EnergyTag

4 November 2026

How Hourly Clean Energy Matching Cuts the Costs and Emissions of Spain's Data Centre Buildout

A summary deck by EnergyTag, based on the study by EnergyTag & PyPSA Labs

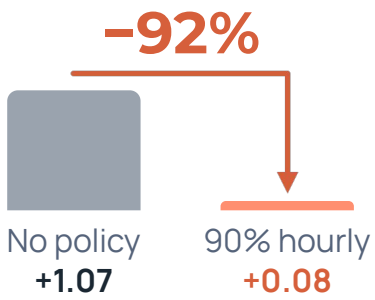
Open-source, replicable and fully transparent study by two independent non-profits with no commercial interest in the outcome of this policy. It received no external funding.

Published under Creative Commons (CC BY 4.0) · Open-source modelling: github.com/pypsalabs/spain-datacenter-decree

Executive Summary: Hourly matching is better for Spain and its data centres

EMISSIONS

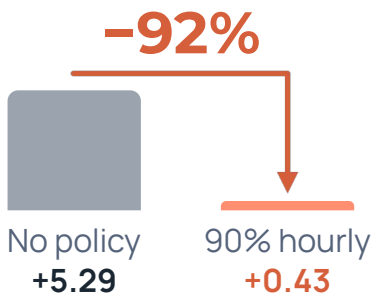
Extra CO2 emissions (Mt a year)



At 6,000 MW: −90%
14.3 Mt → 1.49 Mt
81% above today's level

ENERGY SECURITY

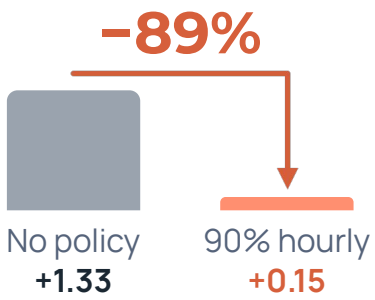
Extra gas burned for power (TWh a year)



At 6,000 MW: −89%
71.26 TWh → 7.54 TWh
as gas plants run more

POWER PRICES

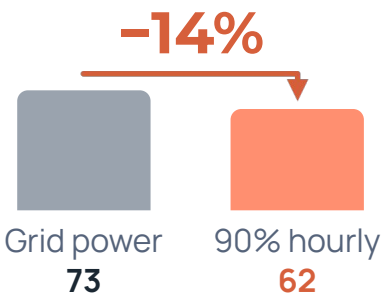
Rise in the spot price everyone pays (€/MWh)



At 6,000 MW: −93%
10.30 €/MWh → 0.73 €/MWh
14% above today's level

DATA CENTRES

What the data centre pays for power (€/MWh)



At 6,000 MW:
still below grid power
Power costs rise with scale

Bars: *a new 500 MW data centre, no policy vs 90% hourly matching on an annual average ·* ***Bottom coral boxes:*** *at 6,000 MW buildout*

STUDY CONCLUSION:

- **New data centre demand must bring new clean supply: keep hourly matching and additionality in decree.**
- **Measure the target as an annual average rather than a floor in every hour: 80%, rising to 90% by the end of the transition period.**

Source: github.com/pypsalabs/spain-datacenter-decree

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Spain is one of Europe's fastest-growing data centre markets

2.5 GW

of computing capacity by 2030 foreseen in the 2024 Artificial Intelligence Strategy, which the government estimates would need 3.5 to 4 GW of electricity demand

2024 Artificial Intelligence Strategy

6.33 GW

of granted transmission access held by data centres: 34% of all access granted to new demand

Red Eléctrica access map, via pv magazine (2 Oct 2026)

12 GW+

of access and connection rights granted to data centres since 2021

MITECO (Aug 2026)

4.4 TWh

a year for a single 500 MW campus, close to 2% of Spanish electricity demand. Data centres are large and run almost flat, around the clock

500 MW campus, flat load

Sources in each box

An open model of Spain's electricity system testing policy scenarios

01

Spain's power system

- PyPSA-Eur v2026.09, open source
- 15 regions: 9 in Spain, 4 in France, 2 in Portugal
- Spain's 2025 fleet, held fixed
- Weather year 2024, 8,760 hours
- Validated against Red Eléctrica's 2024 data
- 2025 prices for gas, coal and CO2

02

Add a new data centre

500 MW

Flat load in Aragón, 4.38 TWh a year; 2,000, 4,000 and **6,000 MW also tested**

It buys the least-cost mix of new onshore wind, fixed and tracking solar, and batteries anywhere in mainland Spain

03

Apply each policy scenario

01 No policy

02 Hourly 80% on average

03 Hourly 90% on average

04 Transition rule 2026

05 Transition rule 2029

06 Decree: 80% every hour

04

Compare with 'no data centre'

Impact on Spain's:

System cost

CO2 emissions

Gas burn

Spot prices

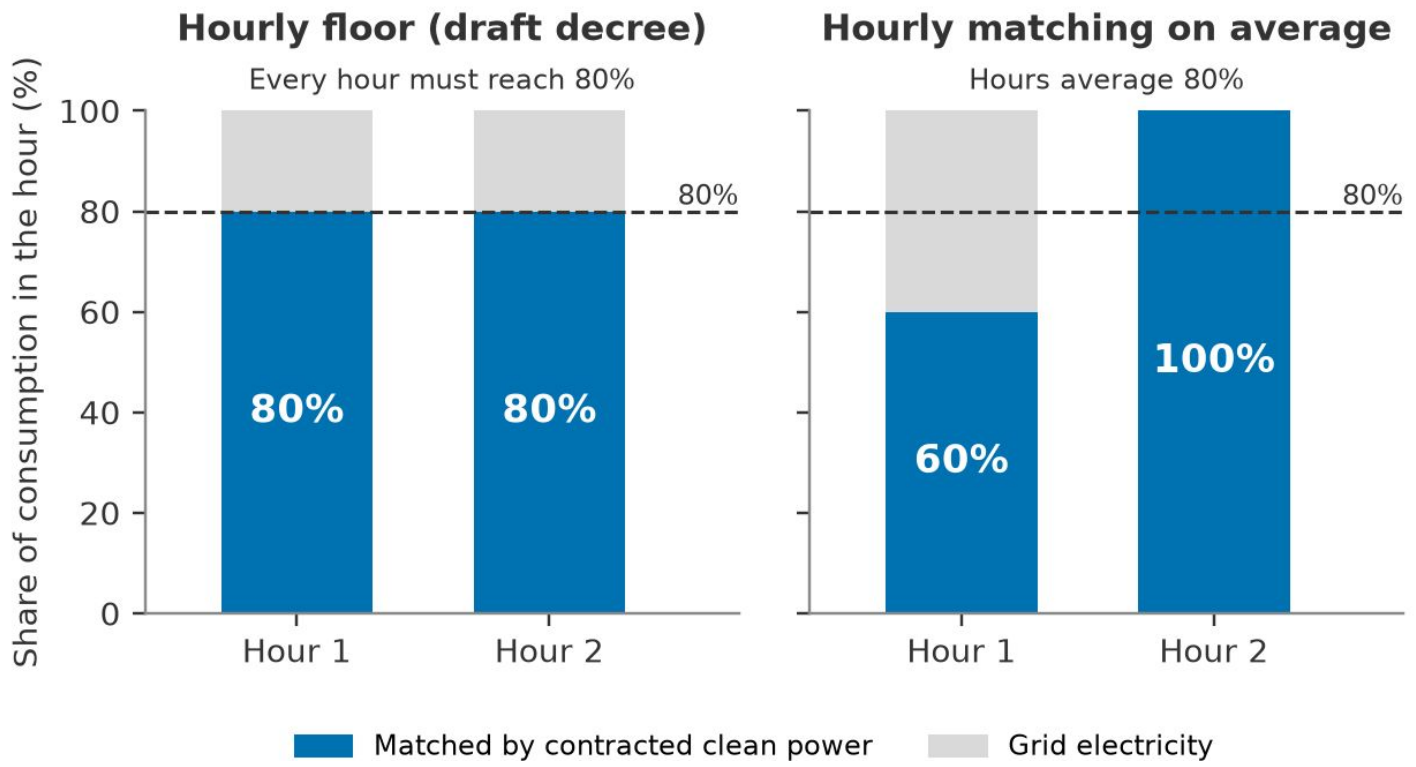
Open source and reproducible: github.com/pypsalabs/spain-datacenter-decree

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Hourly floor every hour vs Hourly matching on average

The draft decree
requires 80% in every hour

Our proposal
80% hourly matching on an annual average



IN THE DRAFT DECREE

80% additionality

of consumption from new Spanish renewables, including storage, via self-consumption or long-term PPAs

80% in every hour

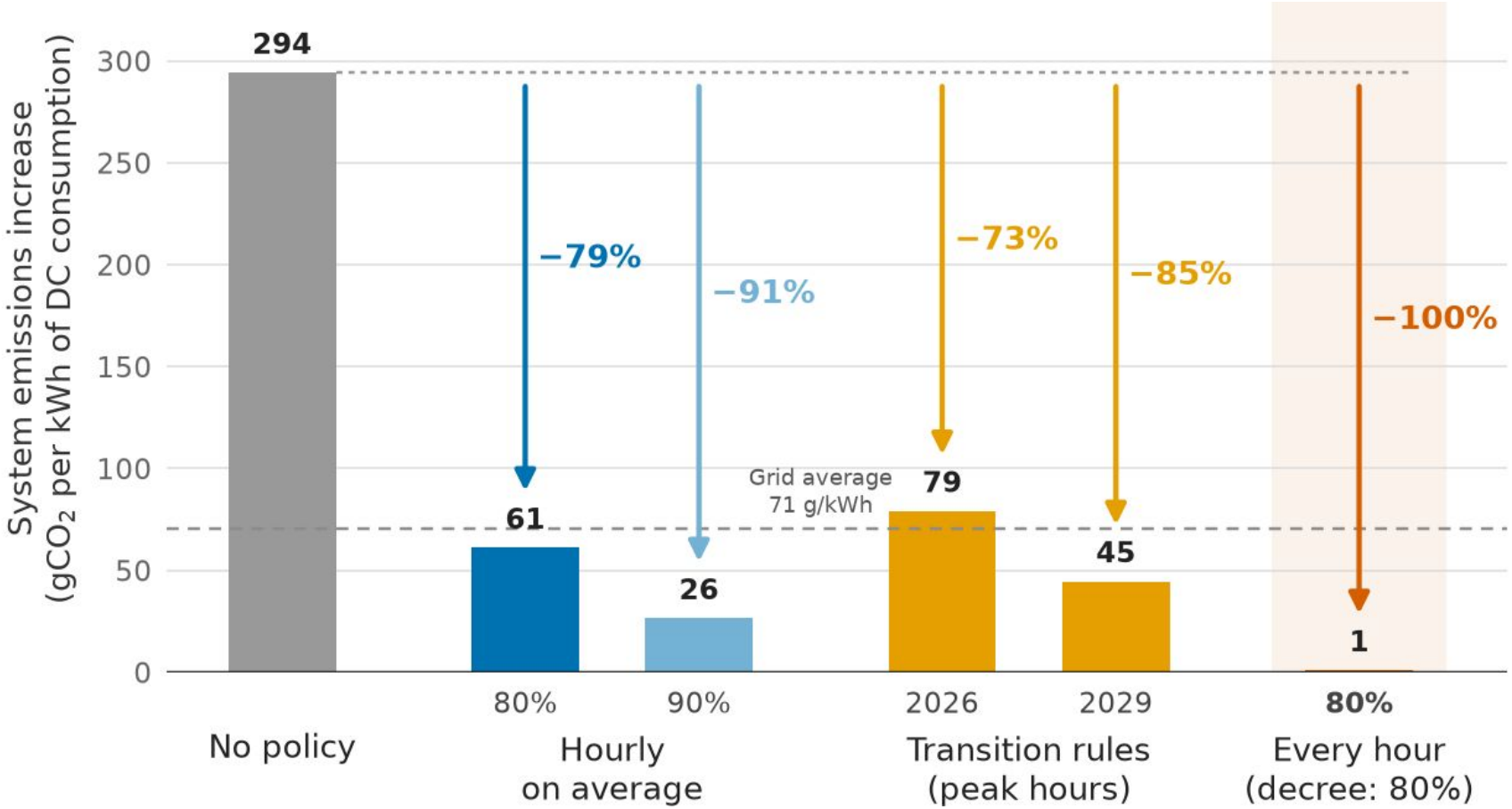
of consumption backed by renewable electricity generated in that same hour

Optional 5-year transition

for data centres that accept automatic curtailment: floors in peak hours only (60% in P1 to 2028, then 70% in P1 and 60% in P2)

Source: github.com/pypsalabs/spain-datacenter-decree

No policy means a significant emissions increase; strong hourly matching mitigates it



ADDING A 500 MW DATA CENTRE

About 4×

CO2 added per kWh consumed, vs average Spanish grid power (71 g/kWh)

+1.1 Mt

CO2 a year: +6% on Spanish power-sector emissions

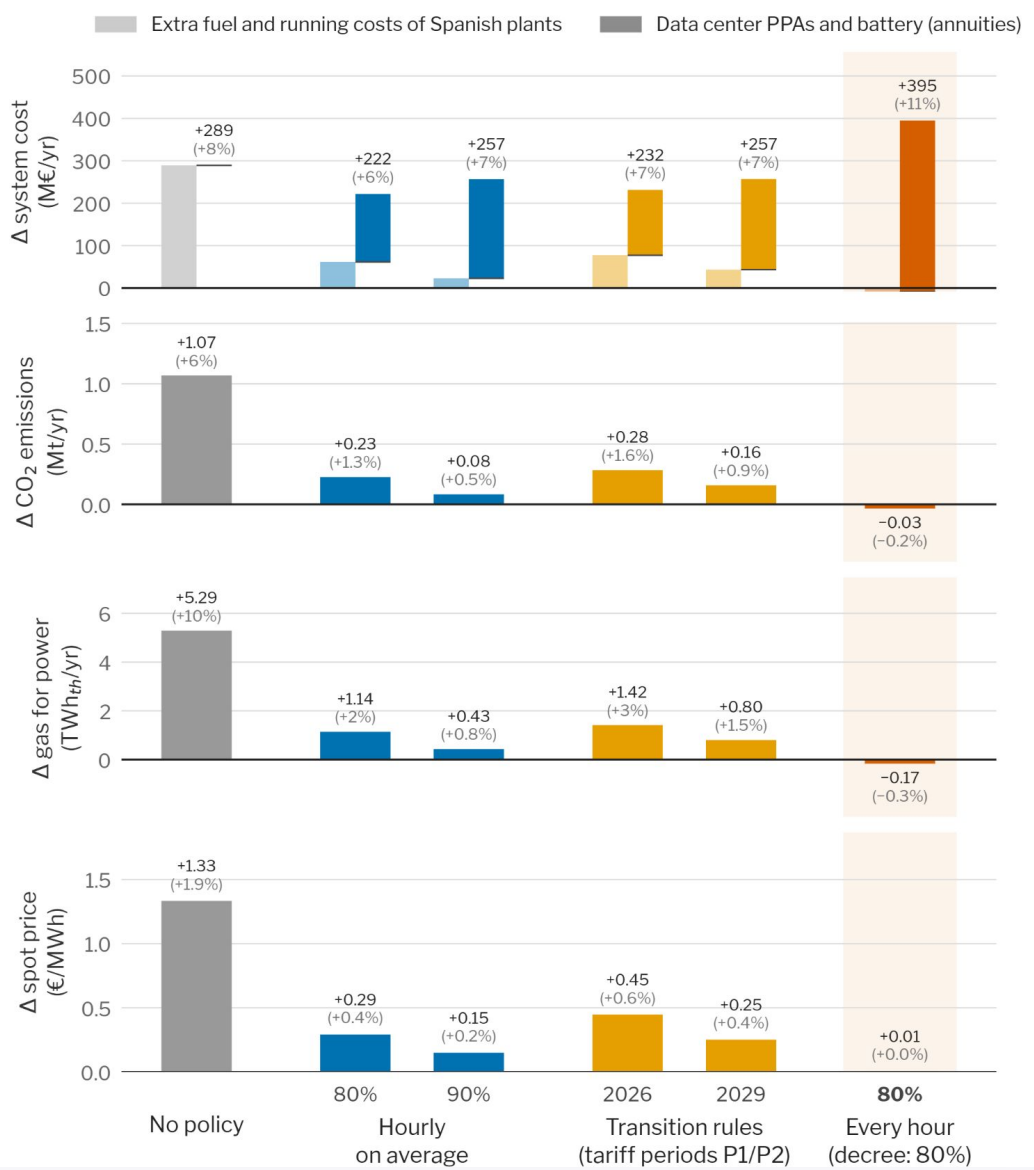
−92%

emissions increase with 90% hourly matching on average

Source: github.com/pypsalabs/spain-datacenter-decree

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Hourly matching averaged annually delivers system-wide benefits at lower cost



SYSTEM COST

€67 million a year lower than without policy

+€222M vs +€289M: Without the policy, the €289 million increase is entirely **higher fuel and operating cost**, borne by all consumers through increased market prices. Under 80% hourly matching, about €160 million of the €222 million is the data centre's own investment in new wind and solar, while about €62 million is extra operating cost borne by all electricity consumers. **The rule puts most of the cost of new demand on the party that causes it,** and the investment it finances is clean capacity that stays in the Spanish system.

CO2 EMISSIONS

79% of the emission increase removed

+0.23 vs +1.07 Mt a year: With no procurement rule, a 500 MW data centre is largely served at the margin by gas. Spanish power-sector emissions rise by about 1.1 Mt CO2 a year (+6%). Hourly matching can remove 79% of this increase.

GAS FOR POWER

+1.14 TWh instead of +5.29 TWh

With no procurement rules gas burned for power increases **by 10%.**

SPOT PRICE

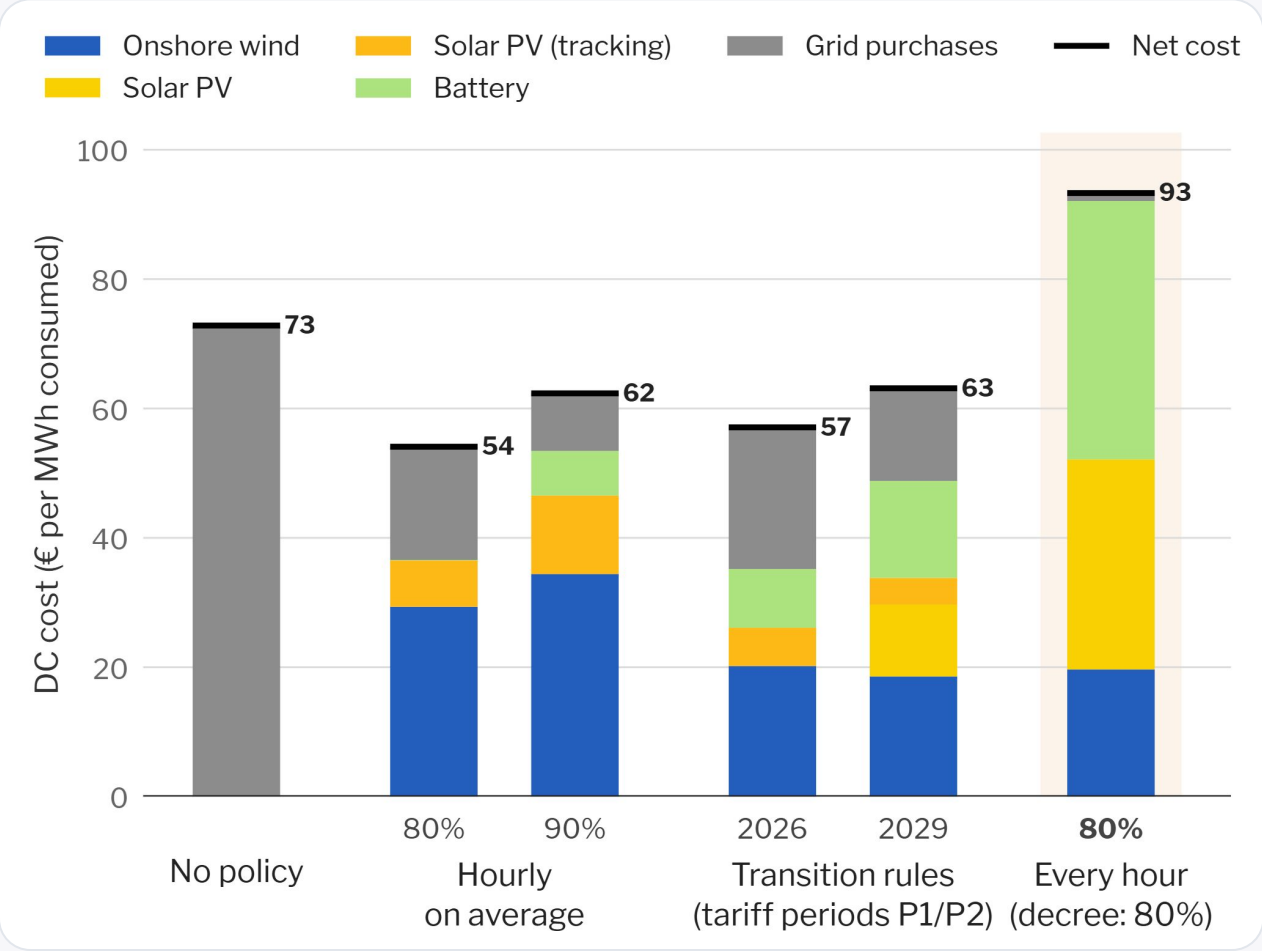
78% of the price increase removed

+0.29 vs +1.33 €/MWh on the price for Spanish consumers when comparing 80% hourly on average to the no policy scenario.

Source: github.com/pypsalabs/spain-datacenter-decree

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Hourly matching averaged annually is most cost-effective way to power data centres



HOURLY 80% ON AVERAGE

54 €/MWh

26% cheaper than grid electricity (73 €/MWh), mostly from onshore wind plus tracking solar

HOURLY 90% ON AVERAGE

62 €/MWh

Still below the average cost of grid electricity and adding battery storage to the 500MW data centre portfolio.

DECREE: 80% EVERY HOUR

93 €/MWh

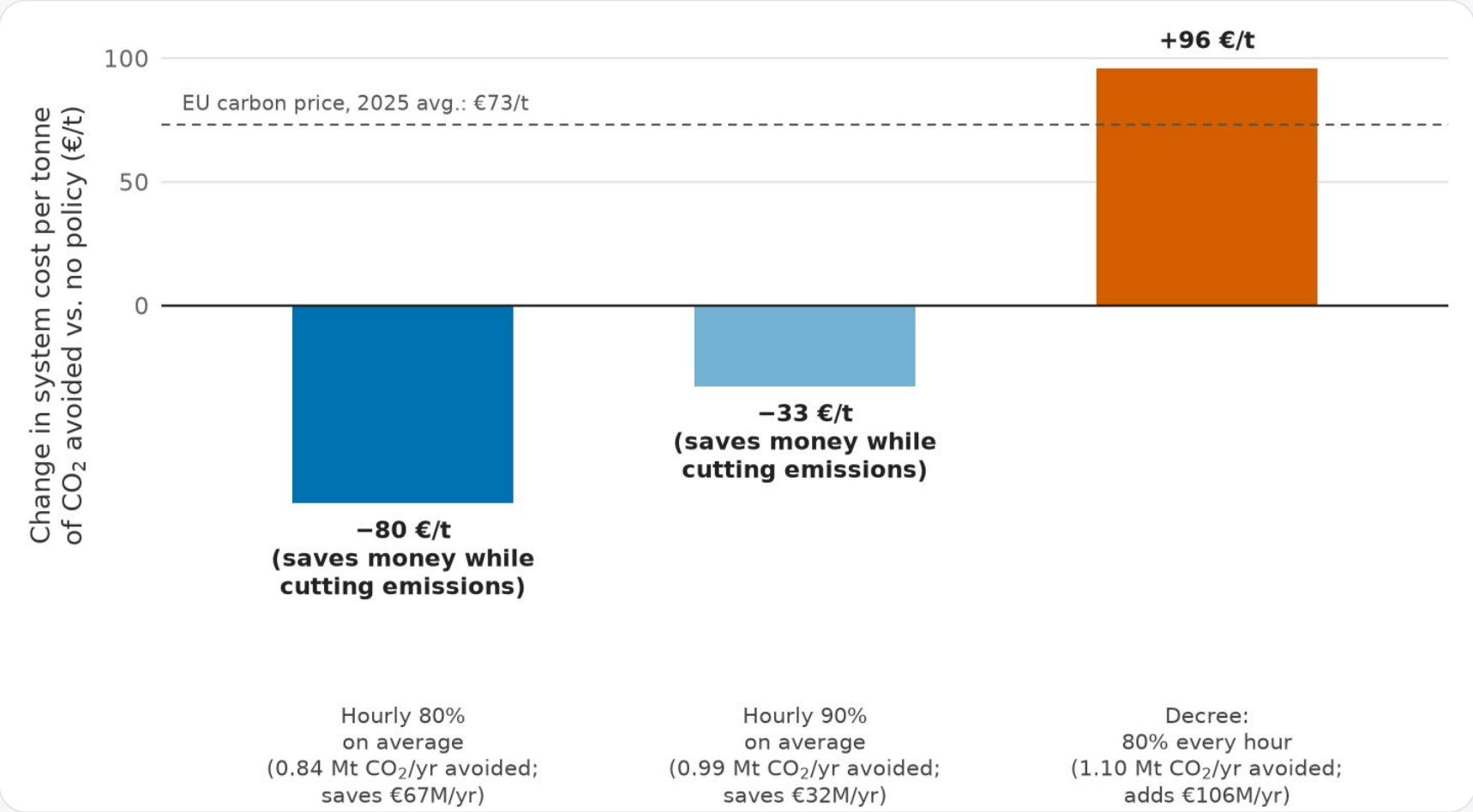
20 €/MWh more than buying from the grid. Switch to a portfolio heavily based on solar PV and battery storage.

GAS PRICE **Model costs use 2025 gas prices (36 €/MWh).** TTF (gas) price reached **100 €/MWh** in late October 2026.

Annualised technology costs, without developer margin; surplus PPA output is not sold in the model

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Hourly matching averaged annually saves money while cutting emissions



HOURLY 80% ON AVERAGE:

−€80/tCO2

Avoids 0.84 Mt CO2 a year and saves €67M a year

HOURLY 90% ON AVERAGE:

−€33/tCO2

Avoids 0.99 Mt CO2 a year and saves €32M a year

DECREE: 80% EVERY HOUR:

+€96/tCO2

Avoids 1.10 Mt CO2 a year but adds €106M a year, above the €73/t EU carbon price

Source: github.com/pypsalabs/spain-datacenter-decree

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Hourly matching matters even more as the data centre buildout grows



No policy, 6,000 MW data centre buildout

+81%
CO2 from Spain's power sector (+14.3 Mt a year)

+71.26 TWh
of extra gas burned for power each year

+14%
on the spot electricity price (+10.30 €/MWh)

With 90% hourly matching

Emissions increase: −90%

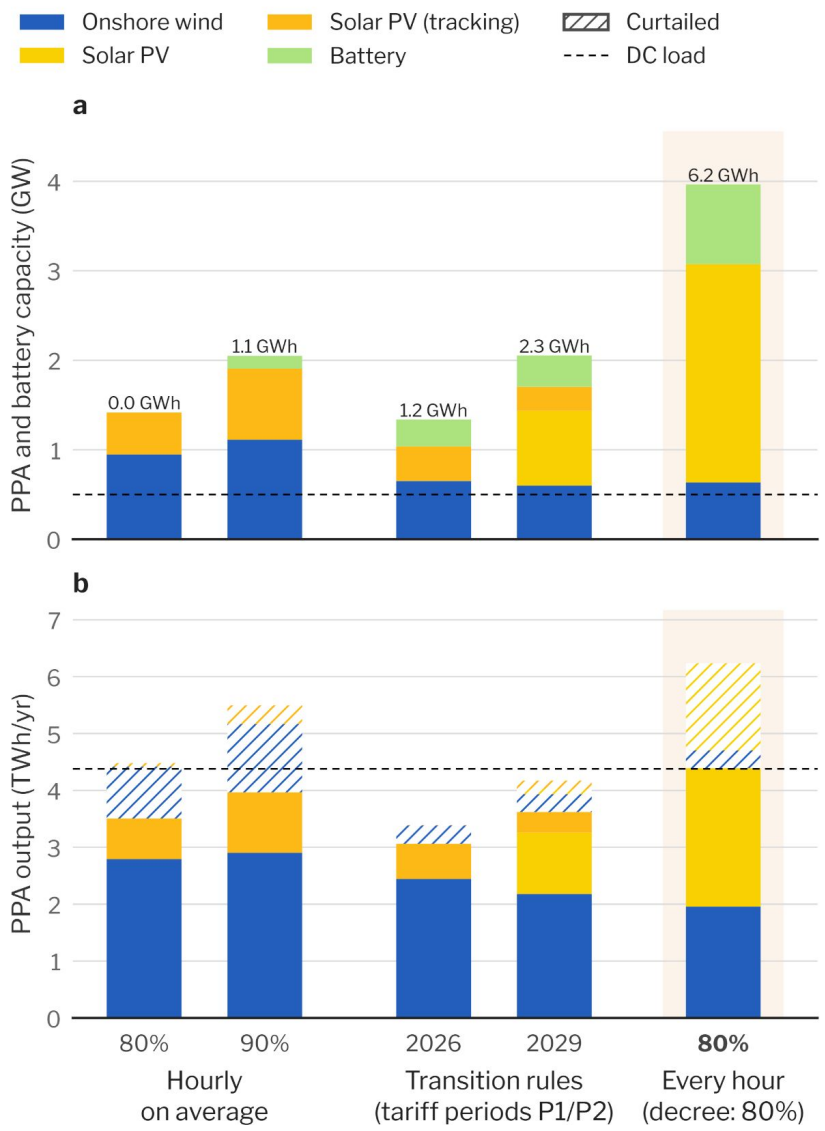
Gas burn increase: −89%

Price increase: −93%

System cost: +0.2% vs no policy

Source: github.com/pypsalabs/spain-datacenter-decree

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At 80% on average, wind leads; at 90%, wind, solar and batteries are all key

0.95 GW of onshore wind at 80% on average, with about 0.5 GW of tracking solar and no battery

1.1 GWh of batteries at 90% on average, with 0.8 GW of solar

6.2 GWh of batteries to hold 80% in every hour; contracted output 41% above consumption

0.95 GW of wind per 500 MW data centre is about 60% of what Spain added in 2025. A 6,000 MW buildout needs about 10.6 GW of onshore wind at 80% hourly matching averaged annually, roughly six to seven years of additions. Faster permitting and grid connection for renewables would help meet these goals sooner and at lower cost.

Contracted assets for a 500 MW data centre ; Wind additions: WindEurope, 2025 statistics

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At today's gas prices, hourly matching removes much more risk

Gas price (€/MWh)



Study model uses 2025 figure. The European benchmark TTF touched 100 €/MWh for the first time since 2022

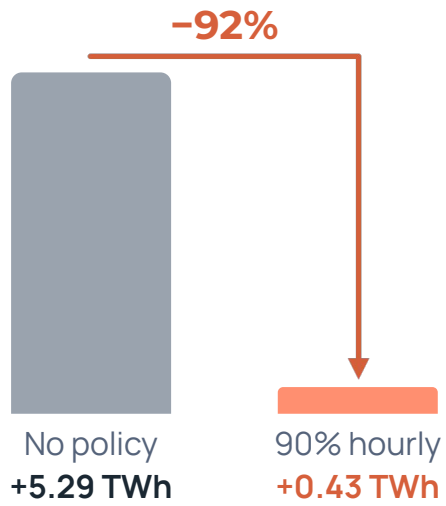
Extra system cost of a 500 MW data centre with no policy (M€ a year)

More than double



At 100 €/MWh, the extra 5.3 TWh of gas burned would cost roughly €340M a year more

Extra gas burned for power by a 500 MW data centre (TWh a year)



Strong hourly matching cuts Spain's and data centres' exposure to volatile gas: insurance for the future

More gas generation means more imported gas and **related exposure to volatile gas markets.**

Sources: report §1.3, §2.7 and Figure 1 · TTF: Euronews, 28 Oct 2026

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Study Recommendations

01

Preserve decree principles: new data centres should bring new clean supply, matched hourly.

02

Keep the hourly target, but measure it as an annual average rather than a floor in every hour.

03

Keep the transitional option, but replace the P1/P2 floors with 80% hourly matching averaged over a year.

04

Use the draft's five-year transition to reach 90% average hourly matching.

05

Verify compliance with hourly data. In the absence of time-stamped GOs, use meter data and avoid double-counting.

06

Use the review clause to raise ambition over time. First review can confirm the path to 90% hourly matching.

07

Back the requirement with an enabling environment for new clean supply.

Start at 80% hourly matching and rise to 90% by the end of the draft's five-year transition.

Full paper, model and data: github.com/pypsalabs/spain-datacenter-decree

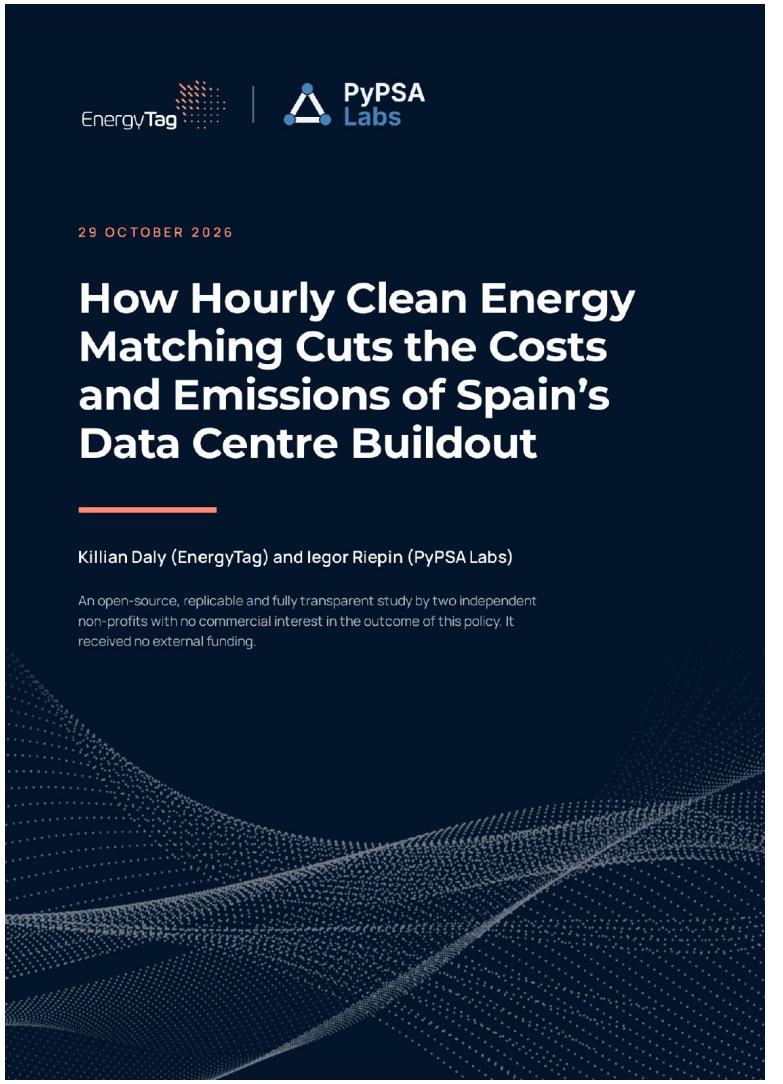
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Read the full study

ACCESS

Full study (PDF) on energytag.org

Open-source, replicable and fully transparent study by two independent non-profits with no commercial interest in the outcome of this policy. It received no external funding.



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Annex: Main study assumptions and limitations

ASSUMPTIONS

Model	Open-source PyPSA-Eur v2026.09. Spain's 2025 system in 15 regions: 9 in Spain, 4 in France, 2 in Portugal
Weather and time	One weather year (2024) at hourly resolution: 8,760 hours
Power fleet	2025 fleet held fixed: no new conventional plants, no new renewables beyond the data centre's own contracts
Fuel and carbon	2025 market prices for gas, coal and CO2. Gas at 36 €/MWh.
Data centre	Flat 500 MW load in Aragón (4.38 TWh a year). Buildouts of 2,000, 4,000 and 6,000 MW also tested
Procurement	Least-cost new onshore wind, fixed and tracking solar, and batteries anywhere in mainland Spain
Validation	Back-cast of 2024 against Red Eléctrica's reported generation, emissions and flows

STUDY LIMITATIONS

01 **One weather year.** 2024 was wet and high-renewable; drier or less windy years would most likely raise the cost of the every-hour rule more than the others.

02 **No surplus sales.** Surplus PPA output is stored or curtailed, not sold. Conservative: sales would cut hourly matching costs further.

03 **Prices.** Modelled spot price is above 2025 actuals (71.9 vs 65.3 €/MWh), while gas at 36 €/MWh is far below the 100 €/MWh TTF reached in late October 2026.

04 **Not modelled.** Network-tariff surcharges and the draft's tolerance for failing hours: the every-hour case is an upper bound on its cost.

05 **Procurement costs.** Based on technology costs, not market PPA prices (2025 offers: solar €32.5–37, wind €53–57/MWh).

Full paper, model and data: github.com/pypsalabs/spain-datacenter-decree