INTERFLEX · NEXT IN FLEX 2026 · DAY 1

Do EVs and batteries help or hurt each other?

Flexible Futures: simulating electric vehicles, batteries and the Belgian electricity system in 2030 and 2040

Sam Hamels · Ghent University

This work is a deliverable of the InterFlex project (WP1, T1.3, D1.3), funded by the Energy Transition Fund of the Belgian federal government, managed by the FPS Economy, SMEs, Self-employed and Energy.

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WHY NOW

By 2030, two huge waves of flexibility arrive at once

ELECTRIC VEHICLES

≈ 2 million

EVs on Belgian roads by 2030: roughly **150 GWh of batteries on wheels**. Over 4 million by 2040.

STATIONARY BATTERIES

3–6 GW

Sum of parks, home and other batteries by 2030.
≈ 2 GW of big parks is already built or contracted

Both earn their keep by shifting electricity in time. So are they partners, or competitors?

EVs: ENTSO-E TYNDP 2024 (1.9 M in 2030), 79 kWh each. Batteries: own synthesis of Elia AdeqFlex'25 and FNA (Oct 2026).

METHOD · 1 OF 2

We simulated all of Europe, hour by hour

8,760 — **hours per year, in sequence.** Every hour of 2030 and 2040, not a few “typical days”.

Europe — **the whole interconnected system,** with real cross-border limits.

TYNDP — **ENTSO-E’s 2024 National Trends:** the same baseline Europe’s grid operators use to plan the grid.

ACSG — **Artelys Crystal Super Grid,** the engine behind the European Commission’s METIS models.

Belgium never acts alone. Through market coupling, our EVs and batteries interact with:

- French nuclear
- German solar and wind
- Dutch gas and solar
- British offshore wind

One central planner

One optimisation dispatches every plant, EV and battery in Europe at the lowest total cost.
Real EVs and batteries chase their own value: rooftop solar, grid connection, specific markets,...

Unit commitment, reserves, cross-border limits and perfect foresight. Detailed results for BE, DE, FR, NL and UK.

METHOD · 2 OF 2

Six deliberately extreme futures

EV CHARGING → / BATTERIES ↓	**Dumb** every EV charges as soon as it is plugged in	**Smart** every EV charges at the best moment before it leaves	**V2G** every EV charges smartly and can also feed power back
Low batteries ½× TYNDP fleet, 2-hour Belgium 2030: 1.1 GW	**Least flexible** the starting point	EVs flexible, few batteries	Maximum EV flexibility, few batteries
High batteries 2× TYNDP fleet, 6-hour Belgium 2030: 4.5 GW (12× the storage)	Battery-dominated	Both provide flexibility	**Most flexible** everything at once

Not forecasts

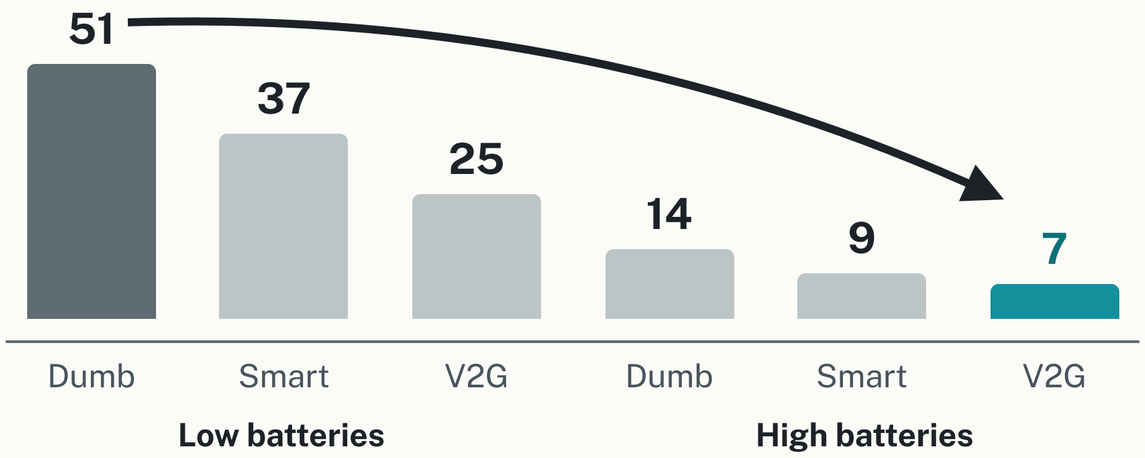
Reality will land somewhere inside this box.
The corners show which way things move, and roughly how far.

Each future simulated for 2030 and 2040. Everything else (plants, wind, solar, demand, grid) is identical across the six.

RESULT 1 · BATTERIES

Even the big wholesale market saturates

Yearly earnings per GW of batteries, €M (Belgium, 2030)



−86%

per-GW earnings, least → most flexible

Smart EVs: a quarter less

same batteries: €51M → €37M per GW

More batteries: each earns less

even with dumb EVs: €51M → €14M

Reserves, imbalance
small markets, fill up fast

→

Wholesale arbitrage
the big one: must generate the bulk of revenue to pay back the batteries

→

Yet it saturates too
in a flexible 2030 scenario

Operating surplus from wholesale arbitrage (no reserve markets or other value stacking). Indicative capital cost in 2030, 2h-battery: €50M/GW/year

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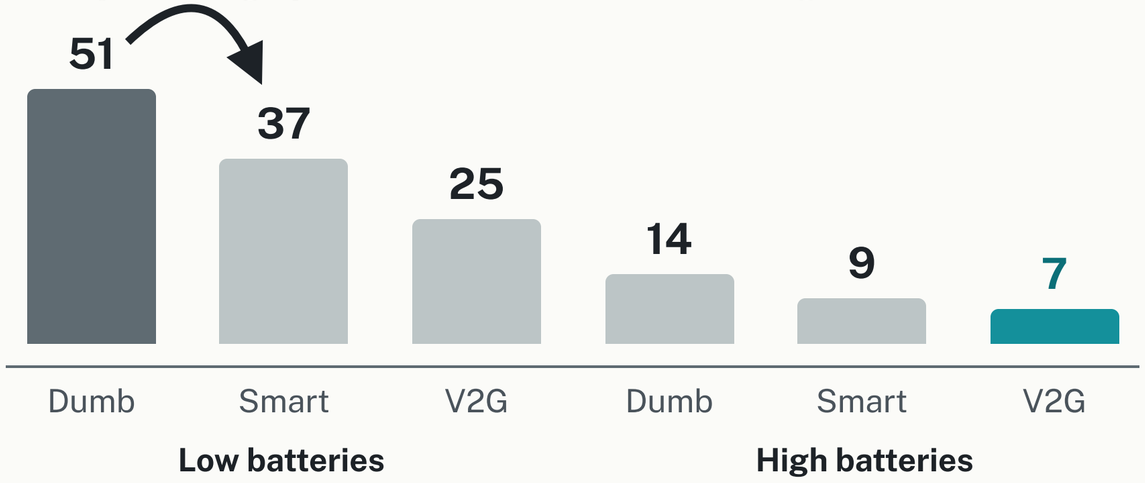

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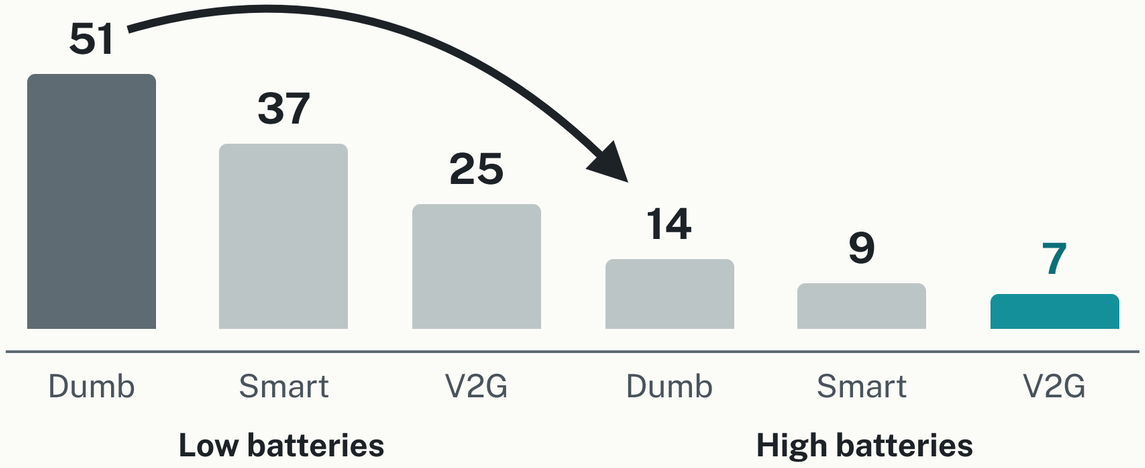

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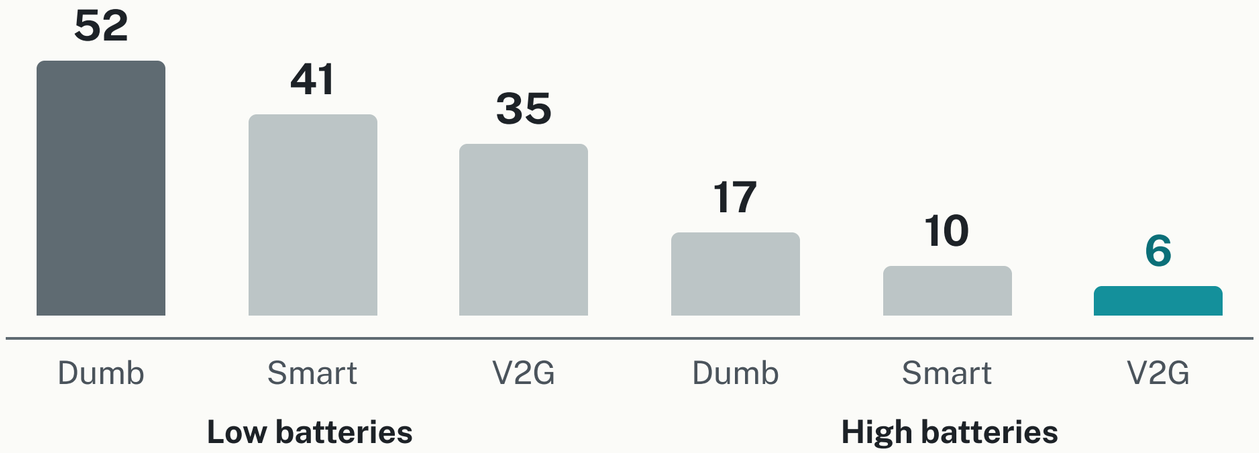
RESULT 2 · CONSUMERS

Consumers win: price spikes almost vanish

Hours above €150/MWh per year (Belgium, 2030)



52 → 6

hours of price spikes per year,
from the least to the most flexible future

−18%

average wholesale price,
from about €72 to €59 per MWh

Cheaper, calmer bills. So who is on the losing side?

Simulated wholesale prices (marginal cost), Belgium 2030. Least flexible = low batteries + dumb charging; most flexible = high batteries + V2G.

RESULT 3 · POWER PLANTS

Gas and nuclear get squeezed

GAS PLANTS (CCGT)

A second wave of pressure

Earnings per GW per year, least → most flexible



€198M



€80M −60%

Runs less: capacity factor 36% → 28%.
Yet still needed: about 3 GW of gas runs
in the 100 hardest hours, in every scenario.

NUCLEAR (DOEL 4 + TIHANGE 3)

Runs more, earns less

Earnings per GW per year, least → most flexible



€365M



€252M −31%

Runs more: capacity factor 72% → 78%,
because flexibility soaks up the surplus solar and wind.

The scarcity hours that used to pay for power plants are exactly the hours flexibility removes.

Belgium, 2030. Operating surplus from energy-market sales (revenue minus variable costs), same bar scale in both panels.

RESULT 4 · EV FLEXIBILITY

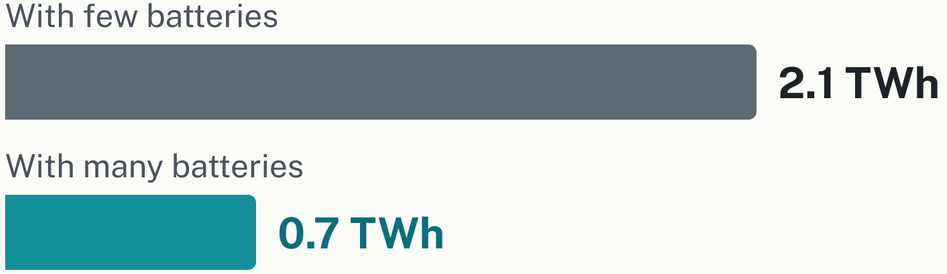
Smart charging: the safe bet. V2G: a gamble.

SMART CHARGING: ROBUST EVERYWHERE

- **No extra hardware**
  beyond a normal home or work charger
- **No extra wear** on the car's battery
- **No energy lost**
  It only shifts timing, while batteries lose 8–9%
- **Easier to accept**
  compared to bidirectional charging

V2G: VALUE DEPENDS ON THE REST

Energy EVs feed back to the grid per year (Belgium, 2030)



−65% batteries take the trades V2G would make (−72% in 2040)

The cars have to charge anyway. Smart charging only decides **when**, and that comes almost for free.

Round-trip losses: simulated Belgian battery fleet, all scenarios. V2G energy: low vs high batteries, both with V2G.

TAKEAWAYS

What to take home

1 · FOR EVERYONE

Get ready for a new chapter: volatility could dampen

Recent years showed rising volatility. With the batteries and smart EVs in the pipeline, prices may flatten again by 2030.

2 · FOR POLICY MAKERS

Prioritise smart charging, and count all flexibility together

Smart charging is no-regret. Determine support for batteries knowing what EVs already deliver, and vice versa.

3 · FOR INVESTORS

Stress-test against the future fleet, not just your individual project

Even wholesale arbitrage saturates.
Reserve and imbalance markets are small and fill up fast.

4 · THE OPEN QUESTION

Cheaper power and less price spikes, but who funds the batteries?

Investors if they overbuild.
Consumers if policy supports them.

Thank you

READ THE FULL REPORT

Flexible Futures: EVs, batteries and the Belgian electricity system

epes.ugent.be › research › InterFlex › D1.3 (PDF, 59 pages)

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AFTER THE TALK

Backup slides

“ALT” = another way to show a main-deck message, to compare and swap.
“EXTRA” = a finding that is not in the main deck, for questions.

READ WITH CARE

An upper bound: it assumes perfect behaviour

THE SIMULATIONS ASSUME

- every EV is **plugged in whenever it is parked**
- **one central planner** steers every charger and battery
- **perfect foresight** of every price and every hour

MEANWHILE, IN REAL LIFE

3–4%

of EVs in a Belgian smart charging app plug in almost every time they get home

80% or more of arrivals, or of parked hours. InterFlex field data, Eneco app users.

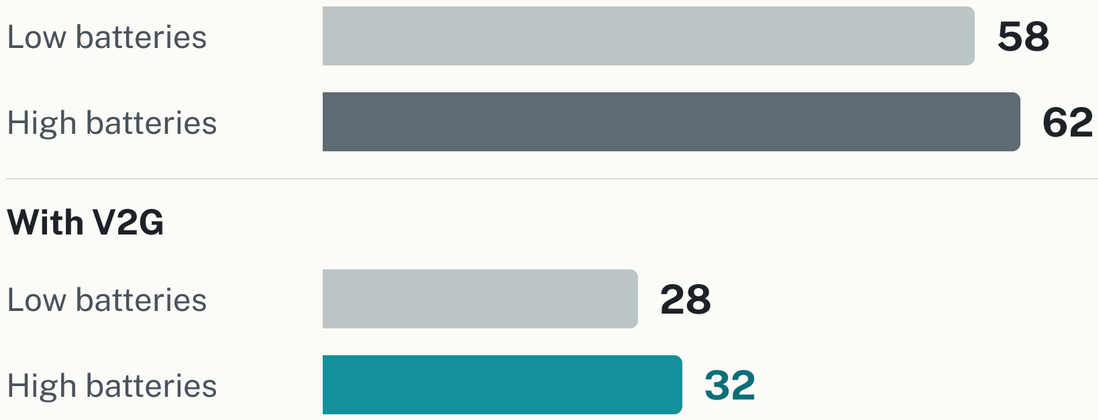
Field data: Eneco SlimLaden users with a connected car, Jul 2025 – Jun 2026 (InterFlex WP with Eneco).

BACKUP · ALT FOR SLIDE 5 (WHOLE BATTERY FLEET)

ALT

Four times the batteries, barely more money

Yearly earnings of the whole Belgian battery fleet, €M (2030)



+€4M

a year for 3.4 GW of extra batteries, in a V2G world

1/2

the same small fleet earns half once EVs do V2G (58 → 28)

High batteries = 4× the power (1.1 → 4.5 GW) and 12× the storage (2.2 → 27 GWh). Operating surplus, wholesale arbitrage only.

BACKUP · ALT FOR SLIDES 5–7 (ONE SUMMARY TABLE)

ALT

Who gains, and who loses?

Who	What we measured	Least → most flexible	Change
Consumers gain	hours above €150/MWh	52 → 6	−88%
Consumers gain	average price, €/MWh	72 → 59	−18%
Batteries lose	earnings per GW	€51M → €7M	−86%
Gas plants lose	earnings per GW	€198M → €80M	−60%
Nuclear loses	earnings per GW	€365M → €252M	−31%

Consumers win. Someone has to fund the batteries behind that: **investors** if they overbuild, **consumers** if policy supports them.

Belgium, 2030. Least flexible = low batteries + dumb charging; most flexible = high batteries + V2G. Earnings = operating surplus on the energy market.

BACKUP · EXTRA FINDING · 2040

EXTRA

By 2040: the same story, only louder

Nuclear is gone and solar has doubled to 26 GW, so the inflexible system swings much harder.

−49% **average price,** from about €134 to €68 per MWh

640 → 297 **hours above €150/MWh.** Fewer, but far from zero

−96% **battery earnings per GW,** from €179M to €7M

−78% **gas plant earnings per GW,** from €681M to €150M

The more variable the system, the bigger both the consumer gains and the revenue squeeze.

Belgium 2040, least vs most flexible future. The inflexible 2040 case is a stress test: policy would likely intervene long before.

BACKUP · EXTRA FINDING · BELGIUM VS NEIGHBOURS

EXTRA

Not a Belgian quirk

2030, least → most flexible	Battery earnings per GW	Gas plant earnings per GW	V2G energy, many vs few batteries
Belgium	−86%	−60%	−65%
Germany	−86%	−58%	−68%
Netherlands	−77%	−63%	−60%
France	−80%	−67%	−41%
United Kingdom	−53%	−43%	−30%

Same direction everywhere. Weaker in the UK: wind-driven, already low prices, and partly cut off from the continent.

Least flexible = low batteries + dumb charging; most flexible = high batteries + V2G. V2G column: low vs high batteries, both with V2G.

BACKUP · HOW TO READ THESE SIMULATIONS

EXTRA

What the model sees, and what it doesn’t

STRONG ON

- ✓ every hour of the year, across all of Europe
- ✓ one official baseline; only EVs and batteries change
- ✓ mechanisms, direction and rough size of effects
- ✓ how resources interact and compete

LEAVES OUT

– real bidding: prices are the marginal cost of the last plant

– reserves, imbalance and capacity payments

– local grids and network tariffs

– new investment in response to prices

– imperfect behaviour and forecasts

Read the numbers as “which way, and roughly how much”, not as a forecast.

Heat pumps are included in demand but not used as flexibility. No new power plants or storage are built endogenously.