CASE for Southeast Asia

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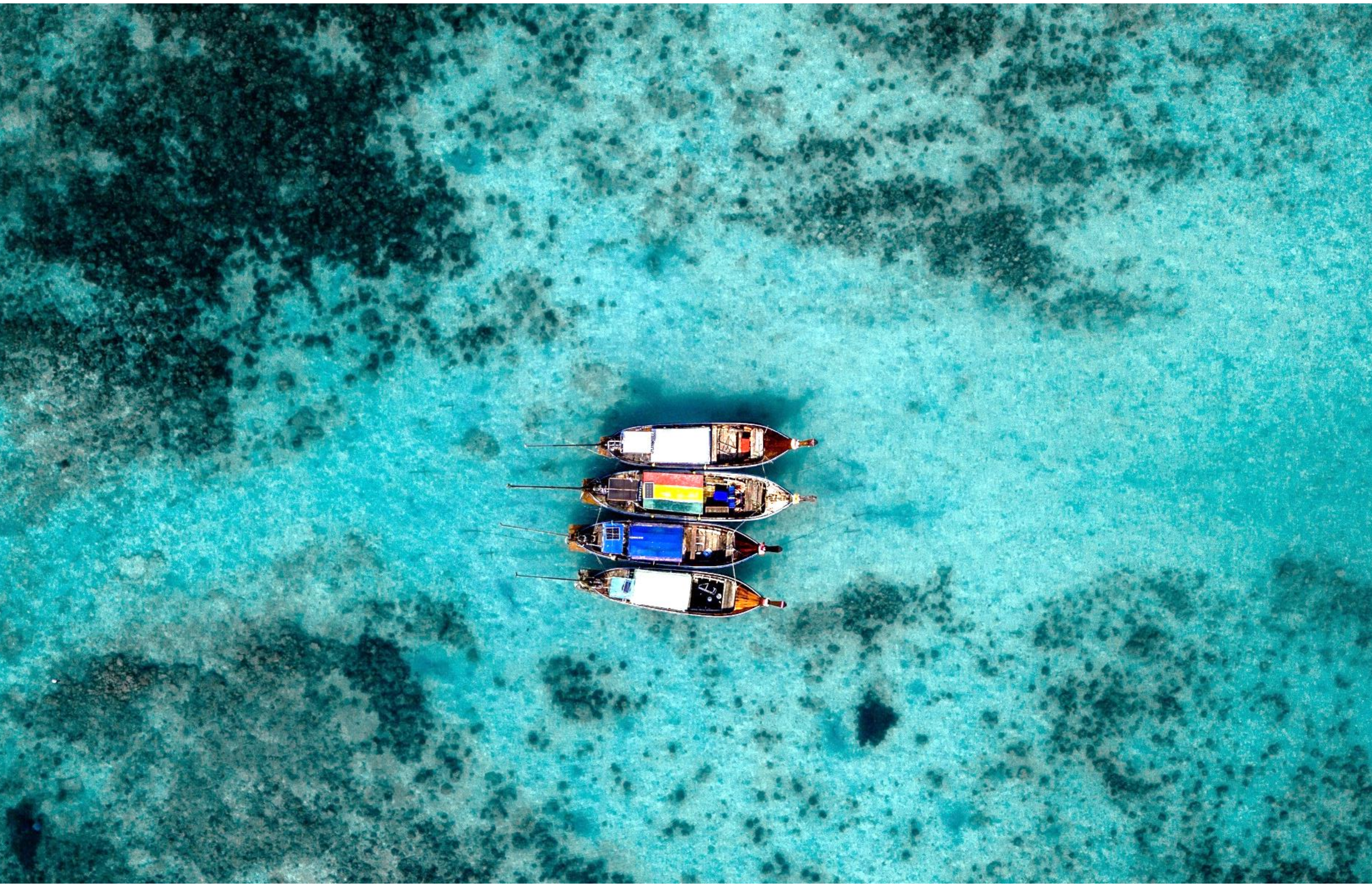
Towards a collective vision of Thai energy transition: National long-term scenarios and socioeconomic implications

Executive Summary

November 2022



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Key findings

Achieving Thailand's vision of carbon neutrality with a cost-efficient transition will depend on today's choices and policy actions, which will shape the energy system in the next decades.

CO_2 emissions need to decrease immediately and drop by 30% in 2030, 50% in 2037 and 80% in 2050 compared to 2019 levels. This is made possible by a fast scaling-up of renewables, improvement in energy efficiency, gradual phase-out of fossil fuels and electrification of other end-use sectors, such as transport and industry. In 2037, at least 50% of the total energy supply should come from renewables. As electricity becomes a major energy carrier, electricity is expected to supply 20% of transport energy demand and 60% of industrial heat demand in 2037. The energy transition needs to start immediately since it requires time, resources and technical and institutional capacity, but also to avoid the risks of technological lock-in that would jeopardise Thailand's climate, energy and broader economic goals.

The transition to a low-carbon energy system will benefit the Thai economy, increase energy security, reduce health impacts and improve the environment.

The significant construction of renewable generation capacity over the next eight years could create over a million new jobs. Building such an ambitious economic program will require time, resources and significant capacity-building efforts. In addition to creating new jobs in manufacturing, installation, operation and maintenance, establishing these renewable generation capacities could position Thailand as a front-runner in the region. Early actions could also act as a green-growth economic impetus post-Covid. An increased share of indigenous renewable energy (RE) sources will reduce fossil fuel-import dependency, mitigating geopolitical and supply shock risks like those encountered in 2022. Thailand's transition to a low-carbon energy system will reduce air pollution in the energy sector, saving 27,000 lives over the next 30 years and reducing the risk of premature death from stroke, ischemic heart disease and lung cancer.

The energy transition represents an opportunity to modernise the Thai energy system and will require a comprehensive program of investments.

The required annual investment to transform the power sector represents 2% to 5% of Thailand's GDP. These investments are relatively evenly distributed across cost-efficient and mature low-carbon technologies, such as solar photovoltaics (PV), battery storage, electric vehicles (EV), etc. Total system costs remain comparable to the ones related to operating today's power system yet comprise additional economic benefits such as reducing exposure to fossil fuel price volatility.

The road to climate neutrality requires the transformation of all sectors, which in turn calls for cross-ministerial dialogue and integrated planning.

Cross-ministerial dialogue and integrated planning are necessary to ensure that all implementation plans are working towards the same goals. Multi-sectorial policy alignment will require stronger cooperation between line ministries to ensure a just and economically viable energy transition. Integrated planning of the energy system transformation requires new regulatory and market frameworks that spur technology cost reductions and unlock investments in renewables and other emerging technologies.

The Thai energy transition to a low-carbon energy system will benefit the Thai economy, increase energy security, reduce health impacts and improve the environment

Emissions

need to peak as early as the end of **2022**

drop by **30%** in **2030**

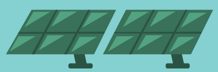
drop by **50%** in **2037**

drop by **77%** in **2050**

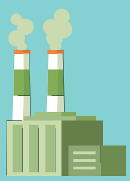
compared to 2019 levels

Action by 2030

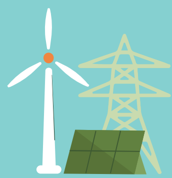
Solar booster program
(5GW per year until 2030)



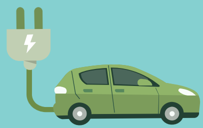
No new coal power plants



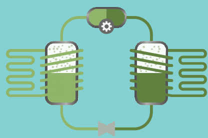
Flexible operation of power system



Increase sales of zero emission vehicles
(100% in 2035)



Increase heatpump in industry
(40% heat supply)



Benefit

Renewable energy technologies can create

1.2 million new jobs

until 2030, which could help revive the economy after the recession.

Reducing air pollution is estimated to

save 27,000 lives

over the next 30 years.

The energy transition will induce a total investment of

THB 8 trillion

in the power sector over 30 years.

How we created the pathway?

The pathway depicted here represents the outcome of several "what-if?" thought experiments, following these guiding principles:

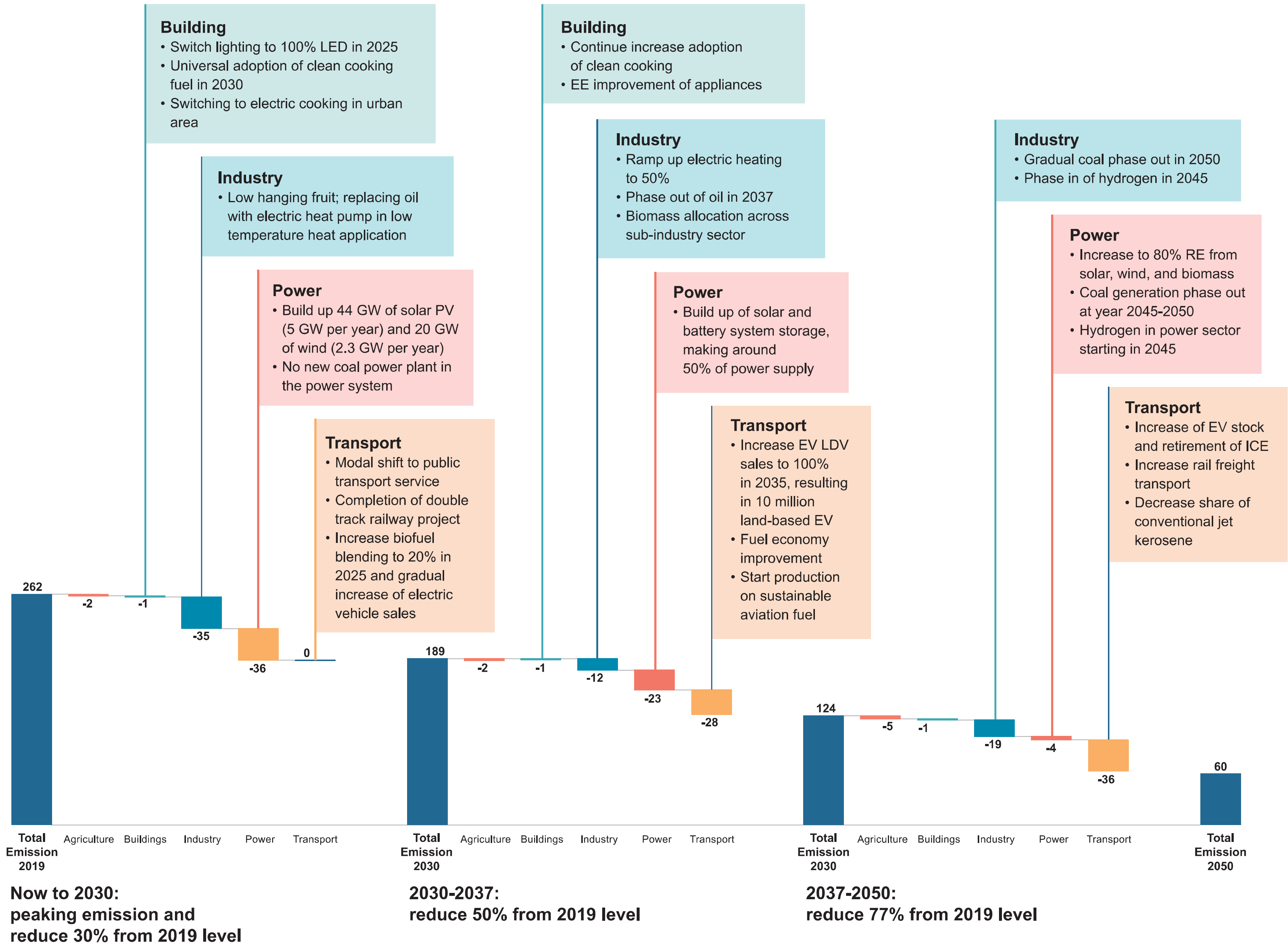
The power sector is the key enabler
to decarbonise several other end-use sectors
(e.g., low temperature heat in industry, electric vehicles in transport, etc.)

Using the best technologies
available at decreasing costs over the transition,
following global trends (e.g., electric vehicles)

Thailand's pursuit of its vision to become
a front-runner in the energy transition

Carbon sinks are available to offset remaining emissions

The power and heat supply side are decarbonised solely under
cost-optimization constraints,
without additional climate constraints.



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Sector specific strategies

A. Power sector transformation

Rapidly scale up renewables, particularly solar PV

Key findings:

- The power system will drive the decarbonisation of the entire Thai energy system through increased electrification of end-use sectors.
- The decarbonisation of the power sector is therefore the pre-condition, backbone and enabler to achieve carbon neutrality.
- Renewables-based electricity is already a cost-effective option in Thailand, particularly solar PV, given the high solar irradiation and sufficient available land.
- Renewables should cover 60% of power supply in 2030, 77% in 2037 and 85% in 2050.

Recommendations:

- **To be on track with its long-term net-zero commitment, Thailand should immediately launch a solar booster program with a yearly installation target of 5 GW per year.**
  A clear annual target in the PDP and a committed implementation plan will build trust among private investors, attract the necessary investments and provide technical certainty on system integration challenges.

- **Thailand should review renewables support mechanisms and remove existing market barriers.** Some regulatory and market barriers must be bypassed in order to facilitate investment and system integration of renewables. Key priorities include a new design of electricity transmission and distribution fees for third party access, a refinement of energy trading regulations, and a review of the grid code. Specific incentives need to be provided to accelerate the installation of small-scale RE such as rooftop solar PV.

Unlock and increase power system flexibility

Key findings:

- With increasing shares of variable renewable energy (VRE), the power system must be redesigned around the flexibility paradigm.
- Up to 15% VRE can be integrated into the power system without fundamental changes in the power system structure. However, existing thermal power plants will gradually need to operate more flexibly to facilitate the integration of renewables and limit curtailment.
- Other flexibility options exist to facilitate the integration challenge (e.g., transmission grid, interconnection with neighbors, demand-side response).
- After 2030, the rollout of battery storage will become a key measure to further support the expansion of solar technologies.
- The gradual electrification of end-use demand (in particular charging of electric vehicles) will provide an important source of additional flexibility to the system and contribute to reduced CO_2 emissions.
- The security of the power supply will be ensured throughout the transition through the reliance on battery storage and gas peaking power plants. Gas peaking power plants will be required in seasons with low solar PV irradiance (typically in July) but their output will be reduced significantly, and in the long-run they should be climate-neutral ready (requiring a fuel-switch towards green hydrogen).

Recommendations:

- **Increase operational and contractual flexibility of thermal power plants.**
  Current power purchase agreements (PPAs) with minimum-take obligations and take-or-pay fuel supply contracts must be revised to facilitate increasing RE shares and minimizing total system costs. Possible options include creating more flexible fuel supply contracts through a portfolio procurement approach (fuel supply contracts with a mix of short-term and long-term products) and tendering new/restructured PPAs with more flexible terms.

- **Support the mid-term rollout of battery storage to facilitate solar integration.**
  Given the correlation of solar PV generation and demand profiles, installing battery storage from 2030 could significantly support the integration of high shares of VREs into the grid and reduce total system costs. In comparison, investments in transmission grid reinforcement will be relatively low. During days with high solar generation, battery storage (stationary or EV charging, in particular bi-directional) could help absorb excess peak generation in the middle of the day and discharge it to supply nighttime demand. Incentives and financing options must be designed to support the development of the battery storage market before the technology is expected to be cost-competitive (in the 2030s).

- **Promote other decentralized solutions (e.g., distributed energy resources and demand response) in enhancing system flexibility.**
  Supporting the deployment of decentralized solutions on both the supply and demand sides will require a comprehensive modernization investment programme. These investments should be relatively evenly distributed across cost-efficient and mature low-carbon technologies.

Phase-out fossil fuels and reassess the role of gas power during the transition

Key findings:

- No new coal power plants must be built, as they are incompatible with climate objectives and bear energy security and economic risks. In addition, coal power plants must be retired more quickly in line with the uptake of renewables.
- By 2050, the amount of thermal power plants required to ensure system adequacy will decrease significantly (from 39 GW in 2019 to 27 GW in 2050) despite a significant increase in power overall power consumption. Other technologies, such as storage and optimal EV charging, alleviate the need and provide additional flexibility to the system.
- Between now and 2050, the economics and operating structure of gas power plants will change progressively as renewables enter the system. The average utilization rate of existing gas power plants will decrease.
- New thermal generators will mostly operate as peaking plants during periods of low renewables output and high inflexible demand, especially in June and July. In order to be aligned with ambitious decarbonisation objectives, those thermal power plants should be ready to switch to zero-carbon fuels (green H_2).

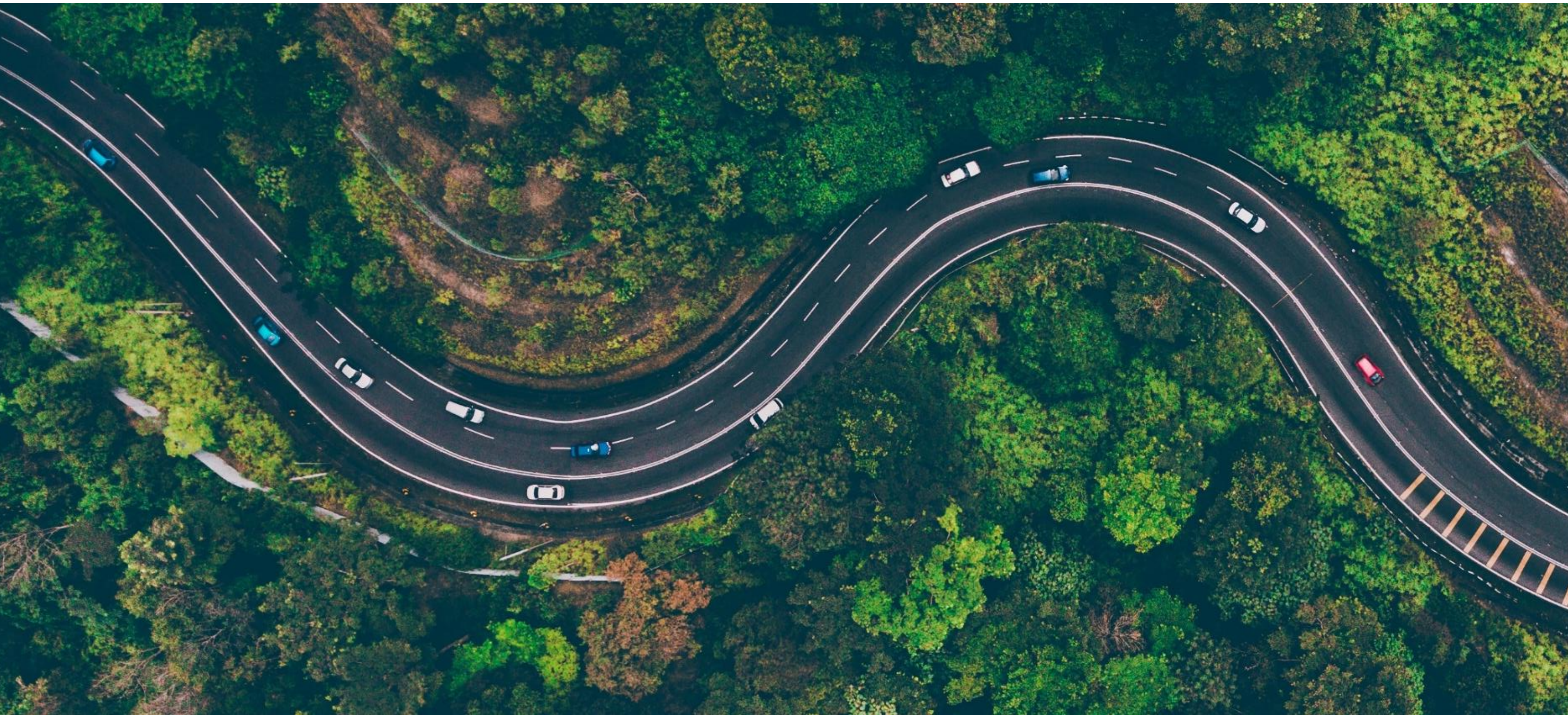
Recommendations:

- **Develop new cost-recovery mechanisms for gas power plants.**
  With the reduced utilization of existing gas power plants, their earnings and cost structure will change significantly over the transition. This situation requires the design of new contracts or other cost-recovery mechanisms for gas power plants that must consider flexibility requirements along the trajectories of renewables uptake.

- **Renegotiate existing long-term contracts of gas power plants.**
  The utilization of existing gas power plants will change as renewables enter the system. This requires a renegotiation of existing PPA contracts to minimize system costs and reduce renewables curtailment.

- **Develop a fossil fuel transition plan with all concerned stakeholders.**
  Achieving ambitious emissions reduction targets will require a fossil fuel transition plan involving all concerned stakeholders and including a just energy transition perspective to mitigate any social impacts. The natural gas policy of the Thai government should be assessed in greater detail, in particular in light of energy security and external price shocks, climate constraints and the optimal cost structure of the power plant mix.

- **Gradually switch fuels from natural gas to green hydrogen on the road to more ambitious climate objectives.**
  The speed of the transition away from natural gas towards green hydrogen will depend on the level of climate ambition. In particular, the transition will depend on the level of sinks dedicated to offset energy-related emissions, as well as carbon pricing instruments and the long-term price evolution of fossil fuels. One key strategy to achieve this transition towards green hydrogen is to ensure that any new investments in gas power plants should be H_2-ready.



B. Transport sector transition

Electrification of transport is key for driving down fossil fuel consumption

Key findings:

- By 2030, the renewables-based electrification of the transport sector will increase the annual electricity demand by 12 TWh, or less than 1 Mtoe, while reducing fossil fuel consumption by almost 6 Mtoe. This electricity demand will be mostly flexible, facilitating the integration of higher shares of variable renewables.
- By 2050, electricity demand in the transport sector will represent almost 20% of the total electricity demand, saving a total of 211 Mtoe of oil products during that year (compared to a scenario without deep electrification).
- Reaching ambitious electrification targets in the transport sector requires the rapid adoption of an infrastructure plan (charging infrastructure and power system integration) in the coming years.

Recommendations:

- **Support EV deployment with both demand- and supply-side policy measures to accelerate transport sector decarbonisation.**
  Examples of demand-side measures include tax incentives and price subsidies on the purchase of electric vehicles, charging infrastructure development, preferential lanes and city access/parking. On the supply side, examples of measures include subsidies to support the automotive and battery industries, R&D programs and mandating emissions reduction from production lines. In addition, improving fuel economy or vehicle standards will play an important role in reducing emissions and developing smart charging incentives will facilitate EV integration into the power system.

Emissions reduction in the transport sector requires a broader strategy than the deployment of electromobility

Key findings:

- While 100% EV sales by 2035 can result in up to 50% of emissions reduction in the transport sector in 2050, additional measures – such as fuel economy standards and CO_2 limits for vehicles – are required to bring emissions down further.
- Modal shift and energy efficiency lead to faster emissions reduction in the mid- to long-term, reducing energy demand by 15% in 2030 and 40% in 2050.
- Accelerated turnover will be required to ensure rapid EV deployment. In addition, stricter emissions standards are required to minimize the emissions of combustion engine fleets, which will still represent a large share by 2050.

Recommendations:

- **Promoting modal shift is as important as the deployment of EVs.**
  Modal shift (including shifting from road to rail and from motorized to non-motorized, as well as scaling up mass public transport systems) should be stimulated to increase both carbon efficiency and energy efficiency of the transport sector. Since public transportation can be electrified faster than private transportation, modal shift that encourages the use of public transport and its electrification are the measures with highest impact to decarbonise the transport sector in the mid-term.

- **Promote faster turnover of more energy-efficient and less carbon-intensive vehicles.**
  Policies and regulations to support a faster turnover of vehicles should be implemented to encourage early retirement, limit the circulation of older vehicles and increase sales of new efficient vehicles. In addition to instruments promoting electromobility (EV tax credits or exemptions to make new vehicles more affordable), several additional measures must be implemented, such as taxation of combustion-engine vehicles, vehicle scrappage policy, stringent emissions standards for vehicles on the road and circular economy practices to receive older vehicles before the end of their lifetime.

C. Industry sector transformation

Energy efficiency and electrification will be key to decarbonise low-temperature heat in the industry

Key findings:

- Despite an expected increase in industrial activity in Thailand, the industrial energy demand can be reduced by more than 10% over the next 20 years through electrification of heat and energy efficiency measures.
- Since the current industry structure in Thailand is dominated by low-temperature heat (e.g in the food and tobacco industries), important CO_2 savings can be provided now by the diffusion of readily available technologies powered by clean electricity (e.g., heat pumps).

Recommendations:

- **Develop incentive schemes for industry to accelerate the switch to electric heating technologies.**
  Maintaining low electricity costs will be a key driver for industry electrification. During the transition period, policymakers should develop programs to facilitate the diffusion of electric technologies while incentivizing the development of renewable electricity sources within industrial parks.

- **Accelerate the deployment of energy efficiency measures targeting energy-intensive industries.**
  The government should strictly enforce the Energy Conservation Promotion Act for energy-intensive industries, such as the cement, steel and plastic industries. Mandatory Minimum Energy Performance Standards (MEPS) should be considered to incentivize the use of energy-efficient equipment in all industrial sectors.

- **Energy Service Companies (ESCOs) can deliver energy efficiency gains financed through energy savings.**
  ESCOs are one of the most effective mechanisms for promoting energy efficiency in the public and industrial sectors, particularly in emerging countries. The government should strengthen the condition of ESCOs markets by promoting energy-saving performance contracting in the industrial sector. In addition, the operation of ESCOs can be encouraged using funds from the Energy Conservation Promotion Fund to increase the number of credit lines granted by the ESCO Fund.

Low-carbon fuel, such as biomass and green hydrogen, will become key for decarbonizing high temperature heat

Key findings:

- While low-temperature heat processes will be decarbonised through renewables-based electricity, high-temperature heat processes, especially in the cement and steel industries, will be decarbonised through the use of clean fuels, such as biomass and green hydrogen.
- Sustainable biomass can provide a large share of high-temperature heat demand and should be reserved to those usages where its value is highest.
- Hydrogen produced from solar power will play a role in decarbonising some industrial sectors in the long run, but its role will likely remain relatively marginal in Thailand.
- In the long run, coal should be replaced by clean fuels, such as biomass or green hydrogen, for the provision of high-temperature heat in industry. Relying on CCUS to abate energy-related emissions is uncertain given the high technology costs.

Recommendations:

- **Incentivize biomass reallocation to high-value use.**
  The government should prioritize the use of biomass in sectors where no other abatement technologies exist, for example in the cement industry. Biomass should phase out of the sectors in which it is currently used and the cascading principle should be followed to minimize negative impacts on the biomass market and on biodiversity.

- **A supportive policy framework will be required to promote the use of green hydrogen in the industry sector.**
  To accelerate the adoption of green hydrogen technologies, several measures must be implemented both on the supply side (e.g., Carbon Contract for Difference (CCfD), carbon pricing schemes, standardisation) and the demand side (e.g., green procurement policies).

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