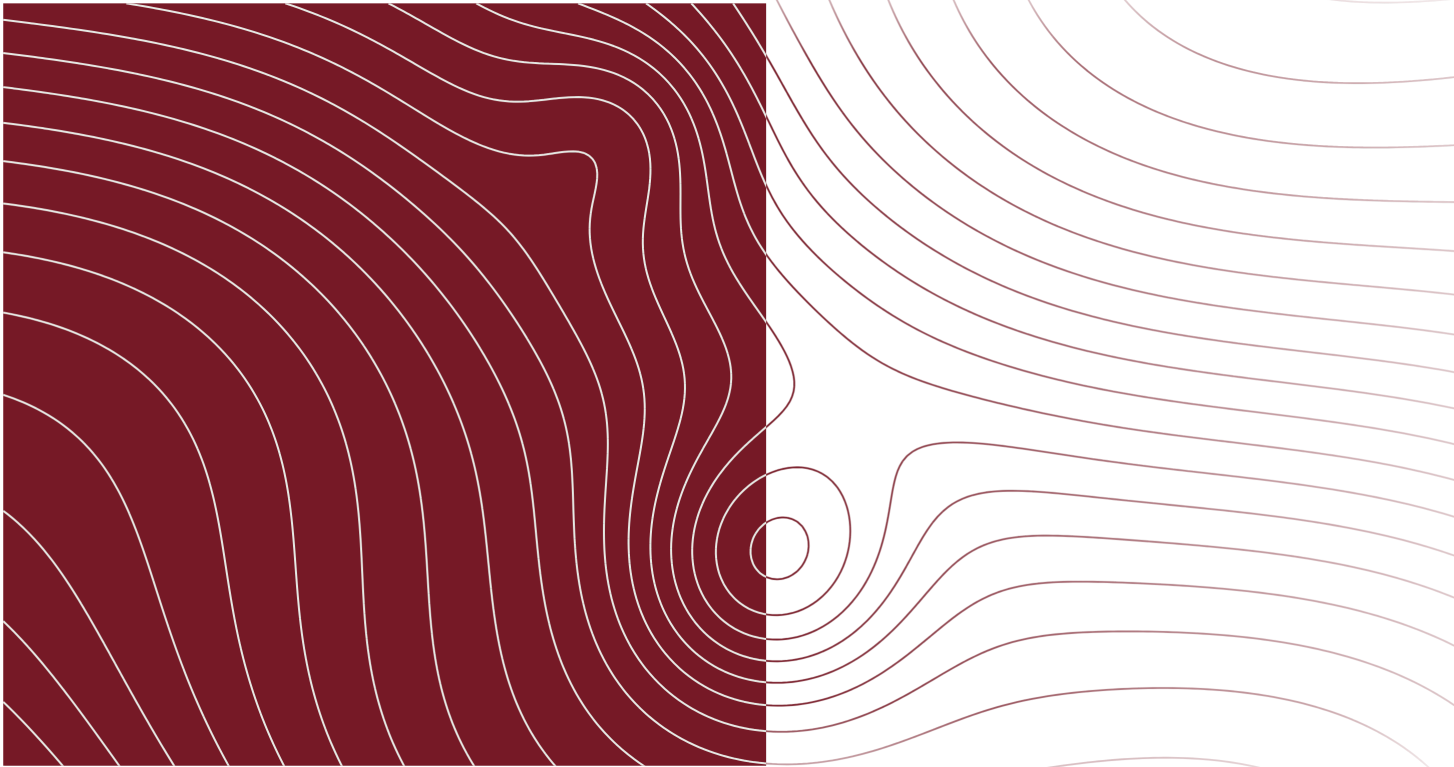




— FUEL SUBSIDY · GABON 2026–2028

From the Brent price to the household budget

*A Monte-Carlo model of fuel-subsidy removal in Gabon, 2026–2028.
Technical note: concepts, equations and models.*

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Status. Working paper. All code, data downloads and the random seed are distributed with the report (Appendix A). Every number in this note is written by a script from the simulation outputs; none is typed by hand.

Abstract

Gabon sells diesel at 575 and gasoline at 595 FCFA per litre whatever the world oil price, and the State pays the difference. On 8 October 2026 the Council of Ministers put that bill at 30 bn FCFA for September alone and noted that the money could instead strengthen health, education and the fight against poverty [10, 15]. This note gives decision-makers the consequences of each option under oil-price uncertainty, and documents the model that produces them. *Keeping prices* costs 203 bn FCFA in 2027 and 173 bn in 2028 (medians; 298 and 310 in the worst case), with no ceiling. *Removing the subsidy* brings diesel to about 1,105 FCFA per litre by end-2027 and the shared-taxi seat from 200 to 300 FCFA. Who gains and who loses then depends less on oil than on *what is done with the saving*. Returned as an equal cash transfer, it leaves 8 consumption deciles out of 10 better off. Sent to health, every consumption decile loses 1.8% to 4.2% of consumption in cash, against services whose incidence we do not measure. An *indexed* health envelope, which receives the saving month by month as the subsidy did, ranges from 145 to 299 bn in 2027 and has a 32% chance of falling by more than a quarter in 2028; a *fixed* annual envelope keeps health stable and moves the oil risk to the Treasury. The model is one Monte-Carlo chain ($N = 20,000$): daily Brent and EUR/USD paths around the ICE futures curve, with dynamics chosen by a 25-year out-of-sample coverage test; refined-product ratios; an import-parity formula; four pump-price rules; three uses of the saving; tiered transport fares; five household types and ten deciles. A correction made on 12 October 2026 is documented.

Keywords: fuel subsidies; Monte-Carlo; oil price forecasting; import parity; distributional analysis; Gabon.

JEL: H22, H23, Q41, C53, C15.

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1. Decisions and consequences at a glance

The question. Should Gabon keep pump prices at 575/595 FCFA, align them on the import price, or do it in steps? And if the subsidy goes, where should the saving go: back to households in cash, to the health budget (indexed on the oil price or fixed each year), or to the CNT public bus company?

Table 1 sets the options side by side for 2027. “Median” is the middle of $N = 20,000$ simulated oil paths; “worst” is the 90th percentile, one chance in ten of worse. Household figures are for the modest household of Libreville (6 persons) and count cash only.

Table 1. Options and consequences in 2027 (bn FCFA, FCFA per month for the household). Median [worst case].

Option	Subsidy bill ^a	Saving, and where it goes	Modest household ^b	Who bears the oil risk
Keep prices	203 [298]	none	0	the State, with no ceiling
Remove; equal cash transfer	–5	208 [299], to every inhabitant	+23,700	households, offset by a transfer that rises with oil
Remove; health, indexed	–5	208, between 145 and 299, to health	–6,100	the health budget
Remove; health, fixed at the median	–5	208 to health; Treasury short 1 year in 2	–6,100	the Treasury
Remove; health, fixed at P10	–5	145 to health; Treasury keeps 63 (median)	–6,100	the Treasury, rarely short
Remove in steps	139 [228]	63 (use as above)	–2,600	shared
Capped indexation	94 [175]	106 (use as above)	–3,900	shared
Remove; CNT fares frozen	–5	1.0 to the CNT; the rest to one of the uses above	varies ^c	the State, for the CNT’s diesel

^a Negative: the State collects a small surplus. ^b Cash balance per month: the transfer received minus the extra cost; 0 means no change. ^c A bus user also saves about 100 FCFA per trip compared with the taxi.

What the numbers say.

- 1. Keeping prices is the only option whose bill has no ceiling.** From November 2026 to December 2028 it costs 420 bn FCFA in the median case and 650 bn in the worst case (§9).
- 2. Removal changes daily prices by steps.** Diesel ends 2027 between 975 and 1,370 FCFA per litre de-

pending on oil; the taxi seat goes to 300 FCFA in all three cases, cooking gas back to 5,950 (§12, §13.3).

3. **The use of the saving decides who loses.** With an equal cash transfer, 8 deciles out of 10 gain and the modest household keeps +23,700 FCFA a month. If the saving goes to health, that household pays 6,100 FCFA a month more in cash, the household with a car 64,700 FCFA, and every decile loses 1.8%–4.2% of consumption in cash.
4. **An indexed health envelope inherits the volatility of oil.** It receives 208 bn in 2027 in the median case, but anything from 145 to 299; in one case out of three (precisely 32%) it falls by more than a quarter from 2027 to 2028. Health would be financed best when oil is dear, which is also when households pay most at the pump.
5. **A fixed envelope moves that risk to the Treasury.** Set at the median saving (208 bn in 2027), it is not covered one year in two, with an average shortfall of 40 bn when that happens. Set at the 10th percentile (145 bn), the shortfall is rare (one year in ten, 15 bn on average) and the Treasury keeps 63 bn in the median case.
6. **The amounts are large for the health sector.** The median 2027 saving equals 55% of the 2026 health budget announced in the draft finance law (377 bn FCFA) and 1.5 times the 2025 budget (141 bn) [16]. How fast it can be spent well is a question this model does not answer.
7. **Public transport is the cheapest use, and the narrowest.** Keeping all CNT fares unchanged costs 1.0 bn a year (0.5% of the saving) and keeps the urban ticket from going from 200 to 300 FCFA and intercity fares from rising by 2,000 to 4,000 FCFA. Only about a quarter of Greater Libreville lives near one of the 8 urban lines, which we had to estimate (§11).

Reading guide. Sections 3–7 build the oil-to-pump-price chain; §8 the price rules; §9 the bill; §10 the use of the saving, including health; §11 public transport (CNT); §12 the households; §13 the three cases; §14 the tests; §15 the limits. Each section ends with a box that says what it means for the decision.

2. Introduction

A fuel subsidy with fixed pump prices transfers the oil-price risk from consumers to the budget. Its future cost is therefore not a number but a distribution, driven mostly by the price of crude and by the exchange rate. Conversely, removing the subsidy transfers that risk back to households, and what they pay becomes the uncertain quantity. This note documents a model that treats both sides in one chain: each simulated oil path is pushed through the import parity, the policy rule, the budget and the household accounts, so that every reported figure carries the uncertainty of the oil price.

The model serves two reports written in French for a Gabonese audience: a household study (“v2”) that fixes everyday prices and household types under three static price steps, and a forecast study that adds time and uncertainty. This note is the methodological reference for both. It states every equation, every parameter with its source, and every assumption that has no source.

Contributions. (1) A transparent oil-to-household chain at monthly resolution, with daily oil dynamics. (2) A model-selection procedure for the oil process based on interval coverage over 295 forecast origins. (3) A scenario construction that keeps the joint consistency of all outputs along each path. (4) An explicit list of unsourced assumptions and of one unexplained calibration gap.

Table 2. Main notation.

t, m	business day, calendar month; $m(t)$ the month of day t
F_m	ICE Brent futures price for the contract of month m (US\$/bbl)
$B_t, \bar{B}_m$	simulated Brent spot, daily and monthly mean
X_t, Y_t	log deviations of Brent and EUR/USD from their centres
$E_t, \bar{E}_m$	EUR/USD (US\$ per euro), daily and monthly mean
R_m^p	ratio of product $p \in \{u, e\}$ (diesel, gasoline) to Brent, per barrel
P_m^g, P_m^s	import parity of diesel (<i>gasoil</i>) and gasoline (<i>super</i>), FCFA/L
$p_m^{g,\pi}, p_m^{s,\pi}$	pump prices under policy π
V	subsidised volume, litres per year
C_m^π	subsidy cost under policy π (FCFA per month)
τ_m^π	equal transfer per inhabitant (FCFA per month)
Δ_m^g, Δ_m^s	pump-price increases with respect to 575 and 595
N	number of Monte-Carlo paths, $i = 1, \dots, N$

3. Overview of the chain

Figure 1 summarises the computation. Only the first block is stochastic at the daily step; the second adds an independent monthly shock; everything downstream is deterministic given the path. Each of the N paths is processed by the full chain for each policy, and summaries (quantiles, fans, scenarios) are taken *at the end*, on the outputs.

The horizon runs from 7 October 2026 (first business day after the last observed Brent quote, 2026-10-06) to 29 December 2028: 583 business days, 27 calendar months (October 2026 to December 2028). October 2026 is a mixed month: its observed days are averaged with the simulated ones.

4. Data and sources

Table 3 lists the inputs. All daily series were downloaded from FRED on 11 October 2026.

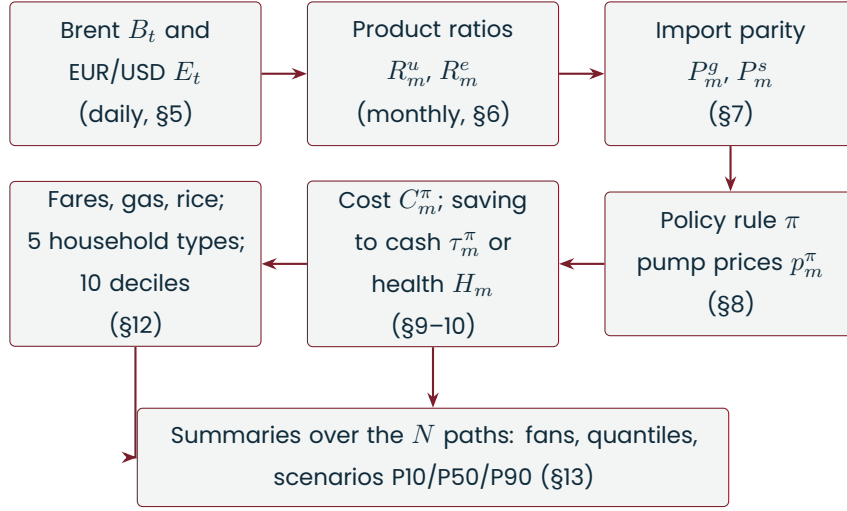


Figure 1. The computation chain. Arrows denote deterministic maps except the first two blocks.

5. Brent and exchange-rate model

5.1 Centring on the futures curve

A futures price is, to a first approximation, the market expectation of the spot price at delivery (we ignore the risk premium and the convenience yield; see §15). We therefore write the simulated spot as a multiplicative deviation from the futures price of the delivery month,

$$B_t = F_{m(t)} \exp(X_t), \quad E_t = E_0 \exp(Y_t), \quad (1)$$

and require $\mathbb{E}[B_t] = F_{m(t)}$ and $\mathbb{E}[E_t] = E_0$, the latter following the convention of central-bank projections that hold the exchange rate constant [6]. October and November 2026 are centred on the first listed contract (December 2026) – an assumption.

5.2 Three candidate dynamics

Let ε_t be the daily log-return shock of Brent. We compare:

$$\text{M1 (random walk, constant volatility): } X_t = X_{t-1} + \sigma z_t, \quad z_t \sim \mathcal{N}(0, 1), \quad (2)$$

$$\begin{aligned} \text{M2 (random walk, GARCH(1,1)-t): } X_t &= X_{t-1} + \varepsilon_t, \quad \varepsilon_t = \sigma_t z_t, \quad z_t \sim t_\nu \sqrt{\frac{\nu-2}{\nu}}, \\ \sigma_t^2 &= \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2, \end{aligned} \quad (3)$$

$$\text{M3 (mean reversion + GARCH-t): } X_t = (1 - \kappa) X_{t-1} + \varepsilon_t. \quad (4)$$

In M1 the daily volatility σ is the standard deviation of daily log returns over the last five years (1,260 days); for the forecast, $\sigma\sqrt{252} = 43\%$. Returns with $|r| \geq 0.5$ are excluded (one day, April 2020, when prices were near zero or negative).

GARCH estimation. M2 is fitted by maximum likelihood with *variance targeting*: $\omega = \hat{v} (1 - \alpha - \beta)$, with $\hat{v}$ the sample variance, so that only (α, β, ν) are optimised (Nelder–Mead). The standardised Student

Table 3. Inputs, values and sources.

Input	Value	Source
Brent spot, daily	last 125.44 \$/bbl (2026-10-06)	EIA via FRED, DCOILBRENTU [3]
EUR/USD, daily	last 1.1259	Federal Reserve via FRED, DEXUSEU [4]
Diesel and gasoline, NY Harbor	monthly means	EIA via FRED, DDFUELNYH, DGASNYH [5]
Brent futures curve	104.72 (Dec 2026) to 76.48 (Dec 2028)	ICE, quotes of 9 Oct 2026 [2]
Product/Brent path	by quarter to 2027Q4	EIA, STEO Oct. 2026, table 2 [1]
Pump prices	575 / 595 FCFA/L	CNPPP, since 1 Jan 2024 [12]
Unsubsidised prices	1,080 / 1,125 FCFA/L	industrial prices, Jan 2024 [12]
Subsidy cost 2024	126 bn FCFA	World Bank public finance review [9]
Subsidy cost Sept. 2026	30 bn FCFA / month	Council of Ministers, 8 Oct 2026 [10]
Population	3,518,621	RGPL census [12]
Fares, tiers, household budgets	see §12	household study (v2) [12]
FCFA per euro	655.957	fixed parity
Litres per barrel	158.987	definition

log-density is

$$\ell_t = \ln \Gamma\left(\frac{\nu+1}{2}\right) - \ln \Gamma\left(\frac{\nu}{2}\right) - \frac{1}{2} \ln(\pi(\nu-2)) - \frac{1}{2} \ln \sigma_t^2 - \frac{\nu+1}{2} \ln\left(1 + \frac{r_t^2}{\sigma_t^2(\nu-2)}\right). \quad (5)$$

On daily data from 1990 to 2026-10-06 ($n = 9,100$ days, excess kurtosis 21) we obtain $\hat{\alpha} = 0.072$, $\hat{\beta} = 0.920$, $\hat{\nu} = 5.6$; long-run volatility 42% per year, end-of-sample conditional volatility 88%. The latter, far above the long-run level, is the reason why M2 forecasts are very wide at short horizons in the current crisis.

Mean reversion. In M3, the monthly reversion speed is $\kappa_m = 1 - \hat{a}$, with $\hat{a}$ the OLS slope of $\ln \bar{B}_m$ on $\ln \bar{B}_{m-1}$, clipped to $[0, 0.2]$, and converted to a daily rate $\kappa = 1 - (1 - \kappa_m)^{1/21}$. On the full sample $\hat{a} = 0.991$.

Why test the dynamics at all? Variance ratios of monthly log Brent,

$$VR(k) = \frac{\text{Var}(\ln \bar{B}_{m+k} - \ln \bar{B}_m)}{k \text{Var}(\ln \bar{B}_{m+1} - \ln \bar{B}_m)},$$

are 0.99 at 12 months, 0.82 at 24 months and 0.60 at 36 months. Values below one point to some mean reversion at long horizons, which would favour M3; heavy tails (kurtosis) favour Student shocks. The choice is therefore empirical (§14). M1 was retained.

5.3 Exchange rate and correlation

EUR/USD follows a random walk with daily volatility σ_E ($\sigma_E\sqrt{252} = 7.5\%$), and its shocks are correlated with the Brent shocks through

$$Y_t = Y_{t-1} + \sigma_E u_t, \quad u_t = \rho z_t + \sqrt{1 - \rho^2} e_t, \quad e_t \sim \mathcal{N}(0, 1) \text{ independent}, \quad (6)$$

with $\rho = -0.034$, the correlation of daily log returns over the last five years. The correlation is small; it is kept for completeness.

5.4 Lognormal centring

If $X_t \sim \mathcal{N}(\mu, s^2)$ then $\mathbb{E}[e^{X_t}] = e^{\mu + s^2/2}$. To impose $\mathbb{E}[B_t] = F_{m(t)}$ we replace, day by day and across paths,

$$\tilde{X}_t = X_t - \widehat{\mathbb{E}}[X_t] - \frac{1}{2} \widehat{\text{Var}}[X_t], \quad (7)$$

where $\widehat{\mathbb{E}}$ and $\widehat{\text{Var}}$ are cross-sectional moments over the N paths (and similarly for Y_t). We do not divide by the empirical mean of e^{X_t} : with heavy tails that mean is dominated by a few extreme paths and makes the median drift. The centring is exact under M1, where X_t is Gaussian.

5.5 Initial physical premium

On 2026-10-06 the spot (\$125.44) was far above the first futures contract (\$104.72): a physical-market premium during a supply crisis. We let it decay with a half-life of $h = 21$ business days (assumption):

$$X_t = \tilde{X}_t + b_0 2^{-t/h}, \quad b_0 = \ln(S_0/F_{\text{Oct}}) = 0.18. \quad (8)$$

Hence $\mathbb{E}[B_t] = F_{m(t)} \exp(b_0 2^{-t/h})$: the premium halves every month and is negligible after a quarter.

Correction of 12 October 2026. In the first published version, the premium was added *before* the centring (7). Since it is the same on every path, the subtraction of $\widehat{\mathbb{E}}[X_t]$ removed it entirely, and the simulated spot started on the futures curve instead of the physical price. The term is now added after centring, as in (8). The median monthly Brent of November 2026 rises from 103.7 to 111.3 \$/bbl; end-2026 indexed diesel prices rise by 35–40 FCFA/L; figures for 2027 and 2028 change by at most one unit.

5.6 Monthly aggregation

Monthly prices are arithmetic means of daily prices, $\bar{B}_m = \frac{1}{|m|} \sum_{t \in m} B_t$. For October 2026, observed days are pooled with simulated days. The monthly step is used downstream because Gabonese pump prices are set at most monthly and household budgets are monthly.

For the decision. The oil price in 2027–2028 is a range, not a number: a median of \$86 in 2027, with one chance in ten below \$57 and one in ten above \$132. Every option must be judged over that range. The model chosen (M1) is the one whose ranges have contained the realised price most reliably since 2000 (§14).

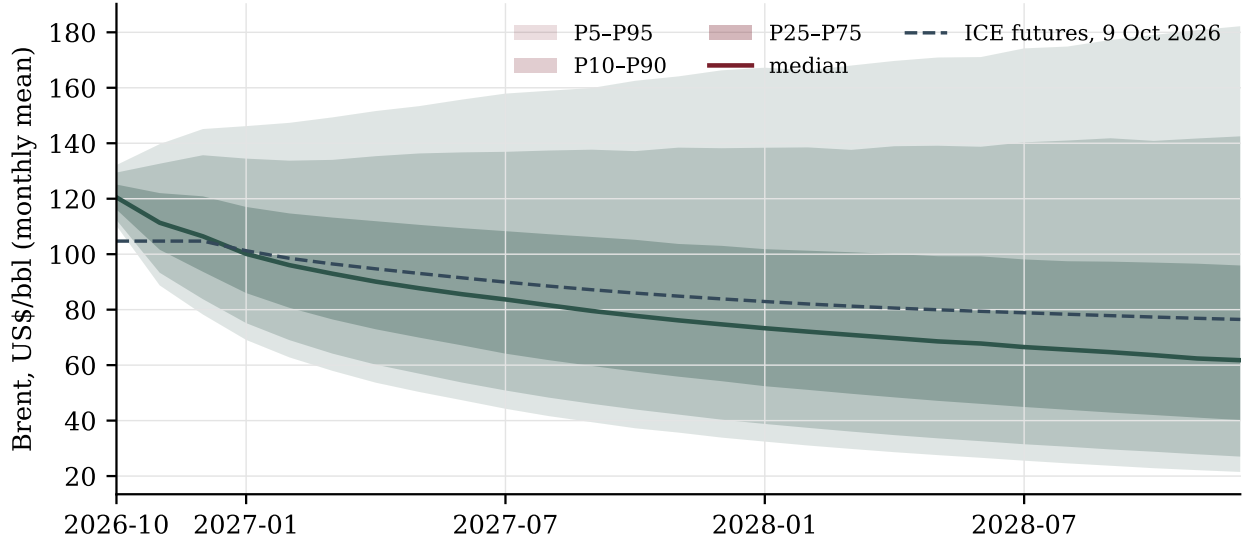


Figure 2. Monthly Brent: median and 50/80/90% bands of $N = 20,000$ paths, and the futures curve of 9 October 2026. The early excess over the curve is the decaying physical premium (8).

6. Refined products

The parity depends on diesel and gasoline prices, not on crude. We model the product-to-Brent ratio (both in \$/bbl) for diesel (u , NY Harbor ULSD) and gasoline (e) as a central path times a stochastic deviation:

$$R_m^p = c_m^p \exp(d_m^p), \quad p \in \{u, e\}. \quad (9)$$

Central path. c_m^p is the EIA STEO wholesale-to-Brent ratio of the quarter of m (diesel and gasoline wholesale prices $\times 42$ / Brent), held at its 2027Q4 value in 2028, times a spot/wholesale adjustment f^p equal to the mean, over 2025Q1–2026Q3, of the observed spot ratio divided by the STEO ratio: $f^u = 1.005$, $f^e = 0.946$.

Deviation. Let $y_m^p = \ln R_m^p - \overline{\ln R_m^p}^{(36)}$ be the historical log ratio minus its 36-month moving mean. We estimate by OLS on 2006–2026 ($n = 233$ months)

$$y_m^p = \phi_p y_{m-1}^p + \beta_p \Delta b_m + \eta_m^p, \quad \eta_m^p \sim \mathcal{N}(0, s_p^2), \quad (10)$$

where Δb_m is the monthly log change of Brent. Crack spreads widen less than one-for-one when crude jumps, hence $\beta_p < 0$. Estimates: diesel $\phi = 0.82$, $\beta = -0.28$, $s = 0.048$; gasoline $\phi = 0.82$, $\beta = -0.13$, $s = 0.046$. In simulation, d_m^p follows (10) started at the last observed deviation from c^p , and Δb_m is the simulated Brent *surprise*: the monthly log change minus the change implied by the futures curve. The shocks η use an independent stream of the generator (seed+1).

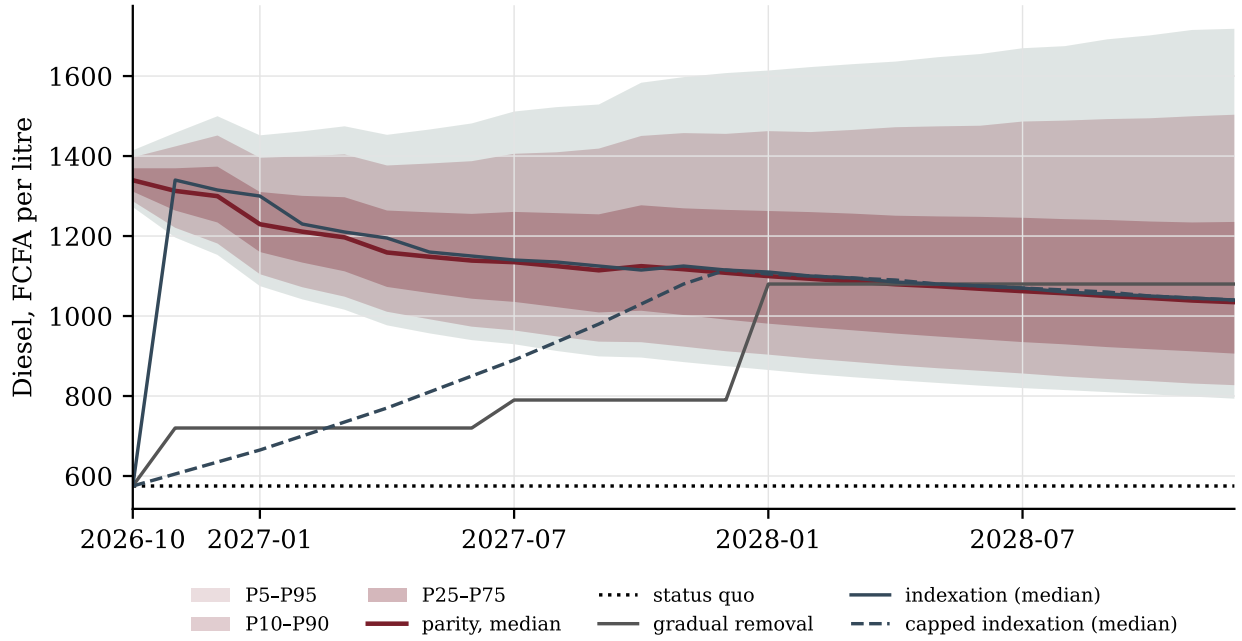


Figure 3. Diesel import parity (median and bands) and median pump price under the four policies.

7. Import parity

The parity is the product price converted into FCFA per litre, plus a fixed term K that collects freight, insurance, storage, distribution margins and taxes:

$$P_m^g = K^g + \frac{R_m^u \bar{B}_m \times 655.957}{\bar{E}_m \times 158.987}, \quad P_m^s = K^s + \frac{R_m^e \bar{B}_m \times 655.957}{\bar{E}_m \times 158.987}. \quad (11)$$

K is calibrated so that the parity of December 2023 equals the unsubsidised industrial prices published for January 2024 (1,080 and 1,125 FCFA/L): $K^g = 662$, $K^s = 771$ FCFA/L. K is held constant in FCFA – an assumption without source, discussed in §15. Figure 3 shows the simulated parity of diesel with the pump prices of each policy.

For the decision. The parity is the price the pump would show without subsidy: 1,155 FCFA per litre of diesel in 2027 (median), well above 575. K is held constant, so if freight and margins stay high after the 2026 crisis, the true parity, and the bill, are higher.

8. Policies

October 2026 keeps current prices under every policy. From November 2026:

- **sq (status quo):** $p^g = 575$, $p^s = 595$.
- **PROG (gradual removal):** the three steps of the household study: S1 = 720/730 (Nov 2026–Jun 2027), S2 = 790/810 (Jul–Dec 2027), S3 = 1,080/1,125 (2028). The calendar is an assumption.

- **IDX (indexation):** the pump price of month m is the mean parity of month $m - 1$, rounded to 5 FCFA:
 $p_m = 5 \text{ round}(P_{m-1}/5)$.
- **IDXP (capped indexation):** as IDX, but the monthly change is clipped to $\pm c$ with $c = 5\%$ [11]: $p_m = 5 \text{ round}(\text{clip}(5 \text{ round}(P_{m-1}/5), (1 - c)p_{m-1}, (1 + c)p_{m-1})/5)$. The value of c is an assumption.

In this note and in the household report, “removal of the subsidy” means IDX: the subsidy disappears in every month whatever the oil price. PROG only reaches the January 2024 unsubsidised level, which may lie below the 2028 parity.

9. Subsidy cost and equal transfer

9.1 Cost

With a share w of diesel in the subsidised volume and an annual volume V ,

$$C_m^\pi = \frac{V}{12} \left[w (P_m^g - p_m^{g,\pi}) + (1 - w) (P_m^s - p_m^{s,\pi}) \right]. \quad (12)$$

The cost is signed: when the pump price exceeds the parity (e.g. PROG in 2028 with cheap oil), the State collects a surplus. $w = 0.60$ is an assumption (no published split was found).

9.2 The volume V and the calibration gap

V is not published. We infer it from announced costs and the historical parity gap $G_m = w(P_m^g - 575) + (1 - w)(P_m^s - 595)$ computed from (11) with observed prices:

$$V_{24} = \frac{126 \text{ bn}}{\frac{1}{12} \sum_{m \in 2024} G_m} = 249 \text{ ML/yr}, \quad V_{\text{sep}} = \frac{12 \times 30 \text{ bn}}{G_{\text{sep } 2026}} = 463 \text{ ML/yr}. \quad (13)$$

The two calibrations differ by a factor 1.9. Out of sample, V_{24} reproduces the announced monthly costs of 2021 (7–9 bn) and 2022 (≈ 15 bn) with the pump prices of the time (585/605) (Figure 4), but gives 16 bn for September 2026 against 30 announced. We could not explain the gap (it may include arrears, other products, or a larger volume). Each path therefore draws

$$V \sim \mathcal{U}(V_{24}, V_{\text{sep}}), \quad (14)$$

independently of the oil path. This widens the cost distribution; Table 4 also reports each calibration alone.

9.3 Equal transfer

The saving of policy π with respect to the status quo is returned in equal shares to every inhabitant:

$$\tau_m^\pi = \frac{C_m^{\text{SQ}} - C_m^\pi}{\text{POP}}, \quad \text{POP} = 3,518,621. \quad (15)$$

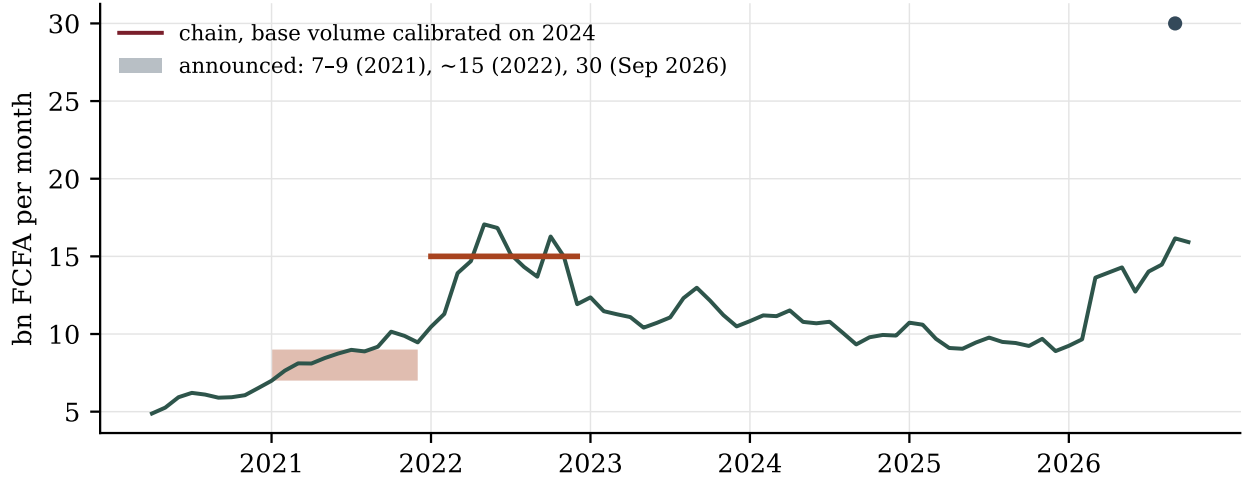


Figure 4. Back-cast of the monthly subsidy cost by the chain with V_{24} and observed prices, against announced amounts.

This transfer does not exist today; it is the benchmark used by the IMF and the World Bank to show the distributional effect of a reform when the saving is recycled. Rows “with transfer” should be read with that caveat.

Table 4. Subsidy cost by policy, bn FCFA: median [P10; P90] over N paths. Last two rows: status quo with each volume calibration alone.

	2027	2028	Nov 2026–Dec 2028
Status quo	203 [139; 298]	173 [102; 310]	421 [282; 650]
Gradual removal	139 [83; 228]	−9 [−74; 117]	164 [51; 373]
Indexation	−5 [−10; 3]	−2 [−7; 5]	−8 [−14; 4]
Capped indexation	94 [52; 175]	−1 [−6; 20]	133 [83; 239]
SQ, $V = V_{24}$ only	143 [108; 198]	122 [77; 212]	296 [216; 435]
SQ, $V = V_{\text{sep}}$ only	266 [200; 368]	227 [142; 394]	550 [401; 808]

10. Using the saving: cash transfer or health budget

When the subsidy is reduced, the State saves, path by path and month by month,

$$S_m^\pi = C_m^{\text{SQ}} - C_m^\pi. \quad (16)$$

On 8 October 2026 the Council of Ministers stated that the subsidy deprives the State of resources that could strengthen investment in health, education and poverty reduction [15]. We compare three uses of S_m^π .

Equal cash transfer. $\tau_m^\pi = S_m^\pi / \text{POP}$ (§9); households receive the saving in cash.

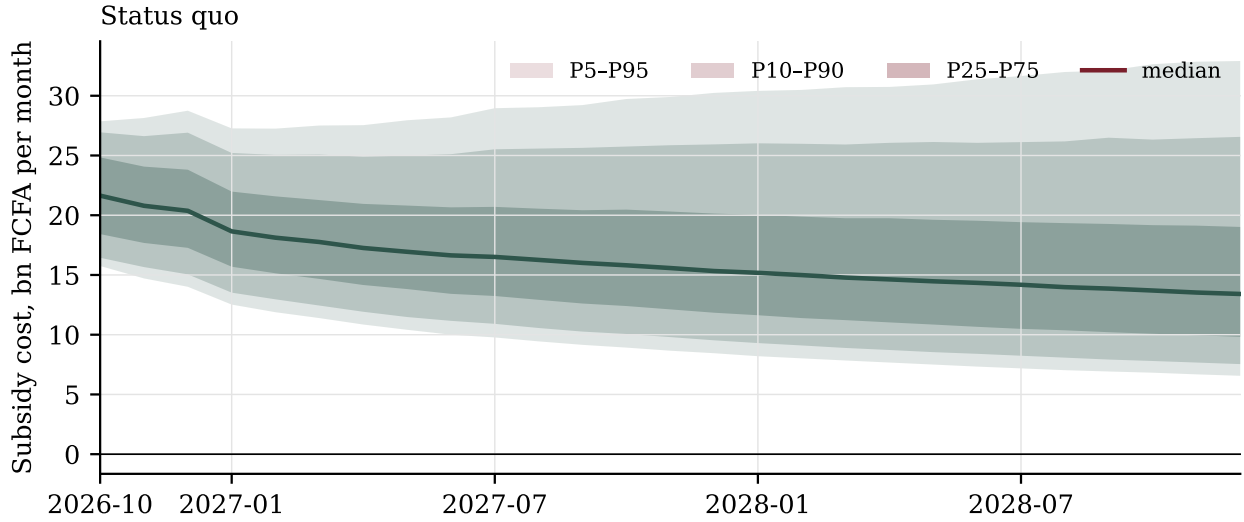


Figure 5. Monthly subsidy cost under the status quo: median and 50/80/90% bands.

Health, indexed. The health envelope receives the saving as it arises, the way the subsidy line followed the fuel price:

$$H_m^{\text{idx}} = S_m^{\pi}. \quad (17)$$

The State's budget is unchanged with respect to the status quo; the oil risk now sits in the health budget.

Health, fixed. The envelope of year y is set in advance at a level $\bar{H}_y$; the Treasury absorbs the difference,

$$H_y^{\text{fix}} = \bar{H}_y, \quad T_y = \sum_{m \in y} S_m^{\pi} - \bar{H}_y, \quad (18)$$

where $T_y < 0$ is a shortfall to be financed and $T_y > 0$ an unallocated surplus. We take $\bar{H}_y$ at a quantile q of the forecast saving, $\bar{H}_y = Q_q(\sum_{m \in y} S_m^{\pi})$, with $q = 50$ (median) or $q = 10$ (prudent). By construction $\Pr(T_y < 0) = q/100$; the informative quantities are the size of the shortfall, $\mathbb{E}[-T_y \mid T_y < 0]$, and the surplus left in the other years.

Households. Under either health rule, households receive no cash: their balance is $-\text{cost}_m^h$, the “without transfer” figures of §12. Health spending is a benefit in kind; its value per inhabitant equals the transfer, H_m/POP , but its incidence across deciles depends on who uses which services and is not modelled.

Two features matter. First, the indexed envelope is large when oil is dear and small when it is cheap: from 2027 to 2028 it falls by more than 25% with probability 32%, which would put recurrent spending such as salaries or medicines at risk. Second, the indexed envelope peaks exactly when households pay most at the pump; a cash transfer would offset that loss, health spending does not.

For the decision. Choosing health over cash is choosing services over compensation: every decile loses 1.8%–4.2% of consumption in cash. Indexing protects the Treasury and exposes health to oil; fixing protects health and exposes the Treasury. A fixed level near the lower end of the forecast (P10) is rarely short and leaves a surplus that could fund a targeted transfer to the poorest.

Table 5. Saving under removal (IDX) and the two health rules, bn FCFA. Indexed: median [P10; P90]. Fixed: level set at the median or at P10 of the forecast saving; mean shortfall when the saving falls short; Treasury balance in the median case.

	Indexed	Fixed at median		Fixed at P10	
	envelope	level	mean shortfall	level	median surplus
Nov–Dec 2026	43 [32; 53]	43	6	32	10
2027	208 [145; 299]	208	40	145	63
2028	175 [105; 310]	175	45	105	70
Nov 2026–Dec 2028	428 [292; 649]	428	86	292	137

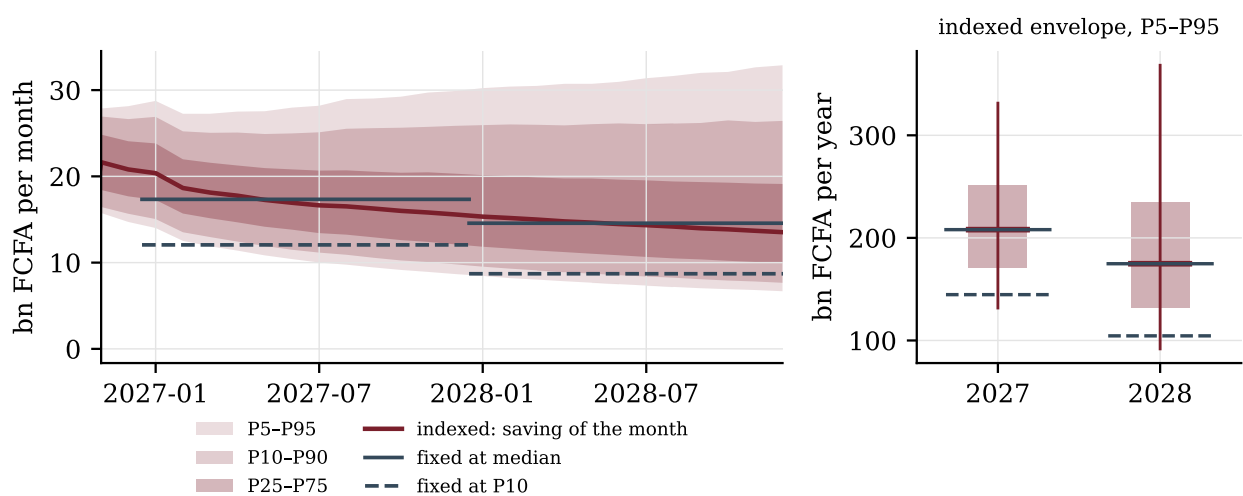


Figure 6. Health envelope under removal (IDX). Left: indexed envelope month by month (median and bands) and the monthly equivalent of the two fixed levels. Right: annual indexed envelope, box P25–P75, whiskers P5–P95, with the fixed levels (solid: median; dashed: P10).

11. Public transport: the national bus company (CNT)

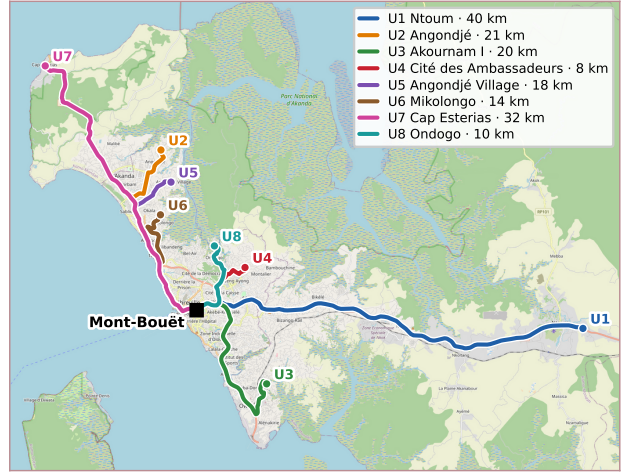
The Compagnie nationale de transport (CNT), formed by merging Sogatra and Trans'Urb, starts with 125 buses, 1,294 staff and 15 lines: 7 intercity lines from Libreville, whose destinations and fares are published, and 8 urban lines in Greater Libreville, run by 45 buses at a 200 FCFA ticket [18, 19, 20]. Its buses run on diesel: removing the subsidy raises its costs, and the State's saving can, conversely, be paid to it. We cost both, line by line.

The lines. Intercity lines are traced on the GIA road graph (OpenStreetMap, fastest path from Mont-Bouët). The 8 urban lines are not published; we *estimate* them. Population comes from the 100 m grid of Greater Libreville (buildings $\times$ people per building, calibrated on the GIA allocation, 2.1 million people in the footprint). Lines are radial from Mont-Bouët; they are chosen one at a time, each time the one

7 intercity lines (published)



8 urban lines (estimated on the GIA road graph)



Basemap: © OpenStreetMap contributors. Routes: OpenStreetMap road graph via GIA (12/09/2026). Urban lines: radial from Mont-Bouët, chosen to serve the most residents within 400 m (population: GIA).

Figure 7. The 15 CNT lines. Left: the 7 published intercity lines, with graph distance and fare. Right: the 8 urban lines estimated on the population of Greater Libreville. Basemap: © OpenStreetMap contributors.

whose terminus adds the most residents within 400 m of the route, with termini at least 3 km apart. The 8 lines serve 542,000 people (26%); even 26 lines serve only 33% (Figure 7).

The cost of each line. For a line ℓ running k_ℓ km a year with consumption c_ℓ (L/km), the diesel bill under policy π is

$$G_{\ell,y}^\pi = c_\ell k_\ell \bar{p}_{g,y}^\pi, \quad \Delta G_{\ell,y} = c_\ell k_\ell (\bar{p}_{g,y}^\pi - 575), \quad (19)$$

where $\bar{p}_{g,y}^\pi$ is the average pump diesel price in year y in one of the three cases (§13). In town, the 45 buses are allocated in proportion to (residents served $\times$ length), run at 15 km/h on average, 14 hours a day, and burn 40 L/100 km. On the road: one departure a day each way, 30 L/100 km and 0.012 L per passenger-km, the household model's assumption, i.e. 25 passengers per departure (38% of seats). If the CNT passed its extra cost on, the fare would become $t_\ell + \lceil \ell_v (\bar{p}_g - 575) \rceil$, rounded up to the step (500 FCFA on the road, 50 in town), ℓ_v being diesel per passenger; this is the coach-fare rule of §12.

What removal costs the CNT. Its diesel goes from about 1.1 to 2.0 bn FCFA a year: an extra 1.0 bn in the median case, 0.7 to 1.5 bn depending on oil (0.6 bn in town, 0.4 bn on the road). On the road, diesel rises from 23%–37% to 44%–72% of the fare: published fares no longer cover the fuel of a coach filled to 38%. Passed on, intercity fares would rise by 2,000 to 4,000 FCFA, and the urban ticket from 200 to 300 FCFA, like the taxi seat.

Table 6. The CNT line by line in 2027 if the subsidy is removed (IDX). Extra diesel cost relative to the status quo, million FCFA a year: median [P10; P90]. Fare: published fare and fare if the extra cost were passed on (median case). Diesel share of the fare: status quo → removal.

Line	km	buses	headway (min)	extra diesel	fare	if passed on	diesel share
<i>Urban, from Mont-Bouët (estimated)</i>							
U1 Ntoun	40	19	20	259 [195; 388]	200	300	41% → 79%
U2 Angondjé	21	5	40	68 [51; 102]	200	300	41% → 79%
U3 Akournam I	20	5	37	68 [51; 102]	200	300	41% → 79%
U4 Cité des Ambassadeurs	8	3	27	41 [31; 61]	200	300	41% → 79%
U5 Angondjé Village	18	3	56	41 [31; 61]	200	300	41% → 79%
U6 Mikolongo	14	2	66	27 [21; 41]	200	300	41% → 79%
U7 Cap Esterias	32	6	50	82 [62; 123]	200	300	41% → 79%
U8 Ondogo	10	2	45	27 [21; 41]	200	300	41% → 79%
<i>Intercity, from Libreville (published)</i>							
Lambaréné	237	2	–	27 [20; 41]	5,000	7,000	33% → 63%
Mouila	431	3	–	49 [37; 74]	8,000	11,000	37% → 71%
Lébamba	540	3	–	62 [47; 93]	10,000	13,500	37% → 72%
Tchibanga	591	3	–	68 [51; 101]	12,000	16,000	34% → 65%
Makokou	560	3	–	64 [48; 96]	12,000	16,000	32% → 62%
Oyem	395	3	–	45 [34; 68]	12,000	15,000	23% → 44%
Bitam	469	3	–	54 [41; 81]	13,000	16,000	25% → 48%

What the saving can pay for. Keeping all CNT fares unchanged costs the extra diesel, 1.0 bn a year, or 0.5% of the median 2027 saving; it is the cheapest use examined here. The CNT's full operating deficit (wages, maintenance, depreciation, minus revenue) would go from 4.9 to 5.9 bn, 2.8% of the saving. A real service, one bus every 10 minutes on the 8 urban lines, needs 157 buses, about 8 bn to buy once and 9 bn of deficit a year. Even that absorbs only a small share of the saving.

Who benefits. With the ticket frozen at 200 FCFA while the taxi seat goes to 300, each bus trip saves about 100 FCFA; at 500 boardings per bus per day, the 45 buses carry 8.1 million trips a year. But only people near a line benefit: about a quarter of Greater Libreville and, on the road, the seven towns served. The rest of the country pays more for diesel with no alternative.

For the decision. Freezing CNT fares costs about 1.0 bn a year, under 1% of the saving, and directly shields bus users from the rise in transport prices, the main expense hit for modest households. This funding should be fixed and multi-year: a fleet must be paid every year, whatever oil does. The effect stays limited to the areas served; extending the network costs mostly buses and drivers, not diesel.

12. Households

The household block applies the rules of the household study [12] to the pump prices of each path and policy. Let $\Delta_m^g = p_m^g - 575$ and $\Delta_m^s = p_m^s - 595$.

12.1 Fares with tiers

A transport fare rises by the fuel cost per seat, rounded *up* to the operator's tier, and never falls below today's fare:

$$\text{fare}_m = \text{fare}_0 + \lceil \ell \Delta_m / k \rceil^+ k, \quad \lceil x \rceil^+ = \begin{cases} \lceil x \rceil & x > 0 \\ 0 & x \leq 0 \end{cases} \quad (20)$$

with ℓ the litres per seat or ticket and k the tier. Shared taxi (Libreville): $\text{fare}_0=200$, $\ell = 0.135$ L of gasoline (6 km, 9 L/100 km, 4 seats), $k = 50$. Taxi-bus: 400, $\ell = 0.10$ L diesel, $k = 100$. *Clando* (informal car): 300, $\ell = 0.18$ L of gasoline, $k = 100$. Intercity coaches (CNT): $\text{fare}_0 = 5,000$ to 12,000, $\ell = 0.012$ L per passenger-km times distance, $k = 500$. Tiers are the reason why a 18-FCFA fuel cost per seat becomes a 50-FCFA fare increase: the household cost is a step function of Δ , which saturates once a tier is passed (§13.3).

12.2 Cooking gas and rice

Cooking gas (12.5 kg) returns to its pre-2024 price when diesel reaches the unsubsidised level: $\text{gas}_m = 5,950$ if $p_m^g \geq 1,080$, else 4,950 (assumption from the 2024 history). The rice surcharge per 22.68 kg bag is proportional to the diesel increase, scaled on the S3 surcharge estimated by the household study's freight model for each province: $\text{rice}_m = \text{rice}^{S3} \cdot \max(\Delta_m^g, 0) / (1,080 - 575)$.

12.3 Household types

Five household types (size, monthly quantities) come from [12]: A modest, Libreville (6 persons; 52 taxi seats); B middle, Libreville (4; 96 taxi seats, 22 taxi-bus trips); C well-off with a car (3; 112 L of gasoline); D rural, Nyanga (5; one return trip per month to the provincial capital, half a gas bottle); E Franceville (5; 60 taxi seats at the Libreville fare, no published local fare). All use one gas bottle per month (D: half), one bag of rice and 2–4 kg of fish. The monthly extra cost and the balance with transfer are

$$\begin{aligned} \text{cost}_m^h &= q_{\text{taxi}}^h (\text{taxi}_m - 200) + q_{\text{tb}}^h (\text{tb}_m - 400) + q_{\text{car}}^h \Delta_m^s + q_{\text{gas}}^h (\text{gas}_m - 4,950) \\ &\quad + (q_{\text{rice}}^h \text{rice}^{S3} + q_{\text{fish}}^h \text{fish}^{S3} + q_{\text{trip}}^h \text{trip}^{S3}) \frac{\max(\Delta_m^g, 0)}{1,080 - 575}, \end{aligned} \quad (21)$$

$$\text{net}_m^h = n^h \tau_m^\pi - \text{cost}_m^h. \quad (22)$$

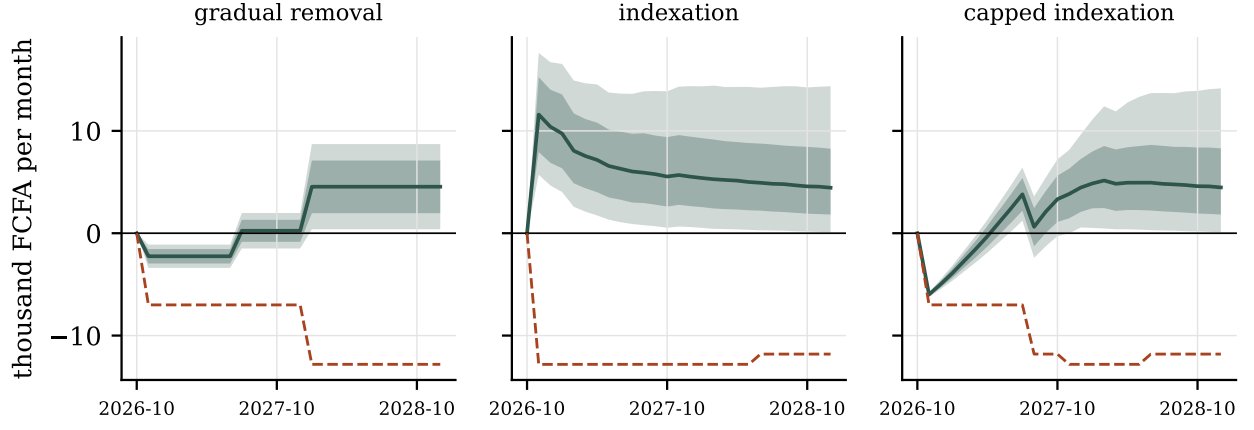


Figure 8. Middle household B (Libreville, 4 persons): monthly balance with transfer (median, 50 and 80% bands, green) and extra cost without transfer (median, dashed), by policy.

12.4 Deciles

For consumption decile j , the loss in percent of consumption over a period T combines direct fuel use, gas and indirect effects:

$$L_j = s_j^{\text{fuel}} \frac{1}{2} \left(\frac{\bar{\Delta}^g}{575} + \frac{\bar{\Delta}^s}{595} \right) + s_j^{\text{gas}} \bar{t}_{\text{gas}} \left(\frac{5,950}{4,950} - 1 \right) + \frac{\bar{\Delta}^g}{1,080 - 575} \sum_k \omega_k \delta_k^{S3}, \quad (23)$$

where bars are means over the months of T ; s_j^{fuel} and s_j^{gas} are budget shares of fuels and butane by decile (World Bank 2023, read from a chart); ω_k are CPI weights (INStat, base 2018) of transport services, electricity–water and food; δ_k^{S3} the sector price increases under full removal (World Bank 2023). The transfer share is $12 \bar{\tau}/c_j$, with c_j the mean consumption per head of decile j (EGEP 2017, FCFA of 2017). The balance is the transfer share minus L_j .

For the decision. Fare tiers, not oil, set what most households pay: the taxi seat jumps by 50 FCFA as soon as the pump price rises, then stays at 300 FCFA even in the worst case. A published fare formula that passes on the actual fuel cost per seat would remove most of that jump.

13. Summaries, scenarios and the three cases

13.1 Quantiles of outputs

Every reported interval is a quantile of an *output* over the N paths: e.g. the P90 of the 2027 cost is the 90th percentile of $\{\sum_{m \in 2027} C_{m,i}^{\text{SQ}}\}_{i=1}^N$. It is *not* the cost computed along the path whose Brent is at its P90. The two differ because the cost also depends on EUR/USD, product ratios and V : here, the P90 of the 2027 cost is 298 bn, while paths around the P90 of the 2027 mean Brent cost 280 bn (correlation 0.79). Fans (Figures 2–5) are month-by-month quantiles; a fan is not a path.

13.2 Scenarios

A table of everyday prices needs internally consistent values (a fare, a household balance and a budget cost from the same world). We therefore define scenarios as sets of paths. Paths are ranked by one named quantity, the cumulative status-quo cost from November 2026 to December 2028, $Q_i = \sum_m C_{m,i}^{SQ}$. With rank $r_i \in [0, 1]$, scenario Pq is

$$\mathcal{S}_q = \{ i : |r_i - q/100| \leq 0.025 \}, \quad |\mathcal{S}_q| = 1,000, \quad (24)$$

and each reported cell is the median of the output over $\mathcal{S}_q$. The same paths are followed through 2026, 2027 and 2028. The ranking quantity is the budget exposure, which is what makes a world “good” or “bad” for the State and, under removal, for consumers.

13.3 Three cases

The household report uses P10 (best case: one chance in ten of a more favourable outcome), P50 (median) and P90 (worst case: one chance in ten of worse); P5 and P95 are given in an annex. Their cumulative status-quo costs are 280, 420 and 650 bn FCFA. Table 7 shows the key lines under removal (IDX).

Table 7. Three cases under removal (IDX). Prices in December of each year; household figures are monthly means over the year (2026: Nov–Dec). FCFA.

	End 2026			2027			2028		
	best	med.	worst	best	med.	worst	best	med.	worst
Brent, \$/bbl (mean)	101	108	118	66	85	120	43	67	120
Diesel, FCFA/L	1,285	1,310	1,345	975	1,105	1,370	890	1,035	1,355
Gasoline, FCFA/L	1,225	1,250	1,280	1,000	1,100	1,305	940	1,040	1,285
Shared taxi seat	300	300	300	300	300	300	250	300	300
Clando	500	500	500	400	400	500	400	400	500
Coach to Oyem	15,500	16,000	16,000	14,000	15,000	16,000	14,000	14,500	16,000
Gas bottle	5,950	5,950	5,950	4,950	5,950	5,950	4,950	4,950	5,950
A modest: extra cost	6,200	6,200	6,200	5,500	6,100	7,100	3,700	5,600	7,100
with transfer	23,500	29,900	35,800	15,600	23,700	34,500	11,400	19,500	36,300
C with car: extra cost	73,800	75,500	77,700	54,900	64,700	80,800	41,400	54,200	80,700
with transfer	−58,900	−57,000	−57,000	−44,700	−49,900	−59,500	−34,000	−41,800	−58,500
Transfer, per head/yr	59,500	72,800	84,400	42,200	59,700	83,300	30,500	50,000	87,300
SQ cost avoided, bn	33	42	49	142	205	294	105	173	306

Two mechanisms explain the table. (i) *Saturation*: by (20) the extra cost of households that do not drive is a step function of the pump price; once the first tier is passed (end 2026, when Brent starts high),

further oil increases barely move it. The State's exposure has no such ceiling. (ii) *Co-movement of the transfer*: $\tau^{\text{IDX}} = C^{\text{SQ}}/\text{POP}$ grows with the oil price, so with the transfer the worst oil case is the best case for poor households; without it, every household is worse off in the worst case.

For the decision. Read every figure as a range. The “worst case” is not a catastrophe scenario but one chance in ten; one year in ten will be worse than that.

14. Validation

14.1 Rolling-origin coverage test

For each month-start origin o from January 2000 to July 2024 (295 origins), we (a) estimate parameters on data before o only (M2 refitted each January), (b) simulate 2,000 daily paths over 27 months of 21 business days, centred on the spot at o (no free history of the futures curve exists, so the centre is flat — a declared limitation), (c) compute the probability integral transform of the realised monthly mean,

$$\text{PIT}_{o,h} = \frac{1}{N} \sum_i \mathbf{1}\{\bar{B}_{o,h}^{(i)} < \bar{B}_{o+h}^{\text{obs}}\}, \quad h = 1, \dots, 27. \quad (25)$$

A calibrated model gives uniform PITs, and the share of PITs within $[(1-c)/2, 1 - (1-c)/2]$ should equal c .

Table 8. Empirical coverage of the central intervals, by dynamics and horizon (295 origins, 2000–2024).

Dynamics	Nominal	1–3 m	4–12 m	13–27 m	All
M1 random walk, const. vol.	50%	57%	54%	49%	51%
	80%	82%	82%	80%	81%
	90%	89%	89%	91%	90%
M2 random walk, GARCH- t	50%	47%	47%	45%	46%
	80%	77%	77%	77%	77%
	90%	86%	88%	91%	89%
M3 reversion + GARCH- t	50%	47%	45%	42%	44%
	80%	76%	74%	71%	73%
	90%	86%	87%	84%	85%

M1 is the best calibrated overall: pooled over horizons, its 50/80/90% intervals contain 51/81/90% of realisations, against 46/77/89% for M2 and 44/73/85% for M3 (Table 8). It is not the best everywhere: at 1–3 months its 50% interval is slightly too wide (57%), where M2 is closer to nominal (47%). M2 and M3 are too narrow at the 50 and 80% levels, M3 markedly so at long horizons, where its reversion pulls the distribution toward the past level; this is consistent with the persistent level shifts of the period (2000s

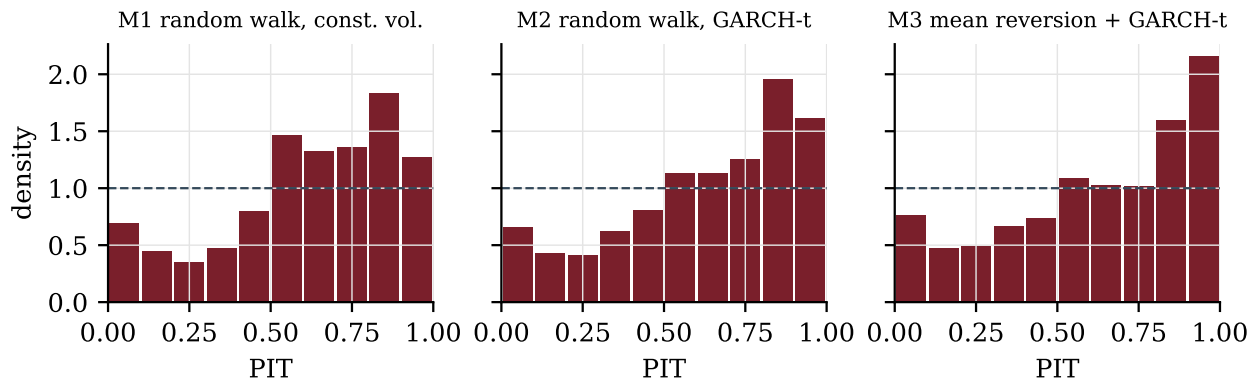


Figure 9. PIT histograms at horizons 13–27 months. Dashed: uniform density.

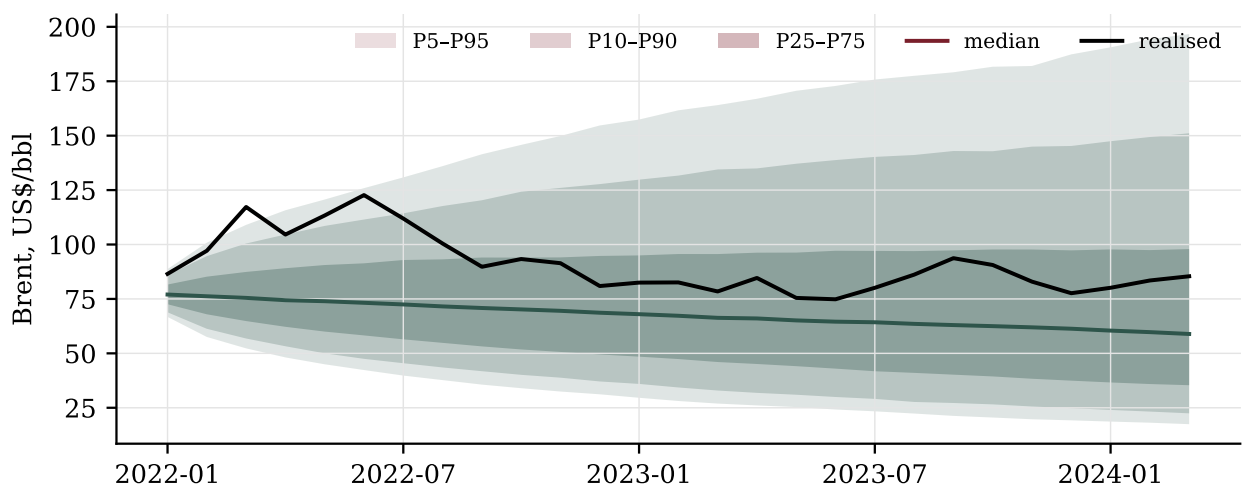


Figure 10. Forecast made on 31 December 2021 with M1 against the realised Brent.

commodity boom, 2014 and 2020 collapses). Despite variance ratios below one, mean reversion does not pay out of sample. The PIT histograms (Figure 9) are not uniform for any model: realisations fall more often in the upper half, which is consistent with the upward trend of 2000–2008. M1 still covers the period best.

14.2 A retrospective case: 2022

Starting on 31 December 2021 (spot \$77.24), M1 with the then five-year volatility (51%) places 26 of 27 monthly means of 2022–2024 within its 90% interval; only March 2022, the first month of the war in Ukraine, falls outside (Figure 10).

14.3 Chain back-cast

With V_{24} and observed prices, the chain gives 2021 and 2022 costs consistent with announced amounts, but half of the September 2026 announcement (Figure 4). This is the main unexplained element of the

model.

For the decision. The ranges are trustworthy: over 25 years they contained the realised oil price about as often as they claim. The level of the bill is less certain: the model explains half the cost announced for September 2026, so the status-quo bill, and the saving, may be larger than shown.

15. Limitations

- **Futures as expectations.** Futures include risk premia and convenience yields; centring on them assumes these are small relative to the price uncertainty.
- **Constant fixed term K .** Freight, margins and taxes are held at their December 2023 FCFA value. Freight and insurance rose during the 2026 crisis; this biases the parity, and hence the cost, downward.
- **Volume and diesel share.** V is uncertain by a factor 1.9; $w = 0.60$ has no source.
- **No quantity response.** Households and transporters do not consume less when prices rise: the status-quo cost and household extra costs are upper bounds in that respect.
- **Flat centre in the backtest.** The coverage test centres on the spot, not on the (unavailable) historical futures curve.
- **Low tail in 2028.** Under M1, 10% of paths have a 2028 mean Brent below \$34; the five-year volatility includes 2020.
- **Health.** The value of health spending to households, its incidence by decile and the sector's capacity to absorb an extra 208 bn a year are not modelled. The 377 bn health budget is the figure of the 2026 draft finance law; we found no confirmation in the final or amended law.
- **CNT.** The 8 urban lines are estimated, not published; consumption, ridership, wages and bus prices are assumptions (§11); the GIA population in the Greater Libreville footprint (2.1 million) is probably high, so shares are safer than head counts.
- **Household data.** Decile budgets are in FCFA of 2017 (EGEP), several shares are read from charts, and the transfer is hypothetical.

Unsourced assumptions. Diesel share $w = 0.60$; constant K ; half-life of the initial premium (21 business days); October–November centred on the December contract; PROG calendar; cap $c = 5\%$; gas at 5,950 when diesel $\geq 1,080$; V uniform between the two calibrations; fixed health levels at the median and at P10 of the forecast saving; for the CNT: routes of the 8 urban lines, 40 and 30 L/100 km, 15 km/h, 500 boardings per bus per day, 150 FCFA per boarding, 150 FCFA/km maintenance, 300,000 FCFA per staff member per month, 75 million FCFA per bus.

16. Consequences by decision

Keep prices. The bill is 203 [139; 298] bn FCFA in 2027 and 173 [102; 310] bn in 2028 (median [P10; P90]); the mean Brent of 2027 has median \$86, above published forecasts of \$70–84 [1, 6, 7, 8]. Nothing caps the bill; households see no change.

Remove, with an equal cash transfer. Diesel ends 2027 at about 1,105 FCFA; the State's bill falls close to zero and each inhabitant receives about 5,000 FCFA a month. The modest Libreville household keeps +23,700 FCFA a month; 8 deciles out of 10 gain; the household with a car loses 49,900 FCFA. The transfer does not exist today.

Remove, saving to health. The same prices, without compensation: the modest household pays 6,100 FCFA a month more (from 5,500 in the best case to 7,100 in the worst), the household with a car 64,700. Indexed, health receives 208 bn in 2027 and 175 bn in 2028, in a wide range; fixed, it receives a stable amount and the Treasury carries the gap (§10).

Remove in steps or with a cap. Both spread the price rise and keep part of the bill in 2027 (139 and 94 bn); both are close to full removal in 2028.

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- [20] Gabon Media Time, “Gabon : le lancement de la CNT attendu à quelques jours de la rentrée”, September 2026.

A. Reproduction

Seed 20261011 for the oil paths, seed+1 for product shocks and V ; $N = 20,000$. In `previsions/`: `validation.py` (coverage test, §14), `simulation.py` (full chain), `tableaux.py` and `build.py` (French report), `technique/calculs.py`, `technique/figures_en.py` and `cnt/lignes.py` and `cnt/couts.py` (CNT lines and costs, GIA road graph read-only), `technique/article.py` (this note). Python 3.11, NumPy, SciPy, pandas, Matplotlib; the GARCH likelihood (Bollerslev [13]), the variance ratio (Lo and MacKinlay [14]) and the PIT (Gneiting et al. [17]) are implemented directly.