

The 24-Hour Economy

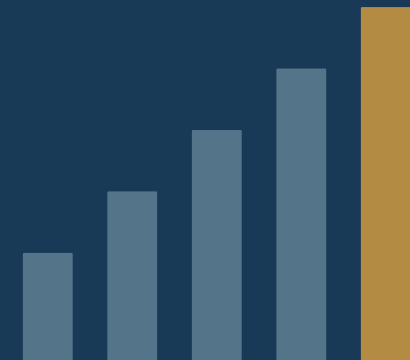
Measuring Additional Production and Employment

Capacity. Energy. Demand. Work. Additionality.

Commissioning institution: Institute of Development and Economic Research (IDER)

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2026 programme records | scenarios

About this publication

Independent research • transparent evidence • reproducible calculations

TITLE AND SERIES

The 24-Hour Economy: Measuring Additional Production and Employment

IDER's Ghana Macroeconomic Policy and Business Intelligence Briefings

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RESPONSIBILITY AND INTERPRETATION

Independent IDER research; citations imply no endorsement. No national causal effect, realised job total or investment return is estimated. Labour and tariff examples are not case-specific legal advice.

DATA, CODE AND ENQUIRIES

Source transcriptions, assumptions, numerical outputs, editable exhibits and code are supplied. External source PDFs are not bundled; source URLs, dates and locators are retained. Research: info@iderafrica.com.

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Report pages and slide numbers match; entries link to their destinations.

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Test additionality at the plant, worker and market levels

Three connected accounts; the number of shifts is an input, not an outcome.

01 PHYSICAL PRODUCTION

Separate scheduled hours from machine runtime, good output, inventories and orders. Estimate what the same plant could have delivered without the extra shift.

02 WORK AND INCOME

Count unique workers and paid hours separately. Track hires, exits, wage premiums, benefits and rest. An extra work period does not necessarily mean an extra person employed.

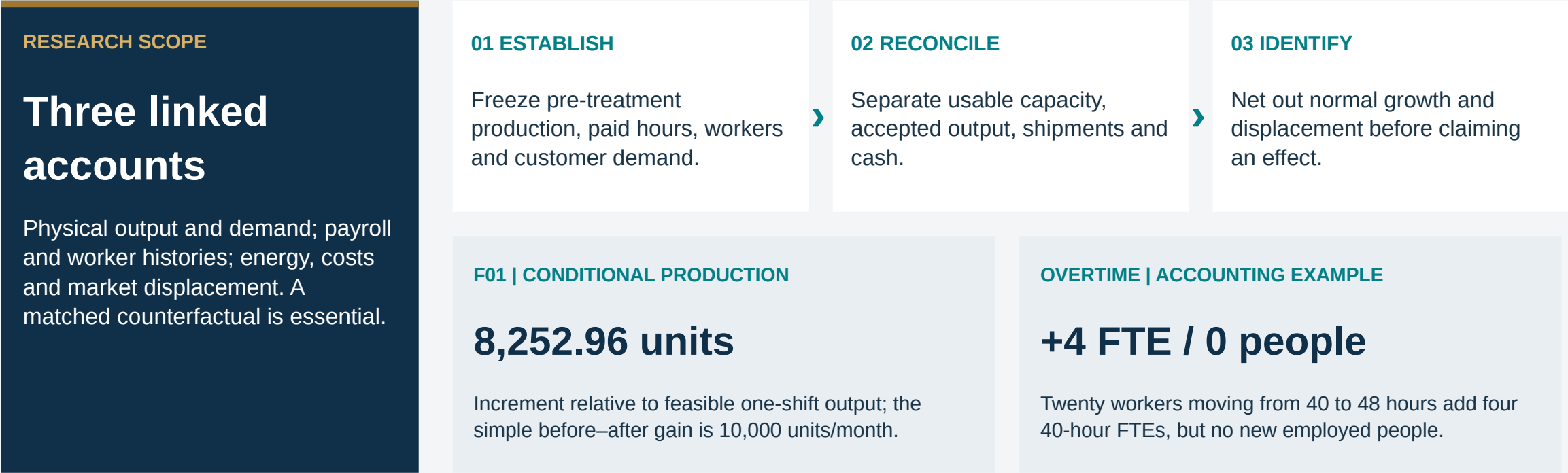
03 NET ECONOMIC CHANGE

Follow customers and suppliers. Distinguish new demand, import substitution, domestic displacement and time reallocation; measure value added rather than summing turnover.

Sources: IDER calculations [\[S99\]](#).

Count additional output and workers—not extra opening hours

Research question: when do additional shifts create production and jobs rather than redistribute existing activity?



Sources: NPA pilot release [\[S03\]](#); World Bank Ghana ES [\[S06\]](#); Hardy–McCasland, WPS 9093 [\[S15\]](#); IDER calculations [\[S99\]](#).

Note: Historical source statistics and conditional enterprise examples are distinct. No national 24H+ treatment effect or job total is estimated.

Capacity, demand and employment require separate evidence

For enterprise executives, workers, MoF, BoG, investors, logistics providers and programme evaluators.

01 | SELLABLE OUTPUT

8,252.96

F01 additional units/month

At 23,000 units of demand, the one-shift counterfactual can supply 14,747.04; two shifts supply 23,000.

VERIFY: orders, quality and baseline capacity

02 | OPERATING CASE

GHS 95,927

F01 incremental surplus/month

Base working-capital finance reduces this to GHS 82,816.83. At 18,000 demand, the financed result is –GHS 2,990.46.

VERIFY: contribution and cash timing

03 | EMPLOYMENT

People ≠ FTE

A 40-hour measurement convention

Report unique workers, total hours and job duration. Reassignment, overtime and job-to-job moves are not automatically net jobs.

VERIFY: payroll, hours, hires and exits

Sources: World Bank Ghana ES [\[S06\]](#); IDER calculations [\[S99\]](#).

Note: F01 values are conditional monthly calculations, before taxes and one-off setup. No enterprise outcome is claimed from these examples.

A 180-day measurement programme with explicit release gates

Proposed sequence after data access, worker safeguards and institutional approval.

DAYS 0–30	DAYS 31–90	DAYS 91–180
PROPOSED OWNER Firms / workers / data custodians Define the plant, shift, worker and market boundaries. Register baseline demand, operating hours and the rollout rule. ACCEPTANCE TEST Every included unit has a baseline, identifier, source and exposure status.	PROPOSED OWNER Operators / utilities / IDER Link shift logs, meter data, payroll, orders and market peers. Include non-takers, closures and missing outcomes. ACCEPTANCE TEST Publish row and value coverage; reconcile output, hours and cash balances.	PROPOSED OWNER IDER / independent methods reviewer Estimate supported comparisons and market spillovers. Publish uncertainty, attrition sensitivity and a plain-language brief. ACCEPTANCE TEST Independent replay; publish descriptive results when causal assumptions fail.

Sources: IDER calculations [\[S99\]](#).

Note: Design milestones are not commitments by named institutions or promises of measured programme success.

Abbreviations and reading terms

Read the unit, population and time basis before comparing indicators.

24H+	24-hour economy and accelerated export development programme.
MoF / BoG	Ministry of Finance / Bank of Ghana.
GSS / GRA	Ghana Statistical Service / Ghana Revenue Authority.
ECG / NEDCo	Electricity Company of Ghana / Northern Electricity Distribution Company.
GRIDCo / PURC	Ghana Grid Company / Public Utilities Regulatory Commission.
NPA / SSNIT	National Petroleum Authority / Social Security and National Insurance Trust.
FTE / HC	Full-time-equivalent hours / distinct worker headcount.
VA / GDP	Value added / gross domestic product; not gross sales.
MW / MWh	Megawatt of power / megawatt-hour of energy.

kWh / GHp	Kilowatt-hour / Ghana pesewa; 100 GHp = GHS 1.
SLT / MV	Special load tariff / medium voltage.
SAIFI / SAIDI	Average interruption frequency / duration per customer.
A / P / Y	Availability / performance / good-output yield in the capacity model.
DiD / ATT	Difference-in-differences / average treatment effect on the treated.
ITT / ICC	Intention-to-treat / intracluster correlation.
MDE / NWC	Minimum detectable effect / net working capital.
MAR / MNAR	Missing at random / missing not at random; assumptions, not observations.
pp / %	Percentage points / percent; GHS is the Ghana cedi.

How to interpret the evidence

No figure changes category simply because it appears in an infographic.

OFFICIAL PROGRAMME RECORD

Assent, launch, reported operating snapshot or budget target. Operator reports are not independently verified net effects.

HISTORICAL SOURCE ESTIMATE

Published survey, electricity statistic or historical fitted coefficient; original period, population and source assumptions retained.

PUBLISHED TARIFF / LAW

Dated official rate schedule or statutory provision; eligibility, contractual terms and applicable exceptions remain essential.

CONDITIONAL ENTERPRISE

Assumed production rate, demand, staffing and costs. Numerical outputs are reproducible scenarios, not firm observations.

ACCOUNTING ADDITIONALITY

Change net of an explicitly specified counterfactual and boundaries. Its arithmetic does not validate those assumptions.

PROSPECTIVE CAUSAL DESIGN

Requires data and assignment evidence. No original programme coefficient is fitted; historical estimates retain their separate source status.

List of figures

Numbered figures link to their analytical pages; green identifiers and page numbers follow the IDER master.

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Production, capacity and additionality

Definitions of key technical terminology — meaning, measurement and interpretation.

Additionality

Output or work above a stated without-intervention alternative, measured for the same unit and period. F01 adds 8,252.96 units relative to feasible one-shift output, not the 10,000-unit before–after gain.

Counterfactual

What the same plant, workers or market would have produced without the added shift or support. It must allow existing spare capacity and common demand; a plausible calculation is not causal proof.

Baseline and before–after change

The baseline records the starting position. A later-minus-earlier difference can include demand growth, spare-capacity use and other shocks. The earlier observation is not automatically the counterfactual.

Capacity utilisation

Use of a stated capacity denominator. Running hours divided by scheduled hours differs from running hours divided by calendar hours; neither ratio alone measures accepted output or customer demand.

Effective good-output capacity

$\text{Scheduled hours} \times \text{rated units per hour} \times \text{availability} \times \text{performance} \times \text{good-unit yield}$. Availability captures usable time, performance captures speed, and yield excludes rejects; losses must not be counted twice.

Bottleneck

The stage that limits completed output across compatible production or logistics capacities. In the depot example, a larger gate capacity adds no dispatches while truck capacity remains the binding limit.

Sources: IDER calculations [\[S99\]](#).

Note: Reading definitions do not establish legal status, operational payment instructions or causal effects.

Demand, value added and market effects

Definitions of key technical terminology — meaning, measurement and interpretation.

Demand-supported output

Good output that can meet accepted orders within production, input and logistics limits. At the assumed 23,000-unit demand, a third F01 shift adds capacity but no additional sales.

Production, shipments and inventories

Goods made, goods dispatched and stocks held are separate records. Opening stock plus good production reconciles to shipments, losses and closing stock. More unsold inventory is not more cash collected.

Constant-price value added

Output value less intermediate goods and services used, valued on a common price basis. Wages are part of value added. Summing supplier and buyer turnover would count intermediate transactions twice.

Time substitution and cumulative addition

Activity moves between hours or months rather than increasing over the full evaluation period. Track cumulative output: clearing a backlog earlier can be followed by lower production later.

Domestic displacement

A participating business gains sales or work that another domestic business loses. Net market addition deducts the counterfactual loss within a stated geography; a gross site gain is not a national gain.

Spillover and import substitution

A spillover changes outcomes at other firms, workers or markets. Import substitution replaces imports with domestic production. Both require domestic value-added accounting; neither guarantees new final demand.

Sources: SNA production accounting [\[S13\]](#); IDER calculations [\[S99\]](#).

Note: Reading definitions do not establish legal status, operational payment instructions or causal effects.

Workers, hours and employment duration

Definitions of key technical terminology — meaning, measurement and interpretation.

Headcount and employment relationships

Headcount counts unique people; employment relationships count jobs held with employers. One person may hold more than one job. Deduplicate identities before combining sites or describing national employment.

Full-time equivalent (FTE)

Hours divided by a stated full-time reference. Here, 20 workers moving from 40 to 48 hours produce 24 FTEs but still 20 people. Paid and actual hours require separate, consistent definitions.

Job-year

One full-time-equivalent job sustained for one year. Eight additional FTEs sustained for six months equal four job-years. A short pilot does not establish permanent employment or an annual job total.

Gross recruitment and net employment

New hires are an inflow, not the net change. Account for exits, previous employment and vacancies at originating firms. A job-to-job move cannot by itself establish national job creation or loss.

Roster coverage

Workers needed to cover an operating position after allowing for usable working hours and absence. The report's 168-hour example requires an integer minimum of five; this alone does not prove a compliant roster.

Loaded labour cost

The employer's labour expense, including basic pay, assumed shift premium and employer contribution. Employee deductions are not extra employer costs. Transport, security and maintenance are separate items.

Sources: Labour Act 651 [\[S09\]](#); IDER calculations [\[S99\]](#).

Note: Reading definitions do not establish legal status, operational payment instructions or causal effects.

Electricity supply, reliability and metered costs

Definitions of key technical terminology — meaning, measurement and interpretation.

Power and energy: MW versus MWh

Power is the rate of electricity delivery; energy is its use over time. One MW sustained for one hour is one MWh, or 1,000 kWh. Capacity in MW cannot be added to annual consumption in GWh.

Installed and dependable capacity

Installed capacity is the rated generation capability; dependable capacity is the source's stated available capability. Neither alone establishes fuel availability, transmission access or electricity at a particular factory.

System peak and feeder-level supply

System peak is the highest recorded system demand for a stated period. A factory's feeder has its own delivery limits and outages. Annual capacity minus peak is not guaranteed spare night-time supply.

SAIFI and SAIDI

SAIFI describes average interruption frequency per customer; SAIDI describes average interruption duration per customer over a stated period. Preserve the source coverage and units; these are not plant-specific uptime logs.

Energy charge and total electricity bill

The energy charge prices metered kWh; service, demand and other applicable charges can be additional. Convert pesewas to cedis before costing. Do not assume every existing fixed charge rises with an added shift.

Generation and consumption

Generation measures electricity produced; consumption measures its use within the source boundary. Trade and system losses can separate them. Annual industrial consumption does not measure night-shift output.

Sources: Energy Commission 2026 bulletin [\[S07\]](#); PURC Q3 2026 tariffs [\[S08\]](#); IDER calculations [\[S99\]](#).

Note: Reading definitions do not establish legal status, operational payment instructions or causal effects.

Contribution, break-even and working capital

Definitions of key technical terminology — meaning, measurement and interpretation.

Unit contribution

Net selling price less variable cost per additional good unit, including the specified material and energy costs. Positive contribution helps cover fixed shift costs; it is not the same as net profit.

Incremental operating surplus

Additional earned revenue less matching additional operating expenses relative to the counterfactual. The F01 measure precedes financing, setup and taxes. Actual cash receipts belong in a separate cash account.

Operating and financed break-even

The extra volume needed to cover the modelled costs. F01 requires 3,136.85 additional units before working-capital finance and 3,427.21 with it. Neither threshold includes every project tax or capital charge.

Net working capital (NWC)

Receivables plus inventories less operating payables tied to the added activity. It is a funding stock, not another operating expense. The assumed F01 base case needs GHS 629,288.20 before customers settle.

Receivable, inventory and payable days

Time ratios connecting sales, stocks and supplier credit to funding needs. The model uses a 30-day month and material-only supplier credit. Its 45-day collection period is an assumption, not an observed delay.

Financing cost and liquidity

Financing cost is the charge for using funds over time; liquidity is cash available when payments fall due. An operating surplus can coexist with a cash shortfall. Do not deduct the NWC stock again as interest.

Sources: IDER calculations [\[S99\]](#).

Note: Reading definitions do not establish legal status, operational payment instructions or causal effects.

Causal identification and treatment effects

Definitions of key technical terminology — meaning, measurement and interpretation.

Causal identification

Evidence and assumptions that separate the intervention's effect from what would otherwise have happened. A programme launch, extra shift or positive coefficient is not sufficient without a credible comparison.

Endogeneity

Participation, operating hours and outcomes may respond to the same demand, financing or energy shocks. A regression can then confuse selection or reverse causation with an effect of additional-shift support.

Difference-in-differences and parallel trends

DiD compares changes between treated and comparison groups. Its causal interpretation requires defensible untreated-trend, timing and other assumptions. Similar pre-trends or a non-significant test do not prove them.

Fixed effects

Controls for stable unit differences and common time shocks in the specified model. They do not automatically remove changing confounders, spillovers or selective reporting. Historical fixed-effects estimates retain their own scope.

ATT and treatment cohorts

ATT is the average treatment effect for treated units. A cohort groups units first treated at the same time. Cohort- and horizon-specific effects require observed outcomes and valid comparisons, not assumed scenario rows.

Intention-to-treat and uptake

An intention-to-treat effect compares units by assignment to an offer, whether or not they take it up. The effect of actual participation requires further assumptions; the two effects must not be substituted.

Sources: [\[S11\]](#); [\[S12\]](#); [\[S15\]](#); [\[S99\]](#).

Note: Reading definitions do not establish legal status, operational payment instructions or causal effects.

Population coverage, selection and spillover exposure

Definitions of key technical terminology — meaning, measurement and interpretation.

Reporting perimeter

The included plants, workers, products, geography and time window. A participating-site total differs from a domestic-market effect. Unlike physical units and overlapping transactions cannot be added without reconciliation.

Selection and survivorship

Participating or still-operating firms may differ from non-participants and closures. A baseline eligible-unit roster is needed to see those omissions. Observed successful sites do not represent the whole programme.

Attrition and differential response

Attrition is loss of observations over time; differential response means unequal observation rates across groups. Missing stressed firms or unpaid workers can change a comparison. Keep counts, reasons and baseline status.

MAR and MNAR

Under missing at random, observed predictors account for response-related outcome differences. Under missing not at random, unobserved outcomes still affect response. Weighting does not automatically resolve the latter.

Common support and positivity

Comparable units must exist at the relevant treatment exposures, and each required observation or assignment must have a positive probability. Estimates outside the observed overlap require additional assumptions.

Control-group contamination

Comparison units may be affected through shared customers, workers, suppliers or electricity networks. Record that exposure instead of calling them untreated. Direct and spillover effects answer different questions.

Sources: IDER calculations [\[S99\]](#).

Note: Reading definitions do not establish legal status, operational payment instructions or causal effects.

Statistical uncertainty, precision and scenario limits

Definitions of key technical terminology — meaning, measurement and interpretation.

Standard error and clustering

A standard error measures sampling uncertainty under a model and design. Clustered inference allows related observations to move together. Many firms within a few shared-shock groups do not supply many independent clusters.

Confidence interval and pointwise coverage

An interval procedure describes repeated-sample coverage under its assumptions. A pointwise interval covers one coefficient, not all displayed effects jointly. The historical intervals here are approximate reconstructions.

Statistical power and minimum detectable effect

Power is the chance of detecting a specified effect under an assumed design. The minimum detectable effect meets a chosen power target. The report's finite-cluster calculations are planning scenarios, not observed impact.

Intraclass correlation and design effect

Intraclass correlation measures similarity within a group. A design effect scales variance relative to a stated independent-observation design. Losing whole clusters is different from losing firms within surviving clusters.

Partial-identification bounds

A range of values compatible with stated outcome limits and missingness assumptions. It need not reflect sampling uncertainty. In the report's conditional contrast, bounds of -6 to $+24$ do not establish a positive effect.

Sensitivity range and rounding residual

A sensitivity range varies declared inputs; it is not a forecast probability or confidence interval. A rounding residual compares displayed totals and components; it is not usable energy or a new observation.

Sources: Hardy–McCasland, WPS 9093 [\[S15\]](#); IDER calculations [\[S99\]](#).

Note: Reading definitions do not establish legal status, operational payment instructions or causal effects.

Five outcomes require five separate denominators

The unit of analysis must be fixed before a site joins the study.

Table 1. Five outcomes require five separate denominators

Question	Preferred measure	Required evidence
Additional production	Good output and constant-price value added above a credible counterfactual.	Shift log, production balance and comparable untreated trajectory.
Additional work	Distinct people, paid/actual hours and duration-adjusted job-years.	Deduplicated payroll, timesheets, hires and exits.
Commercial feasibility	Incremental operating surplus and cash requirement.	Orders, costs, payroll, energy bills and collection dates.
Energy feasibility	Coincident feeder capacity, reliability and metered cost.	Interval demand, outage logs and applicable customer tariff.
Net economic effect	Domestic addition after spillovers and displacement.	Market peers, suppliers, worker transitions and consistent boundaries.

Sources: IDER calculations [\[S99\]](#).

An activity can move without increasing aggregate output

Use the same product, geography and evaluation horizon.

Table 2. An activity can move without increasing aggregate output

Mechanism	What changes	How to classify it
Time substitution	Customers buy at night instead of during the day.	No extra period-wide quantity; access or convenience can still improve.
Firm displacement	A participating outlet gains customers from another domestic outlet.	Gross site gain exceeds net market gain.
Intertemporal shift	A backlog is cleared now but later work falls.	Report cumulative output across an adequate horizon.
Import substitution	Domestic production replaces imports.	Separate domestic VA from unchanged final consumption.
New final demand / exports	More accepted output is sold without corresponding domestic losses.	Candidate additionality; verify prices, quantities and counterfactual.

Sources: IDER calculations [\[S99\]](#).

Production, sales, inventories and cash are not interchangeable

A plant may create output before receiving payment, but unsold stock is not proof of sustainable demand.

Table 3. Production, sales, inventories and cash are not interchangeable

Account	Reconciliation	Interpretation
Physical units	Opening stock + good production = shipments + losses + closing stock.	Adjust returns and transfers; do not count reworked items twice.
Revenue	Matched quantity × net unit price, with quality and product mix controlled.	Nominal sales growth includes price effects.
Value added	Output value less intermediate consumption.	Employee compensation is part of VA, not another intermediate input.
Cash	Opening cash + actual receipts – cash payments = closing cash.	Credit sales and inventory accumulation can consume finance.

Sources: SNA production accounting [\[S13\]](#); IDER calculations [\[S99\]](#).

Institutional milestones are observable; effects require a different dataset

Information cut-off: 28 September 2026.

Table 4. Institutional milestones are observable; effects require a different dataset

Date	Primary-source record	Evidence status
13 November 2025	2026 Budget describes programme target and allocation.	Prospective budget and programme intention.
19 February 2026	Presidency announces assent establishing the Authority.	Institutional event; not additional production.
12 May 2026	NPA announces downstream pilot launch and selected coverage.	Pilot launch; site-level outcomes not supplied.
22 July 2026	NPA reports selected depot visits and operators' shift/throughput statements.	Attributed operating snapshots; no matched baseline or net job estimate.
At this publication cut-off	No linked treated/comparison production–worker panel obtained.	National or pilot causal effect remains unestimated.

Sources: [\[S02\]](#); [\[S03\]](#); [\[S04\]](#); [\[S14\]](#); [\[S99\]](#); see source register.

A target and a budget allocation cannot be combined into a realised cost per job

Different time windows and cost boundaries prevent that calculation.

Table 5. A target and a budget allocation cannot be combined into a realised cost per job

Record	Published amount / horizon	What it does not establish
Government jobs target	Over 1.7 million decent jobs by 2028.	No independently estimated net job total or additionality ratio.
2026 implementation allocation	GHS 110 million in the 2026 Budget.	Not actual disbursement, total public support or complete programme cost.
Additionality denominator	Net attributable job-years for the matched cost period.	Unavailable from a target and an allocation alone.

Sources: MoF 2026 Budget [\[S04\]](#); IDER calculations [\[S99\]](#).

Note: Amounts are attributed programme/budget statements. The report neither endorses nor evaluates attainment of the target.

The first pilot identifies sites to follow—not verified new jobs

NPA release of 12 May 2026; the stated first phase is six months.

Table 6. The first pilot identifies sites to follow—not verified new jobs

Facility type	Announced coverage	Measurement needed
Fuel stations	268	Period-wide fuel volumes, opening hours, payroll and nearby station sales.
Depots	8	Dispatched throughput, truck cycles, queue time and receiver acceptance.
Refineries	2	Feedstock, utilisation, yields, maintenance and pre-pilot continuous operations.
Geography	Greater Accra, Ashanti, Western, Northern	Market boundaries and spillover exposure; not a national sample.

Sources: NPA pilot release [\[S03\]](#); IDER calculations [\[S99\]](#).

Note: Facility types are not interchangeable capacity units. Announced coverage is not verified uptake or a representative outcome sample.

July depot reports show operating changes—not measured net additionality

NPA inspection release, 22 July 2026. Statements below are attributed to the named operators.

Table 7. July depot reports show operating changes—not measured net additionality

Reported site / item	Source-reported operating snapshot	What still needs measurement
Petroleum Hub Limited	About 5,000 tonnes loaded daily; storage about 50,000 tonnes.	Flow and stock differ. No matched pre-pilot daily flow or net market change.
Tema Fuel Company	Two shifts; reported completion of daily loading orders.	Order logs, previous backlog and comparison trends; longer hours depend on demand.
VANA Energy	08:00–22:00; possible extension to midnight. About 35 GOIL gasoline tankers daily.	No stated comparable baseline, tanker payload or distinct-worker count.
Quantum Terminals	Management described purpose-built 24-hour capability.	Separate existing capability from incremental runtime, output and recruitment.
Shared operating constraints	Operators cited roads, lighting, security and third-party staffing.	Verify costs, incidents and truck/receiver capacity at the same sites.

Sources: NPA July depot report [\[S14\]](#); IDER calculations [\[S99\]](#).

Note: Selected management reports, not an audited firm panel. Do not multiply storage by shifts or infer national jobs from longer opening hours.

Do not finance an extra shift using an unverified discount

The programme website describes operational and financing incentives; each actual entitlement needs its own evidence.

VERIFY THE INSTRUMENT

Identify the enacted provision, commencement, eligibility, implementing rule and written approval. A programme webpage is not a firm's tax ruling or tariff contract.

SEPARATE THE BASE CASE

The enterprise calculations assume no special 24H+ tax concession, wage subsidy or night tariff. Approved incentives can be added as distinct, dated cases.

RETAIN PUBLIC COST

Record cash support, tax expenditure, guarantees and user charges separately. A private financing structure does not by itself establish zero public exposure.

Sources: 24H+ incentive statements [\[S05\]](#); IDER calculations [\[S99\]](#).

The enterprise evidence describes a defined historical formal-firm population

The World Bank profile supplies weighted estimates, not raw data for a new regression.

Table 8. The enterprise evidence describes a defined historical formal-firm population

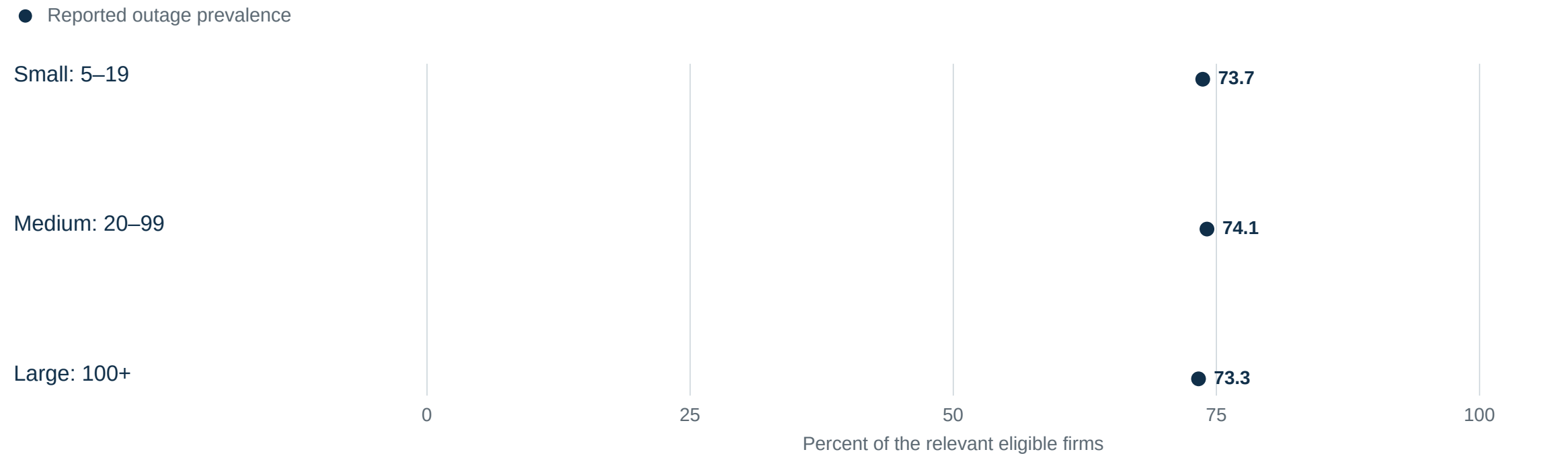
Feature	Source scope	Limit in this report
Fieldwork / observations	713 firms; interviews February 2023–February 2024.	Not a 2026 programme evaluation.
Coverage	Formal private eligible non-agricultural firms with at least five workers.	Informal and smaller firms are outside this profile.
Size	Small 5–19; medium 20–99; large 100+ workers.	Bands are survey definitions, not statutory MSME tax classes.
Inference	Published weighted indicators retained.	Microdata, weights and design covariance not recovered; no new confidence intervals.

Sources: World Bank Ghana ES [\[S06\]](#); IDER calculations [\[S99\]](#).

Outages were common across all three surveyed size bands

Ghana 2023 survey profile; historical percentages of firms reporting outages.

Figure 1. Outages were common across all three surveyed size bands



Sources: World Bank Ghana ES [\[S06\]](#).

Note: The firm survey is not a feeder log or a measure of hours available to a proposed night shift.

Outage prevalence is different from naming electricity the main obstacle

One indicator concerns an event; another asks for the largest business obstacle.

Table 9. Outage prevalence is different from naming electricity the main obstacle

Size	Outages per typical month	Electricity: main obstacle, %	Finance: main obstacle, %
All eligible firms	2.9	6.5	39.2
Small: 5–19	2.7	7.2	40.1
Medium: 20–99	3.6	4.0	40.2
Large: 100+	2.1	10.4	27.9

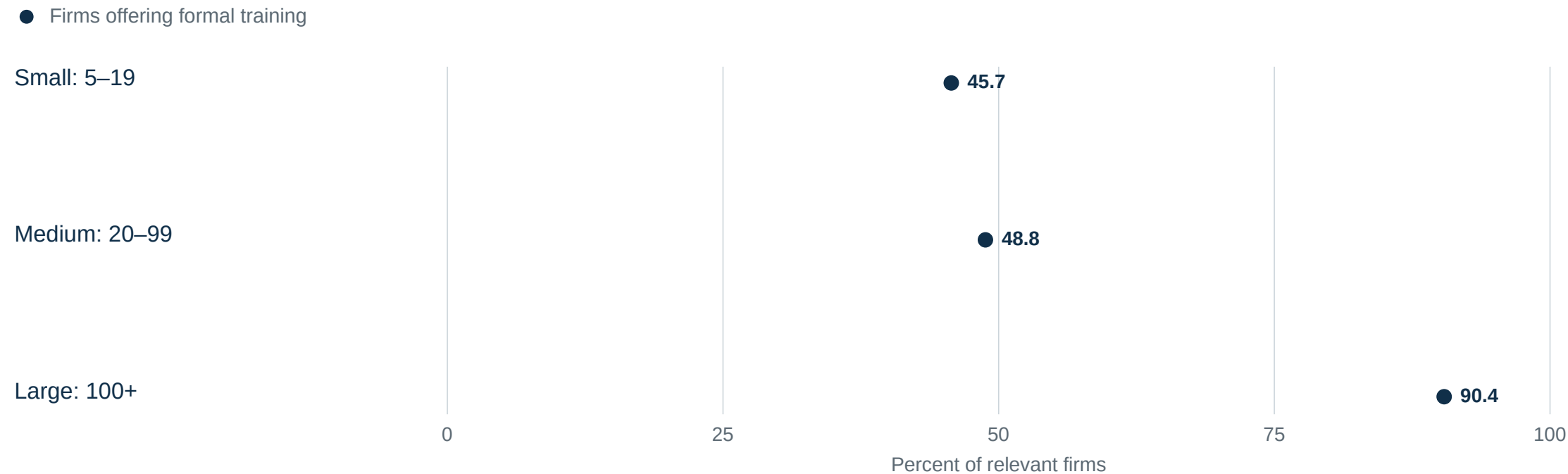
Sources: World Bank Ghana ES [\[S06\]](#).

Note: No standard errors were reconstructed. A low main-obstacle share does not mean that power interruptions are rare.

Formal training provision differs across firm sizes

Historical survey percentages; not programme-induced training or measured skill supply.

Figure 2. Formal training provision differs across firm sizes



Sources: World Bank Ghana ES [\[S06\]](#).

Export exposure and investment finance need firm-level confirmation

Historical profile indicators; they do not quantify unmet orders or unused capacity.

Table 10. Export exposure and investment finance need firm-level confirmation

Size	Direct exports ≥10% of sales: firms, %	Bank-financed investment: firms, %
All eligible firms	9.1	14.1
Small: 5–19	8.7	10.0
Medium: 20–99	7.6	16.6
Large: 100+	17.7	28.5

Sources: World Bank Ghana ES [\[S06\]](#).

Note: No production or employment multiplier is derived from these shares.

Installed capacity is not the power deliverable to a factory at night

Historical national totals, MW; source definitions are preserved.

Table 11. Installed capacity is not the power deliverable to a factory at night

Year	Installed capacity	Dependable capacity	System peak	Simple difference
2020	5,282	4,674	3,090	1,584
2021	5,545	4,864	3,246	1,618
2022	5,610	4,641	3,469	1,172
2023	5,639	4,725	3,618	1,107
2024	5,749	4,704	3,952	752
2025	5,840	4,968	4,283	685

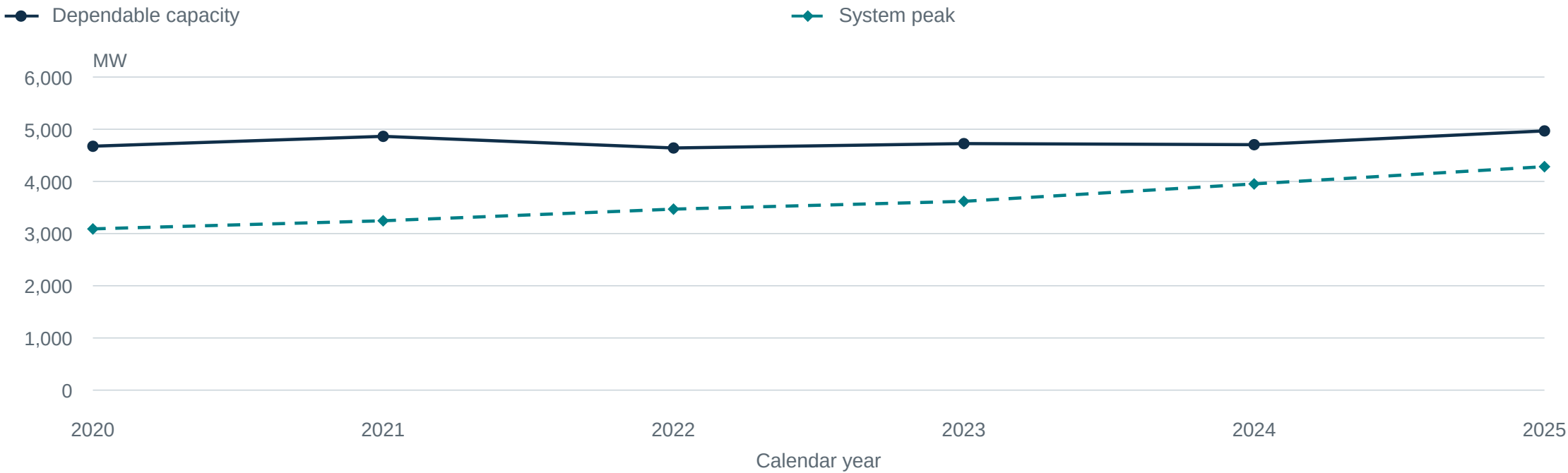
Sources: Energy Commission 2026 bulletin [\[S07\]](#); IDER calculations [\[S99\]](#).

Note: Dependable capacity minus annual system peak is a non-coincident comparator, not an operational reserve-margin guarantee.

The annual dependable-capacity comparator narrowed from 2021 to 2025

Year-end/source capacity and annual peak are not coincident dispatch records.

Figure 3. The annual dependable-capacity comparator narrowed from 2021 to 2025



Sources: Energy Commission 2026 bulletin [\[S07\]](#).

Note: Fuel, outages, transmission, local feeders and reserve requirements still constrain actual deliverability.

Repeated source rows do not establish independently verified stability

Published 2025 values equal the 2024 values for these ECG and NEDCo series.

Table 12. Repeated source rows do not establish independently verified stability

Utility / area	SAIFI: interruptions/customer	SAIDI: hours/customer	Source-year qualification
ECG / Metro	12.2	21.5	2024 and 2025 identical as printed
ECG / Urban	17.1	35.7	2024 and 2025 identical as printed
ECG / Rural	20.6	44.7	2024 and 2025 identical as printed
NEDCo / Metro	52.1	70.3	2024 and 2025 identical as printed
NEDCo / Urban	40.0	33.5	2024 and 2025 identical as printed
NEDCo / Rural	131.9	102.4	2024 and 2025 identical as printed

Sources: Energy Commission 2026 bulletin [\[S07\]](#); IDER calculations [\[S99\]](#).

Note: No refreshed operating-log evidence was obtained to confirm the cause of repetition. No national average or shift-specific uptime is inferred.

Convert pesewas to cedis before costing an additional shift

PURC Fourth Schedule, effective 1 July 2026; selected customer categories.

Table 13. Convert pesewas to cedis before costing an additional shift

Category	GHp/kWh	GHS/kWh	GHS monthly service
Non-residential 0–300	183.9549	1.839549	12.4282
Non-residential 301+	224.0395	2.240395	12.4282
SLT-LV	240.2104	2.402104	500.0000
SLT-MV	208.6329	2.086329	500.0000
SLT-MV2	136.6512	1.366512	500.0000
SLT-HV	188.4762	1.884762	500.0000

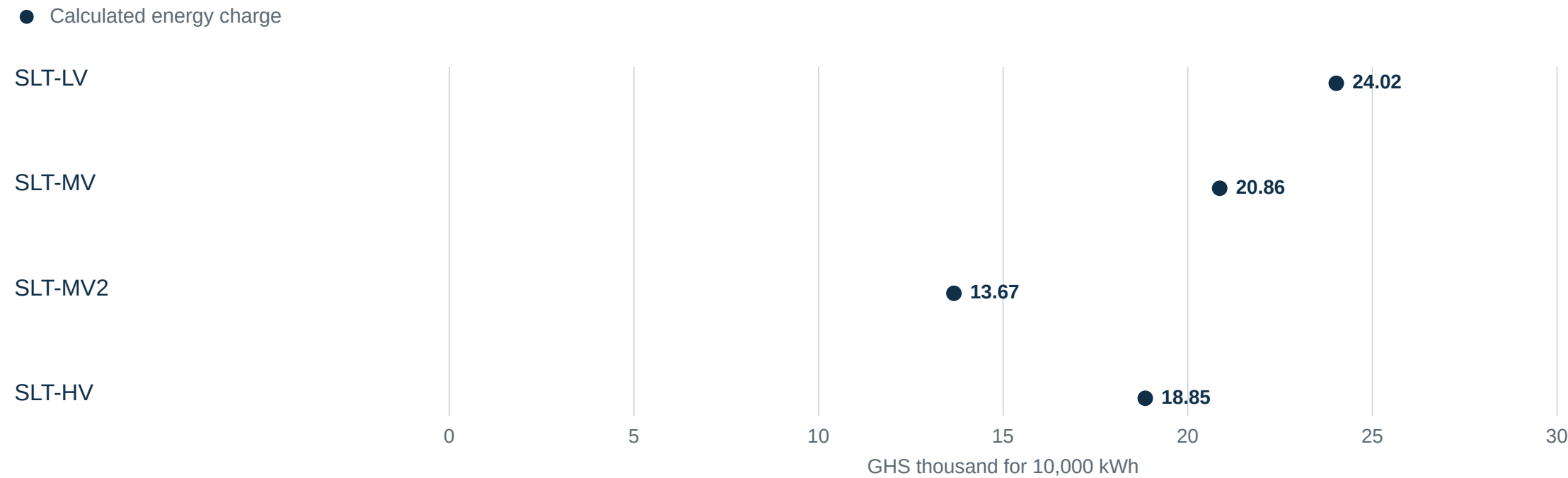
Sources: PURC Q3 2026 tariffs [\[S08\]](#); IDER calculations [\[S99\]](#).

Note: Customer classification and extra bill items must be verified. These published rates do not establish an automatic night discount.

The same extra 10,000 kWh produces different energy charges

Published energy rates applied to an assumed common consumption increment; service charges excluded here.

Figure 4. The same extra 10,000 kWh produces different energy charges



Sources: PURC Q3 2026 tariffs [\[S08\]](#); IDER calculations [\[S99\]](#).

Note: This is tariff arithmetic, not a comparison of otherwise identical eligible firms. Existing fixed service charges are not automatically incremental.

An extra scheduled hour produces nothing when a binding constraint is unchanged

Measure rate, availability, speed and yield separately before attributing a gain.

AVAILABLE TIME

Deduct planned maintenance, changeovers and breaks from the engineering denominator. Keep grid interruption, machine failure and staffing gaps separately measurable.

GOOD OUTPUT

Multiply scheduled time by the availability, performance and yield factors only when their definitions do not overlap. Scrap and rework are not two completed products.

SALEABLE VOLUME

Constrain output by verified orders, input supply and logistics. Inventories are production accounting items but are not equivalent to collected revenue.

Sources: IDER calculations [\[S99\]](#).

F01 is an explicit engineering and demand example—not a surveyed factory

One month: 22 production days; each shift contains eight staffed hours, with break/relief coverage within the assumptions.

Table 14. F01 is an explicit engineering and demand example—not a surveyed factory

Input	Assumed value	Interpretation
Rated throughput / performance / yield	100 units/hour / 95% / 98%	Same product and physical unit.
Shift availability	90% first; 85% second; 80% third	Separate assumed shift factors; not fitted to the firm survey.
Before-period sales / new demand	13,000 / 23,000 units	The counterfactual can use idle first-shift capacity.
Price / material / energy	GHS 50 / GHS 30 / 0.5 kWh per unit	Energy GHS 2.50/kWh is an assumed all-in variable cost.
Extra crew and fixed shift costs	10 workers; basic pay GHS 20/hour; 20% premium	Employer basic-pay contribution and external shift costs separate.

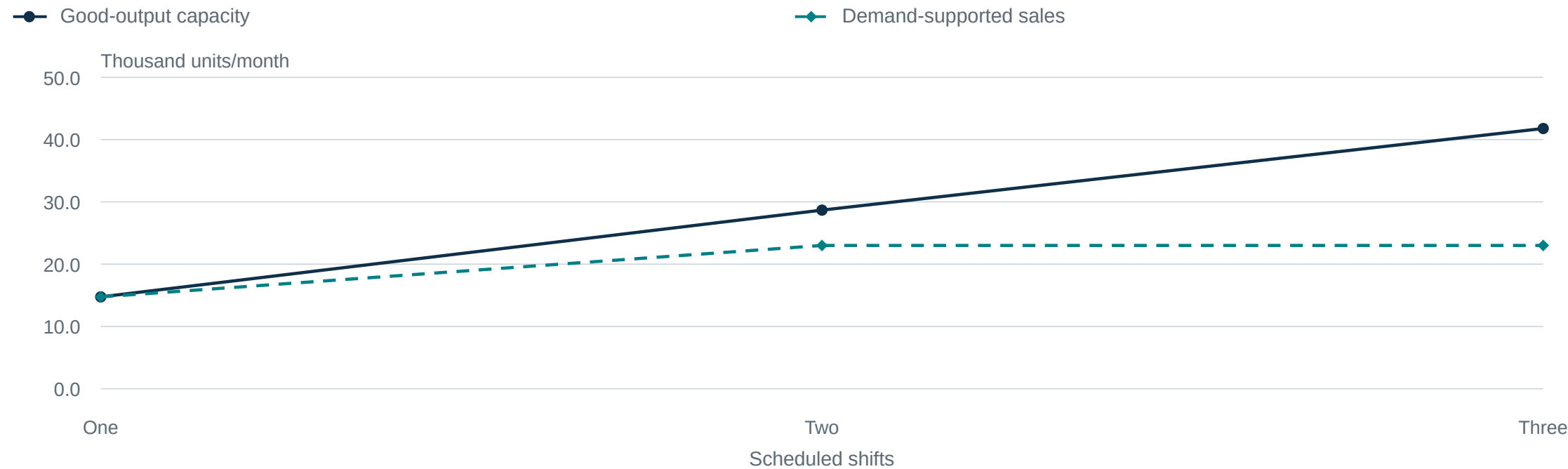
Sources: SSNIT employer guidance [\[S10\]](#); IDER calculations [\[S99\]](#).

Note: Demand is capped and production follows accepted sales; no inventory accumulation or automatic tax incentive is imposed.

A third shift adds capacity but no sales at the stated demand

F01: 23,000-unit demand ceiling in every shift configuration.

Figure 5. A third shift adds capacity but no sales at the stated demand



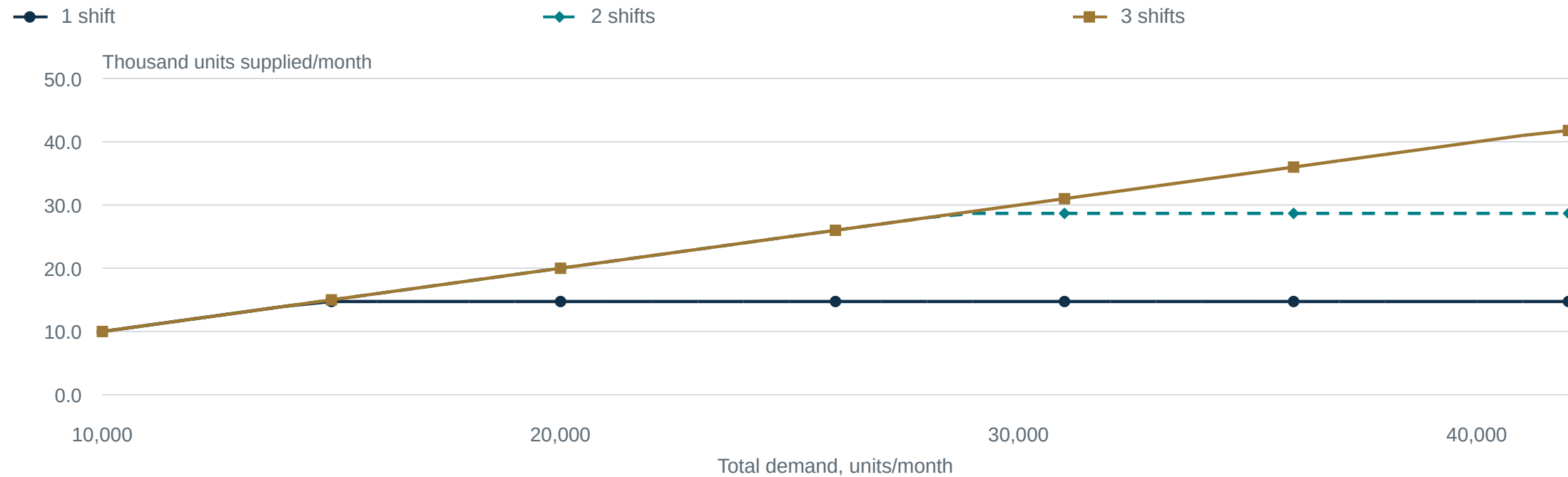
Sources: IDER calculations [\[S99\]](#).

Note: Additional capacity and output are not interchangeable. First-shift counterfactual capacity is 14,747.04 units.

Extra output depends on demand above the one-shift counterfactual

F01: production follows accepted demand; no speculative stockbuilding.

Figure 6. Extra output depends on demand above the one-shift counterfactual



Sources: IDER calculations [\[S99\]](#).

Note: Curves are deterministic capacity constraints, not estimated demand functions.

The 10,000-unit before–after increase contains 1,747.04 units of unused baseline capacity

F01: a common higher demand is applied to both the one-shift and additional-shift alternatives.

Table 15. The 10,000-unit before–after increase contains 1,747.04 units of unused baseline capacity

Configuration	Good capacity	Delivered units	Additional vs one-shift	Extra people
1 shift(s)	14,747.04	14,747.04	0.00	0
2 shift(s)	28,674.80	23,000.00	8,252.96	10
3 shift(s)	41,783.28	23,000.00	8,252.96	20

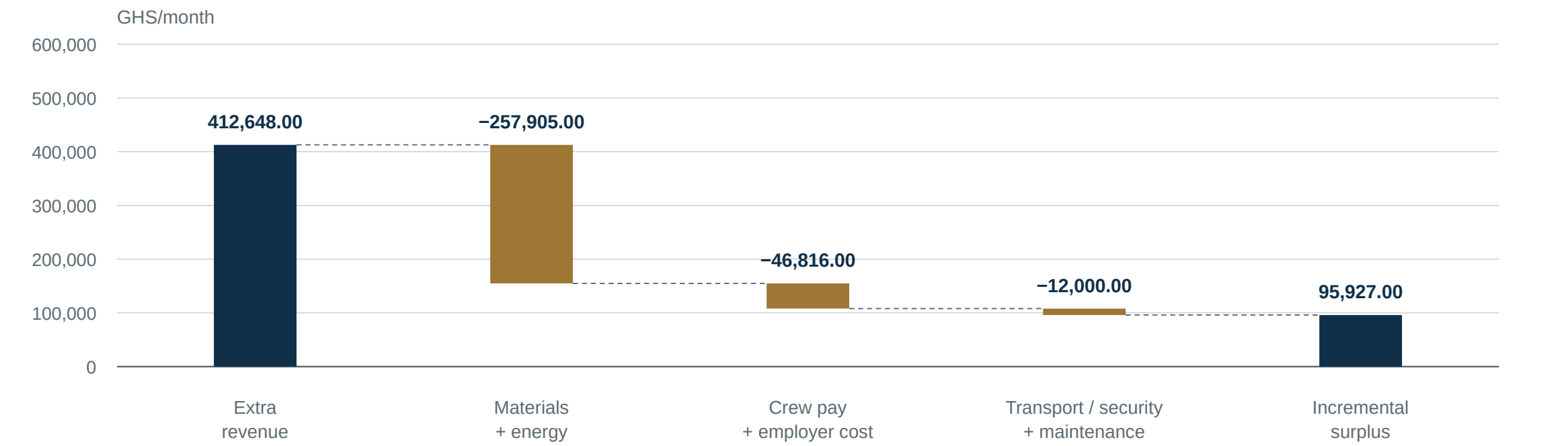
Sources: IDER calculations [\[S99\]](#).

Note: The remaining 8,252.96 units are conditional additional output, not a causal estimate of the national programme.

The extra shift yields GHS 95,927 before financing, tax and setup in F01

Only output above the feasible one-shift counterfactual is credited to the shift.

Figure 7. The extra shift yields GHS 95,927 before financing, tax and setup in F01



Sources: IDER calculations [\[S99\]](#).

Note: Fixed wages are charged even when capacity is unused; existing baseline costs cancel only under the stated unchanged-cost assumption.

Low demand can leave an extra shift loss-making even with reliable power

F01: GHS 2.50/kWh and 20% crew premium held fixed.

Figure 8. Low demand can leave an extra shift loss-making even with reliable power

	14 k demand	18 k demand	23 k demand	28 k demand	33 k demand
Availability 55%	-58.8	2.2	95.9	110.2	110.2
Availability 65%	-58.8	2.2	95.9	140.9	140.9
Availability 75%	-58.8	2.2	95.9	171.6	171.6
Availability 85%	-58.8	2.2	95.9	189.7	202.3
Availability 95%	-58.8	2.2	95.9	189.7	233.1

Incremental operating surplus, GHS thousand/month

Sources: IDER calculations [\[S99\]](#).

Note: Subset of 225 joint cases. Colours indicate signed accounting outcomes, not probabilities or recommended policy choices.

The base extra shift requires at least 3,136.85 genuinely additional units

F01: contribution must cover GHS 58,816 monthly extra-shift costs; no cost is financed twice.

Table 16. The base extra shift requires at least 3,136.85 genuinely additional units

Assumed energy GHS/kWh	Assumed premium	Extra-shift cost, GHS	Minimum extra units
1.50	0%	51,776	2,689.66
1.50	20%	58,816	3,055.38
1.50	40%	65,856	3,421.09
2.50	0%	51,776	2,761.39
2.50	20%	58,816	3,136.85
2.50	40%	65,856	3,512.32
3.50	0%	51,776	2,837.04
3.50	20%	58,816	3,222.79
3.50	40%	65,856	3,608.55

Sources: IDER calculations [\[S99\]](#).

Note: Three premiums and three energy costs are scenarios. The threshold adds to demand already met by the one-shift counterfactual.

Revenue growth overstates both value added and spendable cash

F01 conditional second-shift monthly account.

ADDITIONAL REVENUE

GHS 412,648

8,252.96 additional units × GHS 50. This is not the GDP contribution.

ADDITIONAL VALUE ADDED

GHS 142,743

Deduct materials, energy and GHS 12,000 external shift services. Employee compensation remains within value added.

OPERATING SURPLUS

GHS 95,927

Subtract GHS 46,816 crew pay and employer contribution. Setup, finance and tax are outside this operating measure.

Sources: IDER calculations [\[S99\]](#).

Note: The VA boundary assumes transport, security and maintenance are purchased services. Actual accounts require a consistent production perimeter.

Unique people, employment relationships and FTE hours answer different questions

Use secure identifiers and report the time reference with every number.

Table 17. Unique people, employment relationships and FTE hours answer different questions

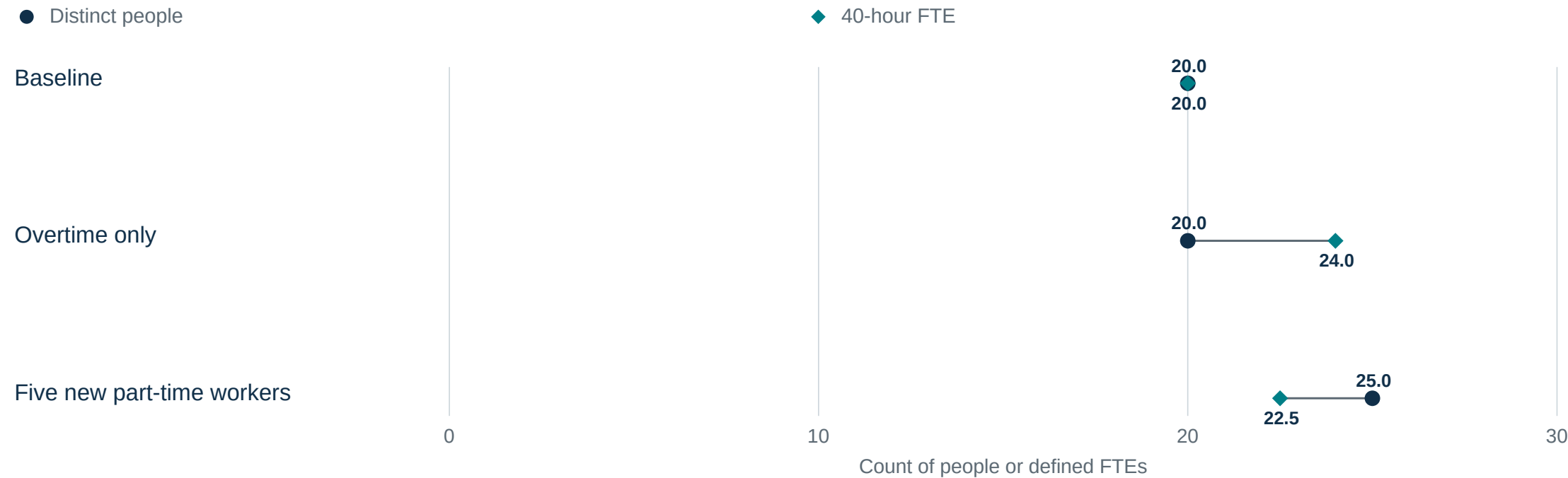
Measure	Construction	Do not confuse it with
People employed	Distinct persons employed in the defined reference period.	Number of shifts, worker-days or payroll transactions.
Jobs / relationships	Distinct person–employer engagements, with entry and exit dates.	Unique persons when someone has multiple jobs.
Full-time-equivalent hours	Total specified paid or actual hours / reference full-time hours.	New people or permanent contracts.
Job-years	FTE time accumulated over the evaluation horizon.	Peak headcount or a short recruitment announcement.
Net employment effect	Change above the counterfactual, including market losses and spillovers.	Gross hires at participating firms.

Sources: IDER calculations [\[S99\]](#).

Extra work hours need not mean extra employed people

Baseline: 20 people × 40 hours/week; FTE convention is 40 hours/week.

Figure 9. Extra work hours need not mean extra employed people



Sources: IDER calculations [\[S99\]](#).

Note: Third case: existing 20 × 40 hours plus five recruits × 20 hours. The overtime case is arithmetic, not a legally approved rota.

One continuously staffed position requires more than three workers

Hours convention: 40/week per full-time worker; productive availability is an explicit planning assumption.

Table 18. One continuously staffed position requires more than three workers

Coverage hours/week	Availability	Coverage FTE	Staff equivalents	Integer lower bound
40	85%	1.00	1.18	2
80	85%	2.00	2.35	3
120	85%	3.00	3.53	4
168	100%	4.20	4.20	5
168	90%	4.20	4.67	5
168	85%	4.20	4.94	5

Sources: IDER calculations [\[S99\]](#).

Note: $168 \div (40 \times 0.85) = 4.94$ staff equivalents. Five is a necessary rounded staffing bound, not proof that a compliant roster exists.

A multi-shift operation needs a compliant roster, not longer individual days

Selected Act 651 provisions inspected; specific contracts, exceptions and later applicable rules require professional review.

Table 19. A multi-shift operation needs a compliant roster, not longer individual days

Provision	Statutory reference	Implication for the pilot
Ordinary hours	Section 33: eight/day or forty/week, subject to express exceptions.	Check actual hours per person; do not multiply each worker’s day by three.
Shifts and averaging	Section 36: prescribed average within four weeks or less.	Retain a dated shift timetable and individual-hour totals.
Breaks and rest	Sections 40–42: breaks; ordinary daily 12 hours and weekly 48 consecutive hours.	Staff for breaks and rest; exceptions must be documented.
Overtime and protections	Sections 35 and 55: fixed overtime rates and specified consent protections.	Do not assume a universal 1.5× premium; use applicable lawful terms.

Sources: Labour Act 651 [\[S09\]](#).

Note: This summary is not a complete employment-law opinion or a universal schedule authorisation.

The GHS 35,200 basic wage bill is only part of the extra-shift cost

F01 monthly crew: 10 workers × 176 hours × GHS 20 basic hourly pay.

Table 20. The GHS 35,200 basic wage bill is only part of the extra-shift cost

Component	GHS/month	Treatment
Basic crew pay	35,200	Assumed wage, not a national wage estimate.
20% shift premium	7,040	Assumption; not a statutory universal night premium.
Employer 13% on basic pay	4,576	Employee deduction is not added as employer cost.
Transport and security	8,000	Assumed purchased worker transport and site security.
Additional maintenance	4,000	Assumed external incremental cost.
Total incremental shift costs	58,816	Fixed to the scheduled extra shift in the model.

Sources: SSNIT employer guidance [\[S10\]](#); IDER calculations [\[S99\]](#).

A shift premium matters differently when demand is near break-even

F01 with second-shift availability 85% and energy GHS 2.50/kWh.

Figure 10. A shift premium matters differently when demand is near break-even

	Premium 0%	Premium 20%	Premium 40%
Demand 18,000	9.2	2.2	-4.9
Demand 23,000	103.0	95.9	88.9
Demand 28,000	196.7	189.7	182.6

Incremental operating surplus, GHS thousand/month

Sources: IDER calculations [\[S99\]](#).

Note: The model does not recommend a wage rate. Terms are assumed; legal and collective-agreement obligations remain controlling.

A positive job count is not a complete worker-outcome assessment

Agree outcome definitions with workers before the pilot starts.

PAID AND SAFE WORK

Track contracted and actual hours, on-time gross and net wages, contributions, paid leave and verified incidents. Separate nonpayment from low pay and hours from people.

SAFE ACCESS TO SHIFTS

Record the availability and cost of transport, lighting, sanitation, supervision and reporting channels. Analyse women, persons with disabilities and caring responsibilities without assuming equal night-shift access.

ADDITIONAL WORKERS

Follow new hires and exits, including contract workers and nonparticipants. A worker recruited from another employer is not automatically a net addition to national employment.

Sources: Labour Act 651 [\[S09\]](#); IDER calculations [\[S99\]](#).

Ten recruits can contain both new employment and job-to-job moves

Independent hypothetical transition example; the origin employer’s response is not observed.

Table 21. Ten recruits can contain both new employment and job-to-job moves

Flow	Assumed persons	What can be stated
Recruited from non-employment	6	Six observed transitions would need prior-status verification.
Recruited from another job	4	Four job-to-job moves; replacements or losses at origin are unknown.
Gross hires	10	Not ten additional national jobs.
Counterfactual / exits	Not observed in this example	Net employment requires baseline trends, separations and vacancy chains.

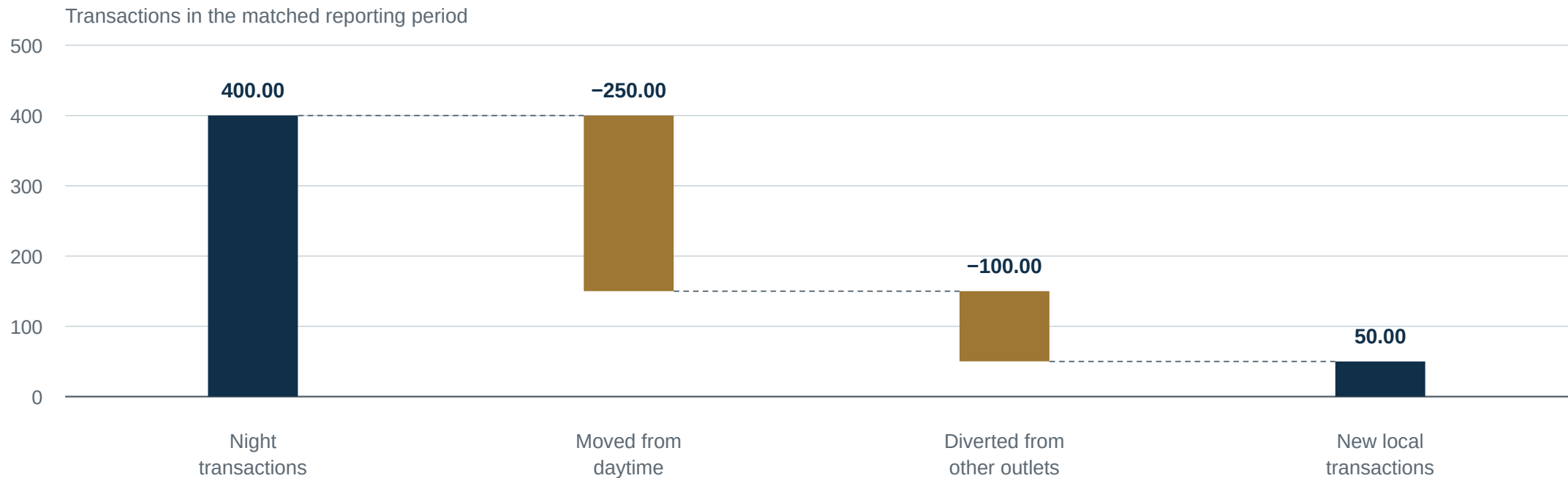
Sources: IDER calculations [\[S99\]](#).

Note: The report does not subtract all job-to-job moves mechanically; origin vacancies may be filled.

Four hundred night purchases can contain only fifty new local transactions

R01 illustrative matched-period decomposition; unchanged product unit and market boundary.

Figure 11. Four hundred night purchases can contain only fifty new local transactions



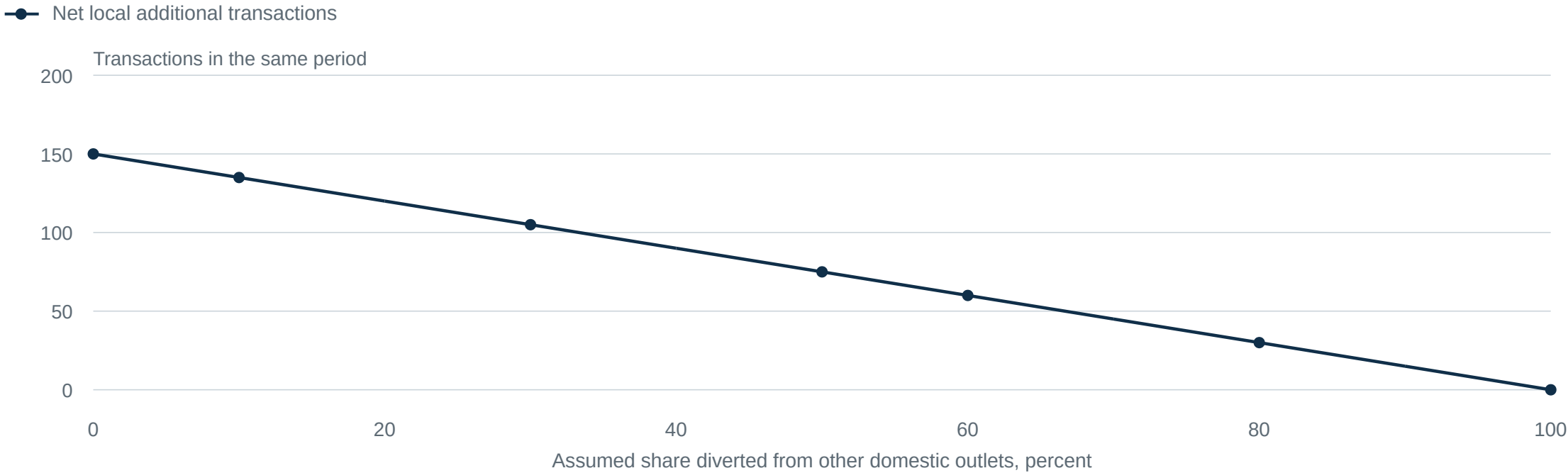
Sources: IDER calculations [\[S99\]](#).

Note: Earlier timing and convenience may benefit customers even where period-wide quantity is unchanged; those benefits need separate measurement.

Gross gains at one outlet shrink as domestic diversion increases

R01: participating site’s full-period increase is 150 transactions.

Figure 12. Gross gains at one outlet shrink as domestic diversion increases



Sources: IDER calculations [\[S99\]](#).

Note: This is a sensitivity curve, not an estimated displacement rate. Market boundaries and substitution must be observed.

Extending a depot gate does not help when truck dispatch remains binding

L01 hypothetical daily throughput; three capacities refer to the same dispatch unit.

Table 22. Extending a depot gate does not help when truck dispatch remains binding

Configuration	Gate capacity	Truck capacity	Receiver capacity	Completed dispatches
Baseline	80	70	90	70
Gate opens longer	120	70	90	70
Linked operations extended	120	100	110	100

Sources: IDER calculations [\[S99\]](#).

Note: The minimum of compatible stage capacities determines throughput in this simplified static system. Queue delays and stochastic arrivals need event data.

Reducing spoilage can add saleable output without adding harvest

C01 hypothetical 100 tonnes entering the chain; no extra agricultural production assumed.

Table 23. Reducing spoilage can add saleable output without adding harvest

Measure	Baseline	Improved chain	Interpretation
Input tonnes	100	100	Same procurement volume.
Loss rate	12%	5%	Assumed physical loss, not value markdown.
Saleable tonnes	88	95	Seven additional saleable tonnes.
Revenue at assumed GHS 4,000/tonne	352,000	380,000	GHS 28,000 extra receipts before incremental costs.

Sources: IDER calculations [\[S99\]](#).

Note: Additional electricity, storage, grading and transport costs are not zero. Trade-sector output valuation is not simply the full commodity turnover.

Billable accepted hours matter more than staffed seats

D01 hypothetical BPO exporter; same task and quality standard.

Table 24. Billable accepted hours matter more than staffed seats

Measure	Before	After	Additionality condition
Client-accepted billable hours/month	1,200	1,800	600 new contracted export-service hours.
Additional gross invoices at GHS 80/hour	—	48,000	Unchanged illustrative price; not domestic currency translation gain.
Staffed but rejected / idle hours	Separate record	Separate record	Never counted as delivered service.
Domestic subcontracted work	Trace origin	Trace destination	Do not count transferred local work as a new export.

Sources: IDER calculations [\[S99\]](#).

Note: The task price and contract increment are assumptions; the report does not estimate a Ghana BPO employment elasticity.

An already-24-hour plant needs a different counterfactual

Do not award the same additionality treatment to an existing continuous operation and a new second shift.

EXISTING CONTINUOUS PLANT

Baseline hours already cover the full operational calendar. Relabelling shifts generates no measured increment. Analyse reliability, yield, demand and maintenance changes instead.

SEASONAL AGRO-PROCESSOR

Compare the same crop season and input quality. A peak-month increase may be offset elsewhere in the year. Observe stocks and annual throughput, not only the launch period.

HEALTH, HOSPITALITY AND SERVICES

Availability can improve timeliness or service quality without a proportional output count. Use sector-specific accepted-service indicators and staffing quality; do not force all sectors into tonnes.

Sources: IDER calculations [\[S99\]](#).

The six enterprise pathways cannot be added into one national effect

F01, R01, L01, C01, D01 and X01 are designed to isolate mechanisms.

Table 25. The six enterprise pathways cannot be added into one national effect

Case	Primary binding test	Potential false positive
F01 manufacturing	Demand above feasible first-shift output; margin above extra costs.	Before–after volume attributed entirely to the second shift.
R01 retail	Full-period and surrounding-market sales.	Night sales treated as new consumption.
L01 logistics	Linked gate, fleet and receiving capacities.	More gate hours treated as more dispatches.
C01 cold chain	Same intake, lower loss and incremental running costs.	Reduced spoilage labelled additional harvest.
D01 BPO exports	New accepted billable tasks and client origin.	Idle desk hours labelled exports.
X01 continuous operation	Change above already-continuous baseline.	Relabelling existing shifts counted as expansion.

Sources: IDER calculations [\[S99\]](#).

Domestic value added—not gross turnover—is the aggregation unit

Use compatible constant prices and final-demand boundaries.

Table 26. Domestic value added—not gross turnover—is the aggregation unit

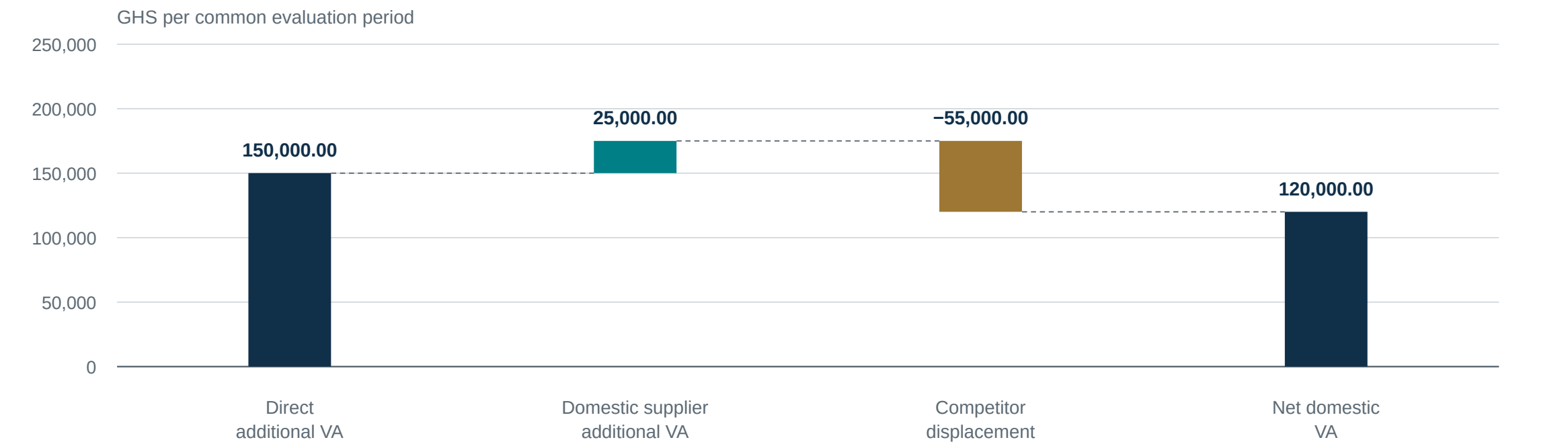
Layer	Treatment	Avoid
Participating firm	Output less intermediate inputs under a consistent account.	Adding wages again on top of value added.
Domestic suppliers	Only their additional VA attributable to incremental demand.	Adding supplier turnover already embedded in purchases.
Imports	Track imported inputs and substituted final imports separately.	Calling foreign input value domestic VA.
Domestic competitors	Include losses and spillovers in the relevant market.	Ignoring displaced production and employment.
Household welfare	Prices, wages, convenience and fiscal effects need a separate assessment.	Equating producer sales or job count with total welfare.

Sources: SNA production accounting [\[S13\]](#); IDER calculations [\[S99\]](#).

A GHS 150,000 direct gain can become GHS 120,000 after market netting

Independent hypothetical constant-price VA account; not a calibrated multiplier.

Figure 13. A GHS 150,000 direct gain can become GHS 120,000 after market netting



Sources: IDER calculations [\[S99\]](#).

Note: The values are imposed to demonstrate consolidation. Real netting requires linked markets and a supported counterfactual.

A national megawatt surplus is not a factory's power contract

Demand and energy need a simultaneous operating test.

COINCIDENT CAPACITY

Measure feeder headroom, voltage quality and the hour-by-hour dispatch requirement. An annual national capacity–peak difference is not a guaranteed local spare margin.

MARGINAL COST

Include metered energy, standby generation, restart losses and applicable fixed or demand charges. Distinguish moving existing load off-peak from adding new energy consumption.

RELIABILITY INTERACTION

Backup power can protect output but increase cost; a cheaper tariff does not help during an outage. Test both uptime and delivered cost rather than multiplying hours by the lowest advertised price.

Sources: Energy Commission 2026 bulletin [\[S07\]](#); PURC Q3 2026 tariffs [\[S08\]](#); IDER calculations [\[S99\]](#).

A profitable extra shift can require cash before the first additional invoice is paid

F01: 30-day modelling month; DSO 45, inventory days 30, supplier days 30.

Table 27. A profitable extra shift can require cash before the first additional invoice is paid

Component	GHS	Calculation / scope
Additional receivables	618,972.00	45/30 × monthly additional sales.
Additional inventories	257,905.00	30/30 × variable material and energy cost.
Supplier-credit financing	−247,588.80	30/30 × material purchases; reduces the need.
Net working capital	629,288.20	Receivables + inventory – payables.
One-off setup cash	100,000.00	Separate assumed setup, not a recurring cost.

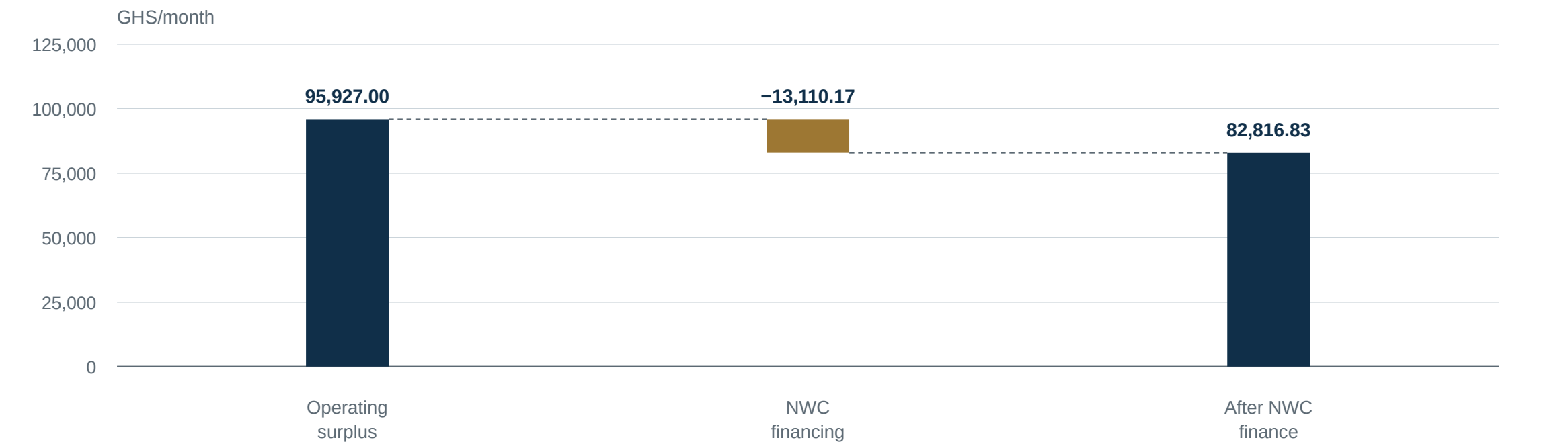
Sources: IDER calculations [\[S99\]](#).

Note: Steady-state cash stocks, not a cash-flow forecast. Taxes, deposits, retained invoices, capex and actual collection uncertainty require separate lines.

Working-capital finance reduces F01’s monthly surplus by GHS 13,110.17

Assumed annual simple funding cost 25%; monthly finance is $NWC \times 25\% / 12$.

Figure 14. Working-capital finance reduces F01’s monthly surplus by GHS 13,110.17



Sources: IDER calculations [\[S99\]](#).

Note: Before corporate taxes and one-off setup. This is not a borrowing quotation, investment recommendation or an NPV calculation.

Operating break-even is lower than financed break-even

F01: identical physical and price assumptions, with the specified working-capital structure.

OPERATING BREAK-EVEN

3,136.85 units

Extra units required to cover GHS 58,816 at GHS 18.75 contribution each.

WITH NWC FINANCE

3,427.21 units

Financing tied to additional sales reduces the unit contribution; fixed setup is still excluded.

DEMAND CHECK

Above baseline

Required additional units must exceed those already supplied by the one-shift counterfactual. Confirm orders and collection risk.

Sources: IDER calculations [\[S99\]](#).

Note: The fixed-cost rule assumes one extra crew. Nonlinear prices, startup losses or capacity changes require a new calculation.

Use net job-years and a matching cost period for fiscal reporting

Independent example: public cash GHS 1.2 m over six months; assumed direct and spillover job changes.

Table 28. Use net job-years and a matching cost period for fiscal reporting

Measure	Conditional value	Interpretation
Direct / supplier / displaced FTE jobs	10 / +2 / -4	Net eight FTE jobs for the stated common period.
Six-month net job-years	4.0	Eight × 0.5 year; not eight permanent job-years.
Public cash per net job-year	GHS 300,000	1,200,000 / 4; cash-cost indicator, not social welfare.
If net additional jobs are zero / negative	No positive finite cost-effectiveness ratio	Publish cost and outcome separately; do not hide the denominator.

Sources: IDER calculations [\[S99\]](#).

Note: These values are not linked to the GHS 110 m budget allocation or the government jobs target. Tax expenditures, guarantees and resource costs remain separate.

The recovered records do not identify a national programme effect

Implementation records, reported depot snapshots and engineering cases are not a treated–comparison panel.

Table 29. The recovered records do not identify a national programme effect

Required evidence	Recovered in this study	Consequence
Plant-level shift and production history	July depot snapshots, but no matched production panel.	Reported levels are not measured additionally; enterprise cases remain conditional.
Worker identifiers, hours and employer transitions	No linked worker panel supplied.	No realised net job count estimated.
Rollout assignment and comparison outcomes	NPA pilot scope is announced; actual assignment and outcomes not linked.	No automatic before–after or participant/nonparticipant effect.
Market spillovers and displacement	Not observed in the source aggregates.	Gross site gains cannot be presented as national additions.

Sources: NPA pilot release [\[S03\]](#); World Bank Ghana ES [\[S06\]](#); NPA July depot report [\[S14\]](#); IDER calculations [\[S99\]](#).

Participation is selected by demand, finance and existing operating capacity

Tax or electricity incentives cannot be treated as random simply because they follow a common programme.

FREEZE BASELINE EXPOSURE

Record operating regime, order book, sector, energy source and location before the offer. Using later night sales or uptake as the sole treatment variable selects on outcomes.

DOCUMENT THE OFFER

Separate application, eligibility, selection, offer, uptake, first additional shift and duration. An offer effect and an actual participation effect have different assumptions.

COMPARE CREDIBLY

Use a documented rollout, oversubscription lottery or defensible discontinuity only when its rules support identification. Historical matching alone does not remove unobserved demand selection.

Sources: Callaway–Sant’Anna [\[S11\]](#); Sant’Anna–Zhao [\[S12\]](#); IDER calculations [\[S99\]](#).

Estimate cohort- and horizon-specific effects when the design permits

Prospective method; no fitted coefficients or inference from the hypothetical cases.

Table 30. Estimate cohort- and horizon-specific effects when the design permits

Design element	Specification	Failure to disclose
Estimand	ATT(g, t) for a defined outcome, cohort and horizon.	A single pooled coefficient with heterogeneous adoption.
Comparison	Never-treated or not-yet-treated units with defensible parallel trends.	Already-affected peers used as clean controls.
Pre-treatment checks	Anticipation, seasonality, baseline support and outcome comparability.	Treating a non-significant pre-trend test as proof.
Adjustment	Doubly robust estimation under required identification and overlap.	Claiming adjustment makes invalid assignment causal.
Uncertainty	Cluster at assignment/shared-shock level; simultaneous horizon bands.	Firm-level standard errors for market-level shocks.

Sources: Callaway–Sant’Anna [\[S11\]](#); Sant’Anna–Zhao [\[S12\]](#); IDER calculations [\[S99\]](#).

A funding threshold or feeder boundary is not automatically a valid instrument

The proposed design must rule out pathways other than the intervention being estimated.

REGRESSION DISCONTINUITY

Use the actual eligibility score and cutoff, with manipulation, bandwidth and baseline-covariate tests. A turnover boundary can also affect tax treatment and disclosure.

INSTRUMENTAL VARIABLES

An electricity-network change can directly affect production and competing firms. Exclusion, anticipation and a credible first stage must be justified; robust errors do not repair invalid instruments.

RANDOMISED SUPPORT OFFER

A fair, authorised oversubscription allocation of additional assistance could identify an offer effect. Do not withhold lawful entitlements or worker protections; track uptake and spillovers.

Sources: Callaway–Sant’Anna [\[S11\]](#); IDER calculations [\[S99\]](#).

The control group must not quietly inherit the treatment

Define economic markets and supplier links before selecting comparison units.

Table 31. The control group must not quietly inherit the treatment

Exposure	Measurement	Analysis response
Competitor proximity	Customer catchment, product market and substitution.	Estimate own-site and market-total changes separately.
Supplier connections	Domestic procurement and capacity at linked firms.	Add only incremental supplier value added once.
Worker mobility	Prior job, origin employer and destination.	Track vacancy chains and separations; do not count moves as net jobs.
Infrastructure spillovers	Shared feeder, port gate, road and security service.	Use cluster or exposure-mapped comparisons; pure firm independence may fail.

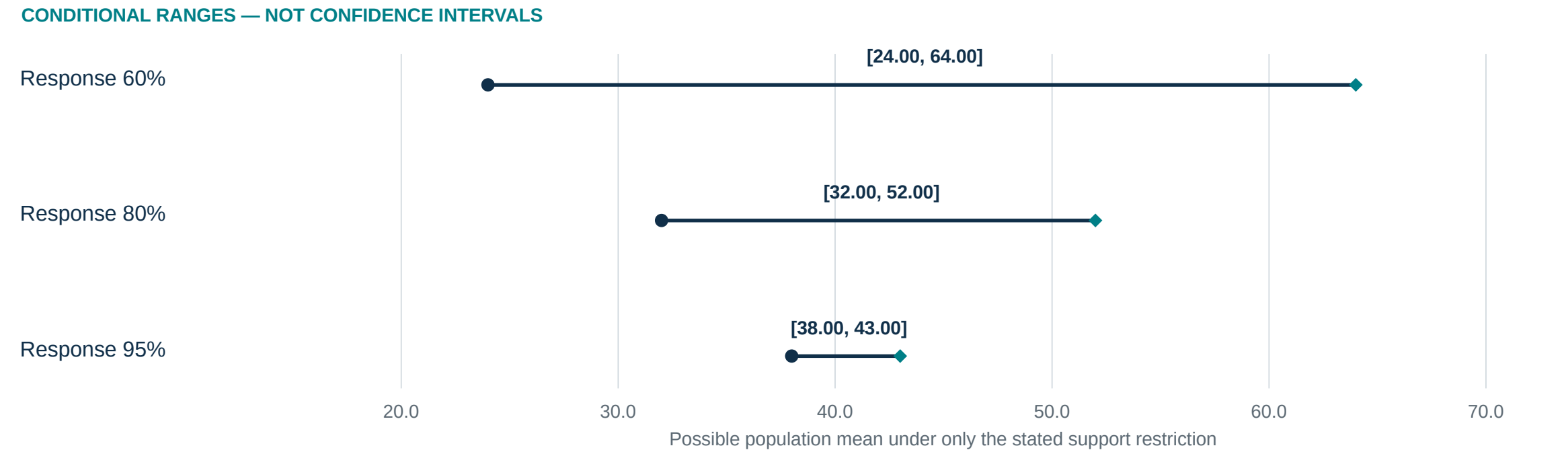
Sources: IDER calculations [\[S99\]](#).

Note: Spillover equations in the catalogue are prospective. No exposure map or national multiplier has been fitted here.

An 80% response rate does not identify the population mean

Hypothetical bounded outcome on 0–100; observed respondent mean 40.

Figure 15. An 80% response rate does not identify the population mean



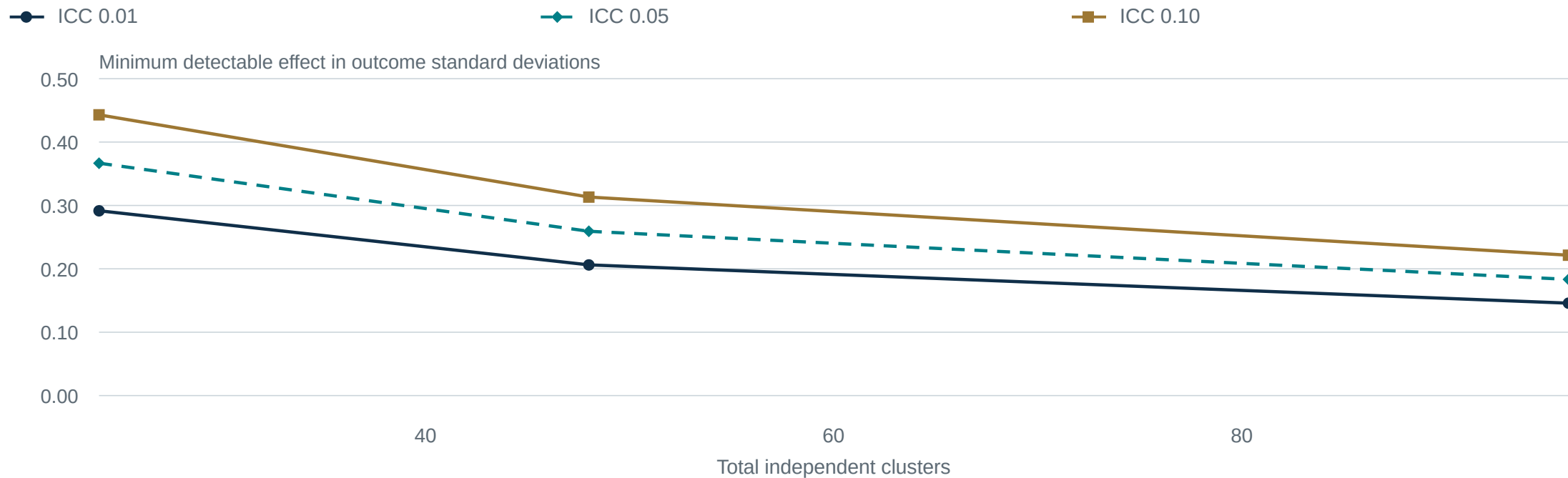
Sources: IDER calculations [\[S99\]](#).

Note: At 80% response the range is 32–52. Not confidence intervals; no missingness rate or national mean is estimated from these scenarios.

More independent clusters improve precision more than duplicated scenario rows

Equal two-arm cluster design; 20 firms/cluster, 90% retention; normal approximation.

Figure 16. More independent clusters improve precision more than duplicated scenario rows



Sources: IDER calculations [\[S99\]](#).

Note: Assumed two-sided 5% level and 80% power. No baseline precision gain assumed. Few clusters, unequal sizes and spillovers need design-specific simulation.

Publish what remains unresolved rather than declaring all bias removed

The target population includes non-takers, closures, informal peers and loss-making businesses where in scope.

Table 32. Publish what remains unresolved rather than declaring all bias removed

Threat	Specific safeguard	Residual limitation
Reverse causation	Record orders and finance before adoption; trace assignment.	Demand-led adoption can remain confounded.
Post-treatment controls	Separate total effects from mediation analysis.	Conditioning on realised output or finance may remove part of the effect.
Selective survival / reporting	Start from a baseline roster and retain closures and missing outcomes.	Weighting needs observed response predictors and overlap.
Outcome manipulation	Reconcile machine meters, deliveries, payroll and bank records.	Administrative totals are not independently audited microdata.
Spillovers / national scaling	Observe market peers and use documented weights.	Selected pilot firms cannot support an unsupported national projection.

Sources: Callaway–Sant’Anna [\[S11\]](#); Sant’Anna–Zhao [\[S12\]](#); IDER calculations [\[S99\]](#).

A causal headline needs more than a well-fitted regression

The review should be signed before national extrapolation or public performance claims.

IDENTIFICATION CHECK

Document assignment, counterfactual, anticipation, interference and the estimand. Register alternative explanations and the analysis horizon before evaluating the outcomes.

DATA AND INFERENCE CHECK

Report original and linked counts/values, duplicates, exclusions, attrition and negative or missing outcomes. Validate dependence, small-cluster inference and multiple outcomes.

RELEASE CHECK

Publish actual estimates only with uncertainty and scope. When the design fails, release descriptive accounting, bounds and the specific missing evidence—not a fabricated causal coefficient.

Sources: Callaway–Sant’Anna [\[S11\]](#); Sant’Anna–Zhao [\[S12\]](#); IDER calculations [\[S99\]](#).

One reporting system needs plant, market, worker and payment records

Headers-only data templates are supplied in the package.

Table 33. One reporting system needs plant, market, worker and payment records

Dataset / grain	Essential fields	Validation
Plant–shift–day	Scheduled/run hours, rated speed, good units, rejects, inventories and dispatches.	Physical conservation, meter alignment and no duplicate product transfers.
Worker–employer–day	Pseudonymous ID, hours, pay, benefit, hire/exit and prior employment status.	Separate persons, jobs, hours and contract duration.
Market–firm–period	Product, price, full-period sales, supplier link and treatment exposure.	Track competitors and nonparticipants; stable units and boundaries.
Energy and cash events	kWh, peak kW, downtime, invoices, cost, due and payment dates.	No energy-sales or accrual-cash substitution.
Roster and assignment	Eligibility, offer, uptake, coverage, weights and closure.	Do not build the sample only from active participants.

Sources: IDER calculations [\[S99\]](#).

Monitor outcomes and constraints with measurable denominators

Proposed pilot outputs; achieved values must come from actual records.

Table 34. Monitor outcomes and constraints with measurable denominators

Indicator	Definition	Frequency / owner
Additional good output	Actual output minus supported counterfactual; physical units and VA separate.	Weekly/monthly / operations + evaluator.
Distinct people and FTE	Unique workers; hours divided by explicit reference, with duration.	Payroll cycle / HR and worker-data lead.
Demand conversion	Accepted incremental orders delivered and collected, not enquiries.	Weekly / commercial and finance.
Shift contribution	Additional earned revenue less matching incremental expenses; cash receipts reported separately.	Monthly / CFO.
Energy / worker protection	Metered cost, outage minutes, rest exceptions and wage-payment status.	Each shift / utility, safety and HR leads.
Market netting / coverage	Peer losses, supplier VA, nonresponse and unmatched records.	Each evaluation release / independent team.

Sources: IDER calculations [\[S99\]](#).

The decision object differs across operators, public bodies and investors

Use the report’s framework with verified institution-specific records.

Table 35. The decision object differs across operators, public bodies and investors

Audience	Useful decision object	Evidence still required
Manufacturers / logistics / exporters	Incremental order margin and linked-stage capacity.	Accepted demand, shift records, energy and cash.
Workers / unions / professional bodies	Paid-hour quality, additional jobs and safe access.	Contracts, rosters, transport, wages and grievance records.
Banks / funds / pensions / insurers / DFIs	Borrower or issuer liquidity under additional-shift cases.	Counterparty books, financing commitments and exposure limits.
MoF / GRA / Treasury / Parliament	Actual support costs and matched net outcome indicators.	Approvals, expenditures, tax costs, duration and additionality.
BoG / researchers / media / partners	A credible output–employment evaluation, not activity publicity.	Linked panel, assignment, coverage and independent replay.

Sources: IDER calculations [\[S99\]](#).

Note: This publication does not prescribe a security trade, lending decision, tax rate or endorsement of a policy alternative.

Validation separates new evidence from stronger conditional tests

Review: 2 October 2026. Original evidence cut-off remains 28 September 2026.

HISTORICAL EVIDENCE

Add six years of sector electricity consumption, the electricity-mix bridge, and published Ghanaian micro-firm coefficients. Source periods and populations stay explicit.

ENTERPRISE ROBUSTNESS

Test first-shift capacity, the demand–availability frontier and customer-payment delays. Finance can reverse an operating surplus without changing production.

CAUSAL RELEASE

Historical coefficients are not re-estimated. Empty current plant and worker templates cannot identify the programme effect. Attrition and small-cluster checks remain assumption-dependent.

Sources: World Bank Ghana ES [\[S06\]](#); Energy Commission 2026 bulletin [\[S07\]](#); Hardy–McCasland, WPS 9093 [\[S15\]](#); IDER calculations [\[S99\]](#).

Note: Additional source tables do not create a treated–comparison panel or a national employment estimate.

The electricity-mix comparison retains the source’s scope and rounding

2020–2025; GWh. Published total includes embedded generation and imports.

Table 36. The electricity-mix comparison retains the source's scope and rounding

Year	Hydro	Thermal	Other	Source total	Total – components
2020	7,293	12,815	57	20,165	0
2021	7,521	14,417	122	22,060	0
2022	8,192	14,818	162	23,172	0
2023	9,187	14,930	148	24,264	–1
2024	9,893	15,506	181	25,580	0
2025	8,752	18,996	197	27,945	0

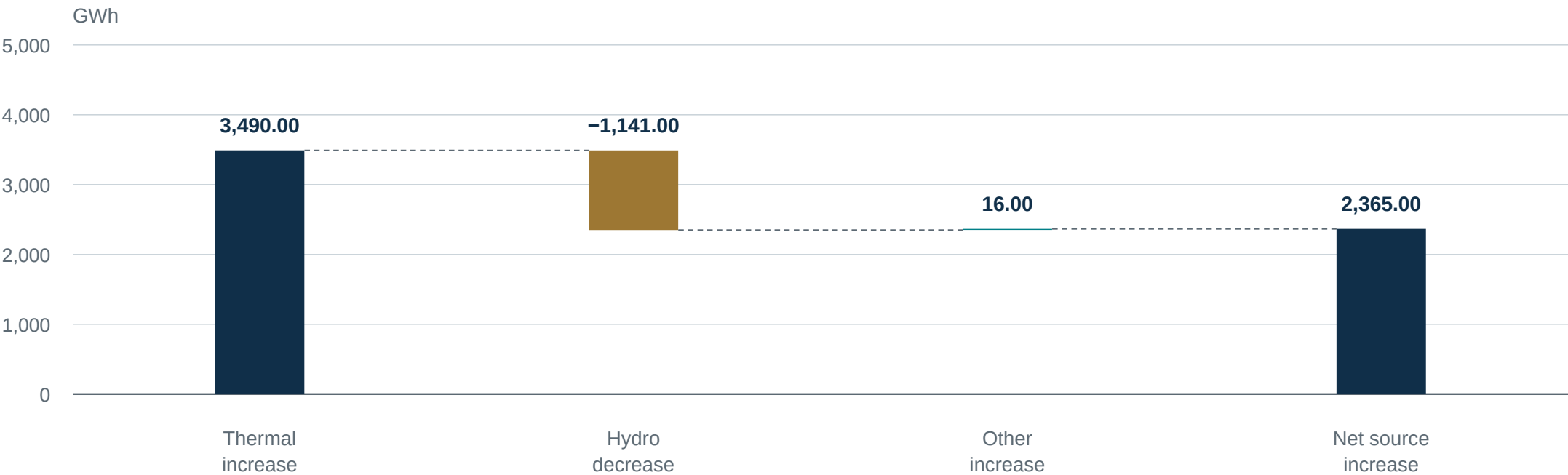
Sources: Energy Commission 2026 bulletin [\[S07\]](#); IDER calculations [\[S99\]](#).

Note: The 2023 residual is –1 GWh. Do not add imports again or interpret annual energy as feeder-level night availability.

Thermal growth exceeded the net electricity increase in 2025

Change from 2024 to 2025 in the source-defined energy series; not a programme effect.

Figure 17. Thermal growth exceeded the net electricity increase in 2025



Sources: Energy Commission 2026 bulletin [\[S07\]](#); IDER calculations [\[S99\]](#).

Note: The net source increase is 9.25%. Input fuel, emissions, dispatch and local delivery require separate records.

Industry used 560 GWh more in 2025; this is not an output estimate

Sector electricity consumption; original published amounts and residual retained.

Table 37. Industry used 560 GWh more in 2025; this is not an output estimate

Sector	2024, GWh	2025, GWh	Change, GWh	Growth, %
Residential	8,084.0	8,713.0	629.0	7.78
Industry	8,076.0	8,636.0	560.0	6.93
Services	4,133.0	4,445.0	312.0	7.55
Agriculture	18.7	22.9	4.2	22.46
Transport	5.0	5.2	0.2	4.00
Residual	0.3	-0.1	-0.4	Not applicable
Total	20,317.0	21,822.0	1,505.0	7.41

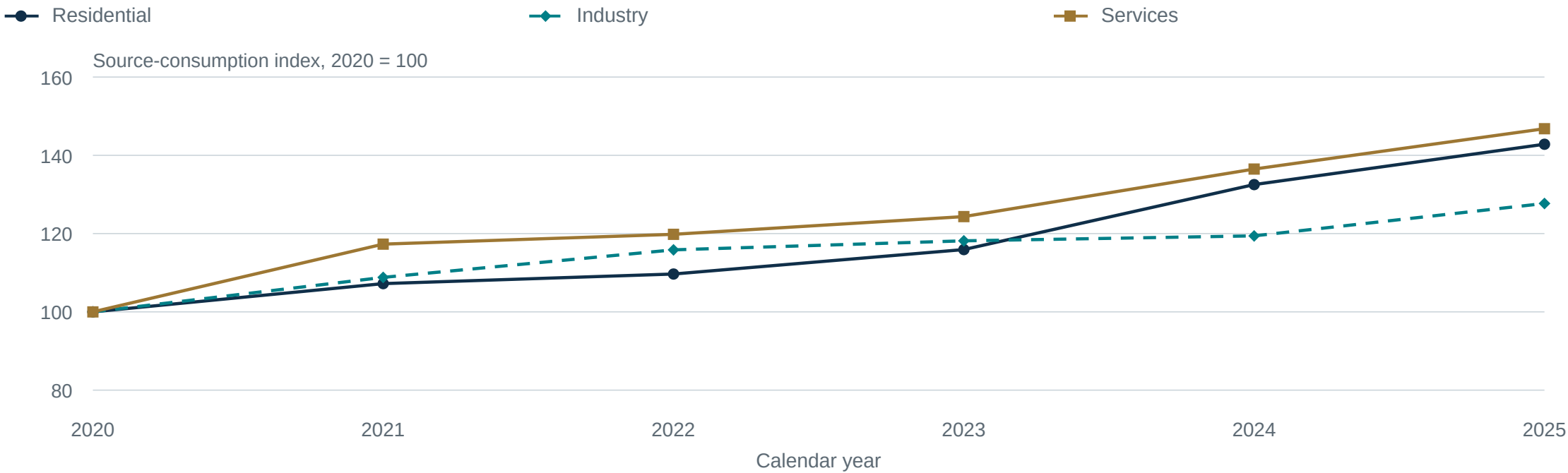
Sources: Energy Commission 2026 bulletin [\[S07\]](#); IDER calculations [\[S99\]](#).

Note: The source totals increase by 1,505 GWh. Residual changes reconcile rounded categories; consumption does not identify efficiency or shift timing.

Sector electricity demand followed different historical paths

2020 = 100; index of the published annual consumption amounts, not a fitted trend.

Figure 18. Sector electricity demand followed different historical paths



Sources: Energy Commission 2026 bulletin [\[S07\]](#); IDER calculations [\[S99\]](#).

Note: Metered night/day profiles, output and fuel substitution are absent. The index cannot be used as a 24H+ treatment effect.

Input and payment constraints can remain after an extra shift is staffed

Ghana 2023 Enterprise Survey profile; weighted historical estimates, not the pilot population.

Table 38. Input and payment constraints can remain after an extra shift is staffed

Firm size	Manufacturers using foreign inputs, %	Import clearance, days*	Firms using supplier/customer credit, %	Investment financed by banks, %
All eligible firms	54.7	20.6	26.1	5.0
Small: 5–19	55.4	21.0	25.3	3.2
Medium: 20–99	44.5	18.7	28.0	5.7
Large: 100+	84.1	22.3	26.3	13.3

Sources: World Bank Ghana ES [\[S06\]](#).

Note: *Manufacturing-only, applicable importing firms. Foreign-input prevalence is a firm share, not the share of materials imported. No standard errors reconstructed.

Historical Ghanaian micro-firms adjusted hours as well as sales

Hardy–McCasland: Hohoe garment firms, March–April 2015; source coefficients per extra blackout weekday.

Table 39. Historical Ghanaian micro-firms adjusted hours as well as sales

Source group / outcome	Coefficient	Clustered SE	Firm-week observations
One-person / Revenue	−4.40	1.24	1,265
One-person / Profit	−4.15	1.27	1,265
With workers / Revenue	0.76	2.33	1,097
With workers / Profit	2.07	2.09	1,097
With workers / Worker hours	3.13	0.96	1,097

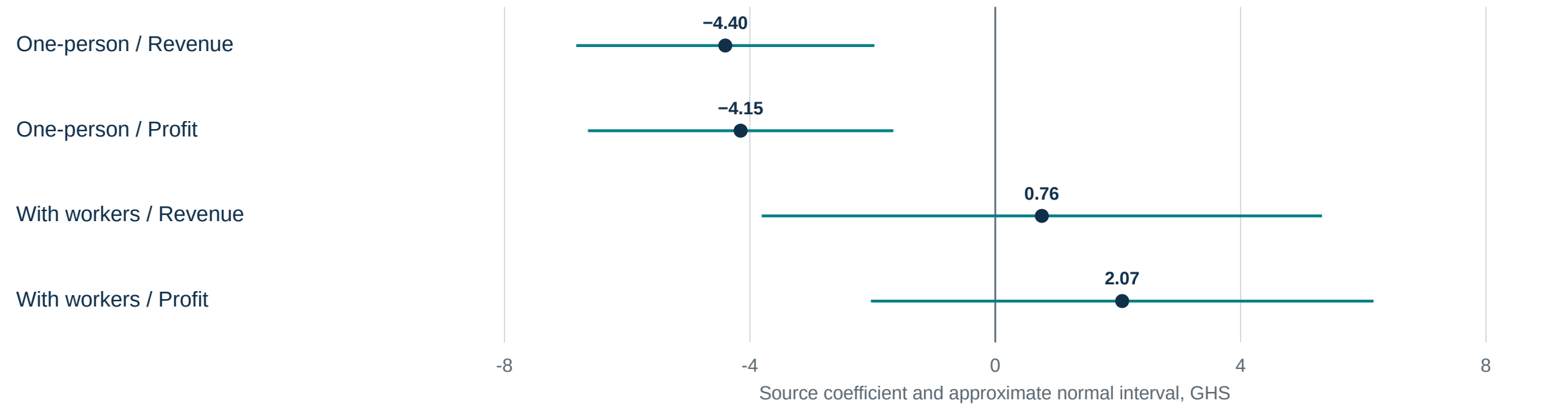
Sources: Hardy–McCasland, WPS 9093 [\[S15\]](#).

Note: Revenue/profit are GHS; worker-hours coefficient is hours. Firm/time effects; neighbourhood-clustered SE. Published estimates, not re-estimated.

Revenue and profit coefficients differ across the historical firm groups

GHS per additional blackout weekday; approximate normal pointwise 95% intervals from published clustered SE.

Figure 19. Revenue and profit coefficients differ across the historical firm groups



Sources: Hardy–McCasland, WPS 9093 [\[S15\]](#); IDER calculations [\[S99\]](#).

Note: Intervals use coefficient $\pm 1.96 \times$ rounded SE, not a recovered finite-cluster covariance matrix. No 2026 programme or night-shift effect is inferred.

Do not transport an outage coefficient into a night-shift employment forecast

The historical design informs measurement; it does not calibrate this report's enterprise examples.

SELECTION

The source analysis retains 342 electricity-connected surviving firms from a 445-firm listing; worker status is defined during the panel. These are selected strata, not Ghana-wide treatment groups.

ASSIGNMENT

Self-reported outages and firm/time effects require an exogeneity argument. Random survey-day assignment is not random assignment of power outages. A positive hours coefficient is not additional people.

NEXT STUDY

Freeze staffing groups before support begins. Reconcile outages to feeder logs; retain exits and excluded units. Test time-varying demand and market interference; do not infer equality from an imprecise estimate.

Sources: Hardy–McCasland, WPS 9093 [\[S15\]](#); IDER calculations [\[S99\]](#).

Note: The historical five-day and seven-day specifications are retained in the data package. Their exposure windows differ; no equality test is manufactured without covariance.

The first-shift counterfactual changes the measured production increment

F01 sensitivity: demand 23,000; common rate, performance and yield; first-shift availability varied.

Table 40. The first-shift counterfactual changes the measured production increment

First-shift availability	Feasible one-shift units	Two-shift units	Increment above one shift
80%	13,108.48	23,000.00	9,891.52
85%	13,927.76	23,000.00	9,072.24
90%	14,747.04	23,000.00	8,252.96
95%	15,566.32	23,000.00	7,433.68
100%	16,385.60	23,000.00	6,614.40

Sources: IDER calculations [\[S99\]](#).

Note: At the 90% base, the naïve 10,000-unit rise exceeds the 8,252.96-unit counterfactual increment by 21.17%. Neither is an identified programme effect.

At 23,000 units of demand, second-shift availability binds below 50.37%

Critical availability after the feasible first shift; F01 rate, performance and yield fixed.

Table 41. At 23,000 units of demand, second-shift availability binds below 50.37%

Monthly demand	Required second-shift availability	One added shift can supply demand?
16,000	7.65%	Yes, within stated capacity
18,000	19.85%	Yes, within stated capacity
23,000	50.37%	Yes, within stated capacity
28,000	80.88%	Yes, within stated capacity
33,000	111.40%	No: requirement exceeds 100%

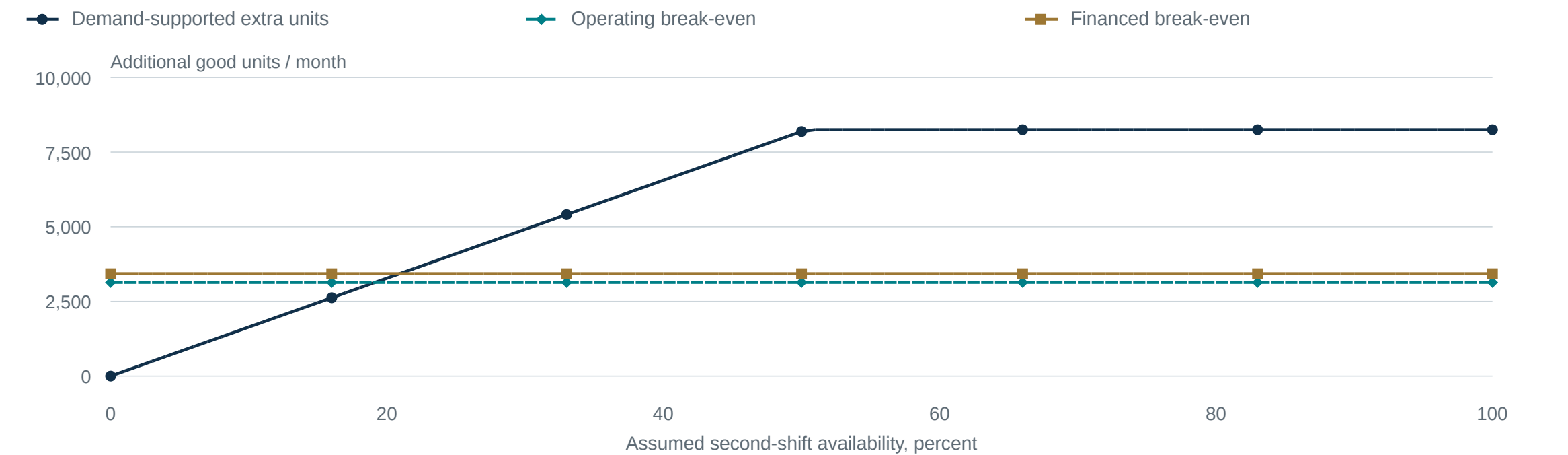
Sources: IDER calculations [\[S99\]](#).

Note: This is a capacity threshold, not a power-availability forecast. Beyond demand coverage, more uptime alone adds no sales under the model.

Capacity adequacy and cost recovery impose different thresholds

F01 at 23,000 demand; one extra staffed crew; all curves and thresholds are conditional.

Figure 20. Capacity adequacy and cost recovery impose different thresholds



Sources: IDER calculations [\[S99\]](#).

Note: Meeting demand is not required to break even. Adequate orders, legal rosters and a finance facility remain separate operating conditions.

Longer customer payment terms absorb more cash than the shift label reveals

F01: same output and costs; receivables varied; 30-day inventory and materials payables retained.

Table 42. Longer customer payment terms absorb more cash than the shift label reveals

Customer payment, days	Required NWC, GHS	Monthly finance, GHS	Surplus after finance, GHS
30	422,964.20	8,811.75	87,115.25
45	629,288.20	13,110.17	82,816.83
60	835,612.20	17,408.59	78,518.41
90	1,248,260.20	26,005.42	69,921.58
120	1,660,908.20	34,602.25	61,324.75

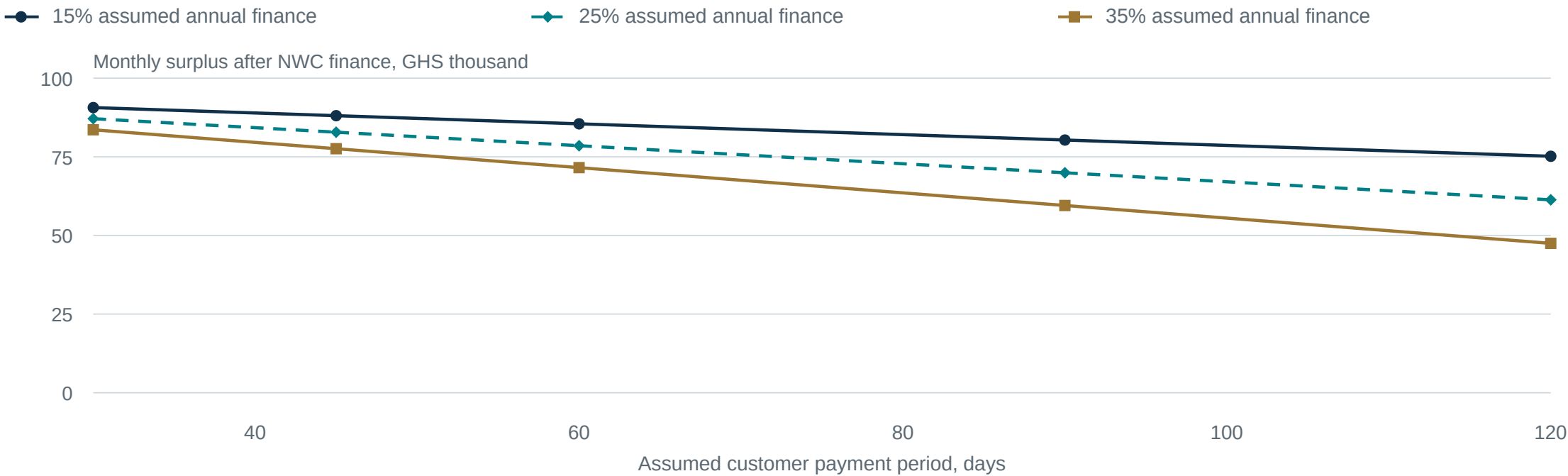
Sources: IDER calculations [\[S99\]](#).

Note: 25% annual simple finance is assumed. The cash stock is not an operating expense; setup, taxes, bad debts and unmodelled capital charges are excluded.

Operating surplus stays fixed while financing consumes the margin

F01: 8,252.96 extra units/month; no volume or default response imposed.

Figure 21. Operating surplus stays fixed while financing consumes the margin



Sources: IDER calculations [\[S99\]](#).

Note: A sensitivity curve is not a lending quotation, receivable valuation or forecast probability.

At 18,000 units of demand, finance reverses the operating surplus

F01 second shift; 45-day receivables and assumed 25% annual finance.

Table 43. At 18,000 units of demand, finance reverses the operating surplus

Demand, units	Extra units	Operating surplus, GHS	NWC finance, GHS	After finance, GHS
18,000	3,252.96	2,177.00	5,167.46	-2,990.46
19,000	4,252.96	20,927.00	6,756.00	14,171.00
23,000	8,252.96	95,927.00	13,110.17	82,816.83

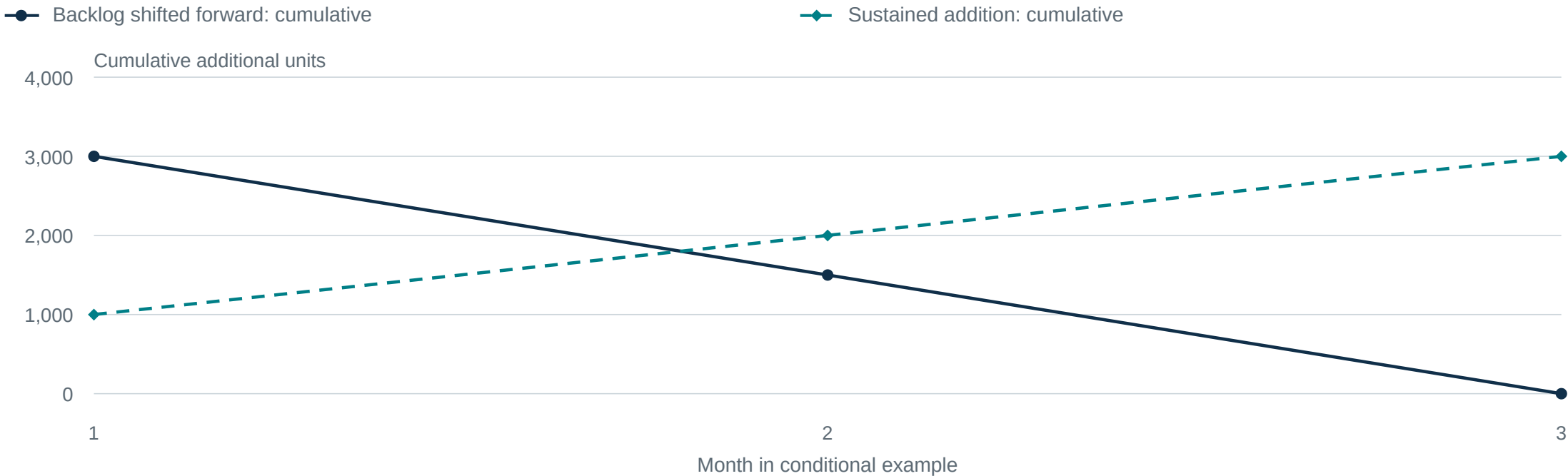
Sources: IDER calculations [\[S99\]](#).

Note: The financed total-demand threshold is 18,174.25 units, versus 17,883.89 before finance. These are mathematical thresholds, not recommended prices or wages.

A first-month gain can disappear when the whole delivery horizon is counted

Two independent three-month scenarios; increments already measured against their stated counterfactuals.

Figure 22. A first-month gain can disappear when the whole delivery horizon is counted



Sources: IDER calculations [\[S99\]](#).

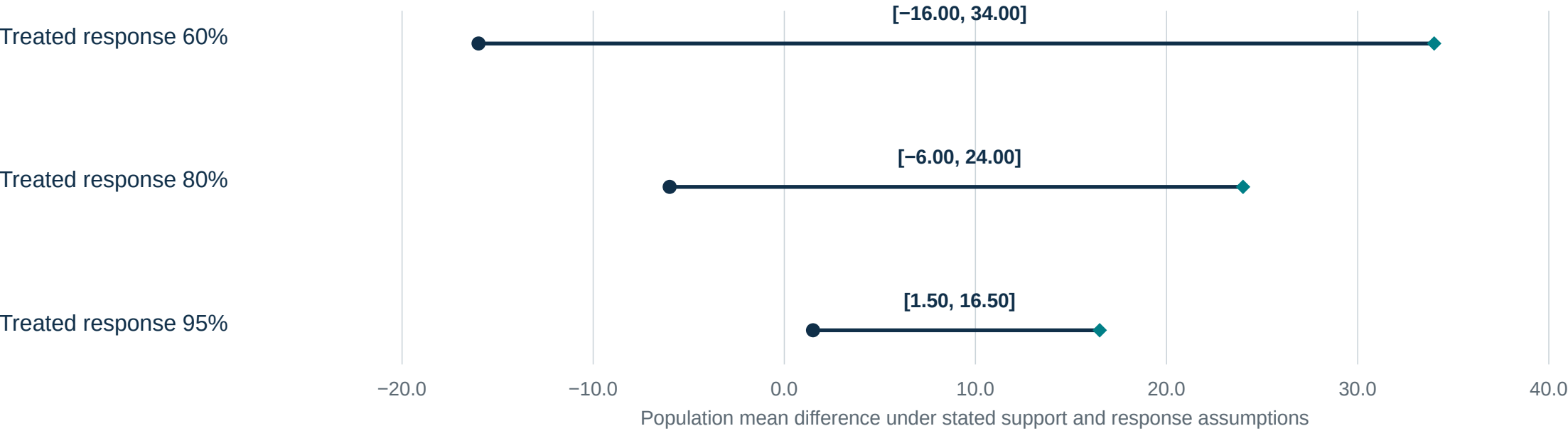
Note: Backlog path: +3,000, -1,500, -1,500; sustained path: +1,000 each month. Earlier delivery can have separate value even when cumulative output is unchanged.

A positive respondent difference can have a negative missing-outcome bound

Observed means 50 versus 40; comparison response 90%; outcome support 0–100.

Figure 23. A positive respondent difference can have a negative missing-outcome bound

CONDITIONAL RANGES — NOT CONFIDENCE INTERVALS



Sources: IDER calculations [\[S99\]](#).

Note: At 80% treated response, the mean-difference bounds are -6 to +24. These are not sampling intervals or causal effects without valid assignment.

Finite-cluster planning is less optimistic than a normal approximation

Balanced two-arm design; 18 retained firms/cluster; ICC 0.05; two-sided 5% level; 80% power.

Table 44. Finite-cluster planning is less optimistic than a normal approximation

Independent clusters	Degrees of freedom	Normal MDE / SD	Noncentral-t MDE / SD
12	10	0.519	0.576
24	22	0.367	0.384
48	46	0.259	0.265
96	94	0.183	0.185

Sources: IDER calculations [\[S99\]](#).

Note: Ideal independent Gaussian cluster means; equal retained sizes; no baseline gain. Whole-cluster attrition, unequal sizes and interference require a new calculation.

Endogeneity and sample selection require evidence at the assignment stage

Current programme outcomes remain unestimated; the historical coefficient is a separate source result.

DESIGN

Freeze eligibility, offer date, uptake, orders and baseline staffing. Estimate offer effects separately from participation; avoid controlling for post-offer credit, orders or hours in a total-effect regression.

INFERENCE

Estimate cohort/horizon effects only with defensible comparisons. Use market/feeder assignment-level dependence and pre-specified outcomes. Non-rejection of a pre-trend or effect is not proof of equivalence.

COVERAGE

Report roster → eligible → linked → observed counts and values. Keep closures, zero/negative outcomes and missing peers. MAR weights require overlap; show non-random missingness and spillover sensitivities.

Sources: Callaway–Sant’Anna [\[S11\]](#); Sant’Anna–Zhao [\[S12\]](#); IDER calculations [\[S99\]](#).

Note: The five current-study empirical templates still contain no observation rows. No national coefficient or artificial confidence band is created.

The validation record separates corrected labels from unchanged assumptions

No historical source value or conditional F01 headline has been silently overwritten.

Table 45. The validation record separates corrected labels from unchanged assumptions

Reviewed issue	Treatment in this edition	Boundary
Operating contribution versus cash receipts	Dashboard uses earned revenue and matching expenses; cash collections are separate.	No claim that a receivable is usable cash.
Energy source perimeter	Imports/embedded-generation note and source residuals retained.	No national annual spare-capacity claim for night feeders.
Historical empirical coefficients	Original clustered SE and distinct populations/window retained.	Not re-estimated and not a 24H+ effect.
Conditional factory and finance	All 225 original cases checked; new counterfactual and payment sensitivities added.	No fictitious factory observations or scenario probabilities.
Chart and catalogue integrity	Every numbered exhibit is bound to data; methods carry assumptions and status.	Reproduction is not an external account audit.

Sources: IDER calculations [\[S99\]](#).

Note: The code and change register record these checks. Legal and tariff sources retain the original evidence cut-off rather than implying a complete October legal update.

An additional shift is a business case only when orders cover its costs

For manufacturers, agro-processors, logistics firms, MSMEs, exporters, executives and finance teams.

F01 | CONDITIONAL CASE

8,252.96 units

Additional monthly output after allowing the first shift to use its spare capacity. The before–after difference is 10,000.

WHAT THIS MEANS

Verify additional demand before staffing unused capacity. The third shift in F01 raises capacity, but not sales at the same 23,000-unit demand.

DO NOT INFER

Longer hours alone do not establish additional national output or employment.

WITHIN 30 DAYS

CFO + operations + commercial lead

Reconcile the order book, capacity and incremental costs; produce a dated cash schedule.

MEASURABLE ACCEPTANCE

Every proposed shift has order, output, staffing, energy and cash evidence or a visible gap.

Sources: IDER calculations [\[S99\]](#).

Note: Conditional examples are not programme outcomes. Proposed actions apply to a defined, authorised scope.

More hours are not necessarily more people in work

For workers, unions, HR teams, professional associations, regulators, lenders and institutional investors.

EMPLOYMENT ACCOUNT

+4 FTE / 0 people

Twenty workers moving from 40 to 48 hours create more paid-hour equivalents, not new employed persons.

WHAT THIS MEANS

Report people, paid hours and job duration separately. Check rest, pay, transport and contribution records; trace recruits who moved from other employers.

DO NOT INFER

Longer hours alone do not establish additional national output or employment.

WITHIN 30 DAYS

HR + worker representatives

Establish pseudonymous worker IDs and a reconciled payroll–hours–roster account.

MEASURABLE ACCEPTANCE

No person is counted twice; hires, exits, overtime, part-time hours and paid contributions remain distinct.

Sources: IDER calculations [\[S99\]](#).

Note: Conditional examples are not programme outcomes. Proposed actions apply to a defined, authorised scope.

Net additionality has to be measured beyond participating sites

For MoF, BoG, GRA, Parliament, development partners, researchers, media, consumers and diaspora organisations.

R01 MARKET EXAMPLE 400 → 50 Night transactions of 400 contain 250 moved from daytime and 100 diverted from peers; only 50 are new in this assumed market.	WHAT THIS MEANS Pilot launches and participation counts do not measure causal output or job growth. Market losses, normal growth and programme costs belong in the assessment. DO NOT INFER Longer hours alone do not establish additional national output or employment.	WITHIN 90 DAYS Data custodians + IDER evaluation lead Publish a pilot roster, assignment record and separate site and market accounts. MEASURABLE ACCEPTANCE Report population coverage, displacement assumptions and unresolved identification; no unsupported national multiplier.
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Sources: IDER calculations [\[S99\]](#).
Note: Conditional examples are not programme outcomes. Proposed actions apply to a defined, authorised scope.

Establish what would happen without the added shift

For the 24-Hour Economy Authority, MoF, sector agencies, IDER and participating firms.

A01 Register the baseline and the exact treatment event

PROPOSED OWNER

Authority data lead + IDER

TIME

Day 30 after approved access

ACTION / DELIVERABLE

Create a plant-level roster with pre-offer shifts, output, orders, employment and energy records. Distinguish eligibility, offer, uptake and first additional shift.

MEASURABLE ACCEPTANCE TEST

100% of in-scope plants have IDs, baseline dates and treatment status. Missing histories and existing 24-hour operators remain visible.

A02 Prespecify the counterfactual and comparison population

PROPOSED OWNER

IDER methods lead + data custodians

TIME

Day 45 design review

ACTION / DELIVERABLE

Document rollout rules, comparison firms, market boundaries, anticipation and potential spillovers before estimating effects. Retain non-takers and closures.

MEASURABLE ACCEPTANCE TEST

A signed design note states the estimand and identifying assumptions. Unsupported comparisons are labelled descriptive, not causal.

Sources: IDER calculations [\[S99\]](#).

Note: Proposed owners and targets; the clock starts after authorised access and approval. No institutional mandate, policy endorsement or investment decision is implied.

Tie shift expansion to accepted demand and physical output

For manufacturers, processors, BPO providers, commercial teams and accountants.

A03 Reconcile the shift-to-output production account

PROPOSED OWNER

Operations + quality + finance

TIME

Day 30 baseline; weekly

ACTION / DELIVERABLE

Match scheduled hours, runtime, good units, scrap, inventories and dispatches. Trace transfers and rework so the same product is not counted twice.

MEASURABLE ACCEPTANCE TEST

Every captured shift balances physical inputs and outputs or reports a quantified residual. Quality and unit changes are flagged.

A04 Validate orders and full-period customer demand

PROPOSED OWNER

Commercial lead + CFO

TIME

Day 30; review monthly

ACTION / DELIVERABLE

Separate new orders, backlog clearance and sales shifted from daytime or peers. Match accepted orders to deliveries, returns and actual receipts.

MEASURABLE ACCEPTANCE TEST

All claimed additional sales have a fixed product unit, period, customer status and evidence of acceptance; speculative enquiries are excluded.

Sources: IDER calculations [\[S99\]](#).

Note: Proposed owners and targets; the clock starts after authorised access and approval. No institutional mandate, policy endorsement or investment decision is implied.

Test the electricity and logistics constraints together

For utilities, regulators, operators, depots, transport firms and logistics customers.

A05 Measure feeder-level demand, interruptions and cost

PROPOSED OWNER

Utility liaison + plant engineer

TIME

Day 30 meter plan; Day 60 review

ACTION / DELIVERABLE

Link interval kW/kWh, outage minutes, restart losses and backup use to each shift. Verify tariff class and distinguish fixed from incremental charges.

MEASURABLE ACCEPTANCE TEST

All cost cases disclose meter coverage, applicable tariff and backup assumptions. No national capacity comparator is described as a local guarantee.

A06 Synchronise the stages that constrain throughput

PROPOSED OWNER

Logistics operations + receiving firms

TIME

Day 45 joint pilot

ACTION / DELIVERABLE

Record gate release, truck availability, customs milestones and receiver acceptance. Test common operating windows before attributing more dispatches to gate hours.

MEASURABLE ACCEPTANCE TEST

Every sampled movement has stage timestamps and an identified bottleneck. Output gains are counted at completion, not from opened gates.

Sources: IDER calculations [\[S99\]](#).

Note: Proposed owners and targets; the clock starts after authorised access and approval. No institutional mandate, policy endorsement or investment decision is implied.

Count additional people and protect the working schedule

For HR teams, workers, unions, contractors, Labour Department and professional bodies.

A07 Maintain distinct person, job and paid-hour records

PROPOSED OWNER

HR + payroll + worker representatives

TIME

Day 30; each payroll cycle

ACTION / DELIVERABLE

Deduplicate worker IDs; record hires, exits, prior employment, contract duration, paid hours and overtime. Publish headcount and FTE separately.

MEASURABLE ACCEPTANCE TEST

Payroll totals reconcile to paid-hour records. No shift, person-day or job-to-job move is automatically labelled a new national job.

A08 Audit rosters, pay and safe access before each shift

PROPOSED OWNER

HR + safety lead + worker representatives

TIME

Before launch; monthly review

ACTION / DELIVERABLE

Check lawful breaks, rest, applicable overtime terms and consent protections. Record transport, lighting, supervision, wage payment and grievance handling.

MEASURABLE ACCEPTANCE TEST

Each active roster has an approved compliance check; exceptions have owners and resolution dates. Workers have a documented reporting route.

Sources: IDER calculations [\[S99\]](#).

Note: Proposed owners and targets; the clock starts after authorised access and approval. No institutional mandate, policy endorsement or investment decision is implied.

Keep accounting gains separate from the cash needed to operate

For CFOs, SMEs, suppliers, contractors, exporters, banks and corporate treasuries.

A09 Build an incremental contribution and break-even account

PROPOSED OWNER

CFO + operations accountant

TIME

Day 30; refresh monthly

ACTION / DELIVERABLE

Charge added labour, materials, energy, security, transport and maintenance to demand above the counterfactual. Test wage and energy assumptions separately.

MEASURABLE ACCEPTANCE TEST

The model reconciles revenue, intermediate cost, compensation and surplus. Fixed staffing cost is retained when demand falls.

A10 Maintain a 13-week working-capital and payment schedule

PROPOSED OWNER

Treasury + receivables and procurement

TIME

Day 30; update weekly

ACTION / DELIVERABLE

Link extra orders to inventory, customer collections, supplier credit, setup and funding. Include delayed-payment cases and committed versus uncommitted finance.

MEASURABLE ACCEPTANCE TEST

Opening cash plus receipts less payments equals closing cash in each scenario. Receivables are never counted as already available cash.

Sources: IDER calculations [\[S99\]](#).

Note: Proposed owners and targets; the clock starts after authorised access and approval. No institutional mandate, policy endorsement or investment decision is implied.

Report net local outcomes and matched public costs

For programme analysts, MoF, GRA, Treasury, Parliament and development partners.

A11 Follow nonparticipating peers and domestic suppliers

PROPOSED OWNER

IDER field lead + market associations

TIME

Day 60 roster; quarterly

ACTION / DELIVERABLE

Measure same-period sales, output and worker changes in linked markets. Separate domestic diversion, supplier gains and import substitution.

MEASURABLE ACCEPTANCE TEST

Each net estimate states geography, product boundary, supplier treatment and missing-peer coverage. No supplier turnover is double-counted as VA.

A12 Reconcile support expenditure to net job-years

PROPOSED OWNER

MoF programme accountant + evaluator

TIME

Day 90 baseline; quarterly

ACTION / DELIVERABLE

Track appropriations, commitments, payments, tax expenditures and guarantees separately. Match actual cost periods to net attributable FTE job-years.

MEASURABLE ACCEPTANCE TEST

Cost per job-year is released only with a defensible positive denominator. Targets are not used as realised jobs; guarantees remain separately disclosed.

Sources: IDER calculations [\[S99\]](#).

Note: Proposed owners and targets; the clock starts after authorised access and approval. No institutional mandate, policy endorsement or investment decision is implied.

Use verified counterparty data and independent evaluation gates

For banks, funds, pensions, insurers, DFIs, private equity, researchers and diaspora investors.

A13 Stress the counterparty’s additional-shift cash exposure

PROPOSED OWNER

Credit / investment analyst + risk team

TIME

Day 45; review monthly

ACTION / DELIVERABLE

Replace the standardised assumptions with contracts, bills and payroll. Test demand shortfall, outages, higher premiums and delayed receipts jointly.

MEASURABLE ACCEPTANCE TEST

Each case identifies evidence, assumptions and liquidity limits. Scenario surpluses are not labelled default probabilities or promised returns.

A14 Prespecify precision, attrition and interference checks

PROPOSED OWNER

IDER methods lead + independent reviewer

TIME

Day 90; first results Day 180

ACTION / DELIVERABLE

Freeze outcomes, horizons and analysis population. Assess clusters, sample size, overlap, nonresponse and market spillovers before fitting the model.

MEASURABLE ACCEPTANCE TEST

The design record includes a power assessment and release decision. Invalid causal designs stop at verified descriptive or bounded results.

Sources: IDER calculations [\[S99\]](#).

Note: Proposed owners and targets; the clock starts after authorised access and approval. No institutional mandate, policy endorsement or investment decision is implied.

Make every public claim reproducible and correctly labelled

For media, consumer groups, think tanks, Parliament, commissioning institutions and IDER.

A15 Attach evidence status and denominators to each headline

PROPOSED OWNER

Publication lead + communications teams

TIME

Day 15 template; every release

ACTION / DELIVERABLE

Show period, population, unit, counterfactual and whether a number is observed, targeted or conditional. Include limitations in extracts and presentations.

MEASURABLE ACCEPTANCE TEST

100% of released figures carry units, sources and reproducible values. Opening hours are never described as measured net jobs or GDP.

A16 Close the pilot with an independent outcome review

PROPOSED OWNER

Authority monitoring + IDER + reviewers

TIME

Day 180; subsequent follow-up

ACTION / DELIVERABLE

Reconcile actual output, jobs, job quality, market changes and costs. Separate implementation fidelity from impact and record the unresolved evidence needs.

MEASURABLE ACCEPTANCE TEST

Release a versioned dataset or disclosure-safe extract, code, exceptions and signed review. No conclusion is conditional on achieving a favourable result.

Sources: IDER calculations [\[S99\]](#).

Note: Proposed owners and targets; the clock starts after authorised access and approval. No institutional mandate, policy endorsement or investment decision is implied.

Definitions, calculations and causal designs have different evidential status

E01–E32 include executed calculations and separately identified historical estimates; P01–P04 remain prospective.

A1 | MATCH THE UNIT

Use the same plant, product, period and geography. Define good output, constant prices, accepted services and the hours convention. Do not combine unlike sector units.

A2 | RECONCILE THE ACCOUNT

Keep capacity, orders, sales, inventories, VA and cash distinct. Include each input cost once; preserve worker identities and separate a person from a job relationship.

A3 | STATE THE LIMIT

All scenario demand, uptime, staffing and finance parameters are imposed. Population and causal estimates require observed coverage, assignment and outcomes. No hypothetical row is a firm observation.

Sources: IDER calculations [\[S99\]](#).

Note: Additional conditions: verify legal scope; document missingness; test spillovers; report uncertainty at the relevant assignment level.

Additional output and counterfactual / Output and domestic value added

E01: results p. 44 | E02: results p. 48

E01 Additional output and counterfactual

EXECUTED CONDITIONAL ADDITIONALITY

$$\Delta Q = Q_1 - Q_0^{cf} \tag{E01.1}$$

$$Q_1 - Q_{pre} = \Delta Q + (Q_0^{cf} - Q_{pre}) \tag{E01.2}$$

Q: matched good units; cf: specified without-shift alternative; pre: earlier observed/assumed level.

ASSUMPTIONS / AXIOMS

F01 uses common demand in both alternatives and idle baseline capacity. Arithmetic does not validate the counterfactual.

8,252.96 additional units; 10,000 before–after.

E02 Output and domestic value added

EXECUTED ACCOUNTING

$$VA = V_{output} - IC \tag{E02.1}$$

$$\Delta OS = \Delta VA - \Delta Comp \tag{E02.2}$$

IC: intermediate consumption; Comp: labour compensation; OS: operating surplus before finance/tax.

ASSUMPTIONS / AXIOMS

Same constant prices and production perimeter. External services are IC; wages are not counted twice.

F01 VA 142,743; compensation 46,816; surplus 95,927.

Calendar and scheduled utilisation / Effective good-output capacity

E03: results p. 40 | E04: results p. 42

E03 Calendar and scheduled utilisation

DEFINED MEASUREMENT

$$U_{cal} = H_{run}/H_{calendar} \tag{E03.1}$$

$$U_{sched} = H_{run}/H_{scheduled} \tag{E03.2}$$

H: machine running, calendar or scheduled hours. Denominators must include their stated exclusions.

ASSUMPTIONS / AXIOMS

A plant calendar differs from an individual worker roster. Calendar 168 hours/week is not a lawful individual schedule.

Hours utilisation is not good-output or demand utilisation.

E04 Effective good-output capacity

EXECUTED ENGINEERING SCENARIO

$$K_s = vH_s a_s p_s y_s \tag{E04.1}$$

$$K_{total} = \sum_s K_s \tag{E04.2}$$

v: units/hour; H: scheduled hours; a: availability; p: performance; y: good-unit yield.

ASSUMPTIONS / AXIOMS

Do not double-count downtime or reject losses across factors. F01 rates and shifts are assumptions.

First 14,747.04; second adds 13,927.76 units.

Production and demand constraints / Contribution of additional demand

E05: results p. 41 | E06: results p. 43

E05 Production and demand constraints

EXECUTED CONDITIONAL BOUND

$$Q_n = \min(K_n, D, I, L) \tag{E05.1}$$

$$Q_0^{cf} = \min(K_1, D, I_0, L_0) \tag{E05.2}$$

D: accepted demand; I/L: compatible input/logistics capacity. All expressed as final good units.

ASSUMPTIONS / AXIOMS

F01 inputs/logistics are non-binding; production follows demand. Inventories require a separate account.

More capacity need not increase delivered output.

E06 Contribution of additional demand

EXECUTED CONDITIONAL SCENARIO

$$\Delta Q(D) = \min(K_2, D) - \min(K_1, D) \tag{E06.1}$$

$$\Delta Q(D) = 0 \quad \text{if } D \leq K_1 \tag{E06.2}$$

K1/K2: one/two-shift good capacity. D varies over stated scenario values, not sampled firms.

ASSUMPTIONS / AXIOMS

Unchanged first-shift capability and non-binding other stages. No price elasticity is estimated.

At D=23,000, incremental units are 8,252.96.

People, hours and FTE / Roster staffing requirement

E07: results p. 50 | E08: results p. 51

E07 People, hours and FTE

EXECUTED WORK-ACCOUNT EXAMPLE

$$FTE = \sum_i h_i / h^* \tag{E07.1}$$

$$\Delta HC = HC_1 - HC_0^{cf} \tag{E07.2}$$

h*: reference 40 hours/week; HC: unique persons. Paid and actual hours must not be mixed.

ASSUMPTIONS / AXIOMS

FTE is a measurement convention; overtime does not automatically create another person employed.

20×48 hours gives 24 FTE and 20 people.

E08 Roster staffing requirement

EXECUTED COVERAGE LOWER BOUND

$$N_{eq} = H_{cover} / (h^* b) \tag{E08.1}$$

$$N_{min} = \lceil N_{eq} \rceil \tag{E08.2}$$

b: productive roster availability; h*=40/week; Hcover: hours requiring one staffed position.

ASSUMPTIONS / AXIOMS

Availability is assumed; integer coverage is necessary, not sufficient for legal breaks, rest and skill mix.

168/(40×0.85)=4.94; integer bound is five.

Loaded additional-shift labour cost / Incremental operating surplus

E09: results p. 53 | E10: results p. 45

E09 Loaded additional-shift labour cost

EXECUTED CONDITIONAL COSTING

$$W_{base} = NHw \tag{E09.1}$$

$$F = W_{base}(1 + \pi + e) + X \tag{E09.2}$$

N: crew; H: paid hours; w: basic hourly wage; pi: premium; e=.13 employer basic-pay contribution; X: external fixed costs.

ASSUMPTIONS / AXIOMS

Premium is imposed, not a statutory universal rate; employee pension deduction is not extra employer cost.

Base 35,200; total extra-shift cost 58,816 GHS.

E10 Incremental operating surplus

EXECUTED ENTERPRISE ACCOUNT

$$\Delta OS = \Delta Q(p - c) - F \tag{E10.1}$$

$$c = c_{material} + k t_e \tag{E10.2}$$

p: net unit price; c: variable resource cost; k: kWh/good unit; te: energy cost; F: fixed extra-shift cost.

ASSUMPTIONS / AXIOMS

Fixed wage cost remains when demand is low. Existing costs cancel only if unchanged in the counterfactual.

Before finance, setup and tax; no investment return claimed.

Operating and financed break-even / Power versus energy comparators

E11: results pp. 47, 69 | E12: results pp. 35, 39

E11 Operating and financed break-even

EXECUTED THRESHOLD

$$\Delta Q^* = F/(p - c) \tag{E11.1}$$

$$\Delta Q_{fin}^* = F/(p - c - nr/12) \tag{E11.2}$$

n: working-capital requirement per additional monthly unit; r: assumed annual simple funding rate.

ASSUMPTIONS / AXIOMS

Positive contribution required. Fixed setup, taxes and nonlinear prices are excluded from this threshold.

Operating 3,136.85; financed 3,427.21 extra units.

E12 Power versus energy comparators

EXECUTED DATED COMPARISON

$$G = C_{dependable} - Peak_{system} \tag{E12.1}$$

$$Cost_{energy} = kWh \times (GHP/kWh)/100 \tag{E12.2}$$

G: non-coincident annual capacity–peak comparator in MW. Energy charge converts pesewas to cedis.

ASSUMPTIONS / AXIOMS

G is not a plant-level reserve margin or contracted delivery. Tariff eligibility and extra charges remain separate.

2025 comparator 685 MW; not guaranteed spare night power.

Incremental working capital / Surplus after working-capital finance

E13: results p. 67 | E14: results p. 68

E13 Incremental working capital

EXECUTED STEADY-STATE EXAMPLE

$$NWC = R_m DSO/30 + C_m DIO/30 - M_m DPO/30 \quad (E13.1)$$

$$J_m = NWC r/12 \quad (E13.2)$$

Monthly additional sales R_m , variable costs C_m , materials M_m ; day conventions are explicit.

ASSUMPTIONS / AXIOMS

Thirty-day modelling month; supplier credit only on materials. No actual borrower record or funding quote.

NWC 629,288.20; monthly interest 13,110.17 GHS.

E14 Surplus after working-capital finance

EXECUTED CONDITIONAL CASH COST

$$\Delta OS_{net} = \Delta OS - J_m \quad (E14.1)$$

$$Cash_{initial} = NWC + Setup \quad (E14.2)$$

Setup is an assumed one-off cash requirement; not repeated monthly operating expense.

ASSUMPTIONS / AXIOMS

Before tax and capex beyond specified setup. NWC stock is not an extra income-statement cost.

Surplus after NWC finance: GHS 82,816.83/month.

Time redistribution and new demand / Domestic displacement and spillovers

E15: results p. 57 | E16: results p. 65

E15 Time redistribution and new demand

EXECUTED ACCOUNTING EXAMPLE

$$Q_{night} = Q_{time} + Q_{diverted} + Q_{new} \tag{E15.1}$$

$$Q_{new} = 400 - 250 - 100 = 50 \tag{E15.2}$$

Same physical purchase unit, geography and full-period baseline.

ASSUMPTIONS / AXIOMS

Categories are imposed and mutually exclusive. Convenience gains need a separate welfare measure.

Night trading can grow without equal market growth.

E16 Domestic displacement and spillovers

EXECUTED CONDITIONAL NETTING

$$\Delta VA_{net} = \Delta VA_{direct} + \Delta VA_{supply} - \Delta VA_{displaced} \tag{E16.1}$$

$$\Delta Q_{market} = \Delta Q_{site}(1 - d) \tag{E16.2}$$

d: assumed domestic diversion share; supply and displacement are additional VA, not turnover.

ASSUMPTIONS / AXIOMS

Consistent geography, period and counterfactual; no empirical national multiplier is calibrated.

150,000 + 25,000 – 55,000 = 120,000 GHS.

Saleable output from lower spoilage / Linked logistics throughput

E17: results p. 60 | E18: results p. 59

E17 Saleable output from lower spoilage

EXECUTED COLD-CHAIN EXAMPLE

$$Q_{saleable} = Q_{in}(1 - \ell) \tag{E17.1}$$

$$\Delta Q = 100(.12 - .05) = 7 \tag{E17.2}$$

Loss share ℓ ; Q_{in} : same input tonnes. Extra storage, energy and logistics costs are separate.

ASSUMPTIONS / AXIOMS

Loss reduction is assumed. More saleable tonnes are not an increase in harvest; retail margin valuation differs.

Seven saleable tonnes per 100 received.

E18 Linked logistics throughput

EXECUTED BOTTLENECK MODEL

$$Q = \min(K_{gate}, K_{fleet}, K_{receiver}) \tag{E18.1}$$

$$\Delta Q = \min(120, 100, 110) - 70 = 30 \tag{E18.2}$$

All capacities refer to completed dispatches/day.

ASSUMPTIONS / AXIOMS

Compatible stages, no stochastic queues and constant dispatch definition. Longer gate hours alone can yield zero.

The gate-only scenario remains at 70 dispatches/day.

Accepted service exports / Employment-flow reconciliation

E19: results p. 61 | E20: results p. 56

E19 Accepted service exports

EXECUTED SERVICE-OUTPUT EXAMPLE

$$\Delta H_{accepted} = H_1 - H_0^{cf} \tag{E19.1}$$

$$\Delta Revenue = p_H \Delta H_{accepted} \tag{E19.2}$$

Accepted billable hours with unchanged task/quality; p_H assumed GHS 80/hour.

ASSUMPTIONS / AXIOMS

New external demand is assumed; exclude idle/rejected time and domestic subcontract transfers.

600 additional accepted hours; GHS 48,000 invoices.

E20 Employment-flow reconciliation

DEFINED WORKER ACCOUNT

$$HC_1 = HC_0 + Hires - Separations \tag{E20.1}$$

$$Hires = FromNonemployment + JobToJob \tag{E20.2}$$

Count unique workers in a specified employer and time window; reconcile multiple-job holding.

ASSUMPTIONS / AXIOMS

Job-to-job moves do not establish net national job creation or loss; observe origin vacancies and counterfactual exits.

Six and four are assumed origin counts, not net effects.

Net FTEs and duration / Matched fiscal cost per job-year

E21: results p. 70 | E22: results p. 70

E21 Net FTEs and duration

EXECUTED JOB-YEAR EXAMPLE

$$J_{net} = J_{direct} + J_{supply} - J_{displaced} \tag{E21.1}$$

$$JY_{net} = \int J_{net}(t) dt \tag{E21.2}$$

t: years; J: additional FTE jobs under matched boundaries. Constant eight jobs for 0.5 year gives four job-years.

ASSUMPTIONS / AXIOMS

No assumption of permanent duration from a short pilot; include closure and negative effects.

10 + 2 – 4 = 8 net FTE jobs in the example.

E22 Matched fiscal cost per job-year

EXECUTED CONDITIONAL RATIO

$$CostPerJY = C_{public} / JY_{net} \tag{E22.1}$$

$$CostPerJY \text{ not reported if } JY_{net} \leq 0 \tag{E22.2}$$

C_{public}: matched actual or explicitly assumed public cost. Transfers, resource costs and guarantees stay separate.

ASSUMPTIONS / AXIOMS

The GHS 1.2m example is not the programme appropriation; no jobs target is used as achieved denominator.

1,200,000/4 = 300,000 GHS per net job-year.

Unobserved-outcome bounds / Cluster-design precision

E23: results p. 76 | E24: results p. 77

E23 Unobserved-outcome bounds

EXECUTED SENSITIVITY EXAMPLE

$$\mu = \rho\mu_{obs} + (1 - \rho)\mu_{miss} \tag{E23.1}$$

$$\mu \in [\rho\mu_{obs}, \rho\mu_{obs} + 100(1 - \rho)] \tag{E23.2}$$

rho: assumed response share; outcome restricted to 0–100; observed mean imposed in the illustration.

ASSUMPTIONS / AXIOMS

Support must be justified for actual data. Bounds are not sampling intervals or corrected national estimates.

At response 80% and observed mean 40, bounds are 32–52.

E24 Cluster-design precision

EXECUTED PLANNING APPROXIMATION

$$DE = 1 + (m - 1)ICC \tag{E24.1}$$

$$MDE/\sigma = 2(z_{.975} + z_{.80})\sqrt{DE/(Km)} \tag{E24.2}$$

K: total balanced two-arm clusters; m=18 retained firms/cluster; ICC assumed.

ASSUMPTIONS / AXIOMS

Normal approximation; no baseline adjustment. Small K, unequal sizes and spillovers require design-specific simulation.

Not the uncertainty of any programme estimate.

Energy changes and indices / Historical coefficient intervals

E25: results pp. 84, 85, 87 | E26: results pp. 89, 90

E25 Energy changes and indices

EXECUTED HISTORICAL ACCOUNTING

$$I_{s,t} = 100C_{s,t}/C_{s,2020} \tag{E25.1}$$

$$\Delta G = \sum_s \Delta G_s + \Delta \rho \tag{E25.2}$$

C: sector electricity consumption; G: source-defined energy total; rho: rounding residual. Units GWh.

ASSUMPTIONS / AXIOMS

Same annual source scope; imports already included where the source specifies. No causal regression on these totals.

Annual consumption is not shift-specific output.

E26 Historical coefficient intervals

SOURCE ESTIMATES / NOT RE-ESTIMATED

$$CI_N = \hat{\beta} \pm 1.96 SE_{cluster} \tag{E26.1}$$

$$b_{mean} = 100\hat{\beta}/\bar{Y} \tag{E26.2}$$

Published Hohoe coefficient and neighbourhood-clustered SE; original monetary/hour units and 2015 window.

ASSUMPTIONS / AXIOMS

Normal pointwise reconstruction from rounded SE. No covariance recovery, heterogeneity test or national transport.

Source-estimated outage effects are not 24H+ effects.

Capacity and availability frontier / Demand and cash-cost thresholds

E27: results pp. 92, 93, 94 | E28: results pp. 95, 96, 97

E27 Capacity and availability frontier

EXECUTED CONDITIONAL FRONTIER

$$\Delta Q = \min(D, K_1 + K_2) - \min(D, K_1) \quad (\text{E27.1})$$

$$A_2^* = \max(0, D - K_1)/(qHPY) \quad (\text{E27.2})$$

D: common demand; K1: feasible baseline capacity; K2=qHPYA2; H=176 hours/month.

ASSUMPTIONS / AXIOMS

Same product, demand and accounting perimeter. A2 above one signals infeasibility; no outage probability is inferred.

At D=23,000, A2*=0.50367 in F01.

E28 Demand and cash-cost thresholds

EXECUTED CONDITIONAL FINANCE

$$n = pDSO/30 + cDIO/30 - mDPO/30 \quad (\text{E28.1})$$

$$D_{fin}^* = K_1 + F/(p - c - nr/12) \quad (\text{E28.2})$$

n: NWC per added monthly unit; m: material cost; c: variable costs; r: annual simple finance rate.

ASSUMPTIONS / AXIOMS

Positive unit contribution, one added crew, sufficient physical capacity. DSO is an assumption, not a measured delay.

Financed threshold: 18,174.25 total units/month.

Cumulative production addition / Differential-response contrast bounds

E29: results p. 98 | E30: results p. 99

E29 Cumulative production addition

EXECUTED HORIZON SENSITIVITY

$$\Delta Q_{0:T} = \sum_{t=0}^T (Q_t - Q_t^{cf}) \tag{E29.1}$$
$$3000 - 1500 - 1500 = 0 \tag{E29.2}$$

Qt and counterfactual use identical units and horizon. Distinct frontloaded and sustained examples.

ASSUMPTIONS / AXIOMS

Track inventories, backlog and later displacement. Earlier delivery value is a separate welfare measure.

One positive month need not be a cumulative gain.

E30 Differential-response contrast bounds

EXECUTED MISSINGNESS SENSITIVITY

$$\mu_j \in [r_j \bar{Y}_j + (1 - r_j)L, \quad r_j \bar{Y}_j + (1 - r_j)U] \tag{E30.1}$$
$$\Delta \mu \in [L_T - U_C, \quad U_T - L_C] \tag{E30.2}$$

rj: response share; L,U: common justified outcome support; group bounds define LT,UT,LC,UC.

ASSUMPTIONS / AXIOMS

Illustrative means 50 and 40. Response/support imposed; causal interpretation requires separate identification.

80% versus 90% response gives bounds -6 to +24.

Finite-cluster planning power / Published component precision

E31: results p. 100 | E32: results p. 86

E31 Finite-cluster planning power

EXECUTED IDEAL DESIGN CALCULATION

$$\delta = (MDE/\sigma)/(2\sqrt{DE/(Km)}) \tag{E31.1}$$

$$Pr(|t_{K-2,\delta}| > t_{K-2,.975}) = .80 \tag{E31.2}$$

K: independent balanced clusters; m=18; DE=1+(m-1)ICC. Noncentral-t power solved numerically.

ASSUMPTIONS / AXIOMS

Ideal Gaussian independent cluster means with equal sizes. No empirical power, actual sample size or cluster-loss guarantee.

Whole-cluster loss changes K, not only m.

E32 Published component precision

EXECUTED SOURCE RECONCILIATION

$$\rho_t = T_t - \sum_s C_{s,t} \tag{E32.1}$$

$$\Delta T = \sum_s \Delta C_s + \Delta \rho \tag{E32.2}$$

T: published total; C: displayed component. Preserve original precision before computing differences.

ASSUMPTIONS / AXIOMS

A rounding-compatible residual is not usable energy or missing funds. Do not invent balancing observations.

Sector-consumption residual change is -0.4 GWh.

Cohort-time causal effect / Randomised additional-support offer

P01: results p. 73 | P02: results p. 74

P01 Cohort-time causal effect

PROSPECTIVE ONLY — NOT ESTIMATED

$$ATT(g, t) = E[Y_t(1) - Y_t(0) \mid G = g] \quad (P01.1)$$

$$ATT_h = \sum_g w_g ATT(g, g + h) \quad (P01.2)$$

G: first treatment cohort; h: horizon; weights refer to a documented target population.

ASSUMPTIONS / AXIOMS

Conditional parallel trends, no anticipation and appropriate interference/overlap assumptions. Not a generic two-way FE shortcut.

No matched outcome panel was obtained.

P02 Randomised additional-support offer

PROSPECTIVE ONLY — NOT ESTIMATED

$$ITT = E[Y \mid Z = 1] - E[Y \mid Z = 0] \quad (P02.1)$$

$$\widehat{ITT} = \bar{Y}_{Z=1} - \bar{Y}_{Z=0} \quad (P02.2)$$

Z: authorised randomly assigned offer; Y: pre-specified output, work or cash outcome.

ASSUMPTIONS / AXIOMS

Fair additional-support allocation; lawful entitlements not withheld. Cluster inference and interference are design-specific.

Uptake effects need extra assumptions beyond offer effects.

Direct and spillover potential outcomes / Response weighting and selection

P03: results p. 75 | P04: results p. 78

P03 Direct and spillover potential outcomes

PROSPECTIVE ONLY — NOT ESTIMATED

$$DE(e) = E[Y(1, e) - Y(0, e)] \tag{P03.1}$$

$$SE(e, e_0) = E[Y(0, e) - Y(0, e_0)] \tag{P03.2}$$

e: specified market/network exposure; direct and spillover estimands need the exposure mapping.

ASSUMPTIONS / AXIOMS

Consistency, assignment support and a credible model of interference. Not estimated from programme announcements.

Market effects may differ from participating-site effects.

P04 Response weighting and selection

PROSPECTIVE ONLY — NOT ESTIMATED

$$\hat{\mu}_w = \frac{\sum_i R_i w_i Y_i}{\sum_i R_i w_i} \tag{P04.1}$$

$$w_i = d_i / Pr(R_i = 1 \mid X_{i,pre}) \tag{P04.2}$$

R: observed response; d: design weight; Xpre: pretreatment predictors.

ASSUMPTIONS / AXIOMS

Requires valid frame, response model and positivity/MAR conditions; add non-random missingness sensitivity.

No weights invented for selected pilot firms.

Unresolved source and coverage limits remain visible

None is removed by a polished chart or an exact accounting identity.

Table 46. Unresolved source and coverage limits remain visible

Limit	Consequence	Treatment
Historical firms, not programme outcomes	Survey and the Hohoe coefficient sample do not establish current plant shift effects.	Survey weights are source-reported; published outage coefficients remain historical and un-reestimated.
Repeated reliability rows	2024 and 2025 ECG/NEDCo values repeat.	No unverified explanation or independent stability claim.
Energy table numbering / rounding	Body table numbers differ from index; 2023 components differ from total by 1 GWh.	Use page locators and body labels; retain printed residual.
Linked firm and worker panel absent	Reported snapshots lack cohort outcomes, selection weights and displacement map.	Conditional cases and prospective methods clearly marked.
External binaries not bundled	Container network retrieval failed.	Source URLs, locators, transcriptions and verification status supplied.

Sources: World Bank Ghana ES [\[S06\]](#); Energy Commission 2026 bulletin [\[S07\]](#); Hardy–McCasland, WPS 9093 [\[S15\]](#); IDER calculations [\[S99\]](#).

Every numerical exhibit has a calculation and a status label

The package is an audit trail for the publication, not an audit of government or enterprise systems.

Table 47. Every numerical exhibit has a calculation and a status label

Layer	Files supplied	Interpretation
Source transcription	inputs/enterprise_survey.csv; energy and tariff files	Historical or published values retain original scope and precision.
Assumptions	inputs/assumptions.json; sector examples	Scenario values are never labelled observed firm records.
Computation	code/analyse.py; code/validation_analysis.py; outputs/*.csv	Exact accounting, threshold and finite-grid calculations.
Exhibits	outputs/figure_data; outputs/table_data	Numerical marks and native table cells bound to files.
Publication	code/build.py; model expressions; navigation registers	Editable text/marks/tables; rendered equations with mathematical sources.

Sources: IDER calculations [\[S99\]](#).

Note: Render and rebuild checks are recorded separately. No external institutional certification or causal validation is claimed.

References and source links — 1 of 6

Titles open the source; page locators and verification limits are retained in the package.

S01 24H+ Secretariat | Accessed 28 September 2026

24-Hour Economy and Accelerated Export Development Programme

Programme overview and production, market/supply-chain and human-capital pillars.

S02 The Presidency, Republic of Ghana | 19 February 2026

Assent to the 24-Hour Economy Authority Bill, 2025

Official release, paragraphs 1 and 5.

S03 National Petroleum Authority | 12 May 2026

Pilot phase of the 24-hour economy in the petroleum downstream sector

Launch date; four regions; 268 stations, eight depots, two refineries; six-month first phase.

References and source links — 2 of 6

Titles open the source; page locators and verification limits are retained in the package.

S04 Ministry of Finance, Ghana | 13 November 2025

2026 Budget Statement and Economic Policy

Paragraphs 991–998 (PDF p. 143); paragraph 1132 (PDF p. 157).

S05 24H+ Secretariat | 12 August 2025; accessed 28 September 2026

24H+ Private Sector Incentives

Operational shift incentives and financing sections.

S06 World Bank Enterprise Surveys | 2024

Ghana 2023 Country Profile

PDF pp. 3–4: 713 firms, interviews February 2023–February 2024; pp. 11–12: appendix.

References and source links — 3 of 6

Titles open the source; page locators and verification limits are retained in the package.

[S07 Energy Commission, Ghana | May 2026](#)

2026 National Energy Statistical Bulletin

PDF pp. 20, 23, 27, 39: Tables 3.4, 3.7, 3.9, 3.16 as printed in the body.

[S08 Public Utilities Regulatory Commission | 16 June 2026; effective 1 July 2026](#)

Third-quarter 2026 electricity, natural gas, water and net-metering tariffs

PDF pp. 1–3; Fourth Schedule, page 3.

[S09 Republic of Ghana; ILO NATLEX copy | 2003; accessed 28 September 2026](#)

Labour Act, 2003 (Act 651)

PDF pp. 16–18: sections 33–44; p. 20: section 55.

References and source links — 4 of 6

Titles open the source; page locators and verification limits are retained in the package.

S10 Social Security and National Insurance Trust | Accessed 28 September 2026

Become an Employer

Employer obligations: 13% employer basic-salary contribution and 5.5% worker deduction.

S11 Brantly Callaway and Pedro H. C. Sant’Anna | 2021; author manuscript revised 2020

Difference-in-Differences with Multiple Time Periods

Journal of Econometrics 225(2): 200–230; author abstract and identification framework.

S12 Pedro H. C. Sant’Anna and Jun B. Zhao | 2020

Doubly Robust Difference-in-Differences Estimators

Journal of Econometrics 219(1): 101–122; author abstract.

References and source links — 5 of 6

Titles open the source; page locators and verification limits are retained in the package.

S13 United Nations, European Commission, IMF, OECD and World Bank | 2008/2009

System of National Accounts 2008

Production-account concepts; dated accounting reference, not a statement about the newest SNA edition.

S14 National Petroleum Authority | 22 July 2026

Fuel Depots in Tema Implementing 24-hour Economy Programme

Inspection narrative: Petroleum Hub, TFCL, VANA and Quantum; operator statements and constraints.

S15 Morgan Hardy and Jamie McCasland | 2019 working paper; 2021 journal publication

Lights Off, Lights On: The Effects of Electricity Shortages on Small Firms

WPS 9093: PDF pp. 9–12 sample/design; pp. 19 and 22 Tables 2/5; pp. 35 and 38 Tables A.3/A.6.

References and source links — 6 of 6

Titles open the source; page locators and verification limits are retained in the package.

S99 Institute of Development and Economic Research | 28 September 2026

24-Hour Economy: Additionality, Enterprise Cases and Evaluation Protocol

This package: inputs/, code/analyse.py, model catalogue, outputs/ and verification/.

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