THE HORIZONTAL ELECTRICITY SYSTEM THINK TANK

1st March 2024

Agenda

1. **Flux50/Vito** – Energyville Paths2050 & Sensitivities
2. **Elia** – System Blueprint Study
3. **Elia** – How to realize Belgian and European offshore ambitions
4. **Florence School of Regulation** – Energy policy ideas for the next European Commission

Flux50/Vito

Energyville Paths2050 & Sensitivities

How can Belgium become carbon neutral between now and 2050?

PATHS2050 – The Power of Perspective
Wouter Nijs

EnergyVille KU LEUVEN vito imec UHASSELT

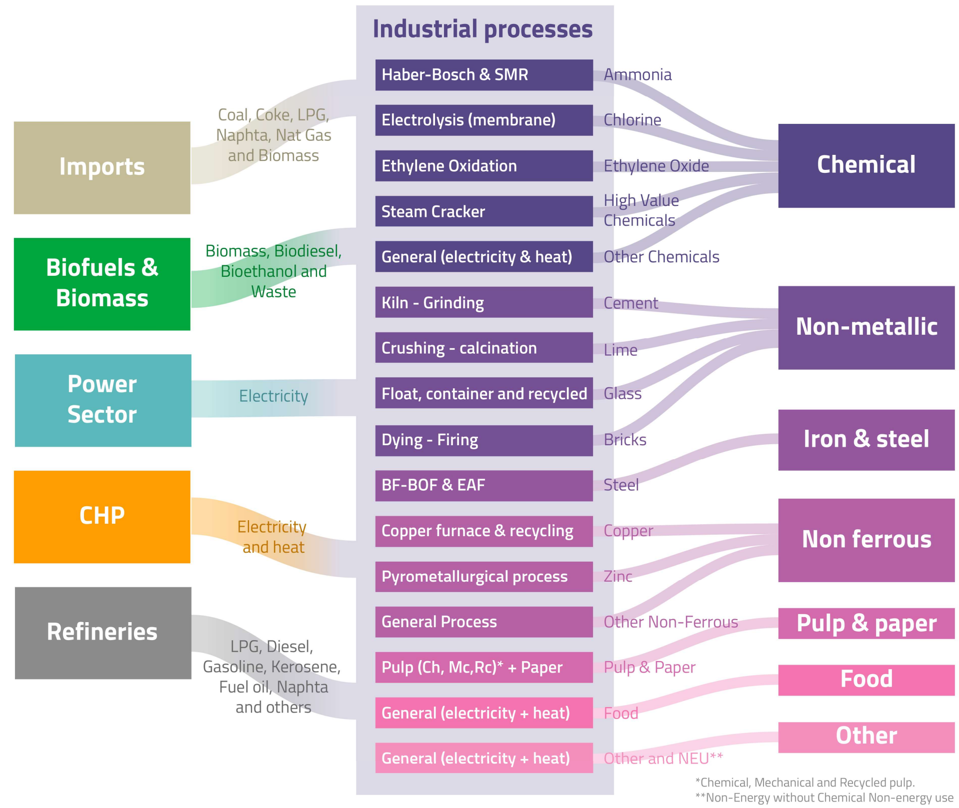
Energy strategies and markets

Our expertise

Techno-economic model development

Pathways to net-zero 2050

Industrial transformation



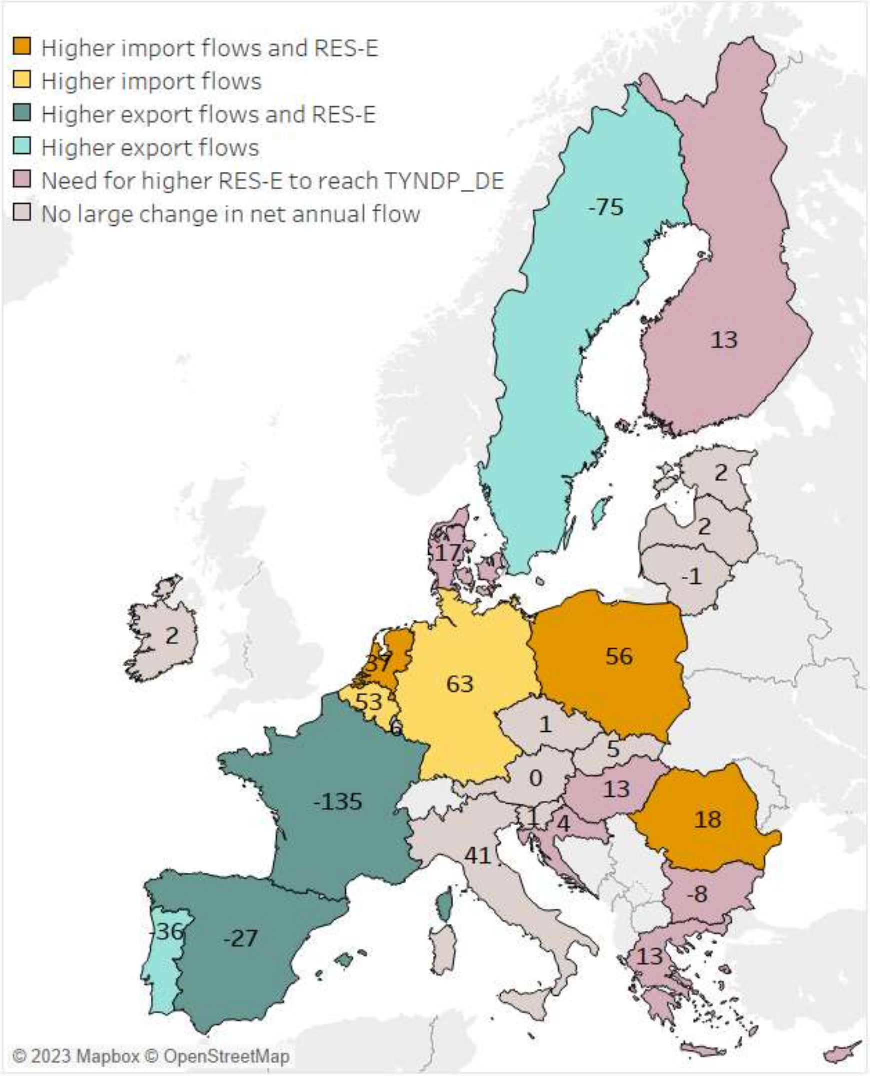
Topics typically addressed

- Speed of electrification. Will industry consume too much electricity ?
- Role of clean gas and the gas grid. Hydrogen (or derived) pipelines ? At what cost ?
- Interconnections and TYNDP 2024
- Industries
  - Role of flexibility in industry
  - Does industry follow cheap energy ?
  - CCS boom but decline after 2040 ?
  - Should we import intermediate products (sponge iron…) ?
  - Are industry clusters at risk ?
  - How much carbon for feedstock ? Are there alternatives ?
- Incentives to do carbon removal ?

Boosting interconnections

Increased electricity imports: Germany (x 6), Poland (x 4), Belgium (x 2.5), Romania (x 1.8), and the Netherlands (x 1.7), compared to highest historical annual import

- The Netherlands, Poland, and Romania: combined focus on import and increased renewables
- Belgium and Germany: import focus
- Spain, France, Portugal, and Sweden: export infrastructure boost.



EU Climate target 2040

Sources for all data: PRIMES

energyville.be/blogs/climate-goal-for-2040-a-new-milestone-for-the-eu/

Klimaatdoelstelling voor 2040: een nieuw baken voor de EU

Nieuws 07-02-2024

Op 6 februari 2024 publiceerde de Europese Commissie (EC) een gedetailleerde impactbeoordeling over mogelijke routes om het afgesproken doel te bereiken om de Europese Unie klimaatneutraal te maken tegen 2050. In deze context bundelden onze EnergyVille/VITO-collega Wouter Nijs en Adviseur van EnergyVille Ronnie Belmans hun krachten om ons inzicht te geven in de aanbeveling van de EC om de uitstoot van broeikasgassen tegen 2040 met 90% te verminderen ten opzichte van 1990. Dit

Dit kan je ook interessant vinden

Nieuws 01-02-2024

Vlaamse regering zet licht op groen voor nieuwe infrastructuurwerken in Open Thor Living Lab in Genk

Nieuws 26-01-2024

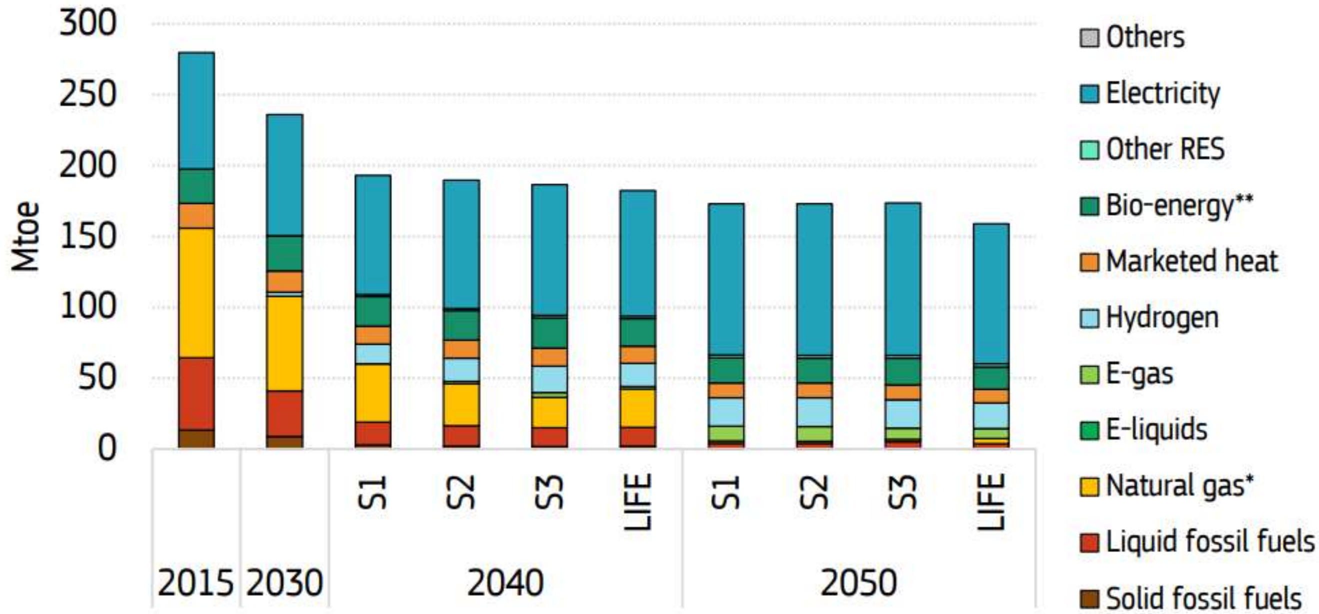
EnergyVille/VITO op de Belgian Renovation Week

Nieuws 15-12-2023

Wetenschap Uitgedokterd: Hoe perovskiet zonnecellen opschalen?

Natural gas: down 75-80% by 2040

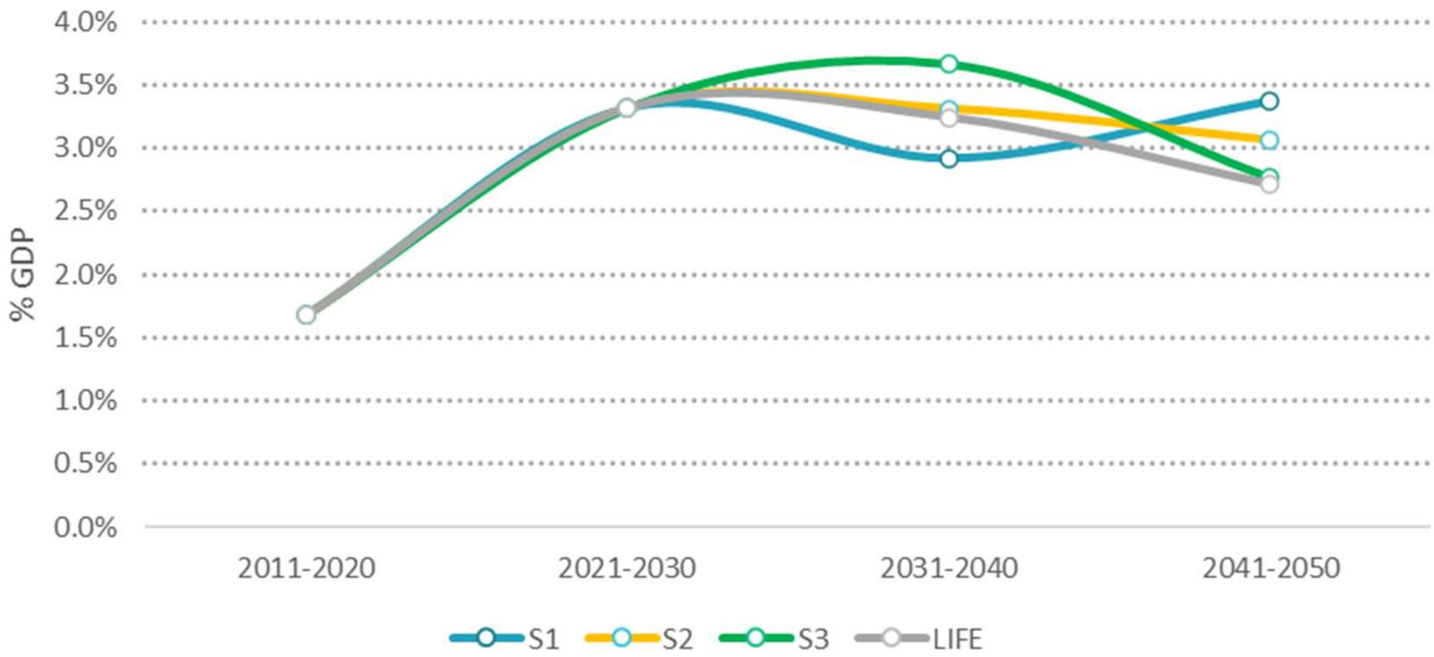
Figure 50: Energy Consumption in industry by fuel



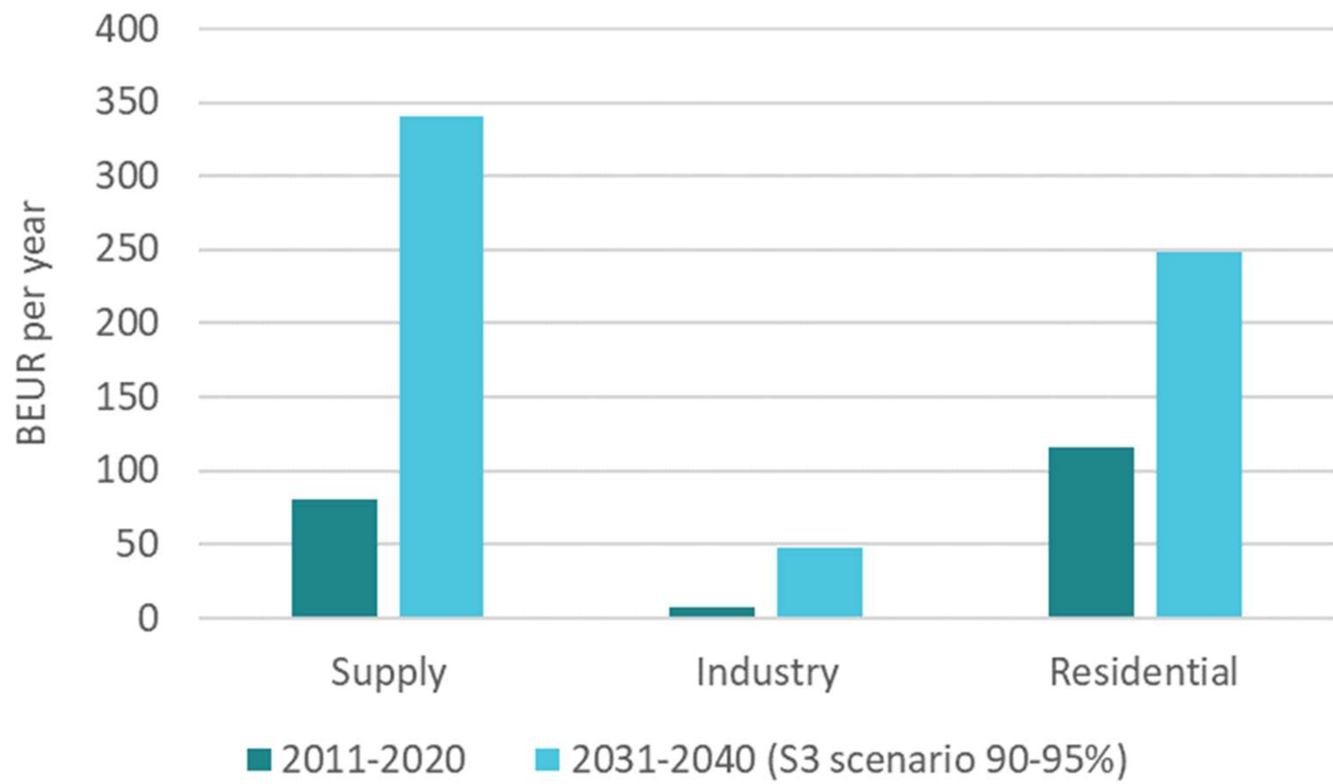
Note: The energy consumption includes the final energy consumption plus the consumption in refineries.
**Natural gas including manufactured gas (coke-oven gas, blast furnace gas & gasworks gas), but not e-gas.*
***Bioenergy including bio-solids, biofuels, biogas (including waste gas and biomethane) and solid waste.*

Source: PRIMES.

Average annual energy system investment needs, excluding transport

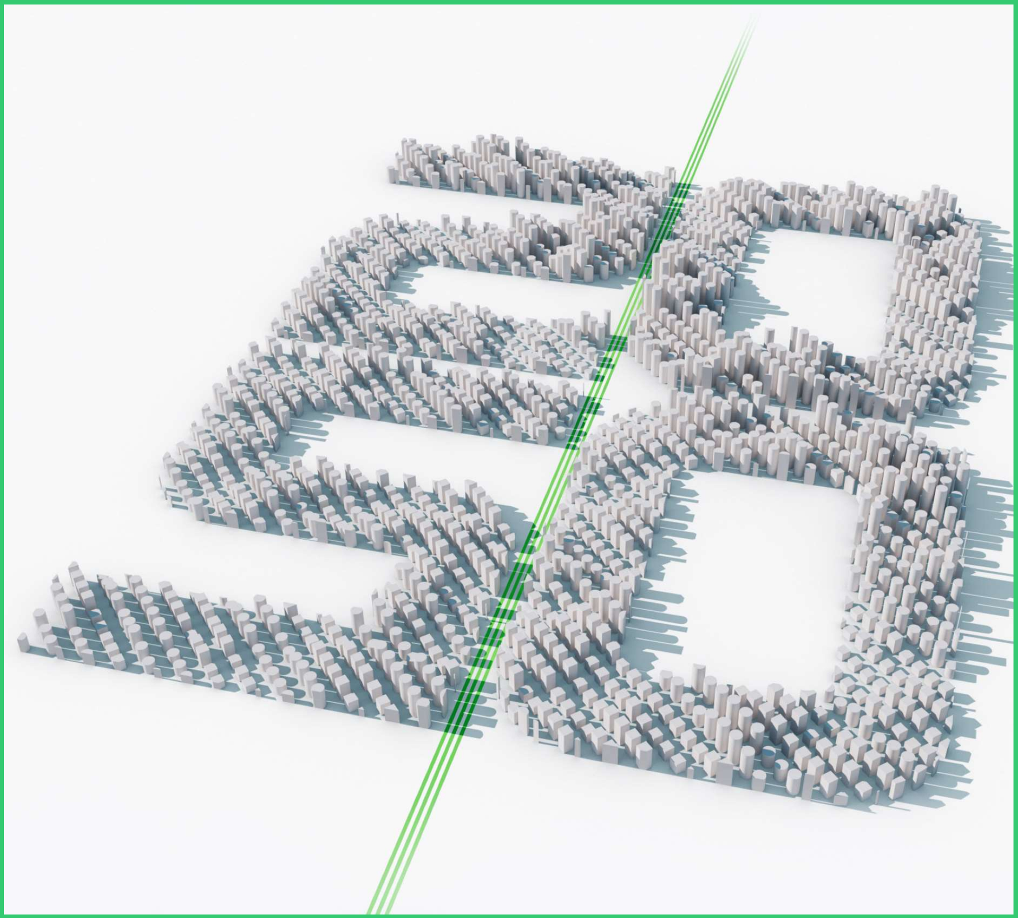


Investment profiles, annual averages, EU, S3



PATHS 2050

The Power of Perspective

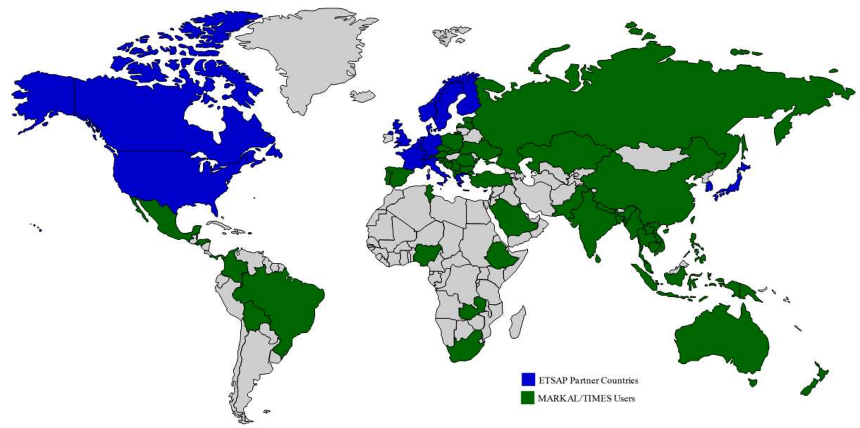


Energy Ville

https://perspective2050.energyville.be

Energy System Analysis and Long–term Energy Modelling - TIMES

- TIMES is a Model Generator for Energy Technology Systems Analysis
- Developed by the
  Energy Technology Systems Analysis Programme (ETSAP)
- Coordinated by the IEA (International Energy Agency, Paris), which is part of the OECD
- Members of ETSAP and TIMES (or MARKAL) users all over the world
- VITO is a contracting partner of ETSAP for 25 years
- More information under http://www.iea-etsap.org



The EnergyVille TIMES Be model

- Most detailed, **full system** optimization model of the Belgian energy system, to date
  - Cross-vector: covering energy use (fossil fuels, renewables, clean molecules and electricity), feedstock
  - Cross-sector: covering all supply (refineries, power sector) and end-use demand sectors (industry, residential, commercial, transport, agriculture)
  - Cross-border: projected and timesliced import/export cost curves for electricity from other EU countries, possible import of clean molecules

- **Cost optimization from now to 2050**: gives insights into pathways to 2050 with intermediate 2030 milestones

- Reporting on **combustion and process scope 1 CO_2** emissions = 85% of Belgian GHG emissions today
  - Scope 2 emissions from imported electricity included but not reported in this project.
  - Bunker fuels for international maritime and aviation sector not included
  - No agricultural CH_4 or N_2O emissions

EPOC 2030-2050

BREGILAB

Procura

economie

What makes TIMES TIMES?

ACT_BND	CCAP0	COM_MSHGV	FLO_FR	GROWTHr	NCAP_DCOST	NCAP_SEMI	REG_FIXT	SC0	tm_scale_cst	UC_RHSRT+
ACT_COST		Com_OFF	FLO_FUNC	IRE_BND	NCAP_DELIF	**NCAP_START**	RemAtRunTime	SEG	tm_scale_nrg	UC_RHSRTS
ACT_CSTPL		OM_PEAK	FLO_FUNCX	IRE_CCVT	NCAP_DISC	**NCAP_TLIFE**	RFCmd_bot	SFCmd_bot	tm_scale_util	UC_RHSS
ACT_CSTRMP		OM_PKFLX	FLO_MARK	IRE_FLO	NCAP_DLAG	NCAP_VALU	RFCmd_DD	SFCmd_top	TS_CYCLE	UC_RHST
ACT_CSTSD	CM_	COM_PKRSV	FLO_PKCOI	IRE_FLOSUM	NCAP_DLAGC	OFFEPS	RFCmd_FLAGS	SHAPE	TS_OFF	UC_RHSTS
ACT_CSTUP	CM_CONST	Com_PKTS	FLO_SHAR	IRE_PRICE	NCAP_DLIFE	PRAT	RFCmd_GAMS	STG_CHRG	UC_ACT	UC_TIME
ACT_CUM	CM_EXOFORC	**COM_PROJ**	FLO_SUB	IRE_TSCVT	**NCAP_DRATE**	PRC_ACTFLO	RFCmd_GLOBAL	**STG_EFF**	UC_ACT+	UC_UCN
ACT_EFF	CM_GHGMAP	COM_STEP	FLO_TAX	IRE_XBND	NCAP_EFFX	PRC_AOFF	RFCmd_OPTIMIZER	STG_LOSS	UC_ACTBET	VA_Attrib_C
ACT_FLO	CM_HISTORY	COM_SUBNET	G_CHNGMONY	MakeCorridorPrc	NCAP_ELIFE	**PRC_CAPACT**	RPT_OPT	STG_MAXCYC	UC_ATTR	VA_Attrib_T
ACT_LOSPL	CM_LINFOR	COM_SUBPRD	G_CUREX	MARKAL-REH	NCAP_FDR	PRC_FOFF	S_CAP_BND	STG_SIFT	UC_CAP	VA_Attrib_TC
ACT_LOSSD	CM_MAXC	COM_TAXNET	G_CYCLE	MULTI	**NCAP_FOM**	PRC_GMAP	S_CM_CONST	STGIN_BND	UC_CAP+	VA_CONSTRUCSHARE
ACT_MAXNON	CM_MAXCO2C	COM_TAXPRD	G_DRATE	**NCAP_AF**	NCAP_FOMM	PRC_MARK	S_CM_MAXC	STGOUT_BND		A_DELIVPERUNIT
ACT_MINLD	CmdF_bot		G_DYEAR	NCAP_AFA	NCAP_FOMX	PRC_NOFF	S_CM_MAXCO2C	SW_LAMBDA		DEMOLHOUSES
ACT_SDTIME	CmdF_GAMS		FFTHD	NCAP_AFAC	NCAP_FSUB	PRC_NSTTS	S_COM_CUMNET	SW_PROB		DEMOLSHARE
	CmdF_Title	COM_VOC	G_OVERLAP	NCAP_AFC	NCAP_FSUBM	PRC_PCG	S_COM_CUMPRD	SW_SPR	UC_CU	VA_HEATNEWVSOLD
	CmdF_top	DAM_BQTY	G_RFRIR	NCAP_AFCS	NCAP_FSUBX	Prc_PKAF	S_COM_FR		UC_CUMACT	VA_HOUSECOOLTARGE
BS_BNDPRS	COM_AGG	DAM_COST	G_TLIFE	NCAP_AFM	NCAP_FTAX	PRC_PKNO	S_COM_PROJ	SW_	UC_CUMCOM	VA_HOUSEDEMOL
BS_CAPACT	COM_BNDNET	DAM_ELAST	G_YRFR	NCAP_AFS	NCAP_FTAXM	PRC_REACT	S_COM_TAX	TM_ARBM	UC_CUMFLO	VA_HOUSESHCOOL
BS_DELTA	COM_BNDPRD	DAM_STEP		NCAP_AFSX	NCAP_FTAXX	PRC_REFIT		TM_DEFVAL	UC_DYNBND	VA_HOUSESTOCK
BS_DEMDET	COM_BPRICE	DAM_VOC		CAP_AFX	NCAP_ICOM	PRC_RESID		_depr	UC_FLO	VA_HSCLTRGTYEARS
BS_DETWT	COM_CSTBAL	DECAYr	GR_ENDFR	NCAP_BND	**NCAP_ILED**	PRC_STGIPS	S_FLO_FUNC	tm_dmtol	UC_FLOBET	VA_HSIMPROVOLD
BS_LAMBDA	COM_CSTNET	**EFF**	GR_GENFR	NCAP_BPME	NCAP_ISPCT	PRC_STGTSS	S_NCAP_AFS	tm_esub	UC_IRE	VA_PERSPHHOLD
BS_MAINT	COM_CSTPRD	END	GR_GENLEV	NCAP_CDME	NCAP_ISUB	PRC_TSL	S_NCAP_COST	tm_expbnd	UC_IRE-E	VA_PPHHEVOL
BS_OMEGA	COM_CUMNET	EOTIME	GR_GENMAP	NCAP_CEH	NCAP_ITAX	PRC_VINT	S_UC_RHS	tm_expf	UC_IRE-I	VA_SECTFUELCONS
BS_RMAX	COM_CUMPRD	FLO_BND	GR_THMIN	NCAP_CHPR	NCAP_MSPRF	R_CUREX	S_UC_RHSR	tm_gdp0	UC_NCAP	VA_TEMPCORR
BS_RTYPE	COM_ELAST	FLO_COST	GR_VARGEN	NCAP_CLAG	NCAP_OCOM	RCAP_BLK	S_UC_RHSRT	tm_gr	UC_NCAP+	VDA_CEH
BS_SHARE	COM_ELASTX	FLO_CUM	GR_XBND	NCAP_CLED	NCAP_OLIFE	RCAP_BND	S_UC_RHSRTS	tm_ivetol	UC_RHS	VDA_EMCB
BS_SIGMA	COM_FR	FLO_DELIV	GROWTH	NCAP_COM	NCAP_PASTI	REG_BDNCAP	S_UC_RHST	tm_kgdp	UC_RHSR	**VDA_FLOP**
BS_STIME	COM_IE	FLO_EMIS	GROWTH_TID	**NCAP_COST**	NCAP_PASTY	REG_BNDCST	S_UC_RHSTS	tm_kpvs	UC_RHSRS	VRAT_FLO
CAP_BND	COM_LIM	FLO_EMIS+	GROWTH_TIDr	NCAP_CPX	NCAP_PKCNT	REG_CUMCST	S_UCOBJ	tm_qfac	UC_RHSRT	YRINPERIOD

Climate Module

Policies

Balancing

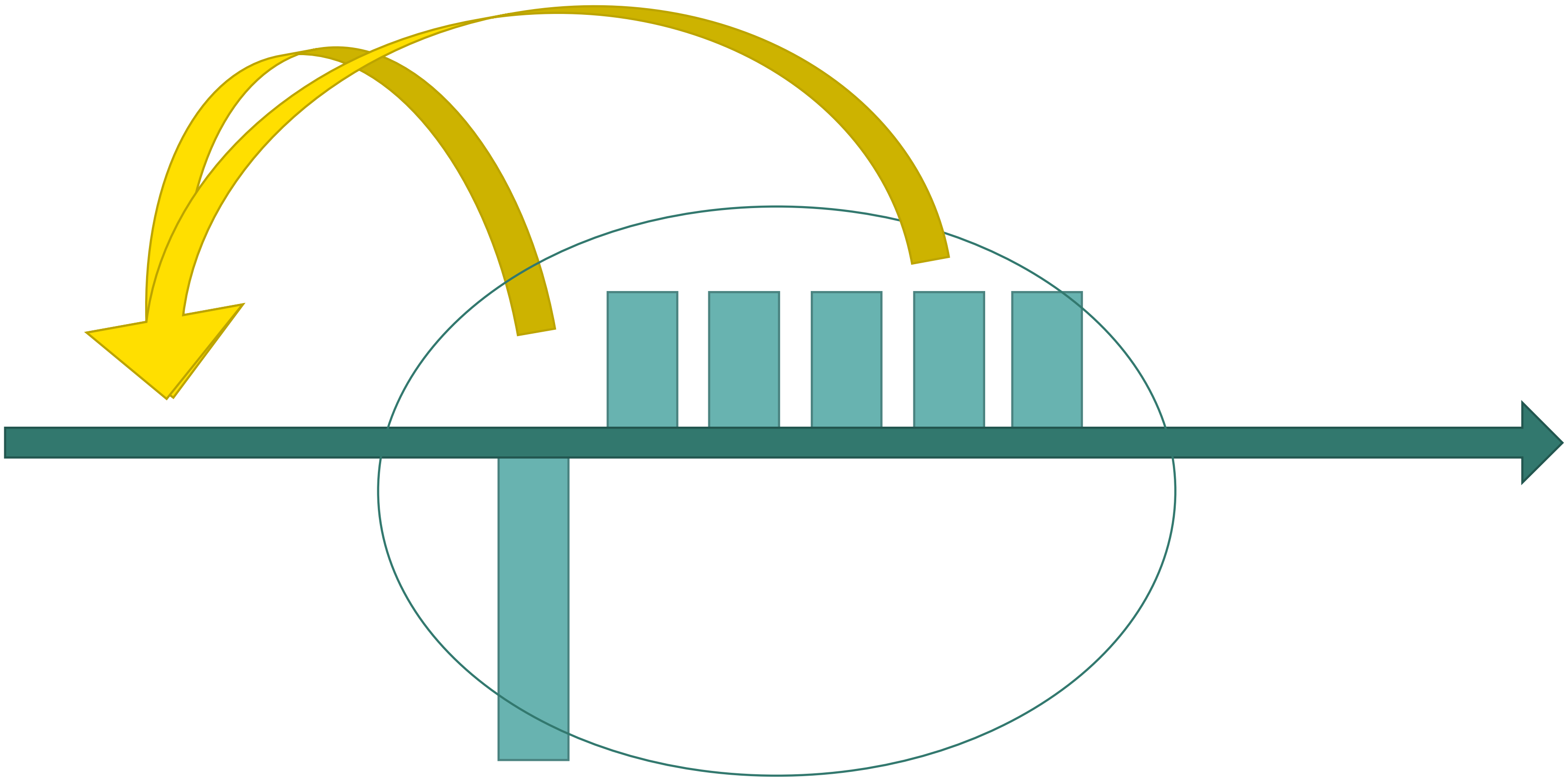
General

Stochastic

Macro

User Constraints

TIMES basics on discounting



Offshore North Sea

2050: ~212 GW, AF 60%

EU countries ambitions 2030, 2050 …

16 GW Direct access for Belgium

Offshore Belgium

>2030 max.: 8 GW

(Source: Fed Gov.)

Electricity import

~6.5 GW → 13 GW by 2040

(Source: ENTSO-E)

Industry

- Output levels constant to 2050
- Refineries cf. EU decrease with 43% in 2050 to 2014

Carbon Capture Utilization & Storage

Access to commercial storage phase?

How much CC(U)S needed?

RES techn. Potential

Roof Solar ~104 GW

Onshore ~20 GW

(Source: Bregilab)

Infrastructure needs

Transmission – distribution

Pipelines

Geographical impact

Import of Green Molecules

Carrier: H_2, CH_4, CH_3OH, NH_3

Shipping + pipeline import

(Source: H_2 Import Coalition, Agora EW)

New Nuclear technology

Small Modular Reactors

By 2050, compliant with EU taxonomy

The 3 scenarios to net-zero 2050

Electrification

- Direct access to additional 16 GW of offshore wind potential
- Allow new SMR technology > 2045 compliant with EU taxonomy

+

Central

- ➢ Industrial product demand stable
- ➢ Population growth → buildings, transport
- ➢ Technical renewable potential: 104 GW rooftop PV, 20 GW onshore, 8 GW offshore wind
- ➢ Interconnection from 6,5 GW to 13 GW by 2040
- ➢ Set of net-zero options for all sectors
  - Energy efficiency
  - Electrification
  - Clean molecules: production + import
  - CCS/CCU options

+

Clean Molecules

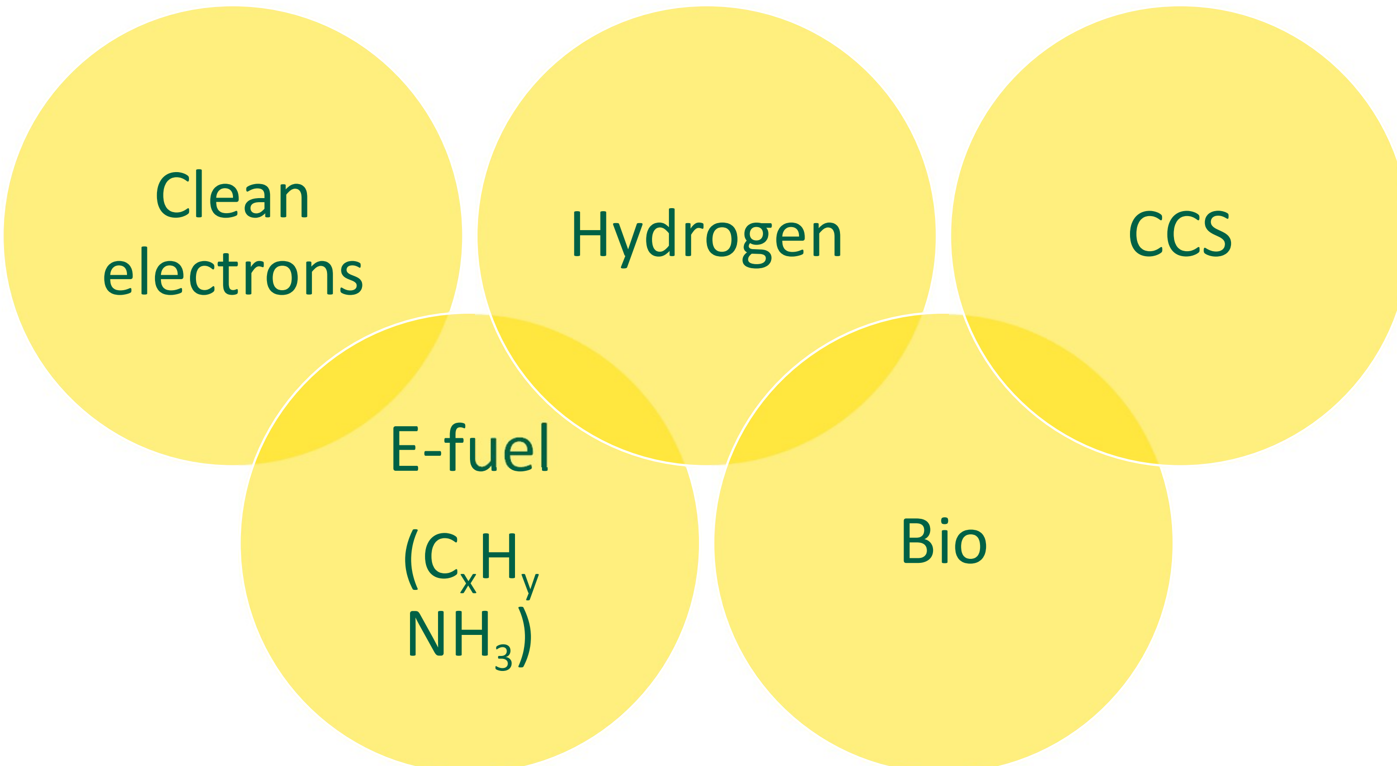
- Lower cost range of hydrogen/molecule import – 2050 : 1,7 €/kg H_2
- Limited access to CO_2 storage: 5 Mton/y

Fit-for-55 by 2030 ?

Evaluation limited to CO_2 emissions

- **No policy projection or prognosis**
- Belgian CO_2 emissions 1990: **120 Mton**
  CO_2 emissions excluding net CO_2 from LULUCF
- Central scenario 2030: **52 Mton**
  → reduction of -57% CO2
- **→ reduction of -54% GHG (estimate)**

Technology options interact



Residential & commercial – final energy demand

Renovation & electrification

By 2030, renovation, insulation and

fuel oil phaseout

realise 50% CO_2 reduction

By 2030, heat pumps are installed in

1,5 million

residential homes and commercial buildings.

By 2050, district heating (8TWh) fulfills the demand of at least

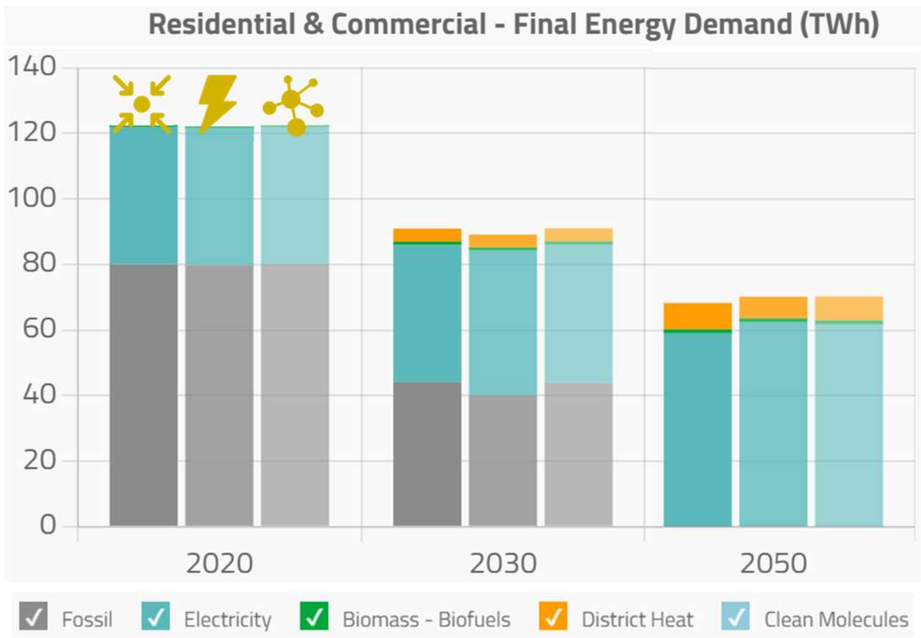
800.000 homes

based on geothermal and waste heat.

By 2050, heat pumps with water buffers and electric water heaters provide

flexibility

to a highly renewable electricity system.



Transport – final energy demand

Electrification

By 2030, investing in more than

2 million

electric person vehicles would be cost effective and puts us on track to net-zero 2050.

By 2050, electrification leads to an efficiency improvement of

76%

Total energy demand decreases from 100 TWh today to 34 TWh.

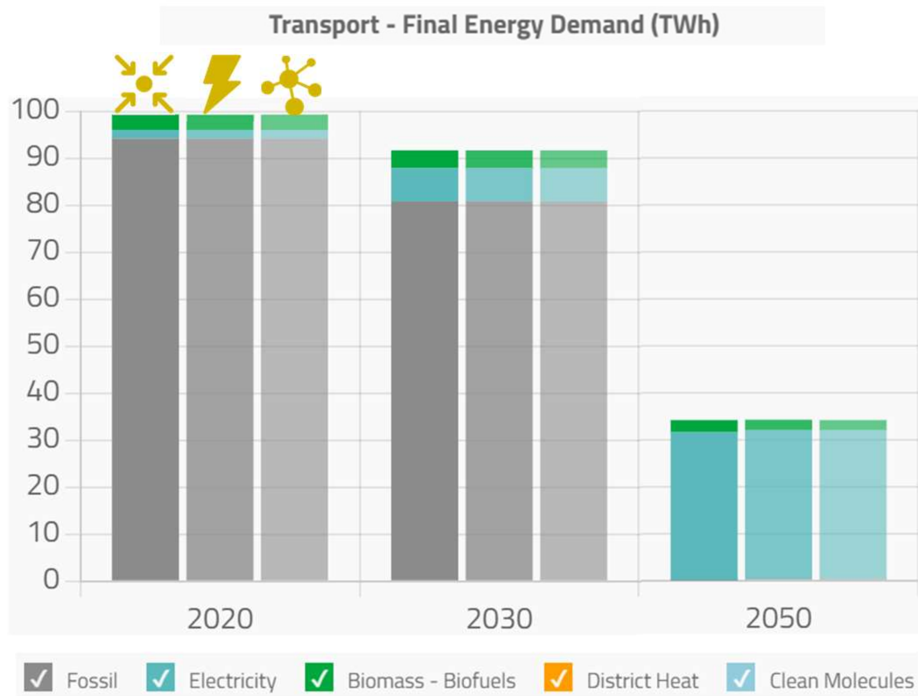
By 2050 our road transport is

fully electrified

By 2050, at least

1,1 million

smart charging stations (average 7,5 kW peak) are needed to provide demand flexibility.



Industry – final energy use

Electrification & limited use of clean molecules

Until at least 2030, fossil fuels remain

dominant

in the industry as final energy demand.

By 2050, electrification of industrial processes leads to an increase of

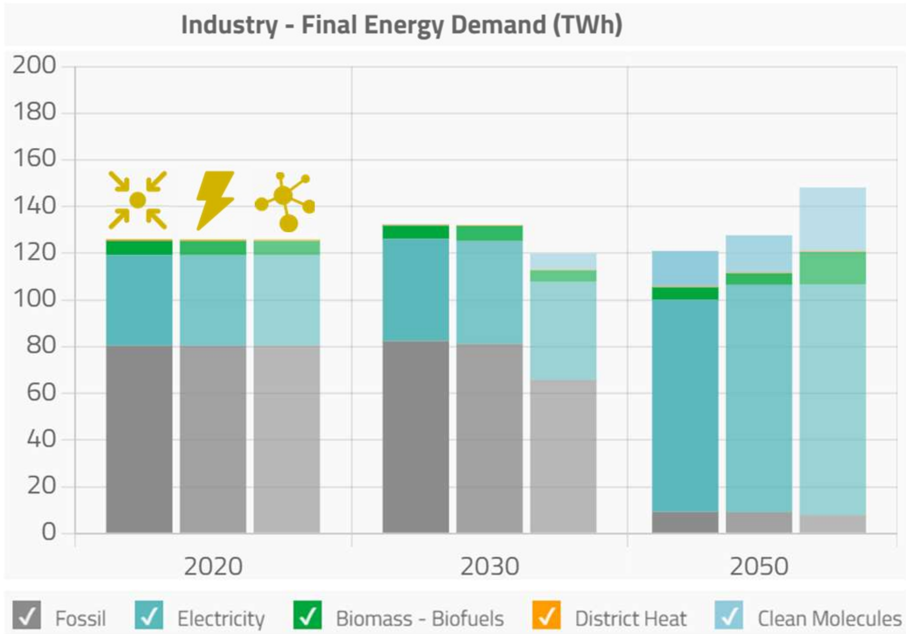
x 2

the current electricity demand in all scenarios.

By 2050, clean molecules amount to

21-25 %

of the final energy demand in industry.



Industry – CO_2 emissions

Carbon capture & storage

By 2030, Carbon Capture and Storage (CCS) removes

17 Mton

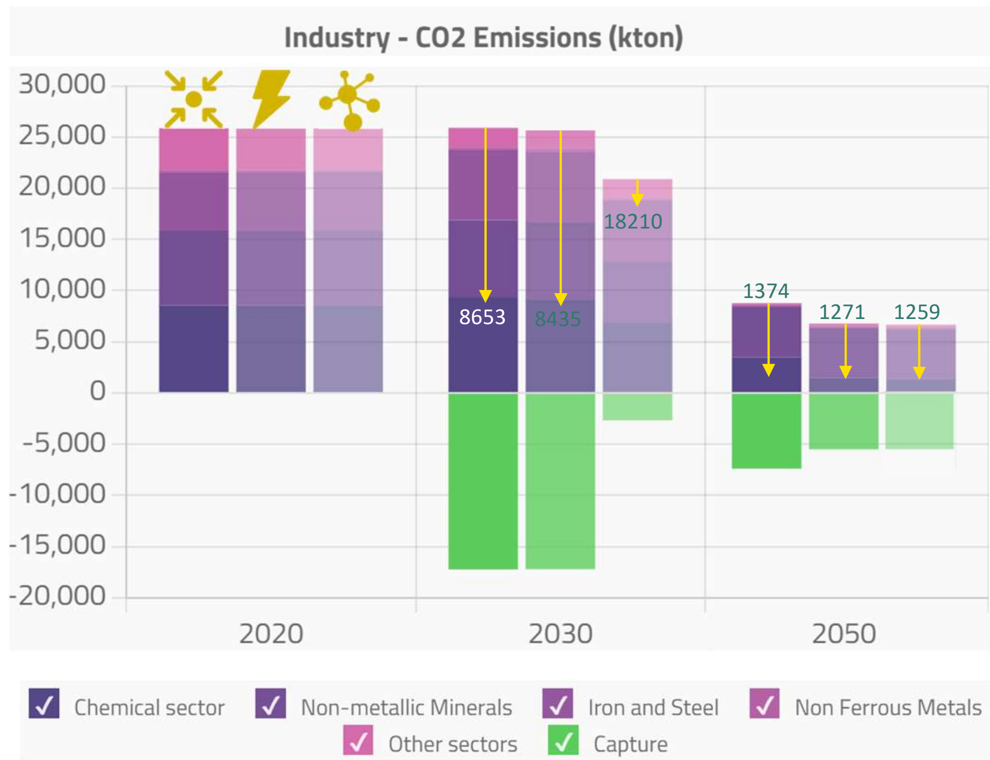
of CO_2 emissions from the atmosphere.

By 2050, CCS is limited to

7,4 Mton

and applied in cement, lime, high value chemicals.

- Clean Molecules, limited storage access (5 Mton/y)
  - Delayed reduction path
  - Carbon capture & *utilisation* in 2050



Power sector - Capacity

By 2030, Solar PV capacity needs to increase

x 4

up to >20 GW in all scenarios,
to be on track to net-zero 2050.

By 2030, wind onshore and offshore

x 2

as no regret in all scenarios.

By 2050 eFuel turbines grow to a capacity of

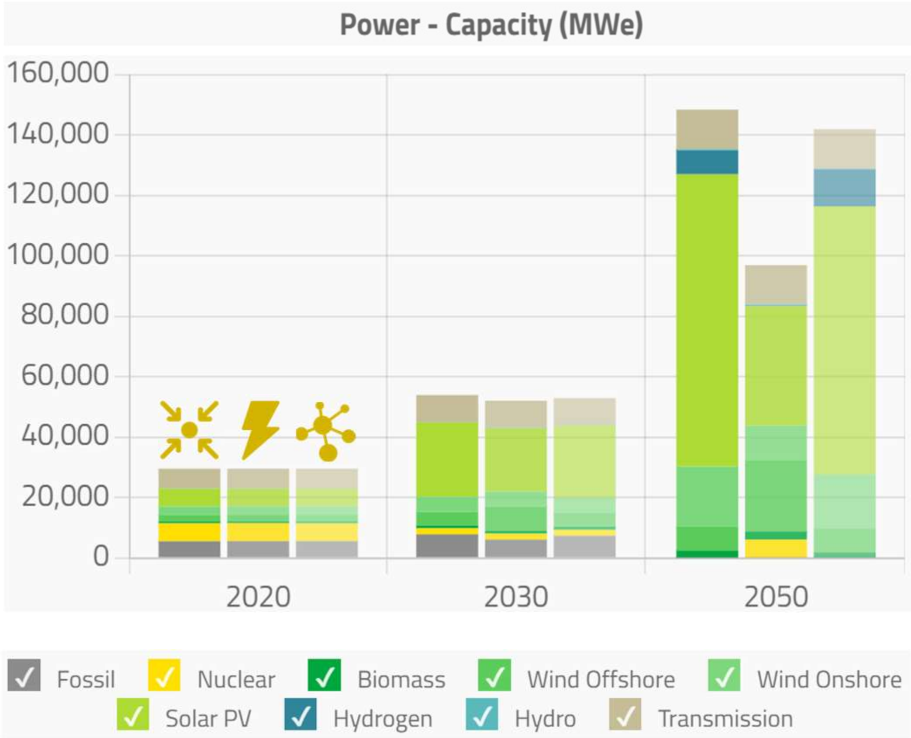
8 GW

in the Central scenario to
provide peak power.

By 2050, additional 16 GW offshore and 6 GW nuclear SMR's

halves

investments in solar PV and
onshore wind in Belgium.

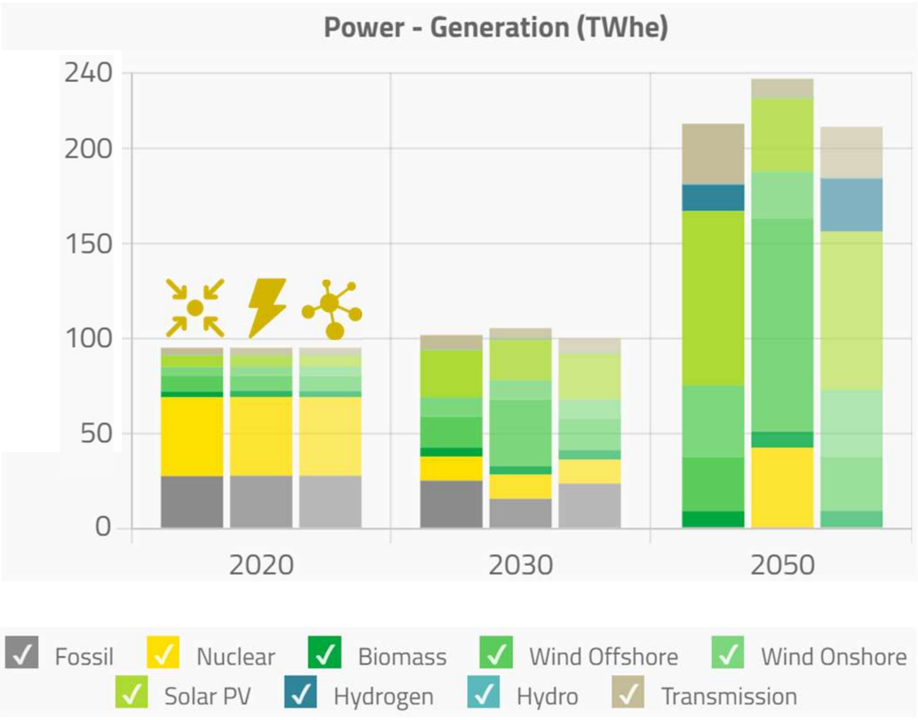


Power sector - Generation

From 2040 onwards the need for

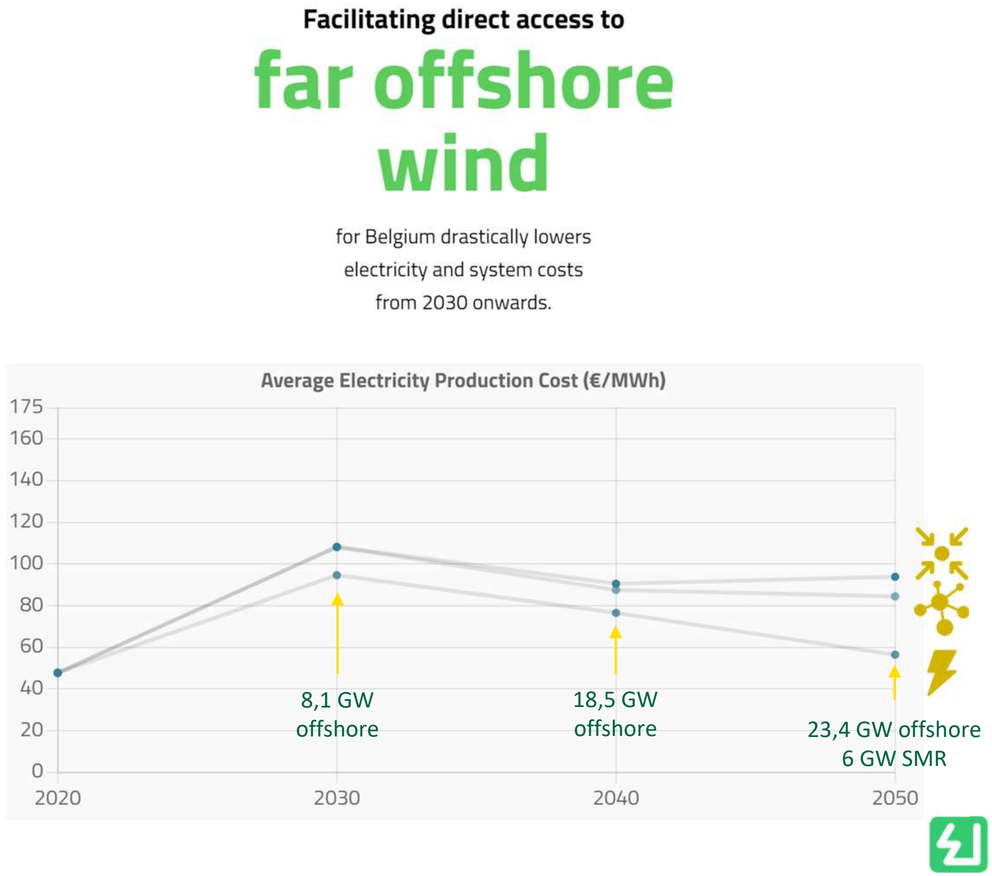
demand flexibility

grows drastically: smart charging, heat pump with buffers, battery storage, hydrogen electrolysers.



Average electricity generation cost

- Central scenario leads to average generation costs of 94 €/MWh
- Offshore wind + SMR leads to lowest generation cost of 56 €/MWh



Annual additional costs compared to a scenario with limited climate ambition

Annual costs per period

Comparison with scenario without climate ambition

Annual costs increase by

11,7 - 21 billion €

by 2050, when net-zero is reached.

Annual costs increase to

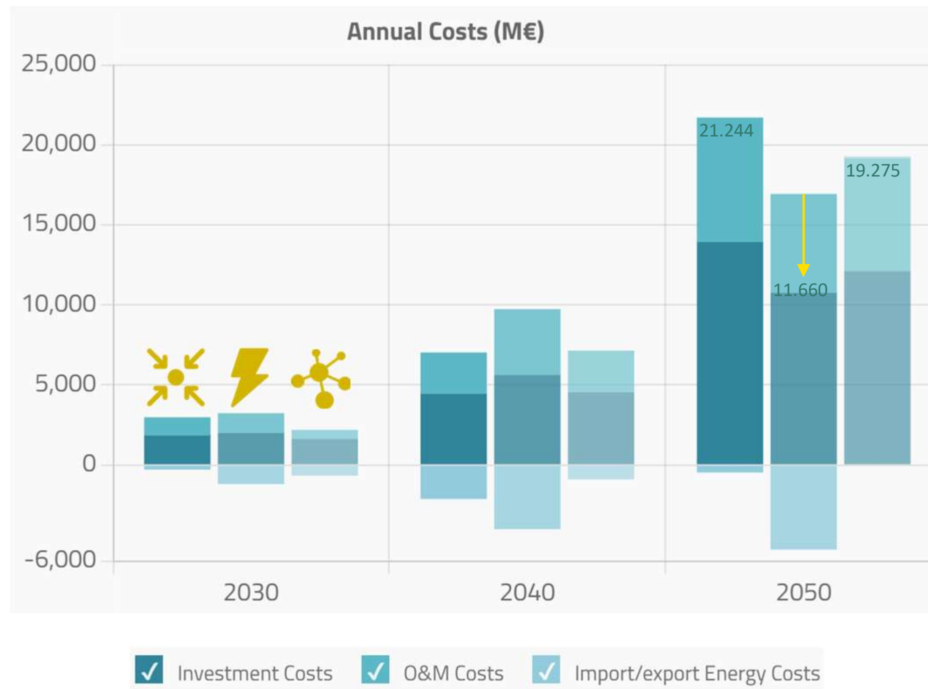
2-4%

of Belgium's GDP (reference 2021) when net-zero is reached.

Access to far offshore wind and SMR leads to

lowest

annual costs increase to reach net-zero in 2050.



More sensitivity scenarios

KEY CONCLUSIONS

SUMMARY FOR EACH SENSITIVITY

OFFSHORE WIND

PV EFFICIENCY AND COST

SMALL MODULAR REACTOR (SMR)

INDUSTRY FLEXIBILITY

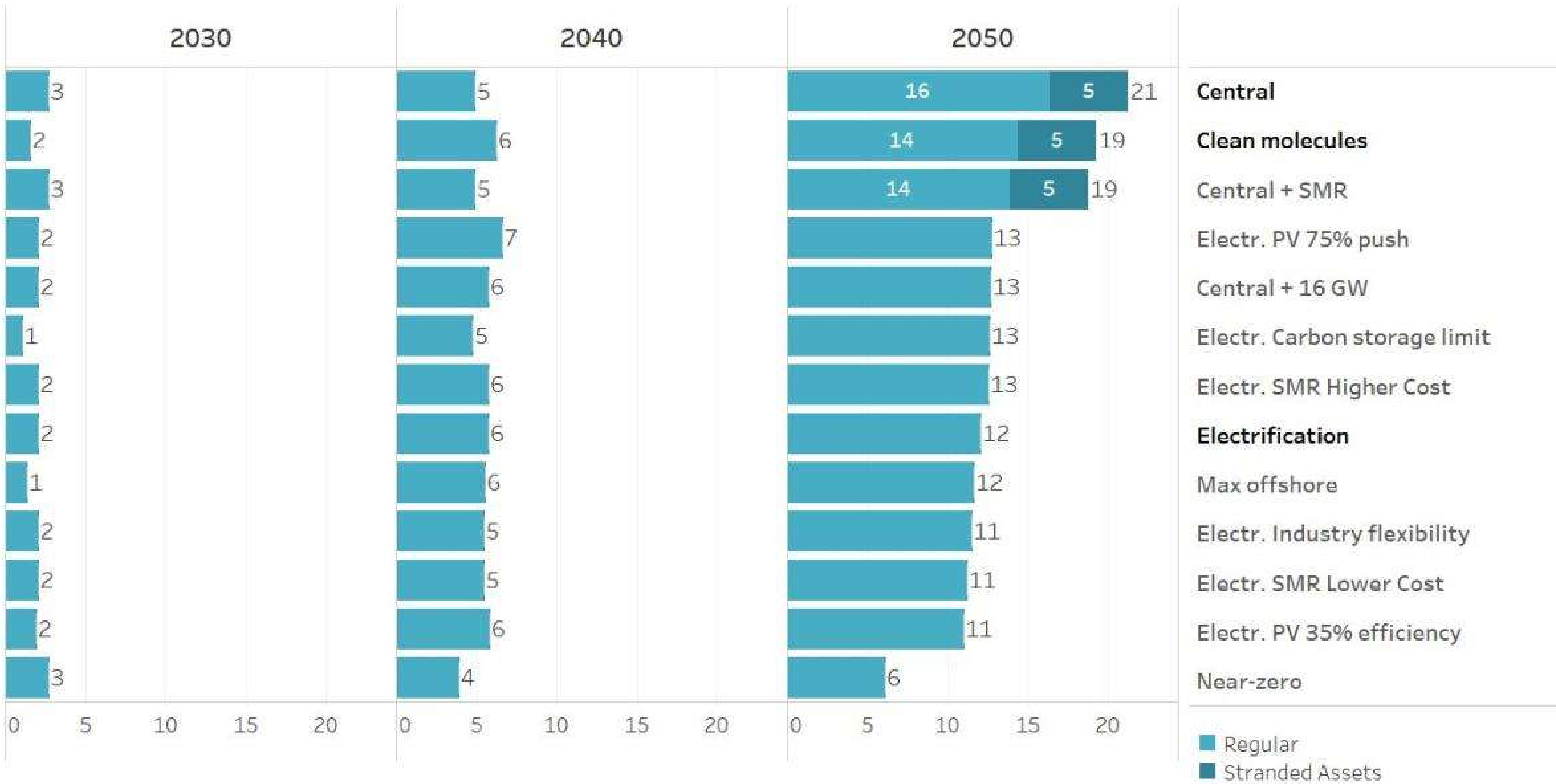
CARBON STORAGE LIMITATION

NEAR-ZERO EMISSIONS

What if …

- Offshore wind: additional direct access is available - >16 – 40 GW
- PV efficiency increases to 35% (tandem cells) = cost/kWpeak decreases by 1/3th
- SMR: in-/decreasing investment costs
- Industry flex: some industry processes with high electricity demand can provide flexibility
- Carbon storage limitation: limit to cross-border storage potential

Annual costs per period



It is important to have clean electrons timely and targeting 2040 already now is crucial.

Current (2020) renewable electricity generation is

22 TWh

By 2030 zero carbon electricity reaches

70 TWh

in all scenarios

By 2040 zero carbon electricity has to reach

150 TWh

to electrify demand timely

PATHS2050 Coalition

- Scenario/storyline development
  - Technology driven
  - Impact of (European or national) legislative packages on cost optimal investments
  - Societal cost optimization
  - …
- Early access to modelling results
- Annual updated Perspectives 2050 platform
  - From complex model → simple storytelling
  - Messages for Policy makers – Society

- 20 k€/year for membership fee ~4 years


PATHS 2050

The Power
Of Perspective

Energy Ville
Empowered by: KU Leuven, VITO, imec & UHasselt

PATHS2050 Coalition

Sharing the power of your perspective

Working document

Date: 09/05/2023

PATHS2050 Coalition – *topics to be discussed*

- Energy infrastructure**:** we need a fundamental re-thinking of the role of energy infrastructure
  - Follow up project Trilate for long term modelling with Elia and Fluxys
  - Follow up project Cirec on the role of materials and circularity

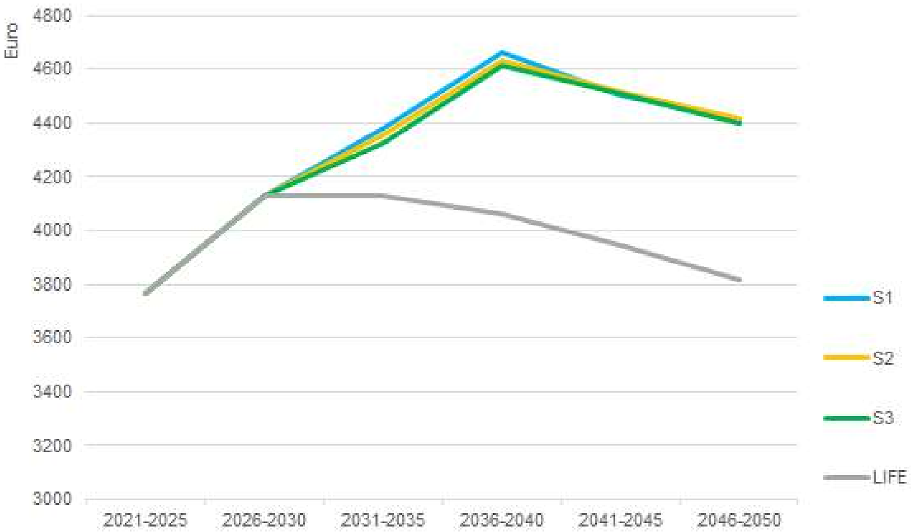
- Cross-border scenarios: we need to tackle the industrial energy transition in a cross-border way and align scenarios with Dutch and German energy clusters

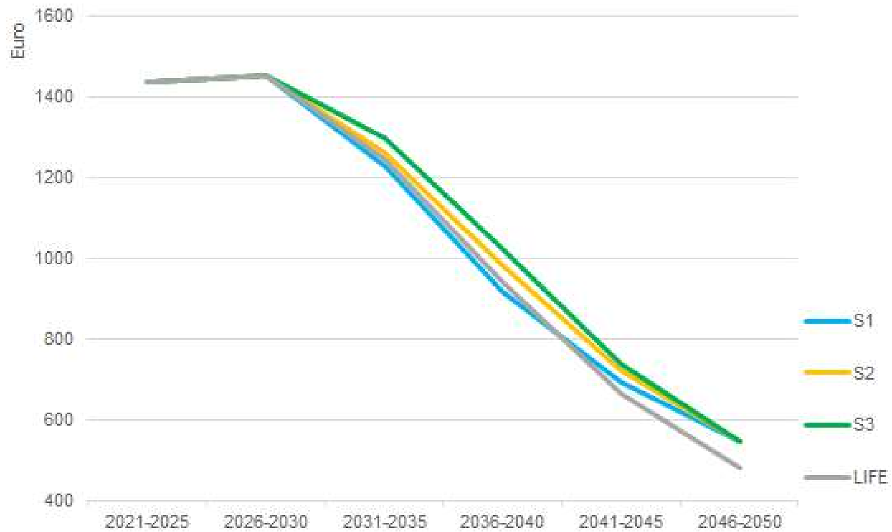
- We need to update scenarios constantly with new trends & evolutions

- We need a broad discussion on societal boundary conditions to energy system scenarios. This includes a discussion on human acceptance towards the deployment of infrastructure, and the necessity to retain certain industrial activity in the region. This Paths 2050 study should be the start of such a discussion, and not the end.

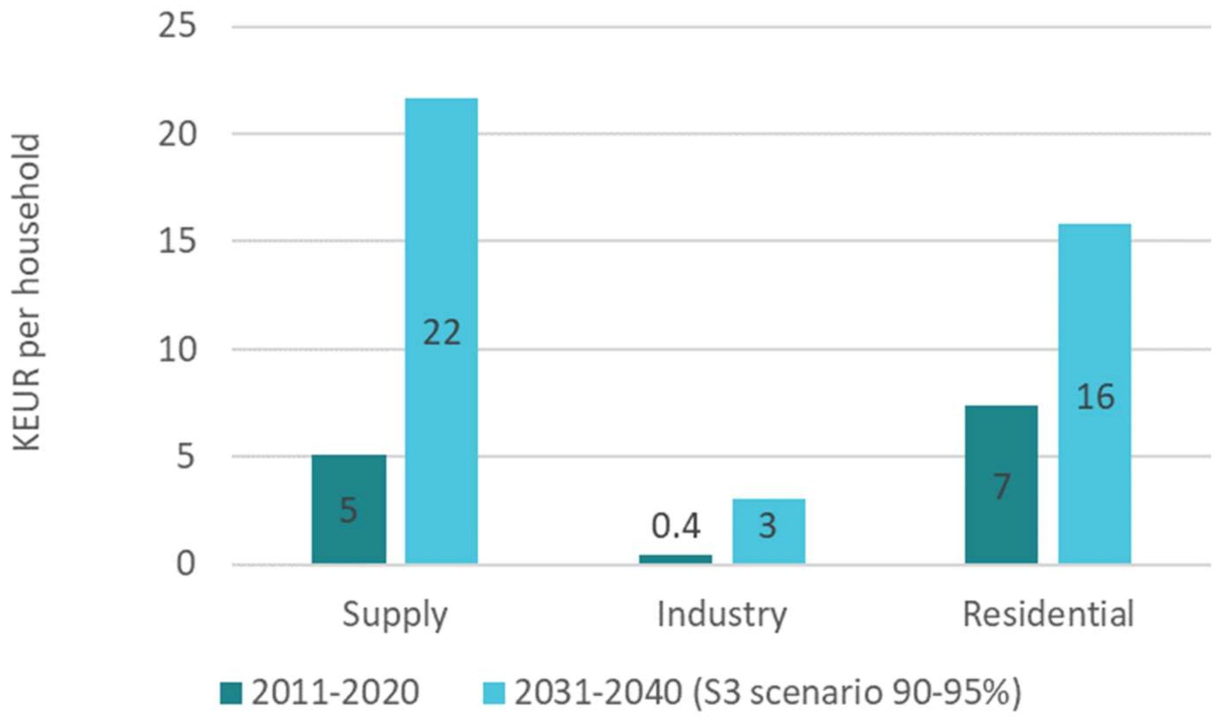
Energy
Ville
ENERGY IN
TRANSITION

Annual expenditures for private vehicles and transport-related energy purchases per household



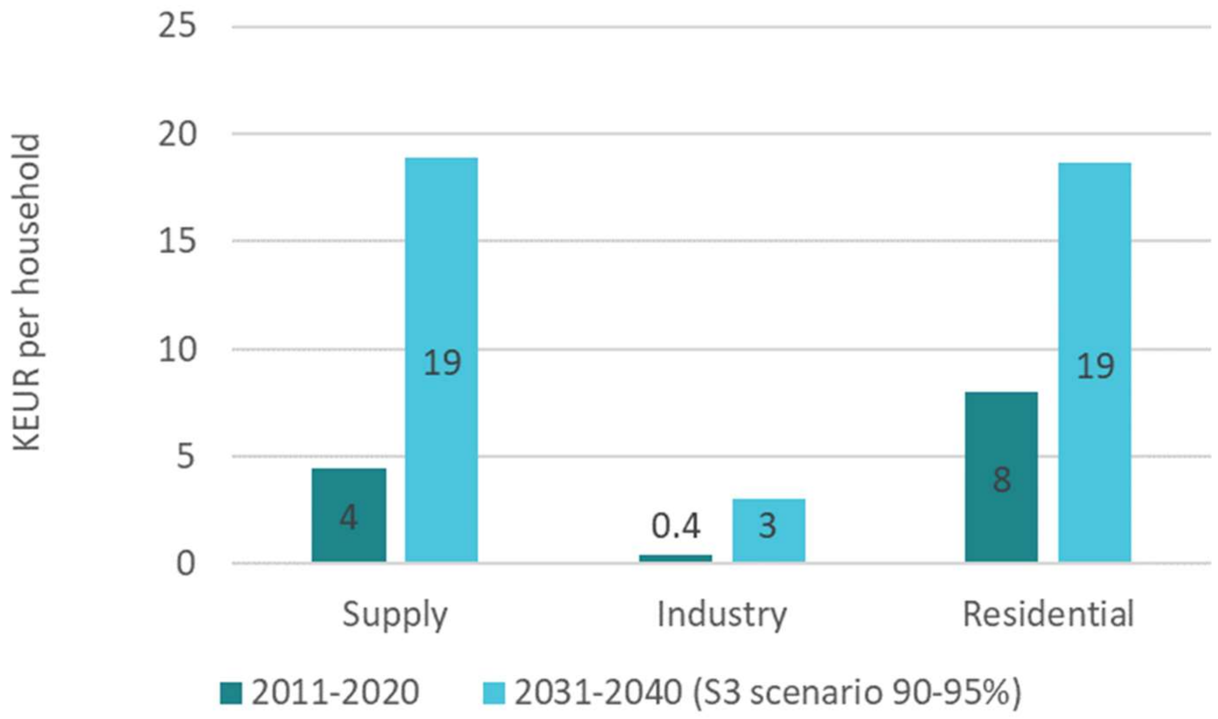


Investment profiles, per household per 10 years, Belgium (based on 3.5% of EU GDP, S3)



Supply includes Power grid, Power plants & Other supply

Investment profiles, per household per 10 years, Belgium (based on 3.5% of EU GDP, S3)



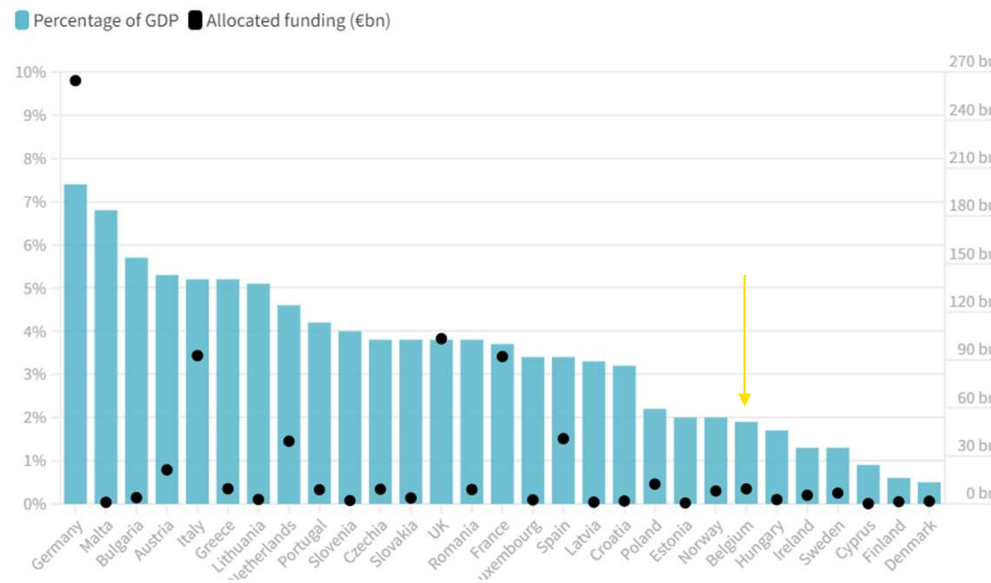
Same data, but part of the PV panels now allocated to the Residential sector. Supply remains high.

Investment needs 2030 - 2050

Energy crisis 2022 – earmarked/allocated funding

- From universal energy subsidies
  - 646 billion € in EU27 from Sept 2021 to Jan 2023
  - 9,4 billion € in Belgium - 1,9% of GDP
  - Earmarked to shield consumers from rising energy costs

- To targeted measures for households and vulnerable SME's



Source: Bruegel (30/03/2023)
https://www.bruegel.org/dataset/national-policies-shield-consumers-rising-energy-prices

België heeft een reductie in EU modellering onder 40%

Mton CO2-eq	Fit For 55* Cost Optimal	Fit For 55* Cost Optimal	Fit For 55* GDP Corrected	REPowerEU Proxy**
Region	EU	BE	BE	BE
ETS	-62%	-26%	-26%	-32%
Niet – ETS	-40%	-41%	-47%	-45%
Totaal	-50%	-34%	-38%	-39%

*Data tov 2005 (voor België zijn 1990 en 2005 zeer vergelijkbaar, een verschil van 1 Mton)

**Source Energyville, based on FF55 data + REPowerEU country data as published in the draft ENTSOs TYNDP24 Scenarios input datasets (https://2024.entsos-tyndp-scenarios.eu/wp-content/uploads/2023/07/20230711-National_Trends_and_Energy_Mix_Survey.xlsx)

Energy Ville

Total final energy demand Belgium

Final energy demand decreases by a

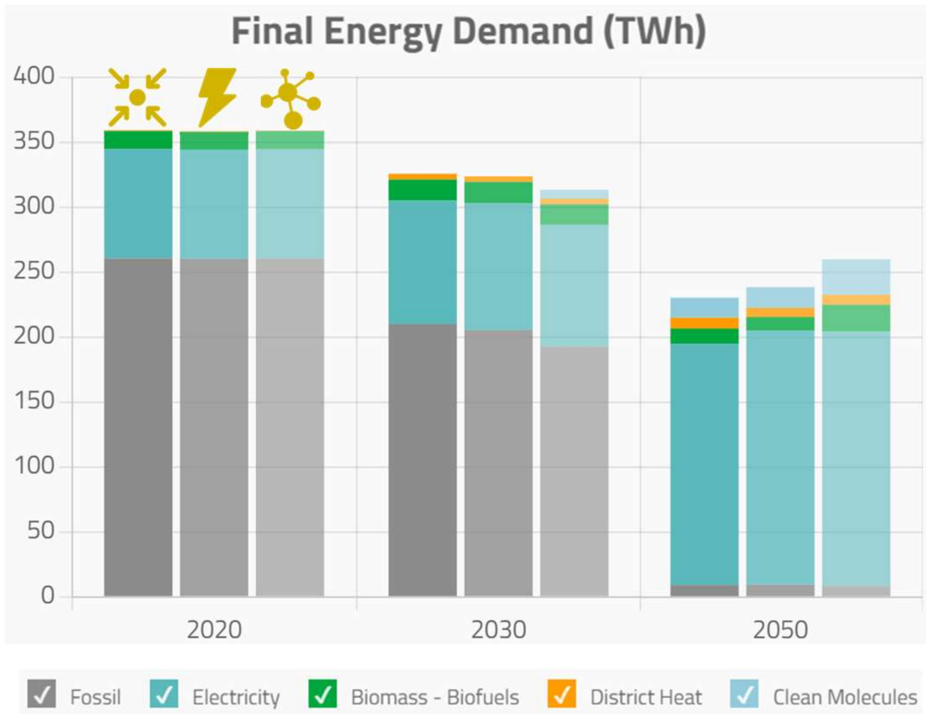
third

regardless of the scenario.

Electricity demand more than

doubles

in the 3 scenarios.



EnergyVille as partner on energy strategies

Diverse client base and collaborations

A wide range of partners (EC-BE-FL-cities, utilities, network operators, sector federations, regulators, companies…)

Energy technologies and grids experts

Allows embedding new technologies in energy system models & ensuring technology-neutral market design

Independent advice and technology-neutral

Science based policy inputs

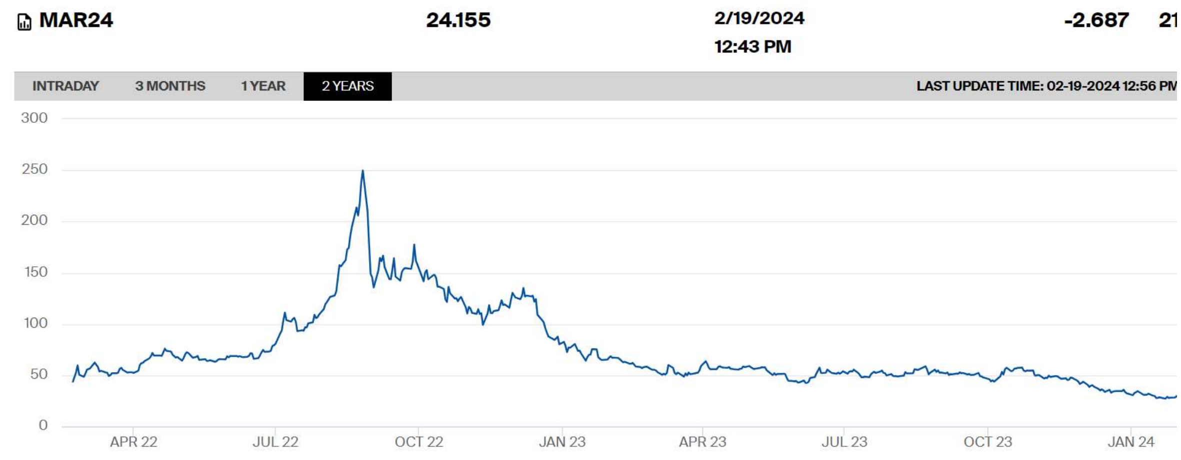
Future-proof solutions

In-depth analysis of future system needs as basis for providing input to desired technological development

Beyond state-of-the-art models

Through our collaboration with universities and participation in (European) modelling projects

Natural gas: volatile but now below 25 EUR/MWh



EU ETS: focus on the longer term.

Trilateral collaboration

At the heart of TRILATE is the belief that the industrial transformation does not stop at national borders.

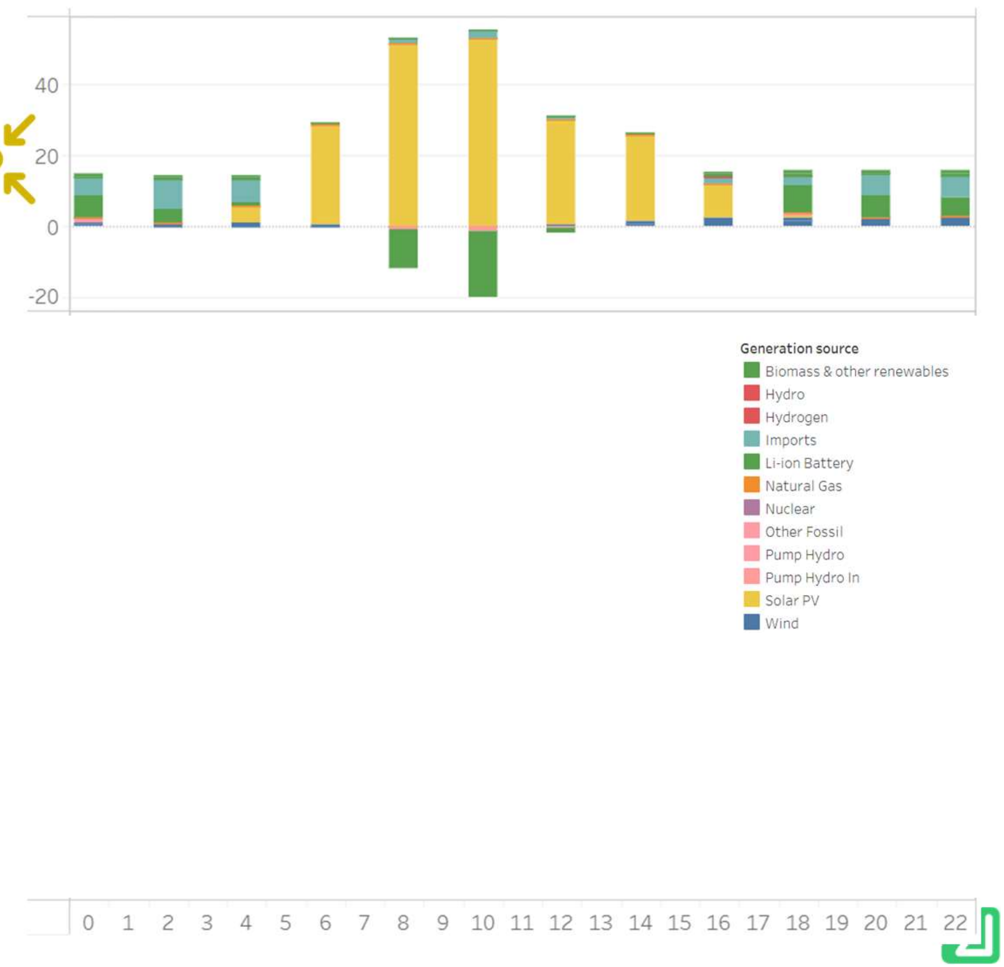
EnergyVille has established and will grow a collaboration platform with Dutch and German partners to contribute to a sustainable and economically viable energy and feedstock supply across borders.

Separately funded (national) research projects join forces with industries to identify the best insights and most promising opportunities for investments.

Power sector – representative summer day 2050

Production + storage

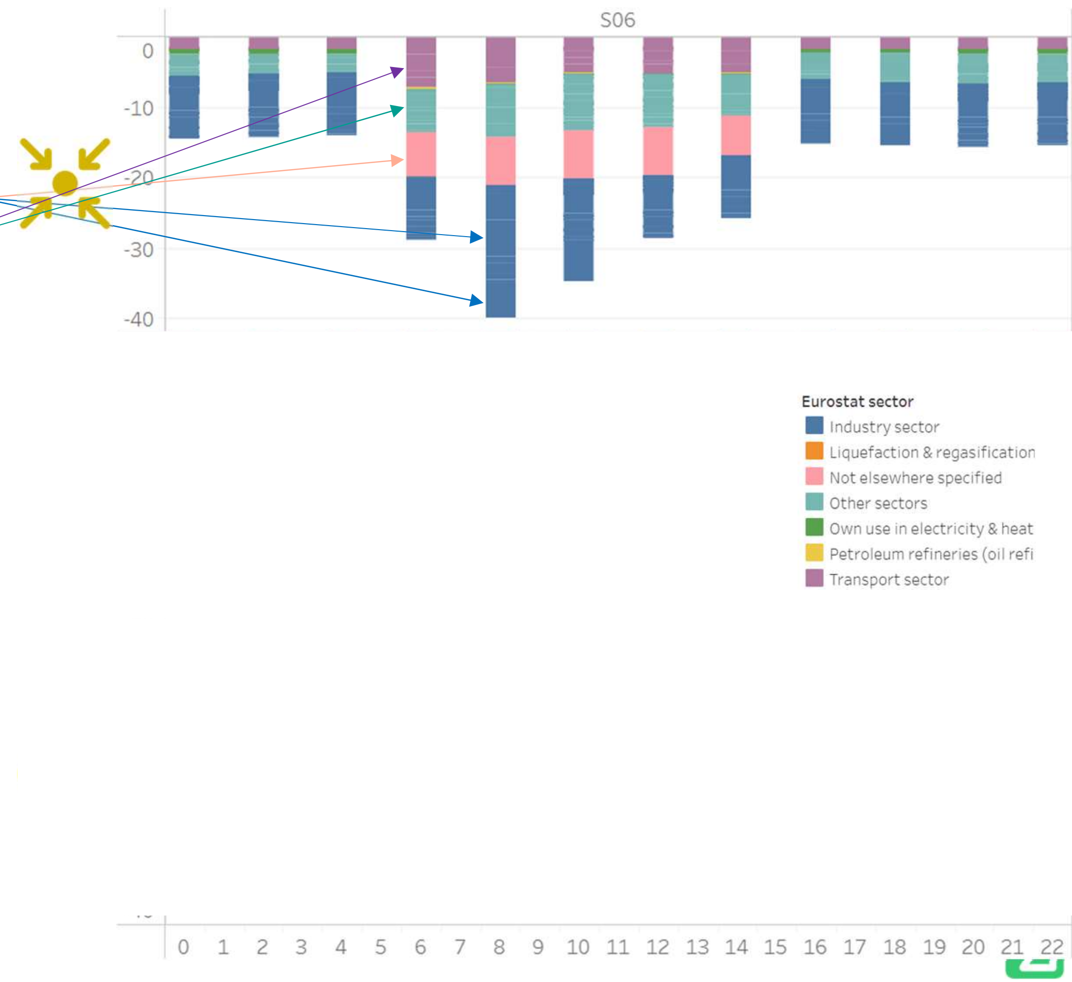
- Central
  - PV peak of 55 GW at noon
  - 18,8 GW battery storage
- Electrification
  - PV peak of <25 GW at noon
  - 5,6 GW battery storage
  - Constant 13 GW wind
  - 6 GW SMR during evening
- Clean Molecules
  - Comparable with Central but
  - 13,5 GW battery storage
  - eFuel peak plants during evening



Power sector – representative summer day 2050

Demand sectors

- Central, accommodate noon peak
  - Electrolysers: 13,2 GW (H_2 production)
  - Smart EV charging, water heating



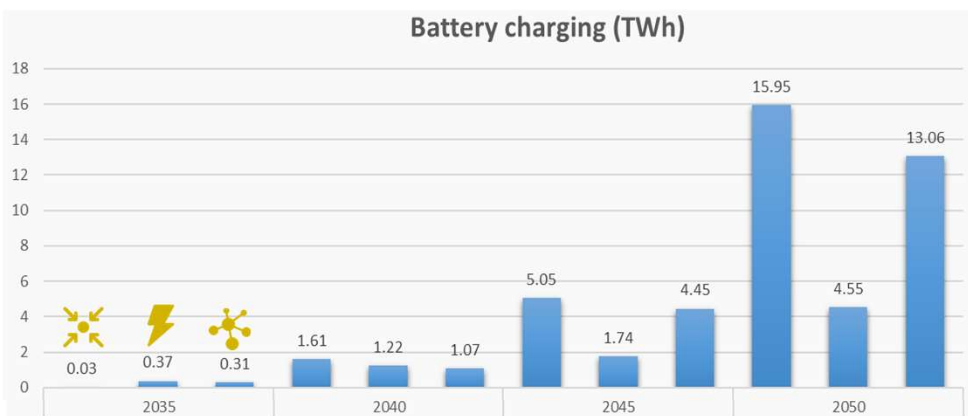
- Electrification, more baseload
  - Electrolyser (8,2 GW) constant production

- Clean Molecules
  - Electrolysers: 10,3 GW (H_2 production)
  - Smart EV charging, water heating

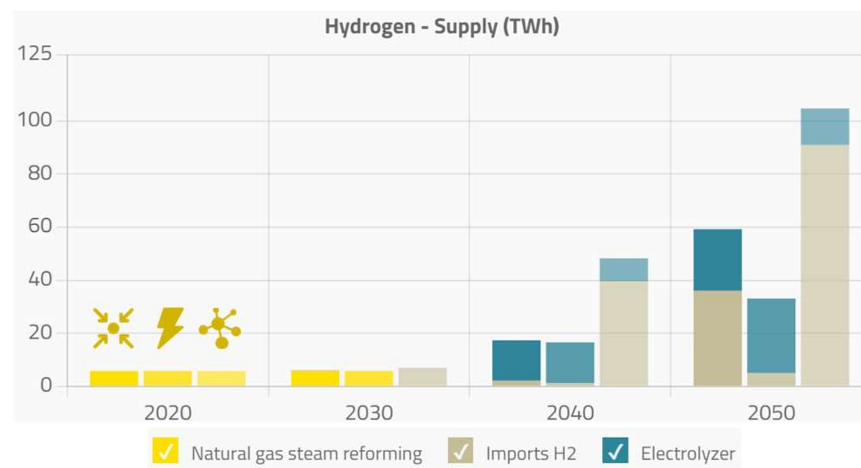
Flexibility needs in the energy system

- Growing from 2040 onwards, by 2050
  - Central: 18,8 GW
  - Electrification: 5,6 GW
  - Clean Molecules: 13,5 GW

- Balance between Belgian production and import 2050
  - Central: 13,2 GW → 23 TWh Belgian production - 36 TWh import
  - Electrification: 8,2 GW → 28 TWh Belgian production – import limited to 5 TWh
  - Clean molecules: 10,4 GW → 13,7 TWh Belgian production – 91 TWh import



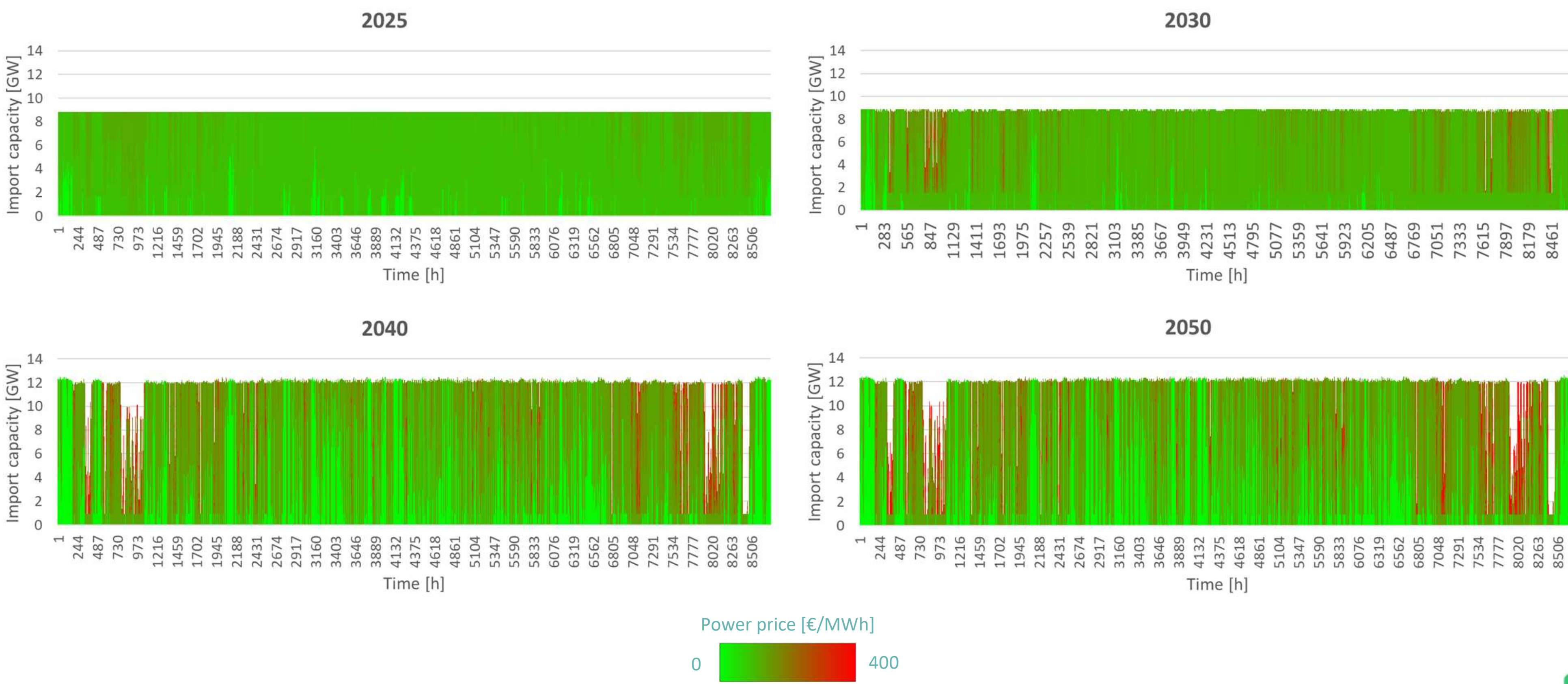
TIMES Be optimizes for the minimal amount of battery capacity needs at national level.
The model does not take local grid issues or short term balancing/frequency control needs into account



Excluding international aviation and maritime transport

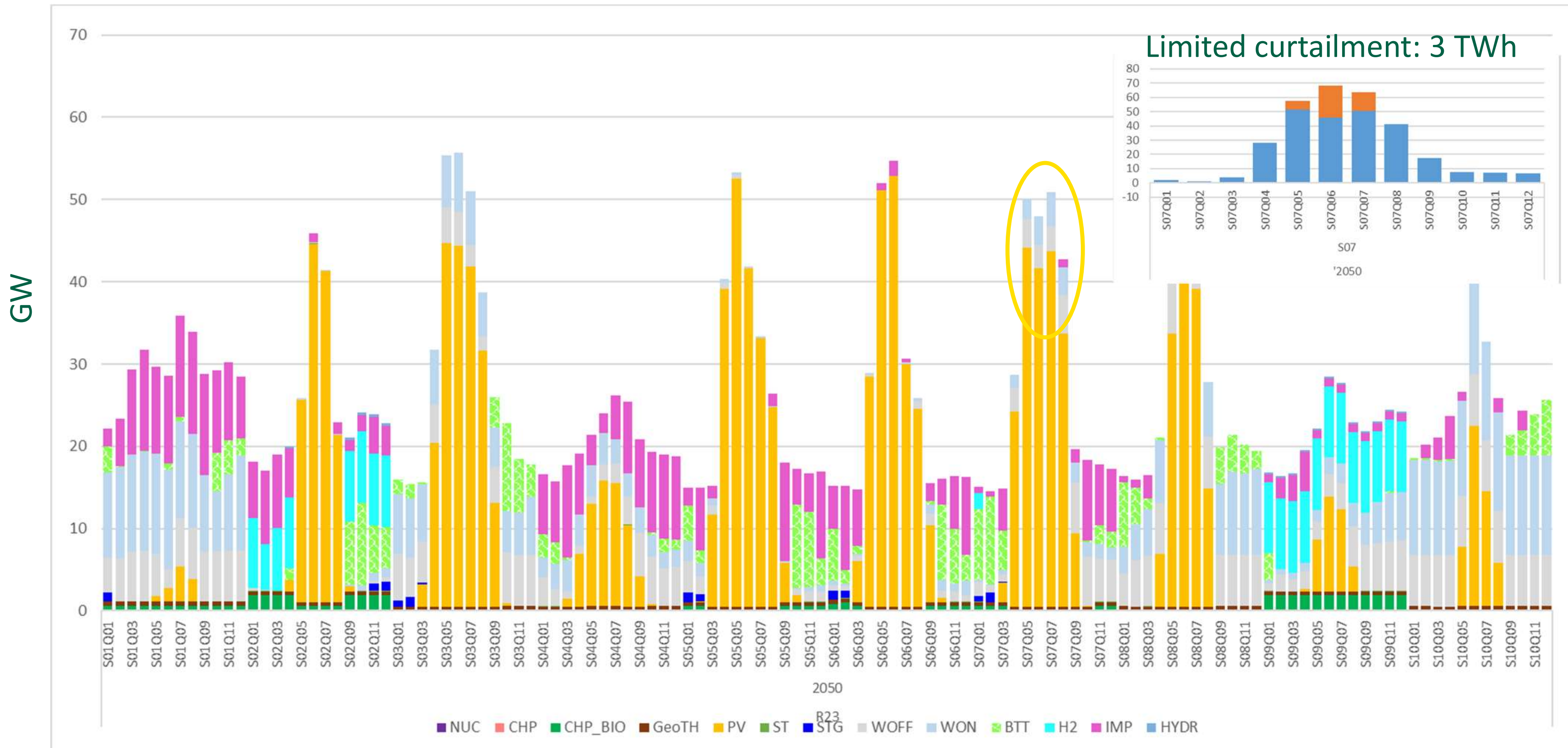
Input data - Imports

Neighboring countries export price curves (hourly)



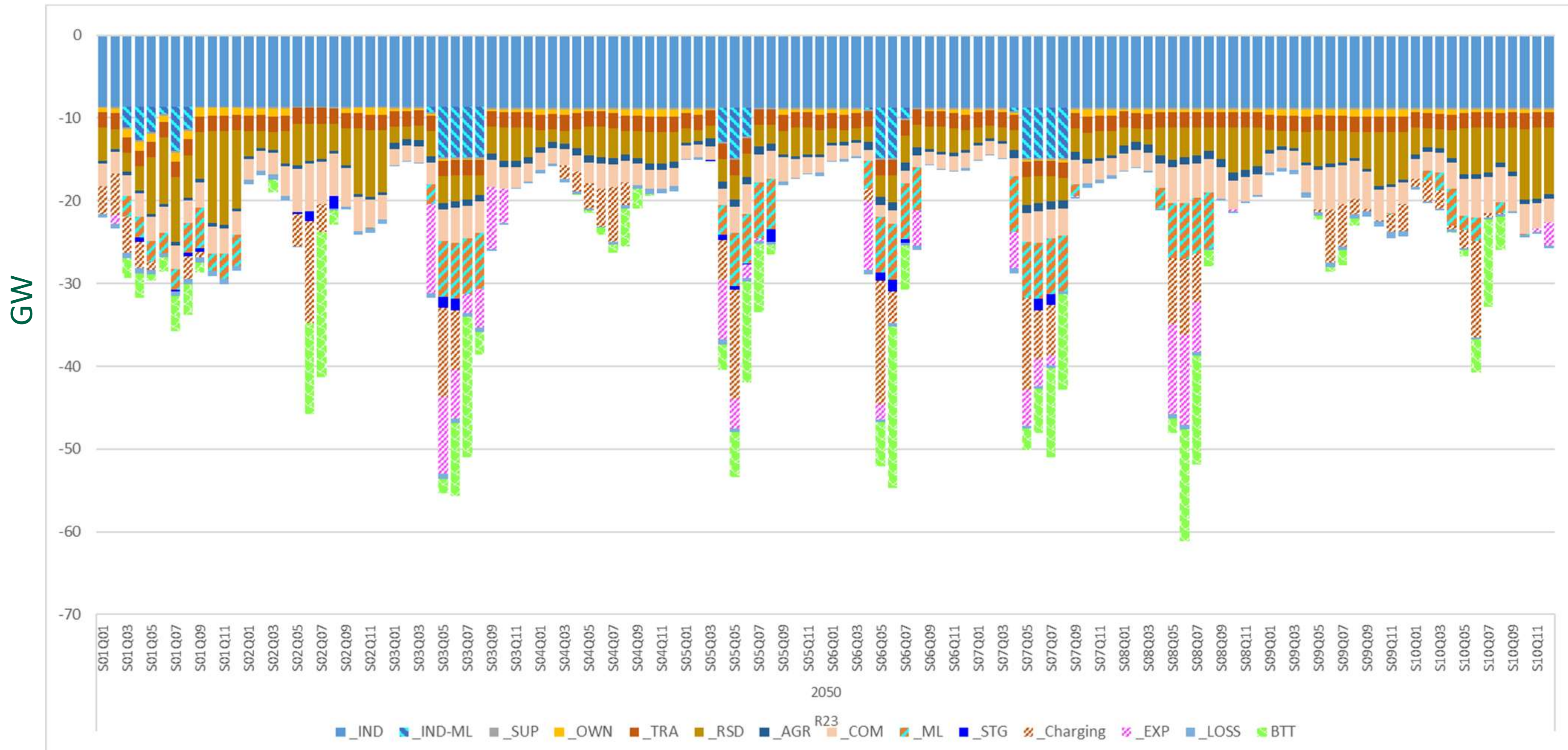
Central scenario

Electricity sector – production 2050 – 120 timeslices (10d/2h)



Central scenario

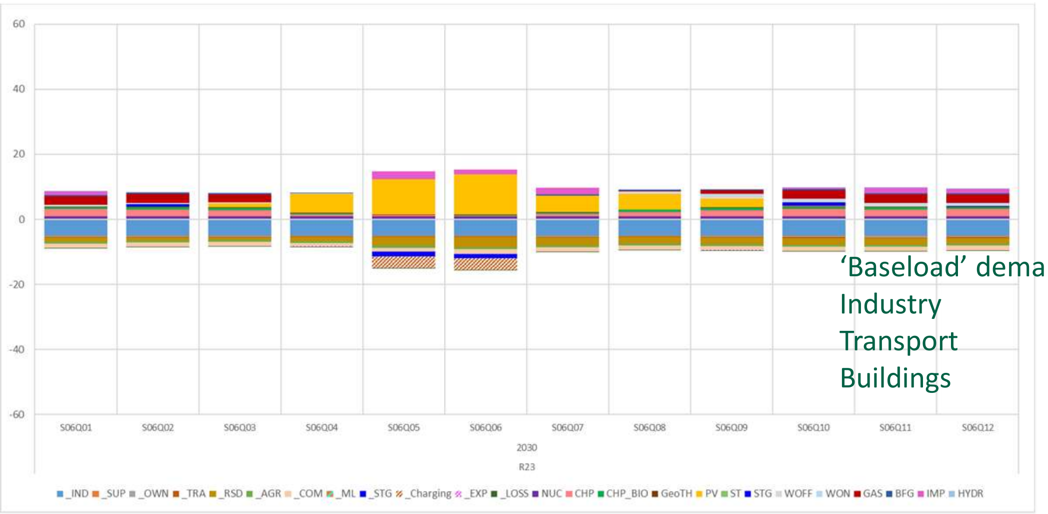
Electricity sector – demand 2050 – 120 timeslices (10d/2h)



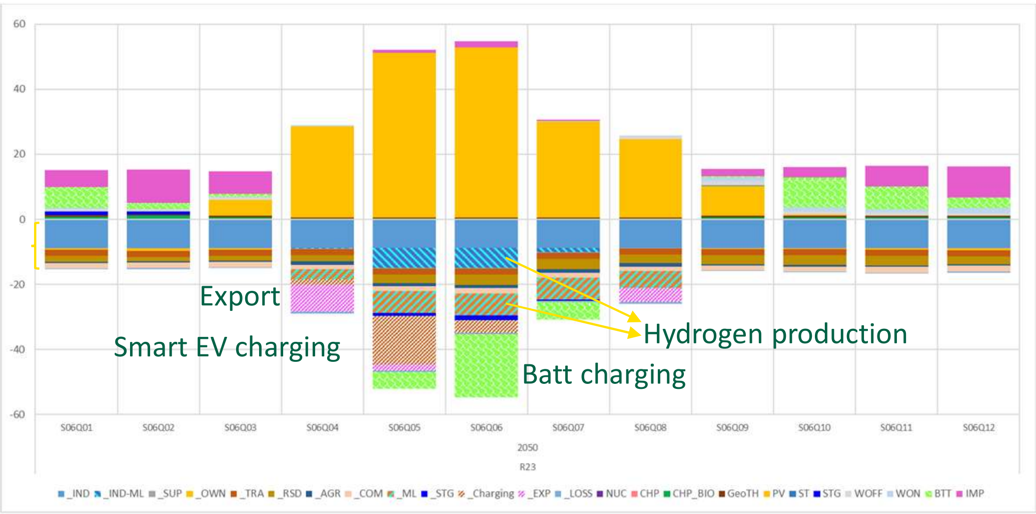
Central scenario

Representative summer day

2030



2050



Battery capacity: from 11 GW in 350 €/ton 2050

→ 18,5 GW in Net-zero 2050

16 TWh (dis)charging in 2050

Elia

System Blueprint Study

Electricity System BluePrint study

Horizontal Electricity Think Tank 01/03/2024

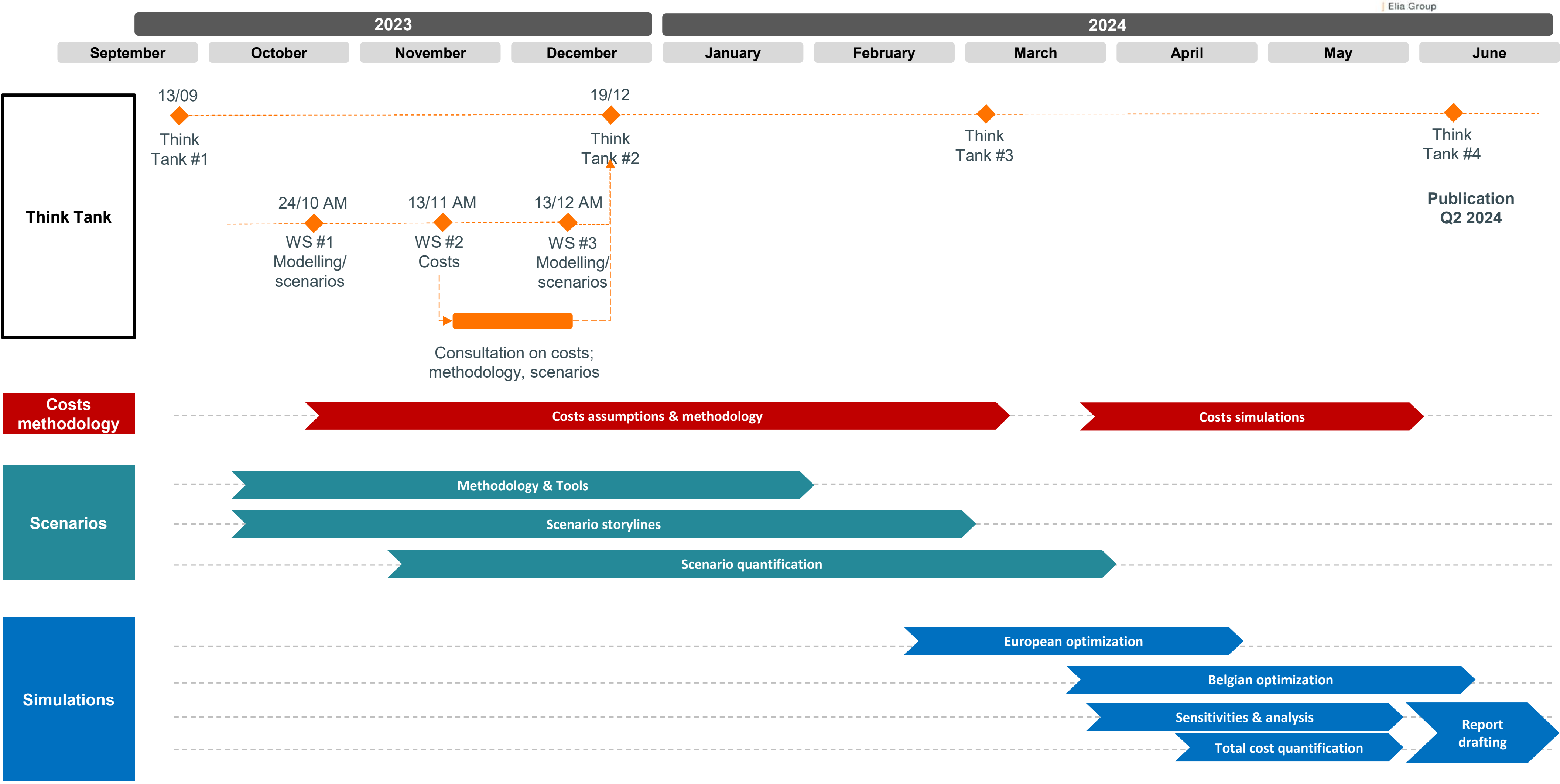
Generated with AI (FireFly)

elia
| Elia Group

Short update on the BluePrint study

- Outcomes of the public consultation
- Modelling improvements (-> multi-energy modelling)
- Energy demand & supply scenarios for Belgium

Timeline



2023
2024
September
October
November
December
January
February
March
April
May
June
Think Tank
13/09
Think Tank #1
19/12
Think Tank #2
Think Tank #3
Think Tank #4
Publication Q2 2024
24/10 AM
WS #1 Modelling/ scenarios
13/11 AM
WS #2 Costs
13/12 AM
WS #3 Modelling/ scenarios
Consultation on costs; methodology, scenarios
Costs methodology
Costs assumptions & methodology
Costs simulations
Scenarios
Methodology & Tools
Scenario storylines
Scenario quantification
Simulations
European optimization
Belgian optimization
Sensitivities & analysis
Total cost quantification
Report drafting

Public consultation outcomes

Main feedback received (non exhaustive)

- Many questions on the modelling of other vectors than electricity
  - We will model all energy vectors (see next slide)
- Costs assumptions for certain technologies, WACC assumption
  - Costs assumptions were updated and aligned with Fluxys
  - We plan to use one WACC (with sensitivities on the main value or between technologies)
  - All costs will be expressed in overnight costs but construction time/costs will be accounted for in the final total costs
  - Costs were updated in €2022 and construction costs removed were applicable (but will be accounted for in the costs calculations)
- Scenarios for Belgium and Europe
  - We will start from the TYNDP2024 scenarios (still under construction at ENTSO-E/G level) and update those with recent information from countries around us – (see next slides for Belgian demand scenarios). Those are/will be aligned with Fluxys.
- CO_2 computation
  - We will assess the CO_2 emissions of the whole EU energy sector and apply a target on the EU emissions
  - We plan to start with a -90% target for 2040 however we plan to assess a sensitivity on it
- Questions on the modelling/clarifications
  - Those will be further answered in the consultation report but the major ones were on the other vectors modelling

➢ We will share a detailed report (with the comments and answers) next week

We will model the whole European energy sector including feedstock and international aviation & shipping requirements

e-

- Hourly Electricity market model of Europe
- Zonal model (higher resolution per country)
- Investments in onshore/offshore grid, offshore windfarms, electrolysers, back up capacity (adeqacy), storage...

H_2

CH_4

- Daily H_2 & CH_4 model of whole Europe
- Explicit modelling of H_2 derivatives (methanol, ammonia)
- Liquids are also part of that model
- Imports outside of EU taken into account
- Investment in grid infrastructure H_2, storage

Liquids including methanol, ammonia

CO_2

- CO_2 model assessing carbon capture options
- Investments in process emissions, electricity generation, transformation processes of molecules or direct air capture to reach net zero emissions at European level

Imports outside of EU

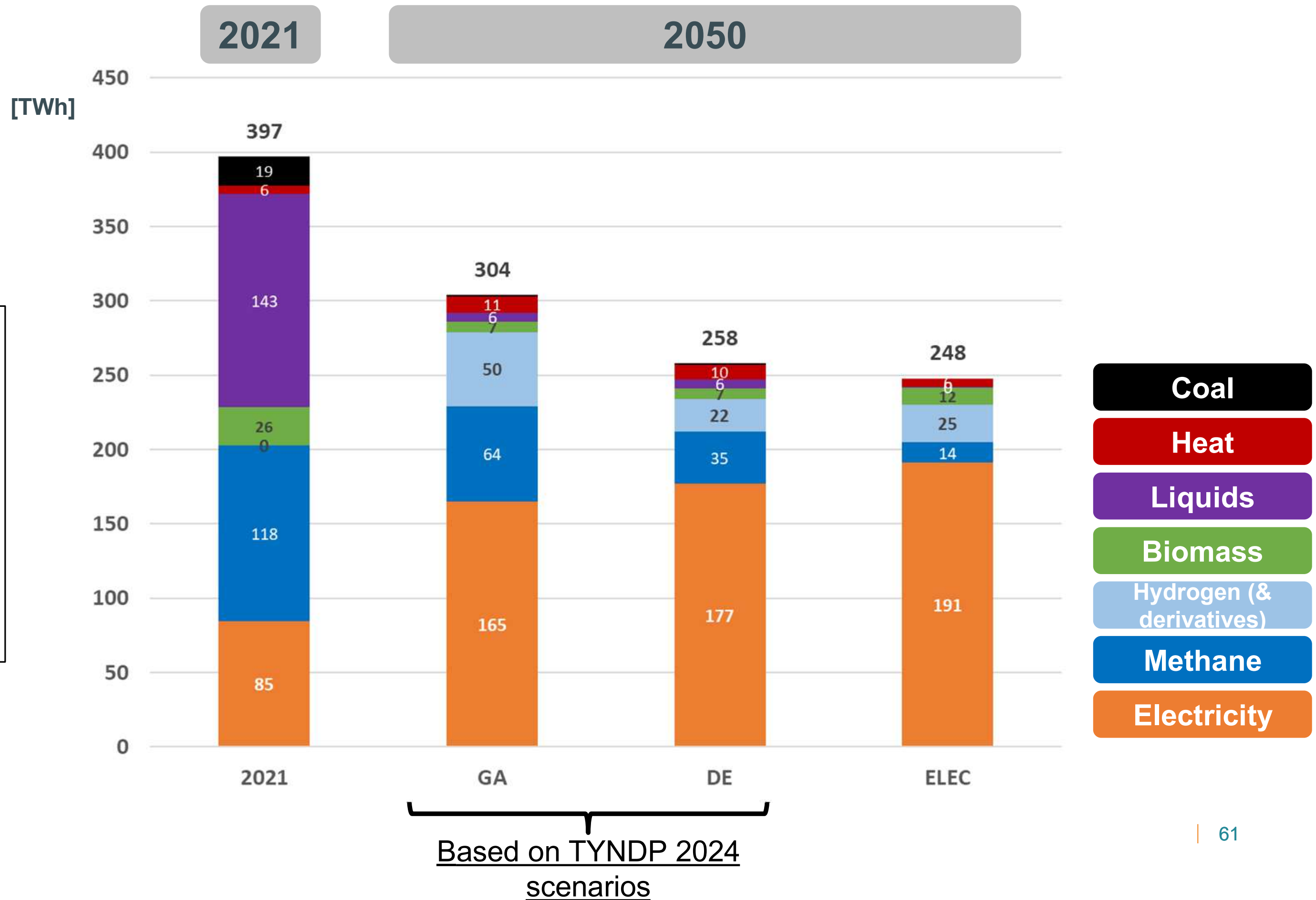
Scenario framework – Demand in Belgium

The final demand will be pre-defined in the models but several scenarios/sensitivities will be used.

Final demand

Final Demand including electricity losses...

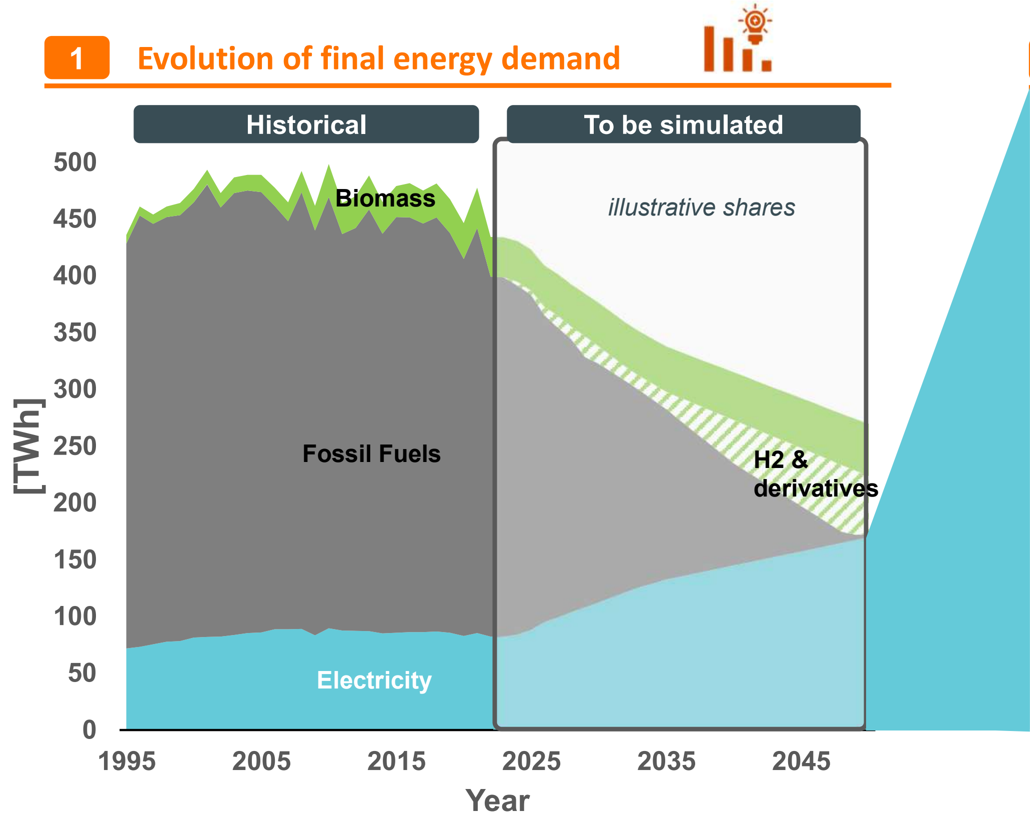
... but excluding:
- Feedstock and international aviation & shipping;
- Power to X and CCS demand for electricity;
- Explicit split in terms of derivatives will be used in the simulations.



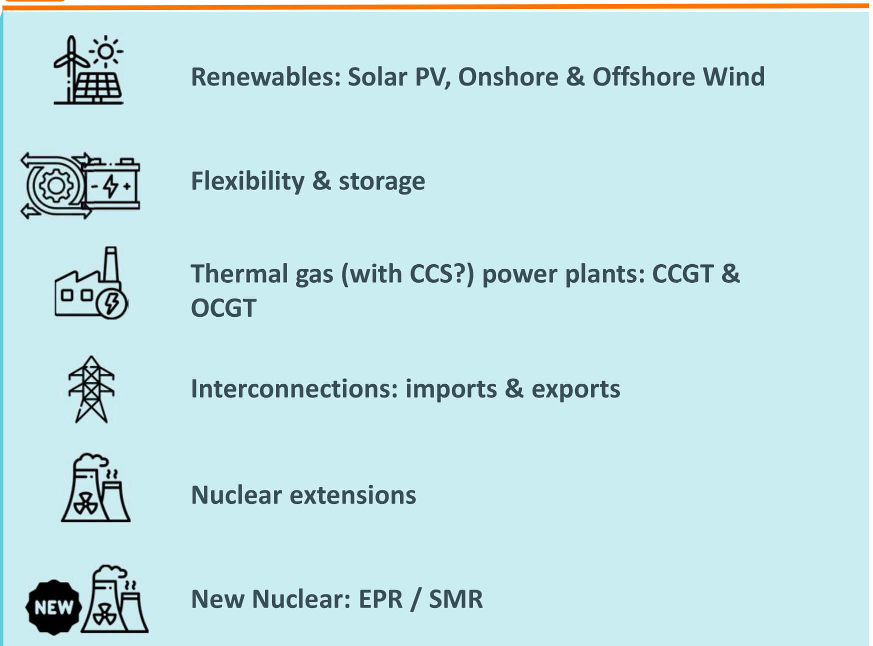
Other demand scenarios to be also quantified (Sufficiency, more heating networks...)

Supply scenarios for Belgium will be assessed as sensitivities and compared between each other

1 Evolution of final energy demand



2 Multiple Supply and storage options



- Renewables: Solar PV, Onshore & Offshore Wind
- Flexibility & storage
- Thermal gas (with CCS?) power plants: CCGT & OCGT
- Interconnections: imports & exports
- Nuclear extensions
- New Nuclear: EPR / SMR

Which sources will be used to supply this electricity?

Comparison should cover: adequacy, grid, costs, welfare, prices, energy dependance, emissions...

Thank you.

Elia

How to realize Belgian and European offshore ambitions

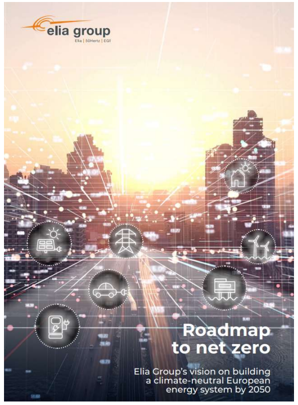
Realising our Belgian and European offshore ambitions

1st March 2024 – Benjamin Genêt

Elia Think Tank

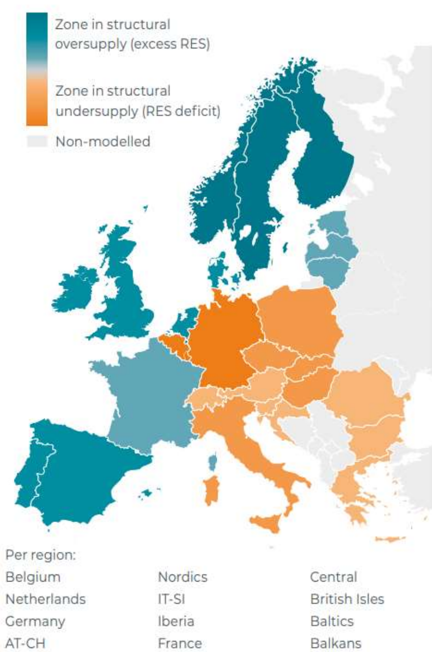
The case for offshore and (hybrid) interconnectors

Interconnectors and offshore are essential contributors to our transition to net-zero



Study published by Elia Group in November 2021

FIGURE 3: THE UNEVEN DISTRIBUTION OF RES ACROSS EUROPE. WHILE BELGIUM AND GERMANY ARE SHORT ON RES, THERE IS AN ABUNDANCE OF RES IN NORTHERN EUROPEAN COUNTRIES



INTERCONNECTORS BALANCE OUT THE UNEVEN DISTRIBUTION OF RES ACROSS EUROPE

The potential for renewable energy sources is unevenly distributed across Europe. In order to share this potential, interconnectors are needed between countries that have an excess in RES and those that have an RES deficit. Given Europe's limited RES potential, cooperative relationships with the UK and Norway would be beneficial and needed, as their offshore RES potential in the North Sea is particularly high.

The unique location of Belgium and Germany next to the North and Baltic Seas will enable them to meet their energy demand in a carbon neutral way via connection to non-domestic RES.

FIGURE 24: WEEKLY VOLATILITY OF OFFSHORE WIND AND CORRELATION OF OFFSHORE WIND ACROSS EUROPE

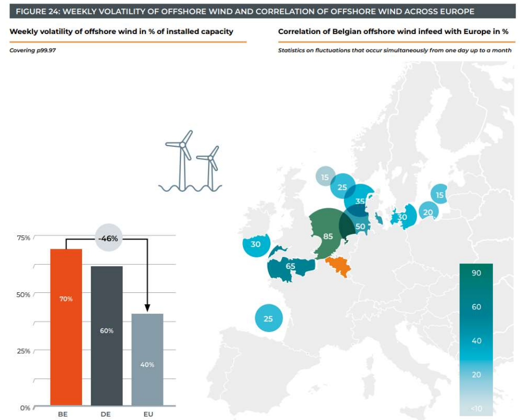
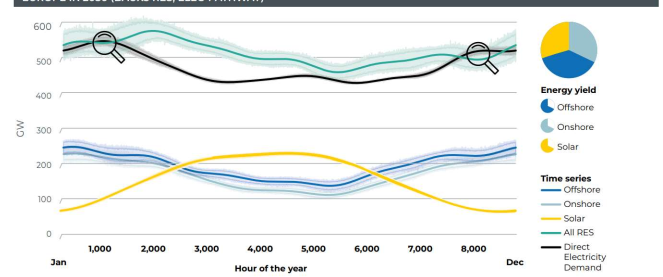


FIGURE 4: SEASONAL PATTERN OF ELECTRICITY GENERATION AND DEMAND (FLUCTUATIONS 1 TO 12 MONTHS). THE RIGHT MIX OF WIND AND SOLAR POWER AVOIDS A SEASON-LONG MISMATCH BETWEEN ELECTRICITY DEMAND AND SUPPLY IN EUROPE IN 2050 (BAUX3 RES, ELEC-PATHWAY)



Triton Link
DK-BE
DANEMARK
Energy
Island
Nautilus: 2nd
interconnector
between UK-BE
THE
NETHERLANDS
UNITED
KINGDOM
FRANCE

The challenges

Developing interconnectors was not easy…

… developing hybrid interconnectors is even more challenging!

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- Lengthy and complex ad hoc negotiations
- Misaligned incentives
    - Grid vs. wind
    - Long RES vs. short RES countries
- No contribution by non-hosting countries
- Limited EU funding
- Limited options in terms of funding at Member States' level, also due to political acceptability

Areas of possible solutions

Improvements in two key areas should be explored

1. **Joint optimised planning**

2. **Practical solutions to cost sharing and funding**

elia group

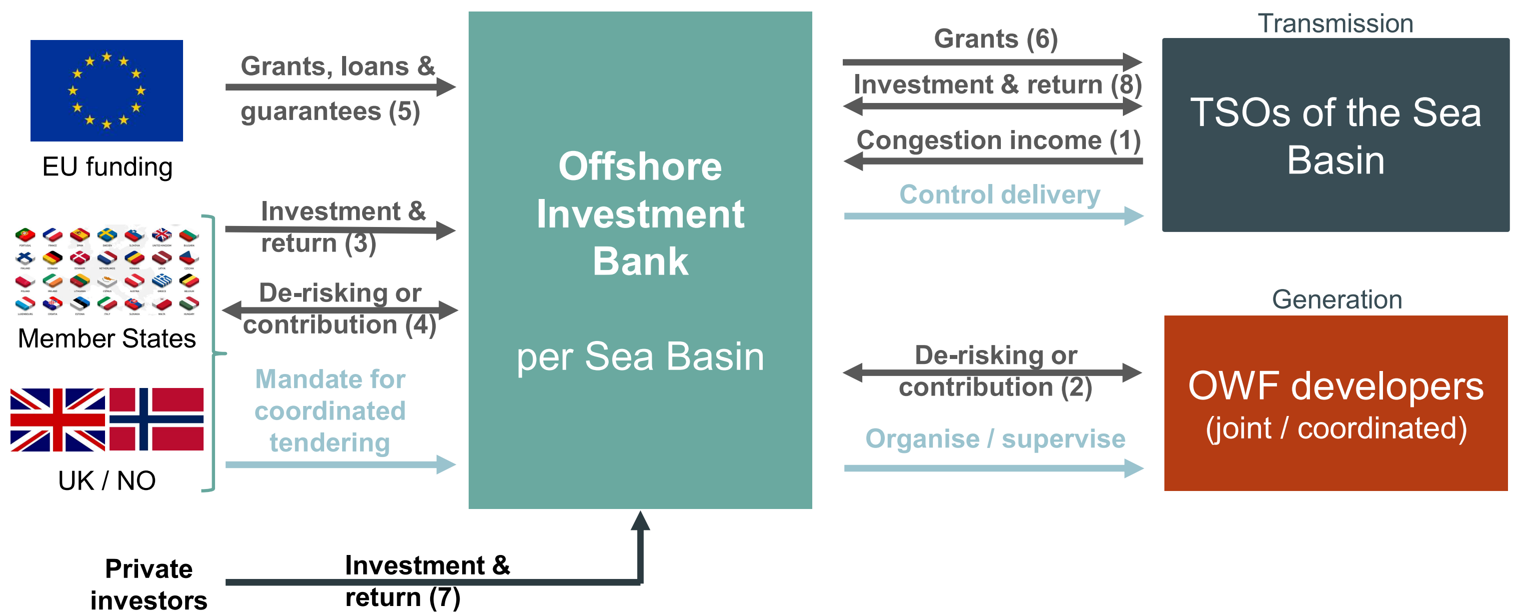
Planning must be improved with the spirit to identify the optimal projects

- **Offshore Network Development Plan is a great first edition!**
- …but improvements are possible on regulatory and modelling levels
  - Starting assumptions are **preventing to identify the most optimal projects**
    - Non-negotiable radial connection ➔ small optimisation space!
  - Some consequences:
    - The share of hybrid interconnectors (14%) is likely an underestimate
    - Alternative topology such as a radial connection to wind in a foreign EEZ cannot be identified
- Towards the next editions and the integration in TYNDP, the spirit of identifying the most optimal projects should consistently drive the modelling choices

An increased focus on sea basin and European optimality implies moving away from a bottom-up consolidation of national ambitions

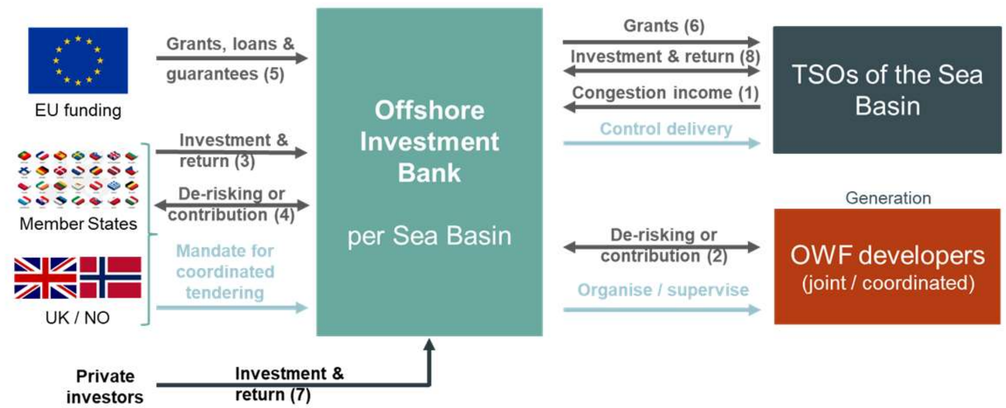
Practical solutions for cost sharing and funding should be found

A possible concept: setting up an offshore investment bank per Sea Basin, streamlining the funding and financing from different origins

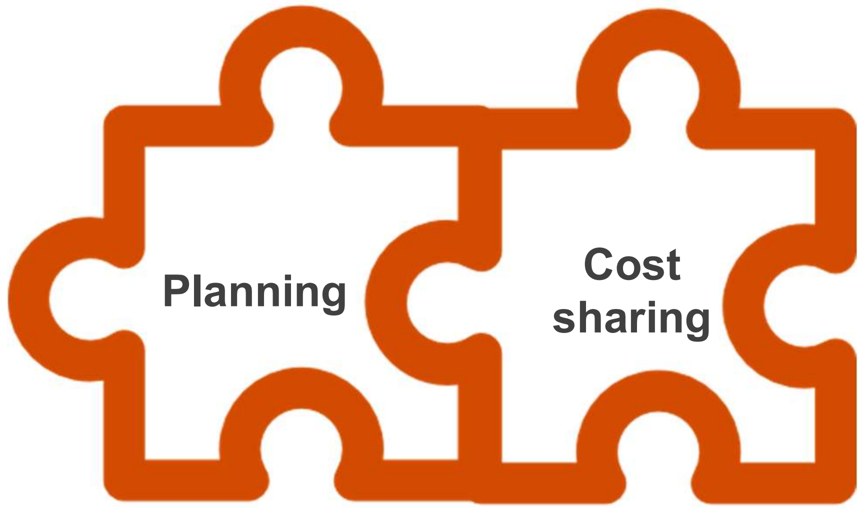


Key design features and benefits of the offshore bank

- **Regional setup per sea basin**
  - Not only EU funding, but also contributions from States
  - Coalition of the willings, building on e.g. NSEC
  - Facilitate involvement of third countries
- **Providing a consistent approach for grid and generation**
  - 2 sides of the same coin!
- **Contributions discussed at political level**
  - Informed by e.g. SB-CBCS to enable fairness
  - But can also consider other parameters
- **Key success factor: a strong Sea Basin planning**
  - The best projects should be prioritised
  - Away from nationalistic perspective
  - Focus on projects of significant regional relevance
- **Enable speed**
  - Administrative simplification
  - Sea basin deal, away from project-per-project negotiation
- **Mitigate financing challenges for project promoters**
  - Attracting private capital seeking stable return for long duration with low risks thanks to state backing
- **Create confidence to develop the supply chain**



Both areas need to be tackled in a consistent way



At sea basin level

We need to plan together what we pay together!

Thank you.

Florence School of Regulation

Energy policy ideas for the next European Commission

FLORENCE SCHOOL OF REGULATION

ROBERT SCHUMAN CENTRE

Energy Policy *ideas* for the next European Commission: from targets to investments

Leonardo Meeus, Ilaria Conti, Lucila de Almeida, Jean-Michel Glachant, Leigh Hancher, Max Münchmeyer, Andris Piebalgs, Alberto Pototschnig

Introduction

- The next European Commission will need to work on energy security
  - By integrating our energy markets and infrastructure across borders, we increase our resilience against shocks, but we also increase our interdependencies.
  - We therefore need to avoid that Member States can voluntarily or involuntarily free-ride on our shared energy security at the expense of others.
- The increasing rivalry between the US and China has also focused our attention to the security issues we might face in
  - The manufacturing of energy technologies
  - The critical raw materials that are used in the energy supply chain.

O1: Make Member States more accountable to live up to their national investment potential for energy efficiency and renewable energy

Current approach

- NECPs with national pledges

Issues with the current approach

- In 2019, the first versions of the **NECPs** fell short of reaching the **EU targets for 2030**. The final revised plans did meet (and slightly exceed) the renewable energy and non-ETS targets (at the level they were then), but still fell short of the energy efficiency target. In 2023, the NECPs had to be updated, and the **gap is widening**
- **Risk unsustainable high carbon prices**, which could result in intervention in carbon markets (as we have experienced intervention in energy markets when prices increased), which would undermine investor confidence further

New/improved instruments

- An **EU Energy and Climate Plan** with investment progress tracking and recommendations for Member States. It can help counter the fragmented reporting we currently have, and the recommendations can also promote cross-border cooperation.
- **Existing EU funding** for Member States, such as the EU Regional Development Fund, the EU Cohesion Fund, or the NextGenerationEU instrument, could be (partly) **redirected** towards renewable energy and energy efficiency investment.
- **A dedicated EU fund** could be set up to directly finance projects in Member States that have an abundance of renewable energy resources, but lack the public budgets to support the investments. Member States that have the economic strength, but do not have the renewable energy resources, or do not live up to their investment potential at the national level, could be expected to contribute to the fund.

O2: Promote multilateral cooperation (and solidarity) among Member States for network infrastructure, resource adequacy and flexibility

Current approach

- TYNDPs, PCIs, ERAA, flexibility assessment, Risk Preparedness Regulation for electricity, and the Gas Security of Supply Regulation.

Issues with the current approach

- The promise that governments will not intervene in markets when prices go up has been broken. We need to **restore investors' confidence**.
- Future network investments in offshore grids, a hydrogen backbone, seasonal storage, and carbon capture and storage infrastructure are more complex. If we are not **proactive in expanding networks**, they will become the bottleneck for the energy transition.
- **Regulators** are good at scrutinizing network investments and costs within a given policy framework. But, the framework or the **mandate** under which they have to make their decisions is not clear due to the gap between the EU and national ambitions.

New/improved instruments

- Modernization and Europeanization of capacity mechanisms & Upgraded ERAA beyond adequacy and electricity
- A top-down EU Network vision and new instruments for network cost allocation

Co-funded by the Erasmus+ Programme of the European Union

O3: Strengthen the management of our global dependencies

Current approach

- NZIA target to manufacture 40% clean tech needs in Europe by 2030
- CRM target by 2030 to ambition is to
  - restart mining (at least 10% of the annual EU's CRM consumption is to be extracted locally)
  - increase processing (at least 40% of the annual EU's CRM consumption will be produced locally)
  - Increase recycling (at least 15% of the annual EU's CRM consumption will be recycled locally)

Issues with the current approach

- We do not know how realistic these targets are for the different technologies or materials that are targeted
- The risks we are exposed to can be very different depending on the concerned CRM or clean tech manufacturing, assessing this properly will require a lot of detailed technical knowledge

New/improved instruments

- Need for specialized agencies that are competent to help manage these security risks?
- Next Multiannual Financial Framework in 2028: Do we want this to be our apollo program?
- Compulsory origin labelling or marking could engage customers to be part of the solution

Co-funded by the Erasmus+ Programme of the European Union

O4: Reinforce the EU institutional setup

Current approach

- European Commission (supported by JRC, Scientific Board), ACER, ENTSOs (ENNOH), EU DSO Entity, European net zero platform, European Critical Raw Materials Board

Risks/issues with the current approach

Competent authorities for national implementation EU NZIA and CRM?
During the crisis, we referred to the International Energy Agency for information and advice
•ENTSOs (ENNOH) and EU DSO Entity are not always neutral (e.g. electricity versus molecules, network versus non-network solutions)

New/improved entities

- More organized capacity building for national administrations via DG Reform
- Stronger energy system analysis competences and resources for ACER to improve the technology neutrality of the TYNDPs and ERAA.
- Reinforced ACER with creation of EU Energy Networks Entity for system planning (Upgraded EERA, EU Networks Vision) and new instruments for network cost allocation
- EU Energy Agency or extended ACER for EU Energy and Climate Plan & to replace the European net zero platform and the European Critical Raw Materials Board

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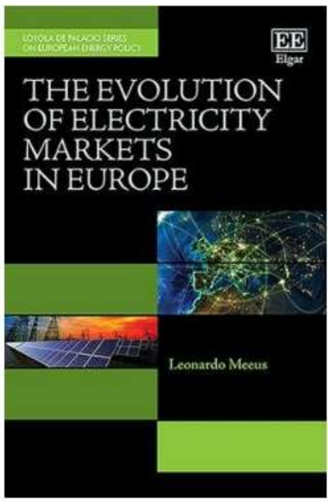

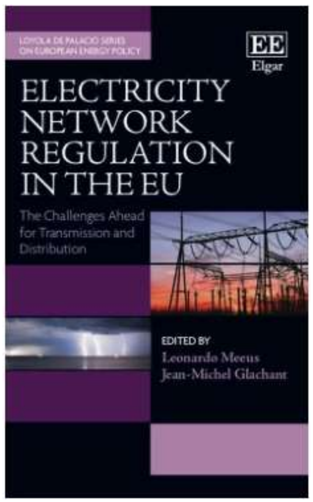

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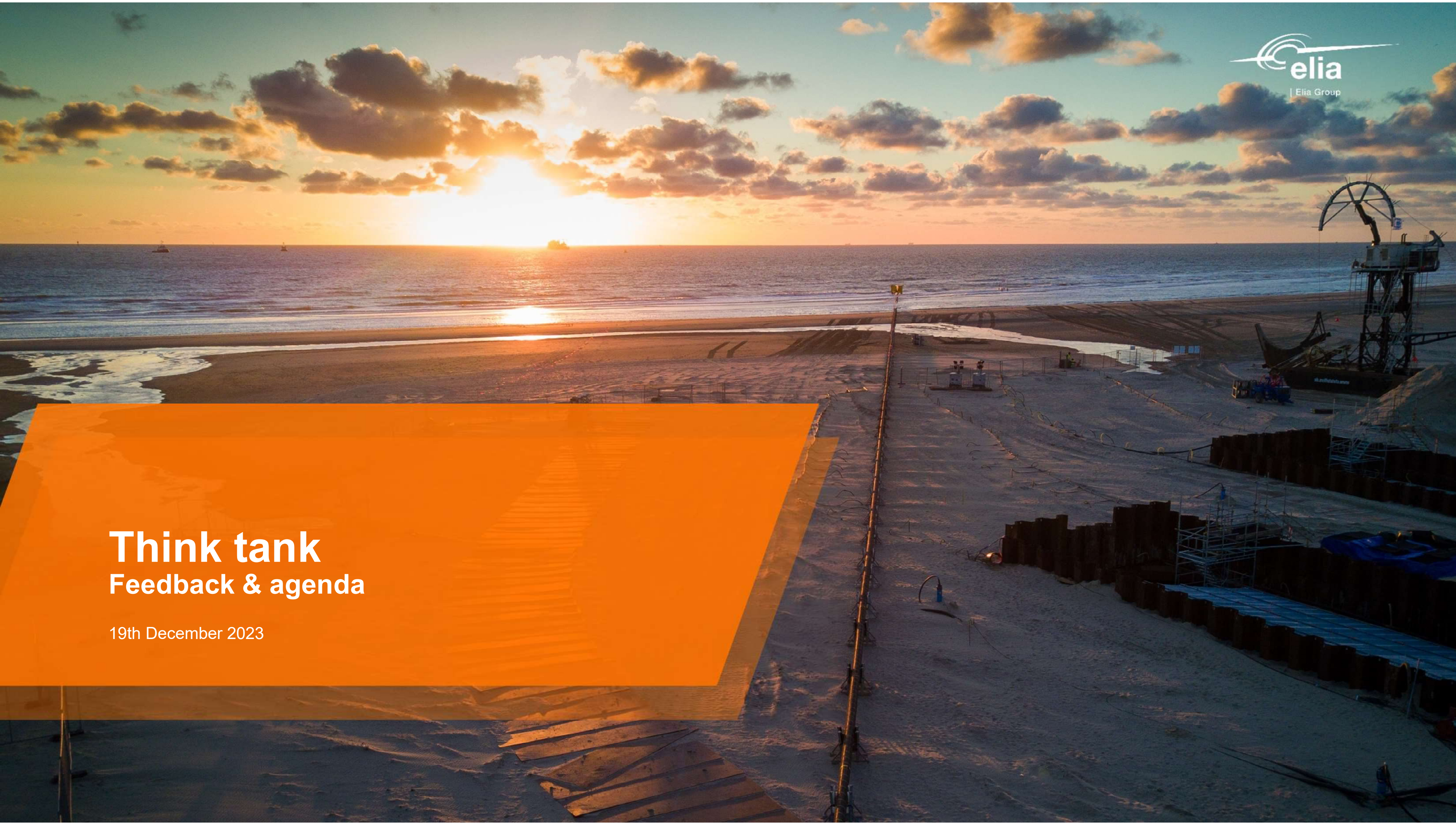

Think tank
Feedback & agenda

19th December 2023

Feedback & agenda

Agenda 10/06/2024:

1. TBD

Dates 2024 – 13-16h:

- 10/06/2024
- 23/09/2024
- 25/11/2024