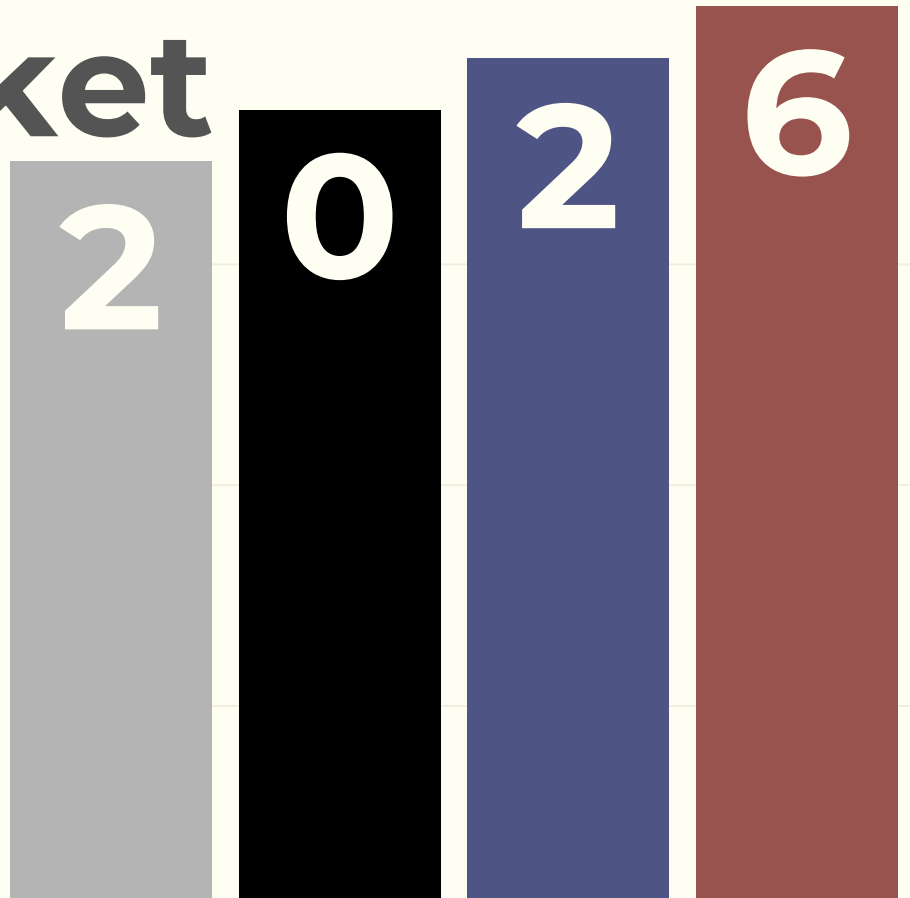
RENEWABLES FIRST

Pakistan Energy Market Review



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Disclaimer:

All the information and analysis provided in this document are accurate and to the best of our knowledge and understanding, in case you identify any error, feel free to reach out to us at: info@renewablesfirst.org

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Contents

Executive Summary **3**

- Understanding the energy landscape 5
- Oil market is import-dependent 10
- Natural gas faces growing supply constraints 16
- Coal shifts towards domestic supply 22

Key insight

- Solar is reshaping Pakistan's energy economy 25

Outlook **30**

Appendix & methodology **31**

Abbreviations **33**

Executive Summary

Distributed solar is the missing piece in Pakistan's energy statistics.

Official figures show primary energy supply rising by just 1.6% in FY25, while reported energy consumption grew by 8%. However, these figures do not account for an additional source of energy generated through rooftop and other distributed solar systems. By incorporating this into national energy statistics, Renewables First's analysis presents a more complete picture of energy supply and consumption, showing that both have grown steadily with the economy.

Pakistan is becoming more dependent on imported fossil fuels, not less.

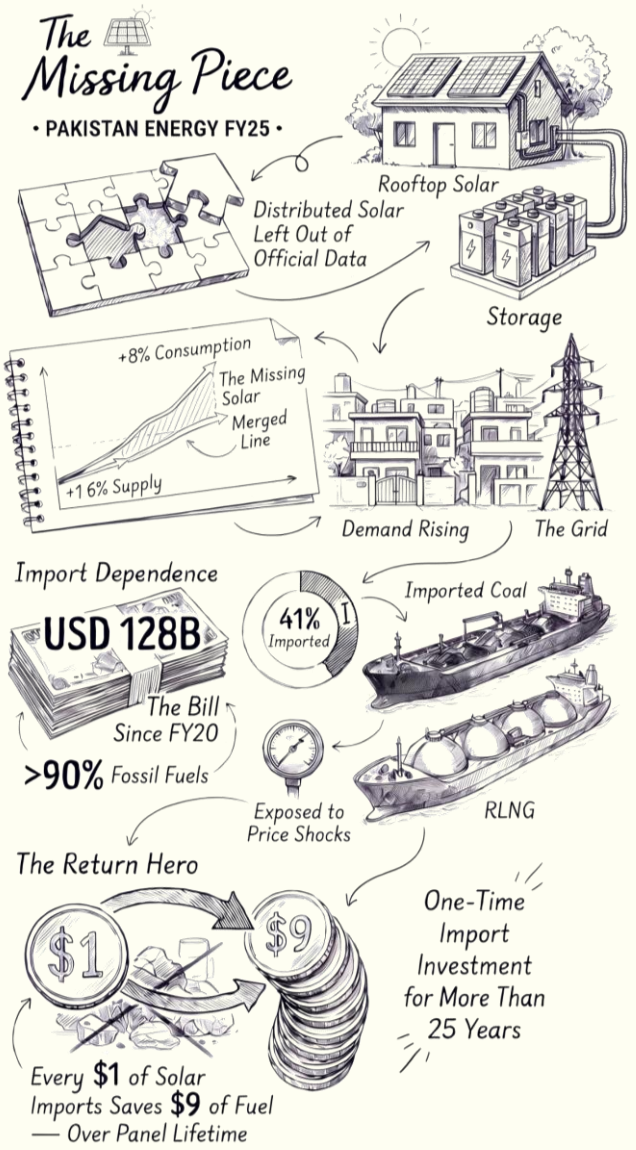
Imported fossil fuels, about 34 Mtoe, now make up 41% of Pakistan's primary energy supply in FY25, up from 37% in FY24, leaving the economy more exposed to global price spikes and supply disruptions with every passing year.

Fossil fuels have consumed more than 90% of Pakistan's USD 128 billion energy import bill since FY20.

Between FY20 and FY26, almost all of the money Pakistan spent on energy imports went to fuels that are less efficient, both economically and physically, than the renewable technologies available to replace them.

Every dollar Pakistan spends importing solar equipment saves nine dollars on fuel over the panels' lifetime.

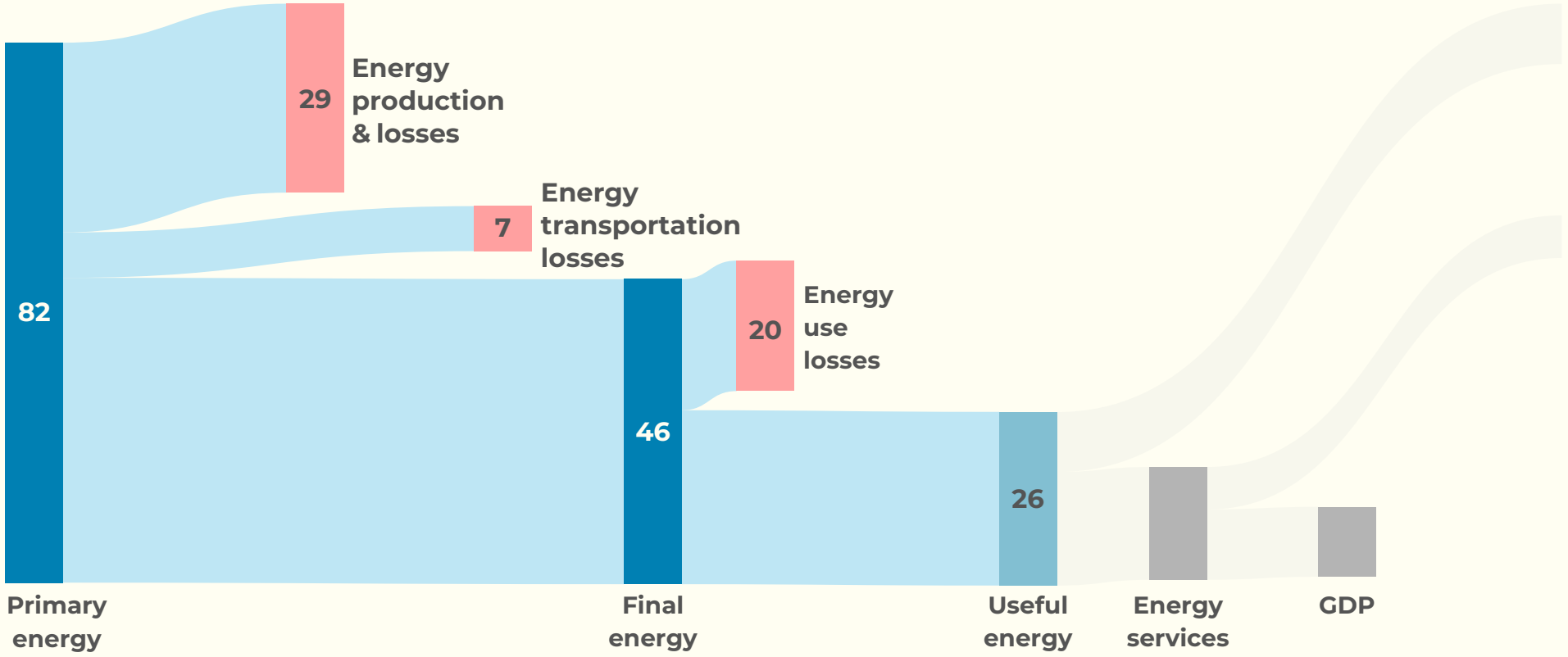
Solar panels and inverters displace imported RLNG and coal that would otherwise be burned for power, turning a one-time equipment import into a lasting reduction in the country's fuel bill.



Note: Fiscal year runs from July to June

The fossil-based energy system is incredibly inefficient, incurring high physical losses

Fossil fuels are a dominant source of energy across the global economy, but their conversion into useful energy services involves significant physical losses. In FY25, Pakistan's 82 Mtoe of primary energy supply yielded just 26 Mtoe of useful energy services*, the actual benefit people and businesses derive from energy use. Converting oil, gas and coal into useful energy services involves multiple stages, each resulting in physical losses. Electricity generated through renewable energy technologies (RETs), by contrast, delivers energy services more efficiently through higher conversion rates and lower physical losses.



Energy flows and physical resources losses, FY25 (Mtoe)

Note: Natural gas held in pipelines is excluded from useful energy
Energy services is useful energy turned into activities e.g. transportation, production; GDP includes activities turned into wealth and value.

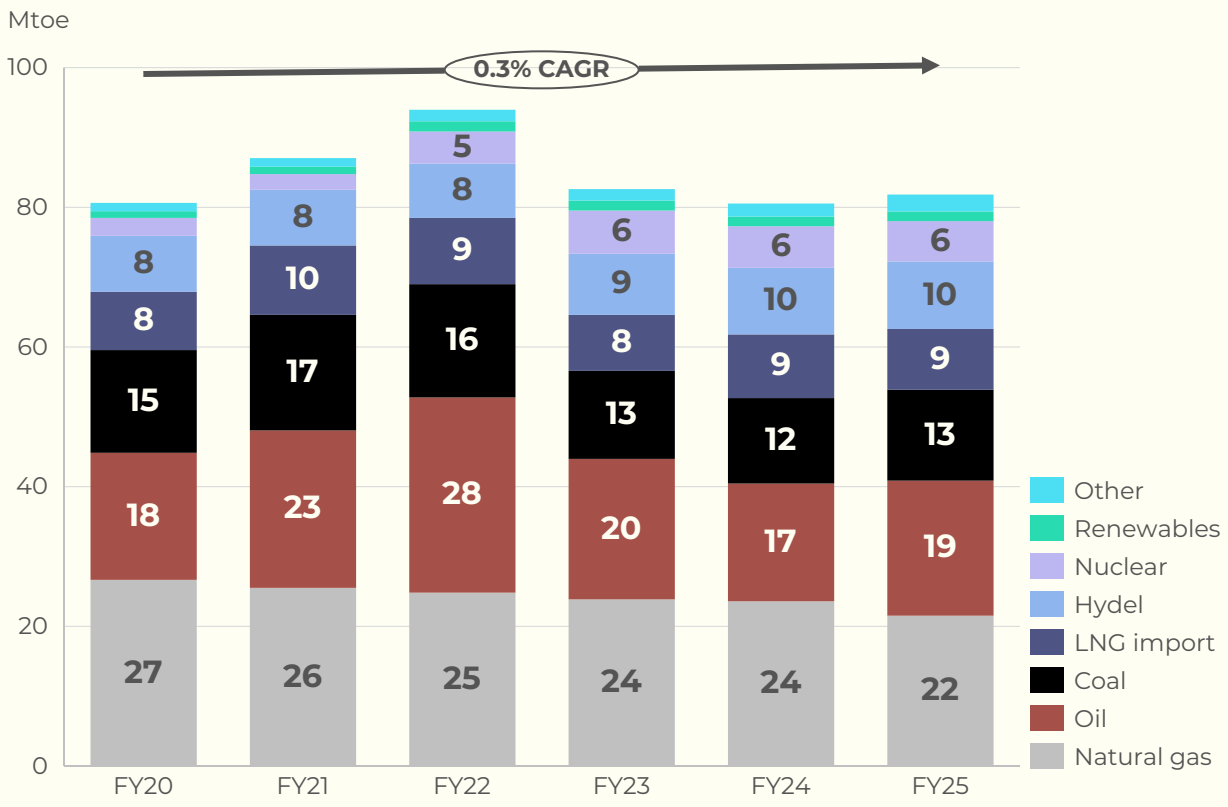
Data source: Energy Yearbook 2025 (HDIP), CORE Finance Mapping, Electrons In Hydrocarbons out, The Incredible Inefficiency of the Fossil Energy System & RF's calculations



Understanding the energy landscape

Official data suggest primary energy supply has remained broadly flat since FY23, even as the economy continues to grow

The uptick in primary energy supply (PES) in FY25 does not reverse the overall trend of suppressed energy demand as reported by official recordkeepers. Pakistan's GDP grew by a yearly average 2.8% over FY20–FY25, while PES recorded a compound annual growth rate (CAGR) of just 0.3% over the same period. Declining natural gas supply drove the decline in PES, with the annual supply averaging 6.3% below the FY20–FY22 average. Meanwhile, non-fossil energy supply, comprising hydel, renewable and nuclear energy, increased from 11.7 Mtoe in FY20 to 16.9 Mtoe in FY25, indicating a shift in the energy mix.



Annual primary energy supply by source

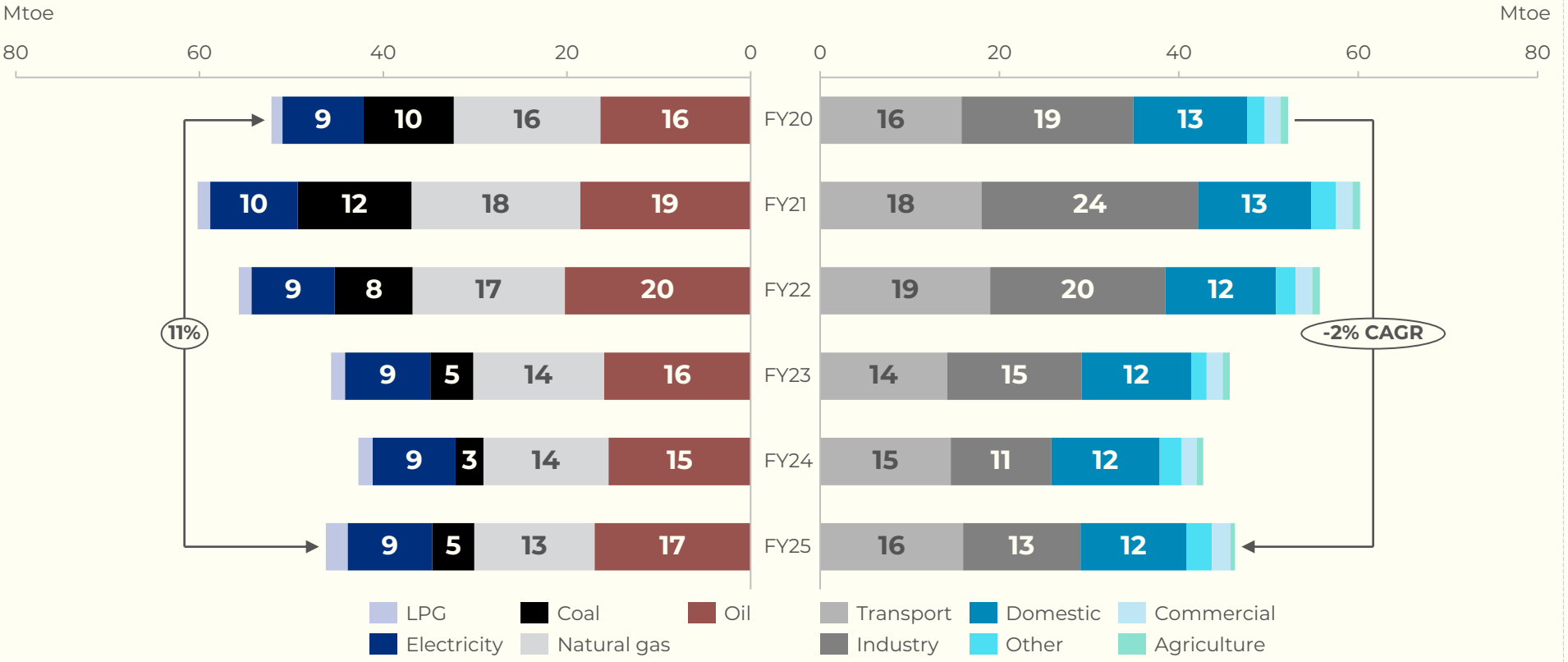
- **LNG imports** contracted from 9.1 Mtoe to 8.7 Mtoe in FY25 as lower power sector offtake left surplus contracted volumes, with excess LNG cargoes diverted to international markets.
- **Coal** supply rose 6% YoY in FY25 with the additional imports of 1 Mtoe to meet higher demand of the brick-kiln industry and other industrial consumers.
- **Oil supplies** increased by 15% YoY, accounting for a 24% of total primary energy supply in FY25, largely driven by the transport sector.
- **Local gas** production fell by 8% YoY after experiencing a short interval of stability over FY23-FY24, continuing the downward trajectory of indigenous supplies.

Methodology note: Official statistics are reported by the Hydrocarbon Development Institute of Pakistan (HDIP), while Renewables First provides a more complete picture of Pakistan's energy landscape by accounting for distributed solar capacity. Other include LPG and imported electricity

Data source: Energy Yearbook 2025 (HDIP), State Bank of Pakistan, Electrons In Hydrocarbons Out, & RF's calculations

The apparent decline in final energy consumption casts further doubt on the completeness of official records

The domestic sector has maintained energy consumption at around 12–13 Mtoe since FY20, while transport and industrial consumption has varied with economic activity. Official statistics show a 2% annual decline in final energy consumption during FY20–FY25, despite average economic growth of 2.8%. This disconnect suggests that official energy records may not fully reflect actual energy consumption in Pakistan.



Final energy consumption by source **Final energy consumption by sector**

Methodology note: Official statistics are reported by the Hydrocarbon Development Institute of Pakistan (HDIP), while Renewables First provides a more complete picture of Pakistan's energy landscape by accounting for distributed solar capacity.For more details, please refer to our earlier research: "The solarisation of Pakistan energy economy"

Data source: Energy Yearbook 2025 (HDIP) & RF's calculations

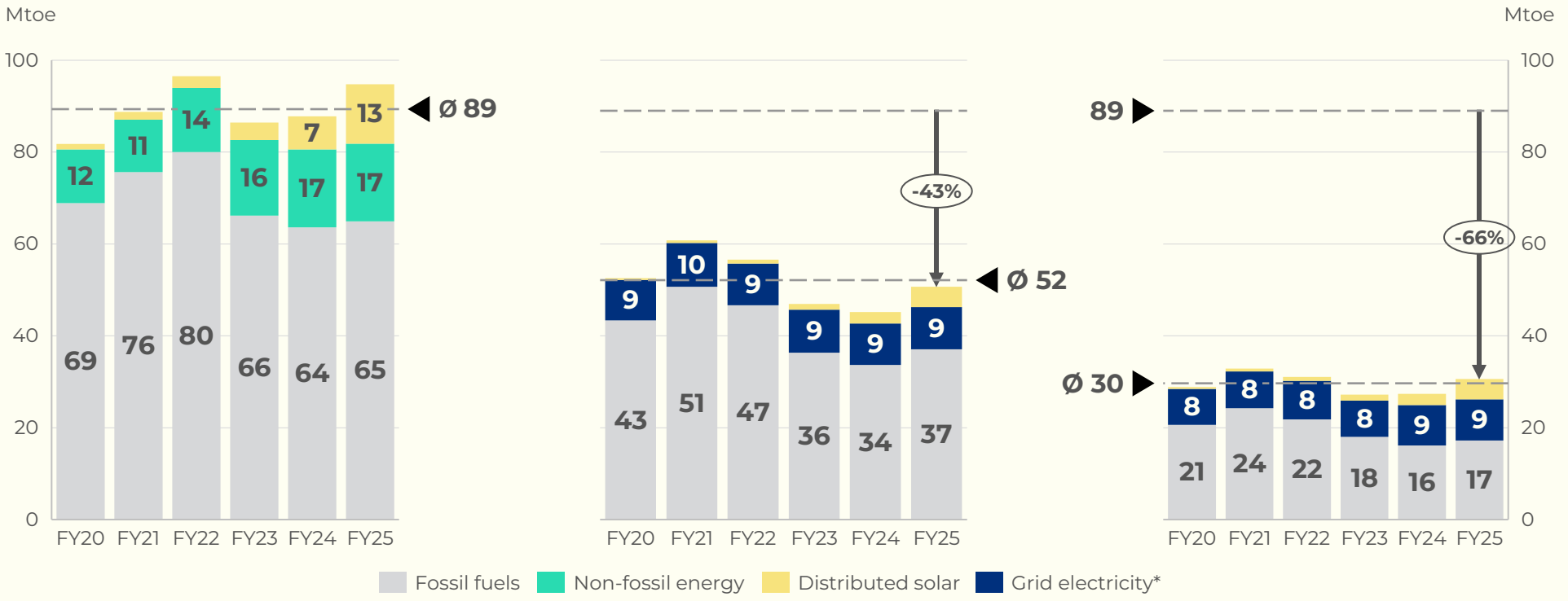
Distributed solar completes the picture of Pakistan's energy supply and consumption

Official statistics use conventional energy accounting methods that do not fully capture Pakistan's distributed solar expansion. Our estimates show that distributed solar had already displaced about 13 Mtoe of primary energy supply requirement in FY25 alone. In other words, without distributed solar, Pakistan would have needed an additional 13 Mtoe equivalent of fossil fuel supplies to meet the same level of final energy consumption.

Primary energy supply
Energy in its raw or procured form before any conversion or transformation.

Final energy consumption
Energy supplied to end users after transformation such as petrol at the pump and grid electricity

Useful energy
The share of final energy that performs physical work, such as vehicle propulsion, industrial heat etc.

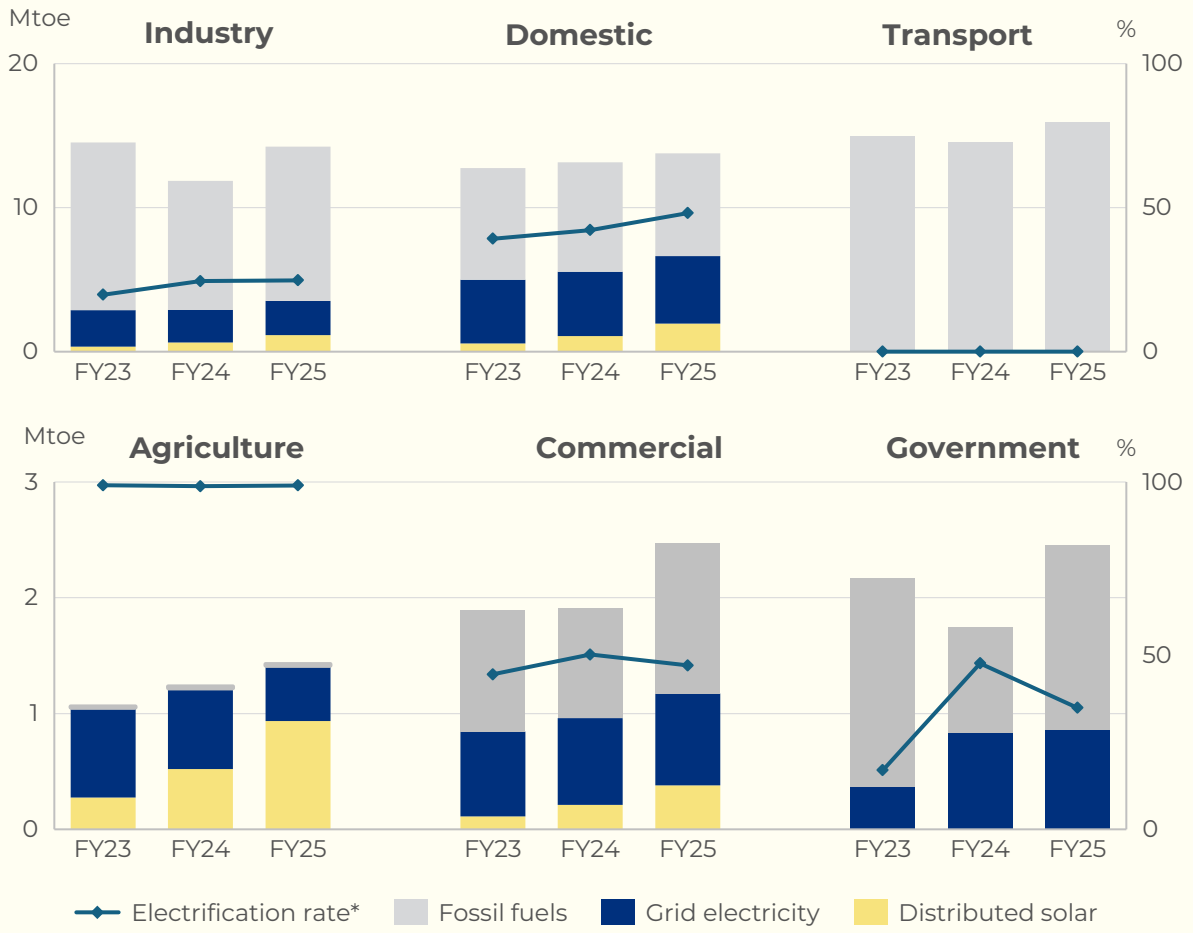


A comparison of primary energy supply, final energy consumption and useful energy

Methodology note: This analysis followed the conversion factors applied by the HDIP and the IEA even though the conventional energy accounting is unable to reflect the real impact and role of electric supply and electrification in the energy sector. **Note:** *Includes electricity generated from all sources of energy, including fossil and renewables. The 9 Mtoe of *final energy consumption* and *useful energy* in FY25 comprises 3.3 Mtoe from fossil resources (oil, natural gas and coal) and 5.8 Mtoe of that. include hydel, nuclear and renewables

Data source: Energy Yearbook 2025 (HDIP) & RF's calculations

Solar adoption across the economy has raised the national electrification rate to 27%, but transport remains untapped



Final energy consumption and rate of electrification

- The **domestic sector** leads in distributed solar adoption, with a 48% electrification rate*. Nearly half of its annual energy demand still relies on natural gas, indicating significant scope for further electrification.
- The rate of electrification in the **industrial sector** increased from 20% to 25% between FY23 and FY25, driven by growing solar adoption among industrial consumers.
- The **agriculture sector's** reliance on grid electricity fell for the third consecutive year, as rising tariffs drove solar electrification up 80% YoY in FY25. However, official statistics classify agricultural high speed diesel oil (HSD) consumption under transport, leaving diesel displacement from solarised tubewells unaccounted for in the reported electrification rate.
- **Transport sector** is the largest consumer of oil products and the least electrified segment too, highlighting the need for electrification to reduce reliance on fossil fuel imports.

*Electrification rate = Electricity (Mtoe) / Final Energy Consumption (Mtoe). Fossil fuels includes natural gas, oil, coal and LPG

Note: The Solarisation of Pakistan's Energy Economy reported an electrification rate of 21.7%, based on a methodology adopted with Ember that includes IEA biomass consumption estimates. This increases total energy consumption and lowers the electrification rate. For further details, see CORE Finance Mapping and The Solarisation of Pakistan's Energy Economy

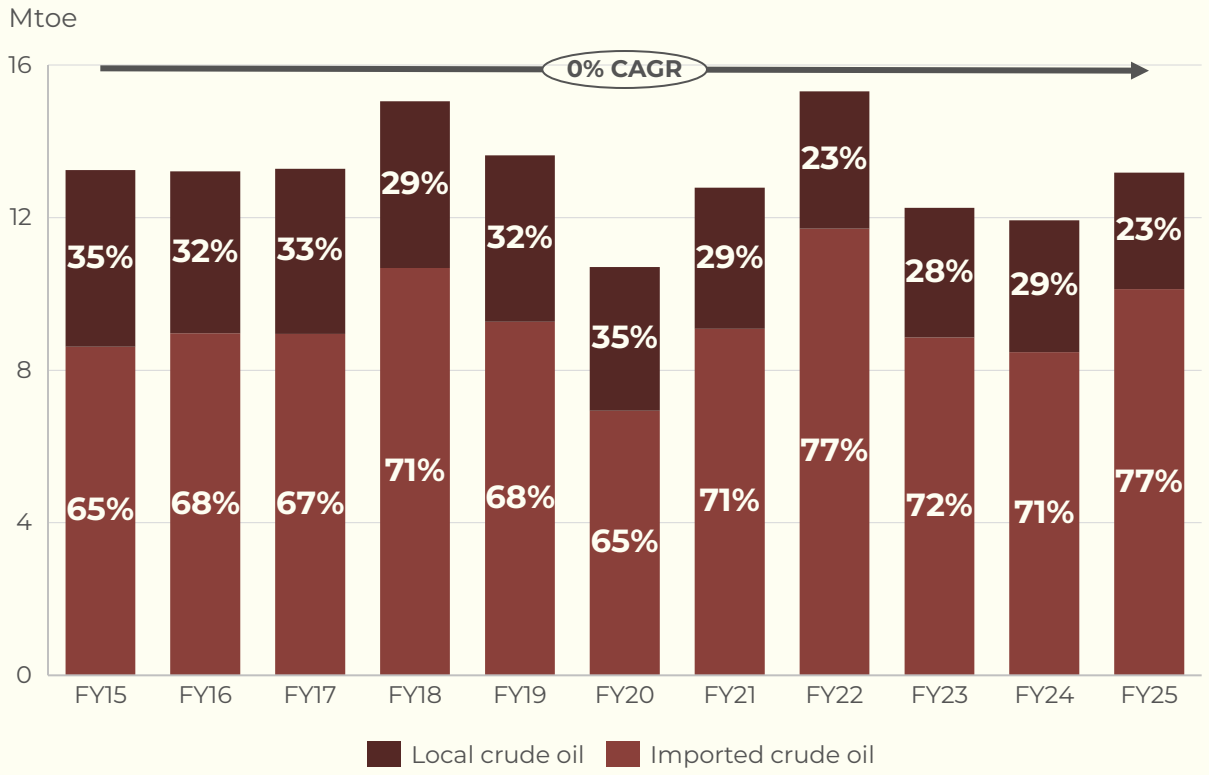
Data source: Energy Yearbook 2025 (HDIP) & RF's calculations



Oil market is import-dependent

A one-third decline in domestic crude production over the last decade has deepened Pakistan's import dependence

During FY15–FY25, domestic crude production fell from 4.6 Mtoe to 3.1 Mtoe, at a CAGR of -4.1%. Over the same period, crude oil imports increased from 8.6 Mtoe to 10.2 Mtoe, at a CAGR of 1.6%. This growing reliance on imported crude oil leaves Pakistan highly exposed to international oil price shocks and supply disruptions.



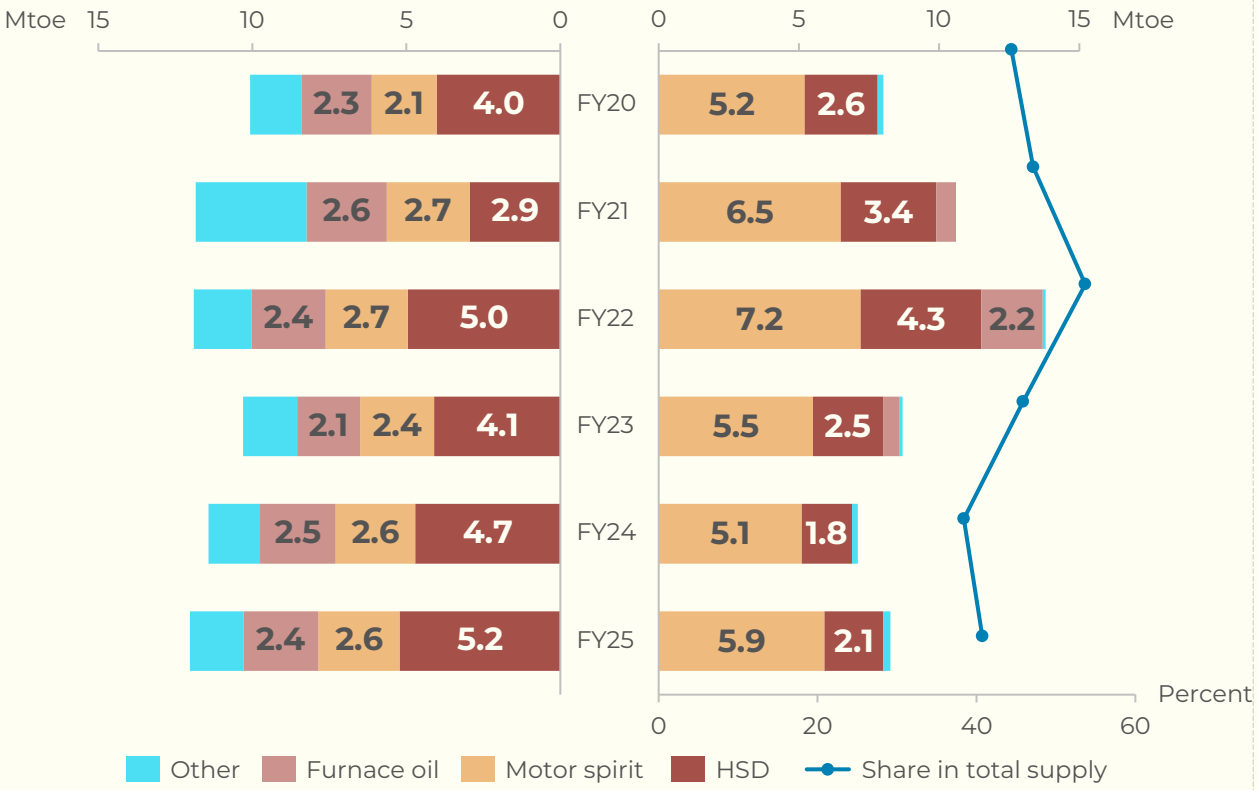
Local crude production and imports, quantity and percent share

- **Domestic crude oil** production fell 12% YoY in FY25 against a 10.5% increase in annual crude supplies. The persistent decline in local production reflects depletion across mature fields, weak reserve replacement and limited upstream investment.
- **Crude oil imports** increased by 20% YoY in FY25 to meet refinery requirements as domestic production declined. Imported crude now accounts for 77% of local refinery requirements, making refinery operations heavily reliant on external supplies.

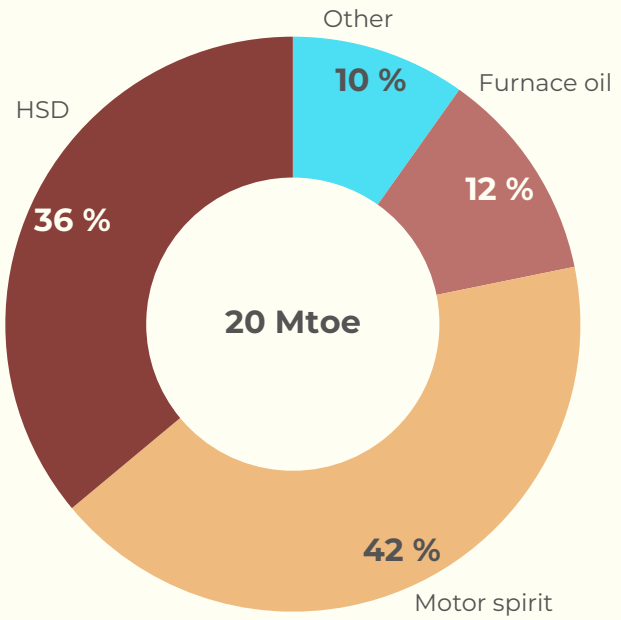
Data source: Energy Yearbook 2025 (HDIP) & RF's calculations

Imports share grew to 41% of annual petroleum supply in FY25 as local refineries are unable to meet petrol and diesel demand

Imported petroleum products maintained a steady share of around 40% in annual demand over the past three fiscal years. Motor spirit (petrol) dominated both overall demand (42%) and import volume (72%) in FY25. Although local refinery output rebounded to FY22 levels, a lack of technical upgrades and capacity expansions leaves the country heavily reliant on fuel imports.



Local refinery output (A) and petroleum products import volume with its share in total yearly supply (B)

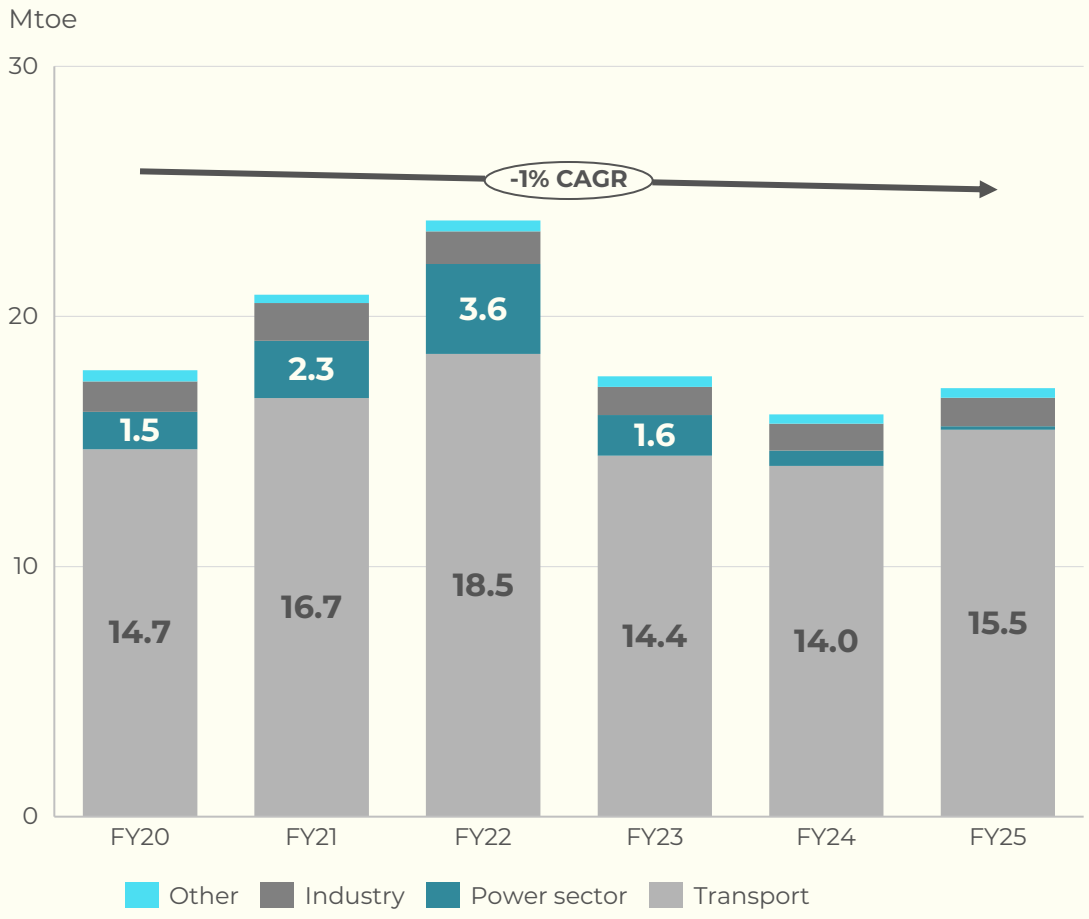


Petroleum products supply mix, FY25

Note: Motor spirit includes high octane blending component (HOBC). HSD refers to high-speed diesel. Others include LPG, refinery gas, Naphtha, kerosene oil and aviation fuel

Data source: Energy Yearbook 2025 (HDIP) & RF's calculations

Petroleum consumption remains well below its FY22 peak despite a modest recovery in transport sector consumption



Annual consumption of petroleum products by sector

Transport sector now explains 90% of annual oil consumption, 8 percentage points (pp) higher than in FY20. The sectoral consumption grew 10% YoY in FY25 to meet transport services demand, reversing the YoY decline of FY23-FY24.

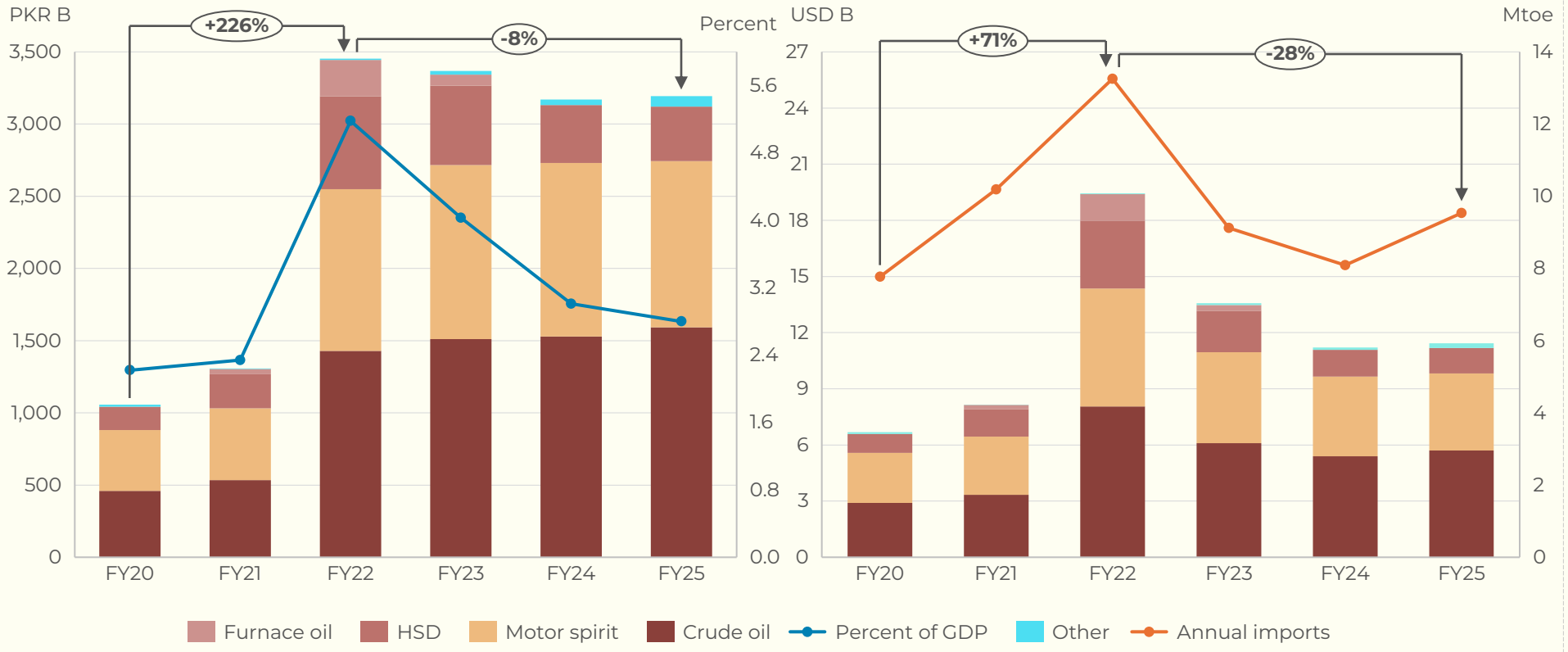
Petroleum use in the **power sector** plunged 77% YoY in FY25 as the sector continued to move away from expensive oil-fired generation through plant retirements and greater reliance on consumer energy resources like the distributed solar.

Oil demand in the **industrial sector** rose 3.2% YoY to 1.14 Mtoe in FY25, reflecting stronger manufacturing activity and increased industrial fuel demand.

Data source: Energy Yearbook 2025 (HDIP) & RF's calculations

Pakistan's dependence on imported oil continues to strain foreign exchange reserves

Pakistan's reliance on imported fossil fuels adds economic pressures, as the country struggles to grow exports enough to finance its rising import bill. Oil import volumes increased by 71% between FY20 and FY22, pushing the import bill up by 226% in PKR terms and adding to inflationary pressures. Although import volumes declined by 28% from their FY22 peak, the import bill fell by just 8% by FY25, reflecting the impact of higher prices and rupee depreciation.



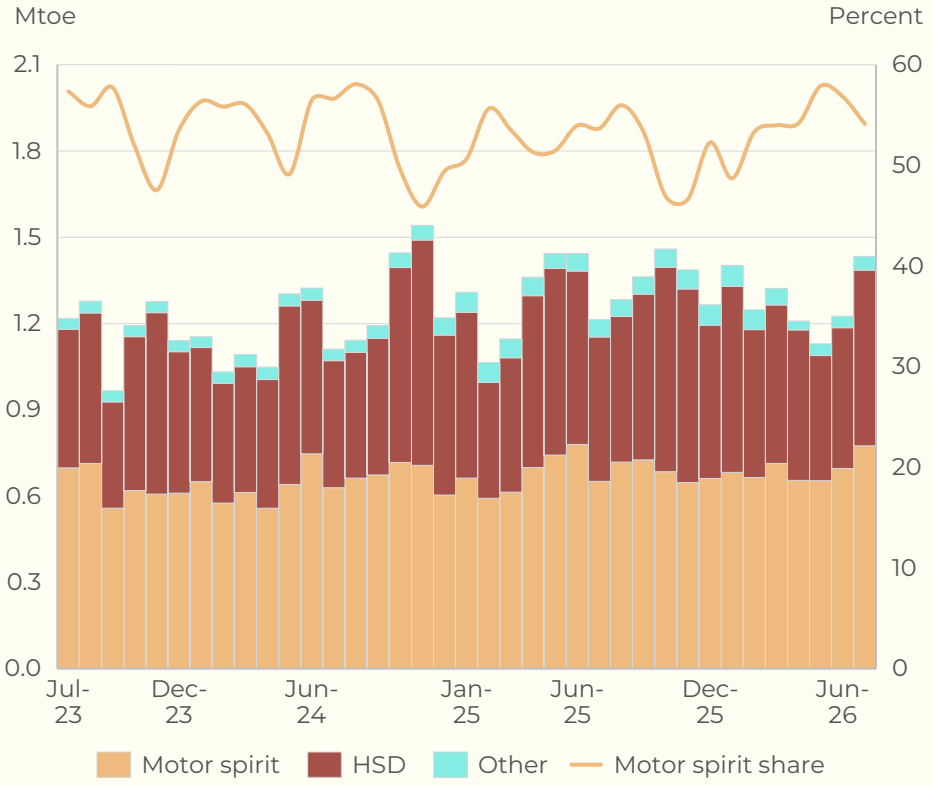
Oil products import value (PKR) and GDP equivalence (percent)

Oil products import value (USD) and quantity (Mtoe)

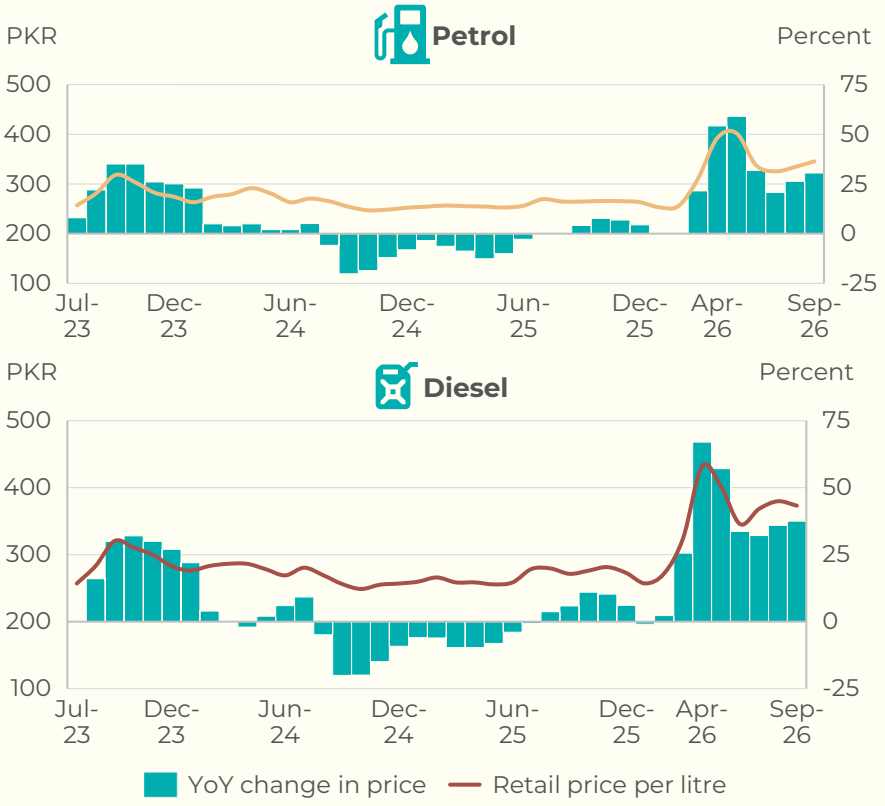
Note: Other include 100/LL, high octane gasoline and jet fuel. Motor spirit also includes HOBC.
Data source: Energy Yearbook 2025 (HDIP) & RF's calculations

The Hormuz crisis exposes economic cost of oil dependence and the critical need for transport electrification

The Strait of Hormuz crisis highlights the economic risks of Pakistan's dependence on imported oil and LNG. Following the US-Israeli strikes on Iran, average petrol and diesel prices rose to PKR 350 and PKR 375 per litre, respectively, during Mar–Sept 26, representing year-on-year increases of 35% and 41%. Since personal mobility accounts for a significant share of petrol demand, electrifying two and four-wheel transport could reduce oil imports, ease foreign exchange pressures and improve economic resilience.



Monthly fuel consumption in transport sector



Average monthly retail prices and YoY change

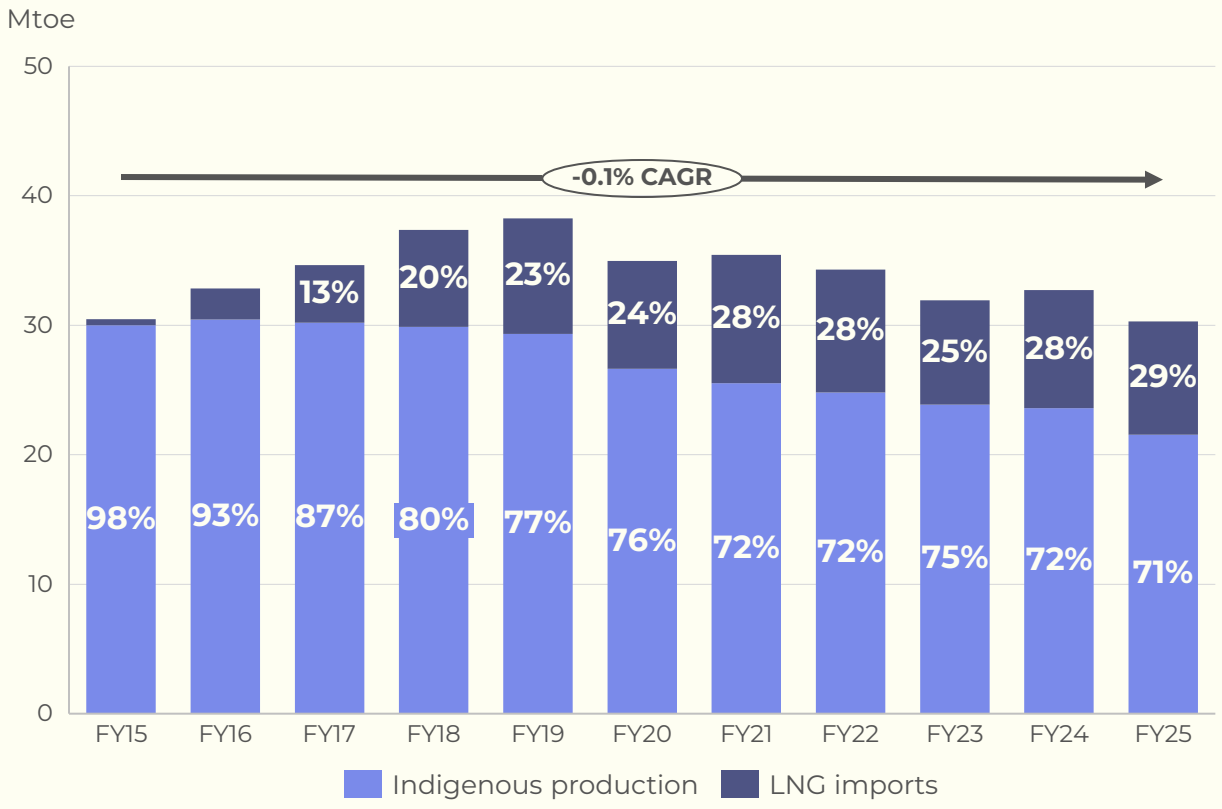
Data source: Energy Yearbook 2025 (HDIP) & RF's calculations



Natural gas faces growing supply constraints

Falling domestic gas output is shifting the gas balance toward LNG imports, exposing the economy to greater external risks

Pakistan's indigenous natural gas production declined from 30 Mtoe in FY15 to 21.5 Mtoe in FY25, at a CAGR of -3.3%. Over the same period, the country expanded its RLNG-fired power generation capacity, while LNG imports grew at a CAGR of 34%, supported by long-term supply agreements with Qatar.

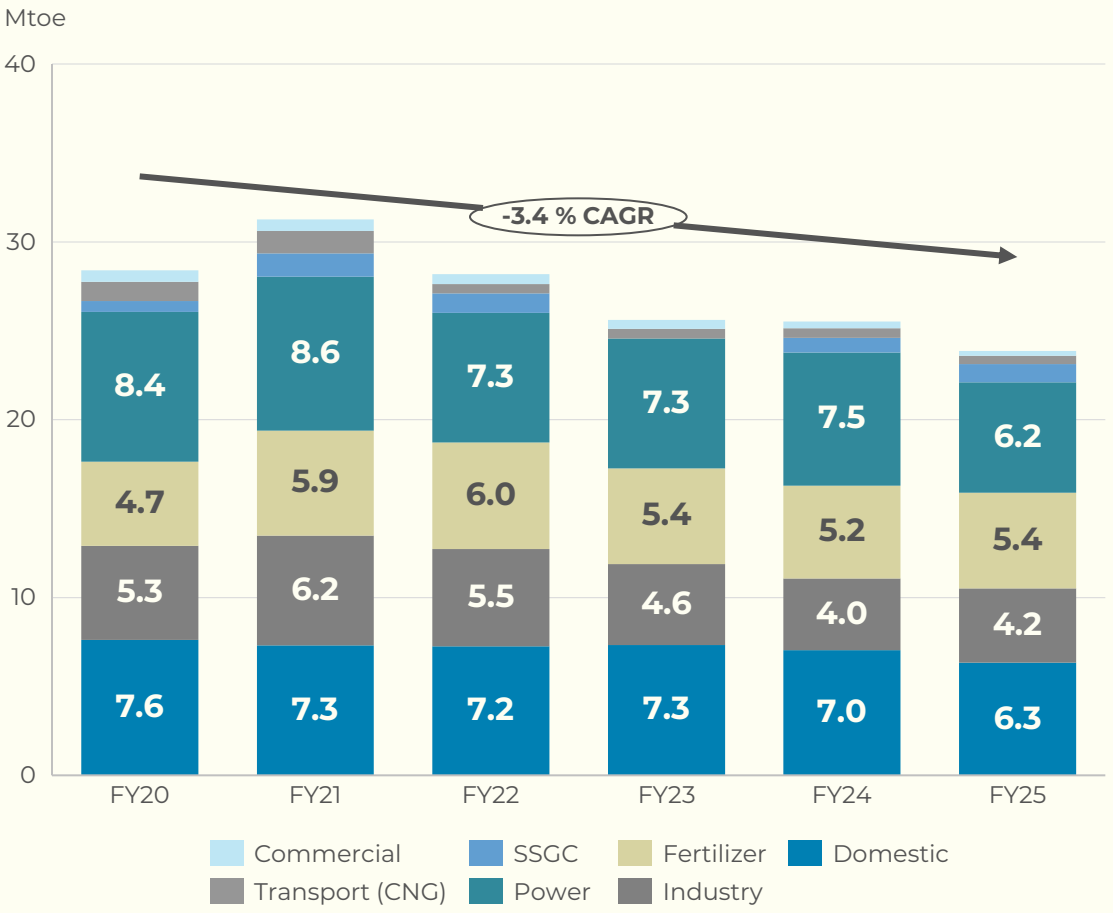


Local natural gas production and LNG import supply

- **Local natural gas** production declined 8% YoY in FY25. The mature fields continue to deplete, and limited exploration activities constrain replacement supply. Excess RLNG supply in FY25 also led to the curtailment of production from domestic gas fields, further reducing indigenous supply.
- **LNG imports** declined 4% YoY to 8.7 Mtoe in FY25 slightly below the five-year average of 9 Mtoe as rising solar adoption led to a reduction in RLNG-fired power generation. This displacement resulted in surplus contracted supply causing LNG cargo deferrals and diversions.

Data source: Energy Yearbook 2025 (HDIP) & RF's calculations

Natural gas consumption has fallen by a quarter since FY21 amid contracting domestic supply and costly LNG



Annual natural gas consumption by sector

Gas consumption in the **domestic sector** declined 10% YoY in FY25, reaching the lowest level over the review period due to policy interventions, namely curtailed supply and tariff hikes.

Improved **industrial activity** drove gas consumption up by 3.6% YoY although annual demand is only second-highest since FY20. Export-oriented industries and cement production were the main drivers of this growth.

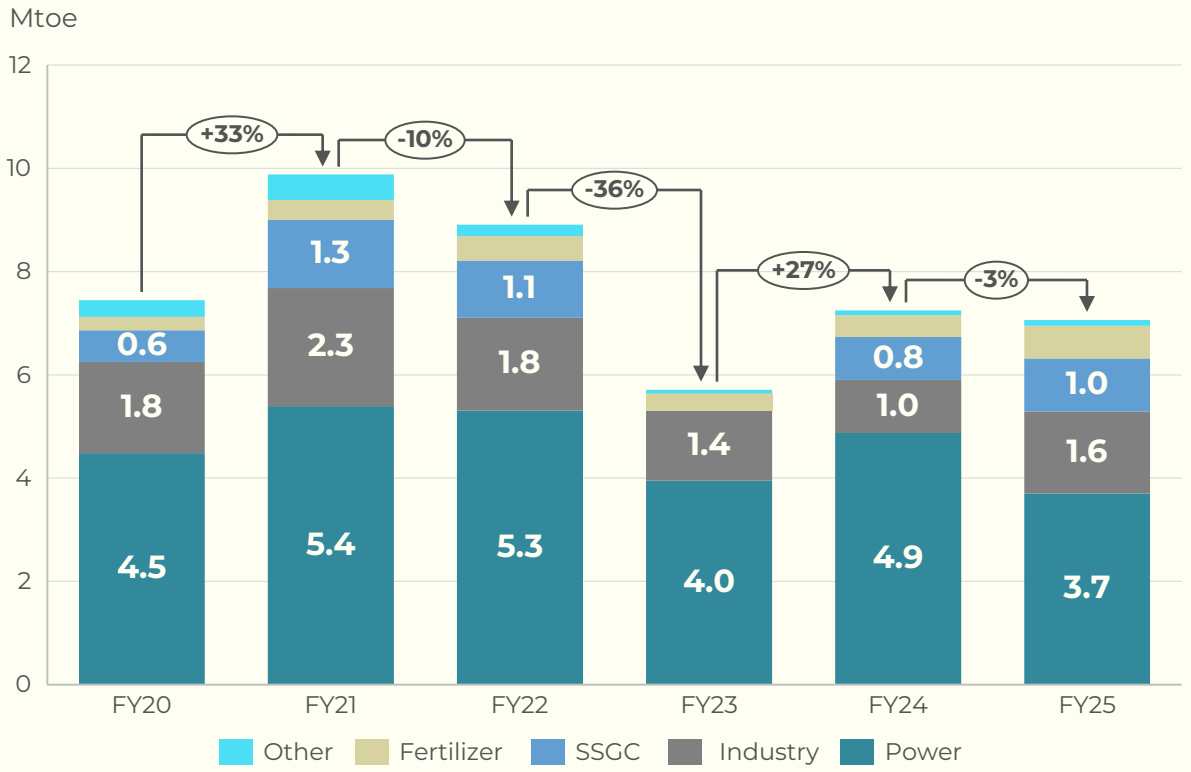
Power sector natural gas demand declined by 17% YoY as rising solar adoption reduced grid electricity demand, while RLNG-fired power plants remained lower on the economic merit order, limiting their utilization.

*For further details on the growth of solar in Pakistan and its impact on grid demand, see our study Pakistan Electricity Review 2026 and Pakistan Energy and Climate insights - PECI

Note: These figures include both indigenous natural gas and LNG consumption reported by SSGC and SNGPL
Data source: Energy Yearbook 2025 (HDIP) & RF's calculations

Lower demand in power sector resulted in excess RLNG that other sectors struggled to absorb

RLNG entered the national energy mix to make up for the falling domestic gas production and has seen annual imports grow from below 0.5 Mtoe in FY15 to an average of 9 Mtoe over FY21-25. RLNG-fired generation capacity, which has grown to 6.7 GW since 2018, was targeted to be the primary driver of consumption along with industrial and fertiliser sectors which have traditionally relied on subsidised local supply. The signing of long-term gas supply agreements have proved less effective against frequent supply disruptions and price fluctuations.



Annual RLNG consumption by sector

- In FY25 RLNG consumption contracted by 24% YoY in **power sector** as continued growth of distributed solar across residential and industrial consumers cut into grid demand.
- The persistent shortage of domestic gas and government's aim to divert surplus LNG towards **industries** increased sectoral consumption by 54% YoY in FY25.
- RLNG held in **gas pipelines** rose 23% YoY, increasing line-pack pressure, curtailing indigenous gas production and driving excess cargo diversions.

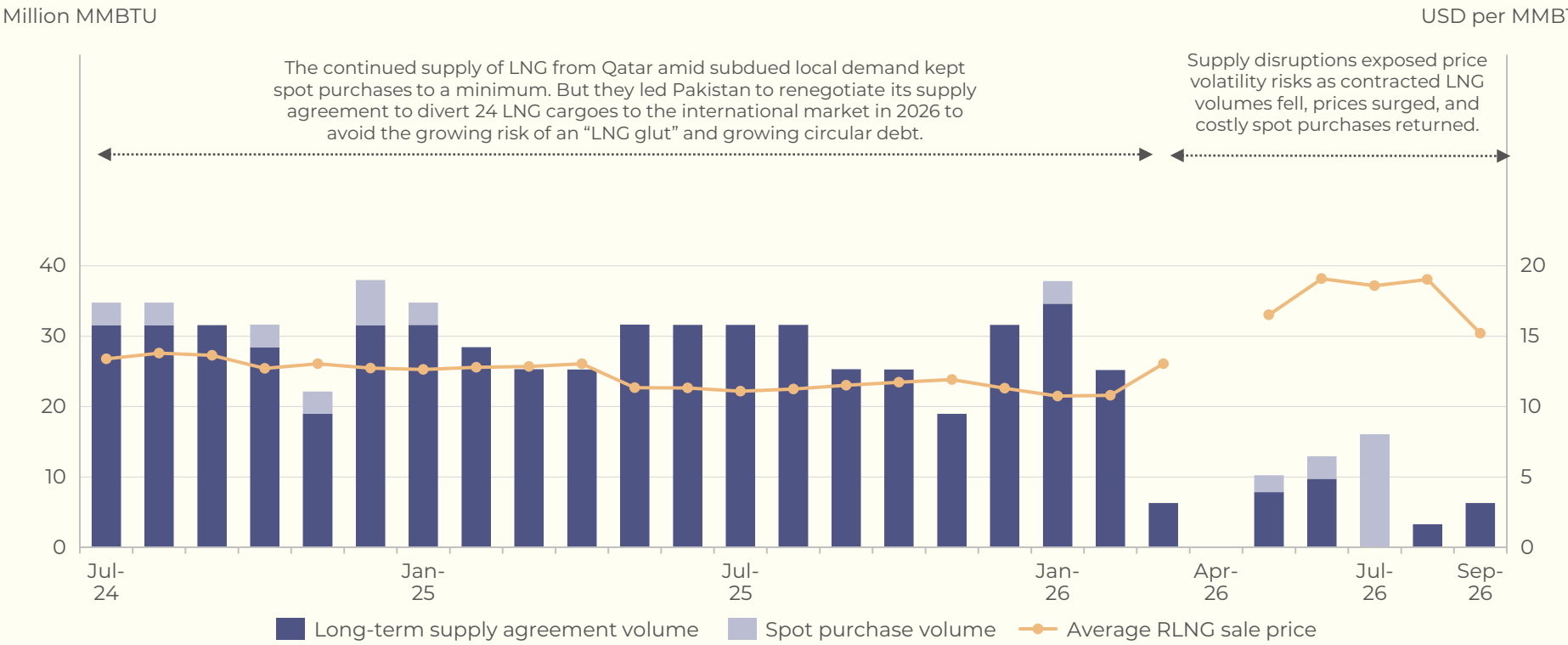
*For further details on the growth of solar in Pakistan and its impact on grid demand, see our study Pakistan Electricity Review 2026 and Pakistan Energy and Climate Insights - PECI

Note: *Refers to the LNG supply situation as of Jun 25, which changed drastically with the US-Israeli attacks on Iran in Feb 26

Data source: Energy Yearbook 2025 (HDIP) & RF's calculations

The Hormuz crisis rapidly turned an apparent RLNG glut into a supply and price shock

Pakistan avoided spot LNG purchases throughout most of 2025 amid surplus supply. However, Qatar's force majeure declaration following the closure of the Strait of Hormuz reduced contracted cargoes from eight in February to none in April 2026, rapidly turning surplus into scarcity and forcing a return to spot purchases. Higher RLNG prices raised power generation costs and electricity tariffs. In contrast, distributed solar adoption helped shield consumers* from rising energy costs, highlighting the value of accelerating renewables deployment to reduce exposure to imported fuels.



LNG import volumes and RLNG sale price, July 2024 - September 2026

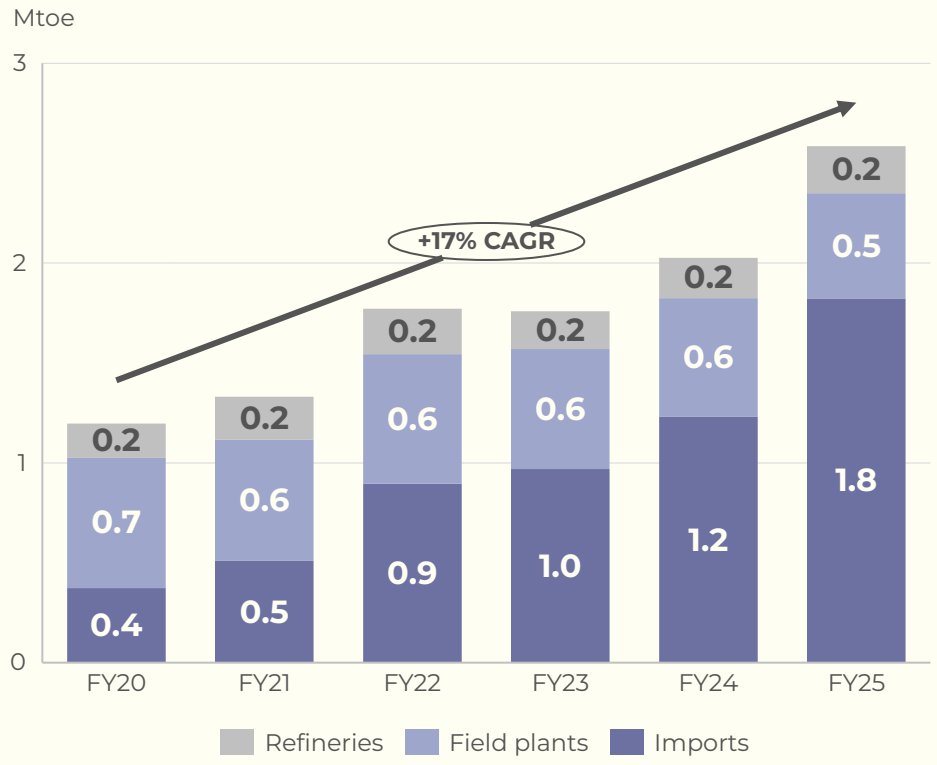
*For further details see our analysis The hedge that paid off: How Pakistan's solar boom is shielding it from the Hormuz crisis

Data source: OGRA Price Notifications & RF's calculations

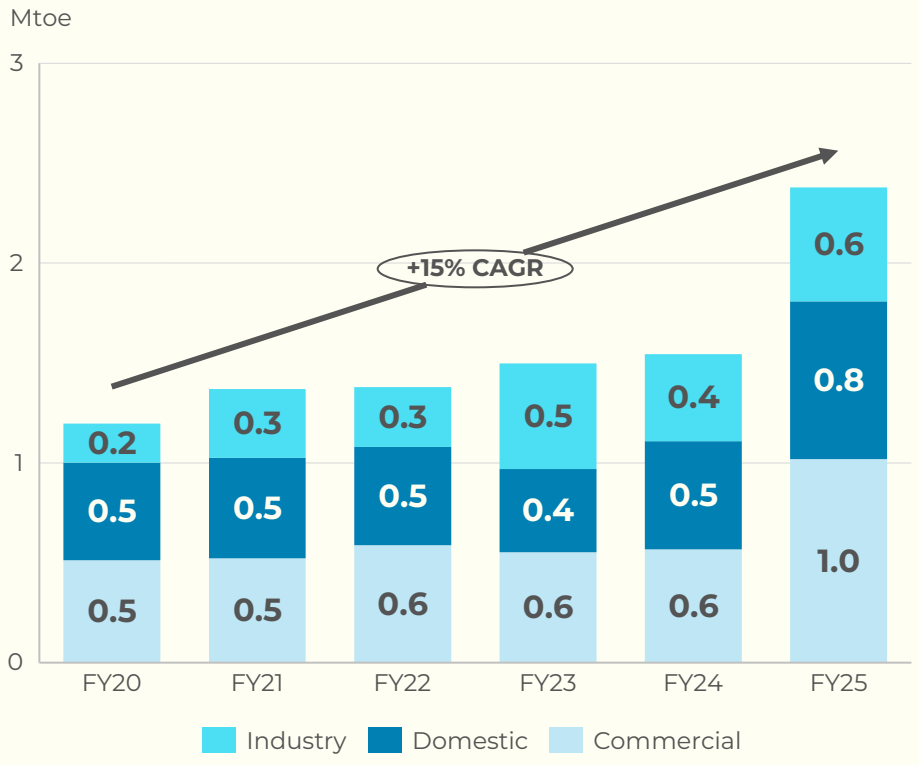
Gas shortages pushed households and businesses onto imported LPG

Domestic LPG production declined from 0.8 Mtoe in FY24 to 0.7 Mtoe in FY25, reflecting continued depletion of gas fields despite high refinery output. Meanwhile, LPG imports rose 48% YoY to meet surging demand.

LPG consumption grew significantly across residential, industrial and commercial categories to make up for the supply shortages of subsidised local gas. The YoY rise of 0.8 Mtoe in LPG demand offsets the 0.7 Mtoe reduction of natural gas consumption across these consumer categories*.



LPG supplies by source



LPG consumption by segment

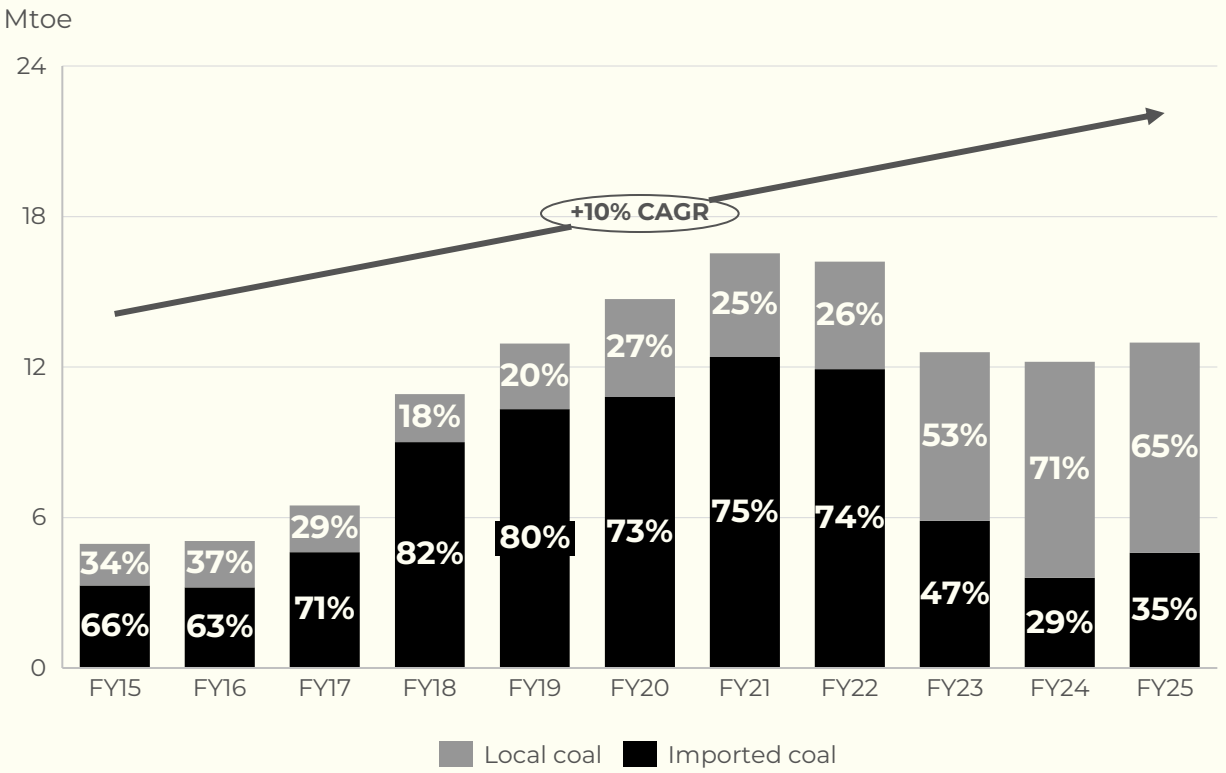
* Includes domestic, industrial, commercial and transport sector for natural gas consumption

Data source: Energy Yearbook 2025 (HDIP) & RF's calculations

Coal shifts towards domestic supply

Coal imports recovered in FY25, but Thar's growing lignite production has overtaken imported supply

Pakistan's annual coal imports declined from an average of 8.2 Mtoe during FY15–FY22 to 4.7 Mtoe during FY23–FY25. Meanwhile, annual indigenous coal production increased from an average of 2.8 Mtoe to 7.9 Mtoe over the same periods largely driven by Thar lignite expansion. However, total coal supply remained well below its FY21 peak due to lower demand.



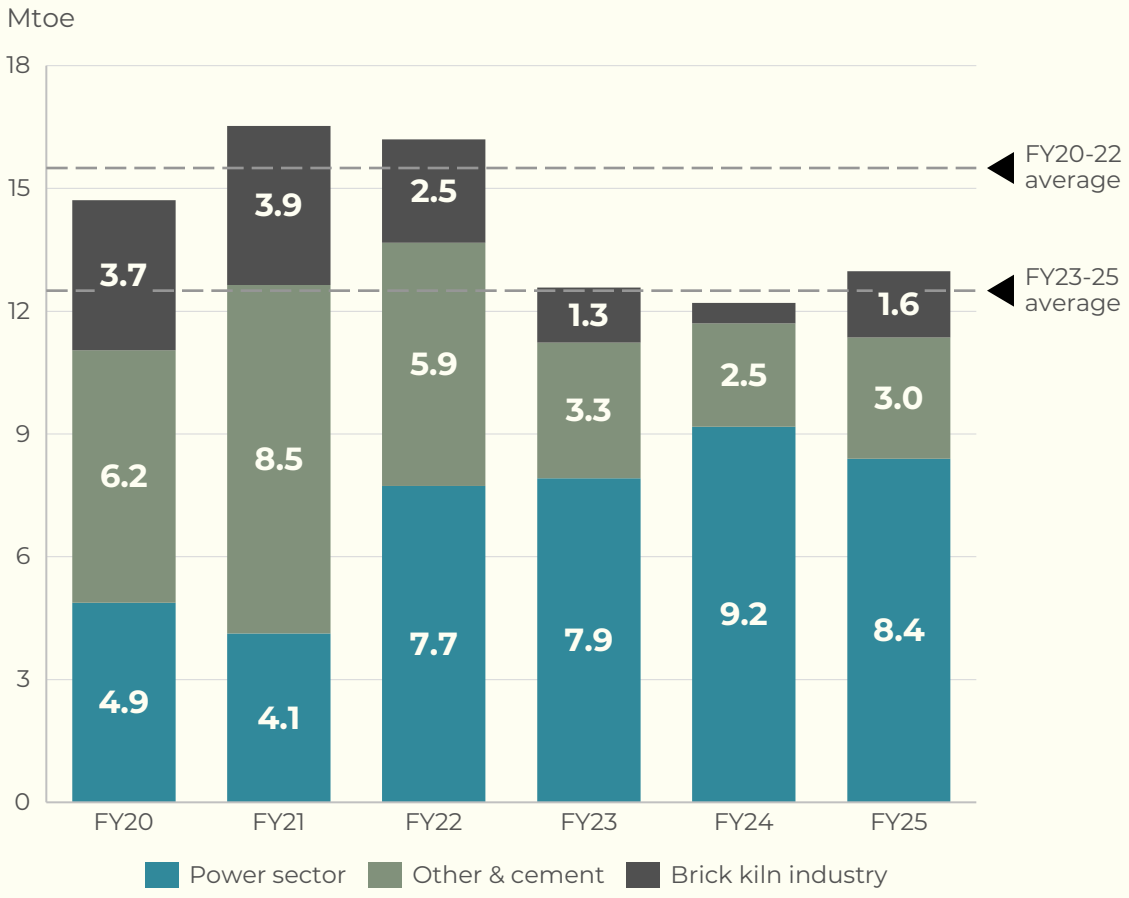
Annual local coal production and import volumes

Indigenous coal production declined by 3% YoY in FY25, its first annual reduction since FY15. As a result, its share of national coal supply fell by 6 percentage points. The decline reflects operational constraints and lower output from mature coalfields, slowing the growth of indigenous coal supply.

Coal imports rose from 3.6 Mtoe in FY24 to 4.6 Mtoe in FY25. However, expanding Thar lignite production and government plans to shift existing coal plants towards domestic coal could limit future import growth, keeping volumes below previous peaks.

Data source: Energy Yearbook 2025 (HDIP) & RF's calculations

Coal demand has shifted toward the power sector, while industrial consumers reduced their consumption by more than half since FY21



Annual coal consumption by sector

Construction-led masonry demand drove coal consumption in brick **industry** from 0.5 MTOE in FY24 to 1.6 MTOE in FY25, which remains far below the trend observed during FY20-22.

The cement sector grew its coal demand by 19% YoY, partly to support the 30% increase in cement exports. The sector shows the steepest decline in coal demand when compared with the FY20-22 period, while also experiencing strong solarisation.

Coal consumption in the **power sector** remained unchanged despite a 9% YoY fall in FY25, reflecting changes in plant dispatch and utilization. The growing reliance on local lignite for power generation signals the fuel's continued role in the coming years.

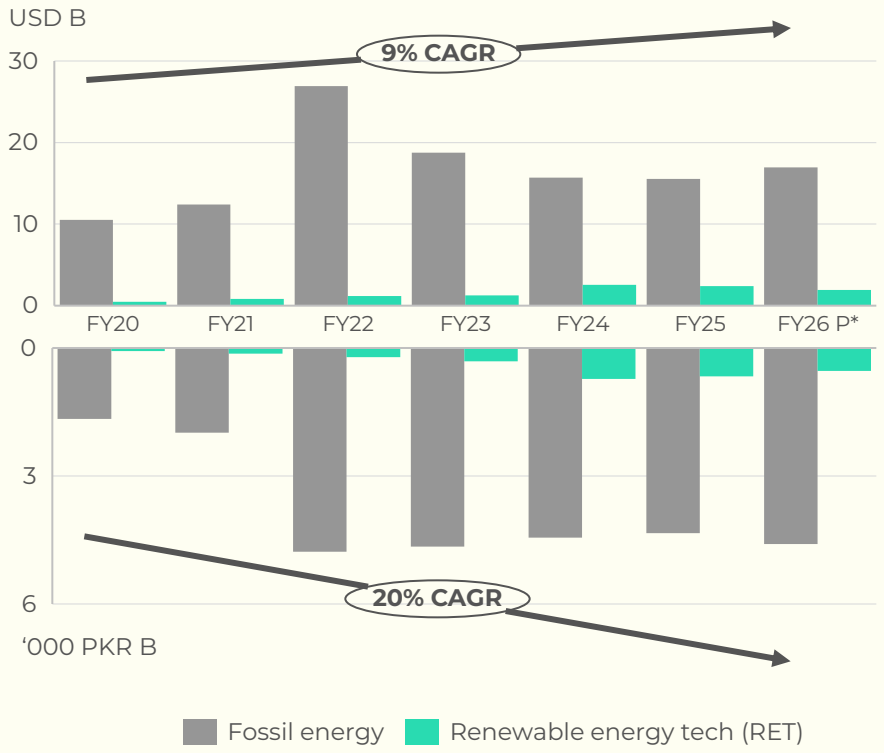
Data source: Energy Yearbook 2025 (HDIP) & RF's calculations



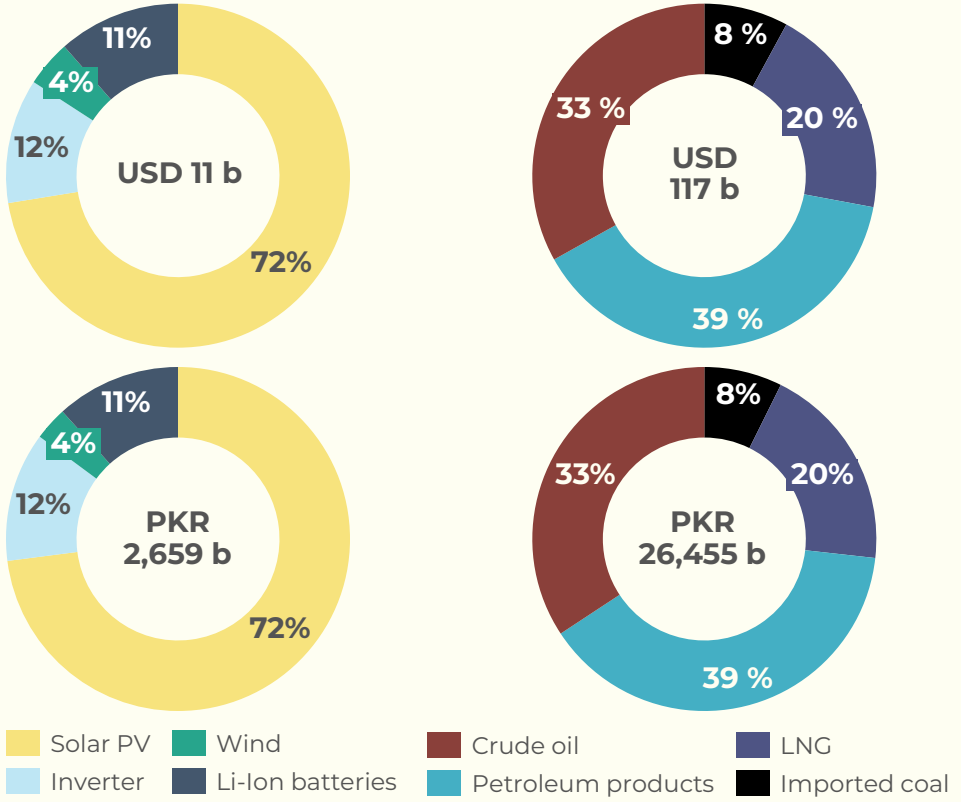
Solar is reshaping Pakistan's energy economy

Fossil fuels accounted for nearly all of Pakistan's USD 128B energy import spending during FY20-FY26*

Limited domestic resources and technological base sustain the country's reliance on imported fuels and energy technologies, putting pressure on scarce foreign exchange reserves. Although imports of RETs have increased sharply since FY20, their value remains small compared with fossil fuel imports. At present, both are necessary inputs to economic growth, but policymakers must assess their respective economic and strategic returns when determining how scarce forex resources are deployed.



Annual energy imports by category



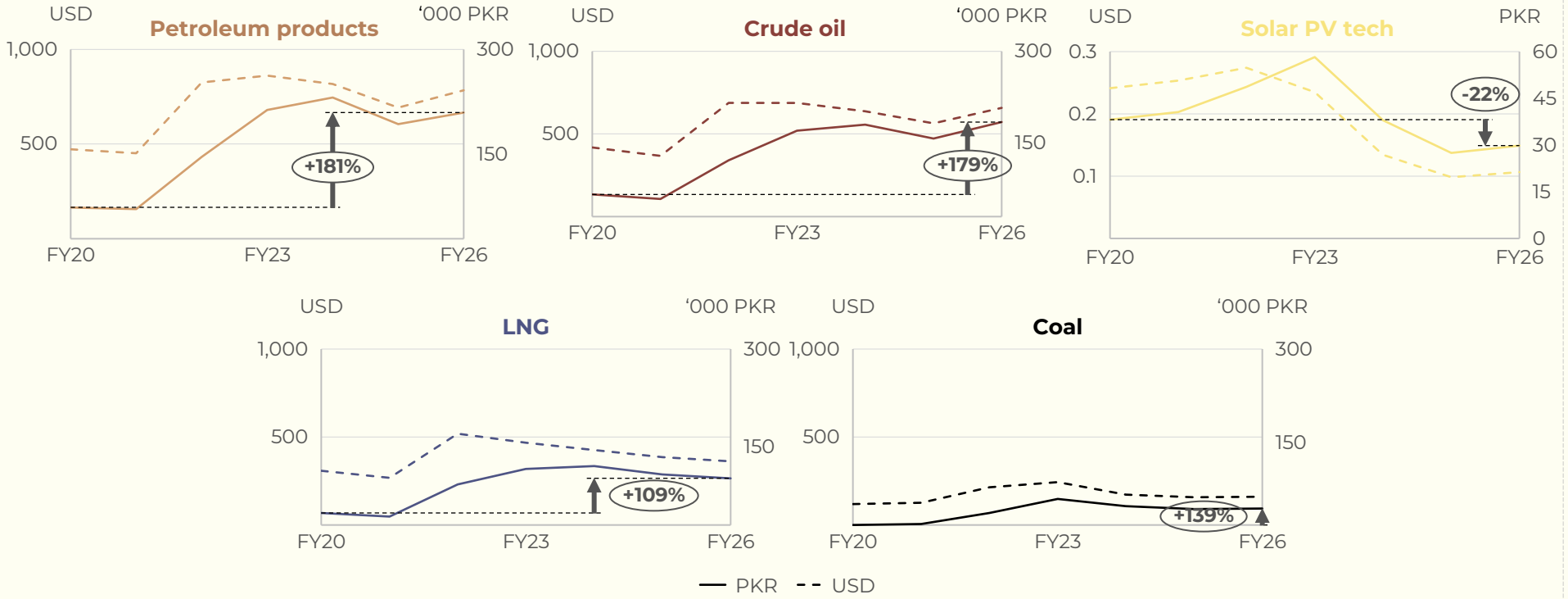
Cumulative value of energy imports, FY20-FY26

Fossil energy includes; coal, crude oil, refined petroleum products and LNG. Renewable energy technology (RETs) includes; solar PV panels, wind turbines, inverters and lithium-ion batteries. P* Incudes provisional data for fossil fuels taken from HDIP and Pakistan Bureau of Statistics (PBS).

Data source: Energy Yearbook 2025 (HDIP), Chinese customs, Pakistan bureau of statistics(PBS), Ember-energy & RF's calculations

Solar PV continues to deliver superior economics for consumers and the economy

Technology entails an inherent advantage over fossil energy: expanding manufacturing capacity can drive technology costs down, while fossil fuel prices remain exposed to volatile commodity markets. Solar PV panels demonstrate this advantage as an imported commodity. Between FY20 and FY26, fossil fuel import costs per TOE increased by 109–181% in PKR terms, while solar tech became 22% cheaper per watt. The rupee depreciation compounds exposure to oil price shocks, making those imports considerably more expensive in local currency than suggested by movements in USD prices alone. Despite similar exchange-rate exposure, declining solar tech prices have helped offset depreciation pressures and sustained a cost advantage for domestic consumers.



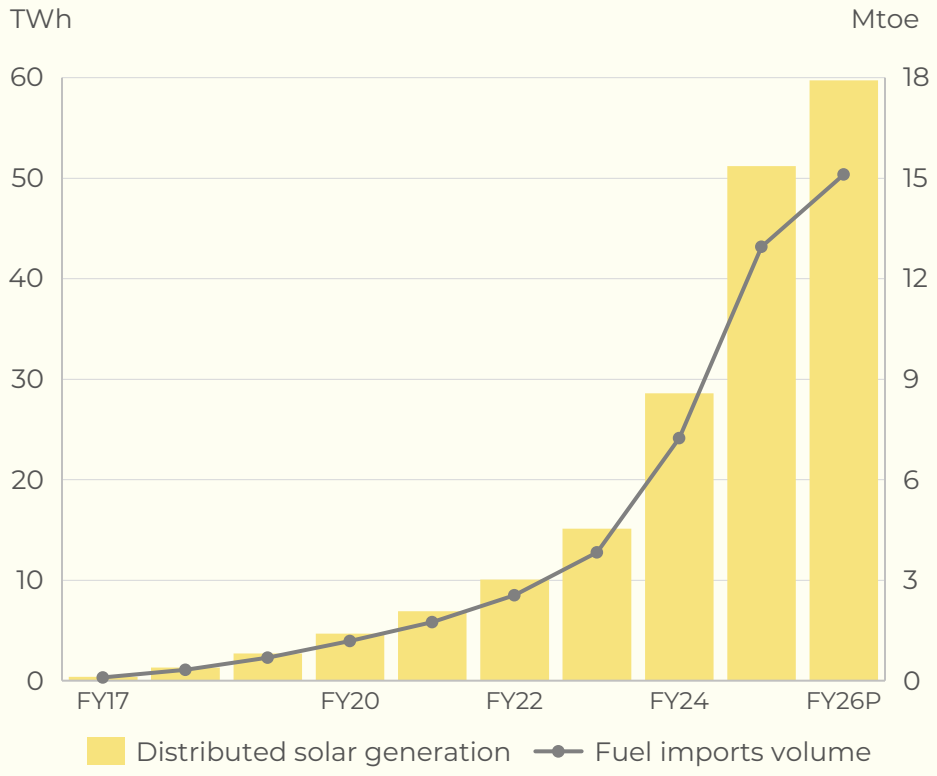
Unit import costs: Fossil fuels per TOE and PV panel capacity per Watt

Note: For FY26 import volume provisional numbers are used

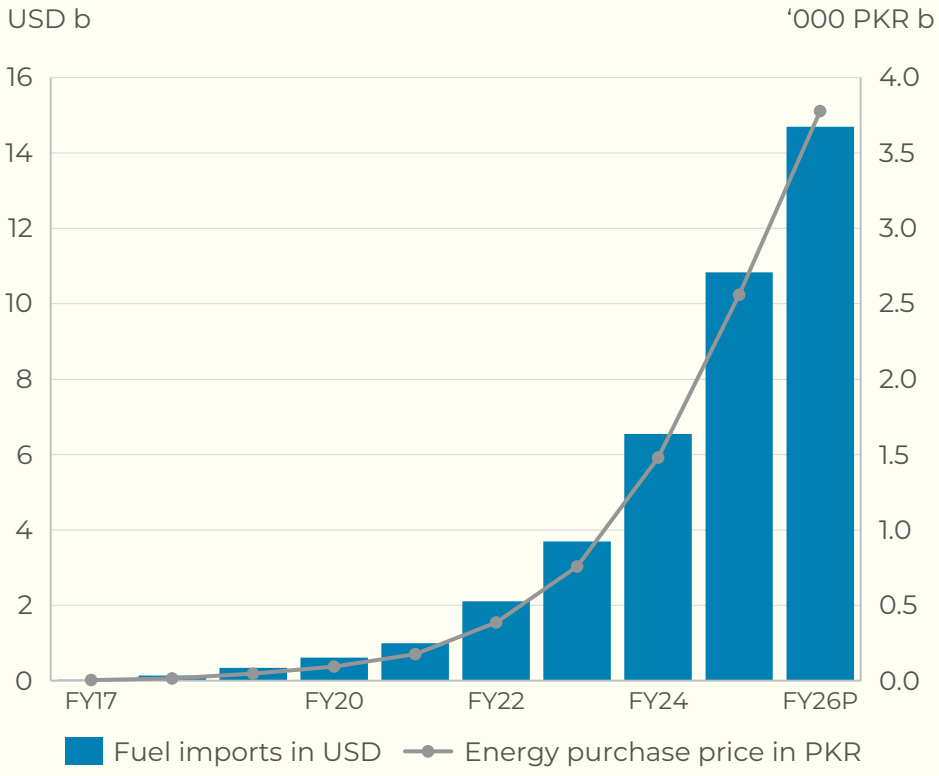
Data source: Energy Yearbook 2025 (HDIP), Ember-energy, CORE Finance Mapping, & RF's calculations

Distributed solar has reduced fossil fuel import needs by an estimated 43 Mtoe, saving USD 15 billion in foreign exchange

The USD 9 b spent on PV module and inverter imports is estimated to have had a net positive impact on the country's macroeconomic fundamentals. Our modelling shows that distributed solar PV has boosted Pakistan's energy consumption, which would have cost the ratepayer Rs 3,778 b in energy purchase price alone if the same amount of electricity was generated through imported coal and RLNG.



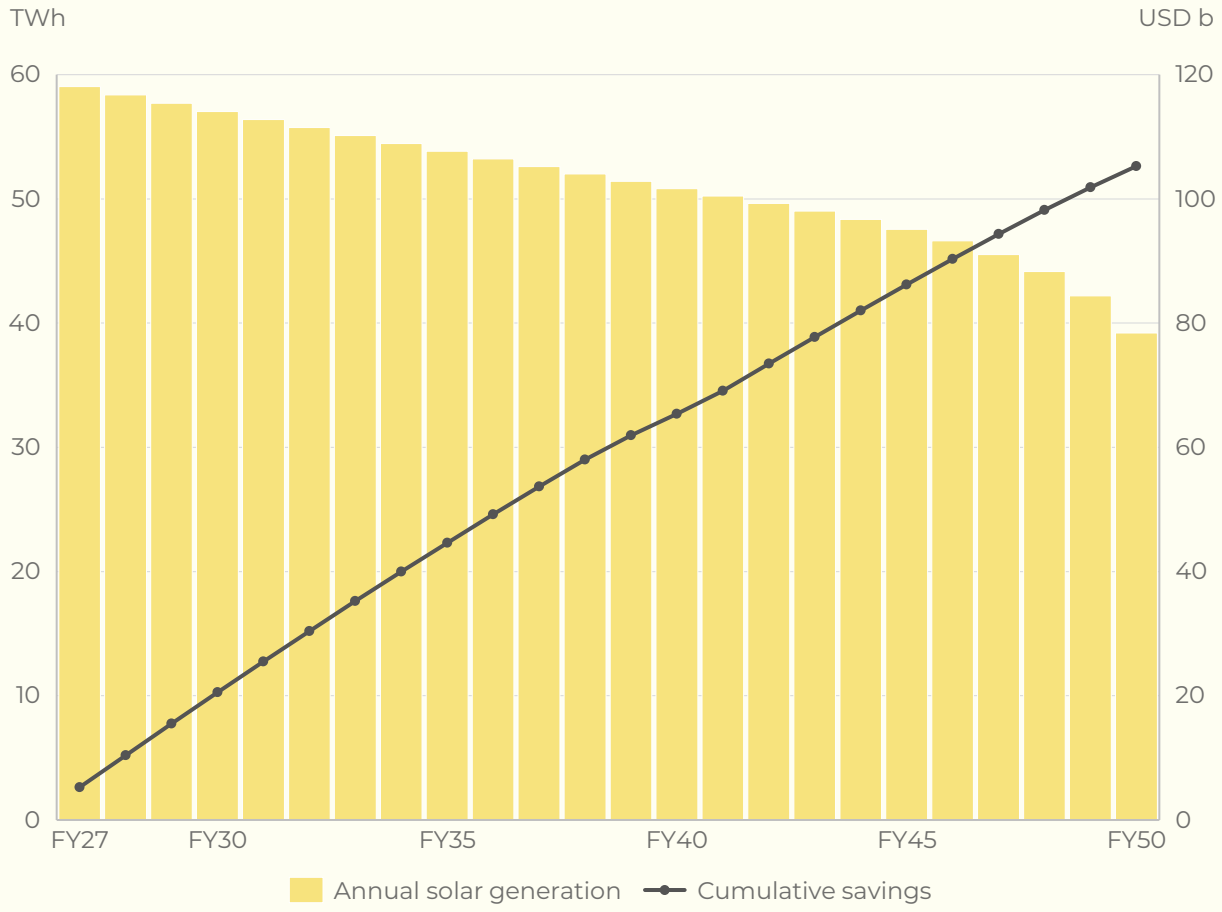
Annual PV generation and fuel imports avoided



Cumulative savings from fossil fuel import avoidance

Data source: Energy Yearbook 2025 (HDIP), NEPRA State of Industry Reports, NEPRA Fuel cost adjustments (FCA), CORE Finance Mapping & RF's calculations

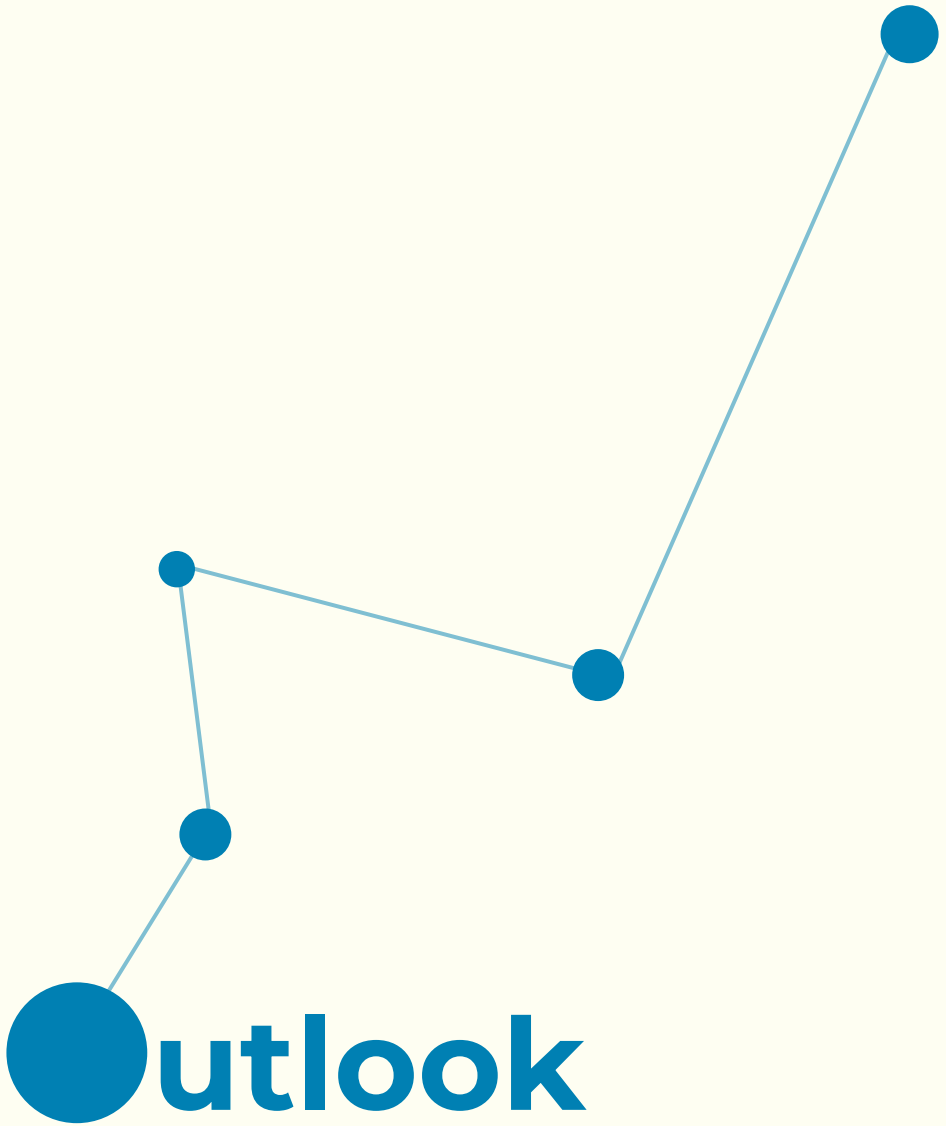
Every dollar spent on solar PV and inverters would yield 9 dollars in fossil fuel import savings



Forecasted distributed solar power and avoided fossil fuel cost

- The infrastructure nature of RETs mean that PV panels will power Pakistani homes and businesses for more than 20 years. They will, however, experience degradation and their utilisation and maintenance vary across different consumer categories. Our forecast accounts for all factors causing a gradual reduction in net capacity factor.
- Even after assuming no inflation and keeping RLNG and coal import prices fixed, local consumers will be substantially better off. Solar capacity and inverters imported at a cost of USD 8.9 billion up to FY26 have already helped avoid nearly USD 14.7 billion in fossil fuel imports. A further USD 4.57 billion investment in future inverter replacements is projected to help avoid an additional USD 109 billion in fossil fuel imports between FY27 and FY50. This brings cumulative savings to approximately USD 124 billion over FY17–FY50, equivalent to USD 9.23 in avoided fossil fuel imports for every dollar invested.

Methodology note: This analysis assumes 65% RLNG and 35% imported coal. A higher coal share could reduce estimated savings, although our assumed 35% coal share is already 8 percentage points above the FY17–FY25 average. Please refer to Appendix I for further details on solar generation and fossil fuel costs. Inverter code HS 85044030 is used in this study.
Data source: Energy Yearbook 2025 (HDIP) & RF's calculations



Outlook

- **Distributed solar is reshaping Pakistan's energy landscape and demands a rethink of national energy planning.**
  Distributed solar raised Pakistan's electrification rate to 27% in FY25, bringing it within 8 percentage points of the 35% target set for 2035 under the Electrify Now campaign. At the current pace, Pakistan could reach the target well ahead of schedule. Energy planning must now catch up by establishing clear roadmaps for integrating Consumer Energy Resources (CERs).

- **Distributed solar is strengthening energy security and easing pressure on foreign exchange reserves.**
  By FY26, distributed solar had helped Pakistan avoid an estimated USD 15 billion in fossil fuel imports. Projections for FY27–FY50 point to a further USD 9 in avoided import costs per dollar spent on solar panel and inverter. Beyond import savings, distributed solar offers the flexibility to reduce exposure to volatile fuel prices and supply disruptions.

- **Declining domestic fossil fuel production reinforces the case for indigenous renewable energy**
  Domestic crude oil and natural gas production fell by 12% and 8%, respectively, in FY25. As indigenous supplies decline, expanding domestic renewable energy becomes increasingly important to bridge the supply-demand gap and strengthen energy security.

- **Changing demand patterns call for a rethink of long-term RLNG commitments.**
  RLNG imports declined from 9.1 to 8.7 Mtoe in FY25, reflecting lower power-sector offtake. As distributed solar reshapes electricity demand, inflexible LNG contracts risk creating costly surplus commitments. Future procurement decisions must account for this changing energy landscape.

- **Transport is the next frontier for electrification and import reduction.**
  Oil supplies grew by 15% in FY25, largely driven by transport, Pakistan's least electrified sector. Growing adoption of electric two- and three-wheelers presents an opportunity to reduce petroleum imports, lower consumer costs and accelerate economy-wide electrification.

Appendix & methodology

Appendix I and methodology

Assumptions for forecasting Solar PV generation	FY26-50
Solar capacity factor (gross)	16.71%
System calibrated losses	18.40%
Annual degradation rate	0.70%
Physical damage	0.45%

Assumptions for inverter pricing	FY26-50
Sector	Fixed FY26 USD/kW
Residential	89.10
Agriculture	39.21
Commercial	49.90
Industrial	37.42

Methodology FY17-FY26

- Pakistan generated 60 TWh of electricity from 50 GW of distributed solar capacity in FY26.
- Fuel-wise EPP data for imported fuels was used to estimate the fuel displaced by solar generation and the resulting savings in PKR and USD.
- Solar generation was used to estimate the TWh of imported fuel displaced, then converted into Mtoe using the HDIP conversion factor of 0.253.
- Avoided fuel import costs were calculated using the USD-per-TOE cost of each fuel to estimate savings in USD.
- For FY26, only imported coal and RLNG data were used to estimate fuel cost and EPP savings from solar generation due to data limitations.

Forecasting Methodology

- We assume Pakistan to have 50 GW of distributed solar capacity installed from FY27, which is then kept constant through FY50 to assess its potential benefits for the economy.
- Solar generation is forecasted using a 16.71% capacity factor, 18.4% availability losses, a 0.7% annual degradation factor, and 0.45% annual physical damage. These factors were applied each year to estimate generation through FY50. Resultantly, the net capacity factor for this fleet declines gradually from 13.6% in FY26 to 11.5% in FY50.
- Inverter replacements were assumed after every 15 years of operation, using FY26 prices as the benchmark for replacement costs.
- Annual physical damage costs for inverters were calculated at 2% each year, using the assumed sector-wise costs.
- For fuel cost savings, we assume a scenario in which solar PV would displace a generation mix comprising 65% RLNG and 35% imported coal through FY50. The cost of LNG and coal is held constant and in real 2026 terms, which will be revised in an upcoming update of this analysis including multiple scenarios.
- Annual fuel import savings were estimated using projected solar generation and the assumed displacement shares of imported fuels.
- Cumulative net import savings through FY50 were calculated by subtracting projected inverter replacement and physical damage costs from total fuel import savings.

Abbreviations

B	Billion
CNG	Compressed natural gas
CAGR	Compound annual growth rate
FCA	Fuel cost adjustment
FO	Furnace oil
FY	Fiscal year
GDP	Gross domestic product
HOBC	High octane blending component
HSD	High speed diesel
K	Thousand
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
M	Million
MMBTU	Million British thermal units
Mtoe	Million tonnes of oil equivalent
MW	Megawatt
PBS	Pakistan bureau of statistics
PES	Primary energy supply
PKR	Pakistani rupee
PSO	Pakistan state oil
TWh	Terawatt hour
RET	Renewable energy technologies
RF	Renewables First
RLNG	Regasified Liquefied Natural Gas
SNGPL	Sui Northern Gas Pipelines Limited
SSGC	Sui southern gas company
USD	United States Dollar
YoY	Year-on-year

Renewables First (RF) is a think and do tank for energy and environment. Our work addresses critical energy and natural resource issues with the aim to make energy and climate transitions fair and inclusive.

Disclaimer:
All the information and analysis provided in this document are accurate and to the best of our knowledge and understanding. In case you identify any errors, please email:
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