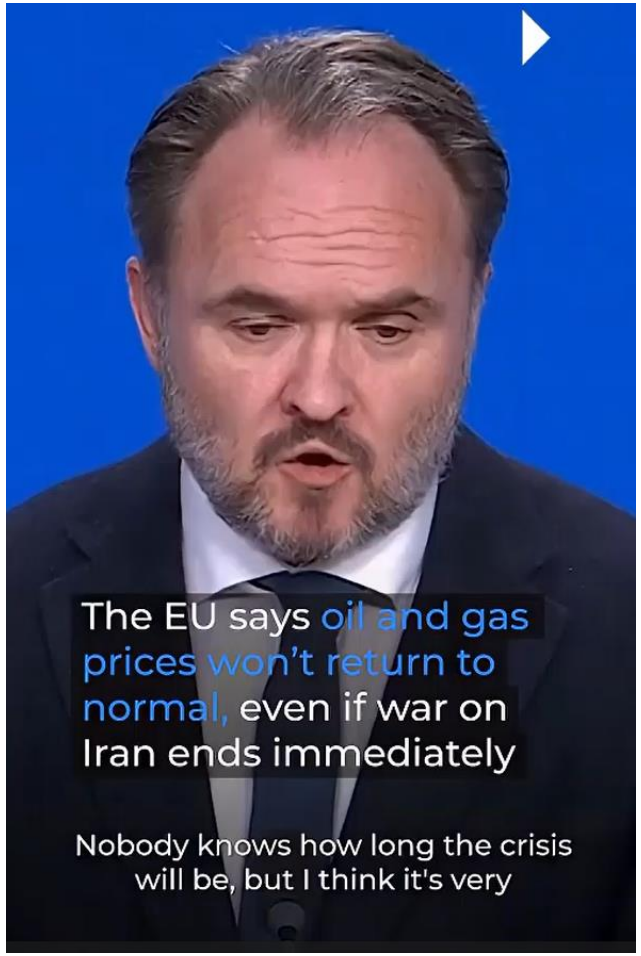
Key Issues in Egypt's Electric Grid — and the Solutions Needed to Unlock Renewable Energy at Scale

ECES
المركز المصري للدراسات الاقتصادية
The Egyptian Center for Economic Studies

Video 1



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Contents

Contents

Objective

A Technical Assessment of Egypt's Grid Readiness for the Renewable Energy Transition

covering

Operational Challenges

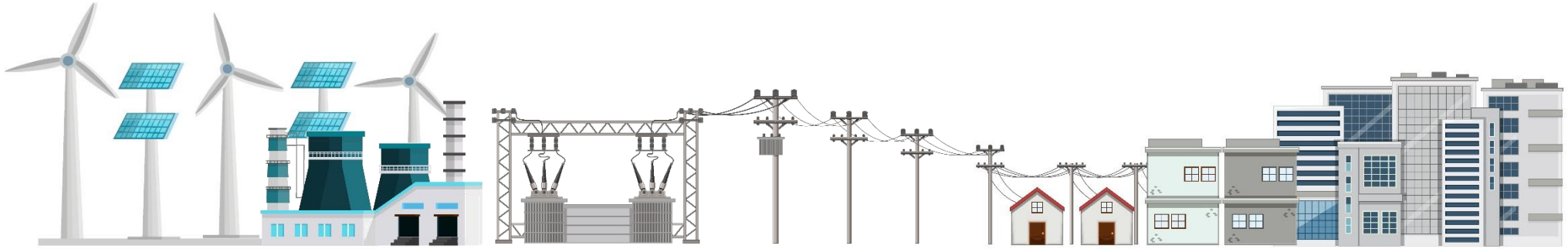
Institutional Gaps

Reforms Required

to reach its **full potential**

Rationale

1. More capacity than we need — yet the problem persists.



59,694 MW

Installed Generation Capacity

As of 2025 — up 53% from 2015

>

36,800 MW

Peak Demand

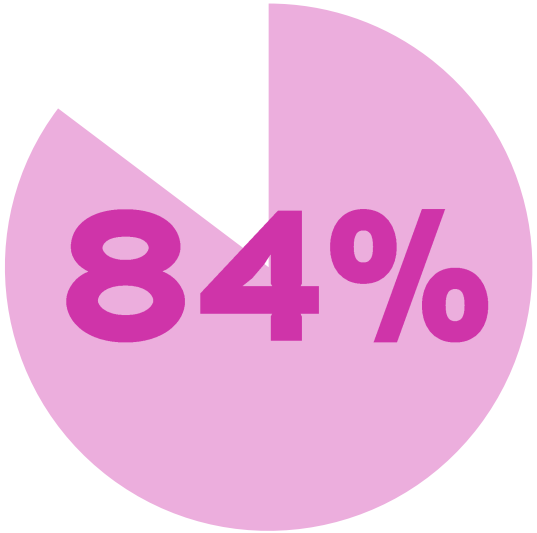
2024 peak — 4,900 MW added in 3 years

Yet, we still have a continuous problem in Electricity

The challenge is not how much electricity we can generate. It is when, where, and how reliably we can deliver it. This is both a grid and energy mix problem, not a generation problem.

Rationale

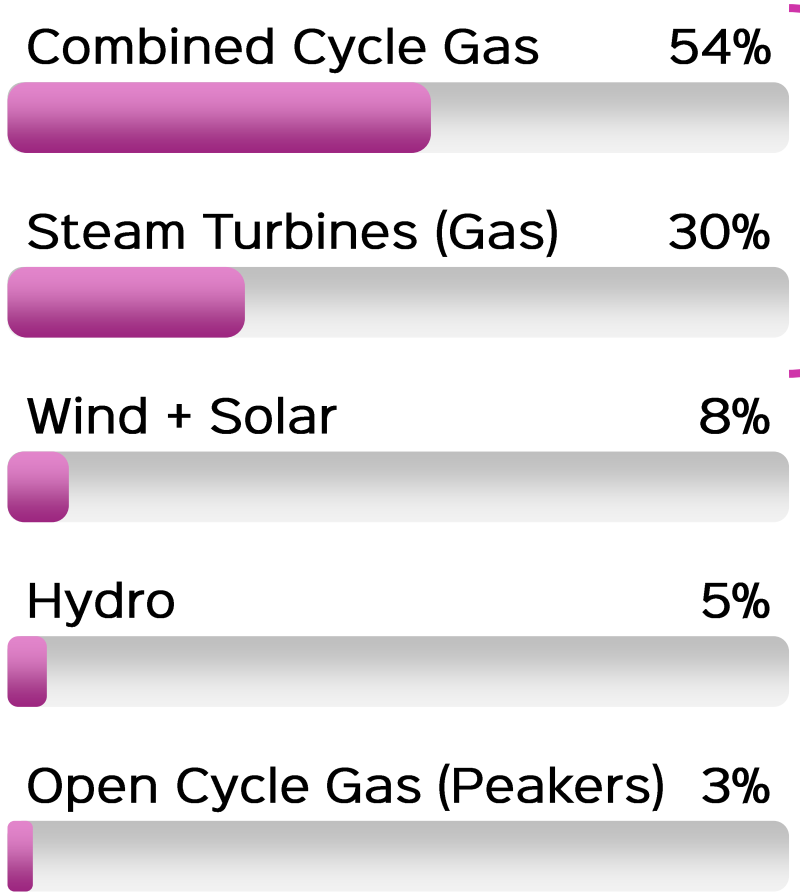
2. Egypt's electricity runs almost entirely on Gas



of Egypt's electricity comes from gas

More than any other source by a wide margin. Egypt's entire electricity system effectively runs on a single fuel.

Generation Mix (2024)



Combined Cycle + Steam = 84% gas-fired — the highest concentration of any fuel in the mix

Rationale

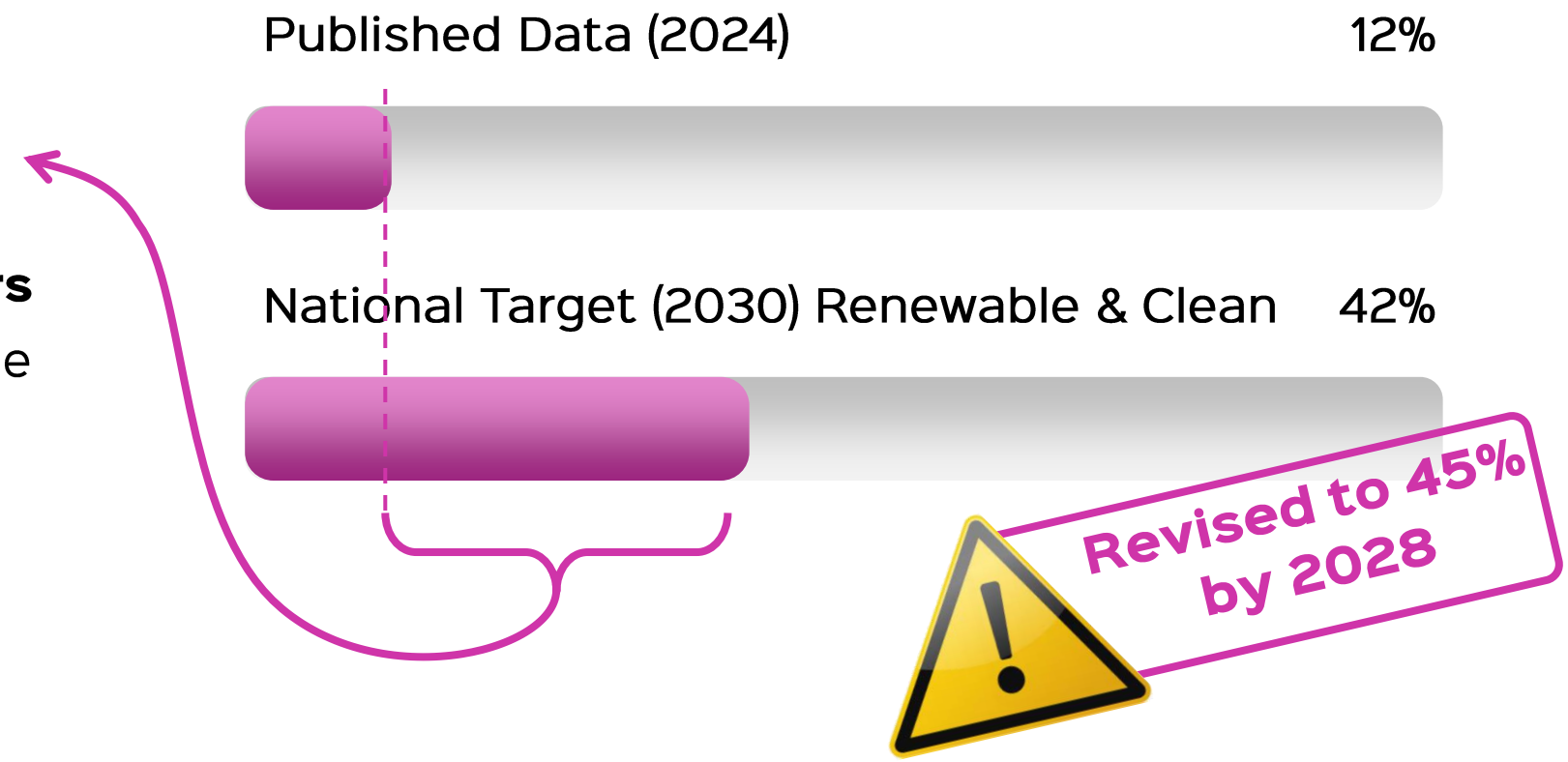
3. Egypt's Renewable Energy Target

+30%

Gap to close in 4 years

Egypt must at least triple its current renewable share to meet its own 2030 national target.

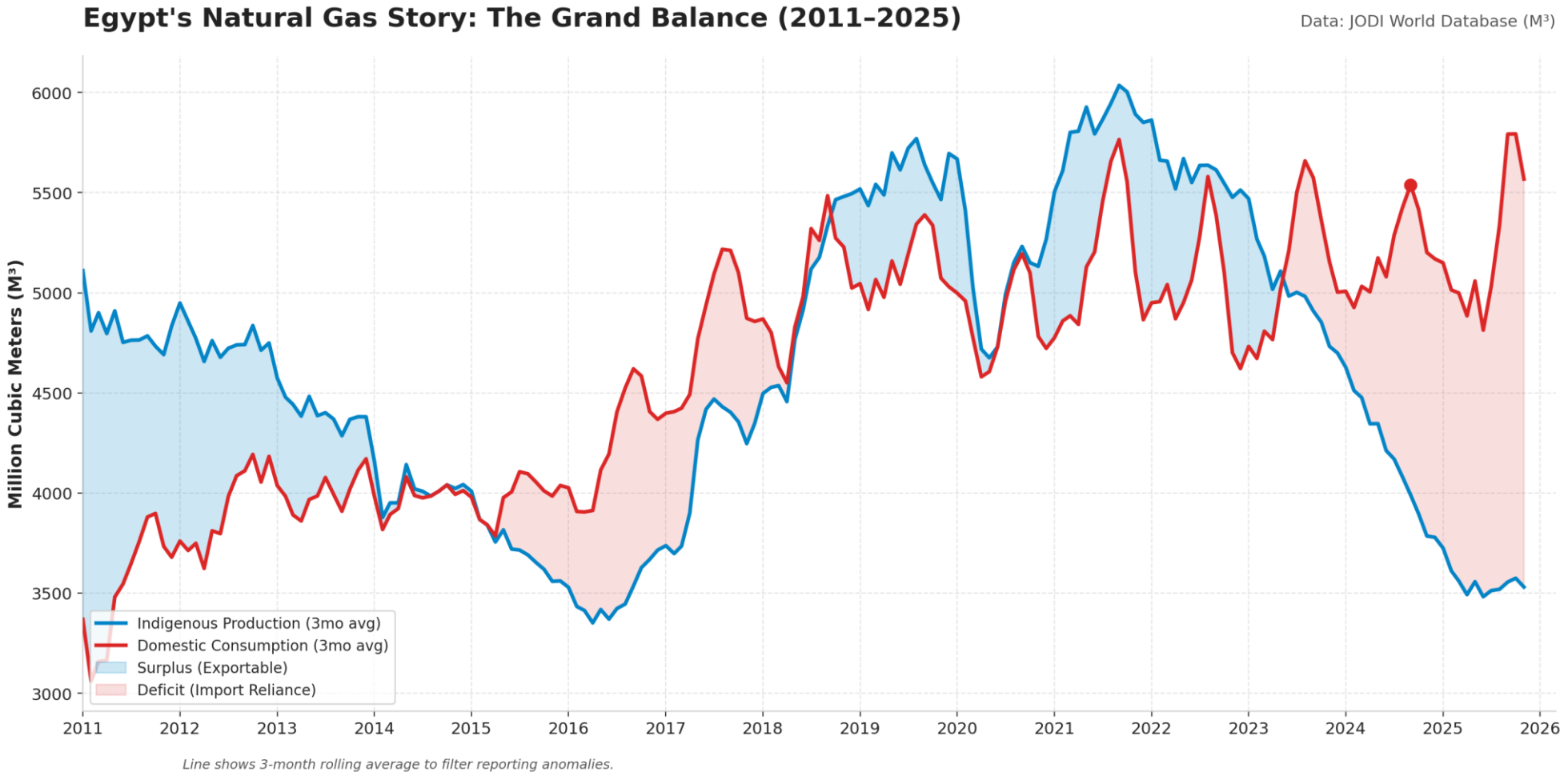
Renewable Share — Where Egypt Stands vs. Where It Must Go



Rationale

4. Supply, Demand, and the Widening Gap

Egypt's energy balance tells a single story: **demand is rising faster than domestic supply can keep up.**



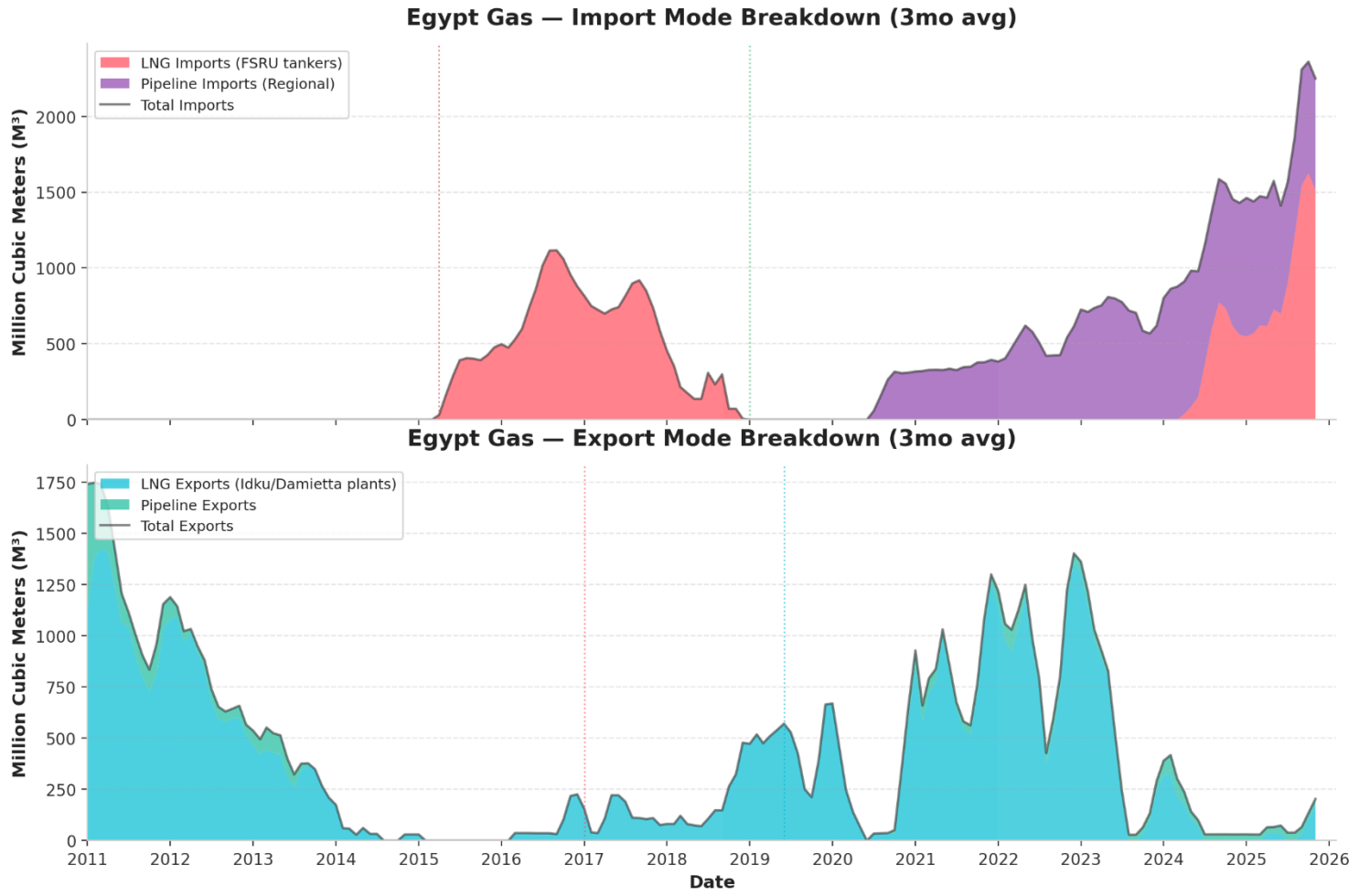
Rationale

5. Egypt: From a Net LNG Exporter to a Net LNG Importer

Egypt's shift from an LNG exporter to importer is not just an energy story — it is a fiscal one.

Every technical gap left unsolved extends the exposure and increases the fiscal burden.

Data: JODI World Database (M³)



Contents

The case for Urgent Reform in 3 Charts

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Why this matters now?

Gas is expensive and unreliable. Demand is surging. The grid wastes one-fifth of everything it generates. And Egypt sits on the world's best solar resource — mostly untapped.

The case for Urgent Reform in 3 Charts

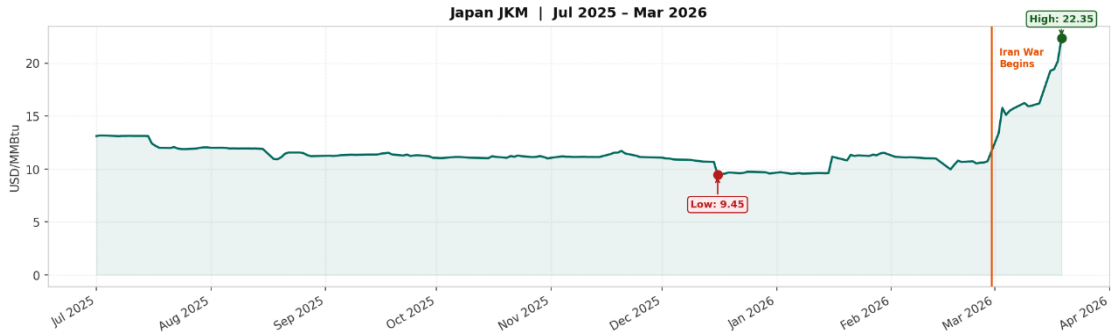
Gas prices doubled — Egypt pays the bill

FEB 2026

28

A war broke out in the Middle East that triggered an immediate repricing of global energy markets — driving up oil and gas prices that every country dependent on energy imports will now bear.

Japan JKM



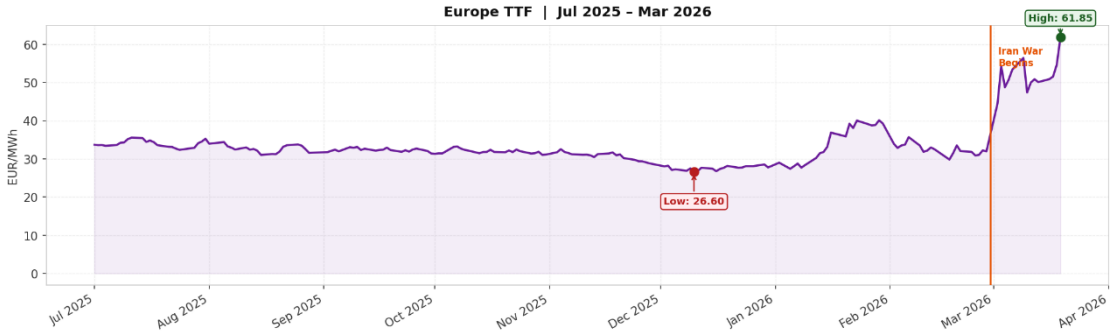
Low → High

$9.45 → $22.35 / MMBtu

+136%

cycle increase

Europe TTF



Low → High

€26.60 → €61.85 / MWh

+133%

cycle increase

The case for Urgent Reform in 3 Charts

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Egypt's Gas Import Bill Is Growing Fast

Monthly cost increase: **+1,090M** **i.e. nearly 3x higher!**

Every dollar Egypt spends importing gas is a dollar that cannot be spent on hospitals, schools, or infrastructure.

1 2 3

The case for Urgent Reform in 3 Charts

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Demand hits 171 TWh, and it's accelerating

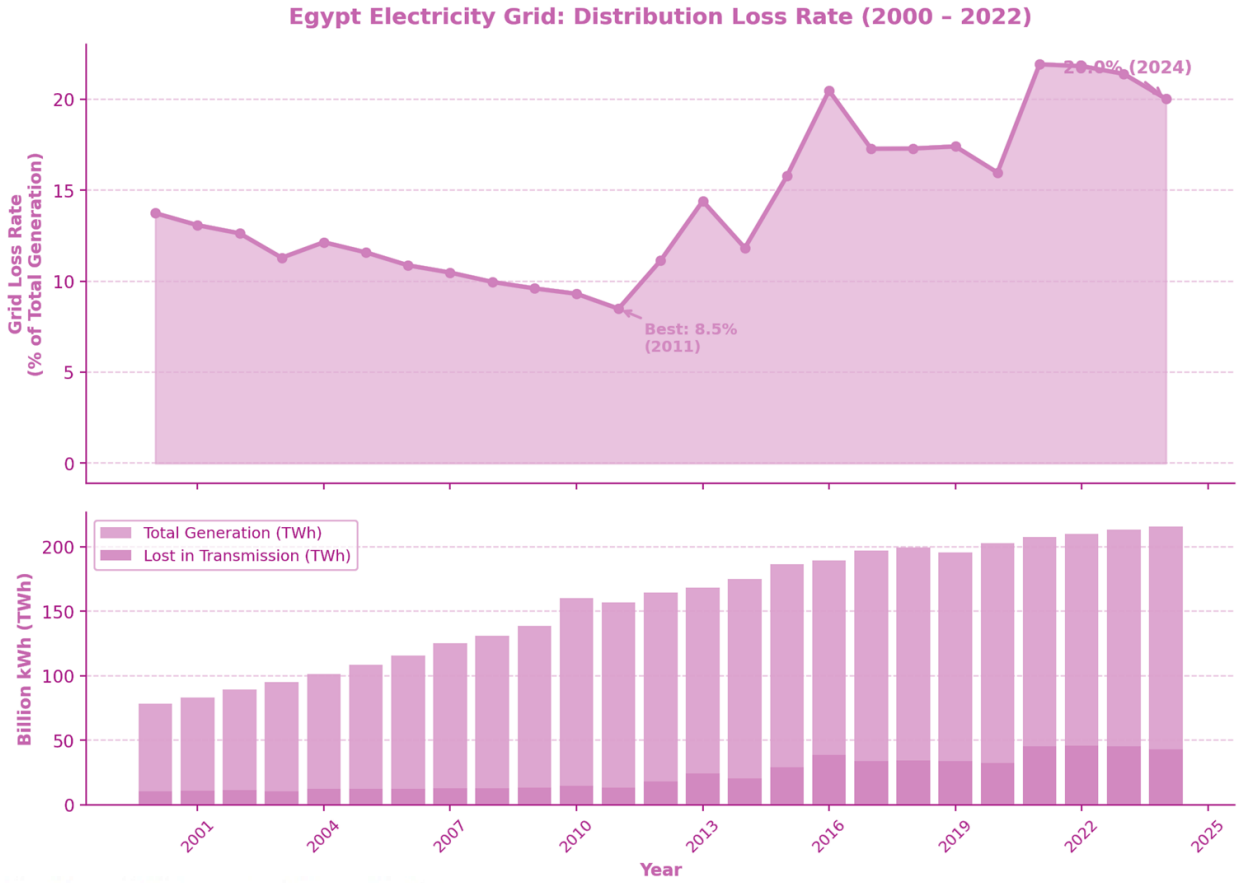
+20%
Increase in consumption over the last 15 years

171 TWh
Total electricity consumption in 2024 and rising fast

Urbanization, industrial expansion, and population growth of 1.7M/year are creating a structural demand floor that rises regardless of supply constraints. More generation is needed — and it must be clean.

Why is the Grid a crucial point of discussion?

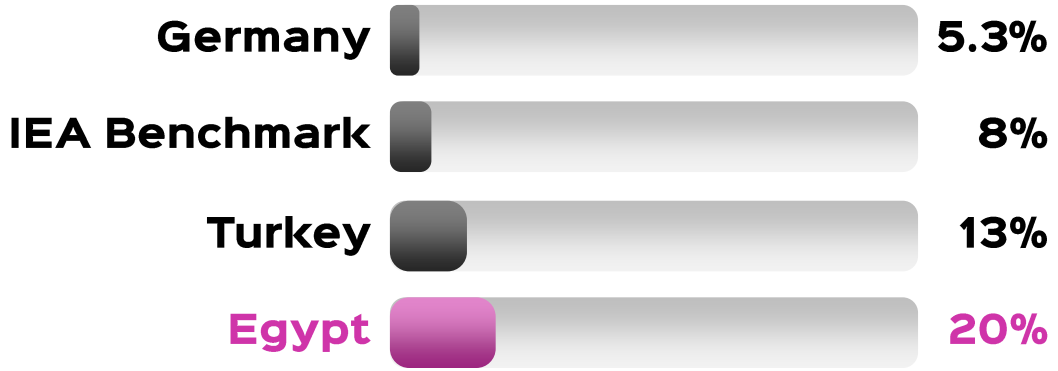
20 cents of every dollar generated is wasted due to inefficiencies in the Egyptian Grid



Data Source: EIA International Energy Statistics

20%

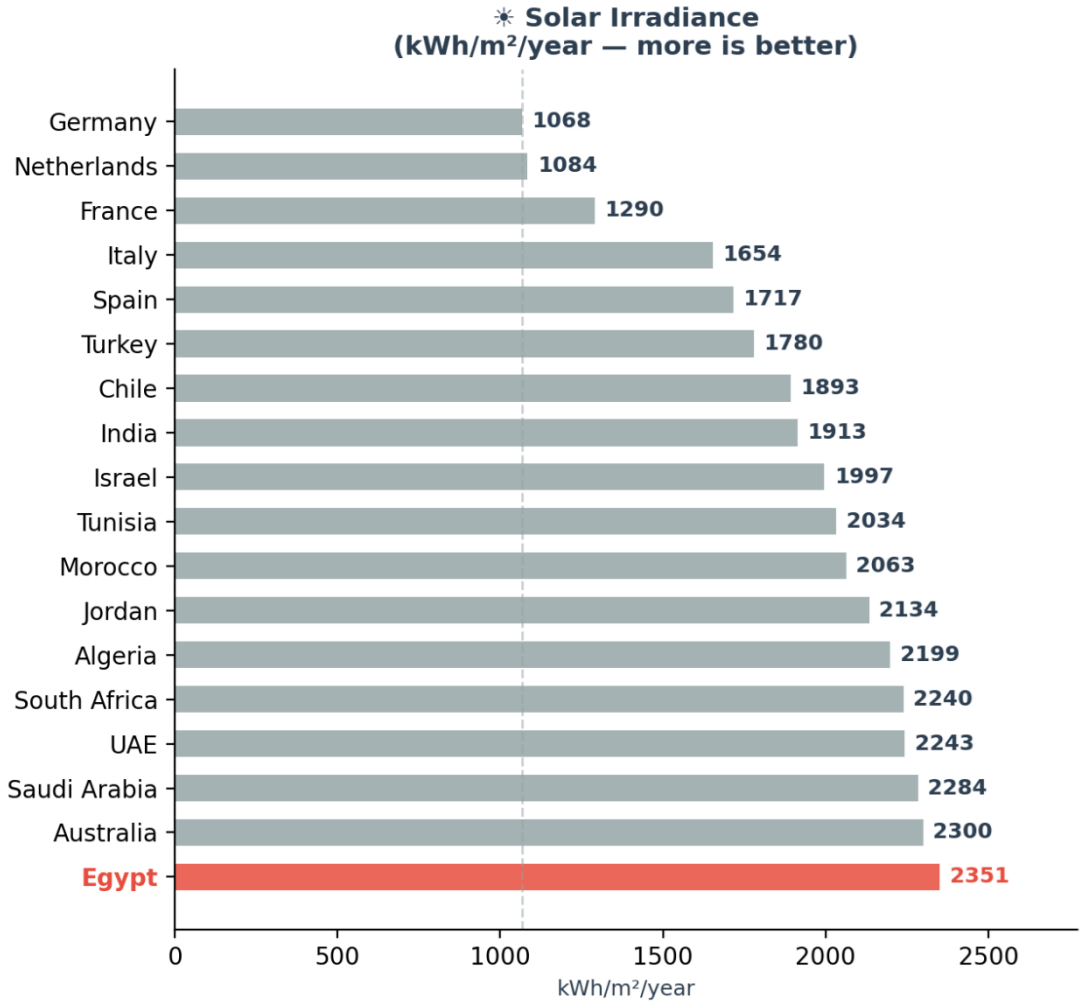
Distribution loss rate in 2024.
Historic low was 8.5% in 2011.



42 TWh lost annually — an implicit waste of billions in gas that could have been exported or avoided entirely.

Why is the Grid a crucial point of discussion?

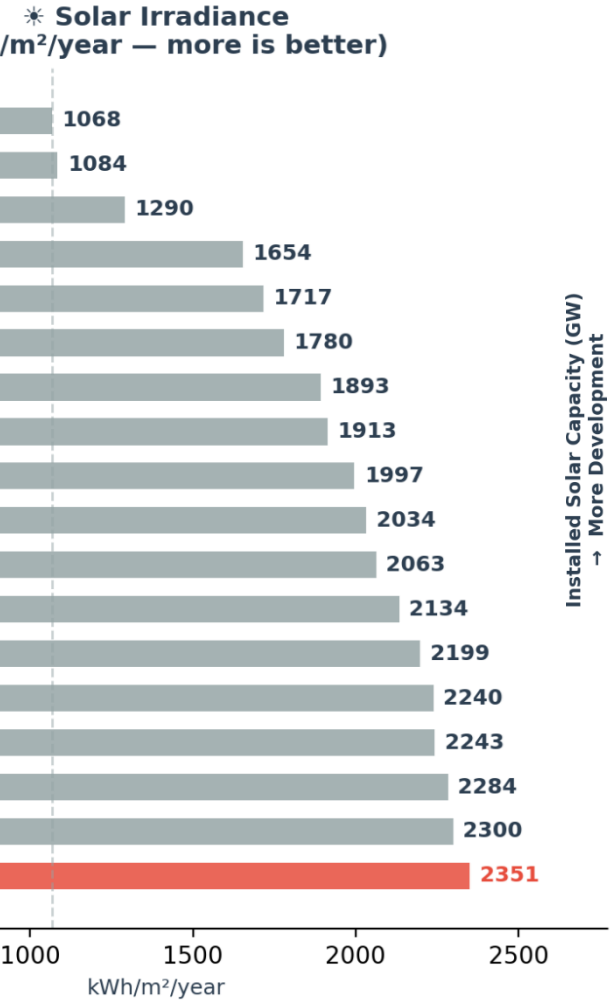
Egypt: Elite Solar Resource

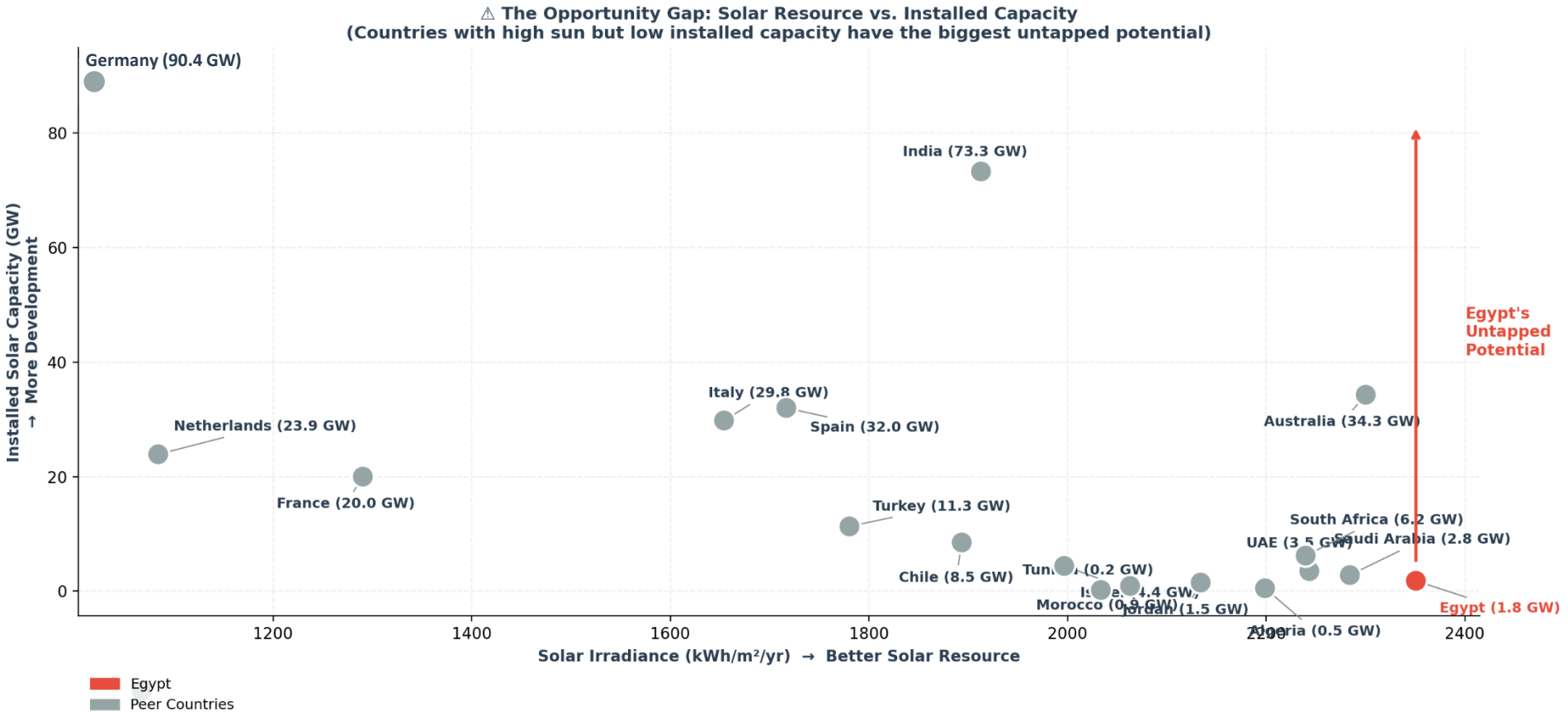


Why is the Grid a crucial point of discussion?

Egypt: Elite Solar Resource

Yet, very low solar energy generation





7 gaps between Egypt and its renewable energy potential

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1. Lagging Grid Codes & Technical Requirements
2. Incomplete Power System Expansion Planning
3. Missing Advanced Planning Tools
4. Weak Electricity – Gas Co-Optimization
5. Weak Cost-Benefit Analysis
6. Missing Advanced Monitoring & Control Systems (WAMS/ PMUs)
7. Enhancing Grid Flexibility in High-Renewable Systems

Lagging Grid Codes & Technical Requirements

1 2 3 4 5 6 7

What Are Grid Codes? Definition:

- Grid codes define the mandatory technical regulations and requirements established by system operators to ensure the safe, secure, and stable operation of the power network.
- Cover voltage, frequency, fault response, and stability behavior
- Set by the system operator — compliance is not optional

The Gap: grid codes have not been updated in over a decade

- Internationally, codes are updated every 1–2 years
- Egypt's codes have not been updated in over 10 years
- Rules written before large-scale solar — now applied to a fast-growing solar fleet

The Solution: Updating Grid Codes

Regularly review and revise national electricity grid codes to reflect technological advancements, operational best practices, and evolving market and policy requirements.

Incomplete Power System Expansion Planning

1 2 3 4 5 6 7

Law no. 87/2015 sets out a clear planning process. Its mandates:

- Multi-year generation and transmission expansion plan
- Mandatory stakeholder consultation before finalization
- Independent review and approval by EgyptERA - جهاز تنظيم مرفق الكهرباء
- Cabinet-level approval of expansion decisions
- Annual security of supply and reliability reporting

The Gap: The law exists, but is not fully-implemented

- Full adoption of the legally required planning procedures has not yet been achieved.

The Solution: Power System Expansion Planning

Full adoption of the law is highly critical to ensure full compliance with relevant procedures.

Lack of Advanced Planning Tools

1 2 3 4 5 6 7

Advanced Planning Tools are not yet adopted. These tools do:

- Model generation, fuel supply, and transmission in one platform
- Capture ramp rates, reserves, network limits, and reliability standards
- Incorporate capital costs, fuel scenarios, emissions limits, and uncertainty
- Include gas–power co-optimization for renewable backup

The Gap: Without these tools, planning is blind

Planning tools have not kept pace with Egypt's rapid energy expansion, planning tools are the tools that provide:

- **Transparency:** all assumptions and trade-offs are auditable
- **Scenario analysis:** test scenarios before major commitments
- **Economic efficiency:** least-cost pathways across both sectors

The Solution: Advanced Planning Tools Adoption

Institutionalize the use of state-of-the-art planning platforms.

Weak Electricity/Renewable Energy – Gas Co-Optimization (Sector Coupling)

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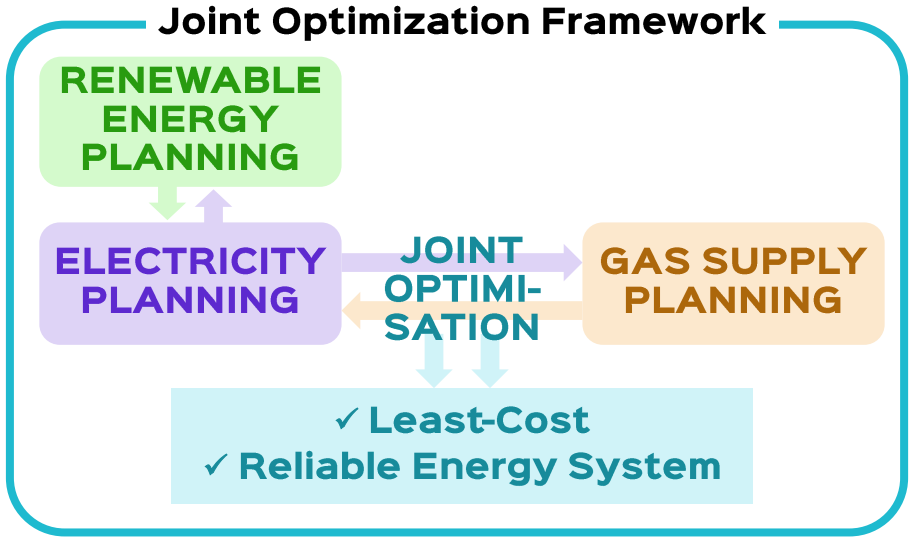
1 2 3 4 5 6 7

Electricity and Gas must be planned together

- Enhanced reliability: joint planning ensures adequate gas for renewable balancing and reserves
- Least-cost dispatch: co-optimization identifies the most efficient strategy across electricity and gas
- Renewable enablement: gas provides essential backup during periods of low renewable output



The Gap: Two Paths — One Choice

✓ If planned together:

- Optimized Capital Investment and Infrastructure Development
- Enabling High Renewable Energy Penetration

✗ If planned separately (Egypt's current situation)

- A gas shortfall instantly kills backup power
- Solar surplus wasted while gas is still burned
- Blackouts follow and investment costs spiral

Weak Electricity/Renewable Energy – Gas Co-Optimization (Sector Coupling)

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The Solution: Advanced Planning Tools Adoption

Adopting integrated electricity–gas co-optimization is highly recommended — it represents a strategic enabler for modern power systems with high renewable energy share. Implementing such frameworks requires

- Advanced planning tools
- Cross-sector data integration
- Coordinated regulatory oversight.

Weak Cost-Benefit Analysis (CBA) for new assets

1 2 3 4 5 6 7

What CBA must establish:

- Compare long-term benefits against total lifetime costs
- Assess economic, technical, and environmental impact together
- Prioritize investments with the highest measurable value
- ENTSO-E standard: full CBA required before any major investment

What a full CBA covers

1 Scenario-Based Assessment

Tested across demand, fuel price, policy, and RE penetration scenarios

2 Multi-Criteria Benefit Evaluation

Socio-economic welfare
Security of supply
CO_2 reduction
RE integration
System flexibility
Market integration

3 Monetization & Non-Monetized Indicators

Reduced generation costs
Avoided curtailment
Congestion savings
Reliability improvements

Weak Cost-Benefit Analysis (CBA) for new assets

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The Gap: without CBA, the wrong investments get built

What gets missed without CBA?

- **Stranded assets:** built just before becoming obsolete
- **Overspending:** costlier options chosen; cheaper ones never assessed
- **Missed opportunities:** high-value investments deprioritized

The Solution: CBA Adoption

Implement CBA that meets international standards, covering **Economic, Environmental, Social** and **National Security** aspects.

Enhanced Monitoring & Control

Enhanced monitoring and control capabilities enable the Transmission System Operator to operate the power system more efficiently, securely, and reliably.

What Egypt Has Today

- EETC operates SCADA across the transmission network — a solid foundation
- SCADA provides system-wide monitoring and control

WAMS and PMUs are not yet integrated, they provide:

- Real-time, high-speed visibility across the entire network
- Detect faults and frequency deviations within **milliseconds**
- Indispensable for grids with high inverter-based generation

Missing Advanced Monitoring & Control Systems (WAMS/ PMUs

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The Gap: WAMS and PMUs are not yet integrated into Egypt's grid; the operator lacks the speed and visibility required.

- SCADA updates every 2–4 seconds — grid faults occur in milliseconds
- At high renewable penetration, SCADA alone is too slow to respond

SCADA today

SLOW

2 – 4

seconds

Update interval
for system monitoring

VS

Grid Fault / PMU

< 0.5

seconds

Fault propagation
& PMU response needed

CRITICAL SPEED

The Solution: WAMS and PMUs Utilization

For modern power systems with significant renewable energy penetration, WAMS are indispensable. They provide the visibility, real-time data, and control capability needed to maintain reliable, stable, and efficient grid operation.

Enhancing Grid Flexibility

1 2 3 4 5 6 7

Renewable Energy output is highly variable and less predictable, introducing fast fluctuations in power generation.

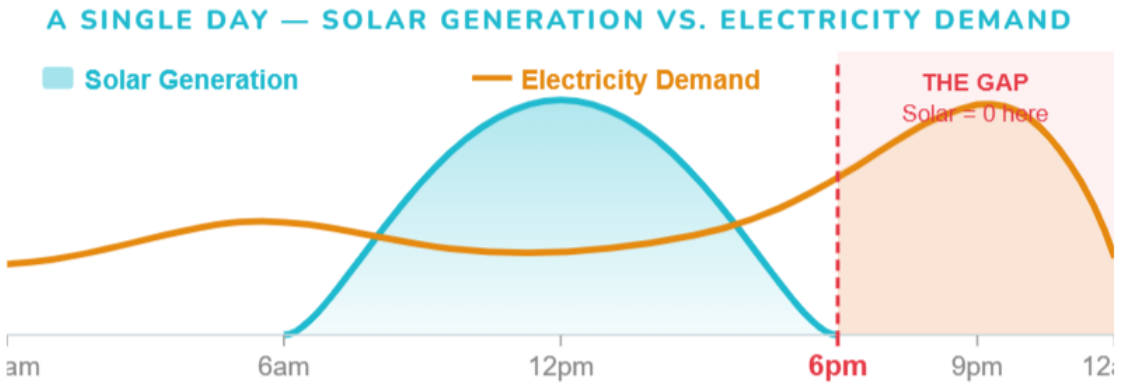
Why Flexibility is critical?

- Solar and wind output is highly variable and less predictable
- They cause fast fluctuations, reduced inertia, and operational uncertainty
- Frequency, voltage, and power quality all become harder to control
- Without flexibility, the grid cannot safely absorb large renewable volumes

Solar peaks at noon, demand peaks at 8pm

8–10pm

Egypt's critical peak demand window



Solar generation ends at sunset — exactly when Egyptian homes, air conditioners, and factories draw maximum power. The two curves do not overlap at the critical hour.

Enhancing Grid Flexibility

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The Gap: Egypt Lacks the Tools to Absorb Renewable Variability

- Energy storage to buffer solar and wind fluctuations
- Reactive power compensators to stabilize voltage
- Frequency-responsive loads to balance the system in real time

Without these tools, each new gigawatt of solar added increases operational risk.

The Solution:

1. Battery Energy Storage (BESS)

1,800 MW
BESS capacity in pipeline

Bridge the gap between solar noon and the 8pm demand peak

- 1,800 MW already in the pipeline for 2025–2026
- Provides synthetic inertia and black-start capability

Enhancing Grid Flexibility

1 2 3 4 5 6 7

2. Reactive Power Compensators

Only 1

STATCOM currently deployed in Egypt (200 MVAR)

Keep voltage stable as renewables swing

- STATCOMs respond in milliseconds — faster than any generator ramp
- Increases transfer capacity of existing lines at no extra build cost

3. Demand-Side Management (DSM)

Zero

new capital investment required

Engage Stakeholders

- Industrial and commercial loads reduce consumption on demand
- Requires guidelines, an operational framework, and incentives

Reform Scorecard: what Egypt must do

Area	Current Status	Required Action
Grid Codes	Not updated in 10+ years	Annual review committee; align with ENTSO-E / IEEE
System Planning	Law exists, not fully followed	Enforce Law 87/2015; adopt gas–power co-optimisation
EMT Modeling	Not required or in use	Mandate EMT studies for all new inverter-based plants
WAMS / PMU Monitoring	SCADA only	Deploy WAMS and PMUs across transmission network
BESS Deployment	1,800 MW in pipeline	Continue scale-up; prioritise evening-peak discharge
STATCOM Deployment	Only one STATCOM	Deploy multiple STATCOMs at strategic RE-connected nodes
Demand Response	No formal framework	Develop DSM guidelines, incentive schemes, smart metering
Cost-Benefit Analysis (CBA)	Not systematically applied	CBA is the single most critical step — it must be conducted first, as its results determine the sequence, scale, and prioritisation of every other reform on this scorecard

Good News: most needed reforms do not require capital investments & there is no need for a new law.

Conclusion

Egypt has the resource. It needs the Grid Readiness to use it safely.