Spending Public Money Smarter for Energy Security: Four energy-importing countries show how public financial support for clean energy can reduce exposure to fossil fuel price shocks

Methodology and References

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This document provides a methodology and reference list for the International Institute for Sustainable Development's *Spending Public Money Smarter for Energy Security: Four energy-importing countries show how public financial support for clean energy can reduce exposure to fossil fuel price shocks*.

This technical note outlines the methods used to estimate the impacts of clean energy support policies on the key energy security metrics in China, Germany, India, and Türkiye that are presented in the digital story.

The study first involved a literature review and interviews with experts to understand the status of global research on how public financial support for clean energy affects the "four A's" of energy security (availability, affordability, accessibility, and acceptability). Based on this analysis, we selected the four case study countries and the following metrics for the analysis of

- energy import dependence and energy import bills,
- diversity of electricity supply sources, and
- energy price volatility.

Data heterogeneity and lack of transparency in some countries mean that we could not assess all metrics using the same methodology for all countries.

The financial impacts of clean energy support policies were estimated, as outlined below.

China

Estimated savings from meeting growing energy demand from renewables compared to coal-fired power were based on projections of energy expansion under the International Energy Agency (IEA) World Energy Outlook's (WEO's) 2025 Stated Policies Scenario (STEPS) (IEA, 2025b).

The analysis used IEA projections of electricity generation from solar photovoltaic and wind energy for 2024, 2035, and 2050 under STEPS. These electricity generation values were converted into installed capacity estimates (5.5 TW) using technology-specific capacity factors from the IEA's Global Energy and Climate Model (IEA, 2025a). For solar photovoltaic, a blended capacity factor of 11% was used, reflecting a 55/45 mix of utility-scale and rooftop systems. For wind, a blended capacity factor of 25% is applied based on a combination of onshore and offshore installations (90/10) (Energy Research Institute of Chinese Academy of Macroeconomic Research, 2025).

The increase in installed capacity between benchmark years was distributed evenly across the intervening years to estimate average annual capacity additions. This produces a year-by-year projection of cumulative installed solar and wind capacity from 2025 to 2050.

From the model, we then calculated annual investment and operation costs. Capital costs are based on projected technology costs in alignment with the IEA WEO (2025b), while operation and maintenance (O&M) costs are applied to the cumulative installed capacity. Annual costs are summed over the period 2025–2050 to estimate total system costs. Following the STEPS projection, total renewable energy costs are estimated at approximately USD 4.6–5.1 trillion for solar and USD 1.2–1.3 trillion for wind.

To provide a comparison with coal, the model estimates the cost of generating the same amount of electricity using ultrasupercritical coal power plants using IEA WEO 2025 data (IEA, 2025c). Coal generation costs include capital expenditures, O&M costs, and fuel costs.

Fuel costs are based on a coal price of USD 22/MWh, derived from China's benchmark coal prices and typical ultrasupercritical plant efficiencies (Qinhuangdao Q5500 benchmark coal price and thermal efficiency of 45%). Coal plant capital costs are assumed at USD 800/kW, with annual O&M costs of USD 30/kW, both aligned with the WEO 2025 assumptions.

Over the period 2025–2050, the total cost of the coal pathway is estimated at approximately USD 7.6–8.4 trillion, compared with USD 5.8–6.5 trillion for the renewable energy pathway. This suggests that expanding solar and wind power could reduce total system costs by around USD 1.8–1.9 trillion over the period, equivalent to average annual savings of approximately USD 73–77 billion under both scenarios. The comparison excludes variable renewable energy integration costs on grids, storage, and curtailment on one side and the cost of coal's carbon and air pollution externalities on the other.

India

Benefits from the Prime Minister's Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) program for electric vehicles (EVs) sold between 2024 (program start) and May 2026 are calculated based on the fuel savings and vehicle stock data from the Ministry of Heavy Industries (2026).

EVs sold through the program are assumed to travel 15,000 km annually on average, resulting in an estimated saving of 330 litres of fuel per vehicle per year. Avoided fuel consumption is then calculated based on official EV sales data and converted into consumer cash savings, assuming the price of INR 100 per litre of fuel, gross of electricity charging costs. Since the focus is on consumer cash savings, we do not calculate fiscal losses from foregone excise revenues.

To assess the impact on crude oil imports, we convert avoided fuel consumption into crude oil volumes with a 1:1 ratio. Refineries produce a slate of products (petrol, diesel, naphtha, liquefied petroleum gas, fuel oil, etc.), and assuming that 1 tonne of avoided refined fuel results in 1 tonne of avoided crude input makes for a reasonable simplification to allow us to carry out the calculation without a co-product cost allocation. This assumed production yield is close to the ratio currently observed in Indian refineries (Petroleum Planning and Analysis Cell, 2026).

Avoided crude oil import volumes are then calculated using an 88% import crude oil dependency ratio. Avoided import costs are then calculated based on the crude oil price of USD 80 per barrel (real, adjusted for inflation), aligned with the IEA's medium-term forecast and an exchange rate set at INR 86 /USD 1 based on the average exchange rate in 2024 and 2025 (IEA, 2025).

Türkiye

Since more than 90% of Türkiye's gas is imported and gas is the most expensive source of generation in the merit order dispatch (EPİAŞ, n.d.), we assume that 1 MWh of renewable power—produced by generators that receive support from the Renewable Energy Resources Support Scheme (YEKDEM) and the Renewable Energy Resource Area (YEKA) programs—displaces 1 MWh of gas power from imported sources.

Data on YEKDEM-enabled renewable electricity generation volumes and support costs are taken from annual electricity reports by the Turkish Energy Market Regulatory Authority (n.d.).

To estimate savings from avoided gas imports, YEKDEM-linked renewable electricity generation figures are converted into equivalent gas volumes, assuming a 55% thermal efficiency for gas plants (with 180 m3 required for generating 1 MWh of electricity). Avoided gas volumes are then translated into avoided import bill savings using gas-price and monthly exchange rate data from Ember (n.d.-b), the latter being calculated using daily foreign exchange rates from Türkiye's Central Bank.

Net savings from YEKDEM are calculated on an annual basis by subtracting total support costs from gas import savings.

A similar methodology is used to estimate net savings from YEKA-linked generation, but power generation amounts are calculated based on installed capacity data, assuming a 20% capacity factor for solar and a 33% capacity factor for wind plants. YEKA-installed capacity numbers are based on Ember data sourced from the Turkish Energy Market Regulatory Authority (n.d.).

YEKA functions through reverse auctions to determine long-term power purchase agreements. There is no embedded subsidy premium. Instead, the mechanism serves as a long-term hedge, where the state must ensure that payments to subscribed generators meet the clearing auction price. Capacities already in operation cleared well below projected wholesale spot prices, meaning that renewable energy has always resulted in savings, and their addition to the electricity mix has consistently brought down electricity costs for consumers. Certain rounds allow developers to sell power directly at market rates for the first 5 years of operation. Therefore, YEKA involves no direct subsidies from the government or price support from consumers.

The state-owned BOTAŞ keeps gas tariffs below market levels for gas-power generators. Ember's gas-price data does not account for these subsidies, so gas import savings are likely higher than our estimates.

Our analysis also compares YEKDEM support costs and YEKA contract prices with wholesale electricity prices and gas generation costs. Wholesale electricity price (market clearing price) data is taken from Ember, based on Energy Exchange Istanbul data (EPİAŞ, n.d.). YEKA's GES-1 and GES-24 strike prices are taken from the Ministry of Energy and Natural Resources (2025).

Germany

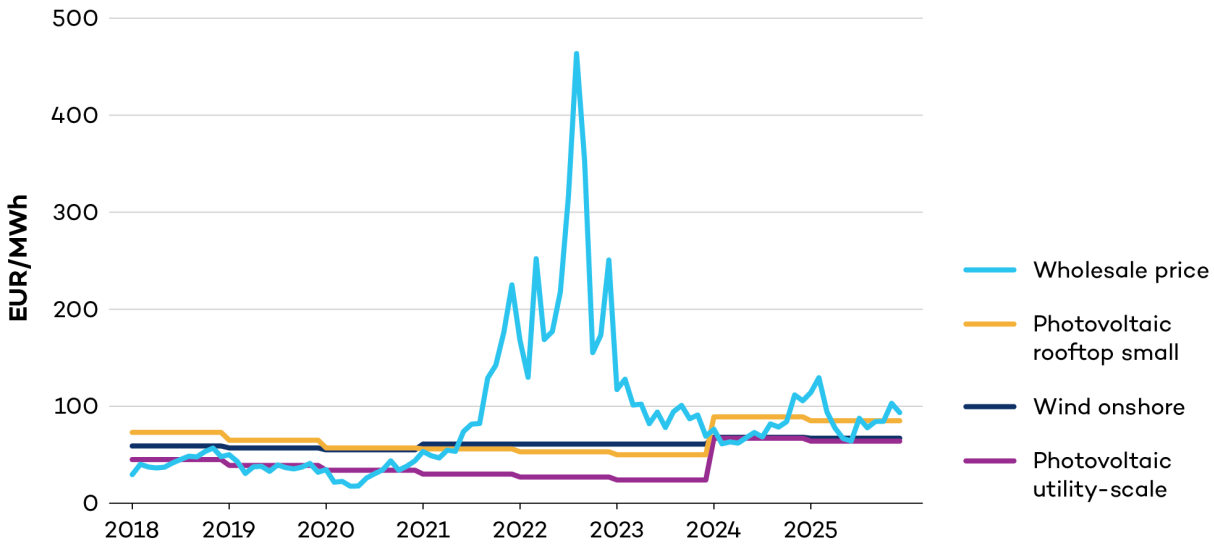
The analysis for Germany covers two main renewable energy support mechanisms under the Renewable Energy Resources Act (EEG): the feed-in tariff (FiT) and the feed-in premium (FiP). It uses

- historical data on EEG generation and payments from 2020 to 2024 (Netztransparenz.de, 2025),

- official projections for 2025 and 2026 (Netztransparenz.de, 2025), and
- our projection for future developments through 2050 (based on the assumption that generation would be constant but support levels would fall over time, as the FiT and FiP are only provided for 20 years, compared to the ~30-year life of the assets, assuming some refurbishment) (Climate Council, n.d.).

For each mechanism, annual renewable electricity generation is multiplied by the corresponding support rate to estimate total annual subsidy expenditures. The FiT provides a fixed payment to developers and therefore was simple to project into the future. However, we assumed that the support rate will gradually decline from around EUR 0.27/kWh in 2020 to near zero by 2040 as existing contracts expire, but the assets can continue generating electricity given lifespans of >20 years.

Figure 1. Renewable energy provides Germany with a price-stable source of electricity supply compared to volatile gas-linked wholesale electricity prices



Note: Renewable energy prices are based on the levelized cost of energy specific to Germany, which were verified as being very similar to the actual cost of generation as published in power-purchase agreements.

Source: Kost, 2024.

In contrast, the FiP support rate varies over time in response to changes in wholesale electricity market prices (historical data sourced from Ember, n.d.-a). We projected future electricity prices based on a mid-range gas-price scenario derived from European Central Bank estimates (2026). Gas-price projections assume gas prices continue to stay at almost double 2025 levels for 2026, remain 30% higher than 2025 levels in 2030, ~10% higher in 2040, and then fall to around half 2025 levels by 2050, aligning with the gas price prior to 2022, in a period characterized by geopolitical stability. As renewable energy capacity in the system increases, some decoupling of gas and electricity prices is projected.

The expenditures from both mechanisms are combined to calculate total annual renewable energy support and an average blended support rate across all policy-supported renewable

generation. This provides an estimate of the overall level of financial support provided to renewable electricity producers over time.

Similarly to calculations for Türkiye, Germany's savings from avoided gas imports are estimated by converting EEG-related renewable energy generation figures into equivalent gas volumes, assuming a 47% gas-plant efficiency. Projections to 2050 were based on a mid-range gas-price scenario derived from the European Central Bank (2026).

Renewable energy prices are based on the levelized cost of energy specific to Germany, which were verified as being very similar to the actual cost of generation as published in power purchase agreements.

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