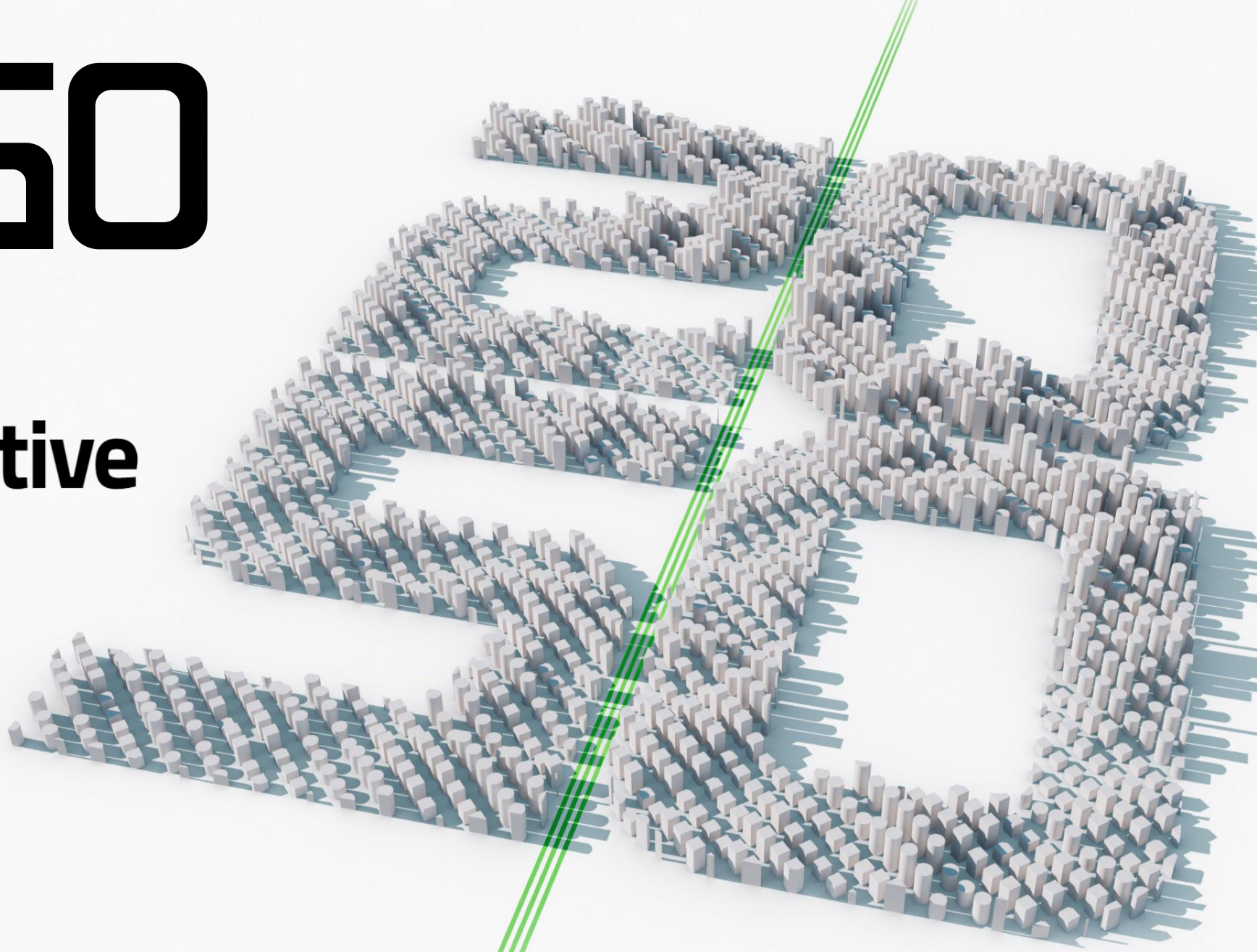
How can Belgium become carbon neutral between now and 2050?

PATHS 2050 – The Power of Perspective

Pieter Lodewijks

PATHS 2050

The Power of Perspective



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Offshore North Sea

2050: ~250 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

Total final energy demand Belgium

Final energy demand decreases by a

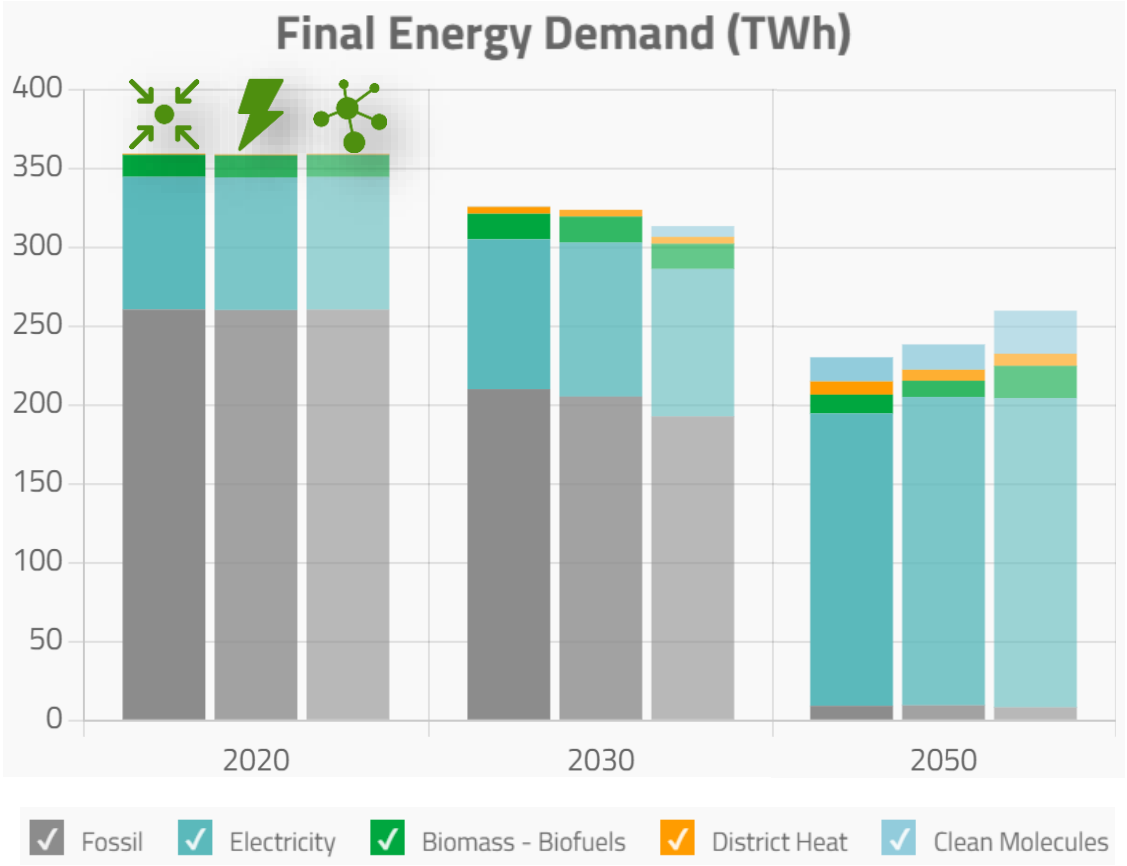
third

regardless of the scenario.

Electricity demand more than

doubles

in the 3 scenarios.



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

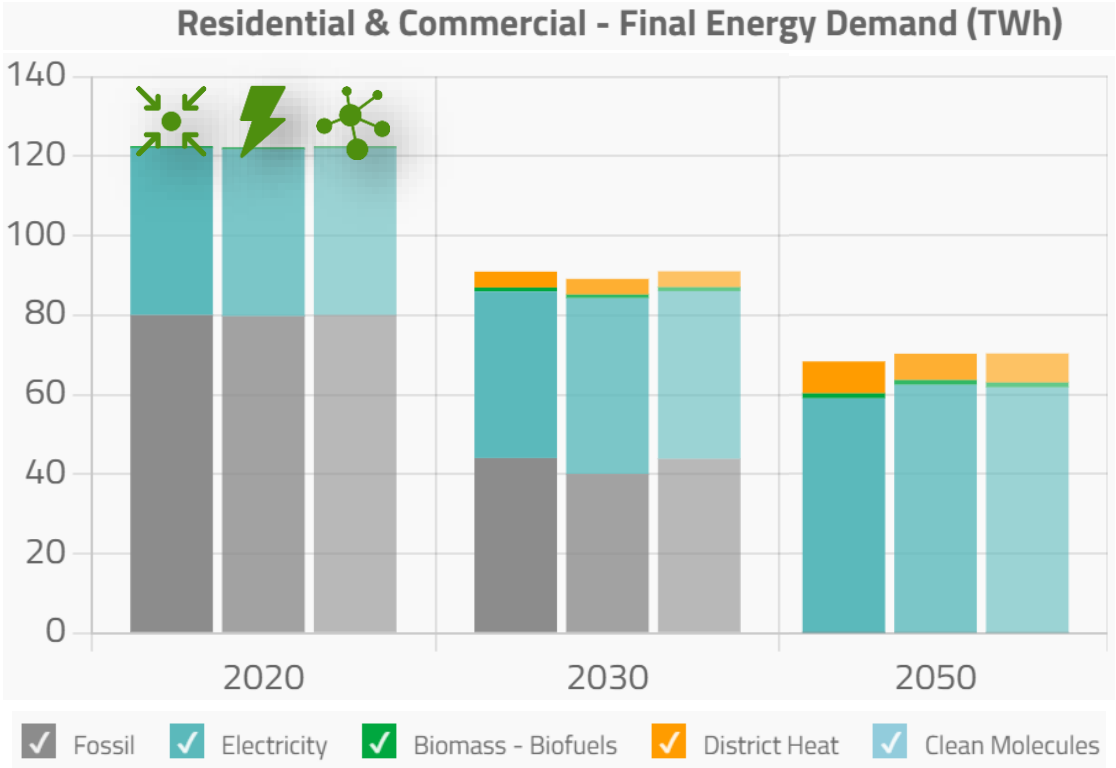
800.000 homes

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.



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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.

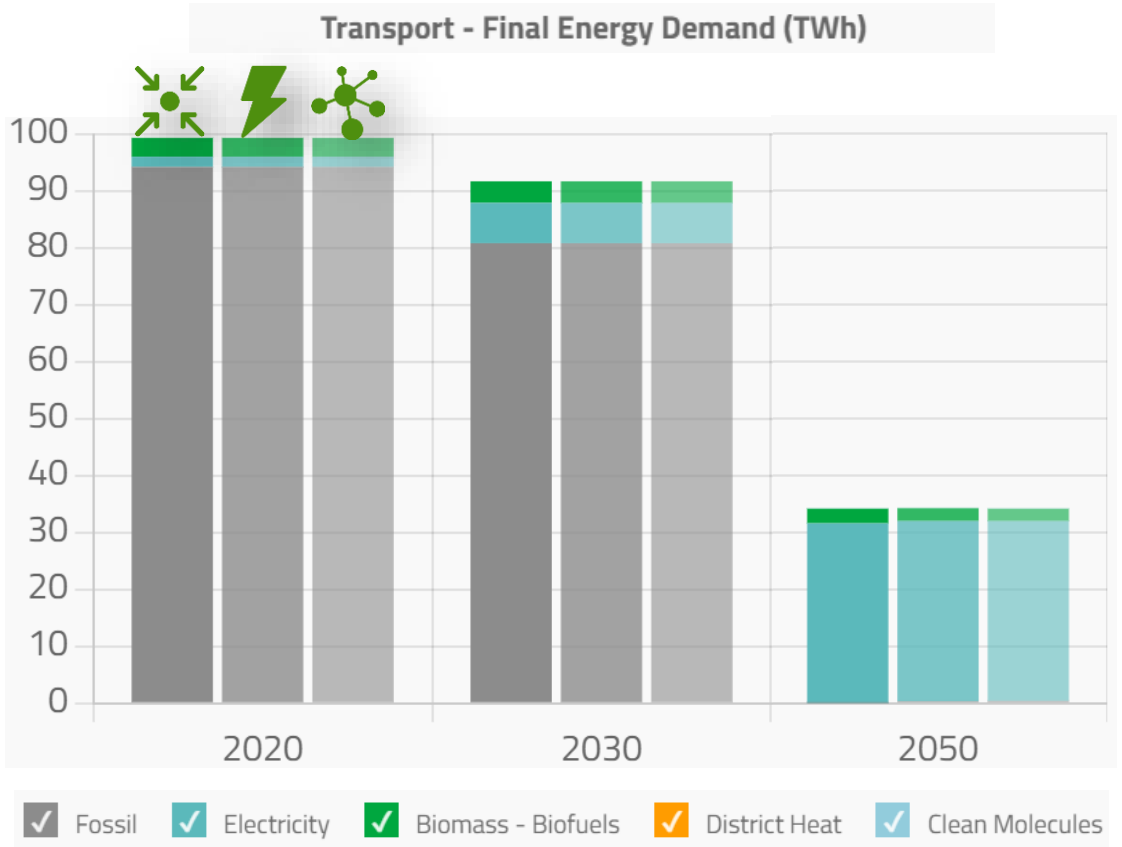
By 2050 our road transport is

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

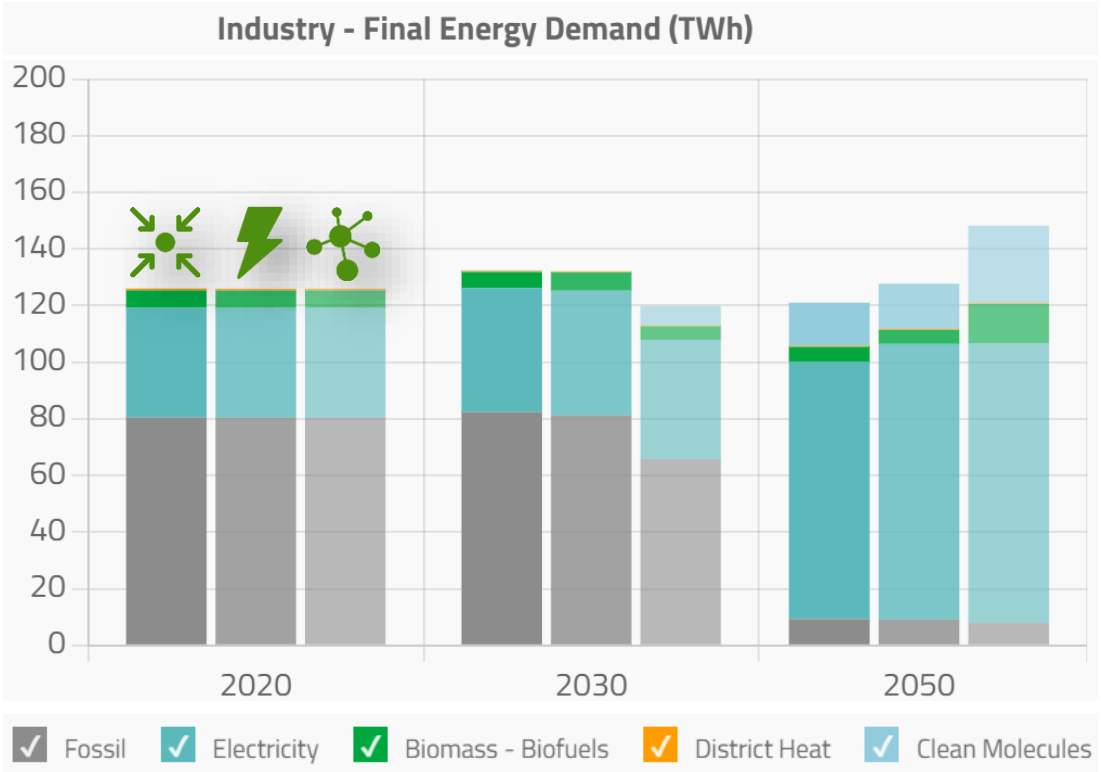
x 2

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

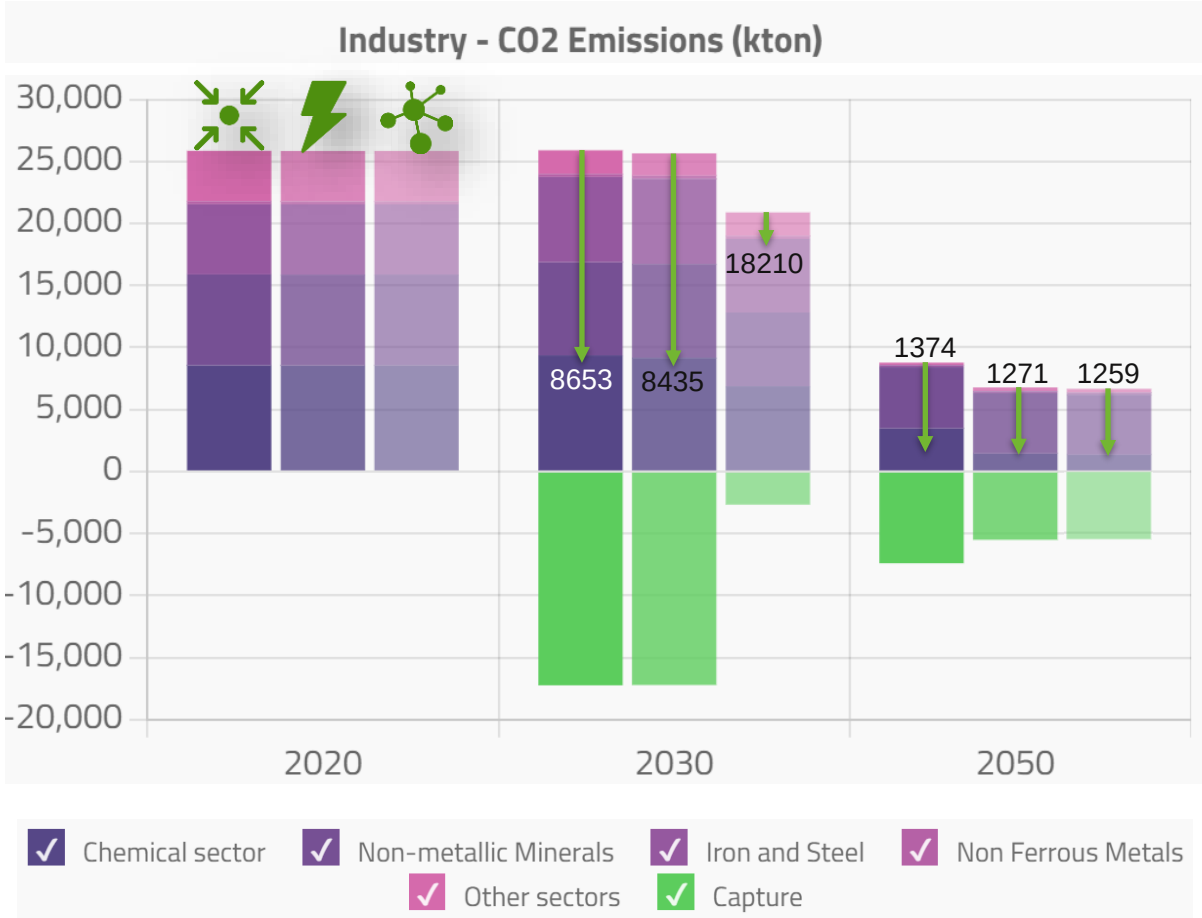
17 Mton

of CO_2 emissions from the atmosphere.

By 2050, CCS is limited to

7,4 Mton

and applied in cement, lime, high value chemicals.



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

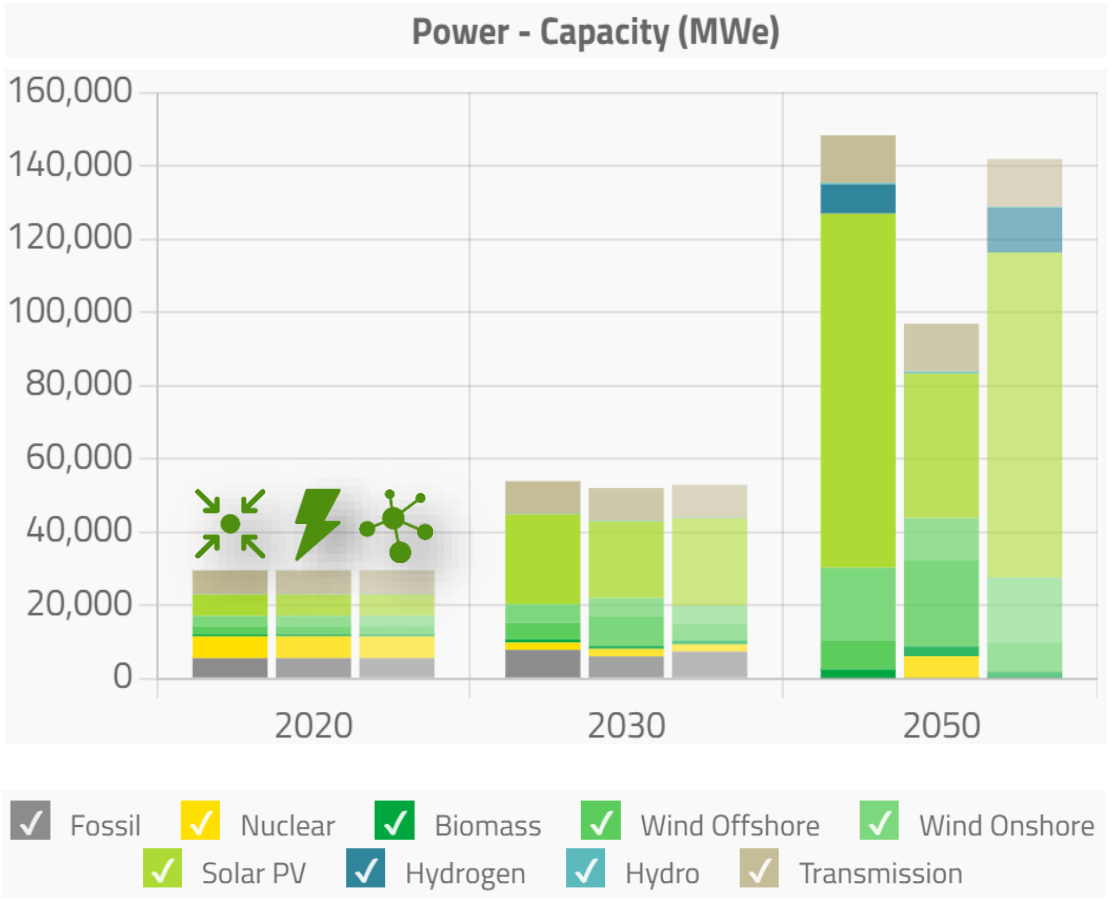
8 GW

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.

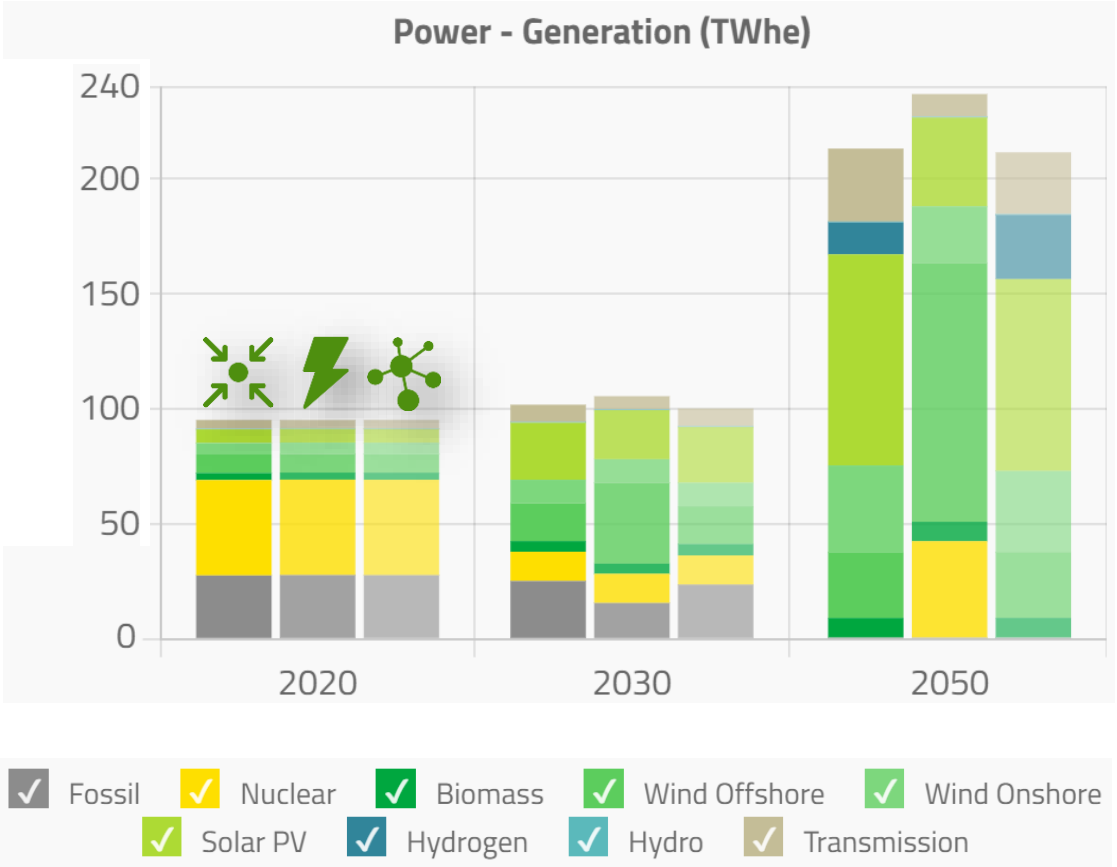


Power sector - Generation

From 2040 onwards the need for

demand flexibility

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



Fit-for-55 by 2030 ?

Evaluation limited to CO_2 emissions

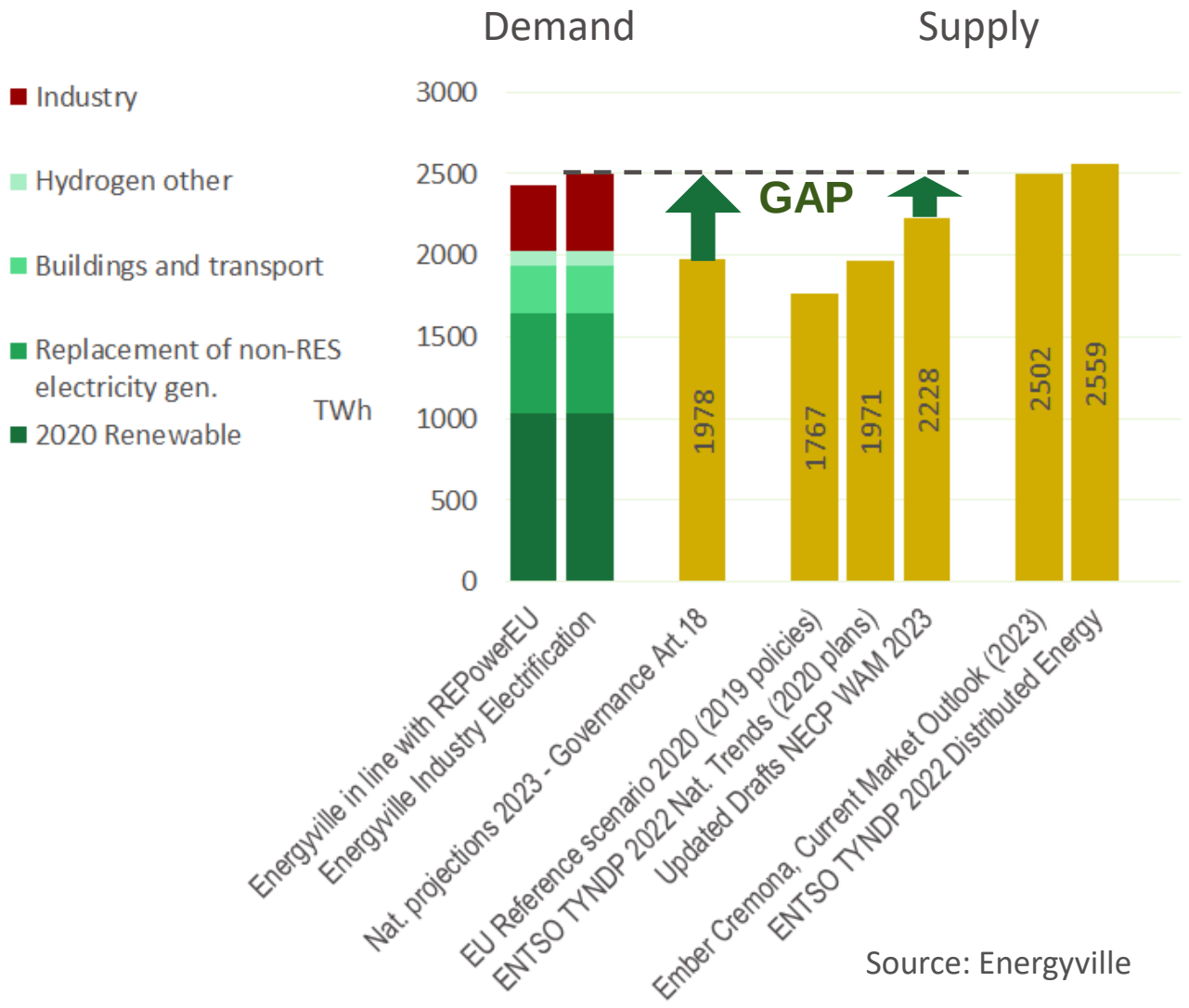
- **No policy projection or prognosis**
- Belgian CO_2 emissions 1990: **120 Mton** CO_2 emissions excluding net CO_2 from LULUCF
- Central scenario 2030: **52 Mton**
  → **reduction of -57%**

EU 2030 electricity demand- supply assessment for key industry sectors

A quantitative assessment for Concawe

Renewable electricity demand vs supply - 2030

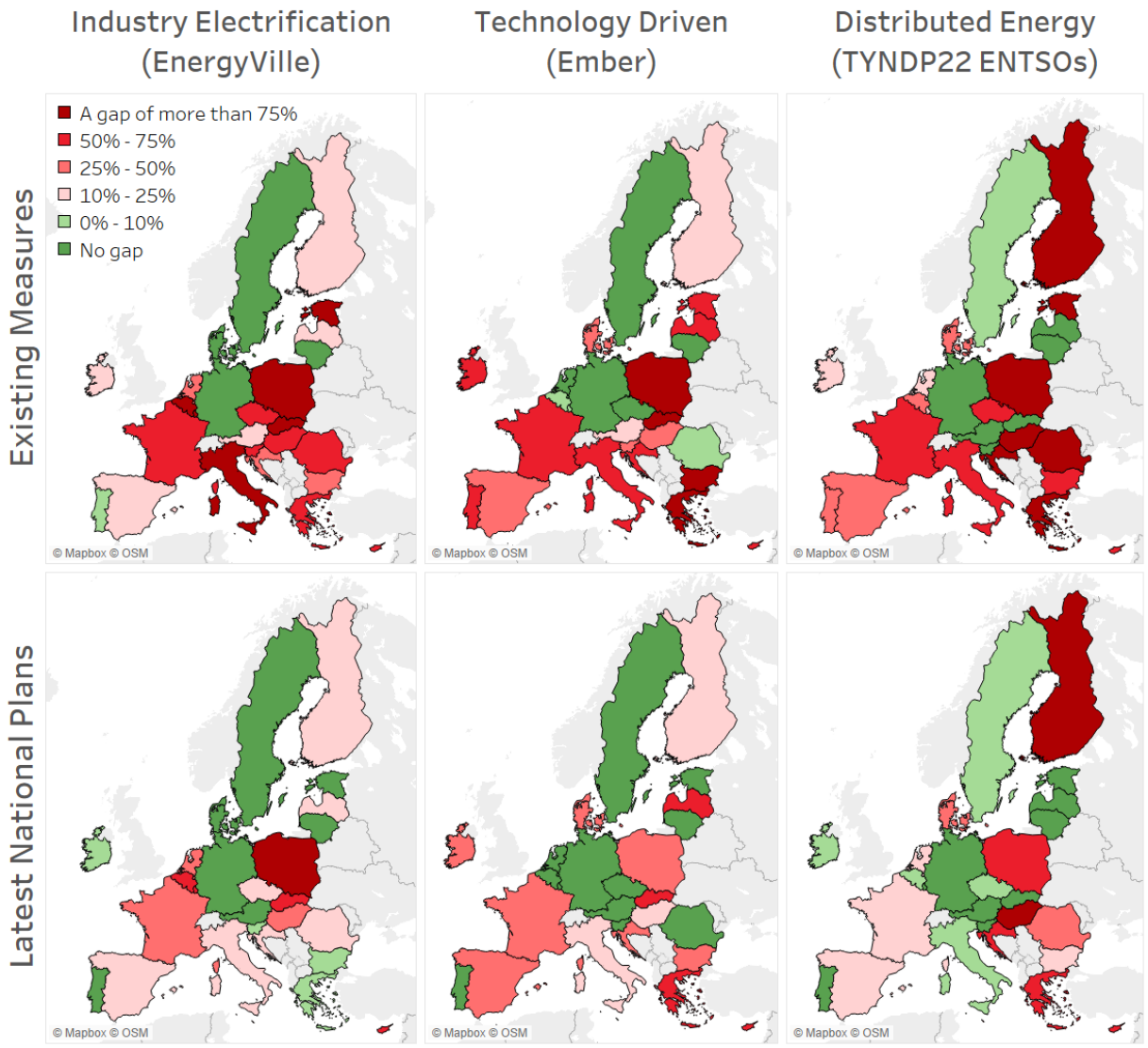
- Demand side
  - Double ambition: replacing existing non-RES + increasing end-use demand
- Supply side
  - Gap of 500 TWh in national projections that include existing measures
  - Still a gap of 250 TWh including ‘additional measures’



Source: Energyville

Member state analysis – supply/demand focus on RE

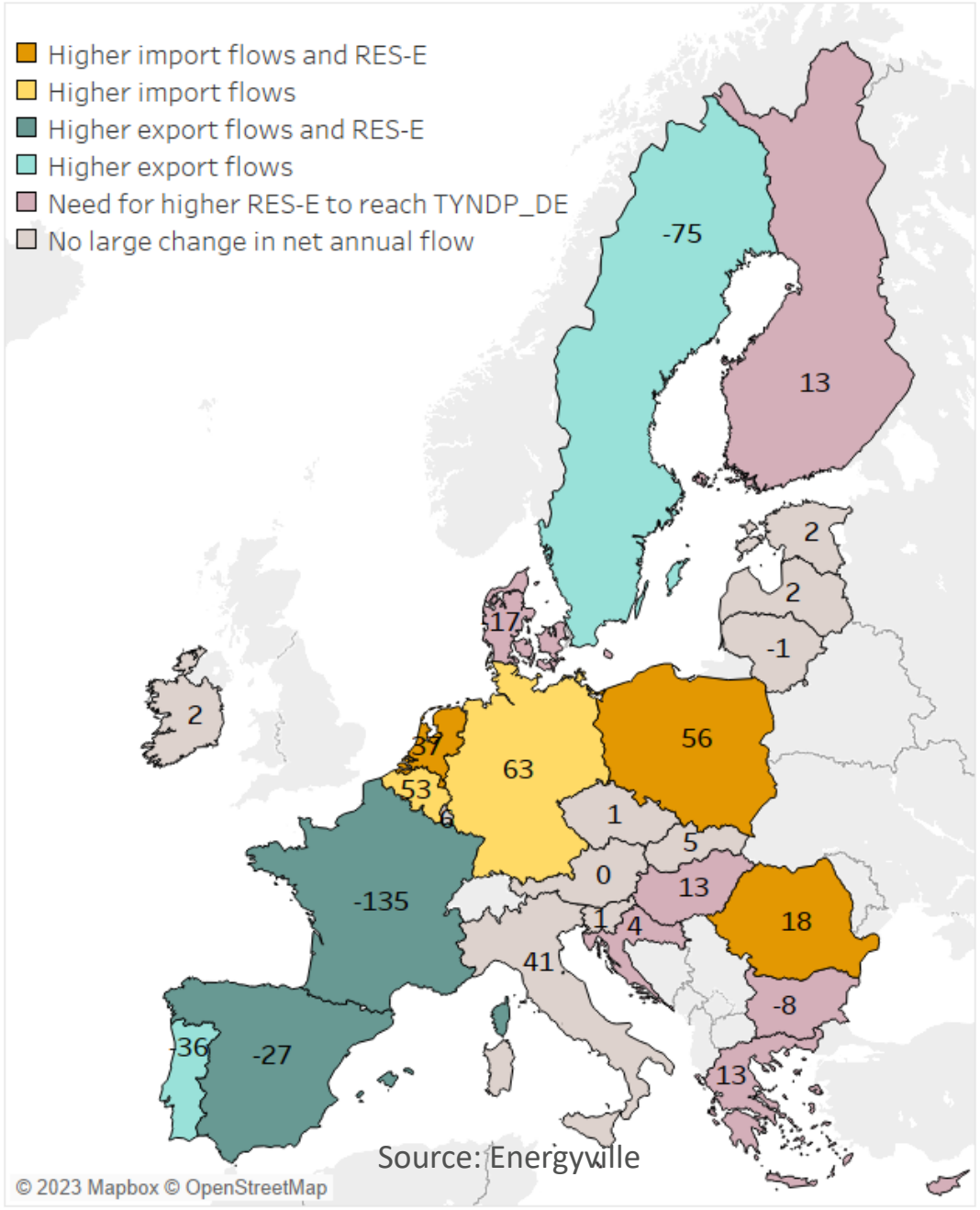
- **National Energy & Climate Plans**
  - **Existing measures** from national projections for most countries not enough
  - Latest updated national plans ‘with **additional measures**’ often not enough



Source: Energyville

Member state analysis – supply/demand total electricity

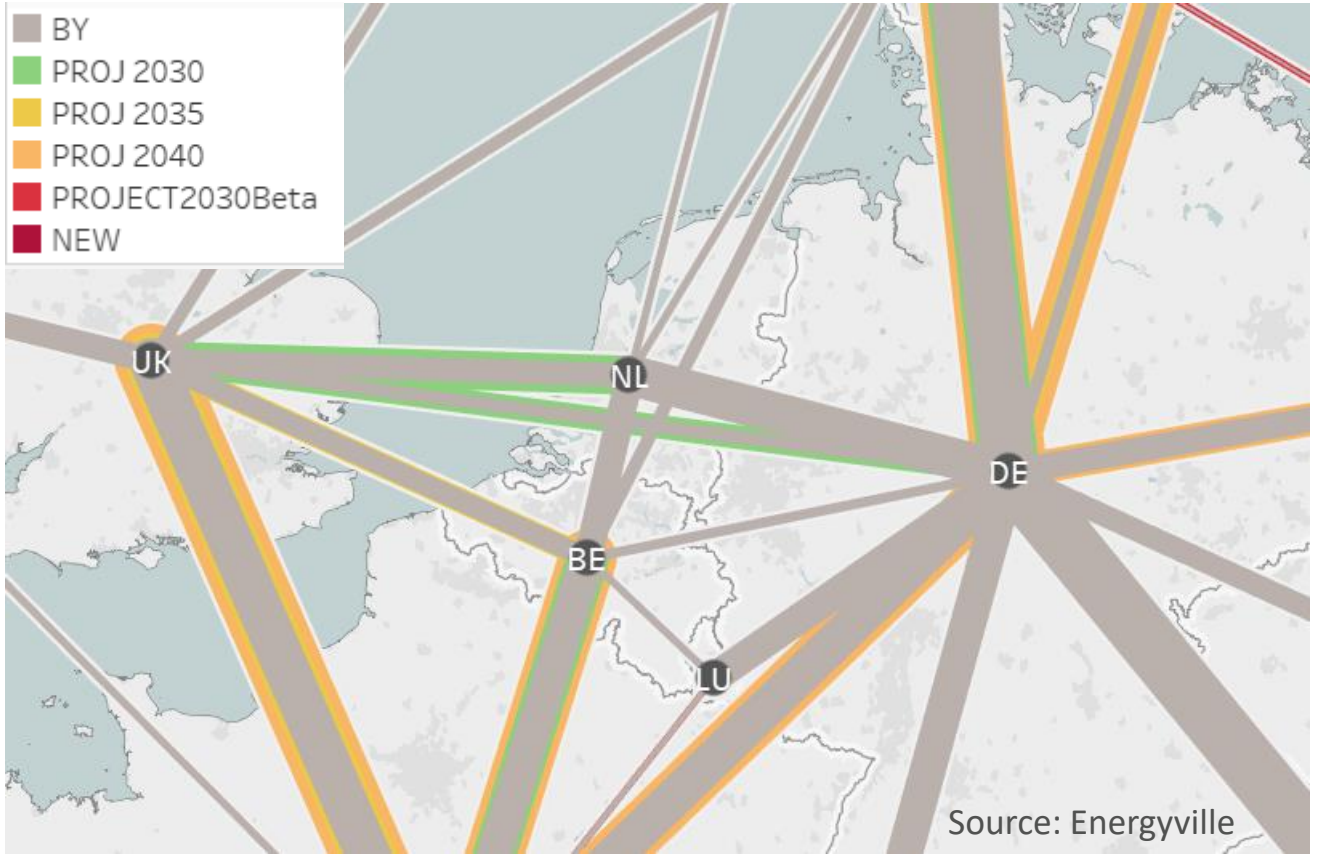
	CHANGE IN NET ANNUAL ELECTRICITY BALANCE	LEVEL OF RES-E ENOUGH ?	KEY MESSAGE
	> 50% imports	NO	• Prepare for high import flows or increase RES-E to cover local demand.
		YES*	• Prepare for high import flows that are needed to cover local demand
	> 50% exports	NO	• Prepare for high export flows • Increase export ambition • Higher RES-E target is advisable to increase total EU generation.
		YES*	• Prepare for high export flows • Increase export ambition through reducing own demand
	< 30%	NO	• Higher RES-E target is advisable to increase total EU generation.
		YES*	• RES-E level OK • No large change in the net annual electricity flow



Source: Energyville

Case of interconnections in Trilateral region

- To realise the necessary import/exports by 2030
- These plans should be realized by 2030



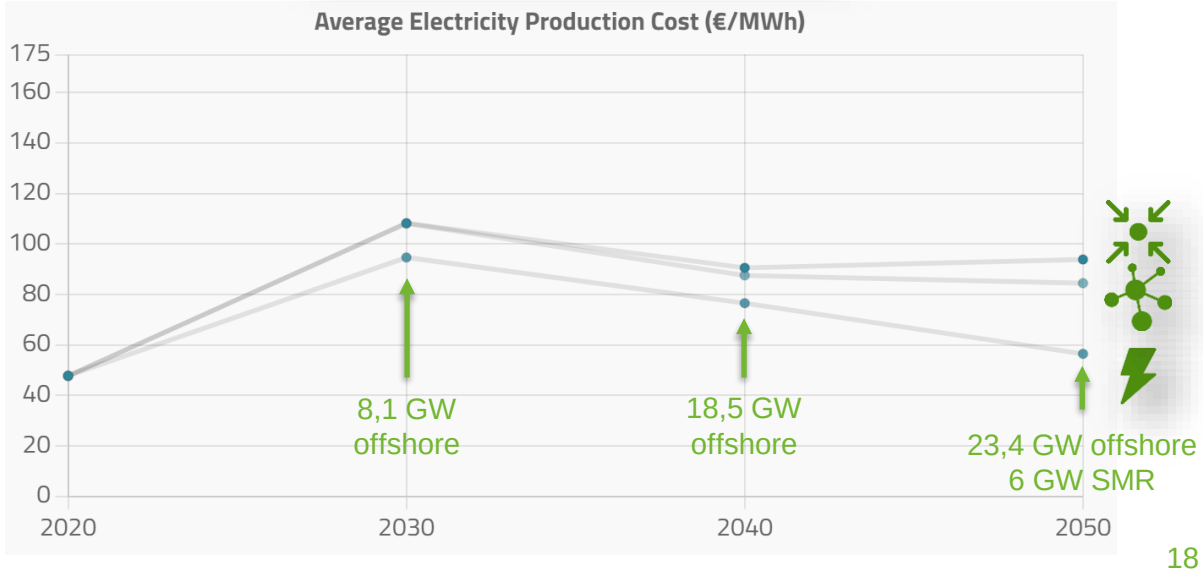
Average electricity generation cost

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

Facilitating direct access to

far offshore wind

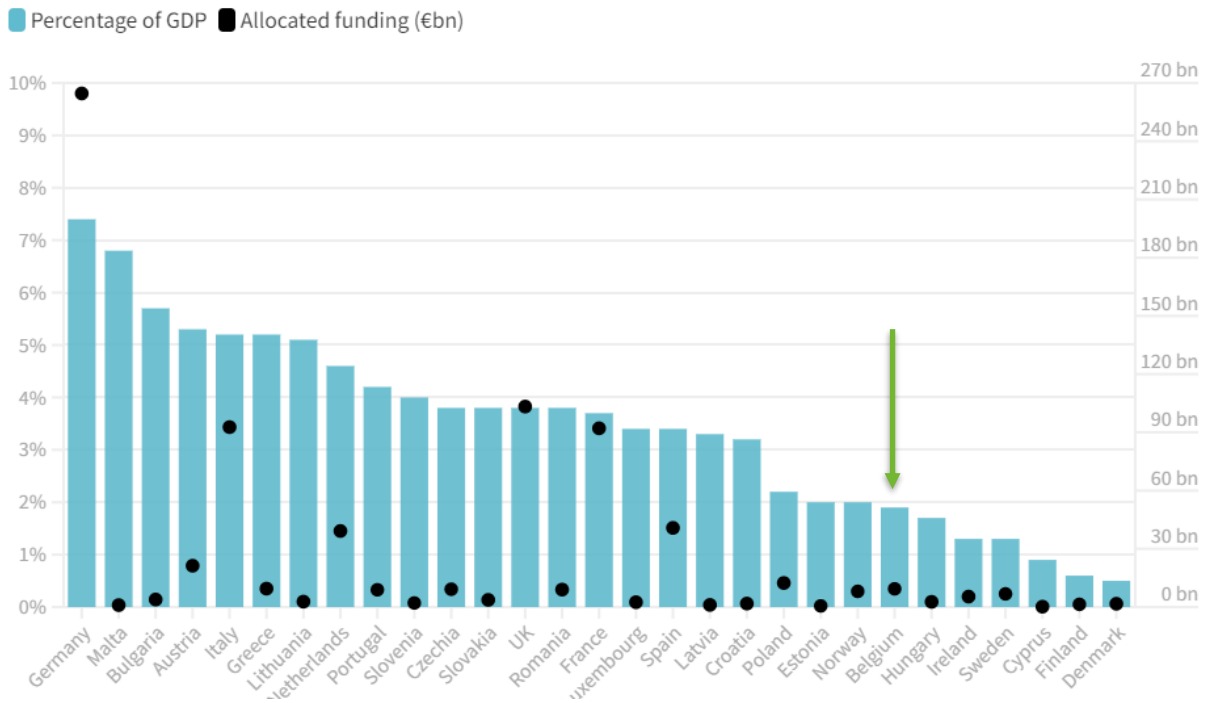
for Belgium drastically lowers electricity and system costs from 2030 onwards.



Investment needs 2030 - 2050

Energy crisis today – 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

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

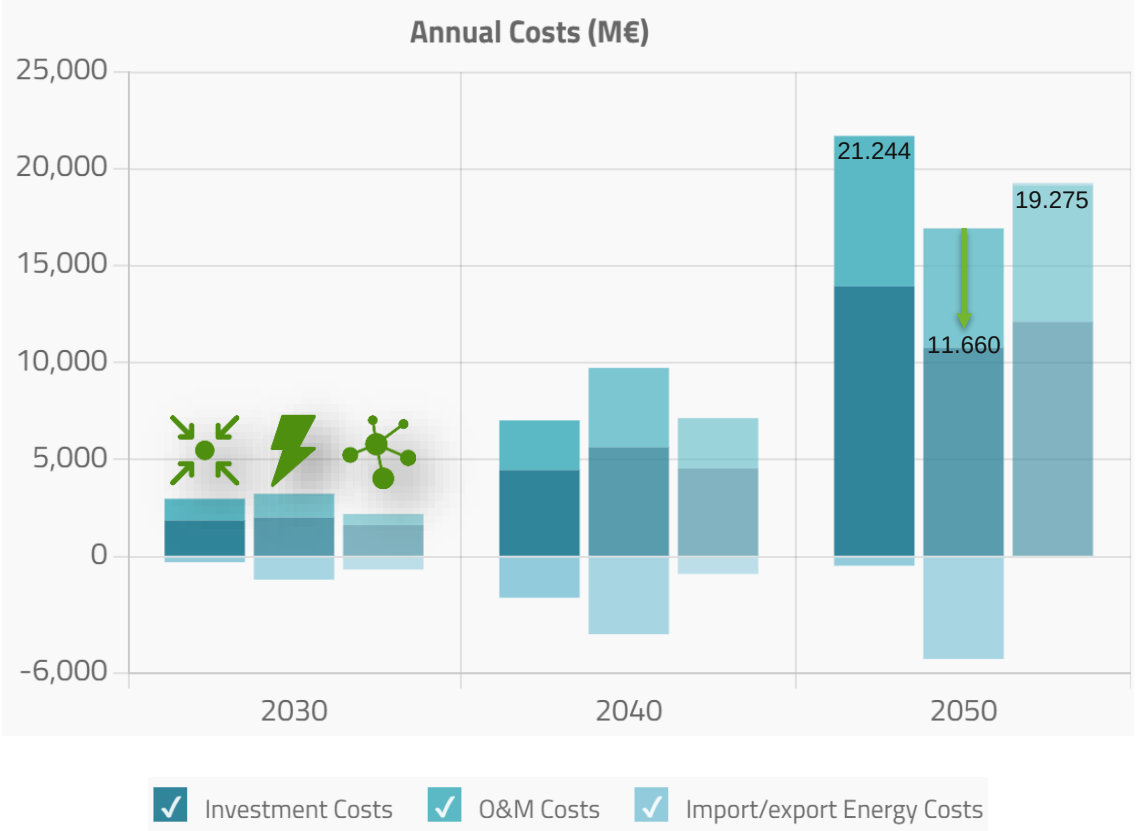
2-4%

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.



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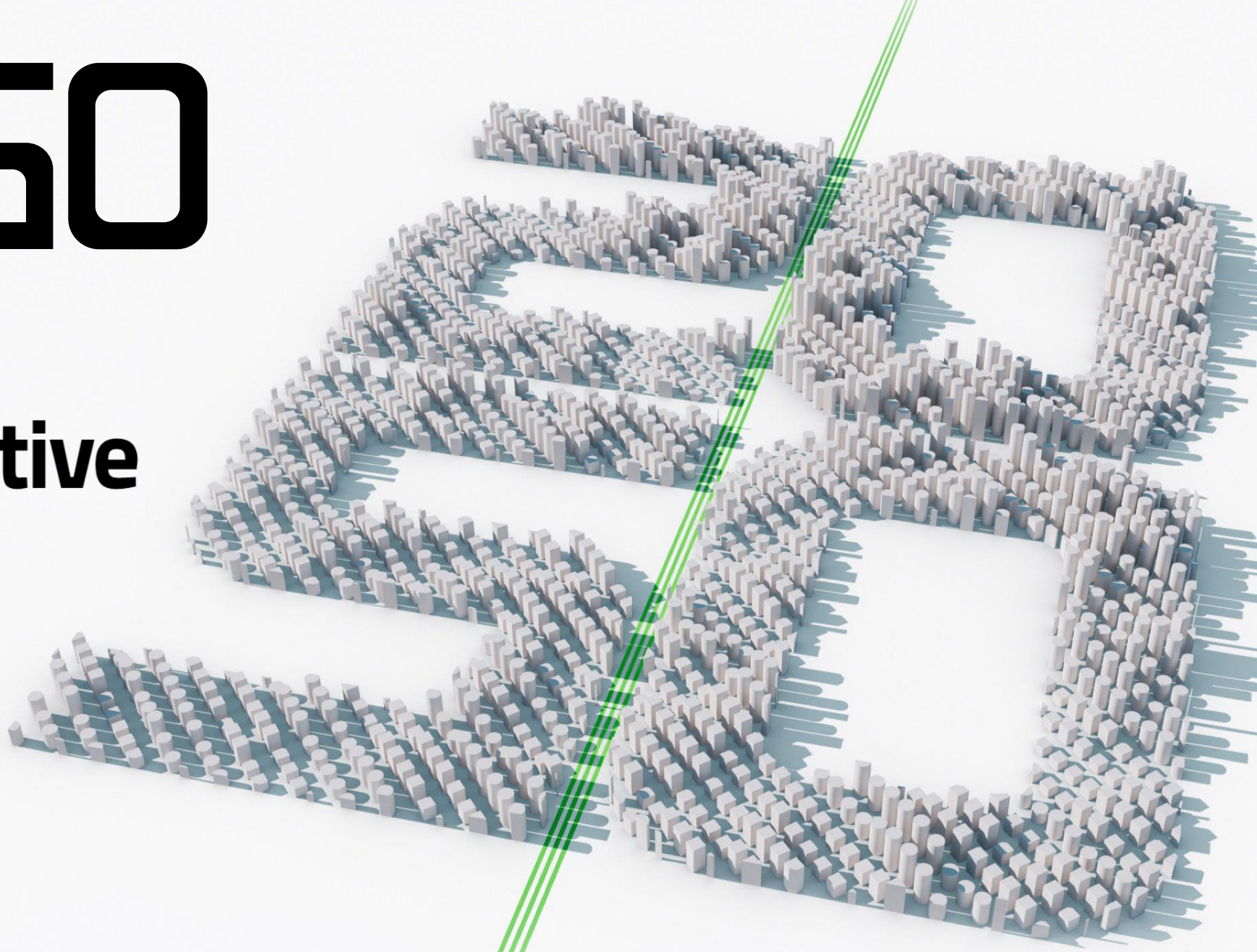

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