

GASBU LABS // TECHNICAL WHITEPAPER

FuelCast: Predicting European Retail Fuel Prices

Per-station price-rise prediction and national forecasting built on 21 million market prices, with tax-normalised training data and strict walk-forward validation.

GasBu Labs · September 2026 · labs.gasbu.app

Abstract. GasBu monitors more than 73,000 fuel stations across Europe; its prediction models currently target three markets — Spain, France and Italy (≈44,000 stations, 21.4 million recorded prices since October 2024). We describe FuelCast, a two-layer forecasting system: a per-station gradient-boosted classifier that estimates the probability a given station will raise its diesel price within 3 days, and an asymmetric error-correction model (ECM) for national averages. All models are trained on net-of-tax prices reconstructed from each country's verified legislative calendar, and evaluated exclusively walk-forward. Acting only on the top decile of the classifier's most confident calls, 75–90% of flagged stations raised their price within the horizon (base rates 21–58%), with AUC 0.75–0.85. The 2026 Strait of Hormuz supply shock and the tax interventions it triggered serve as a live stress test and a natural experiment.

01 // DATA

A market observatory, not a scrape

The GasBu platform ingests official government price feeds (Spain's Ministry for Ecological Transition, France's roulez-eco, Italy's MIMIT) into a PostGIS-backed store. Prices are append-only and event-based: a new record is written only when a station actually changes a price, so the series carry genuine repricing behaviour rather than polling noise. The modelling dataset covers October 2024 to August 2026: ≈12,200 Spanish mainland stations (668 daily observations), ≈10,100 French stations (313 days) and ≈21,700 Italian stations (287 days). Brent crude is converted to EUR per litre via EUR/USD and aligned to the same daily grid.

Two structural exclusions matter. The Canary Islands, Ceuta and Melilla (≈530 stations) operate under a separate tax regime (IGIC plus a regional fuel levy) with its own 2026 intervention calendar, and are excluded from the Spanish models. Germany, despite contributing the largest raw feed (12.5M records), is deferred: its algorithmic repricing (≈9 changes per station per day) requires intra-day event timestamps that the current ingestion pipeline does not yet preserve.

02 // TAX NORMALISATION

Models should learn markets, not decrees

Retail fuel prices embed VAT and excise duty, and in 2026 both moved repeatedly. Every price is therefore converted to a net-of-tax series, $p_{\text{net}} = p_{\text{pump}} / (1 + \text{VAT}) - \text{excise}$, using each country's legislative calendar, verified against primary sources:

COUNTRY	MEASURE	WINDOW	EFFECT (DIESEL)
Spain	RDL 7/2026: VAT 21→10%, excise to EU min.	22 Mar – 30 Jun 2026	–23.8 c/l at pump
Spain	RDL 18/2026: excise –15/–10/–5 c/l	Jul / Aug / Sep 2026	phased unwind
France	no fiscal intervention	—	clean control
Italy	2026 Budget: excise realignment	from 1 Jan 2026	+4.05 c/l overnight
Italy	DL 33/2026 + extensions: excise cut	19 Mar – 6 Jun 2026	–20 c/l, halved 25 May

The calendar is validated by the data itself: on the night Spain's RDL 7/2026 took effect, the mainland average fell 23.5 c/l against a theoretical full pass-through of 23.8 c/l — agreement within 0.3 cents. Italy's three steps are equally visible, and equally absent from the net-of-tax series (Figure 2). Training on net prices removes every such artificial jump and makes the three markets directly comparable.

03 // NATURAL EXPERIMENT

The Hormuz shock as a stress test

On 2 March 2026 the Strait of Hormuz closed and Brent rose ≈65% within a month (peak near \$118/bbl). The three markets diverged instantly: France passed the shock through one-for-one, while Spain and Italy decoupled via the fiscal measures above. From the pre-crisis period we measure a pass-through of ≈0.90 from Brent (EUR/l) to pump prices and a pronounced "rockets and feathers" asymmetry: cost increases transmit roughly three times more readily than decreases. Both facts are encoded in the models — the ECM carries separate adjustment speeds for rises and falls.

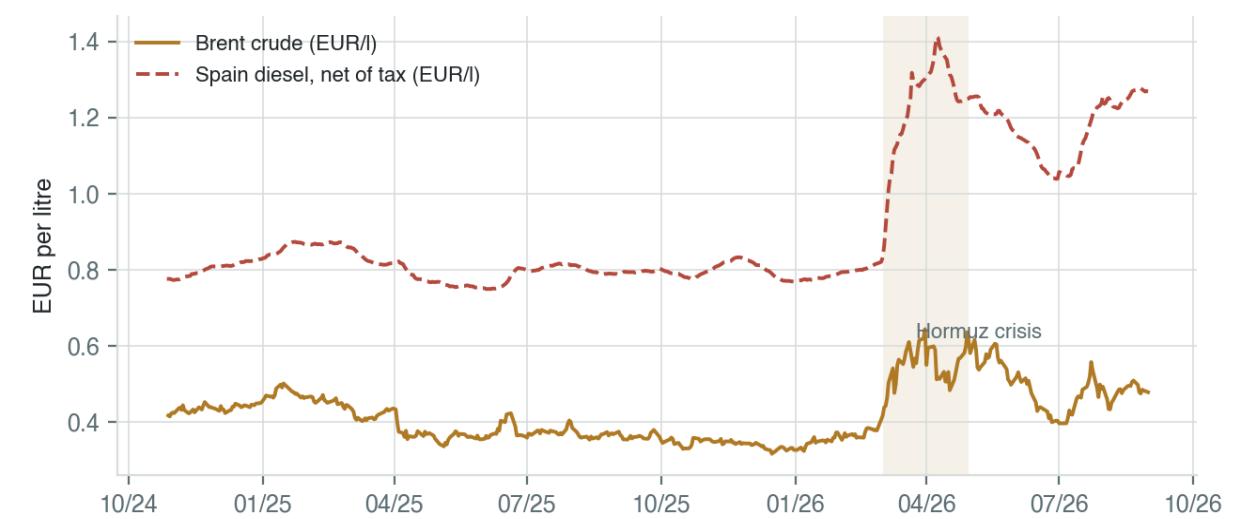


Figure 1 — Brent crude (EUR/l) and the Spanish national diesel average net of tax, Oct 2024 – Aug 2026. Shaded: the acute phase of the Hormuz crisis.

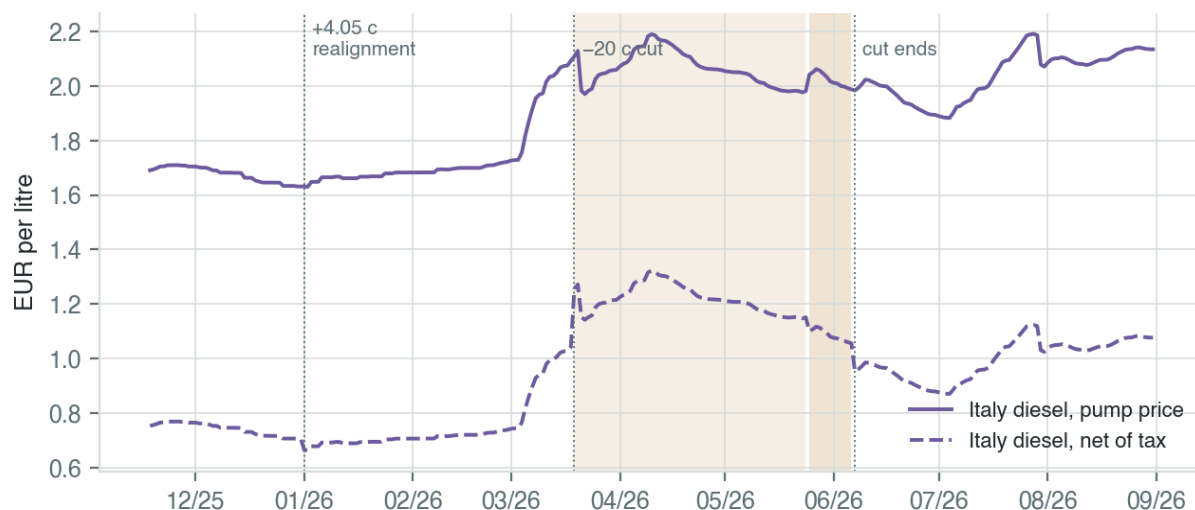


Figure 2 — Italy: pump price vs. net-of-tax diesel. Three fiscal steps in one year (January realignment, March crisis cut, phased withdrawal) disappear from the net series the models train on.

04 // MODEL I

Per-station classifier: "will this station raise its price within 3 days?"

For every station-day we build 18 features from three groups: the station's own behaviour (days since last change, historical repricing frequency, share of past changes that were increases, 7/14-day momentum), its competitive environment (deviation from the provincial median, provincial price momentum, share of neighbouring stations that repriced in the last 3 days) and the macro signal (Brent EUR/l changes over 1/3/7/30 days, day of week, brand). A LightGBM classifier is trained per country on 6.4M (ES), 2.8M (FR) and 5.0M (IT) samples. Days adjacent to tax-calendar boundaries are masked, since imperfect same-day pass-through would otherwise generate spurious labels.

TEST FOLD (HELD-OUT)	BASE RATE	AUC	TOP-DECILE PRECISION	LIFT
Spain · Jan–Feb 2026	44.5%	0.816	89.4%	2.0×
Spain · May–Jun 2026	24.6%	0.845	75.2%	3.1×
Spain · Jul–Aug 2026	58.5%	0.824	89.6%	1.5×
France · May–Jun 2026	28.3%	0.746	57.3%	2.0×
France · Jul–Aug 2026	50.4%	0.764	83.4%	1.7×
Italy · Jun–Jul 2026	20.9%	0.760	75.1%	3.6×
Italy · Jul–Aug 2026	52.1%	0.769	87.1%	1.7×

The product-defining metric is top-decile precision: when the system alerts only on its 10% most confident calls, three quarters to nine tenths of those stations actually raise their price within 3 days. Feature attribution differs by market — Spain is driven by Brent momentum (macro), France and Italy by station-local behaviour (micro) — consistent with the pass-through lags measured independently.

05 // MODEL II**National averages: asymmetric error correction**

A second model tracks each national average: a long-run equilibrium against Brent with the pass-through coefficient fixed at the measured 0.90, distributed lags of signed Brent changes (0–7 days), and separate error-correction speeds above and below equilibrium. Forecasts iterate daily with Brent held at its last value.

MARKET · HORIZON	MAE (ECM)	MAE (NAIVE)	DIRECTION HIT RATE
Spain · 3 days	0.96 c/l	1.04 c/l	66%
France · 3 days	1.73 c/l	1.88 c/l	67%
France · 14 days	6.46 c/l	6.59 c/l	63%
Italy · 14 days	6.43 c/l	7.58 c/l	66%

An honest caveat belongs here: for Spain at 7–14 days, a far simpler heuristic — elasticity times the recent Brent change, the marker already shipped in the GasBu app — predicts direction better than the ECM (72% vs. 58% at 7 days). Where the simple model wins, the simple model ships.

06 // VALIDATION**Honest numbers or nothing**

All results above are strictly walk-forward: models are fitted only on data prior to each test fold and never see their evaluation period — no random splits, no leakage. Every model must beat both a no-change forecast and the production heuristic before being considered. Two further negative results are reported deliberately: (i) a pooled three-country model improves ranking for the shortest-history market (Italy, +0.033 AUC in one fold) but degrades top-decile precision, so per-country models remain in production and pooling is reserved for cold-starting new markets; (ii) a daily-granularity German model reaches only AUC 0.62 — Germany's synchronised algorithmic repricing requires intra-day event data, which is queued as an ingestion upgrade.

07 // OUTLOOK**From research to product**

Trend markers derived from this work are already live in the GasBu app across ten languages. The next release path is: probability calibration and alert thresholds, extension from diesel to gasoline, a magnitude head ("by how much"), and a nightly scoring job feeding push notifications — "fill up today, your station is likely to raise its price" — at the 75–90% precision level documented above. Germany follows once event-time ingestion lands; its >20 c/l intra-day price cycle is the largest untapped prediction opportunity in the dataset.

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Data: proprietary market monitoring built on official national price feeds. Brent: ICE via Yahoo Finance (derived indicators only). © 2026 GasBu.