energy storage

IEA Technology Collaboration Programme

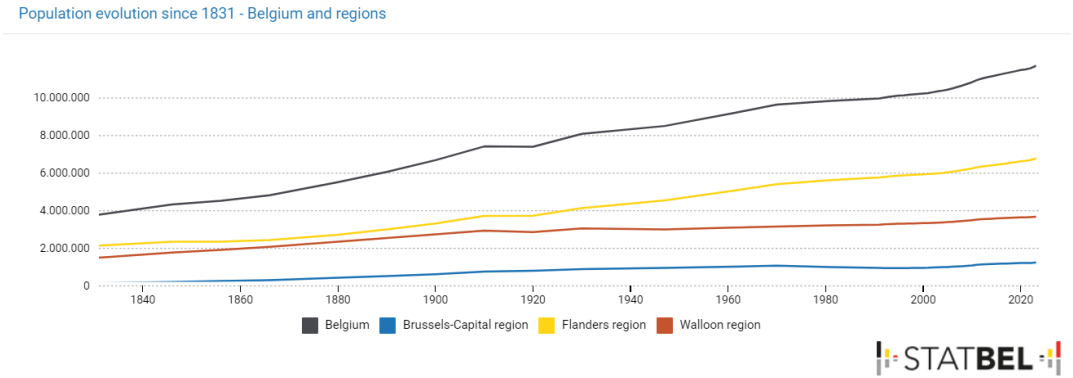
COUNTRY REPORT
Belgium

Bert Gysen

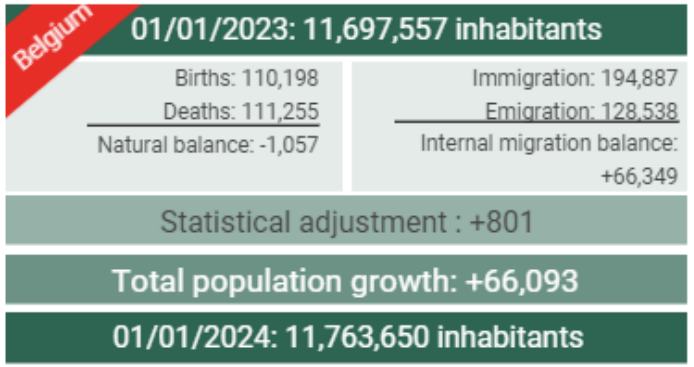
ExCo, 12-14 November 2024

Country Specific Information

- 11.763.650 inhabitants (1/1/2024)
- 0,57% growth compared to 1/1/2023
- 30688 km²
- 7,4 ton CO2 emission/capita



Source: https://statbel.fgov.be/en/themes/population/structure-population#panel-11



Source: https://statbel.fgov.be/en/themes/population/structure-population

Country Specific Information

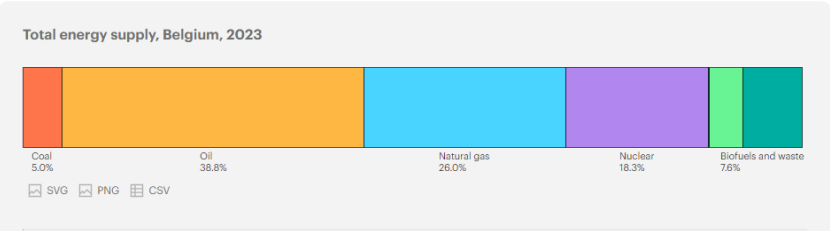
Source: https://www.iea.org/countries/belgium/energy-mix

Energy Supply

Largest sources of energy in Belgium, 2023

Oil
39%
of total energy supply

Natural gas
26%
of total energy supply

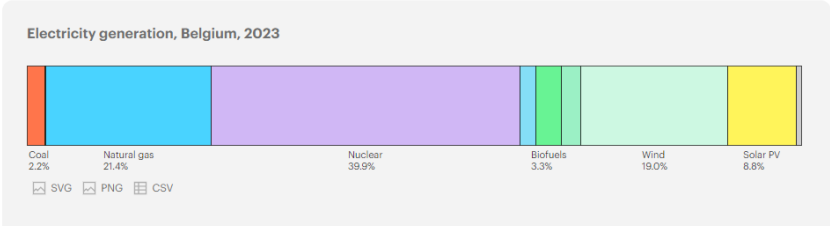


Electricity generation

Largest sources of electricity generation in Belgium, 2023

Nuclear
40%
of total generation

Natural gas
21%
of total generation

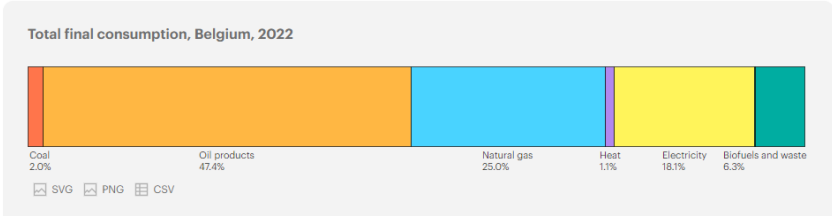


Total final consumption

Largest sources of energy in final consumption in Belgium, 2022

Oil products
47%
of total final consumption

Natural gas
25%
of total final consumption



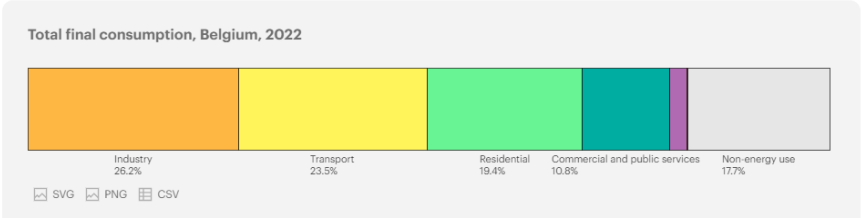
Sectors in TFC

Largest sectors in final consumption in Belgium, 2022

Industry
26%
of total final consumption

Transport
24%
of total final consumption

Residential
19%
of total final consumption



Country Specific Information

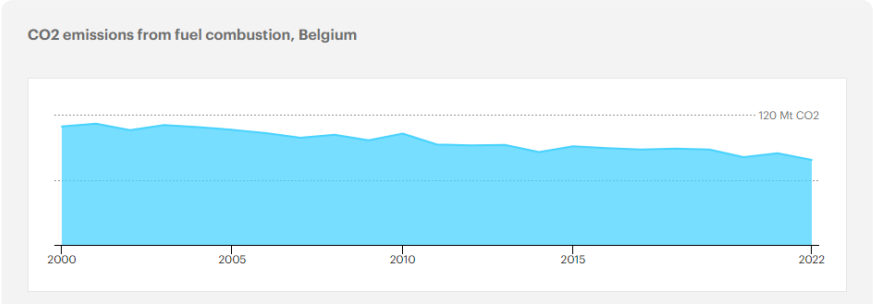
Source: https://www.iea.org/countries/belgium/energy-mix

CO2 emissions

CO2 emissions from fuel combustion in Belgium

Total, 2022
78.814
Mt CO2

Trend
↓28%
change 2000-2022

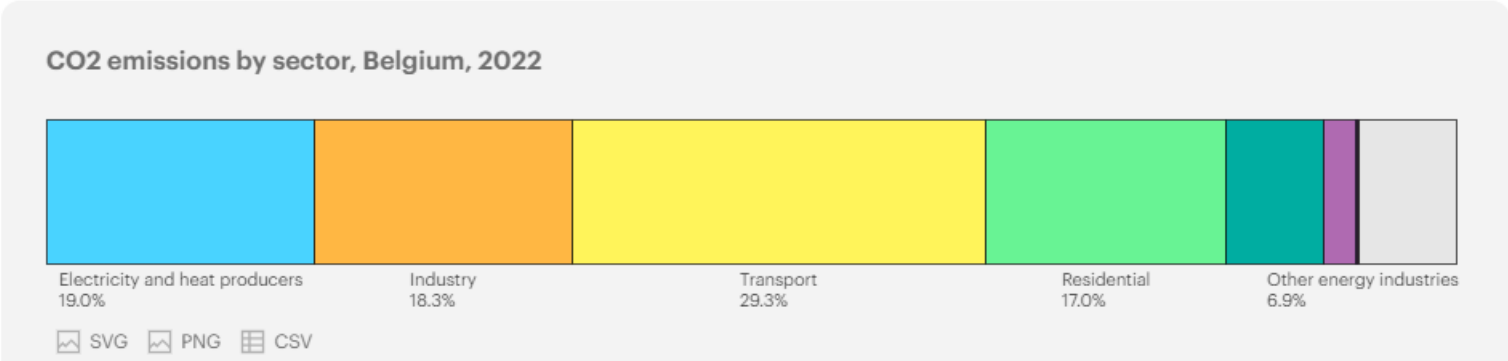


Largest sources of CO2 emissions in Belgium, 2022

Transport
29%
of total energy-related CO2 emissions

Electricity and heat producers
19%
of total energy-related CO2 emissions

Industry
18%
of total energy-related CO2 emissions

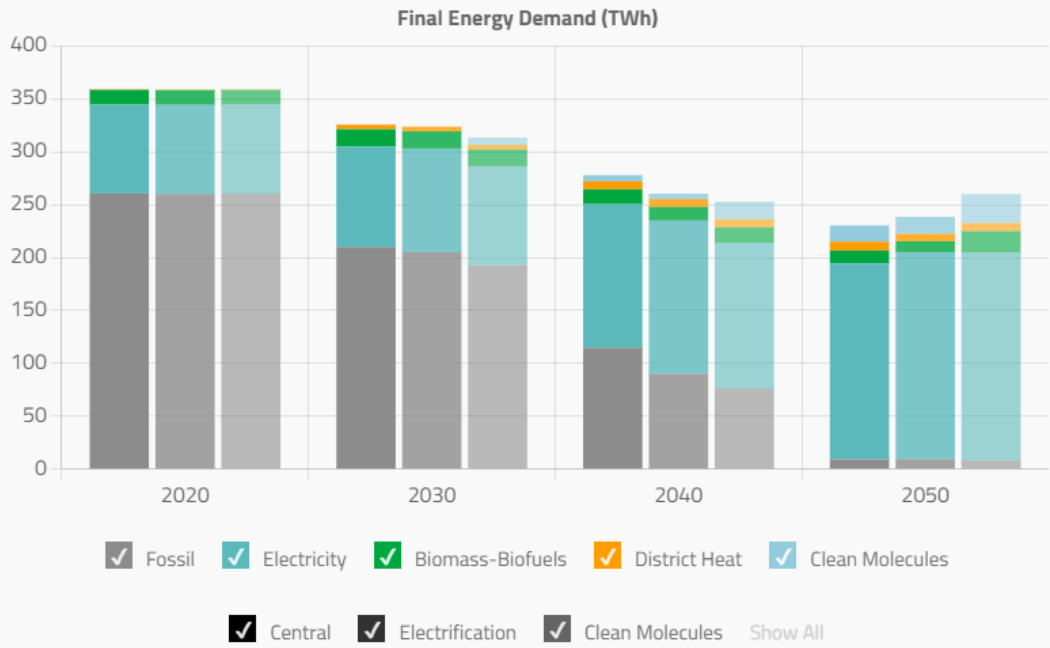


Scenario's: Paths 2050 The Power of Perspective

https://perspective2050.energyville.be/

Final energy demand decreases by a third regardless of the scenario.

Electricity demand more than doubles in the 3 scenarios.



01 Central Scenario Concept

Our fundamental approach for this Central Scenario:

What if we walk the road to a carbon neutral Belgium with a balanced set of options across the board?

02 Electrification Scenario Concept

Our fundamental approach for this Electrification Scenario:

What if we walk the road to a carbon neutral Belgium with access to more offshore wind and the option to invest in new nuclear technology?

03 Clean Molecules Scenario Concept

Our fundamental approach to this Clean Molecules Scenario:

What if we walk the road to a carbon neutral Belgium with the options to import synthetic molecules at lower costs and have a more limited access to cross-border CO_2 storage?

Scenario's: Paths 2050 The Power of Perspective

https://perspective2050.energyville.be/

From 2040 onwards the need for

demand flexibility

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

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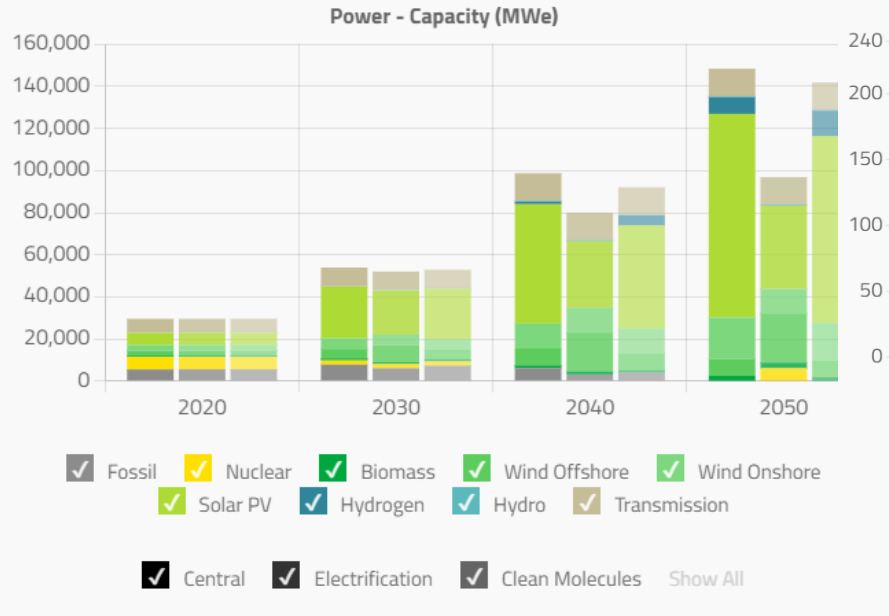
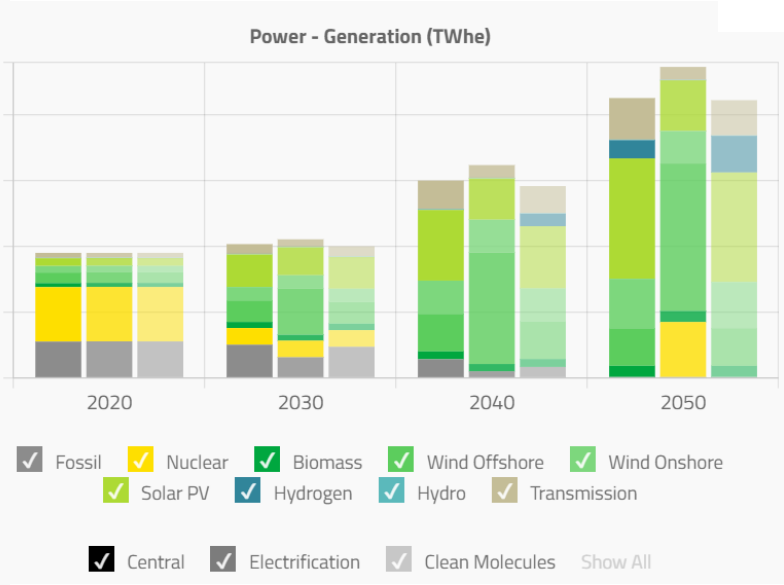
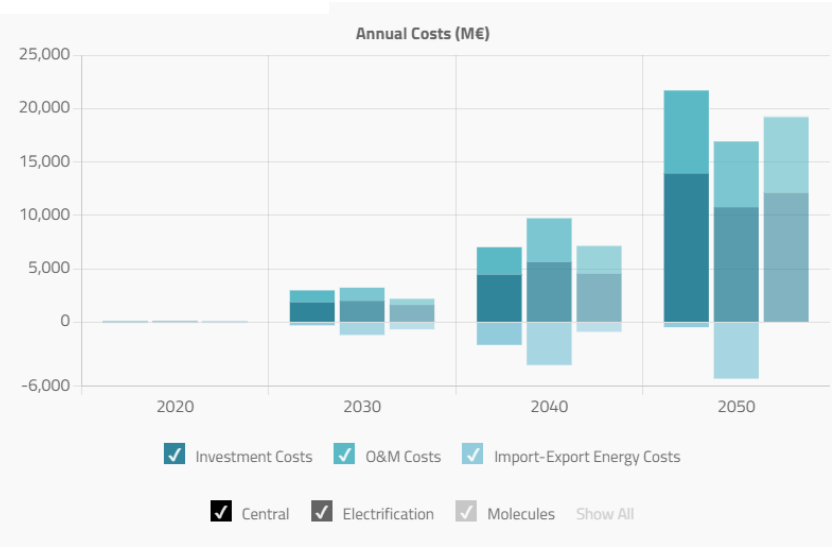






By 2030, Solar PV capacity needs to increase

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.

Battery storage increases to almost

19 GW

in the Central scenario.

Power sector – representative summer day 2050

Production + storage

Central

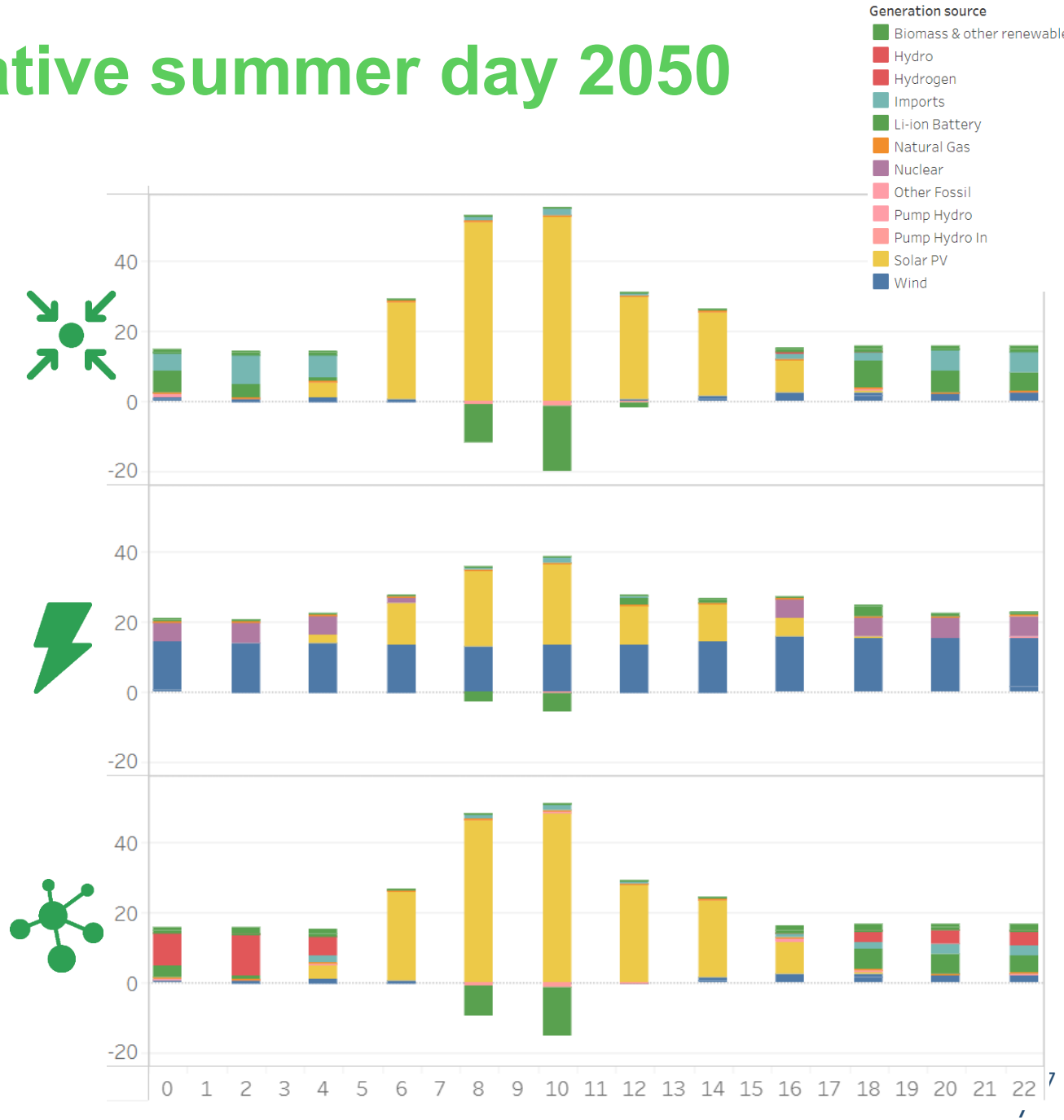
PV peak of 55 GW at noon
18,8 GW battery storage

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



RDD Information

- **Regional/federal level**

- **Regional level:**
  - VLAIO (Flanders)
  - Portail de la Recherche et des Technologies (Wallonia) et Agence pour l'Entreprise et l'Innovation (Wallonia)
  - Innoviris (Brussel)
- **Organised in different ways**
  - Spearhead clusters in Flanders (flux50 for Energy related research and innovation)
  - Competitiveness poles in Wallonia
- **Fund for scientific research : FWO (Flanders)/FNRS (wallonia/Brussels)**
  - Basic research (PhD, strategic basic research)

RDD Information : Federal/national level

- **Energy transition fund – financing mechanism for supporting R&D in Energy**
  - 2016 – 2025
  - Financed through fee 20 Mio euro/year by the nuclear power plant operators
  - Supports with grants issues through competitive calls
  - Yearly call
  - Topics are related to transition grid (interconnection, balancing,…), offshore wind,.. (topics where the federal government is responsible for)

- **BELSPO (Belgian science policy office)**
  - Space research & applications
  - Princess Elisabeth station (south pole)
  - …

Energy Storage Landscape

- **EnergyVille:** association of research institutes (KU Leuven, VITO, imec, Uhasselt)
- **Flux 50:** spearhead cluster for energy: facilitates collaboration between relevant industry, academic/research and governmental players
- **Sirris:** applications of sustainable materials (including materials for energy applications)
- **Agoria:** innovation-focused association that provides business development services to entrepreneurs in a wide range of tech fields (including energy storage)
- **WaterstofNet:** sustainable hydrogen energy solutions; industry and public authorities
- **ODE**: organization for sustainable energy
- **Universities:** UGent, VUB, KULeuven, UHasselt, UAntwerpen, ULiege, UCL,…
- **Multiple industries/harbours**

Energy Storage – General situation Belgium

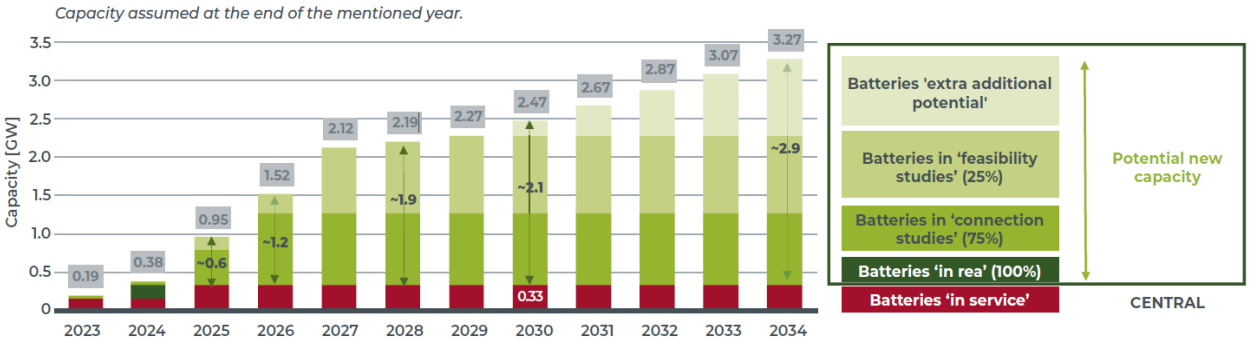
- **Big awareness of need for flexibility to support a sustainable energy transition**
  - Acknowledgement that energy storage is/can be an important flexibility provider
- **Subsidies for small scale batteries (2019-2023)**
- **Transmission tariff exemption for electricity storage plant**
- **Markets open for (large) scale batteries or aggregated batteries**

Energy Storage – Current situation & Trends

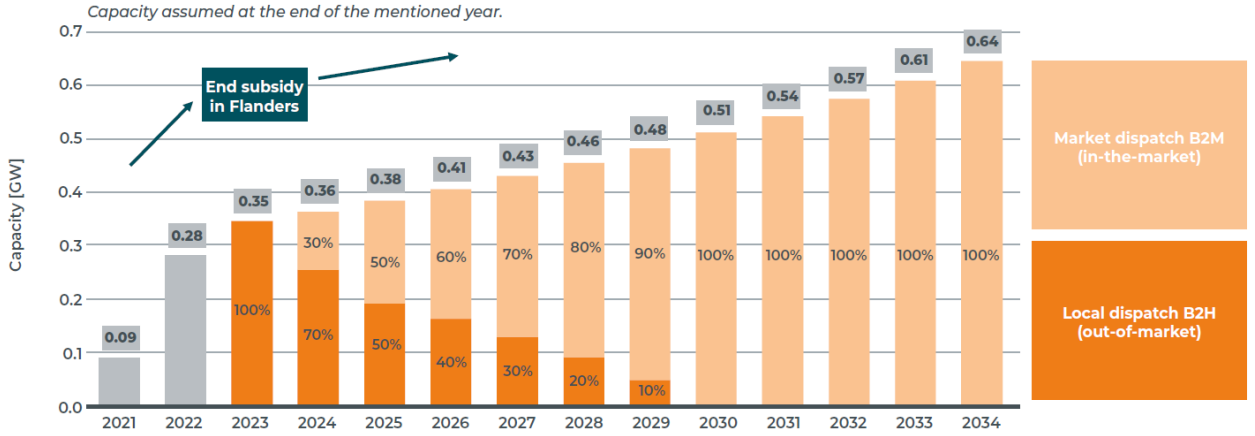
- **Pumped storage capacity**
  - Operation optimized by hourly economic dispatch model
  - + Ancillary services
  - 1.224MW/5.913MWh currently installed (expansion planned)
- **Large scale batteries (grid-connected)**
  - Historical driver (2016-2019): Primary reserve (FCR; Frequency Containment Reserve)
    - 1h-duration BESS (Battery Energy Storage System)
  - Imbalance market + Secondary reserve (aFRR; automated Frequency Restoration Reserve)
    - 2h/4h-duration BESS
  - Capacity Remuneration Mechanism (CRM)
    - 1h/2h/4h-duration BESS
- **Small scale batteries (behind-the-meter)**
  - Rise of residential and commercial PV energy production
    - Local consumption
  - Smart metering
  - Aggregation for market participation (e.g. FCR, CRM)

Energy Storage – Current situation & Trends

- **Large scale batteries**
  - 152 MW BESS operational on TSO grid (Elia)
  - Current capacity x 10 in next 2 years (1500 MW)
  - 3.900 MW in total for projects in pipeline

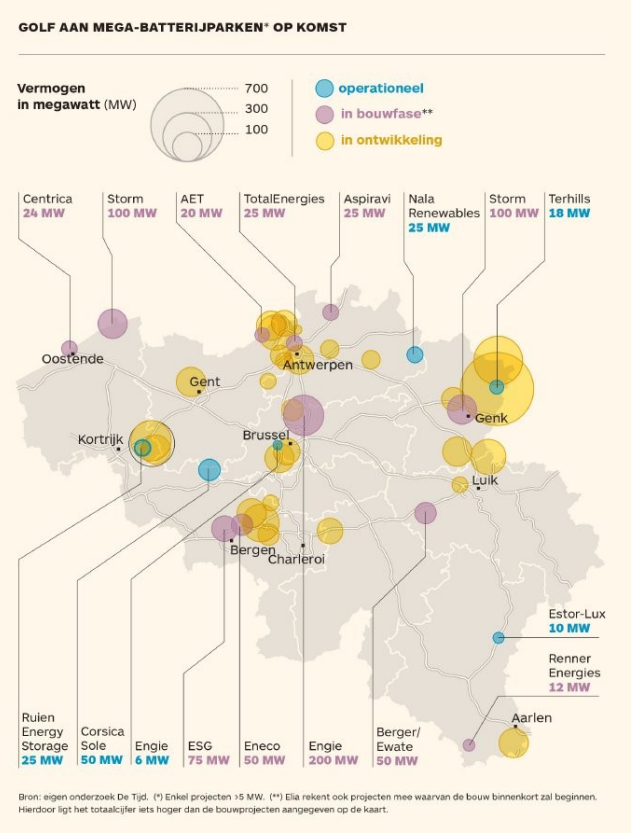


- **Small scale batteries**
  - 125.000 home batteries in Flanders (2023)
    - 1.035 MWh
  - Projection:
    - 510 MW/1.023 MWh (2030)
    - 640 MW/1.290 MWh (2034)



Energy Storage – focus on CRM

- **Capacity Remuneration Mechanism**
  - Nuclear phase-out + ageing of thermal-fleet + developments in neighboring countries + widespread electrification -> **Security of supply**
  - CRM since 2019, first auction in 2021, first activation in Nov. 2025
  - Three auctions: Y-4, Y-2, Y-1; pay as bid remuneration
  - Contracts up to 15 years



Top 3 cases/projects

- **Green turtle project (Giga storage) : 700 MW battery storage in Dilsen-Stokkem : biggest in Europe**
  - 2025-2028: construction of battery park : 600 Mio euro
  - 5 GW in the pipeline in Belgium (from different suppliers)

THE BATTERY PARK IN DETAIL

For the construction of the battery park in Dilsen-Stokkem, GIGA Storage opted for reliable technology and sustainable and recyclable materials.

The battery park in Dilsen-Stokkem will consist of:
- 720 batteries, each with an inverter
- 185 medium-voltage transformers
- 5 high-voltage transformers with a total capacity of 1,500 MVA
- 25,650 m² of planting area around the new battery park

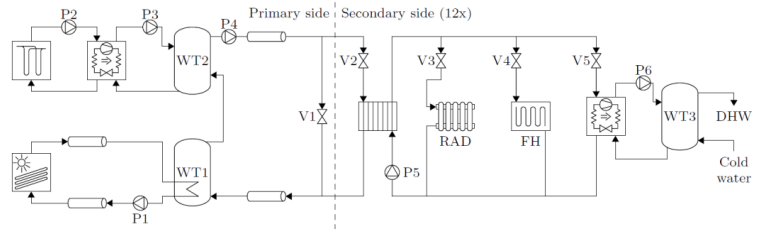
The battery park will store the average annual energy consumption of 385,000 households and feed it back into the electricity grid.

Top 3 cases/projects

- **HEU-SEEDS : cost-effective and replicable RES-integrated electrified heating and cooling systems for improved energy efficiency and demand response (start: January 2024)**
- The SEEDS project is co-funded by the EC and aims to boost the electrification of thermal systems in buildings through an integrated approach leveraging energy efficient renovation and smartification of HVAC systems. The strategy will be tested in six pilots throughout Europe including 1 replication site.
- The SEEDS solutions aim to reduce the thermal energy demand of buildings and enable the deployment of energy flexibility to increase the RES share thereby enhancing grid stability in a cost-effective way and with low life cycle environmental impact
- **Pilot in BE: De Schipjes (Bruges, heritage restrictions) + Replication site in BE: Stijnstreuvelstraat (Bruges)**
  - 12 households, focus on EE and ecological sustainability under heritage restrictions. Key features include a low temperature thermal network, a centralized ground source heat pump, solar collectors and innovative water heating systems

DE SCHIPJES 1.0

Volledig hernieuwbaar, dus zonder gasketel

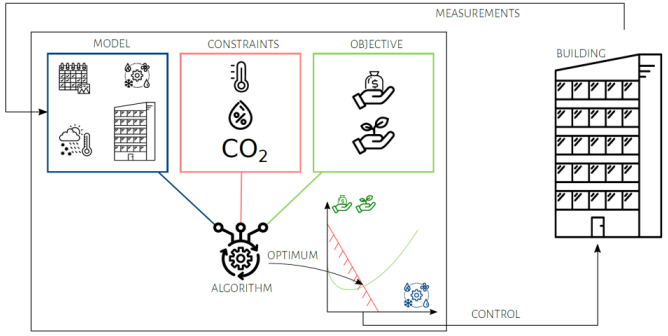


GSHP: Grondgekoppelde warmtepomp
STC: Zonnecollector
WT: Water tank
BHP: Booster warmtepomp
FH: Vloerverwarming
HE: Warmtewisselaar (substation)
RAD: Radiatoren

Bron: J. Jansen

INNOVATIEVE AANSTURING

Model Predictive Control (MPC)



Bron: Builtwins

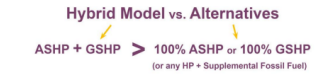
NAAR DE SCHIPJES 2.0

Hybride* collectieve systemen maken decarbonisatie haalbaar en betaalbaar

HYBRIDE WARMTEPOMPSYSTEEM (GEO-WP + LUCHT-WP)
voor maximale systeemefficiëntie en kosteneffectiviteit (CAPEX versus OPEX)

- GEO-WP
  - Verwarmingsgedomineerd → dalende bodemtemperatuur → lagere COP → gevaar voor thermische uitputting
  - Om de systeemefficiëntie hoog te houden meer boorputten nodig → duur en ruimte nodig
  - Dimensioneren op de piek is heel dure oplossing, en deze 100% capaciteit slechts voor een paar dagen per jaar
  - Merendeel van de warmtevraag is op veel minder dan 50% van de ontwerpcapaciteit
- Voeg een lucht-WP toe … wat een kleiner boorveld toelaat!
  - Warmtevraag is er voor het merendeel van de tijd bij buitenluchttemperaturen die interessant zijn voor lucht-WPen
  - **Optimale seizoensrendementen** in plaats van ogenblikkelijke rendementen → spaar de capaciteit van de GEO-WP voor momenten met lage buitenluchttemperaturen (terwijl de grondtemperatuur nog steeds hoog is omdat de lucht-WP werd ingezet voor gemiddelde buitenluchttemperaturen)
  - **Systeemregeling is dan cruciaal**!

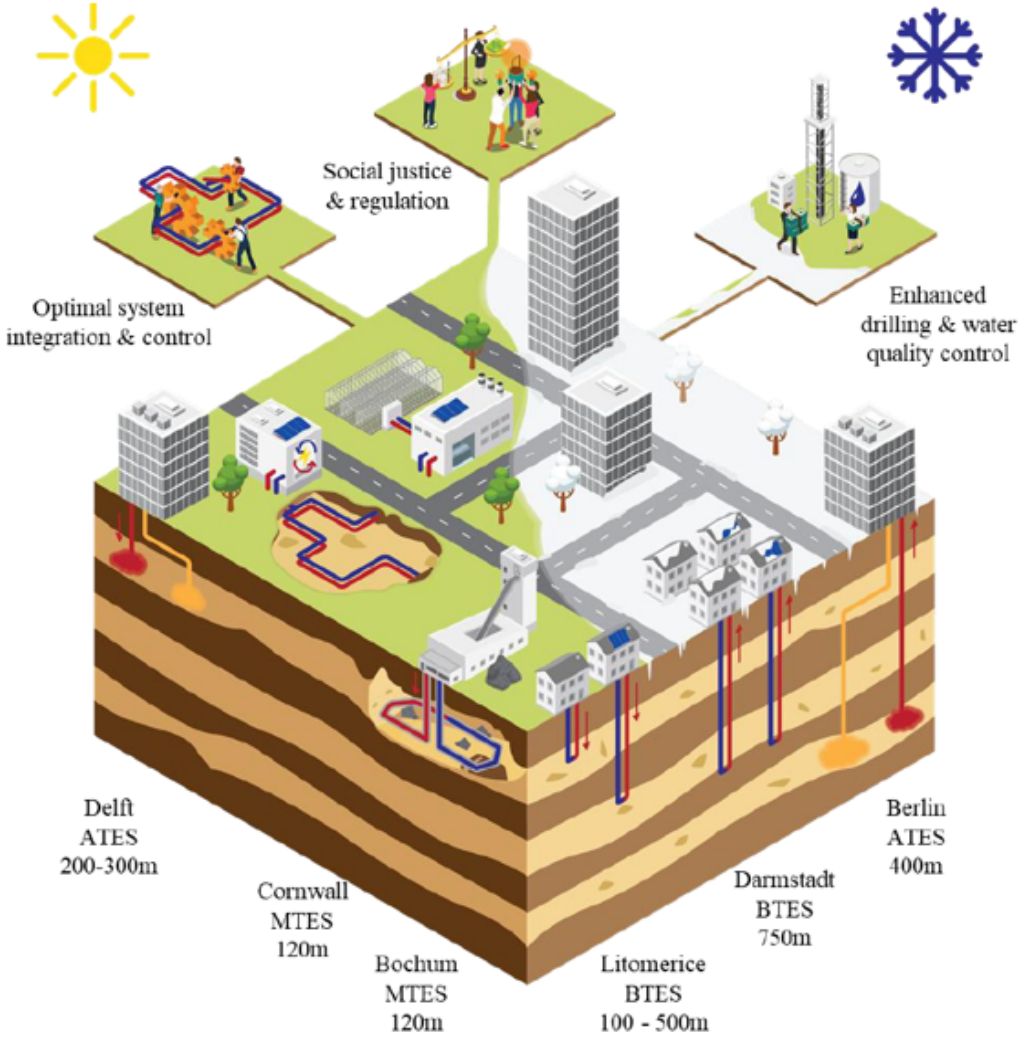
* hybride = combinatie van meerdere hernieuwbare technologieën



Top 3 cases/projects

Horizon Europe PUSH-IT (2023-2026)

Project summary



- Aim: Demonstrate the use of **high temperature geothermal reservoirs** to provide energy storage for the energy system
- 3 innovations:
  - Enhanced drilling & water quality control
  - Social justice & regulation
  - Optimal system integration & control
- 3 real demo sites:
  - Delft, NL: HT-ATES
  - Darmstadt, DE: HT-BTES
  - Bochum, DE: HT-MTES
- 3 follower sites:
  - Berlin, DE: HT-ATES
  - Litomerice, CZ: HT-BTES
  - Cornwall, UK: HT-MTES
- VITO contribution: smart control of the demand side (buildings heat load), production side (when to switch which unit?) and storage (when to charge?)

energy storage

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The Energy Storage TCP

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