies	Low Temperature Heat Demand	Small scale hybrid heat pumps (households)	Lower	Higher
Technologies	Low Temperature Heat Demand	Small scale all-electric heat pumps (households)	Higher	Lower
Technologies	Low Temperature Heat Demand	Small scale CHP incl. fuel cells (households)	Higher	Lower
Technologies	Private transport	EV	Higher	Lower
Technologies	Private transport	FCEV	Lower	Higher
Technologies	Heavy goods transport	EV	Higher	Lower
Technologies	Heavy goods transport	FCEV	Lower	Higher

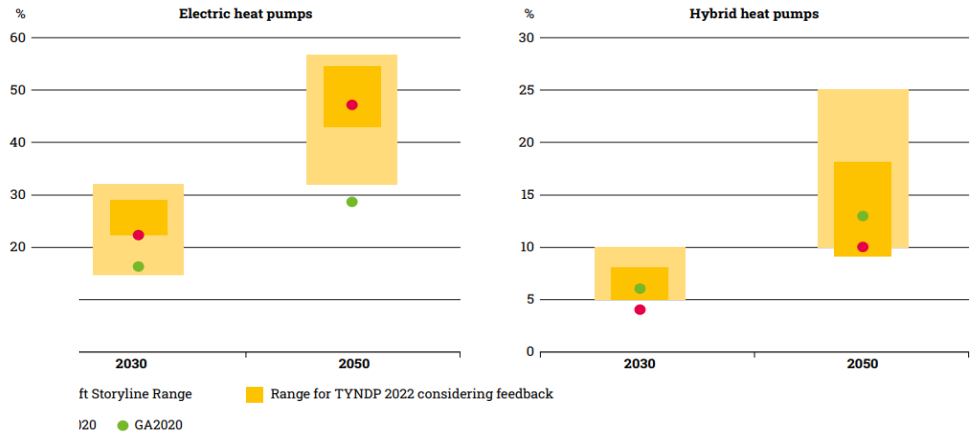
Source: ENTSOS TYNDP 2022 SCENARIOS (FINAL STORYLINE REPORT)

TYNDP 2022 Storylines ‘data – for – quantatitave – ranges’

Characteristics

EV/FCEV/ICE/GAS CARS ETC.

DISTRICT HEATING/(HYBRID) HEAT PUMPS/ GAS CONDENSING BOILERS ETC.



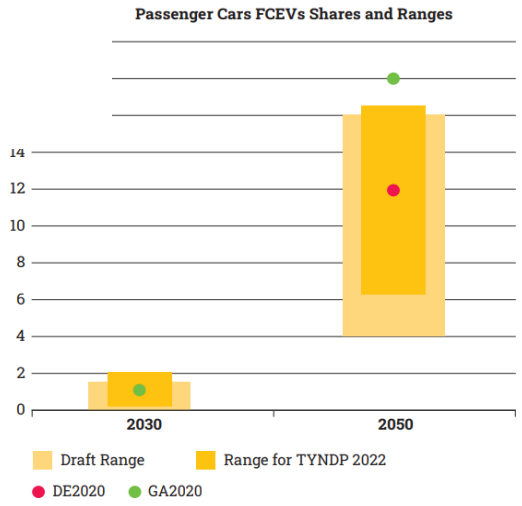


Figure 8: Market share of FCEVs in passenger car fleet

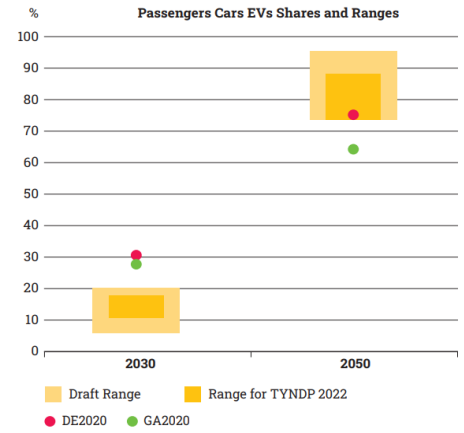


Figure 7: Market share of EVs in passenger car fleet

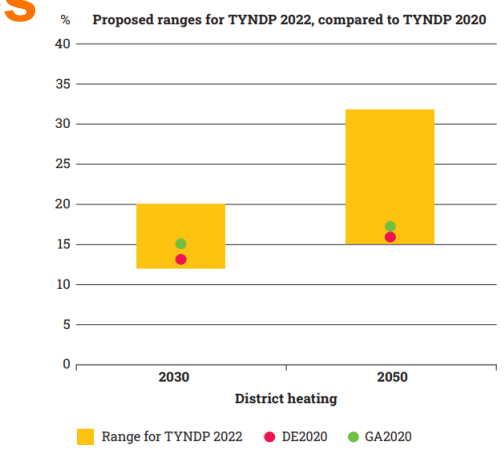


Figure 6: Market share of district heating in the built environment

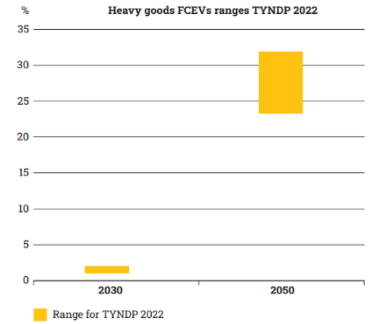


Figure 10: Market share of FCEVs in heavy goods vehicles

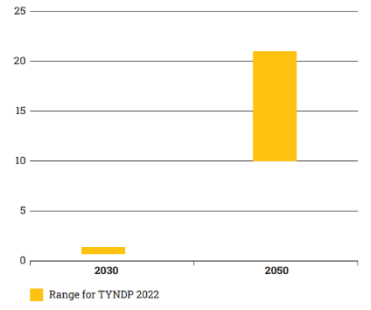


Figure 9: Market share of EVs in heavy goods vehicles

Source: ENTSOS TYNDP 2022 SCENARIOS (FINAL STORYLINE REPORT)

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Source: ENTSOS TYNDP 2022 SCENARIOS (FINAL STORYLINE REPORT)

TYNDP 2022 Storyline Matrix (Example on Technologies)

Technologies	Electrictiy supply for direct electricity demand	Solar-PV		Higher	Lower
Technologies	Electrictiy supply for direct electricity demand	Onshore wind		Higher	Lower
Technologies	Electrictiy supply for direct electricity demand	Offshore wind		Lower	Higher
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Source: ENTSOS TYNDP 2022 SCENARIOS (FINAL STORYLINE REPORT)

TYNDP Storylines ‘data – for – quantitative – ranges’

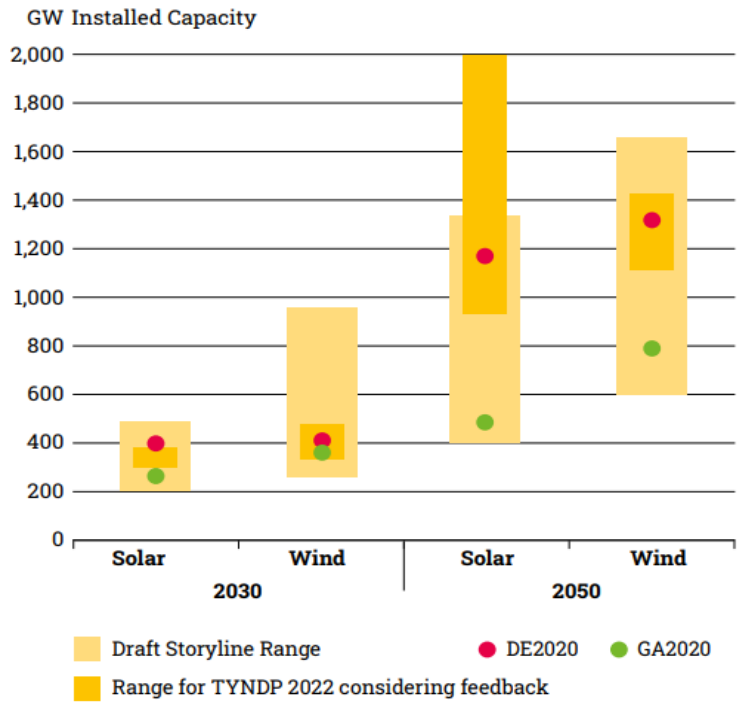


Figure 11: Installed capacities for solar PV and wind generation for EU27 (comparison between initial range from the Draft Storyline Report and the updated range considering consultation feedback)

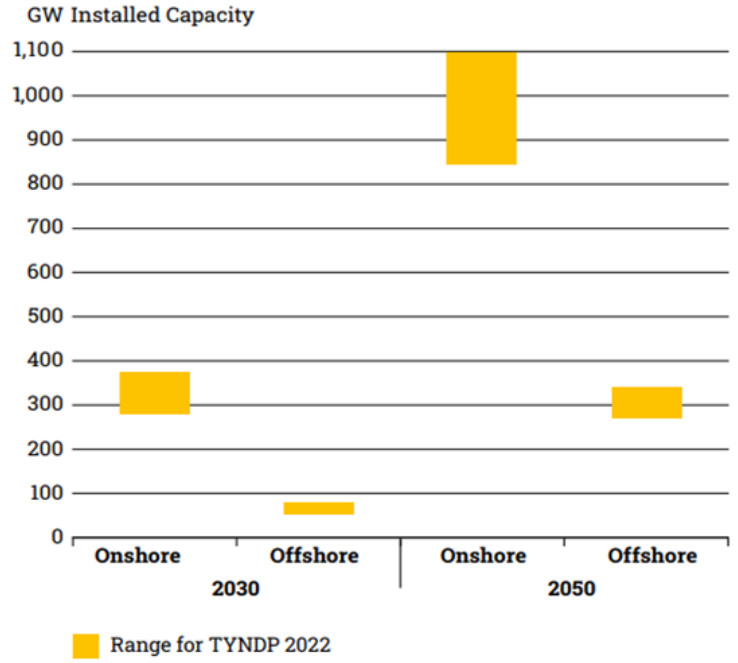


Figure 12: Trajectories of onshore and offshore wind technologies for EU27

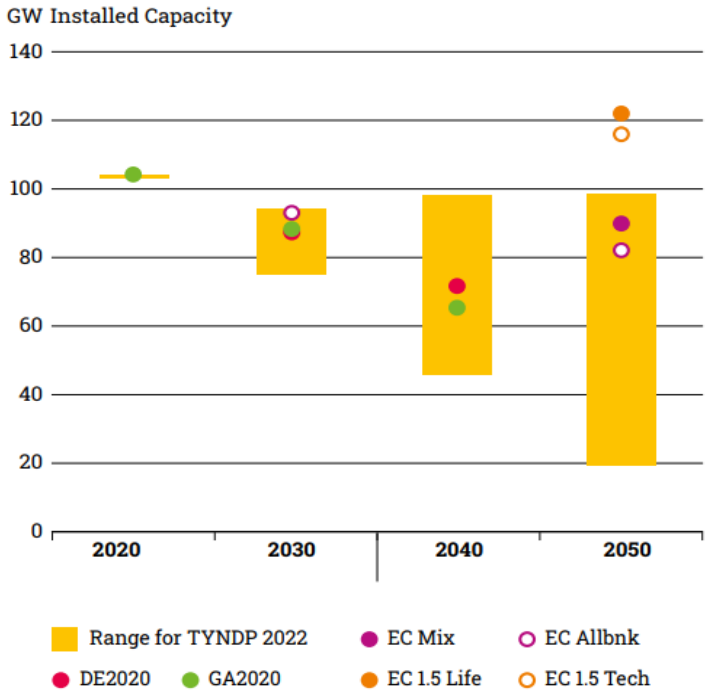


Figure 13: Trajectories for nuclear generation capacity for EU27

Source: ENTSOS TYNDP 2022 SCENARIOS (FINAL STORYLINE REPORT)

TYNDP Storylines ‘data – for – quantitative – ranges’

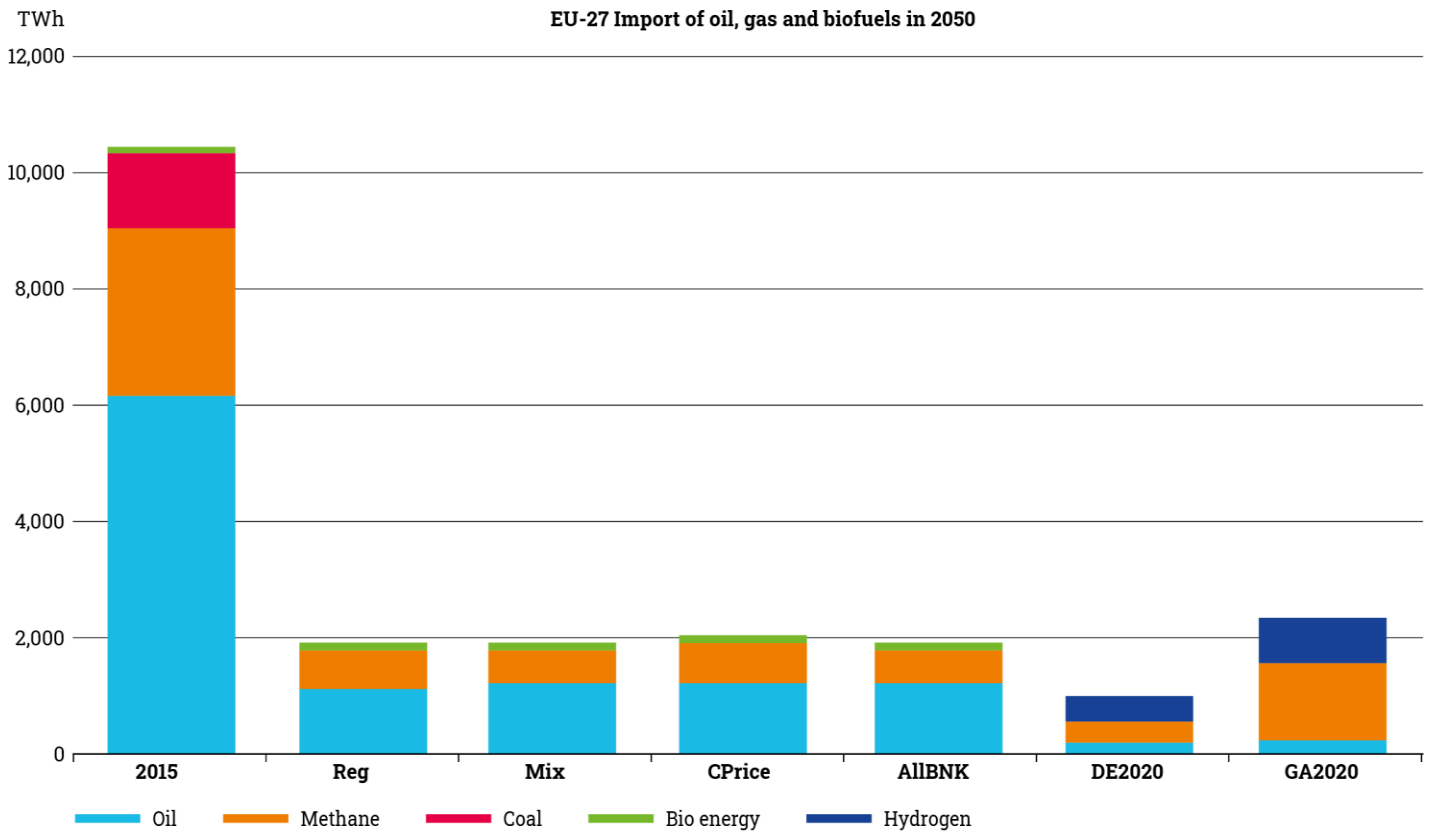
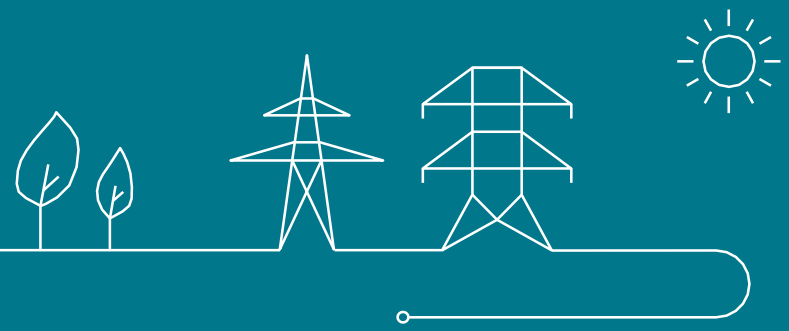


Figure 14: Import of oil, gas and biofuels in 2050

Source: ENTSOS TYNDP 2022 SCENARIOS (FINAL STORYLINE REPORT)

Coffeebreak – 20’



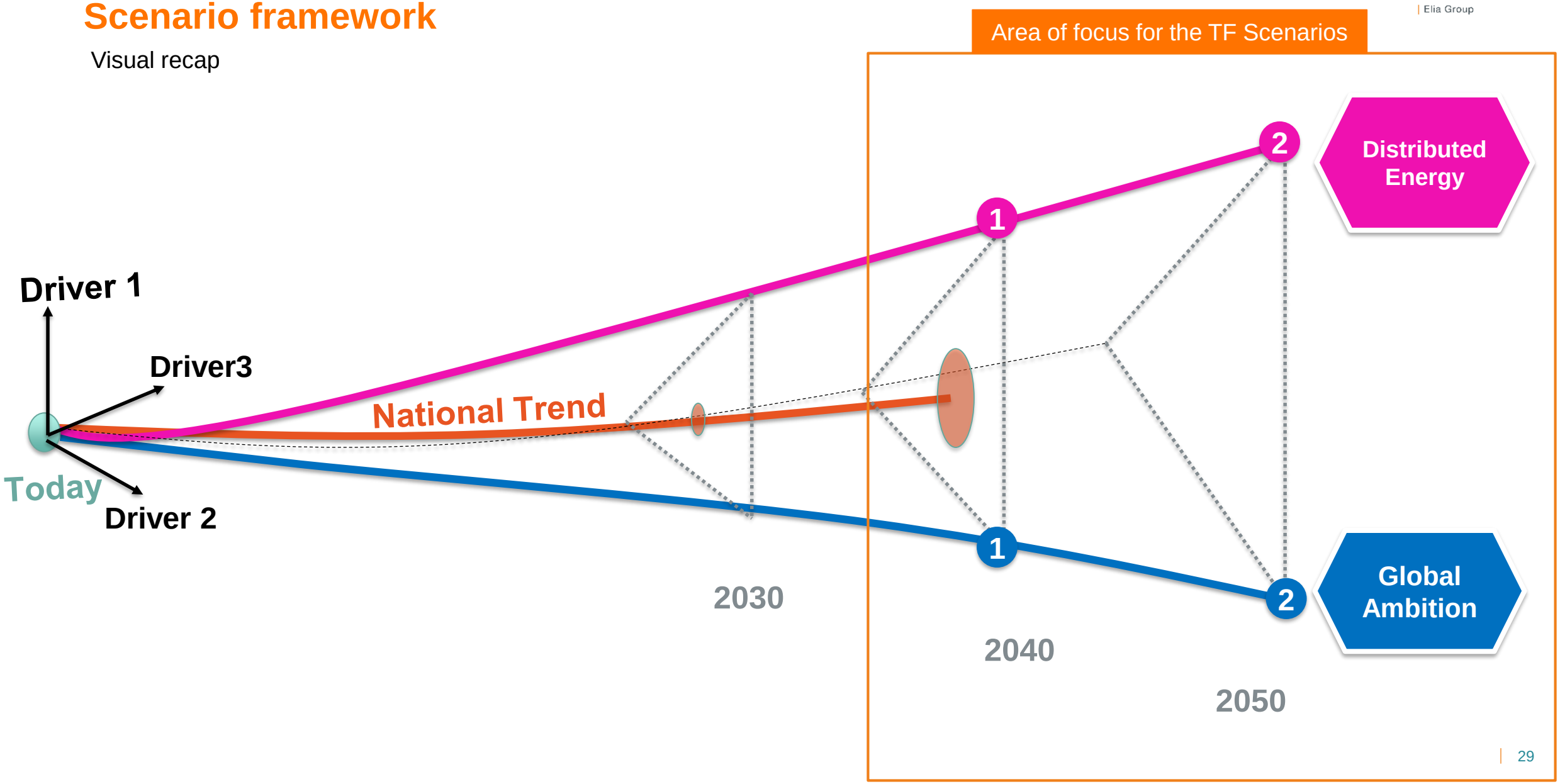
2040 & 2050: introduction to key questions & drivers for Belgium

Scenario framework

Visual recap

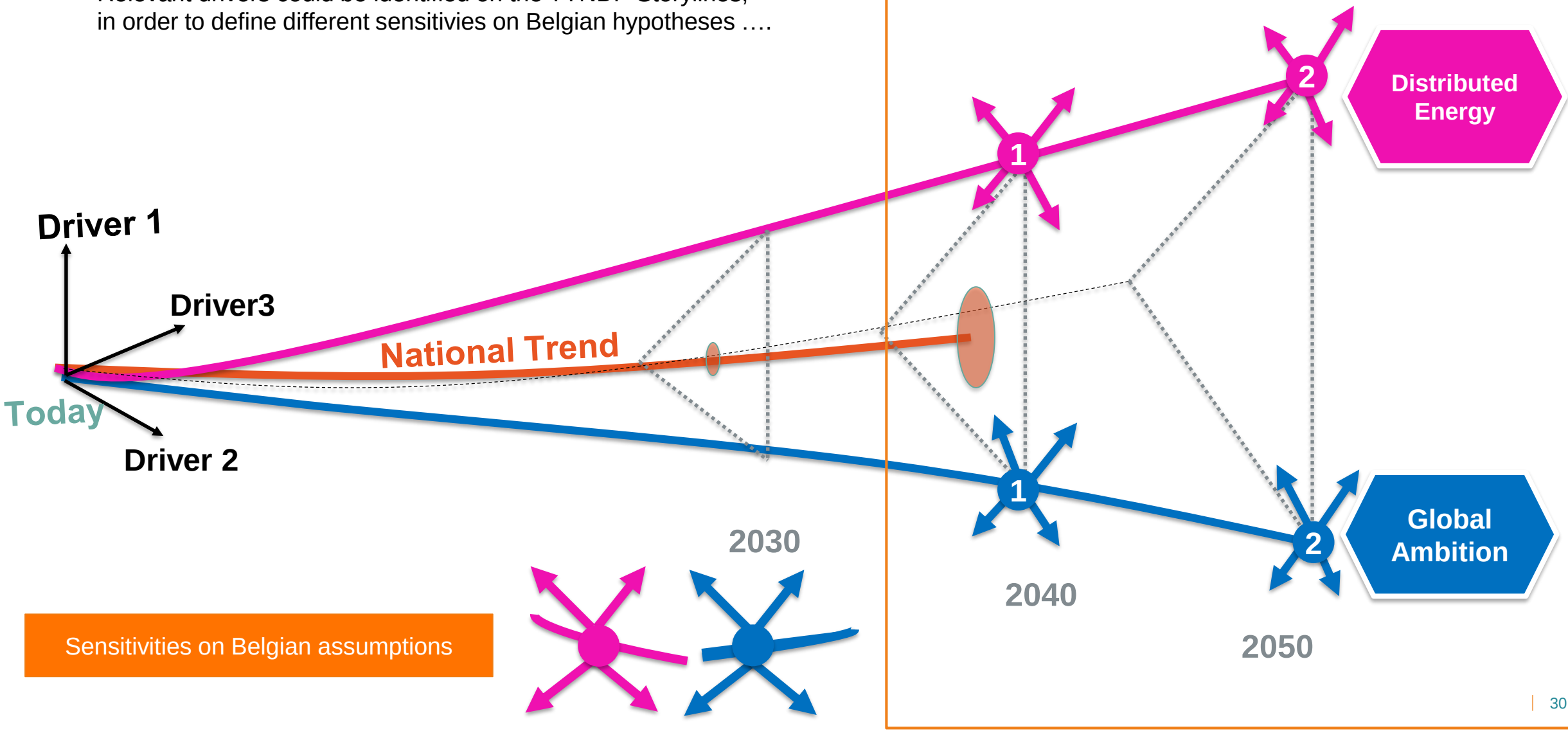
Scenario framework

Visual recap



Sensitivities

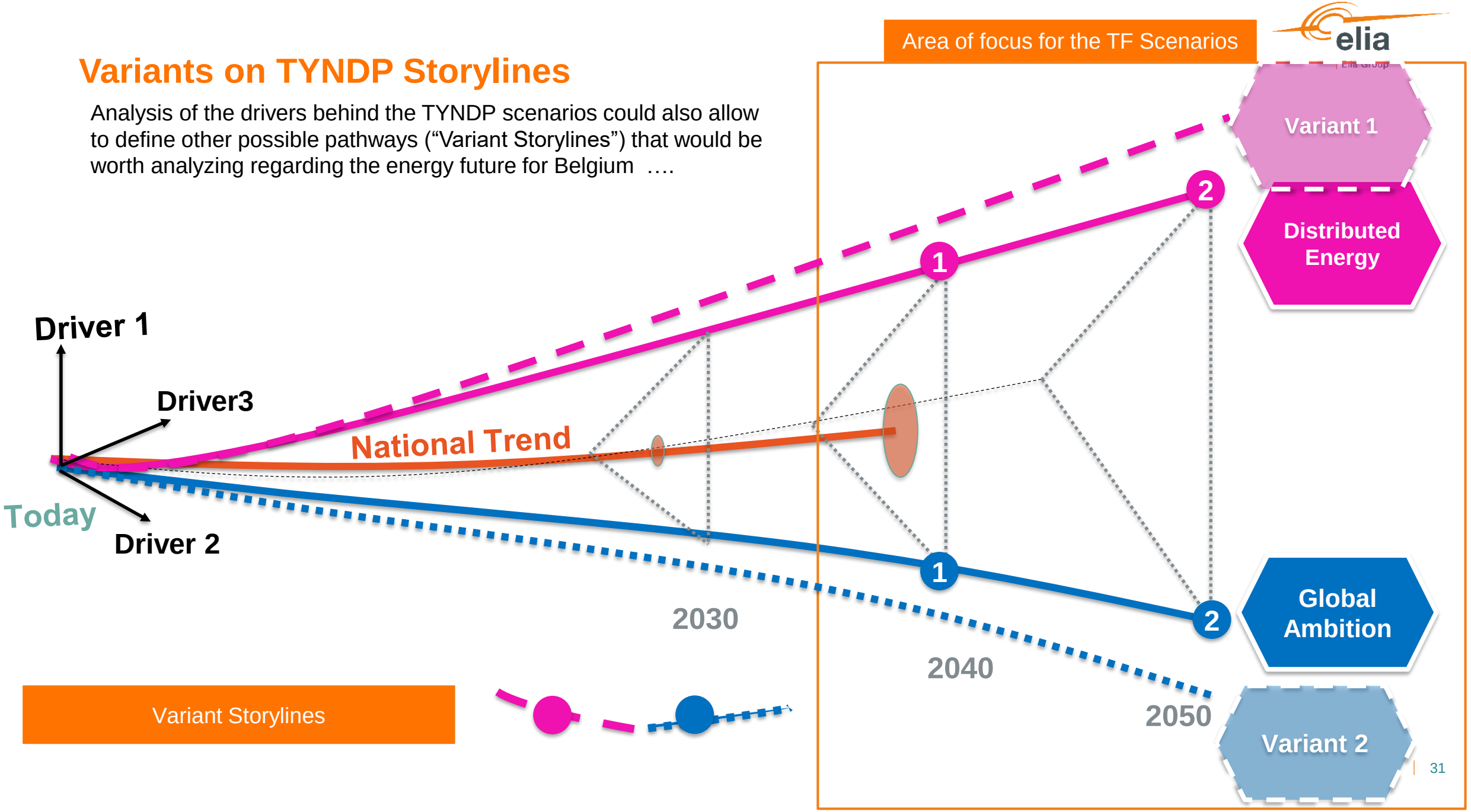
Relevant drivers could be identified on the TYNDP Storylines, in order to define different sensitivies on Belgian hypotheses ….



Sensitivities on Belgian assumptions

Variants on TYNDP Storylines

Analysis of the drivers behind the TYNDP scenarios could also allow to define other possible pathways (“Variant Storylines”) that would be worth analyzing regarding the energy future for Belgium ….



From storylines to scenarios

At “Storyline” level we only set the input parameters that are needed for our modelling to be performed.

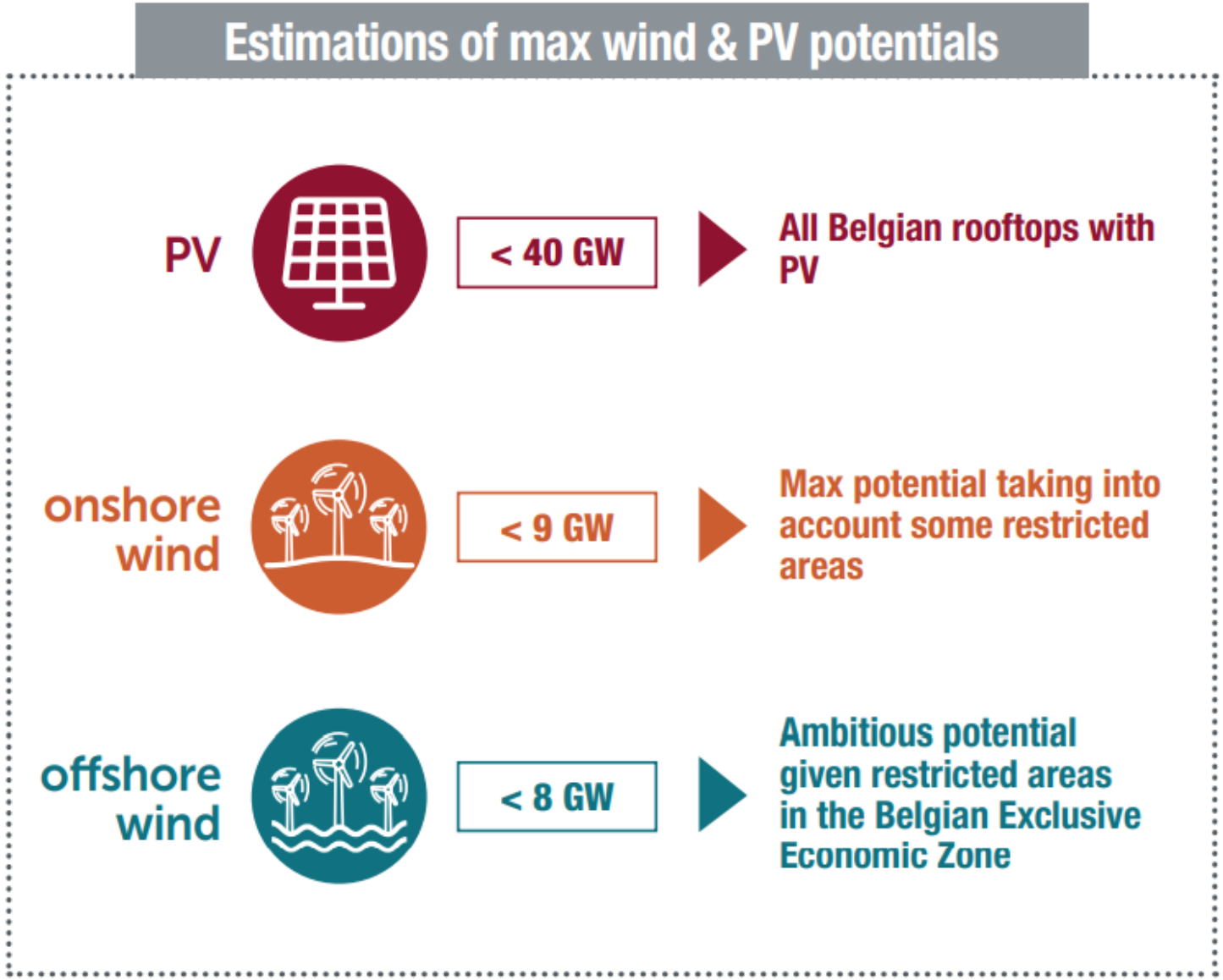
The final number of e.g. heat pumps and electric vehicles, etc…. are, based on input assumptions and parameters, finally quantified within the modelling exercise.

The consequences of such input assumptions on energy demand and supply and associated emissions are thus not yet know at “Storyline” level.

These can only be provided after the energy market modelling exercise is completed..

For illustration:
Some “indicative” ranges of Electricity Supply and Demand towards 2040 for Belgium….

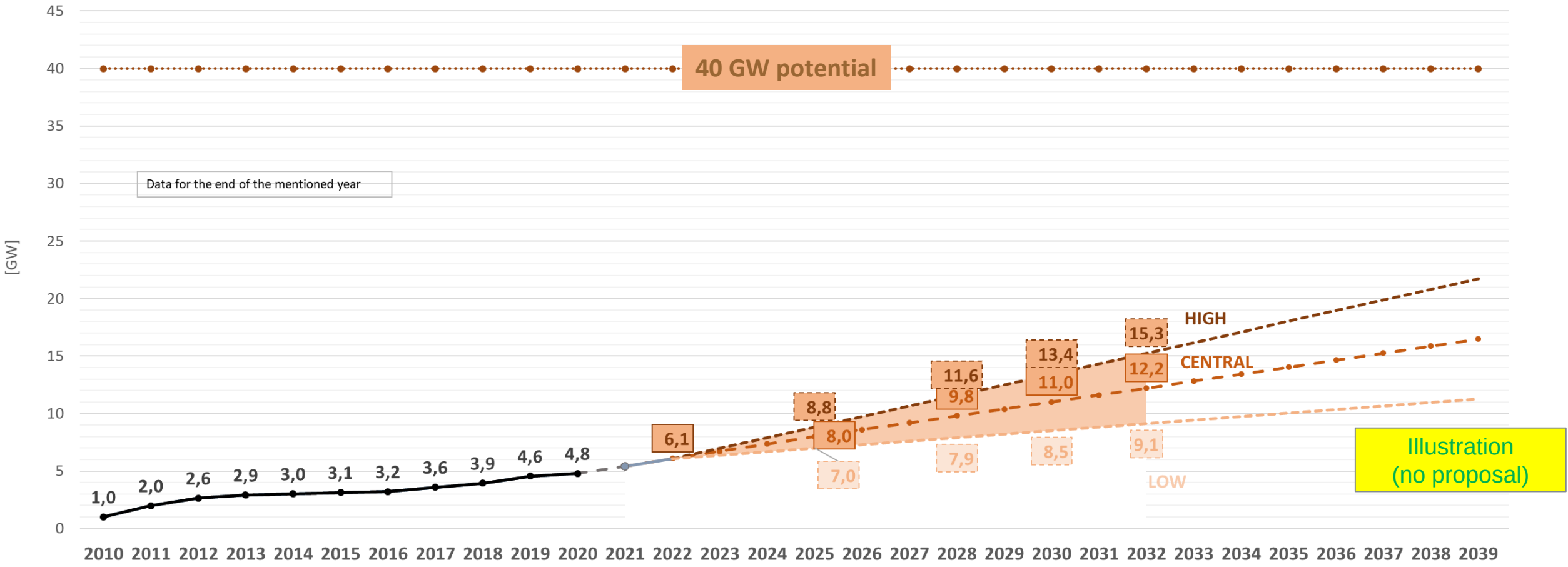
Estimations of Wind and PV potentials



Source: ELIA ELECTRICITY SCENARIOS FOR BELGIUM TOWARDS 2050 (November 2017)

PV

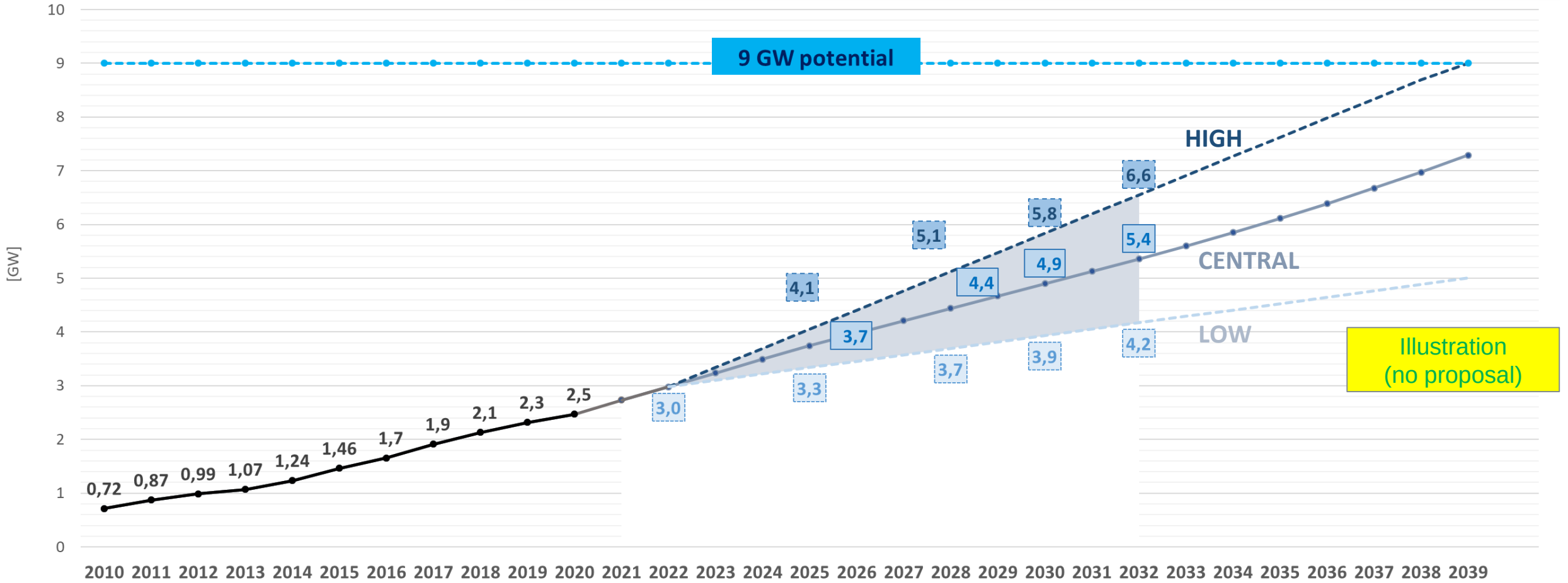
The scenario quantification exercise will assess whether **PV** will be either <u>within</u> these ranges, <u>outside</u> these or even reach the <u>maximum potential</u>, following each different Storyline



Source: Adapted from ELIA ADEQUACY AND FLEXBILITY STUDY FOR BELGIUM 2022-2032 (JUNE 2021)

Onshore wind

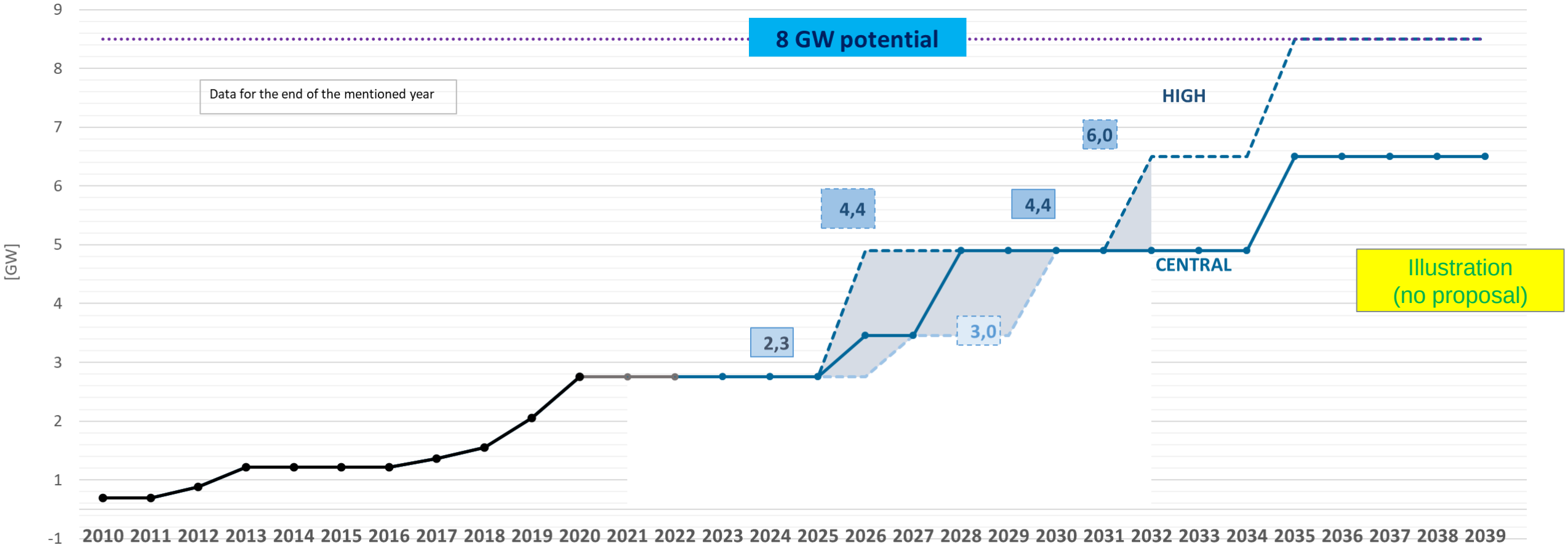
The scenario quantification exercise will assess whether **Onshore Wind** will be either within these ranges, outside these or even reach the maximum potential, following each different Storyline



Source: Adapted from ELIA ADEQUACY AND FLEXBILITY STUDY FOR BELGIUM 2022-2032 (JUNE 2021)

Offshore wind

The scenario quantification exercise will assess whether **Offshore Wind** will be either within these ranges, outside these or even reach the maximum potential, following each different Storyline



Source: Adapted from ELIA ADEQUACY AND FLEXBILITY STUDY FOR BELGIUM 2022-2032 (JUNE 2021)

Total demand

The scenario quantification exercise will assess whether **Total Demand** will be either within or outside these ranges, following each different Storyline.

'High load'

CENTRAL

'Low load'

Illustration (no proposal)

* the 2020 value is an estimation

Source: Adapted from ELIA ADEQUACY AND FLEXBILITY STUDY FOR BELGIUM 2022-2032 (JUNE 2021)

Brainstorm / discussion about possible national sensitivities & variant storylines around the TYNDP storylines

Scope of the brainstorm exercise

- We will now split the group into small groups.
- Each small group is expected to :
  - Select within the « Storyline Matrix » the **most important** DIMENSION/CHARACTERISTIC for Belgium according to you

and then

either

  - #1 Modify the given CHARACTERISTIC (HIGH, LOW etc..) of the selected DIMENSIONS (thus not necesarily all) with respect to the defined TYNDP Storylines for DE and GA

or

  - #2 Propose a NEW CHARACTERISTIC value(s) for a new « Variant or Sensitivity » (Variant 1 or Variant 2)

- A representative of each small group will be invited to present their findings to the whole group afterwards.
- Every suggestion by each small group needs to be properly explained and argumented.
- These input will be discussed – challenged within the whole group.
- This input will be analyzed further and consolidated after this Workshop, with an explanation of the analysis performed.

GREEN TRANSITION

climate ambitions

High level driver	Dimension	Characteristic	Storyline 1 (DE)	Storyline 2 (GA)
Green transition	by 2030	Compliant with Green Deal (−50 − 55 % GHG emissions)	Yes	Yes
Green transition	by 2050	Reach carbon neutrality	Yes	Yes
Green transition	EU Carbon Budget	Compliant with EU strategies (LTS)	Yes	Yes

GREEN TRANSITION

climate ambitions

High level driver	Dimension	Characteristic	Storyline 1 (DE)	Storyline 2 (GA)	Variant 1	Variant 2
Green transition	by 2030	Compliant with Green Deal (-50-55% GHG emissions)	Yes	Yes	Yes	Yes
Green transition	by 2050	Reach carbon neutrality	Yes	Yes	Yes	Yes
Green transition	EU Carbon Budget	Compliant with EU strategies (LTS)	Yes	Yes	Yes	Yes

Example

We believe that all Storylines should be compliant with the “Green Transition targets” at least for BE

DRIVING FORCE OF ENERGY TRANSITION

Decentralised vs centralised
Self-sufficiency vs imports

High level driver	Dimension	Characteristic	Storyline 1 (DE)	Storyline 2 (GA)
Driving force of energy transition	Initiative	Level of Decentralisation (Prosumer vs. Global)	Higher	Lower
Driving force of energy transition	Global Technology and Commodity Trade	Benefits from global synergies (sociatal acceptance and efficincies)	Lower	Higher
Driving force of energy transition	Autonomy	Share of energy autarky	Higher	Lower

DRIVING FORCE OF ENERGY TRANSITION

Decentralised vs centralised
Self-sufficiency vs imports

High level driver	Dimension	Characteristic	Storyline 1 (DE)	Storyline 2 (GA)	Variant 1	Variant 2
Driving force of the Transition	Initiative	Level of Decentralisation (Prosumer vs. Global)	Higher	Lower	Maximum Prosumer*	Tbd
Driving force of the Transition	Global Technology and Commodity Trade	Benefits from global synergies (societal acceptance and efficiencies)	Lower	Higher	Tbd	tbd
Driving force of the Transition	Autonomy	Share of energy self-sufficiency	Higher	Lower	Tbd	tbd

Example

Maximum Prosumers* = We believe that in BE all Costumers could become Prosumers in 20XX because … … so a new “Variant 1” should capture this.

High level driver	Dimension	Characteristic	Storyline 1 (DE)	Storyline 2 (GA)
Energy intensity	Residential and Tertiary	Behaviour: surface per person	Lower	Higher
Energy intensity	Residential and Tertiary	Behaviour: share of homeoffice	Higher	Lower
Energy intensity	Residential and Tertiary	Level of energy efficient consumer behaviour (lower room temperature)	Higher	Lower
Energy intensity	Residential and Tertiary	Level of energy efficient consumer behaviour (electric appliances)	Higher	Lower
Energy intensity	Residential and Tertiary	Level of renovation rate	Higher	Lower
Energy intensity	Transport	Level of public/shared transport (occupation per car)	Higher	Lower
Energy intensity	Transport	Number of traveled km per person (including vacation, trade and work)	Lower	Higher
Energy intensity	Transport	Share of autonomous vehicles	Similar	Similar
Energy intensity	Transport	Share of non-motorised transport	Higher	Lower
Energy intensity	Industry	Growth of industry (on shoring, export)	Lower	Higher
Energy intensity	Industry	Raw materials and feedstock (focus on non-energy fuels)	Lower	Higher
Energy intensity	Industry	Data centres	Similar	Similar

ENERGY INTENSITY

Circularity, efficiency and behavioural change

High level driver	Dimension	Characteristic	Storyline 1 (DE)	Storyline 2 (GA)	Variant 1	Variant 2
Energy intensity	Residential and Tertiary	Behaviour: surface per person	Lower	Higher	tbd	tbd
Energy intensity	Residential and Tertiary	Behaviour: share of homeoffice	Higher	Lower	tbd	tbd
Energy intensity	Residential and Tertiary	Level of energy efficient consumer behaviour (lower room temperature)	Higher	Lower	tbd	tbd
Energy intensity	Residential and Tertiary	Level of energy efficient consumer behaviour (electric appliances)	Higher	Lower	tbd	tbd
Energy intensity	Residential and Tertiary	Level of renovation rate	Higher	Lower	tbd	tbd
Energy intensity	Transport	Level of public/shared transport (occupation per car)	Higher	Lower	tbd	tbd
Energy intensity	Transport	Number of traveled km per person (including vacation, trade and work)	Lower	Higher	tbd	tbd
Energy intensity	Transport	Share of autonomous vehicles	Similar	Similar	tbd	tbd
Energy intensity	Transport	Share of non-motorised transport	Higher	Lower	tbd	tbd
Energy intensity	Industry	Growth of industry (on shoring, export)	Lower	Higher	tbd	tbd
Energy intensity	Industry	Raw materials and feedstock (focus on non-energy fuels)	Lower	Higher	tbd	tbd
Energy intensity	Industry	Data centres	Similar	Similar	tbd	tbd

High level driver	Dimension	Characteristic	Storyline 1 (DE)	Storyline 2 (GA)
Technologies	Low Temperature Heat Demand	District heating (circularity)	Higher	Lower
Technologies	Low Temperature Heat Demand	Small scale gas boilers (households)	Similar	Similar
Technologies	Low Temperature Heat Demand	Small scale hybrid heat pumps (households)	Lower	Higher
Technologies	Low Temperature Heat Demand	Small scale all-electric heat pumps (households)	Higher	Lower
Technologies	Low Temperature Heat Demand	Small scale CHP incl. fuel cells (households)	Higher	Lower
Technologies	Private transport	EV	Higher	Lower
Technologies	Private transport	FCEV	Lower	Higher
Technologies	Heavy goods transport	EV	Higher	Lower
Technologies	Heavy goods transport	FCEV	Lower	Higher

TECHNOLOGIES

Supply, Demand, Sector Coupling (incl. hydrogen), E&G Flexibilities

High level driver	Dimension	Characteristic	Storyline 1 (DE)	Storyline 2 (GA)
Technologies	Heavy goods transport	Compressed Methane Cars	Lower	Higher
Technologies	Aviation and shipping	Liquids (methane, hydrogen, bio or synthetic fuels)	Lower	Higher
Technologies	Aviation and shipping	Electricity	Higher	Lower
Technologies	Industry: high temperature heat	Methane	Lower	Higher
Technologies	Industry: high temperature heat	Hydrogen	Lower	Higher
Technologies	Industry: high temperature heat	Electricty	Higher	Lower
Technologies	Carbon economy	CCS (all sources)	Lower	Higher
Technologies	Sector coupling	Share of P2X	Higher	Lower
Technologies	Electrictiy supply for direct electricity demand	Solar-PV	Higher	Lower
Technologies	Electrictiy supply for direct electricity demand	Onshore wind	Higher	Lower
Technologies	Electrictiy supply for direct electricity demand	Offshore wind	Lower	Higher
Technologies	Electrictiy supply for direct electricity demand	(New) nuclear	Lower	Higher
Technologies	Electrictiy supply for direct electricity demand	Small Scale CHP (including fuel cells)	Higher	Lower
Technologies	Electrictiy supply for direct electricity demand	Large Scale CHP (including fuel cells)	Lower	Higher
Technologies	Electrictiy supply for direct-electricity demand	Concentrated Solar Power	Lower	Higher
Technologies	Electricity balancing	Thermal Generation	Similar	Similar
Technologies	Electricity balancing	DSR based on Smart Metering	Higher	Lower
Technologies	Electricity balancing	Flexible power to heat	Higher	Lower
Technologies	Electricity balancing	Batteries (behind the meter)	Higher	Lower
Technologies	Electricity balancing	Large scale electricy storage	Lower	Higher
Technologies	Electricity balancing	Smart charging	Higher	Lower
Technologies	Electricity balancing	P2x	Higher	Lower

High level driver	Dimension	Characteristic	Storyline 1 (DE)	Storyline 2 (GA)	Variant 1	Variant 2
Energy technologies	Low Temperature Heat Demand	District heating (circularity)	Higher	Lower	tbd	tbd
Energy technologies	Low Temperature Heat Demand	Small scale gas boilers (households)	Similar	Similar	tbd	tbd
Energy technologies	Low Temperature Heat Demand	Small scale hybrid heat pumps (households)	Lower	Higher	tbd	tbd
Energy technologies	Low Temperature Heat Demand	Small scale all-electric heat pumps (households)	Higher	Lower	tbd	tbd
Energy technologies	Low Temperature Heat Demand	Small scale CHP incl. fuel cells (households)	Higher	Lower	tbd	tbd
Energy technologies	Private transport	EV	Higher	Lower	tbd	tbd
Energy technologies	Private transport	FCEV	Lower	Higher	tbd	tbd
Energy technologies	Heavy goods transport	EV	Higher	Lower	tbd	tbd
Energy technologies	Heavy goods transport	FCEV	Lower	Higher	tbd	tbd
Energy technologies	Heavy goods transport	Compressed Methane Cars	Lower	Higher	tbd	tbd
Energy technologies	Aviation and shipping	Sythetic Liquids	Higher	Lower	tbd	tbd
Energy technologies	Aviation and shipping	Methane (liquified)	Lower	Higher	tbd	tbd
Energy technologies	Aviation and shipping	Hydrogen (liquified or ammonia)	Lower	Higher	tbd	tbd
Energy technologies	Aviation and shipping	Electricity	Higher	Lower	tbd	tbd
Energy technologies	Industry: high temperature heat	Methane	Lower	Higher	tbd	tbd
Energy technologies	Industry: high temperature heat	Hydrogen	Lower	Higher	tbd	tbd
Energy technologies	Industry: high temperature heat	Electricty	Higher	Lower	tbd	tbd

TECHNOLOGIES

Supply, Demand, Sector Coupling (incl. hydrogen), E&G Flexibilities

High level driver	Dimension	Characteristic	Storyline 1 (DE)	Storyline 2 (GA)	Variant 1	Variant 2
Energy technologies	Carbon economy	CCS (all sources)	Lower	Higher	tbd	tbd
Energy technologies	Sector coupling	Share of P2X	Higher	Lower	tbd	tbd
Energy technologies	Electrictiy supply for direct electricity demand	Solar-PV	Higher	Lower	tbd	tbd
Energy technologies	Electrictiy supply for direct electricity demand	Onshore wind	Higher	Lower	tbd	tbd
Energy technologies	Electrictiy supply for direct electricity demand	Offshore wind	Lower	Higher	tbd	tbd
Energy technologies	Electrictiy supply for direct electricity demand	(New) nuclear	Lower	Higher	tbd	tbd
Energy technologies	Electrictiy supply for direct electricity demand	Small Scale CHP (including fuel cells)	Higher	Lower	tbd	tbd
Energy technologies	Electrictiy supply for direct electricity demand	Large Scale CHP (including fuel cells)	Lower	Higher	tbd	tbd
Energy technologies	Electrictiy supply for direct electricity demand	Concentrated Solar Power	Lower	Higher	tbd	tbd
Energy technologies	Electricity balancing	Thermal Generation	Similar	Similar	tbd	tbd
Energy technologies	Electricity balancing – Flexibility	DSR based on Smart Metering	Higher	Lower	tbd	tbd
Energy technologies	Electricity balancing	Flexible power to heat	Higher	Lower	tbd	tbd
Energy technologies	Electricity balancing– Flexibility	Batteries (behind the meter)	Higher	Lower	tbd	tbd
Energy technologies	Electricity balancing	Large scale electricy storage	Lower	Higher	tbd	tbd
Energy technologies	Electricity balancing– Flexibility	Smart charging	Higher	Lower	tbd	tbd
Energy technologies	Electricity balancing– Flexibility	P2X	Higher	Lower	tbd	tbd

Feedback + Q&A

Thank you!