Research Intelligence

Rooftop Solar

Global Clean Energy Trends and Investment Opportunities in Thailand



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Introduction

Rooftop solar power, or solar rooftop, is gaining popularity worldwide amid the growing shift towards clean energy to mitigate environmental impacts and reduce greenhouse gas emissions. Currently, the regions with the highest adoption of solar rooftops are Asia-Pacific, Europe, and North America. Countries showing significant growth include China, India, Germany, and the United States, driven by supportive government policies and advancements in solar cell technology. These developments have led to a continuous decline in solar panel prices, making rooftop solar installations increasingly cost-effective.

In Thailand, the solar rooftop market is also gaining significant attention and experiencing rapid growth, with promising potential for the future. This aligns with the country's efforts to mitigate climate change impacts and achieve carbon neutrality by 2050 and net-zero greenhouse gas emissions by 2065. As electricity prices rise due to increasing energy costs, contrasting with the declining cost of solar panels, solar rooftop installations have become a key strategy supported by the government for the private sector to reduce energy expenses.

The purpose of this report is to focus on understanding the current situation and growth developments of solar rooftops in Thailand. The key drivers are both demand and supply factors, particularly government policies reflecting a commitment to sustainable clean energy use. The report also employs PESTEL analysis to examine external factors influencing growth, as well as economic, social, and environmental viability, and the future implications of solar rooftops for the business sector.

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Rooftop solar's role in securing a sustainable future

What is rooftop solar and why does it matter?

Rooftop solar systems make use of what would be otherwise unused space on the roof of a building to provide occupants and owners with access to their own micro-power station. Installing rooftop solar systems is helping to shift electricity generation to a greater reliance on sources of clean energy, to green the economy overall, and to help countries (including Thailand) move towards their national commitments to increase the share of renewables in the energy mix and to cut their greenhouse gas emissions. This technology thus offers a wide range of benefits that include the following.

1) **Reduced greenhouse gas emissions from the energy sector:** Generating electricity directly from sunlight reduces reliance on fossil fuel-powered energy (i.e., that is generated from oil, coal and natural gas), the most important source of carbon dioxide emissions and a major source of other greenhouse gases. Increasing the use of rooftop solar systems will therefore help to substantially reduce the threat of climate change, as well as to alleviate other environmental impacts related to electricity generation, such as the air pollution that results from the combustion of fossil fuels.

2) **Lower expenditure on energy:** Installing rooftop solar systems can generate major cost savings, especially in situations where demand for electricity from a building's occupants peaks during the day. Becoming partly or fully self-sufficient in energy production also reduces exposure to the risk of future price hikes, while any unused electricity that is generated by these systems can be sold back into the grid, thus potentially offsetting installation costs or even turning this into a profitable investment. Rooftop solar can thus help both households and organizations switch from the use of fossil fuels and instead take advantage of a freely available and unlimited resource to make major reductions to their outgoings.

3) **Reduced dependency on energy imports:** By slashing demand for external sources of energy and instead drawing this directly from the sun, spending on energy imports can be reduced. Increasing energy independence in this way is especially important for developing and newly industrialized countries since these typically experience rapid rates of urbanization, which then underpins sharply increasing demand for electricity (as seen in e.g., China and India).

4) **More efficient use of space:** Rooftop solar systems are installed on the roofs of commercial and residential buildings, which is almost always dead space that serves no other purpose. Because this converts unused areas into sources of energy, this dramatically increases their value.

5) **Increases energy independence:** Installing a rooftop solar system improves households' and businesses' energy security by reducing their dependency on external sources of electricity. This also helps to insulate homes and businesses from the effects of power cuts.

6) **Supports the development of the green economy:** Support for the wider solar industry will open up new employment opportunities in areas including the production of solar equipment, the installation of solar systems, the repair of these, and the future research and development of solar technology. In addition, rooftop solar offers communities a way to develop low-carbon businesses, which will then allow local economies to grow and social progress to be made while at the same time lessening environmental impacts and fostering secure and sustainable development.

Demand for rooftop solar systems from both household and business buyers has strengthened noticeably over the past two to three years. Interest in moving away from grid-based power systems and towards independent energy production has received a significant spur from the recent surge in global energy costs and the knock-on effects of this on domestic electricity prices, while in many countries, including Thailand, governments have rolled out policies to encourage greater uptake of solar systems. Meanwhile, the supply side of the market has been aided by progress on solar cell and battery technologies that has pushed up their efficiency, cut production costs, and made installation of rooftop solar a much more financially appealing prospect.

How do rooftop solar systems work?

The operation of solar rooftops begins with installing **photovoltaic solar panels (PV)** on the roofs of residential homes, commercial and industrial buildings, and in large-scale or utility activities. These are able to convert incoming solar energy into electricity, although this is produced in the form of direct current (DC) power, which is incompatible with the alternating current (AC) electricity used across most of the power grid and all but specially designed domestic electrical appliances. **An inverter** is therefore needed to convert the solar panel-generated DC power to usable AC. Utilizing locally produced electricity also faces challenges that come in the shape of the differing load profiles of, for example, homes and offices and the need to sync this with energy availability. Thus, demand from domestic residencies is typically heaviest during the evening and night, whereas for offices, retail spaces and industrial units, demand is often high during the day and low at night, although for industries that operate around-the-clock, demand for electricity may likewise never slacken. **In some of these cases, it may be necessary to use batteries to store surplus electricity generated** during the day and thus maintain continuity of supply when the sun is obscured or night has fallen. **Alternatively, grid-tied systems** are able to use national supply to buffer local generation, absorbing excess supply when local demand is low (i.e., this is sold into the grid) and supplying additional power when it is not possible to meet local demand from solar-generated electricity alone (i.e., electricity is bought in from the grid).

Figure 1

Rooftop Solar System Diagram



Source: Created by AI

Box A Types of Solar Power and Factors Influencing Market Growth

Table 1

Global Solar Market by Installation Type

	**Ground Mounted Solar Panels**	• Generally installed in large open areas, typically agricultural or otherwise unused industrial space. • Suitable for utility-scale or other large-scale commercial undertakings. • Sited for optimum insolation and to enable scalability and more intensive energy production.
	**Rooftop Solar Panels**	• Installed on the roofs of residential, commercial and industrial properties • Suitable for use in urban areas, where available space is limited but demand for electricity is high. • Can be either grid-tied or used off-grid, thus supplying electricity either to users via the national distribution system or to these directly.
	**Building Integrated Photovoltaics (BIPV)**	• Solar technology can be integrated into a building's structure, for example by being built into its roof, walls or windows. • Has the dual function of being a part of the building's structure and a source of electricity.
	**Others**	• New innovative types of solar cells include thin-film, perovskite[1/] and bifacial solar PV cells. These offer the advantage of being flexible and light, and of generating greater quantities of electricity. • Currently deployed in niche applications or in pilot projects to assess suitability for large-scale production and use.

Source: Arizton Advisory & Intelligence (2024), Krungsri Research

Table 2

Key Market Drivers

Cost effectiveness	• Falling PV costs and government incentives (e.g., tax credits and refunds) are making the installation of rooftop solar systems more cost effective
Technological advancements	• Ongoing progress with solar technology has improved efficiency and durability, and this has supported further growth in the market since as the efficiency of rooftop solar systems has climbed, costs have fallen.
Energy independence	• Installing rooftop solar allows households and businesses to free themselves from dependency on the grid and so achieve partial or total energy independence.
Urbanization	• PV is useful in urban areas because these are marked by both high population density and limited access to space. Rooftop solar offers a way of reducing energy costs while improving the efficiency of the electricity generating system.

Source: Arizton Advisory & Intelligence (2024), Krungsri Research

1/ Perovskite is a newly discovered material that can be used to manufacture highly efficient PV cells. Manufacture involves a solution-based production process that keeps costs low but which can be adapted to allow for the manufacture of cells with different properties. For example, using a particular solution produces clear PV cells, which can then be used to manufacture electricity-generating windows (source: Mahidol Science Sustainable Development Goals (SDGs).

Growth in global solar PV sales and high-potential markets

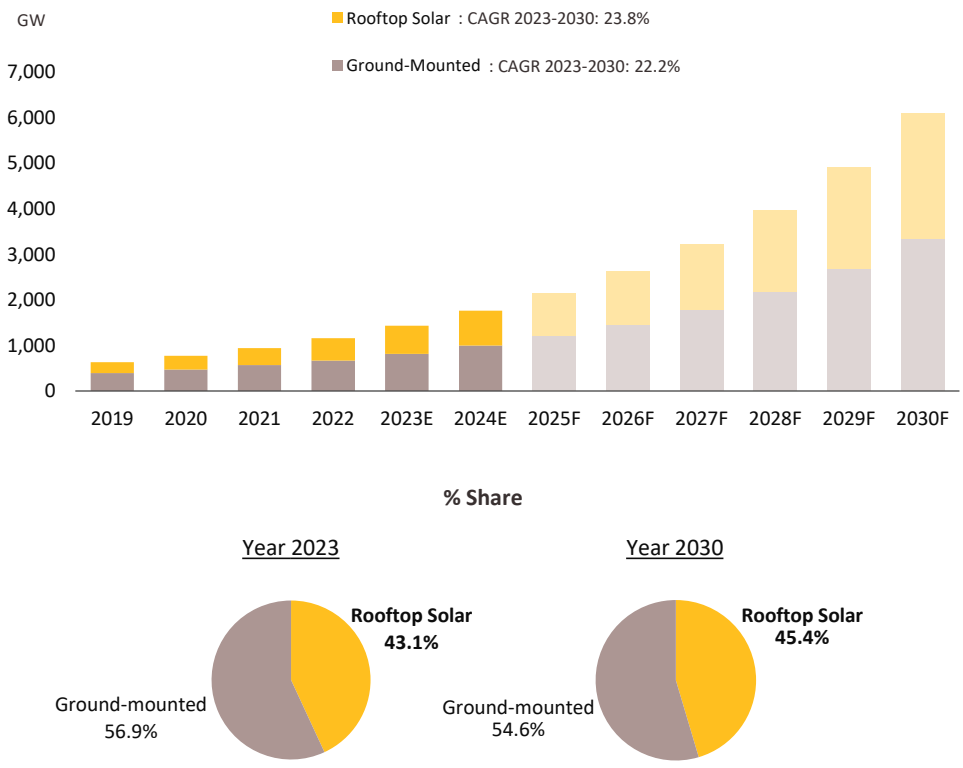
The global solar PV market

As of 2023, global solar PV installed capacity stood at 1,439.30 GW. This was more than double its 2019 level and with growth expected to hit 22.9% CAGR through the decade, this should reach 6,094.03 GW by 2030 (Figure 2). Such high levels of growth will be sustained by a combination of strong government support in many countries, for example through the issuing of tax credits to investors in solar power, and the falling cost of PV modules, which is then broadening market access.

Installed capacity was split 56.9% and 43.1% between ground-mounted and rooftop solar systems in 2023, but **with growth in the latter forecast to average 23.8% CAGR 2023-2030 (ahead of the rate at which ground-mounted installed capacity will expand), the share of supply accounted for by rooftop systems is expected to grow to 45.4% by 2030** (Figure 2).

Figure 2

Global Solar Photovoltaic (PV) Market, Installed Capacity and Forecast in GW, by Deployment
CAGR (2023-2030: 22.9%)

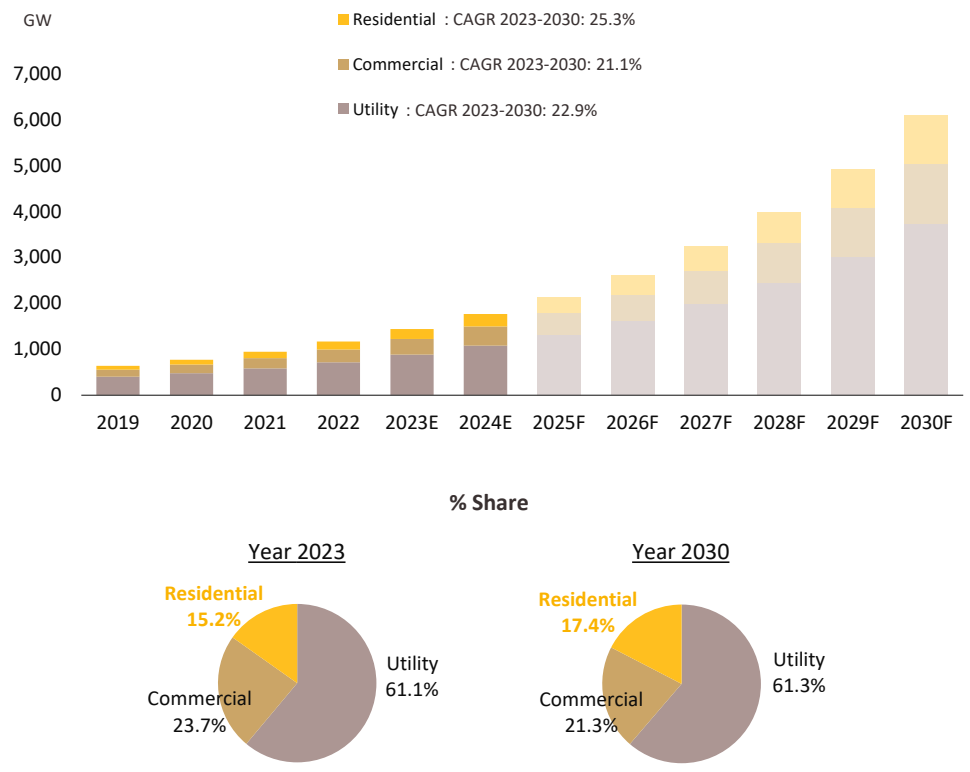


Source: Mordor Intelligence, Krungsri Research

Considered by source, at 61.1%, utility-scale players producing electricity for supply to the grid represented the largest single share of capacity, followed by **industrial and commercial sources** (23.7%) and **residential generators/households** (15.2%). Nevertheless, the rate of uptake is faster for the latter than for the utility segment and so the contribution from this segment to the total is forecast to rise to 17.4% by 2030 (Figure 3). This mirrors findings by Mordor Intelligence, which over 2023-2030 sees global rooftop solar installed capacity expanding by 25.3% CAGR in the residential segment, ahead of the utility and commercial segments, where growth will average 22.9% and 21.1% respectively (Figure 3). Likewise, a report by the International Energy Authority (IEA) predicts that under its 'Net Zero Emissions by 2050 Scenario'[2/], the number of households generating their own power from rooftop solar will more than quadruple from 25 million in 2022 to over 100 million by 2030. This surge in the market is being driven by the falling cost of solar PV modules, increased access to financing by households, and the rising prices paid for grid-supplied electricity, which combined are encouraging businesses and households to increasingly turn to solar solutions.

Figure 3

Global Solar Photovoltaic (PV) Market, Installed Capacity and Forecast in GW, by End user
CAGR (2023-2030: 22.9%)



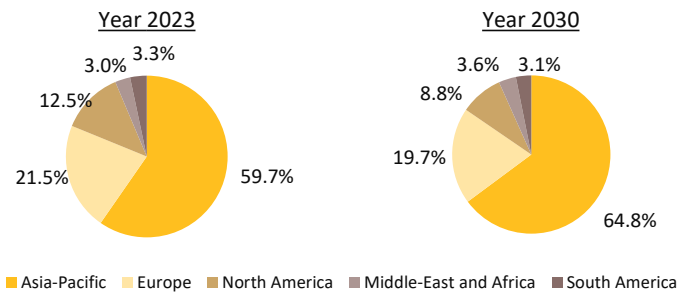
Source: Mordor Intelligence, Krungsri Research

2/ This is a planning framework that is based on an analysis of a wide range of factors, including the speed of the energy transition (i.e., the switch away from the use of fossil fuels and towards the use of renewables, such as solar), improvements to energy efficiency, greater investment in clean energy technology, and a number of assumptions about changes to the economy and social behaviors (e.g., alterations to consumer behavior and the rate of adoption within the industrial sector).
Source: Net Zero by 2050: A Roadmap for the Global Energy Sector, IEA

Growth in the solar PV market is most pronounced in the Asia-Pacific region, which as of 2023 was home to 59.7% of all installed capacity worldwide, ahead of Europe and North America at respectively 21.5% and 12.5% (Figure 4). Moreover, growth rates are also higher in Asia-Pacific than elsewhere, and so at 24.4% CAGR compared to Europe's and North America's 21.3% and 16.8%, distribution will tip even more favorably in Asia's direction. By 2030, installed capacity is therefore forecast to be split 64.8%, 19.7% and 8.8% between the three regions. This discrepancy is partly explained by the fact that Asia is home to countries such as China, Japan, South Korea, India and other emerging markets that are both centers of electronics production and leaders in the solar industry. Demand in Asia is being lifted further by government policy that includes setting targets for uptake of renewables and tax breaks for investors in the industry, as well as rapid rates of economic growth and urbanization. With overall demand for energy rising from urban and industrial consumers, solar power thus represents an attractive and sustainable option for those looking to respond to these changing conditions (source: Arizton 2024).

Figure 4

Global Solar Photovoltaic (PV) Market, % Share by Geography



Source: Mordor Intelligence, Krungsri Research

Policy initiatives supporting growth in the market for solar energy in the major economies

Growth in the market for solar PV, including the rooftop solar segment, has been helped substantially by government efforts to encourage the private sector to increase its use of solar energy (Table 3). **In many countries, energy policy** is now strongly focused on meeting commitments to reach carbon neutrality by 2050. This is being achieved by encouraging the use of renewables and clean energy through tax breaks, changes to the regulatory environment, creating increased opportunities for work and employment, and emphasizing the positive environmental impacts of the energy transition. Government initiatives, including tax credits for companies investing in solar power, have thus made the switch to solar more feasible from a financial point of view, and thanks to this, installed capacity in countries including the US, Germany, China, India and Japan has risen. Details of these policies are given in Table 3.

Table 3

Government Policies Targeting the Solar Industry

The European Union	• Under the 'EU Solar Rooftop Initiative', starting in 2026, there will be a phased introduction of the requirement that construction of all new buildings (public buildings, commercial units, and residential accommodation) must include the installation of solar panels. From 2027, support will also be provided for the installation of rooftop solar systems in older buildings (source: Research & Markets).
US	• Federal policy includes Investment Tax Credits (ITCs), which give 30% rebates to those installing rooftop solar systems. • At the state level, policies include the California Solar Mandate, which since 2020 has required the installation of solar cells in new residential buildings, and the Net Metering project, which allows homeowners to sell excess power back into the grid. The latter has been implemented in 44 states as well as in Washington DC (source: Mordor Intelligence, U.S. Department of Energy).
China	• The government has set up a feed-in tariff (FiT)[3/] to allow producers to sell electricity back to the grid, and has provided financial support to assist with the cost of installing solar systems. Support has also come for many large-scale renewables projects, including the Solar PV Poverty Alleviation Program (a project that aims to combat poverty in deprived communities through increased access to solar energy). (source: Mordor Intelligence).
India	• The government has set an ambitious target of reaching 500 GW of installed renewables capacity by 2030. To this end, the government has introduced production linked incentives (PLIs) to encourage an expansion in domestic solar cell production capacity, and promoted the installation of rooftop solar systems by businesses and households. (source: Research & Markets). • The government also hopes to increase annual domestic solar cell production capacity from 9.71 GW in 2023 to 40 GW, and to rapidly overhaul domestic solar supply chains. This should then help to accelerate growth in the market. (source: Mordor Intelligence).
Japan	• The Japanese government has introduced a feed-in tariff (FiT) to allow small-scale operators of solar cells to sell surplus electricity back into the grid, and has in addition run programs to encourage solar power units to be installed in schools, public spaces, and residential accommodation. Local tax refunds are also available to those installing rooftop solar systems. (Mordor Intelligence).

Source: Compiled by Krungsri Research

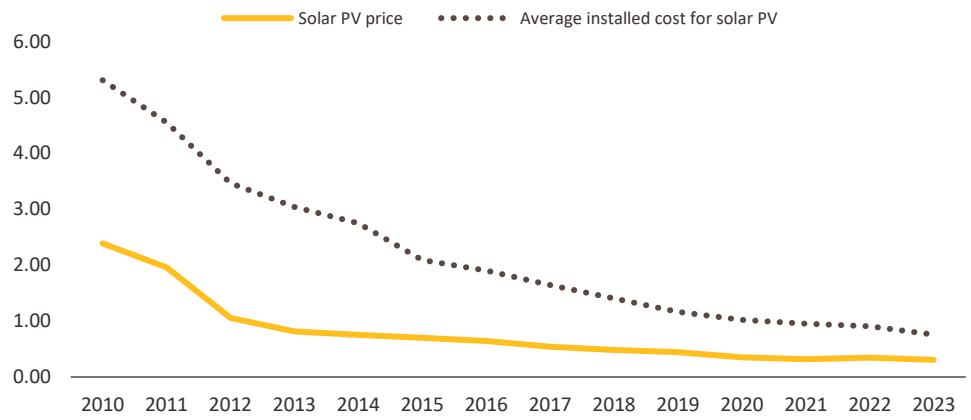
3/ Feed-in tariffs have been introduced in many countries to encourage an increase in the use of renewables. These typically offer a guaranteed price to those generating electricity from renewables when this is sold into the grid, but details such as the actual price paid, the duration of the price guarantee, and the goals of the policy naturally vary from country to country.

Trends in global prices for solar cells

Prices for solar cells have fallen steadily in recent years (Figure 5), moving against generally rising energy prices, and the outcome of this divergence has been to make it increasingly cost-effective for households and small businesses to meet their electricity needs through the installation of rooftop solar systems. Thus, cost of installing solar PV systems have slipped from an average of USD 5.31/watt in 2010 to just USD 0.76/watt in 2023 (an average annual decline of -13.7%), while over the same period, the average global price of solar PV cells has dropped to USD 0.31/watt (down -13.6% per year). Technology will continue to make progress in the coming period and so these trends are very likely to persist, further raising output, increasing durability, and improving the overall efficiency of rooftop solar systems through, for example, the use of lithium-ion or new solid-state batteries. Solar systems will thus represent an increasingly attractive value proposition and the market will continue to expand.

Figure 5

Cost for solar photovoltaics worldwide from 2010 to 2023 (in U.S. dollars per watt)



Source: Statista

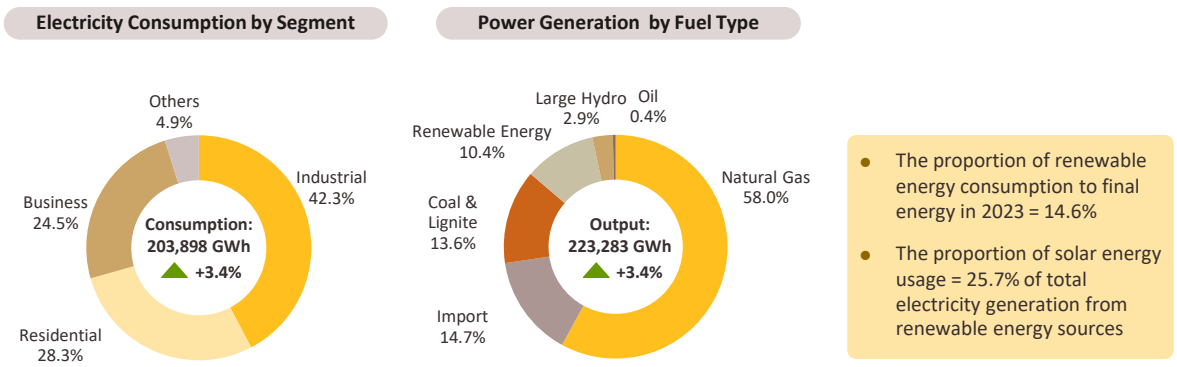
The current situation and future outlook for rooftop solar in Thailand

National power supply

Total national electricity demand came to 203,898 GWh in 2023, up 3.4% from 2022. The largest consumer of this was the industrial sector, which absorbed 42.3% of total usage. This was followed by household users (28.3%), businesses (24.5%) and 'other' end users (a group that includes non-profit organizations, agricultural pumps, and public and temporary uses, which accounted for a further 4.9% of total usage). **Electricity generation totaled 223,283 GWh** (also up +3.4% from a year earlier), with 58.0% of this coming from natural gas-powered generators, 14.7% from imports, 13.6% from coal and lignite, 10.4% from renewables, 2.9% from hydro, and 0.4% from oil. In the year, 14.6% of total consumption thus came from alternative energy, up slightly from 2022's 14.0%, though of this total, 25.7% came from solar power (Figure 6). Mordor Intelligence sees domestic solar generating capacity growing by 7.2% CAGR over 2024-2029.

Figure 6

Energy Production and Consumption in Thailand, 2023 (% share)



Sources: Energy Policy and Planning office (EPPO), Department of Alternative Energy Development and Efficiency (DEDE)

The 2024 situation in the domestic energy market and the outlook for 2025-2027 is described below.

- **Demand for electricity**

  Having grown 3.4% in 2023, demand for electricity is expected to have expanded by another 5.0-6.0% in 2024. An uptick in economic activity, most obviously in the tourism sector and adjacent parts of the economy, has lifted demand, but at the same time, overall recovery remains patchy and limited and in particular the manufacturing and export sectors struggled through the year. Alongside this, electricity bill exceeded the THB 3.63/unit averaged over 2019-2021, while the government has moved to a position of encouraging households, businesses, and industrial operations to increasingly generate and distribute electricity themselves through the use of rooftop solar, and this has further impacted growth in demand.

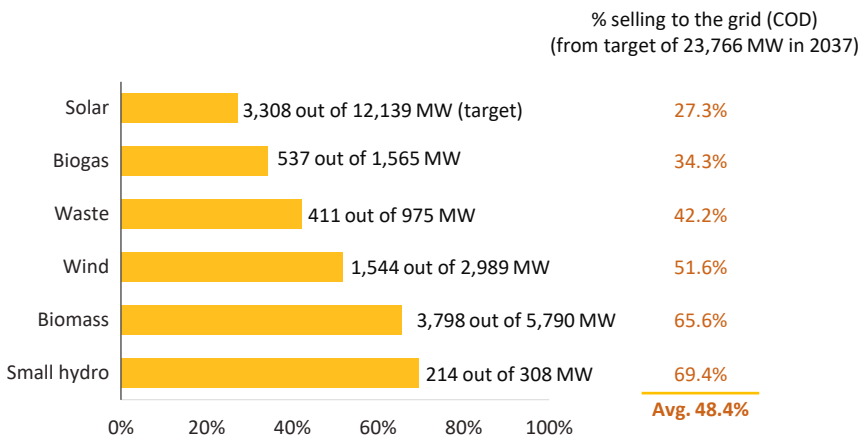
Looking out over the next few years, demand growth is expected to remain at around 5.0-6.0% annually over the period 2025-2027. Efforts to encourage the increased use of energy saving measures as per the National Energy Plan, ongoing plans to promote greater individual and local electricity production, and prices that are likely to remain above THB 4.00/unit (up from the THB 3.76/unit averaged over 2019-2022) will all conspire to restrain growth in demand for grid-delivered power. **However, these same factors will tend to encourage players in the private sector to switch to rooftop solar as they look to cut their spending on electricity.**

- **Electricity generation**

A total of 9,922 MWs of renewables capacity was contracted to supply the grid in 9M2024. The solar segment enjoyed ongoing expansion through the year, and so 91.5% of the targeted capacity of 3,692 MW of solar power was bought by the authorities in the year. As per suppliers' contractual obligations, solar generating capacity will continue to grow[4/], but with electricity prices remaining above recent averages, private-sector organisations are increasingly turned to rooftop solar as a way of meeting the need for electricity during the daytime. This was reflected by a shift in peak electricity demand from daytime to nighttime. However, data on power generated by installed solar for the first nine months of 2024 show that this reached just 27.3% of the long-term target of 12,139 MW, significantly below the progress made on other sources of energy (Figure 7). Nevertheless, the draft PDP2024 plan will increase the target for the quantity of electricity generated from renewables, raising this to 51% of all supply by 2037 and the end of the plan's timeframe. The most important source of this will be solar, which it is hoped will contribute 16% of total supply. This represents a significant investment opportunities for solar energy projects in the future.

Figure 7

Renewable Energy Generation Capacity (as of September 2024)



Source: Department of Alternative Energy Development and Efficiency (DEDE)
Note: Including off grid power generation

4/ This includes non-PPA (power purchase agreement) approved projects, PPA projects not yet supplying the grid, and projects that are now providing power to the grid (i.e., those with a COD, or commercial operations date).

The installation of solar rooftop systems for electricity generation in Thailand.

Installing solar cells to produce electricity for on-site consumption began to gather speed from 2019 onwards, and between 2019 and 2022, the government actively pushed for households to install rooftop solar systems that had a peak output of less than 10 kW in residential accommodation (i.e., 10 kWp). These policies aimed to help households produce their own electricity but then to sell any surplus that they generated back into the grid, and as a result 5,609 domestic solar systems were installed over the period. These had a combined capacity of 30,845 kWp.

To match supply to rising demand, the government plans to increase purchases of electricity from solar generation based in residential properties, and so this will climb to up to 90 MW annually over the period 2021 to 2030 (this was agreed at a meeting of the Energy Planning and Policy Committee held 8 February, 2023). At the same time, the price paid for this electricity was raised from THB 1.68/unit to THB 2.20/unit for a period of ten years. As a result, interest in rooftop solar installations rose further, and over 2021 and 2022, enrolments in the program doubled from their level in 2020. As of 30 June 2023, 6,149 households with a total generating capacity of 131 MW had thus agreed contracts with the state provider. At the same time, 18,717 households had installed rooftop solar systems to generate power for their own use or for distribution directly to third parties that had a total capacity of 2,050 MW (Table 4).

Table 4

Rooftop Solar Power Generation Project Status 2023 (as of 30 June 2023)

Year: SCOD	Projects with government commitments*		Produce electricity for their own use and sell it directly to customers	
	Number of project	Installed capacity (MW)	Number of project	Installed capacity (MW)
Solar energy	**14,957**	**6,481**	**18,971**	**2,349**
- Solar farm	647	5,875	222	147
- Solar rooftop	**6,149**	**131**	**18,717**	**2,050**
- Solar floating	1	48	32	152
- Solar government/agricultural cooperatives	98	383	-	-
- Solar for the public sector	8,062	44	-	-

Source: Electricity Generating Authority of Thailand (EGAT), Metropolitan Electricity Authority (MEA), Provincial Electricity Authority (PEA)
* This includes companies that have agreed power purchase agreements (PPAs), both those that have reached their commercial operation date (COD) and so are supplying power to the grid and those that have not yet reached their COD and so are not yet actively providing power

- **Solar power's potential relative to other renewables**

Considering the six factors of (i) access to inputs, (ii) costs and technology, (iii) environmental impacts, (iv) social and community impacts, (v) law/the regulatory environment , and (vi) government policies (i.e., targets and management of the grid) (Figure 8), **solar performs well in comparison to other types of renewable power and the risks associated with investing in it are correspondingly low.** Most obviously, the primary input to solar power generation is free and essentially limitless, but in addition, the cost of solar technology has fallen precipitously in recent years, while the government has moved to offer clear benefits to those investing in this area. **Nevertheless, the current legal framework is still not fully comprehensive**, despite (i) the passing of the 2013 law allowing for public-private partnerships for private-sector investors in solar farms operated by government agencies and agricultural cooperatives, and (ii) the liberalization of laws governing the installation of rooftop solar systems that then allow for this electricity to be supplied to the grid on a commercial basis. This enhances the attractiveness of investing in the utilization of this inexhaustible natural energy source.

Figure 8

Risk Assessment in Power Generation Projects Categorized by Fuel Type.

	Raw Material	Cost/Technology	Environment	Society/Community	Law	Policy
Biomass	●	■	■	■	■	■
Biogas	■	■	■	■	■	■
Waste	■	■	●	●	■	■
Solar	▲	▲	▲	▲	■	▲
Wind	▲	■	■	■	●	●
Hydro	▲	■	●	●	●	■

▲ Low Risk ■ Moderate Risk ● High Risk

Source: Krungsri Research

Factors driving growth in the domestic market for rooftop solar installations

Expansion in the domestic market for rooftop solar systems has benefited from positive factors on the demand and supply sides of the market. With regard to the former, demand for electricity is rising, while for the latter, investment has benefited from periodic government support policy and the introduction of the feed-in tariff, which provides an additional financial incentive underpinning the expansion in the supply of renewables. This part discusses the evolution of Thailand's clean energy policies and their impact on the transition from fossil fuel-based power generation to clean energy, with PESTEL analysis. The latter identifies other external factors that could benefit entrepreneurs in driving the growth of the solar rooftop market, beyond government policies.

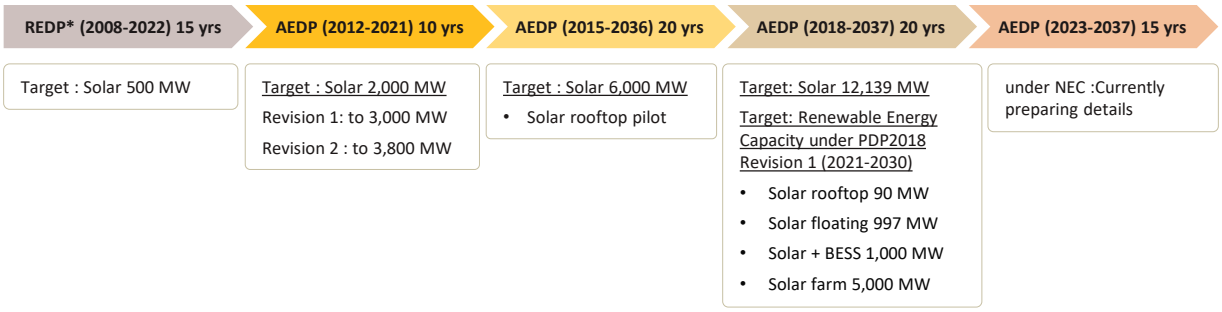
Government solar energy support policies

The solar energy purchase target is periodically adjusted to align with government policies and other supporting measures. These revisions are shown in Figure 9, which traces the evolution of these targets from the Renewable Energy Development Plan (for 2007-2022) through to the Alternative Energy Development Plan, or AEDP2018, which covers the period 2018-2037 and sets a target of solar supply reaching 12,139 MW by the end of the plan's lifespan. The AEDP2024 is currently under development.

Government policy regarding state purchases of solar power firmed up substantially over 2019-2022, and this thus moved to a greater focus on the promotion of rooftop solar. This was achieved through a liberalization of the rules governing installation together with the rollout of supporting measures. As a result, production of solar power expanded from supply that was produced for sale into the grid to include a greater share of private-sector players generating power to consume themselves or to distribute directly to third parties, generally either to cut costs or to reduce carbon dioxide emissions. These players thus generate power without a contract to supply the grid and so are classified as 'independent power suppliers' (IPSs).

Figure 9

Target Purchases of Solar Power under the REDP and AEDP



Source: Energy Policy and Planning office (EPPO), Department of Alternative Energy Development and Efficiency (DEDE)
*REDP: Renewable Energy Development Plan

Investment in grid-tied solar systems is continuing to expand thanks to government support and the introduction of the feed-in tariff, and domestic capacity is now on track to reach 7,000 MW (Table 5). Potential growth areas for investment will include solar farms, domestic rooftop solar installations (the target is for a total of 90 MW of capacity), and solar farms coupled with battery energy storage systems. Since 2022, the government has been buying in electricity generated from rooftop solar installations, with initial purchases set at 10 MW, and going forward, generation of power by IPSs producing this for themselves or for direct supply to other energy consumers will continue to rise.

Table 5

Renewable Energy Capacity under PDP2018 Revision 1 (2021-2030)

Year: SCOD	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Solar energy	**45**	**10**	**34**	**300**	**400**	**898**	**800**	**1,300**	**1,600**	**1,700**	**7,087**
- Solar rooftop		10	10	10	10	10	10	10	10	10	90
- Solar floating	45		24			298	50		280	300	997
- Solar farm + BESS				100	100	100	100	200	200	200	1,000
- Solar farm				190	290	490	640	1,090	1,110	1,190	5,000

Source: EPPO, PDP2018 Revision 1 (2021-2030)

The government's electricity purchase policy shifted from Adder to Feed-in-Tariff to reflect the real costs.

Thailand has transitioned from the Adder system[5/] to the Feed-in Tariff (FiT) system[6/] for purchasing electricity from the private sector. Currently, there are both private entities under the Adder system with ongoing contracts and those operating under the FiT system for Solar rooftop projects. These two systems differ in terms of electricity purchase prices and trading mechanisms. The FiT system reflects the real costs in the current market and offers a fixed rate (excluding inflation factors), impacting the profitability of investments for grid sales. In 2024, the government opened a bidding process to purchase electricity from renewable energy sources under the FiT system for the period 2021–2030, with a focus on solar farms, amounting to 5,000 MW.

However, the main beneficiaries of these policies have been major players with access to capital and technology since these are the key criteria considered by the authorities when awarding contracts. Similar policies have been introduced in countries including China, Japan and India to encourage an increase in private-sector investments in clean energy, and in the case of Thai rooftop solar installations operating under the FiT (for systems installed in the central region using monocrystalline solar panels), the payback period is just 6.1 years. These also have an IRR of 15%, which is better than those operating outside the feed-in tariff[7/].

5/ This refers to the additional payments made from 2006 onwards to suppliers of power generated from renewables. Contracts were for 7 years and were awarded on a first-come first-served basis

6/ This offers favorable net prices for purchases of electricity that better reflect the costs of production. Supply contracts are typically for 20-25 years and fall under the oversight of the Energy Regulatory Commission (ERC). For rooftop solar systems, the FiT was introduced in 2013.

7/ MDPI Journal. Performance and Economic Evaluation of Solar Rooftop Systems in Different Regions of Thailand

Environmental factors affecting the domestic market for rooftop solar

To assess the opportunities in Thailand's solar rooftop market, we can apply the PESTEL analysis framework, which examines external factors across 6 dimensions: Political (P), Economic (E), Social (S), Technological (T), Environmental (E), and Legal (L). This comprehensive approach enables businesses to evaluate factors influencing the growth and investment viability in the solar rooftop sector in Thailand, beyond merely considering government support policies, as summarized in Table 6.

Table 6

PESTEL Analysis of the Market for Rooftop Solar Systems

	Positive factors	Negative factors
Political factors	Government policies that support the development of the market for rooftop solar systems include the following: • Promotions encouraging private-sector players to generate their own electricity and to sell any excess back into the grid. • Funding and other assistance is available for households and commercial operations installing solar cells. • Investment support provided through the BOI for both manufacturers of solar cells and those generating power from these.	• Changes to government contribute to delays and discontinuity in policy. • Problems with limits on transmission infrastructure trouble the industry.
Economic factors	• Demand for electricity is increasing, especially as a result of investments by foreign companies in energy-intensive businesses such as data centers and cloud service providers. • Average electricity prices of THB 4.0-4.2/unit are making rooftop solar installations an attractive financial proposition. • Access to funding and business investments are both rising, as seen in the increase in green loans and financing specifically for rooftop solar systems.	• High levels of household debt are undercutting spending power and may impact spending on residential solar systems. • New loan-to-value rules enforced by the Bank of Thailand may affect households' access to financing.
Social factors	• The population is expanding and demand for residential properties continues to rise. • Limited access to space and high population density in urban areas makes rooftop solar systems an attractive option for those wishing to generate their own electricity or to engage in community-level energy projects.	• Urban and rural communities experience significant inequalities in terms of access to infrastructure and energy.
Technological factors	• Technological advances are helping to cut the costs and improve the efficiency of rooftop solar. • Spending on R&D is increasing.	• Players face challenges accessing solar technology and recruiting the skilled staff needed for installing and maintaining solar systems.

Table 6

PESTEL Analysis of the Market for Rooftop Solar Systems (Cont.)

	Positive factors	Negative factors
Environmental factors	• Demand for solar solutions is being boosted by the need to tackle climate change through cuts to greenhouse gas emissions and the development of the clean energy sector. In particular, demand will be boosted further by the introduction of the EU's Carbon Border Adjustment Mechanism[8/] (CBAM), which will push companies to cut supply-chain emissions through greater use of renewables, and the Corporate Sustainability Due Diligence Directive (CSDDD)[9/], which is forcing corporations to carry out comprehensive auditing of the environmental impacts associated with their supply chains.	• Tightening environmental regulations may push up costs. This may include those related to the disposal of solar cells that have reached the end of their lifespan and stricter standards regarding the installation of these. This will be needed to ensure that supply chain tracking and traceability is effective.
Legal factors	Laws governing the installation of solar cells were tightened in 2024. These changes included: • Safety standards: Compliance with new stricter laws is mandatory. • Connecting power supplies: Connections with the building's internal power supply have to meet official safety standards, and these must be inspected and certified by a licensed electrical engineer. • Environmental impacts: Environmental impacts arising from production and installation must be minimal, and waste must be properly disposed of.	• Problems related to legal restrictions on land use, permitting processes, and property rights may make installing solar systems complex and time-consuming, and this may then hold back investment. • Business overheads may be lifted by the complexity of regulations on, for example, taxation and schemes to promote energy-efficiency, further impacting investment decisions.

Source: Krungsri Research

8/ The Carbon Border Adjustment Mechanism, or CBAM, is one of the core components of the EU's 'Fit For 55' program. This was announced as part of the European Green Deal and the EU's plans to reach net zero emissions by 2050.

9/ The CSDDD holds companies responsible for any negative impacts on human rights or the environment (e.g., through the use of forced labor, environmental degradation, etc.) that occur as a result of their activities or of companies within their supply chains. These regulations form an important part of the EU Green Deal (source: Global Compact Thailand, 24 April 2024).



Krungsri Research View: Opportunities and Challenges for Thailand's Business Sector

In the long term, the future of solar rooftop installation projects in Thailand shows significant growth potential, driven by regulatory changes and supportive policies under the PDP2024 plan. This plan aims to increase the share of renewable energy in electricity generation to 51% of total electricity production from all fuels by the end of 2057, aligning with the country's stricter goals for energy security and sustainability. Specifically, 16% of the total electricity is targeted to come from clean solar energy**. However, in the near term, key trends that will facilitate rooftop solar panel installations include:**

- **Changes to regulations should support the further expansion of the industry,** and at present, the Ministry of Energy is in the process of drafting an important new law that will ease the regulations governing the market for rooftop solar systems. This should help to remove bureaucratic bottlenecks, and by making the permitting process less troublesome and installations more feasible, this will encourage businesses to increase investment.

- **Market dynamics** are adding to the tailwinds generated by regulatory liberalization. Thus, demand is being boosted by the growing realization among players in the commercial, industrial and educational sectors of the financial benefits of installing rooftop solar, the increasing reliance and dependability of solar systems generally, and the fact that domestic electricity prices remain above THB 4.00/unit. On the supply side, prices for solar power have fallen, and with Chinese solar cell production troubled by an oversupply of capacity, global prices for solar cells will continue to come under pressure. Indeed, in many cases, these are falling below their cost of production (source: Bloomberg News, 12 September, 2024) and Thailand will be among the beneficiaries of this trend. Beyond this, ongoing progress on technologies connected to solar cells and battery energy storage systems will increase their efficiency and lift uptake rates further.

However, while the overall outlook for the rooftop solar market is positive, the industry will face challenges on both the technological and commercial fronts, while physical factors limit the efficiency of rooftop installations. **To address these issues, businesses will need to consider the following approaches.**

- **Players will need to adapt their business strategies** by forming partnerships and business relationships with other companies and potential customers, including real estate and property developers, hotels, and modern trade operators, as well as data centers since these are especially energy-intensive and are likely to operate according to environmental standards that require the use of clean energy. This will then help providers extend their marketing channels and build economies of scale, thereby adding to the opportunities available to generate profits from investments made in rooftop solar systems.

- **Companies will also need to raise the quality of their management and operations,** especially with regard to the efficiency of the transmission systems used to distribute electricity to customers, whether those are part of the national grid or a private network. Highly efficient rooftop solar installations will need to be designed and sized appropriately to balance local production possibilities with local demand, and this will require that space is effectively managed and that the right architectural technologies are utilized, though success in this will reduce overheads and maximize the stability of energy supply and storage. Moreover, the development and rollout of energy systems will need to be transparent, aligned with downstream business traceability standards under global trade regulations emphasizing increased environmental friendliness.

In addition to helping companies reduce their expenditure on energy, the development of the rooftop solar market will generate a wide range of new business opportunities. These will include the installation of solar panels and other related equipment, managing the software needed for solar power systems and electricity transmission, and the manufacture of energy storage systems (ESSs). This will then spur the development of a comprehensive and wide-reaching clean energy ecosystem, one outcome of which will be to help the country meet its environmental, social and governance (ESG) goals. **Therefore, investing in solar rooftops is a crucial step for businesses to embrace the clean energy trend, enhancing the competitiveness of Thai enterprises on the global stage. It is becoming an essential upstream industry in the global supply chain, aligning with the current global industrial shift towards reducing energy costs and carbon emissions, which are key to achieving sustainable growth.**

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