USAID
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USAID CLEAN POWER ASIA

FINAL REPORT

2016-2021

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1 EXECUTIVE SUMMARY

Photo credit:
Pitoon Junthip
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USAID Clean Power Asia

Energy consumption across Southeast Asia is projected to double by 2040. Without a concerted effort to promote low emission power systems, the region will continue to rely heavily on conventional energy sources such as coal and large-scale hydropower to meet demand. Further expansion of conventional power plants will have far-reaching negative impacts, both for global greenhouse gas emissions as well as for ecosystems, human health, fisheries, and livelihoods throughout the Mekong River basin and beyond.

The United States Agency for International Development (USAID) Clean Power Asia program was a $16.3 million contract, implemented by Abt Associates, which worked with Lower Mekong countries and other Association of Southeast Asian Nations (ASEAN) member states to encourage power sector investments in environmentally friendly, grid-connected renewable energy (RE) sources. The program focused explicitly on incorporating renewable energy into planning, promoting smart incentives, building an enabling environment for renewable energy policies and frameworks, and mobilizing finance. The program collaborated with diverse stakeholders, partners, and regional organizations in four Lower Mekong (LM) countries, Cambodia, Laos, Thailand, and Vietnam, and shared lessons learned and best practices among additional ASEAN member states, including the Philippines and Indonesia. USAID Clean Power Asia's goal was to accelerate the regional transition to a high performing, low carbon power sector, that was to be accomplished with three interconnected outcomes: high renewable energy scenarios included in energy planning; improved enabling policy, regulatory, and technical environment for renewable energy deployment; and increased investment in and deployment of grid-connected renewable energy projects.

The USAID Clean Power Asia program began at a time when innovations in power system planning to incorporate more renewable energy were being driven by unprecedented cost reductions, especially for solar and wind projects. The program focused at a national level in Laos and regionally across Southeast Asia to consider higher levels of RE than accounted for in current power plans, demonstrating that by using new sources of data and tools better adapted to evaluating greater RE levels, the potential for increased solar and wind in power development plans became clear, resulting in increased solar and wind targets.

The program provided technical assistance and capacity building to select countries driven by their needs and interests, with lessons learned shared regionally to ensure broader implementation and harmonization of policies and regulations to increase RE in the generation mix, including incentives, power procurement practices, and technical standards for utility-scale, customer, and advanced technologies. This was complemented by technical assistance and capacity building to improve project bankability and access to finance to facilitate private investment in renewable power. Partnerships developed with private institutions, funded by their own funds and other donors, resulted in over $1 million USD of in-kind and direct funding to complement USAID funding for programmatic activities.

Despite the challenges due to COVID-19 restrictions on travel and meeting with stakeholders, USAID Clean Power Asia has contributed to the proposal, adoption, and/or implementation of **16 new policies and regulations** across multiple countries. **Over $7 billion of investment** has been mobilized in renewable energy investments, resulting from installation of **more than 9,000 megawatts** of renewable energy capacity. Based on these policies and installed RE projects, USAID Clean Power Asia has contributed to preventing **over 93 million tons** of carbon dioxide equivalent in greenhouse gas emissions being released into the atmosphere over the next 15 years. In addition, the expansion of webinars due to an inability to convene in person enabled reaching a greater number and far more diverse set of stakeholders, including more women, to share best practices and lessons learned over the five years of the program.

2 INTRODUCTION & BACKGROUND

Overall objectives and major achievements

Just as all action begins with planning, the same is true of the power sector in the Lower Mekong and Southeast Asia broadly. The USAID Clean Power Asia program began at a time when innovations in power system planning were incorporating more renewable energy, driven by unprecedented cost reductions, especially for solar and wind projects. The program focused on ensuring greater consideration for higher levels of renewable energy in power sector plans, including through the use of new sources of data and tools better adapted to enable informed decision-making for greater RE levels.

The program included a focus on Laos, which has abundant hydro and other renewable resources in demand by neighboring countries Cambodia, Thailand, and Vietnam. Cambodia, Thailand, and Vietnam received assistance in revising power development plans from other USAID programs and donors including the Asian Development Bank (ADB), International Energy Agency (IEA), World Bank, and USAID Vietnam Low Emission Energy Program (V-LEEP). Regionally, USAID Clean Power Asia supported planning for improved connectivity and power trade among ASEAN member states in support of the ASEAN Plan of Action for Energy Cooperation.

Bringing those plans to life required an improved enabling policy and regulatory environment that enhanced energy services, attracted private sector investment, and strengthened energy security throughout the region. Regional knowledge-sharing provided an opportunity for policymakers and regulators to learn from peers and international best practices on how to define, clarify, and achieve policy objectives and develop regulations that support rather than inhibit integration of increased RE in Southeast Asian power systems. It also developed a network of practitioners capable of providing longer-term sharing beyond the end of the USAID Clean Power Asia program.

Augmenting these plans, policies, and regulations was a focus on promoting investment in RE projects in the current policy and regulatory environment. The program improved project bankability and access to finance to facilitate primarily private sector investment in RE generation; advanced technologies to complement or facilitate RE such as battery storage; and transmission infrastructure, working with utilities, developers, investors, financiers and banks, corporations and industry associations. This was facilitated by direct technical and financial feasibility support, development of financial tools and models specific to the region, capacity building to lending and financing institutions and negotiating equitable financing agreements, including balancing major risks for all parties through an appropriate mix of loans, equity, guarantees and letters of credit.

The program focused on Laos' planning process due to its strategic role in the LM region power sector, and because other donors and international organizations including the ADB, the World Bank, and the IEA (with European Union funding) were assisting other LM countries. A long-term integrated resource and resilience plan (IRRP), as well as a complementary vulnerability assessment and resilience action plan, were completed, enabling Laos to combine its domestic and export

Drone footage of a solar farm in Thailand.

Photo credit: USAID/RDMA

power needs into one plan for the first time. It also included analyzing power sector needs in the context of the entire energy sector in which it operates, to develop scenarios through 2055 to complement short and medium-term plans, and to evaluate the robustness of those plans given key social objectives and risks not in the control of planners. The planning efforts resulted in the designation of two RE zones that would enable access to additional RE resources for domestic use and export, facilitating more power trade with Vietnam. IRRP capacity building has built the foundation for planners in the Ministry of Energy and Mines (MEM) and the utility Électricité du Laos (EDL) to continue long-term planning. In cooperation with the Thai Wind Energy Association (ThaiWEA) and the Global Wind Energy Council (GWEC), the program facilitated advancing the wind target in Thailand's power development plan from 2018-2037.

Laos committed early in the program to conducting a solar pilot auction, to determine the market price for solar power and learn the process for future scaling up of competitive procurement, with USAID Clean Power Asia supporting auction design and implementation preparations. The solar pilot auction support, which began with defining key objectives that would guide the auction, ended with the finalization of the auction design as well as the documents required for approval by the government and required regulations for auction implementation. Critical regulations governing technical equipment and project connections with the grid were completed, as were guidelines for developers to conduct solar, wind, hydro and biomass project feasibility studies.

Planning on a regional basis provides an opportunity to identify strategies and investments to diversify resources to improve energy security, improve the flexibility of the power system, increase reliance on indigenous renewable resources, and reduce overall costs. Regional power plan development is also a key requirement to move towards a voluntary Southeast Asian power market. USAID Clean Power Asia supported completion of the third ASEAN Interconnection Masterplan study (AIMS) III, one of three foundational studies sponsored by the Heads of ASEAN Power Utilities and Authorities (HAPUA). The ASEAN Ministers of Energy accepted the study and adopted a revised target for solar and wind as part of their 23% of primary energy RE goal.

To strengthen commitment for deploying RE, the program supported analyses including the impact on utilities and participating and non-participating customers, resulting in revision of policies and regulations for rooftop solar photovoltaics in the Philippines and Vietnam. In the Philippines, this was followed by capacity building of utilities to facilitate successful implementation of the solar photovoltaics (PV) policy. In Vietnam, the resulting solar PV policy revision was extremely successful in promoting investment in rooftop PV by offering a feed-in tariff (FIT) that would ensure installation of rooftop solar is cost-effective, supported by USAID Clean Power Asia's customer economics analysis. Program staff and partners analyzed policies and developed regulatory guidelines for advanced technologies, including battery energy storage systems (BESS) in Vietnam and Thailand, as well as DPV and electric vehicles (EV) in Thailand. USAID Clean Power Asia support led to a policy decision allowing for the use of BESS in Vietnam and consideration of BESS regulations development in Thailand.

Program interventions directly supported the deployment of RE by mobilizing critical finance and investment from the private sector. Through transaction assistance and support for financing structures, USAID Clean Power Asia facilitated investment of 305 MW of utility-scale wind and solar in Vietnam, including a B.Grimm Power solar project, and 54 MW of rooftop solar for three major corporations in Thailand and Vietnam. To support this assistance, program staff and partners developed standard financial models to evaluate solar, wind, and biomass project bankability, adapted for use in Southeast Asian countries. Technical studies and Environmental and Social Impact Assessments (ESIA) completed for a solar project and transmission line for a developer to sell power from Laos to Vietnam led to inclusion of the line in Vietnam's power development plan, though not yet in Laos' power development plan. Financial models, a bankability assessment, and an equity partner strategy will support the developer in attracting both equity and debt financing for the project.

Over the past five years, USAID Clean Power Asia leveraged **over $1 million** USD of in-kind and direct contributions through collaboration with diverse stakeholders, partners at local and national levels, and regional organizations in Cambodia, Laos, Philippines, Thailand, and Vietnam. This includes contributions by the Hawaii Natural Energy Institute on rooftop solar, utility scale solar, and battery energy storage regulations and standards in Laos, Thailand, and Philippines; by the Global Green Growth Institute with support for the solar pilot auction in Laos; and ClimateWorks support for a rooftop solar webinar series, among several others.

COVID-19 pandemic adaptation

The emergence of the COVID-19 global pandemic in early 2020 presented the USAID Clean Power Asia team with unprecedented implementation challenges. The appearance of the first imported case of COVID-19 to Thailand in mid-January 2020 and confirmation of local transmission by the beginning of February, followed by the virus' rapid spread throughout Southeast Asia and escalation to a pandemic as declared by the World Health Organization in March, significantly impacted the timing and design of activities in the approved FY20 work plan, both across the region and in the countries where USAID Clean Power Asia implemented activities.

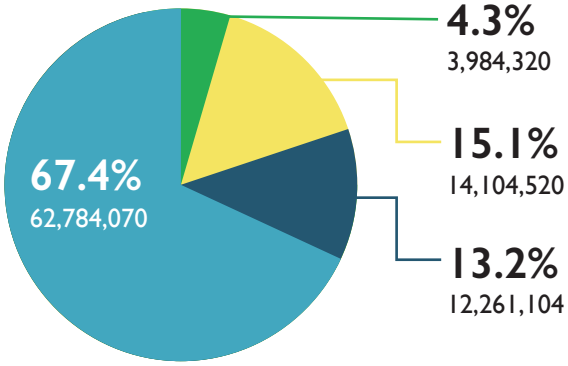
The impacts of COVID-19 caused a number of postponements and delays across multiple tasks due to travel restrictions and restrictions on large gatherings, including meetings of government counterparts. By the end of March 2020, the Southeast Asian countries where USAID Clean Power Asia worked formalized immediate restrictions which demanded adaptation and agility. In Thailand, universities moved to online classes and government employees began to work remotely. In Laos, the government issued a memo prohibiting meetings with foreigners, postponed large gatherings, and subsequently moved to remote work through most of June 2020. In Vietnam, the government stopped issuing visas for foreigners and Manila, capital city of the Philippines, was on lockdown. These restrictions forced USAID Clean Power Asia to implement all activities without staff, consultant, and subcontractor travel, through support of local consultants, with all events moving to the internet.

The inability of program staff to travel throughout the region was compounded by requirements for our government counterparts and other partners working from home, some with insufficient access to the necessary telecommunications infrastructure for effective remote work. These twin actions meant that USAID Clean Power Asia had to immediately postpone many events, resulting in lingering impacts on subsequent activities. To the extent USAID Clean Power Asia was able, program staff supplemented delays to approved work plan activities with additional virtual activities, and by the end of June 2020, program staff finalized development of a detailed plan, with adjustments to work plan activities to adapt to the new reality. Delays experienced due to COVID-19 often caused a chain reaction through subsequent sequenced activities in the work plan that relied on completion of previous steps.

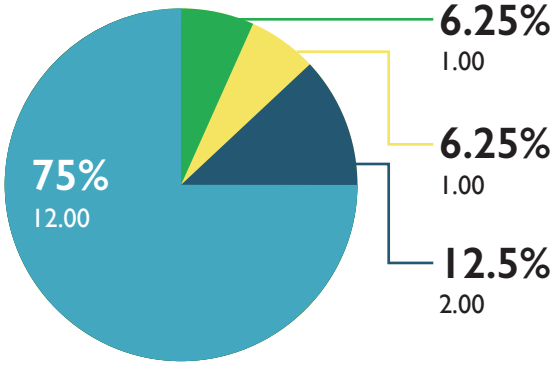
Beginning in July 2020, for government and the private sector, travel restrictions within countries eased and business began to resume, with some limitations on the number of people who could meet and with social distancing requirements in place. Despite national level restrictions across the region being slowly relaxed as the pandemic threat came under greater control, normal program operations including regional and international travel of staff and consultants for program activities, conferences, and workshops did not resume for the remainder of the program. All program activities adapted to virtual meetings and workshops, with the **RE*learning*** series continuing while additional virtual workshops were implemented as part of USAID's Asia EDGE Power Sector Learning Series, implemented cooperatively by the Southeast Asia EDGE Hub, NREL and USAID Clean Power Asia, increasing the number of individuals reached by the program, especially women.

MEL results by key performance indicators

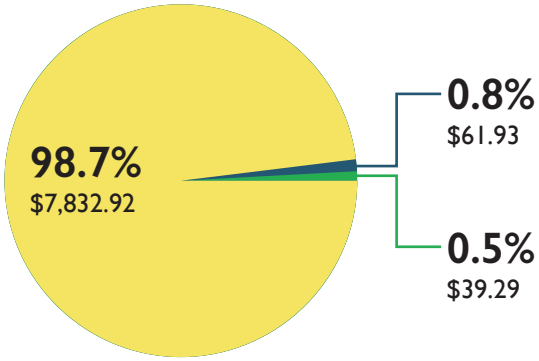
93,134,014 tCO2e avoided



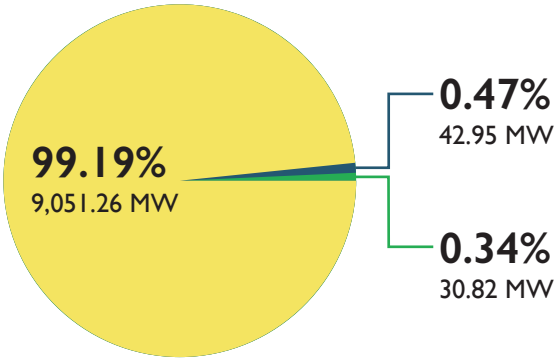
16 policies/guidelines



7,934 mUSD Mobilized



9,125 MW financially closed



Laos Thailand Vietnam Philippines

Over the past five years, USAID Clean Power Asia collaborated with diverse stakeholders, partners at both local and national levels, and regional organizations in Laos, Philippines, Thailand, and Vietnam to overcome policy and technical barriers to deployment of clean energy technologies and to accelerate the regional transition to a low-emissions energy sector through investments in clean energy.

As a result, USAID Clean Power Asia contributed to the proposal, adoption, and/or implementation of 16 new policies and regulations across target countries. In total, over $7 billion of investment was mobilized in renewable energy, resulting from the installation of more than 9,000 megawatts (MW) of renewable energy capacity. Based on these policies and installed RE projects, USAID Clean Power Asia contributed to preventing over 93 million tons of carbon dioxide equivalent in greenhouse gas emissions from being released into the air over the next 15 years. The four charts above provide detail on key achievements by country.

It is important to note that program success is measured not only by indicators, but also by success in the approaches or strategies used, such as qualitative achievements. This includes an increased level of renewable energy technical knowledge among training participants and strengthened collaboration among government agencies on renewable energy policy development.

3 ACTIVITY AREAS

I IMPROVING POWER SECTOR PLANNING

II FOSTERING SUPPORTIVE POLICY FRAMEWORKS

III MOBILIZING FINANCE AND INVESTMENT

IV PROMOTING ENHANCED REGIONAL COLLABORATION

Photo credit:
Unsplash

IMPROVING POWER SECTOR PLANNING

- *Regional*
- *Laos*
- *Thailand*

Photo credit:
Siphachanh Thythavy
Abt Associates/
USAID Clean Power Asia

Efforts to improve data and analytical tools for RE analysis and planning ensured that energy planners and utilities can easily access quality data and effective tools to improve the enabling policy environment and support greater investment mobilization.

At the Southeast Asia regional level, USAID Clean Power Asia worked with the ASEAN Centre for Energy (ACE) and GE Energy Consulting to conduct the ASEAN Interconnection Masterplan Study (AIMS) III, the basis for regional planning and development of the ASEAN Power Grid (APG), with interconnected grid systems to facilitate increased power trade to reduce costs, increase security of supply, and achieve ASEAN's 23% RE goal. Program staff also supported the National Renewable Energy Laboratory (NREL) in developing the Southeast Asia RE Data Explorer, an innovative web-based analysis tool that utilizes geospatial and spatiotemporal RE data to visualize, execute, and support analysis of RE potential under various user-defined scenarios. A database of RE resources, technical potential, and cost information, the tool is available for all 10 Southeast Asian countries and 12 other developing countries around the world. Program staff also supported the implementation of a number of studies to facilitate development of cross-border power trade between Laos and Vietnam.

At the country level, program staff and subcontractor Stockholm Environment Institute (SEI) implemented the Integrated Resource and Resilience Planning (IRRP) initiative to support Lao energy planners and utilities from the Ministry of Energy and Mines (MEM), Électricité du Laos (EDL), and EDL-Generation Public Company (EDL-Gen). IRRP is an extension of Integrated Resource Planning (IRP) and aims to produce least-regrets power development plans (PDP) that meet multiple social objectives in different potential futures.

Program staff and SEI facilitated MEM to identify pathways to integrate renewable energy zones (REZ) into Laos' transmission plans (an extension of IRRP) to address the limitation of RE deployment through conventional transmission planning. To improve power sector resilience in Laos, program staff supported NREL experts to conduct a power sector Vulnerability Assessment (VA) and to develop a Resilience Action Plan for planners and utilities in FY2019. After completing the resilience plan, program staff continued to support NREL to prioritize and select the actions and develop an implementation plan, and also supported NREL to virtually assist the Government of Laos (GOL) during the COVID-19 pandemic to implement selected activities included in the Resilience Action Plan.

REGIONAL

AIMS III Identified need for additional interconnections to increase power trade and facilitate renewable energy investment.

Map credit: Dr. Akbar Swandaru ASEAN Centre for Energy

At the Southeast Asia regional level, from April 2019 to April 2021, program staff worked with ACE and GE Energy Consulting to conduct AIMS III, and had several in-person and virtual consultative meetings with the 10 ASEAN member state energy planners and utility experts, under the supervision of the Heads of ASEAN Power Utilities/ Authorities (HAPUA).

AIMS III builds on the AIMS II study which evaluated a comprehensive plan of capacity expansion and transmission interconnections required to satisfy future regional power demand. AIMS I first proposed a regional transmission network, whereas AIMS II studied the viability of bilateral and economic power exchange through 2025.

AIMS III extended the time horizon of the study through 2040, focusing on increasing the penetration level of variable renewable energy (VRE) in the regional energy mix and promoting both bilateral and multilateral power trade, while maintaining grid stability and reliability.

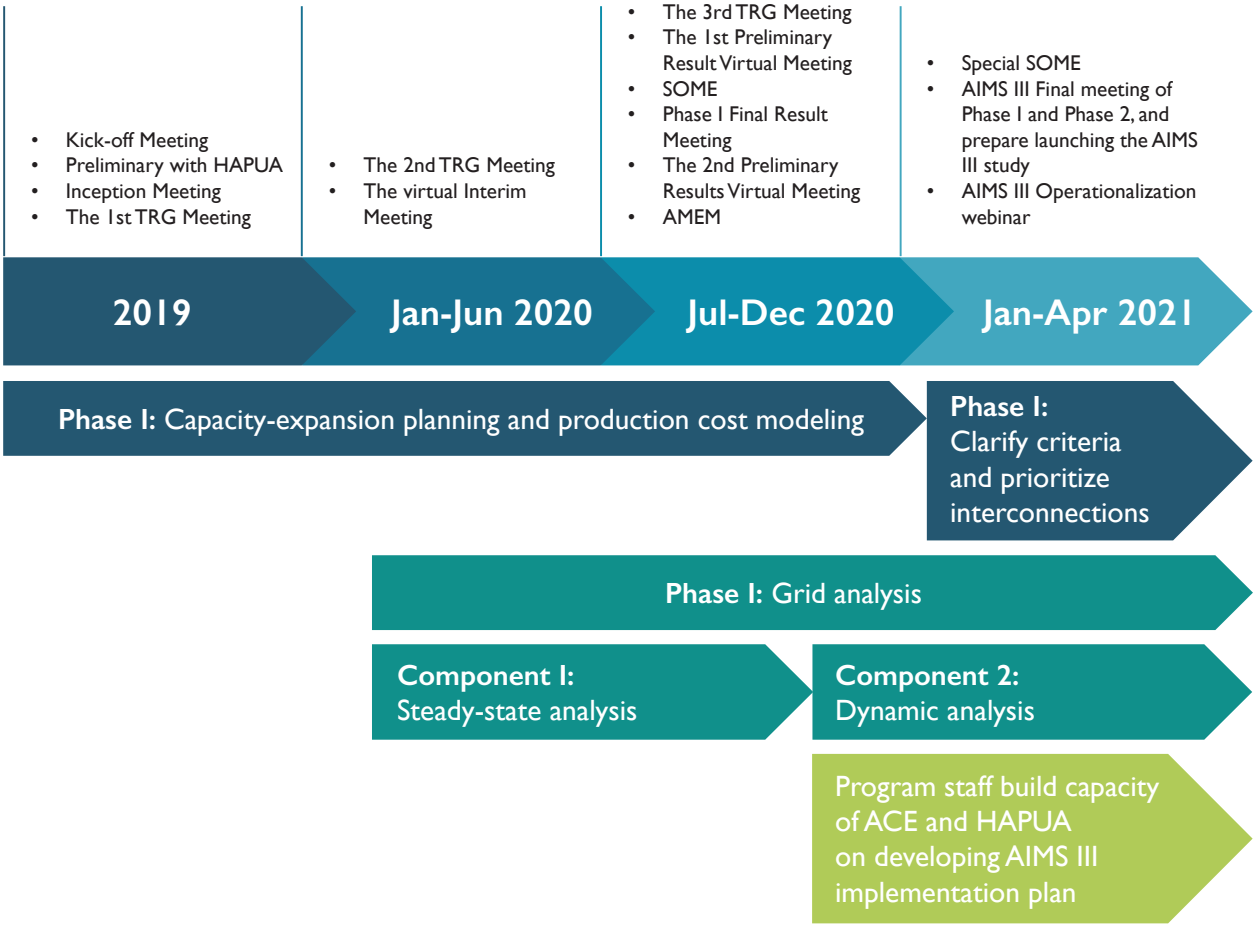
AIMS III included a wind and solar resource assessment which identified 62 high potential project sites. The study found that additional interconnections could at least triple power trade in the region and facilitate greatly increased solar and wind capacity. As a result of the study, at the ASEAN Ministers on Energy Meeting in November 2020, the Ministers increased the target for power sector capacity contributing to the ASEAN 23% by 2025 RE target from 30% to 35%, with the additional 5% expected to come from solar and wind.

To improve planning data and tools at the regional level, program staff supported NREL to collect data to build the Southeast Asia RE Explorer platform to visualize and analyze RE technical potential and to test a beta version of the tool with ASEAN energy policymakers and planners before officially launching it in 2020. USAID Clean Power Asia also supported the implementation of a number of studies to facilitate the development of cross-border power trade between Laos and Vietnam.

1 ASEAN INTERCONNECTION MASTERPLAN STUDY (AIMS) III

Led by HAPUA, AIMS III is the third version of a regional plan to develop the APG, which aims to update the plan for interconnected grid systems and facilitate increased power trade to reduce costs, increase supply security, and achieve ASEAN's 23% RE goal. There are three phases of AIMS III, beginning with Phase 1, Capacity-Expansion Planning. Capacity-expansion planning is a process for analyzing VRE technical potential, identifying optimum addition of new power plants and transmission interconnection capacities to meet future demand in various scenarios and different levels of VRE penetration, and evaluating socio-economic-environmental benefits of different energy scenarios. The last stage of Phase 1 was to conduct a production-cost simulation, which aimed to validate the results by assessing the operating performance of future power systems and understanding the interaction of electricity systems on displaced generation capacity, fuel saved, and emissions avoided by integrating the regional power system with different levels of VRE penetration. AIMS III Phase 1 consisted of several

AIMS III Key Components Timeline



AIMS III Study Scenarios

Cases	Description	Share of vRE
Base case	Represents current energy planning and policy perspectives, they are comparable with ASEAN PDPs	3-4% share of VRE in total generation by 2020, and 8% by 2040
Optimum RE case	Develop optimized thermal (Coal and NG), VRE and inter-country exchange projections	9% by 2025, no long-term target by 2040
ASEAN RE target	Develop optimized thermal and inter-country exchange projections with VRE, which aims to achieve the 23% REmap	10-12% of VRE by 2025 and 15% by 2040
High RE case	Develop optimized thermal and inter-country exchange projections with VRE, which aims to achieve higher ASEAN RE targets	10-12% of VRE by 2025 and 25-30% by 2040

steps, the first to establish a working team to oversee the study, which included a Technical Advisory Committee (TAC) comprised of the HAPUA Secretariat, HAPUA Working Group 1 to 5 representatives, ACE, and program staff. The role of the TAC was to assist development of study objectives, scenarios, and sensitivities; review the modeling team's methods, data sources, assumptions, and other key issues; and interpret results to present to decision-makers. The Modeling Working Group (MWG) was comprised of representatives from GE Energy Consulting and Southeast Asian utility experts, with the responsibility to assemble and validate data from a variety of sources, construct system models, simulate operations under a variety of assumptions, and analyze and verify simulation results.

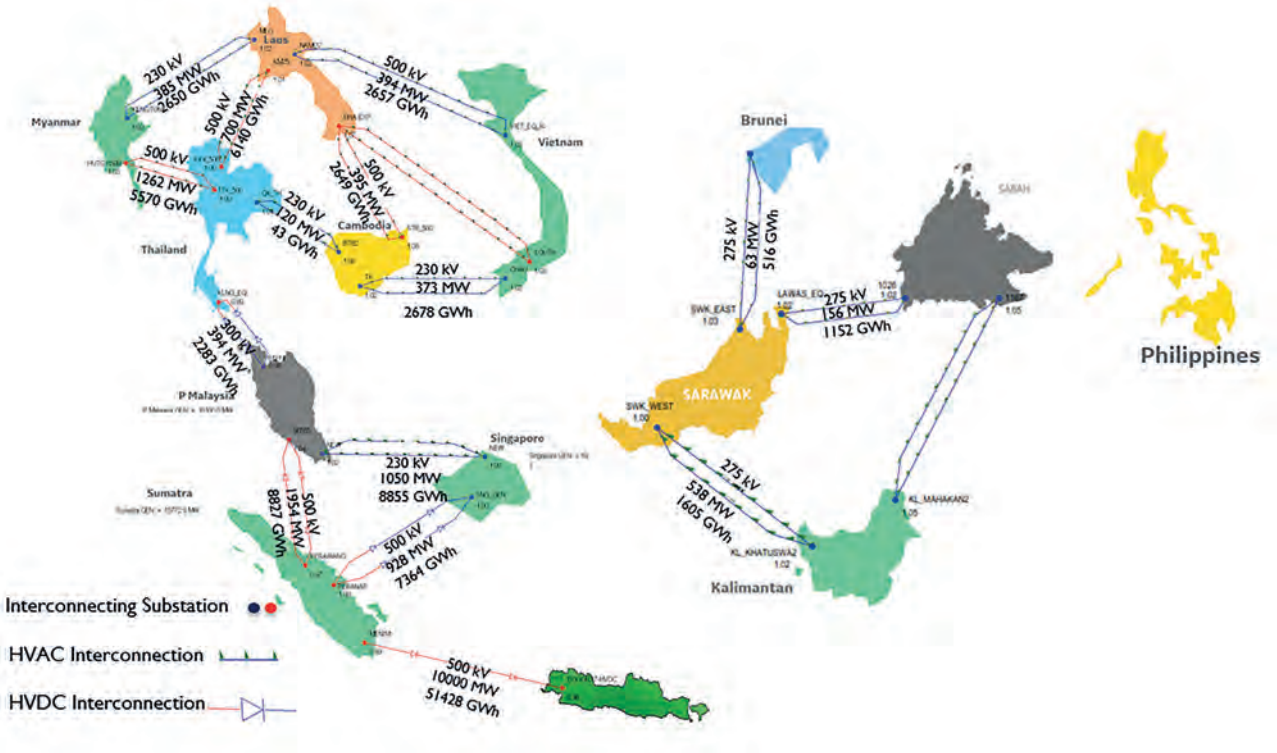
The Technical Review Group (TRG) included representatives from NREL, HNEI, IEA, and IRENA, and provided objective, unbiased technical peer review and guidance at all stages of the study; advised on preliminary and intermediate analytical results and conclusions at key points in the study to effectively guide next step analytics; and reviewed and commented on draft and final reports.

AIMS III Phase 2 was grid analysis, which included developing an ASEAN interconnection grid model, transmission analysis, and stability analysis by using both steady-state (or static) analysis and dynamic simulations. Grid analysis evaluated the overall grid performance in ASEAN based on proposed transmission interconnections and VRE capacities as informed by capacity-expansion planning results from Phase 1.

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

Under the RE target and higher RE target study scenarios, study results proved that it is technically and economically feasible to achieve the 23% RE target by 2025, where VRE accounts for 9% of total energy generation. It is also possible for ASEAN to set higher RE targets, where VRE accounts for approximately 25% of the generation mix achievable by 2040, potentially providing the lowest system cost, mobilizing higher RE investment, and reducing GHG emissions. According to AIMS III Phase 2 grid analysis results, all interconnections proposed by capacity-expansion planning up to 2040 were found sufficient and feasible and there would be no impact on ASEAN power system reliability and stability when integrating VRE to achieve the ASEAN target.

An RE resource assessment on solar and wind technical potential in Southeast Asia showed there is huge potential for solar and wind power in the region, which could be utilized to achieve the 23% RE target by 2025 and establish higher RE targets. It showed that solar technical potential will be over 8,000 GW of installed capacity whereas wind technical potential will be up to 342 GW of installed capacity. The results of economic analyses found that a high RE scenario, with 25% VRE of total generation by 2040, provides the lowest system cost compared to other cases (e.g., lowest production cost despite the highest building cost). From a socio-economic-environmental analysis in the high RE scenario, there will be more than 700,000 jobs created with solar and wind capacity estimates based on project opportunities over the next 20 years. There would be nearly 2 million tons of CO2 emissions avoided resulting from increased VRE shares from 2030-40 in Indonesia, Thailand, Vietnam, and the Philippines, compared to the base case.



LESSONS LEARNED

COVID-19 impacts: Travel restrictions due to the COVID-19 global pandemic that began in February 2020 meant that program staff were not able to travel to most ASEAN countries. Therefore, all AIMS III regional meetings with HAPUA, ASEAN policymakers, energy planners and utilities, GE Energy Consulting, and TRG members became virtual events. Transforming these meetings to a virtual format was challenging and took longer than anticipated due to the highly technical nature of AIMS III. For instance, an Interim Meeting was initially planned as a three-day meeting in May 2020 in Vietnam to present assumptions and the methodology, and preliminary results of capacity-expansion planning in four study scenarios for each ASEAN country. However, translating that format to a virtual setting required the Interim Meeting to take place online over the course of 11 days, which affected other planned activities and the AIMS III timeline.

Data availability: Higher RE scenario planning and analysis requires higher resolution data. For example, the production-cost simulation requires hourly solar and wind data as input into the GE-MAP (a GE simulation software) in different locations in Southeast Asia. Such data was not readily available for all ASEAN countries and thus, it was necessary to hire consultants from AWS Truepower to develop and simulate the hourly data. In another example, dynamic data from Southeast Asian power systems is needed for AIMS III Phase 2, but most countries were not able to provide this type of data. As a result, the modeling team had to develop their own assumptions based on international publications and reports, verify these assumptions with relevant energy planners and utilities before simulation with modeling software—another unexpected expense and delay.

Data collection: Some ASEAN countries required non-disclosure agreements (NDA) before sharing data with ACE and GE Energy Consulting. The NDA process prolonged the data collection process, requiring at least two months for drafting, reviewing, and signing agreements. The process is longer when NDAs involve government entities and state-owned utilities requiring additional approvals and signatures from high-level staff.

ASEAN has no long-term RE target set beyond 2025: ASEAN has set a 23% RE goal in total primary energy supply to be achieved by 2025. However, there is no longer-term RE target beyond 2025. Therefore, it has been challenged to set and determine RE targets for the high RE scenario addressing how much VRE will be in the generation mix by 2040. Program staff, supported by the TRG, worked with ACE to discuss the appropriate VRE penetration level for ASEAN member states in the high RE scenario case and a consensus was reached to achieve a VRE share of 25-30% in the generation mix by 2040.

Harmonization of AIMS III and ASEAN Energy Outlook (AEO6)[1]: During the initial stages of determining AIMS III study scenarios, the scenarios were not harmonized with AEO6 scenarios because both projects had not previously interacted. Program staff proposed to ACE the benefits of harmonizing study scenarios between AIMS III and AEO6 so that both projects could potentially refer to the same information on the current energy plan and compare the VRE share in total generation between the ASEAN RE target case (AIMS III scenario) and ASEAN Plan of Action for Energy Cooperation (APAEC) target scenario (AEO6 scenario).

[1] AEO6 identifies future energy scenarios for 10 ASEAN member states as ASEAN Total Primary Energy Supply. AEO6 was developed by ACE with the support of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

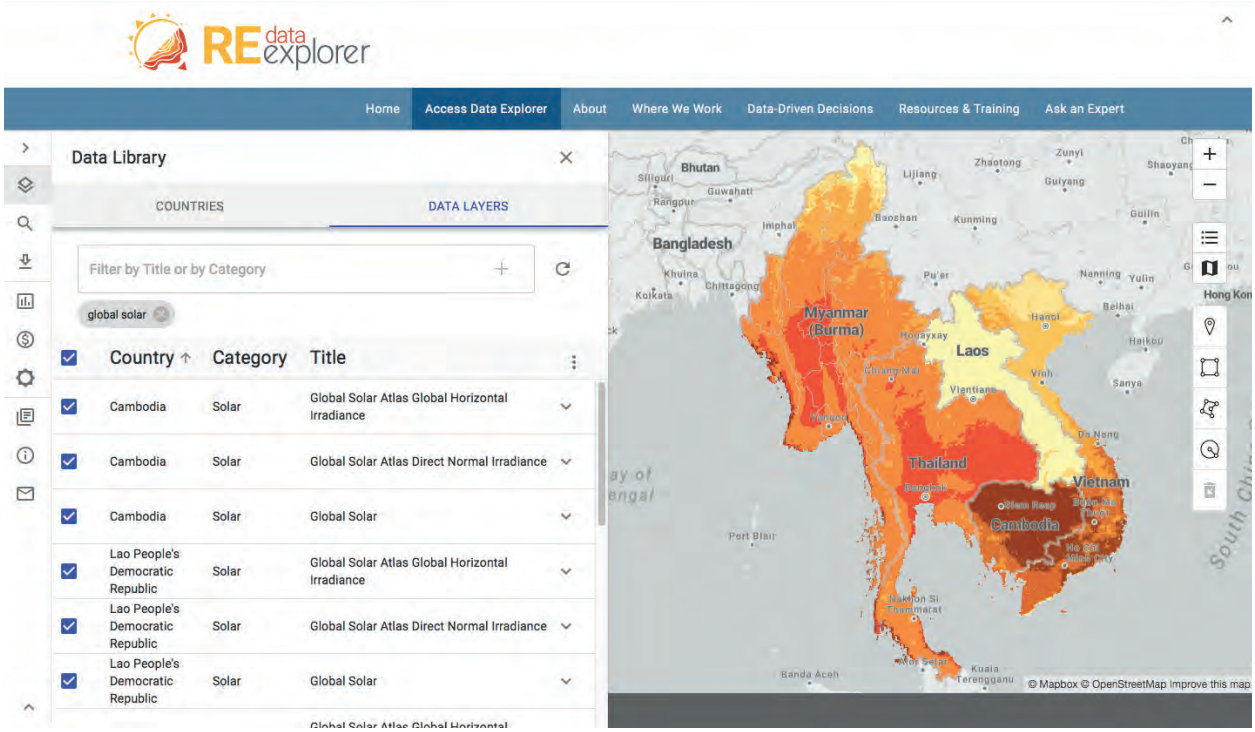
2 IMPROVED PLANNING DATA AND TOOLS

Workshop participants get hands-on practice using NREL's Renewable Energy Data Explorer at a planning workshop in Bangkok in 2017.

Photo credit: Michael Wykoff Abt Associates/ USAID Clean Power Asia

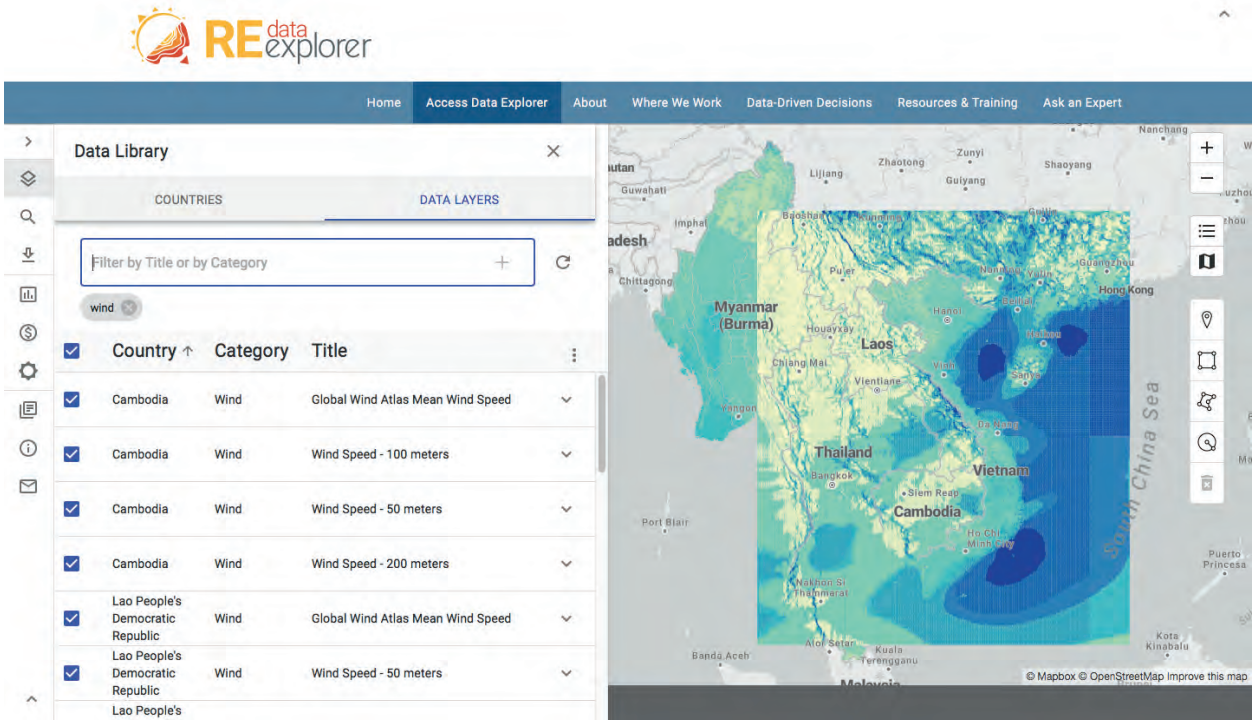
To improve data and tools for RE analysis and planning, program staff supported NREL to develop the Southeast (SE) Asia RE Data Explorer, a tool for visualizing and analyzing RE technical potential, a country's estimated available resource potential to generate electricity by applying the limitations of topographic, environmental, and land use constraints. It assists ASEAN energy planners and energy decision-makers to establish higher RE targets and provides better opportunities to RE developers for future RE projects.

Program staff supported NREL to test a beta version of the tool with ASEAN energy policymakers and planners before launching it in mid-2020. The SE Asia RE Data Explorer is a dynamic, web-based geospatial analysis tool that facilitates RE decision-making, investment, and deployment, bringing together RE resource data and other modeled or measured geographic information system (GIS) layers, including land use, weather, environmental, population density, administrative, topology and grid data. By combining these data sets, decision-makers can explore and synthesize information about RE potential to guide planning, policymaking, and investment. NREL and partners including USAID and other institutions developed the SE Asia RE Data Explorer for all 10 ASEAN member states and another 12 developing countries around the world.



Wind map generated for 5 Lower Mekong countries from RE Data Explorer

Map credit: Pitoon Junthip Abt Associates/ USAID Clean Power Asia



Solar map generated for 5 Lower Mekong countries from RE Data Explorer.

Map credit: Pitoon Junthip Abt Associates/ USAID Clean Power Asia

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

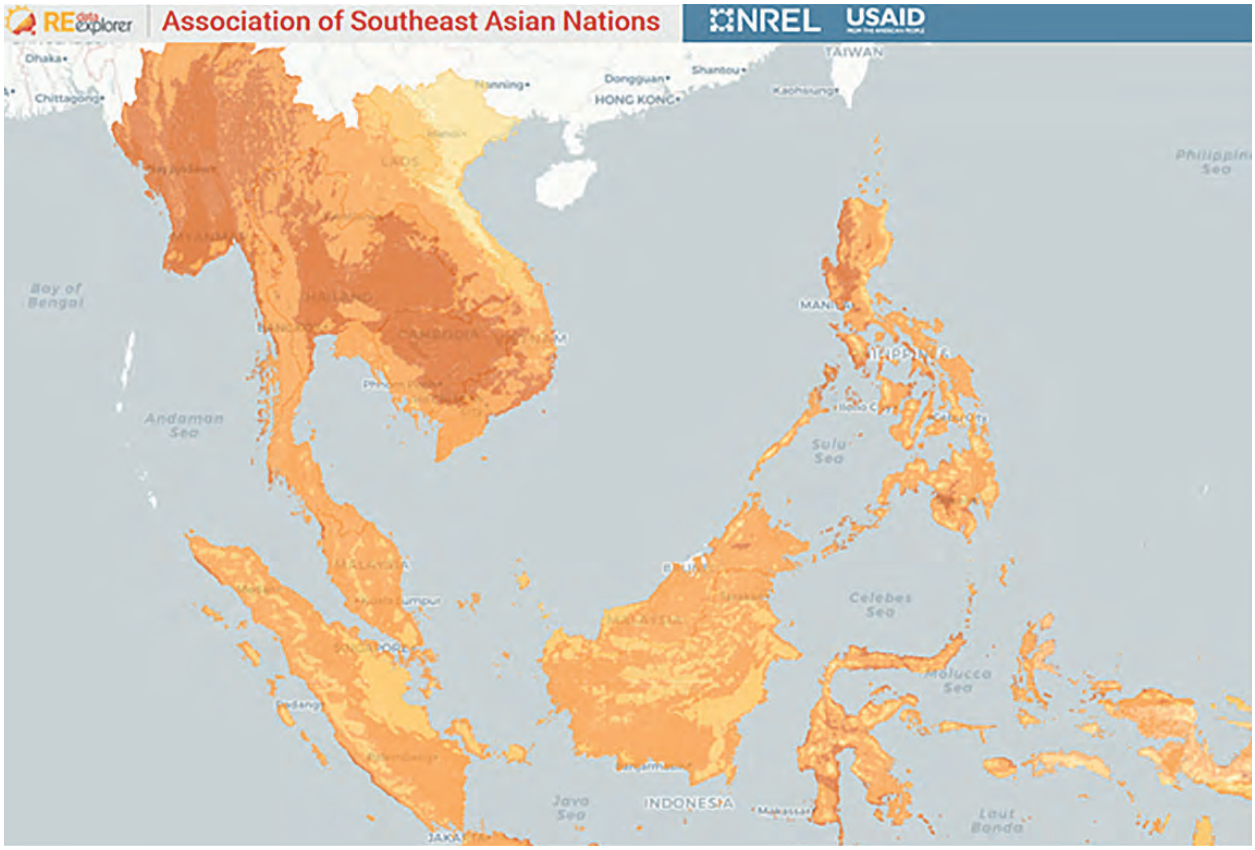
In 2017, program staff collaborated with NREL to collect and input data into the SE Asia RE Data Explorer and document additional data availability and features in the SE Asia RE Data Catalog for Lower Mekong countries. The tool enables users to visually explore spatial data sets for RE resources and other basic infrastructure and to complete technical potential analyses for a set of the RE resources. Program staff identified gaps in available data through comparison with RE analysis priority topics for each country, and prepared guidelines for addressing the gaps, shared and discussed with Lower Mekong stakeholders.

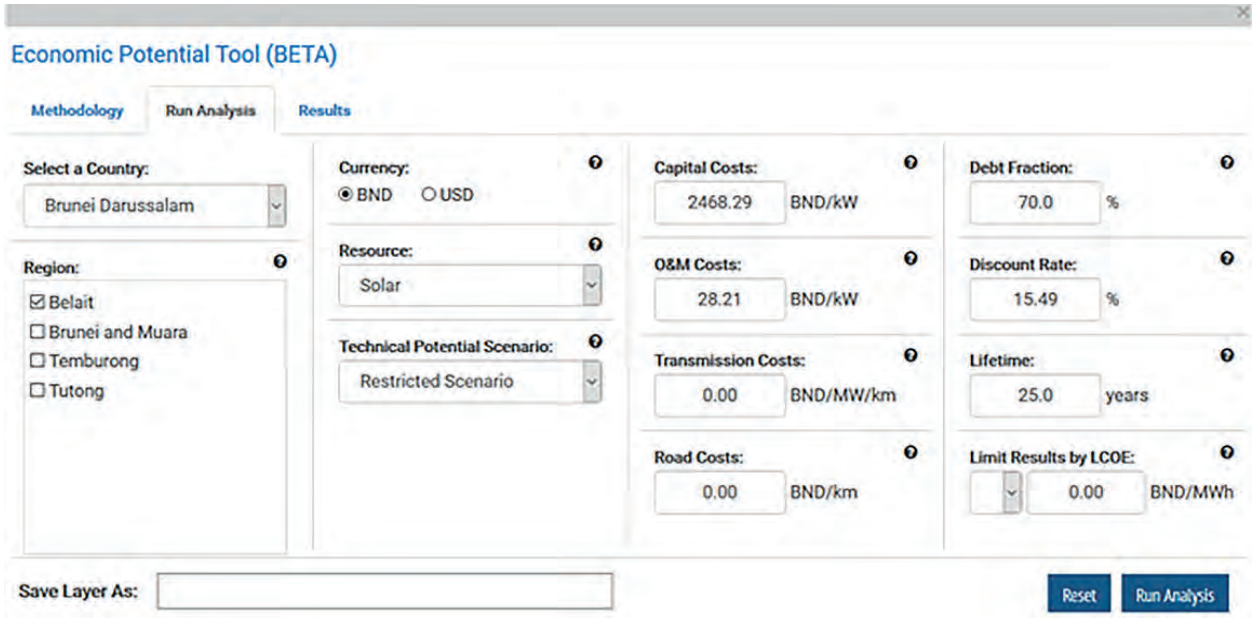
In mid-2017, program staff organized a workshop with two agencies in the Thailand Ministry of Energy (MOE): the Department of Alternative Energy Development and Efficiency (DEDE) and the Energy Policy and Planning Office (EPPO). The workshop introduced the first iteration of the RE Data Explorer, provided training on how to use the tool, and discussed its use in setting RE targets, a key step in Thailand's RE planning process. Program staff and workshop participants discussed the incorporation of Thai power data into the tool for use by Thailand and other Lower Mekong countries in RE target setting and planning. To validate data and train a broader set of regional stakeholders on RE Data Explorer, in June 2018, program staff organized a Renewable Energy Sub-Sector Network (RE-SSN) side meeting in Bangkok to present an overview of the SE Asia RE Data Explorer and the need for developing RE data management plans.

In mid-2019, program staff and ACE presented the new SE Asia Data Explorer platform and a levelized cost of energy (LCOE) tool in Laos and Thailand, and at another RE-SSN side meeting. In addition to the platform and tools, discussions were had on how the technical and economic potential analyses can be used in power sector planning. ACE co-presented the tool and LCOE analysis with NREL at the ***Asia Clean Energy Forum*** in Manila in June 2019 during a session on facilitating RE investment for the private sector. At the end of 2019, program staff and ACE presented the SE Asia RE Data Explorer in a webinar, targeting all ASEAN regulators and utilities.

In January 2020, USAID Clean Power Asia worked with ACE to present the SE Asia RE Data Explorer at a working meeting on AEO6 development in Bangkok, including functionalities for analyzing technical potential and economic analysis and RE resource assessment for AIMS III. During the event, program staff worked with ACE to present preliminary results of RE Data Explorer functionality and ways to use the tool to conduct technical potential and economic analyses using site-based LCOE for energy experts, decision-makers, and power developers in the region.

Program staff successfully completed this activity by encouraging ACE to use the SE Asia RE Data Explorer to conduct RE resource assessment for AIMS III. ACE compared technical potential results obtained from RE Data Explorer and the raw data from the RE technical potential analysis completed by AWS Truepower, which resulted in the incorporation of additional sites into AWS Truepower's RE Resource Assessment. At the end of the resource assessment, ACE and GE Energy Consulting used SE Asia RE Data Explorer to conduct technical potential analysis for four of the 10 Southeast Asian countries, documenting these as case studies on the use of planning tools for AIMS III and AEO6.





USAID Clean Power Asia and the ASEAN Centre for Energy worked with NREL to develop tools for Southeast Asia, used here to calculate solar economic potential.

Map credit: Pitoon Junthip Abt Associates/ USAID Clean Power Asia

Workshop participants get hands-on practice using NREL's RE Data Explorer at a planning workshop in Bangkok in 2017.

Photo Credit: Michael Wykoff Abt Associates/ USAID Clean Power Asia

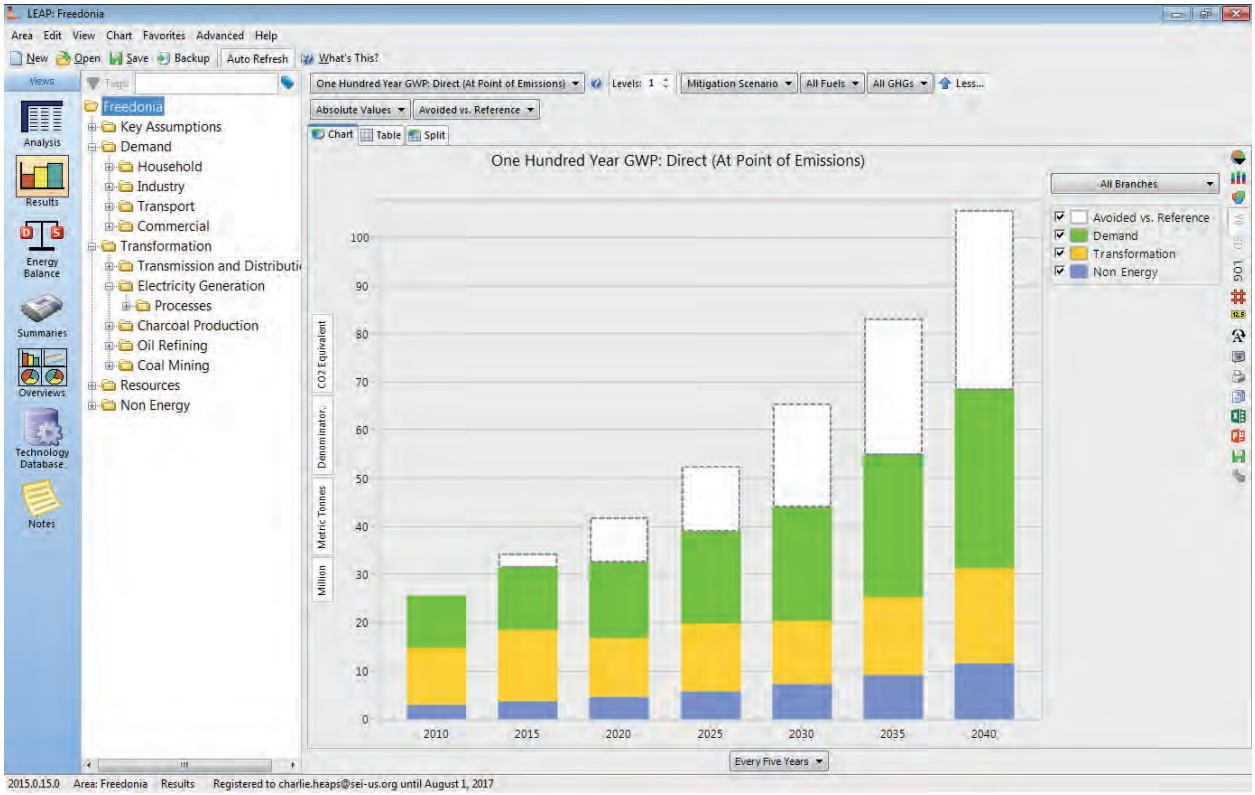
LESSONS LEARNED

SE Asia RE Data Explorer: The main advantage of this tool is that it is easily accessible through web browsers and is open-source and bears no cost to visitors, thereby generating interest not only among energy planners, but also the general public interested in various energy potential and GIS in the region. Another advantage of SE Asia RE Data Explorer is its use in validating the results of the RE resource assessment for AIMS III, providing an opportunity for ACE to compare technical potential results of SE Asia RE Data Explorer with the data from the RE resource assessment under AIMS III. Given the tool's reliability and accuracy, program staff and ACE were able to conduct assessments for four out of ten Southeast Asia countries for AIMS III: Brunei, Indonesia, Malaysia, and Singapore, while the remaining six countries preferred to use their own data rather than the data in SE Asia RE Data Explorer.

Low Emissions Analysis Platform (LEAP): LEAP is a software tool for tracking energy consumption, production, and resource extraction in all sectors of an economy and modeling energy scenarios. The SE Asia RE Data Explorer can directly export data into LEAP through an application programming interface (API), to enable the SE Asia RE Data Explorer to import estimated technical potential to LEAP or vice versa. Still to be evaluated is the question of potential licensing requirements, branding the tool, and other non-technical issues. Program staff and SEI supported NREL to develop a link and a guideline to map results from SE Asia RE Data Explorer to LEAP. NREL completed the API in 2020, which is currently ready for use, and program staff provided support to complete the guidelines for using the API in mid-2020.

Developed by SEI, LEAP was selected for Integrated Resource and Resilience Planning and capacity building in Laos. This graph shows the direct 100-year global warming potential for a sample country.

Photo credit: Pitoon Junthip Abt Associates/ USAID Clean Power Asia



3 LAOS-VIETNAM POWER TRADE

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

Export potential between Laos and Vietnam

572 MW	5,000 MW	17 GW
Current imports from Laos to Vietnam	Targets for power exports by 2030 in MOU between governments of Vietnam and Laos	Import potential from Laos

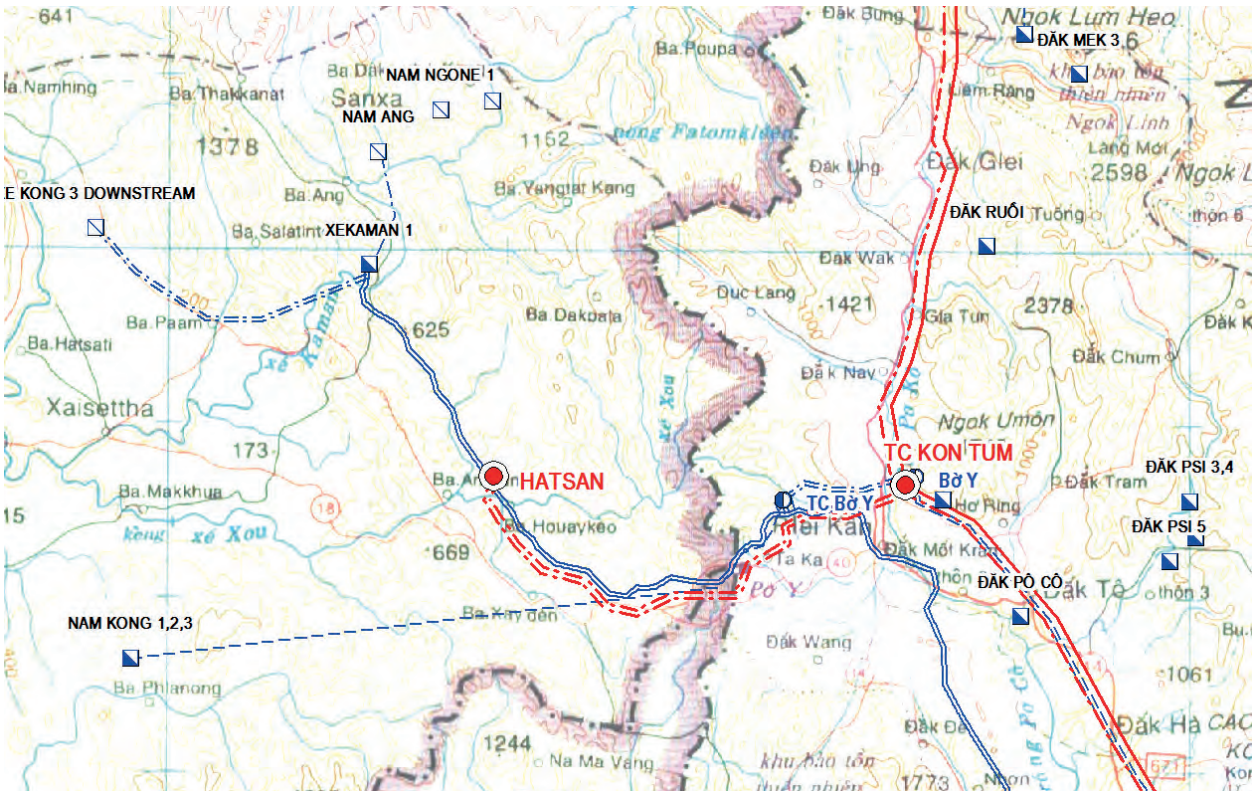
With ample natural resources, Laos has great potential to generate power from RE, including hydro and solar. The country has already attracted considerable private sector investment in power generation in recent years, particularly from hydropower. Multiple hydro projects are under construction and expected to begin operations in the next few years. However, with limited domestic demand and insufficient transmission infrastructure, EDL, the state utility, has limited opportunities to sell the electricity it will be purchasing from the generators.

Because of these limited opportunities, there is an urgent need to upgrade and expand the country's transmission grid, and connect with neighboring countries to export power. So far, the development of such cross-border transmission infrastructure has been slow, largely due to EDL's limited ability to invest in transmission. Several multilateral development banks and international donors have been working with the Lao government to overcome this challenge, aiming to encourage private sector investment in transmission, without burdening government finances.

There is significant potential for power exports from Laos to Vietnam, which is faced with power shortages in the near future. In order to facilitate power trade between the two countries, in 2016, the governments of Vietnam and Laos signed a Memorandum of Understanding (MOU) with targets for power exports from Laos to Vietnam of 1,000 MW by 2020, 3,000 MW by 2025, and 5,000 MW by 2030. In recent years, a handful of hydro projects in Laos have been built for export and are currently selling their entire electricity output to Vietnam through a power purchase agreement (PPA) with Vietnam

There is large potential for RE-based power exports from Laos to Vietnam, providing opportunities for investment in transmission infrastructure.

Photo credit: https://pxhere.com/en/photo/768308



Vietnam's draft PDP8 considers a 500 kV transmission line between southern Laos and central Vietnam

Map credit: Ministry of Industry and Trade, Draft PDP8

Electricity (EVN), the national utility. These projects connect to EVN's power grid via single 230 kV transmission lines built specifically for the projects, while several other Lao-based projects are under development and have signed MOUs and PPAs with EVN to export power via similar single transmission lines.

International studies have suggested the construction of a 500kV transmission line between southern Laos and central Vietnam, which would connect several generation projects and reduce the need for multiple dedicated transmission lines. Such a transmission line would achieve higher economies of scale, allow more projects to sell electricity to Vietnam, and minimize environmental and social impacts of cross-border transmission infrastructure development.

To facilitate private sector investment in cross-border power trade from RE sources, USAID Clean Power Asia supported a U.S. project developer in its efforts to develop a high-voltage transmission line between southern Laos and central Vietnam and a large solar project in southern Laos to connect to the transmission line. In addition to the solar project, the developer aims to have several hydro projects in the area connect to the transmission line to export electricity.

Program support covered the preparation of Environmental and Social Impact Assessments (ESIA) for the two projects, as well as a technical report, which forms the technical component of the feasibility study for the transmission line. Abt Associates subcontracted with two consulting firms in Laos and Vietnam for these studies, with program staff supporting the implementation of the studies, which were submitted to the relevant authorities in Laos and Vietnam. In addition to these studies, USAID Clean Power Asia engaged a financial advisor to prepare detailed financial models for the projects, conduct an assessment of the projects' bankability and major risks, and develop a strategy to bring in additional investors into the projects.

LESSONS LEARNED

Challenges and limitations: As noted, a single 500kV cross-border transmission line would provide several benefits over multiple 230kV transmission lines, due to higher economies of scale and lower environmental and social impacts. Nevertheless, in practice, developing such a line is a lengthy and complicated process, involving multiple stakeholders with different interests and priorities. Because of the innovative nature of the transmission line, procedures for project development and obtaining approvals had not been fully established. Meeting all the authorities' requirements necessitates dedication and perseverance from a developer, because the transmission line has not been included in official plans for transmission infrastructure in Laos and Vietnam.

Consideration of transmission line in Vietnam's PDP8: The Ministry of Industry and Trade (MOIT) of Vietnam is currently preparing the country's 8th Power Development Plan (PDP8), for the period 2021-2030, with a vision to year 2045. In February 2021 MOIT released the draft PDP8, with the objective to obtain feedback before finalizing the plan. The draft considers a 500 kV transmission line from southern Laos to central Vietnam, to be implemented between 2026 and 2030 in case of increased electricity imports from Laos. The consideration of the transmission line in the draft PDP8 is an important step in implementing a 500 kV cross-border transmission line. Nevertheless, the PDP8 is still in draft form and the consideration of the line is provisional. In addition, the project would need the approval and support of the Lao government as well, and it is unclear whether Laos would support a privately developed and owned transmission line to Vietnam. The power transmission sector in Laos has recently been restructured, which may complicate the completion of the line by a private sector company.

For Virtual ACEF 2020, USAID Clean Power Asia developed social media toolkits for cross-promotion of an online side event on June 16 attended by approximately 300 participants.

Image credit: USAID/RDMA

A single high-voltage cross-border transmission line would provide benefits over multiple medium-voltage transmission lines, due to higher economies of scale and lower environmental and social impacts.

LAOS

USAID Clean Power Asia COP Dana Kenney leads a panel discussion at the ***Forum on the Vulnerability Assessment and Resilience Action Plan for the Lao PDR Power Sector*** in May 2019 in Vientiane.

Photo credit: Maythiwan Kiatgrajai Abt Associates/ USAID Clean Power Asia

In FY2017, program staff conducted a data and planning assessment, focusing on Cambodia, Laos, Thailand, and Vietnam. The assessment documented tools and processes for developing RE targets and PDPs and identified potential capacity building needs for counterparts in establishing higher RE targets and integrating these targets into PDPs.

The data and planning assessment was completed at the end 2017, and program staff worked with SEI to develop the IRRP capacity building program, presented to the GOL at the beginning of 2018, as they had demonstrated interest in the proposed program.

USAID Clean Power Asia took the first step in analyzing potential RE zones as an integral part of the IRRP capacity building. The concept of RE zones (REZ) was introduced in the capacity building plan, which describes RE "study areas" as regions in the country that merit further consideration as possible REZs, based on an assessment of their technical resource potential. SEI conducted a geographic information system (GIS)-based analysis of solar photovoltaic, wind, and small hydropower (appropriate for generation capacities of not more than 30 MW) potential across Laos by assembling a variety of publicly available data sources. USAID Clean Power Asia then convened an ***Integrated Resource and Resilience Planning (IRRP) Consultative Workshop on Renewable Energy Zone (REZ) Study Areas and Demand Model Development*** in mid-2018 where staff and subcontractor SEI engaged with a broad group of RE project developers (public and private), planners, and regulators to introduce the concept of REZs and gather input on the commercial viability of REZ study areas.

Supporting the GOL desire for IRRP, program staff introduced a resilience planning process and worked with stakeholders to define the overall objectives, constraints, metrics, and activities of the capacity building program. The IRRP capacity building program aimed to increase the skill of GOL staff on energy planning with the use of planning tools like the LEAP model; to evaluate higher RE levels in power sector planning; and devise low-regrets power development pathways. MEM established two working groups consisting of representatives from MEM, EDL, and EDL-Gen: the Demand Working Group (DWG), in charge of developing demand model of future energy demand, and the Supply Working Group (SWG), involved in developing energy supply to satisfy the projected electricity demand.

Identification and establishment of REZ were key components of the IRRP capacity building program in evaluating the need to either build new transmission lines or upgrade exiting transmission lines in Laos depending on solar and wind potential. REZs considered solar, wind, and small hydro resources, which were more effective and applicable for Laos compared to other RE sources. The REZ study areas were specified in terms of their geography, resource potential, and likely production costs for generation and transmission, promoting the addition of RE generation in the IRRP supply model, and supporting transmission infrastructure to facilitate domestic supply and bilateral power exchanges between Vietnam and Laos. To improve power sector resilience in Laos, program staff worked with NREL experts to support the GOL to conduct a power sector VA and develop a resilience action plan, with power sector risks identified then incorporated into the IRRP models.

1 CAPACITY BUILDING FOR INTEGRATED RESOURCE AND RESILIENCE PLANNING

Initiated in January 2018, the four-phase IRRP Capacity Building Program for Laos focused on devising low-regrets power development pathways that best satisfy a range of planning objectives given multiple uncertainties and possible futures. Analyses required to identify low-regrets pathways were conducted in a long-term electricity planning model for Laos, built on LEAP and used by the IRRP core team to forecast energy demands and supply processes and to explore a range of uncertainties and normative scenarios.

During an in-depth advanced training session in January 2020, and as part of the capacity building program, program staff and SEI introduced a new tool, the Next Energy Modeling System for Optimization (NEMO), linked with LEAP to optimize capacity-expansion modeling with transmission limits. In November 2020, program staff and SEI held a hybrid workshop on IRRP pathways, where participants selected and finalized a set of long-term, low-regrets power development pathways for Laos by using outputs from the IRRP model, generated by LEAP and NEMO, to present results to decision-makers.

In December 2020, program staff and SEI held a mini-conference to share and report on final IRRP results. Participants in Vientiane included the Vice Minister of MEM, promoted to MEM Minister in March 2021, the IRRP core team, and MEM, EDL, and EDL-Gen representatives. The event presented high-priority least-regrets pathways resulting from the IRRP analysis and received feedback from decision-makers on the best path forward as well as proposed RE targets.

IRRP Capacity Building Program Timeline

January 2018 - January 2019

- Formation of IRPP core team
- Stakeholder analysis and mapping
- Specification of IRRP objectives, constraints, and metrics
- Identification of RE study areas

Phase A: Preparation

Phase B: Demand Analysis

February 2018 - January 2019

- Modeling platform selection
- Training on demand modeling
- Constuction of IRPP demand model

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

With regard to IRRP capacity building and the low-regret pathways of the Lao PDP, Option 6 was selected of the top three options as the least-regrets pathway for the Laos PDP as it provided the lowest electricity production costs and better scores on IRRP metrics reflecting social-economic-environment benefits compared to other options. PDP Option 6 would allow Laos to have higher power generation from solar, small hydro, and a small portion of coal to satisfy Laos' energy objectives.

To identify the pathways that are robust given uncertainties and events not in the control of planners, including climate change, as well as the established societal objectives, 345 possible energy scenarios were identified, based on three PDP options suggested by MEM, including PDP Option 3 (hydropower dominates in electricity generation supply); PDP Option 4 (coal dominates); and PDP Option 6 (diversifying electricity generation supply from solar, hydro, and small portion of coal). The Demand and Supply Working Groups, supported by SEI, evaluated all 345 possible energy scenarios and short-listed 30 after considering energy objectives and metrics on economic, social, and environment perspectives.

The establishment of the IRRP core team and internal processes for conducting IRRP analyses strengthened the GOL's ability to conduct long-term power planning in the context of the entire energy sector. Capacity assessments before, during, and after the implementation of the IRRP capacity building program showed evidence of improvement over time in competency areas of analytical techniques essential to IRRP, such as the use of normative scenarios and large scenario ensemble analysis, and LEAP to inform and/or improve the Lao PDP.

December 2018 - June 2020

- Training on supply modeling
- Construction of IRPP supply model

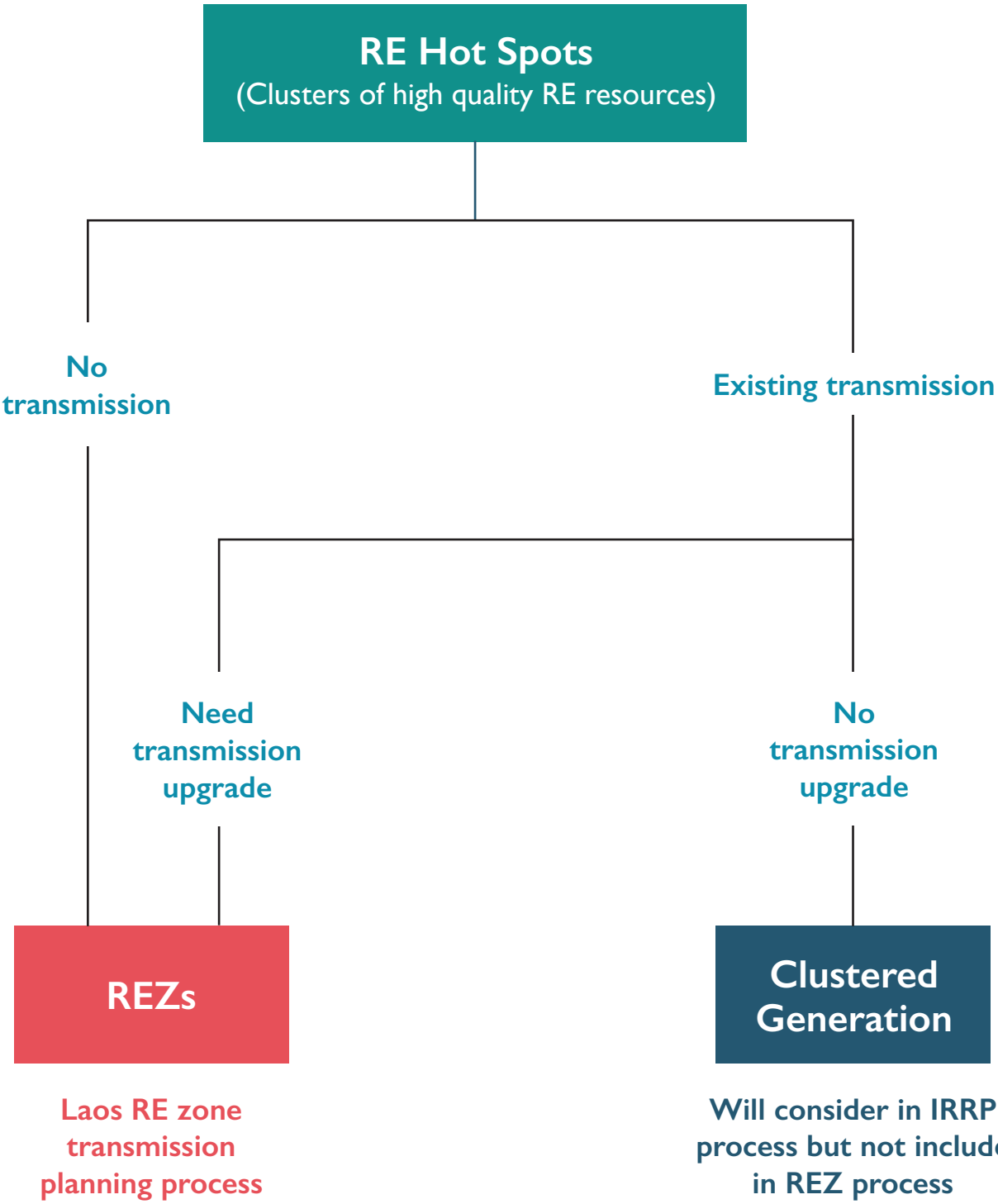
Phase C: Supply Analysis

Phase D: Pathways Analysis

June 2020 - December 2020

- Integrated supply-demand modeling
- Identification of low-regrets planning strategies and policy recommendations

Differences in RE Zone and Generation Cluster Candidates



In addition, based on successfully completing the IRRP, the GOL has institutionalized long-term energy planning by establishing a permanent team from the IRRP core team specifically for this purpose. For Lao RE target setting, according to modeling results, the recommended PDP Option 6 pathway will result in increased solar generation, accounting for 8% of total electricity generation by 2050 and 12% by 2055. These targets are in line with Laos' national RE targets for solar, accounting for 6-8% of the generation mix by 2050.

LESSONS LEARNED

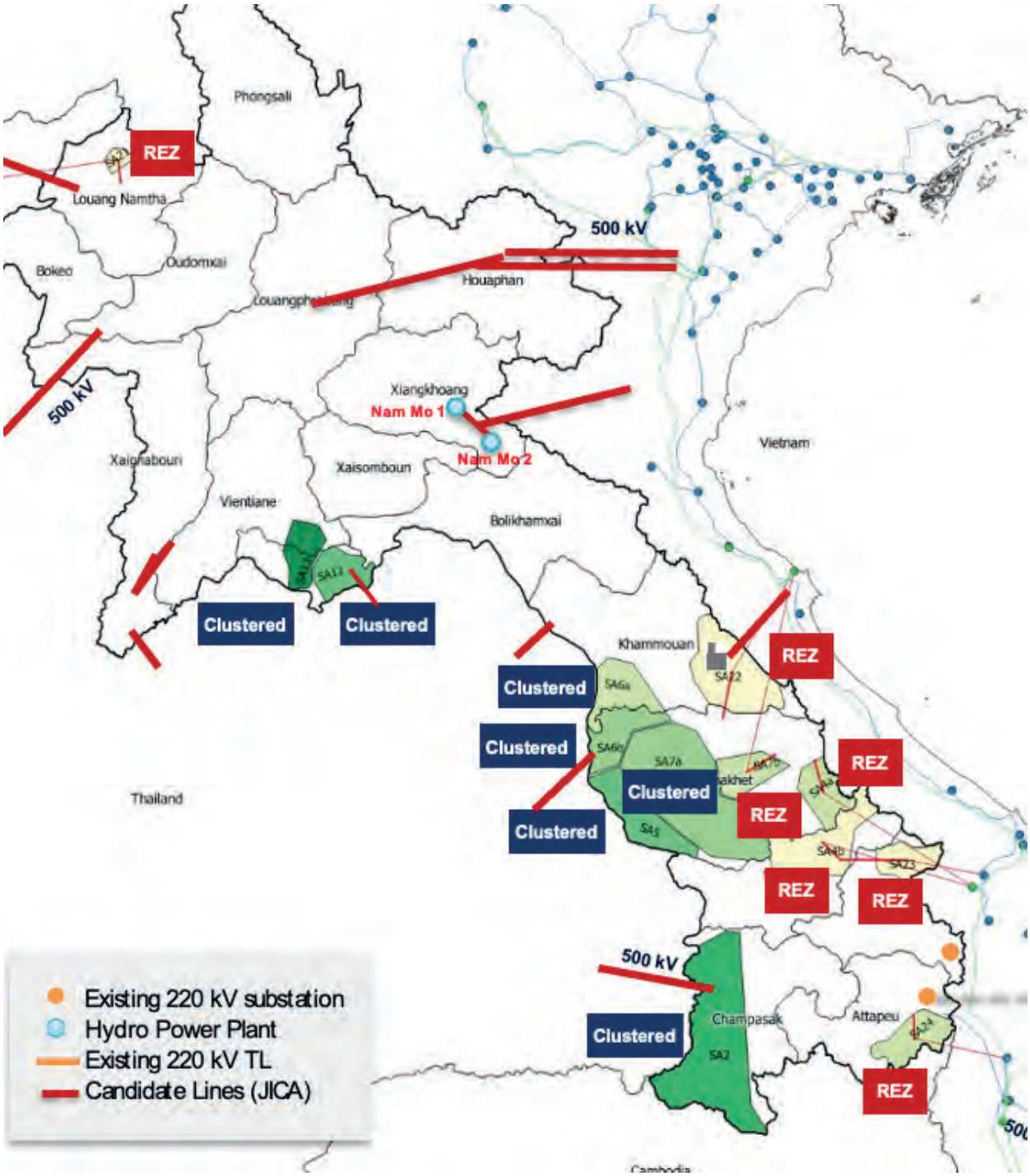
IRRP capacity building program: As a result of the capacity building program, Laos now has the ability to develop a more resilient and strategically planned PDP that takes into account key vulnerabilities and risks while simultaneously providing the foundation upon which to implement a robust regulatory framework to attract private investment and improve power system performance. The IRRP capacity building program also provided energy planners with the appropriate skills to use LEAP and NEMO software, how to incorporate risks to the power sector into planning, and a thorough understanding of the approach to, and benefits of, conducting long-term integrated resource and resilience planning.

COVID-19 impacts: Due to the COVID-19 global pandemic, several events initially scheduled in 2020 were postponed indefinitely due to travel restrictions imposed throughout the region. Some key activities such as the IRRP pathways workshop and mini-conference, originally scheduled for February 2020, had to be postponed and in-person interaction between SEI experts and participants was necessary due to the in-depth training required to learn how to use the IRRP model. However, program staff and SEI adapted and managed the workshop with obstacles of time difference and virtual meeting efficacy, occurring at the end of 2020.

Participants engage in group activities at a vulnerability assessment workshop in Vientiane in August 2018.

Photo credit: Pitoon Junthip Abt Associates/ USAID Clean Power Asia

2 IMPLEMENTATION OF RENEWABLE ENERGY ZONES



USAID Clean Power Asia worked with Laos stakeholders to identify 7 candidate RE zones and 7 generation clusters which were included in the IRRP supply model.

Map credit: Pitoon Junthip Abt Associates/ USAID Clean Power Asia

An RE zone (REZ) is a geographic area enabling development of cost-effective and profitable grid-connected renewable energy. An REZ has high-quality RE resources, suitable topography and land use designations, and demonstrated developer interest, all of which support cost-effective RE development. REZ transmission planning is a process designed to highlight geographic areas that enable the development of grid-connected renewable electricity. This activity aimed to encourage renewables by providing assurance to project developers interested in entering the energy market. As a result, REZ planning aims to shorten project timelines to appeal to the interests of private developers, compared to the longer periods typical of projects under the purview of governments or regulatory authorities.

The IRRP capacity building plan describes RE "study areas" as regions in the country that merit further consideration as possible REZs, based on assessments of their technical resource potential. To complete this activity, SEI used GIS to conduct an analysis of solar photovoltaic, wind, and small hydro potential (appropriate for generation capacities of not more than 30 MW) across Laos by assembling a variety of publicly available data sources. The assessment quantified the remaining potential of wind, solar, and small hydro. Program staff distinguished between two broad types of study areas: those located near existing or planned transmission infrastructure (generation clusters) and those that are not (candidate REZs). The reason for the distinction was to define a candidate REZ, which necessitates the development of new or upgraded transmission lines.

Program staff consulted with RE developers, EDL, and other stakeholders during a consultative workshop on study areas and demand model development in mid-2019 to prioritize and select the most promising areas as candidate REZs. Program staff and SEI included candidate REZs as supply options in the supply-side and integrated supply-demand modeling in the IRRP capacity building program. Building on the technical potential analysis identified and characterized candidate REZs in Laos, this work was integrated into the IRRP capacity building program and evaluated REZs as supply options in IRRP.

The Japan International Cooperation Agency (JICA) was assisting Laos by conducting a medium-term plan for the power sector, focused on domestic and export needs, and resulting in a detailed plan for the transmission system. In order to ensure the same transmission plans were included in the IRRP analysis, USAID Clean Power Asia collaborated with JICA to share and incorporate data from their study into the IRRP analysis and to coordinate transmission analyses to ensure transmission requirements serving candidate REZs were considered in their planning. Integration of supply and demand planning to identify least regrets scenarios completes the IRRP, which provides the foundation for a long-term PDP. In January 2020, USAID Clean Power Asia, SEI, and JICA co-hosted a workshop in Vientiane to share lessons learned on improving power sector generation and transmission planning. Representatives from the GOL and international donors attended the workshop to review proposed REZs and associated impacts on transmission plans. During the event, updates on study projects on power generation and transmission planning; IRRP supply model (which incorporated transmission lines suggested by JICA based on the Laos Power System Master Plan report); and REZ impacts on transmission plans were presented.

Based on JICA's study and MEM's recommendation, program staff and SEI initially prioritized the REZs for analysis in the IRRP transmission options using the criteria that the top priority areas would share a border with Vietnam for future cross-border trade, where the generated electricity could be used for domestic consumption and/or export to a neighboring country.

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

Amount of solar and wind technical potential

over

175,000

GWH

of solar energy generation potential available from candidate REZs and clustered generation

over

11,000

GWH

of wind energy generation potential available from candidate REZs and clustered generation

To promote inclusion of RE zones in transmission planning in Laos, two study areas (SA), SA4a in Savannakhet and SA22 in Khammouan, were nominated as final REZ candidates, and presented to the GOL during the mini-conference. Both areas are expected to connect to the domestic grid and interconnect with the Vietnam grid for electricity export, potentially increasing domestic electricity supply and electricity exports to Vietnam. However, the GOL has not currently committed to include both REZs in the PDP since electricity demand in Laos will not significantly increase in the next 10 years and it also depends on electricity needs from Laos' neighboring countries. It is necessary to conduct further studies before incorporating REZs into the new PDP, including a full reliability analysis, detailed feasibility study, and Environmental and Social Impact Assessment on proposed transmission lines before approving transmission planning.

The GOL now has the foundation to continue evaluating REZs, incorporating them into their IRRP process, and including them into the system in the future. In addition, coordination between USAID and JICA was enhanced, and will continue between their new program and the USAID Laos Energy Security program.

LESSONS LEARNED

COVID-19 impacts: Activities pertaining to REZs were already in the final phase when the COVID-19 global pandemic began. To complete the activities, a component of REZ—transmission plan designation—had to occur synchronously with the IRRP pathways workshop, postponed from February to November 2020. The delay in completing the activities was mainly due to travel restrictions imposed across the region, which affected all in-person activities. Program staff and working groups had to adapt and eventually held the workshop and mini-conference virtually. The working group in Laos joined the event in-person, while program staff and SEI participated virtually.

Lao transmission planning and power import policy of other countries: Inclusion of REZs in Laos' transmission plans will not only improve the Laos power sector, but also will benefit neighboring countries reliant on Laos power exports to meet growing domestic demand. To facilitate power import and develop and/or extend interconnection and electricity generated, REZs will rely on the power import policy of Laos' neighboring countries. For example, Vietnam has agreed to buy 600 MW of wind power from Laos, from an area in Attapeu, one of the REZ candidates; the project development agreement (PDA) for the project was approved in 2020, though Thailand and Cambodia do not currently have policies on importing renewable power.

In-depth discussion at an IRRP training workshop on RE zones in January 2019 in Vientiane.

Photo credit: Pitoon Junthip Abt Associates/ USAID Clean Power Asia

THAILAND

Aerial drone view of wind turbines generating electricity in Huai Bong, Nakhon Ratchasima, Thailand.

Photo credit: theevening via iStockphoto

Thailand was a pioneer among Southeast Asian peers in stimulating RE development and allowing private companies to sell RE-based electricity to the national grid. The government provided the first incentives as early as 2002, and in 2006, introduced a so-called 'adder' tariff, which is paid in addition to the base tariff for the first seven years of project operations.

The introduction of the adder led to a sharp increase in RE project development over the subsequent decade. In 2020, renewable energy accounted for 10% of total electricity supply, and the country's installed RE capacity included 2.9 GW of solar, 1.5 GW of wind, and 3.3 GW of biomass power, of which 1.9 GW is selling to the grid and the remainder for onsite consumption by agro-industries.

Thailand's electricity development is guided by a PDP, prepared every few years by the MOE. The Alternative Energy Development Plan (AEDP), prepared by the Department of Alternative Energy Development and Efficiency (DEDE), details plans specifically for RE for electricity generation and heat applications. While the latest PDPs and AEDPs have maintained high long-term targets for RE deployment, in the last five years, Thailand experienced limited growth in installed capacity, due to power system overcapacity and concerns over the effect of high RE tariffs on overall electricity tariffs.

Thailand's power sector is heavily dominated by gas-fired power generation, supplying 55% of total electricity in 2020. While the share has been decreasing somewhat over the last few years, the country will continue to largely depend on natural gas for electricity, with the addition of 5 GW of new gas-fired power capacity by 2023. This additional capacity means that the power system has overcapacity and a high reserve margin, which has been in the range of 40%, compared with the internationally accepted level of 15%. This means that there would be limited opportunities for additional RE capacity in the next few years. To overcome some of the challenges faced by the RE industry, USAID Clean Power Asia engaged with government agencies and the private sector, with a focus on wind power.

1 UTILITY-SCALE WIND IN THAILAND

Thailand has considerable potential for additional wind power but currently lacks a mechanism for implementing new projects.

Photo credit: Silezkiy via Elements Envato

Thailand has moderate potential for wind power development, estimated at 5-10 GW, and over the past decade, the country has made considerable progress in the development of wind power with the current total installed capacity at 1.5 GW, consisting of 32 wind projects. These projects sell electricity to national utilities under long-term power purchase agreements (PPA), signed between 2008 and 2015. However, since 2015, Thai energy authorities have not awarded any new wind power projects.

While most solar projects can be built in less than a year, wind energy projects require a significantly longer timeline for project development. These projects require at least a year of onsite wind measurements, time needed to sign the PPA and arrange financing, and one to two years of construction. Thus, consistent long-term planning by energy authorities is crucial for a country's wind power development.

Thailand's electricity development is guided by the PDP, and in early 2019, the government approved the latest PDP, which included an additional 1,485 MW of wind power by 2037 but did not foresee any new wind capacity before 2034. In other words, for the next 10-15 years, developers would have no opportunity to develop new projects and then have a sudden ramp-up in capacity within a three-year period.

One of the reasons contributing to the lack of planning for wind power was

its perceived high costs among Thai policymakers. Given the rapid growth of RE over the last decade, the Thai government is cautious about the effect of high tariffs for renewables on the overall electricity tariff for consumers. Existing wind projects in Thailand receive tariffs in the range of 6-8 THB/kWh. To limit the impact of RE growth on consumer energy tariffs, the MOE announced in 2017 that Thailand would not contract any new generation from RE in the next five years, unless projects would be able to generate at the wholesale tariff level (approximately 2.4 THB/kWh).

In the last few years, the cost of wind power generation has decreased considerably, due to the development of new technologies for low wind speeds and the rapid growth of wind power worldwide. Analysis by the Thai Wind Energy Association (ThaiWEA) showed that new wind projects in Thailand would be able to generate power below 3 THB/kWh, while also bringing considerable benefits to local communities through improved infrastructure, job creation, and quality of life improvements.

Thailand's electricity development is guided by the PDP, and in early 2019, the government approved the latest PDP, including an additional 1,485 MW of wind power by 2037.

USAID/RDMA's Deputy Mission Director, Jeffrey Spence, and the Thai Ministry of Energy's Inspector General, Dr. Twarath Sutabutr, delivered opening remarks at the ***Thailand Wind Energy Roundtable*** in Bangkok in December 2019.

Photo credit: Kwanta Norkum Abt Associates/ USAID Clean Power Asia

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

By the numbers

0

Original target for additional wind power (MW) by 2024

270

New target for additional wind power (MW) by 2024 in revised PDP

In August 2019, the Thai government appointed a new Minister of Energy, who publicly announced the ministry's plan to revise the PDP and increase the share of RE in the new plan. Considering the ongoing PDP revision, the intention to increase the share of RE, and ThaiWEA's efforts in lobbying energy agencies, program staff seized the opportunity to work with ThaiWEA and the Global Wind Energy Council (GWEC) to organize a high-level dialogue with Thai energy officials on how wind power can contribute to Thailand's sustainable energy future and economic development. A wind energy roundtable took place in December 2019 and brought together representatives from Thai energy agencies and the wind industry to discuss the potential for a higher wind energy target in the PDP. Representatives from the government included high-level officials from MOE and other relevant agencies while representatives from the wind industry were wind turbine suppliers, local and international project developers, and consulting companies.

Prior to the roundtable, ThaiWEA and GWEC, with inputs from program staff, prepared a position paper on wind energy potential in Thailand and presented the paper during the event. The roundtable provided a platform for a highly interactive and frank discussion between government and industry representatives to share their respective views and concerns, and the event contributed to enhanced understanding of each party's needs and concerns, encouraging further discussions on ways to promote investment in wind energy in Thailand in the near term.

A few months after the roundtable, the MOE announced plans to accelerate procurement of wind energy in the next five years. During a public hearing on the new PDP in February 2020, MOE presented revised targets for RE; the target for wind power is 90 MW each year between 2022 and 2024, for a cumulative amount of 270 MW. This was later included in the revised PDP approved in October 2020. While the total target for wind power in the revised PDP did not increase, the inclusion of wind procurement in the next few years is a positive development since the previous PDP did not set forth any new wind procurement until 2035, while also providing a perspective for a higher wind target in future PDPs.

LESSONS LEARNED

High-level dialogue to facilitate engagement between government and private sector: A high-level dialogue like the Thailand wind energy roundtable was an effective mechanism to engage with government agencies on the consideration of renewable energy targets in national PDPs. Through the high-profile nature of the USAID-supported event, the roundtable attracted high-level representation from multiple Thai energy agencies. This allowed government and industry representatives to exchange views and concerns, and explore how concerns and requirements from the government side related to the concerns and needs from the private sector wind industry. For example, the government aims to achieve low tariffs for wind power, but the wind industry requires a clear and consistent pathway for developing wind projects, so that companies can establish local manufacturing facilities and build local capacity, which help to drive down costs and provide additional economic benefits.

Political will and lobbying efforts: While the roundtable contributed to the revision of the PDP, a one-off event like the roundtable is insufficient to influence plans and policies that guide longer-term market trends. First, there needs to be a clear opportunity and indication of a willingness to regularly reevaluate and revise plans while setting clear long-term market trends, as was the case with the nomination of the new energy minister and his intention to revise the PDP and raise the share of RE. In addition, intense and direct lobbying plays an important role. A few months before the event, ThaiWEA elected a new president, who in the run-up to the roundtable held multiple meetings with several agencies to the share the latest information on the cost of generation and local benefits of wind power. This laid the groundwork for attendance of high-level government officials and re-consideration of wind power in the revised PDP.

Potential of wind power in Thailand's power system: While the overall target for wind energy in the revised PDP did not increase from the previous version, the new plan recognized the potential for wind to effectively contribute to Thailand's power system. The near-term procurement plans provide the opportunity for the development of new wind projects in the next few years, and a successful procurement process and project implementation would provide perspectives for further revisions of the PDP and the incorporation of additional wind projects in the longer term. However, since the approval of the revised PDP, the Ministry of Energy and the Office of the Energy Regulatory Commission (OERC) have not announced which procurement mechanisms will be used for the 270 MW, and due to the relatively long development timeline for wind projects, the procurement process would need to start by mid-2021 to implement the first 90 MW in 2022.

> High-level dialogue is an effective mechanism to engage with government agencies, though plans should be regularly re-evaluated and revised based on market trends.

II FOSTERING SUPPORTIVE POLICY FRAMEWORKS

- *Utility-Scale*
- *Distributed Generation*
- *Advanced Technologies*

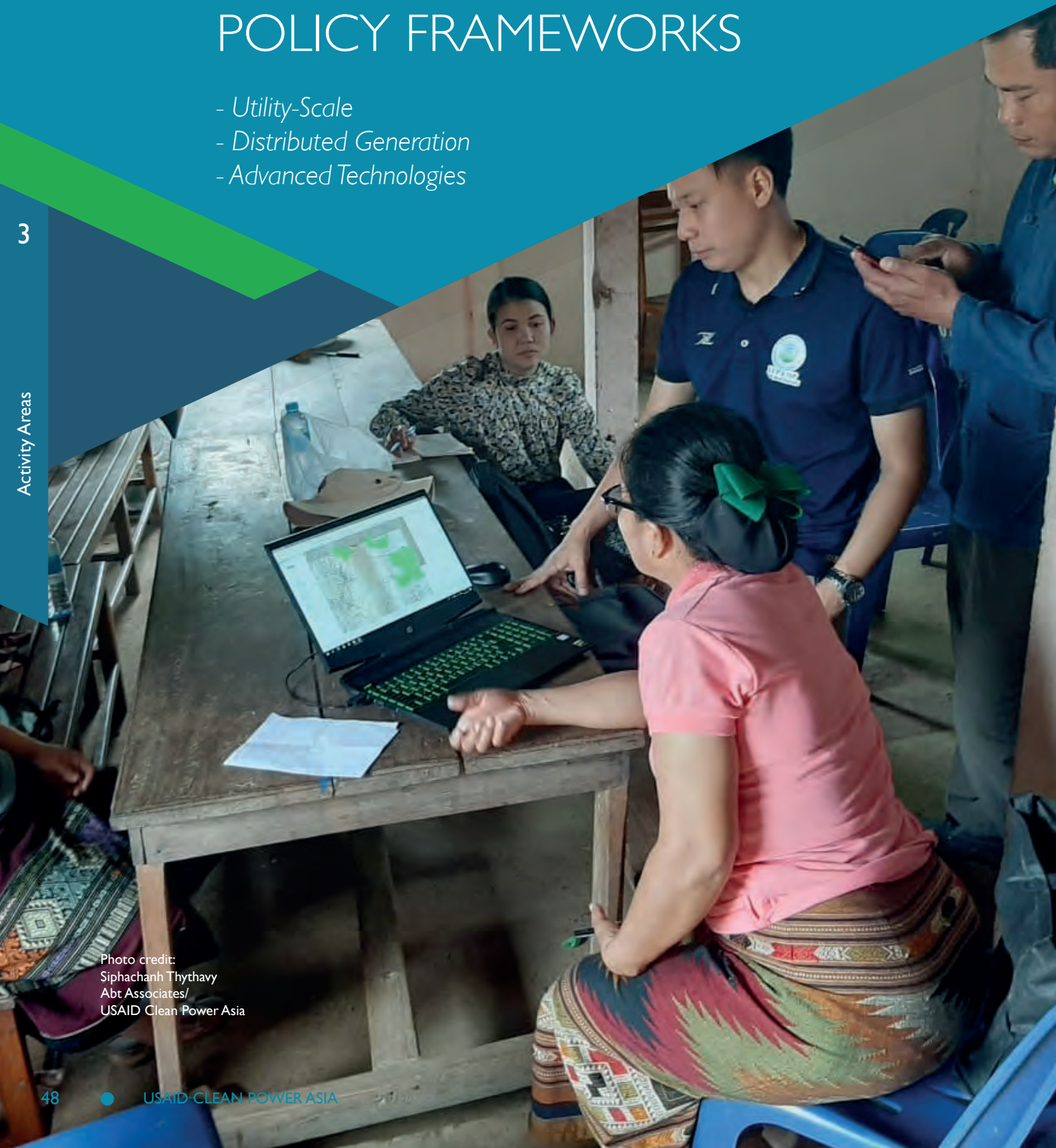


Photo credit:
Siphachanh Thythavy
Abt Associates/
USAID Clean Power Asia

Many countries in Southeast Asia have set RE targets including an aspirational regional target of 23% RE in total primary energy supply by 2025. To reach that target, each country has adopted some form of national policy to promote and incentivize RE deployments at varying stages of advancement, and USAID Clean Power Asia supported efforts to foster an environment conducive to the greater development and deployment of grid-connected renewable energy.

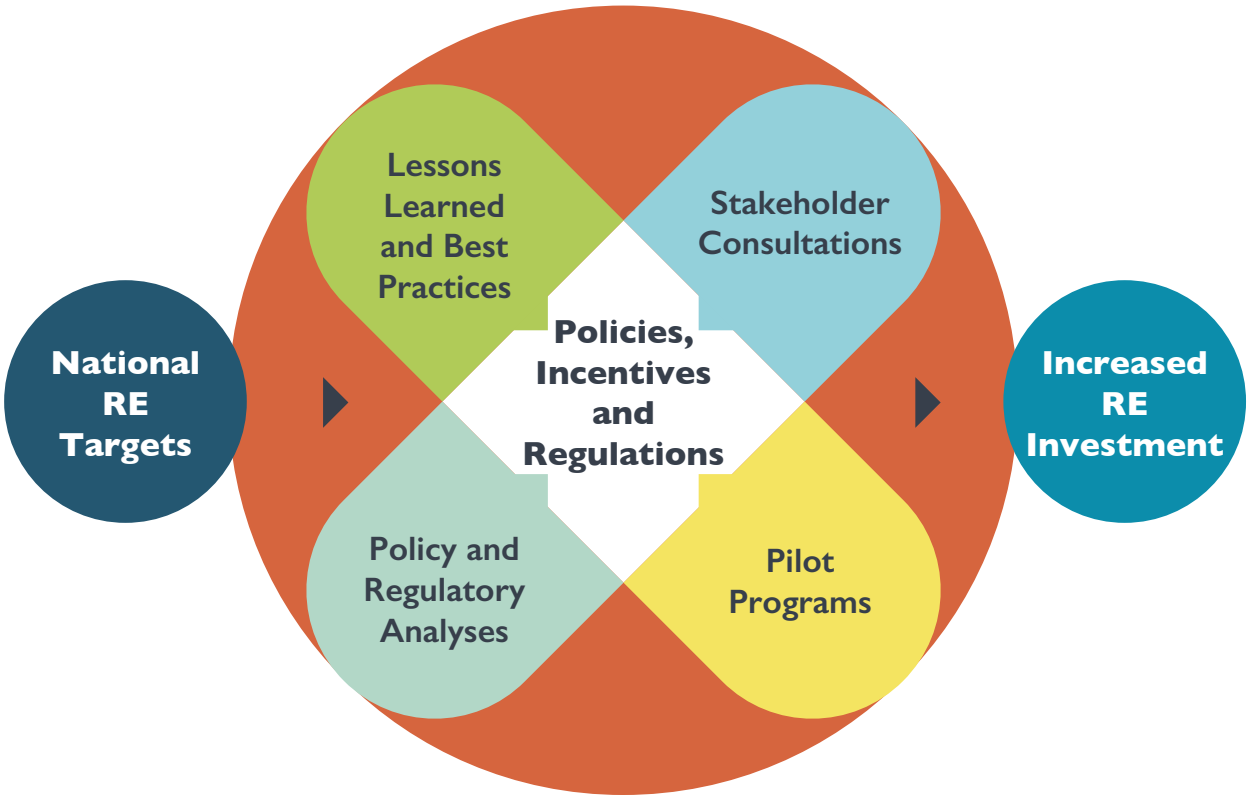
Throughout the region, diverse stakeholders and international and regional experts regularly convened to exchange lessons learned and best practices to institute frameworks that reduce risks and encourage greater RE investment. Successful approaches were then documented and shared widely to promote the scale-up of renewable energy while encouraging pilot program development.

With the rapidly declining cost of technologies, especially for solar PV, wind, and battery energy storage, coupled with the increasing maturity of the energy sector as a whole, policies that support the deployment and integration of renewables are evolving, requiring novel ways to promote deployment and supplement outdated traditional instruments. As countries progress toward low carbon solutions and economies, USAID Clean Power Asia's support for policy frameworks included developing appropriate policies and incentives, regulations and standards, and evaluating the policy and regulatory impacts on key stakeholders to promote an enabling environment conducive to RE development that eliminates technical and regulational barriers.

Certain countries such as the Philippines, Thailand, and Vietnam are more advanced in terms of maturity and comprehensiveness of RE policies when compared to Laos and Cambodia. Several RE policy incentives are currently being implemented in the region, including feed-in tariffs (FIT), self-consumption schemes, net-metering, tax incentives, and financing schemes, as well as market-based mechanisms like competitive energy procurement. Many countries are considering updating regulations to improve technical requirements and facilitate more RE interconnection to the grid, while transparently and competitively driving costs down. Therefore, it was imperative to tailor the program's policy and regulatory support according to each country's need as well as to promote knowledge exchange, lessons learned, and best practices regionally. Over the past five years, USAID Clean Power Asia strategically approached policymakers and relevant counterparts and successfully supported 16 policies and/or regulations as well as facilitated training for 370 people (87 women/283 men) across Southeast Asia

USAID Clean Power Asia took each country's varying needs and designed the interventions and focus in three groups of policies/regulations: utility-scale, distributed generation, and advanced energy technologies. Utility-scale interventions focused on policies and regulations for RE technologies connecting to the grid at higher voltage level and are governed by operational requirements of the utility. For instance, a 20 MW solar project connecting to a utility-owned and operated substation would be considered utility-scale. Distributed generation or customer-related intervention deals with policies and regulations that have direct impact on consumers or customers and distribution utilities serving the customers, such as a distributed photovoltaics (DPV) net-metering program and distribution grid connection requirements. Lastly, interventions in advanced technologies aimed to address policy implications from emerging and disruptive technologies like battery energy storage.

UTILITY-SCALE



Typically, RE generation is categorized according to the size and grid interconnection as either utility-scale or distributed generation, so this section covers USAID Clean Power Asia's policy and regulatory interventions for utility-scale RE generation. Generally, RE projects that have comparatively larger installed capacity, contractual obligation to supply electricity to the grid, and connection to a substation or transmission networks are considered utility-scale.

Unfortunately, particularly for solar, there is no consensus on what "comparatively larger" size entails as different entities have defined varying capacity threshold for utility-scale projects. For example, the Solar Energy Industries Association, the leading trade group for solar developers in the U.S., defines utility-scale solar as greater than 1 MW while the National Renewable Energy Laboratory (NREL) chose a 5 MW threshold. Regardless of size and technology, utility-scale RE projects will require contractual obligations such as a power purchase agreement between the generator, or seller, which is the RE plant, and the offtaker, or buyer, typically a local utility.

Within Southeast Asia, utility-scale RE projects are dependent on government policies mandating inclusion within the country's PDP and governmental announcements to procure energy, particularly for Thailand and Vietnam. Larger capacity projects (>90MW for Thailand) with PPAs are listed individually in the PDP while smaller projects are grouped by technology to inform the country's power supply and demand. The development of the PDP is mainly for energy planning purposes. Laos, and to a certain extent Cambodia, prior to the recent solar auction conducted by ADB in September 2019, rely heavily on bilateral negotiation between the project developer and relevant government entities to develop RE projects. Therefore, stakeholders involved with utility-scale policies and regulations include utilities, system operators, and government authorities. The private sector has a more limited role to influence policymaking which is typically done through a public consultation process.

Influencing utility-scale power development policies and regulations, USAID Clean Power Asia focused on supporting and promoting competitive procurement as a transparent mechanism to procure RE and to lay the regulatory foundations to enable and facilitate RE deployments. USAID has been at the forefront of RE auctions around the world from Mexico, Senegal, Zambia, Kazakhstan, Colombia, India, and others, and continued with USAID Clean Power Asia activities in the region with country-specific support in Laos and the Philippines, as well as broader regional promotion of auctions. With varying degrees of advancement in RE for each country in the region, USAID Clean Power Asia's efforts aimed to support appropriate utility-scale RE regulations through stakeholder consultations and addressing their needs to provide a sufficient foundation and build the capacity of relevant personnel.

1 COMPETITIVE PROCUREMENT

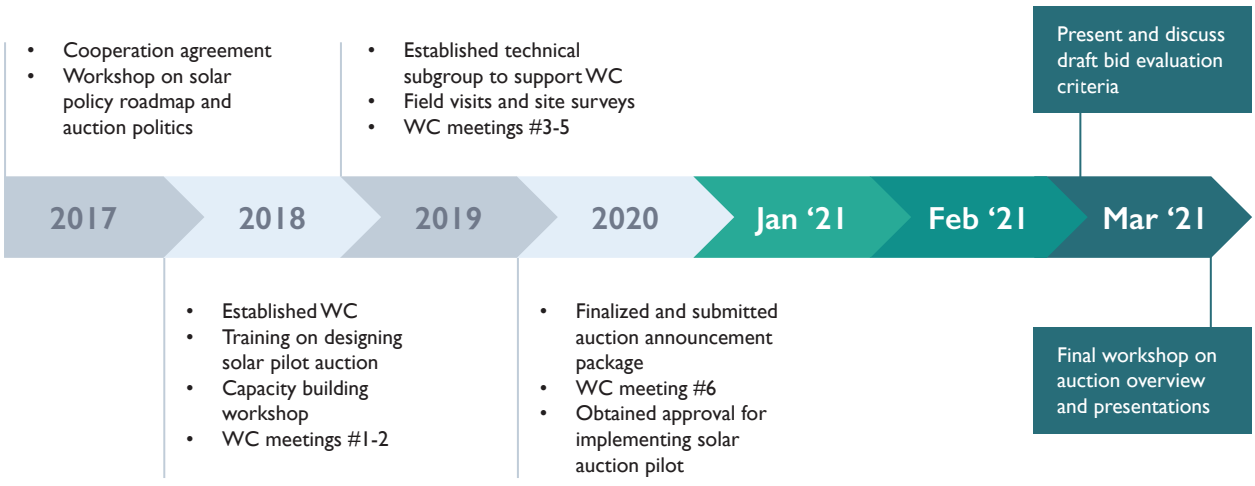
MAJOR HIGHLIGHTS AND ACHIEVEMENTS

A competitive procurement is a market mechanism to achieve competitive allocation of a good, which in this case is energy, and price discovery when confronted with price uncertainty. In the case of RE auctions, synonymous with RE competitive procurement, the product under bidding is a given volume of electricity (kWh), capacity (kW), or both. Benefits for a well-designed RE auction include an open and transparent process, reduced time to project completion, improved energy planning, lower energy prices for new generations, along with any other specific goals such as community participation and the socioeconomic aspect of RE.

USAID Clean Power Asia's support to promote competitive procurement in the region included the Laos solar pilot auction and regional auction events to share global trends and benefits of auctions and inform key concepts of auction design. Under competitive procurement, USAID Clean Power Asia successfully achieved eight policies, a significant feat that helps Laos establish the necessary foundation for their first-ever energy auction.

On August 8, 2017, USAID Clean Power Asia entered into a Cooperation Framework Agreement with the Laos Ministry of Energy and Mines (MEM) to provide technical assistance on various initiatives to contribute to the country's exploration of grid-connected PV and other RE resources to complement existing and planned hydropower investments. The primary counterpart under MEM with responsibility for RE activities was transferred from the Department of Energy Policy and Planning (DEPP) to the Institute of Renewable Energy Promotion (IREP) following a restructuring in mid-2018.

Solar Pilot Auction Timeline



Support for Laos Solar Pilot Auction

Auction Design and Procedures	Design auction approach, bidder qualifications, rules, penalties, etc.; identify steps and responsible entities to announce and conduct the auction; develop templates and forms for bid submission; and establish reference prices
Site Selection	Assess resource potential, collect site information, conduct site assessments, determine land use rights or relevant permits/licenses, etc., to secure the project site(s) for auction
Standardize Legal Agreements	Head of Agreement (HOA), Power Development Agreement (PDA), Power Purchase Agreement (PPA), and Concession Agreement (CA), all necessary to develop power project in Laos
Supporting Regulations	Regulations to ensure minimum technical requirements and streamlining the technical review process which include guidelines for feasibility studies, technical standards, and technical connection requirements

USAID Clean Power Asia began the solar auction initiative by conducting market and regulatory analyses to assess the current situation and provide policy recommendations. Preliminary findings were presented at a workshop on developing a solar policy roadmap and auction policies in November 2017 in Vientiane, which also addressed policy objectives that would guide the solar pilot auction. In April 2018, program staff conducted training on solar technology and financial modeling to enhance understanding of the benefits of solar technology, trends towards RE auctions, basic finance for project evaluation, and financial modeling for utility-scale solar project evaluation. This was followed by a workshop on designing a solar pilot auction to present auction design recommendations and calculation of a ceiling price for the auction, while collecting feedback from key public stakeholders including MEM, Électricité du Laos (EDL), and the Ministry of Planning and Investment (MPI).

Despite some initial delays from MEM's internal restructuring, USAID Clean Power Asia obtained governmental buy-in in 2018 on the benefits of competitive RE procurement, the most critical step to move forward with program activities. In November 2018, a significant milestone was achieved when the Government of Laos, initiated by IREP, turned buy-in into a commitment to proceed with the country's first-ever solar pilot auction with establishment of a Working Committee (WC) to oversee auction design, procedures, regulations, and implementation documentation. The WC of multiple MEM entities and other ministries including MPI, Ministry of Finance, and Prime Minister's Office held meetings in December 2018 on

consultation and capacity building of government staff to understand auction design and gather feedback on policy objectives and requirements for Laos, clarifying and defining auction processes and responsible entities, and ultimately assembling everything into the auction announcement package by September 2020.

To support the monumental task of implementing this first-ever solar pilot auction, USAID Clean Power Asia partnered with the Global Green Growth Institute (GGGI) and the Hawaii Natural Energy Institute (HNEI) to leverage the resources and capabilities of each partner. Work supporting the solar pilot auction was grouped into four main categories: auction design and procedures, site selection, standardized legal agreements, and supporting regulations. GGGI provided support on site selection and technical standards for solar while HNEI contributed to the interconnection requirements and provided expert review on site assessment and auction documents. Program staff collaborated with several subcontractors including Guidehouse on the auction design, Chulalongkorn University on guidelines for conducting feasibility studies, and DFDL on standardized legal agreements.

Since this is the first-ever energy auction in Laos, much effort was needed to develop the design, procedures, and relevant documents in order to conduct the auction. For RE, subsequent regulations to define detailed procedures is needed, and based on the auction report, Designing a Solar Pilot Auction for Laos, written in collaboration with subcontractor Guidehouse, program staff developed the auction announcement package with the announcement and 15 annexes necessary to conduct the solar pilot auction.

A key component for a solar pilot auction is auction design, specifying requirements for each design element: site selection, timing, conditions for participation, bid evaluation, qualifications, penalties, and payments. Supporting the auction design are other relevant documents including forms, checklists, and templates which have been developed and are ready for use. One of the bid evaluation criteria is the reference price, which serves as a ceiling price for the auction, where bids above the reference price will be disqualified from the bidding process. Program staff worked closely with the WC to determine the reference price, with a major challenge arising in that the price should reflect both risk-return tradeoff to potential bidders and the willingness to pay of EDL, sole offtaker of the projects. A high reference price might attract more bidders to the auction, but may not be acceptable to the Government of Laos or EDL. To overcome this challenge, program staff regularly consulted with the WC to discuss criteria and methodology used for reference price calculation, and the final reference price takes into account cost of equity and debt, technical factors, risk of developing and operating a solar project in Laos, and availability of risk mitigation mechanisms.

During auction design preparation, program staff held informal consultations with multiple solar developers in the region to gauge interest in the Laos auction and gather inputs on critical elements and major considerations for these stakeholders on participating in the auction, demonstrating there is significant interest among the private sector. It also emphasized the need for a design to ensure the process will be open and transparent, and highlighted concerns about bankability of the contractual arrangements. In addition to private sector feedback from an April 2018 workshop, feedback from financial institutions and solar developers was taken into consideration in auction design.

Auction Annoucement Package Components

Auction Announcement		
Annex 1: Admissible Project Sites and Grid Connection	**Annex 6:** Technical Connection Requirements for solar auction	**Annex 11:** Bid Winner Announcement Template
Annex 2: Solar Pilot Auction Timeline	**Annex 7:** Investment Application Form for Energy Power Sector	**Annex 12:** Solar Head of Agreement Template
Annex 3: Flowchart of Solar Pilot Auction Process	**Annex 8:** Project Proposal Form	**Annex 13:** Solar Concession Agreement Template
Annex 4: Joint Venture and Consortium Declaration Form	**Annex 9:** Bidding Document Checklist	**Annex 14:** Guidelines for Feasibility Study for Solar
Annex 5: Solar PV Technical Specifications and Standards	**Annex 10:** Price Proposal Template	**Annex 15:** Solar Power Purchase Agreement Template

For the auction, a government-sited approach was used, where the government provides and pre-develops a project site to a certain degree such as land permits, grid connections, resource availability, and environmental assessments. In partnership with GGGI and in consultation with the WC, program staff determined potential sites, and after gathering data to conduct the analysis, engaged provincial governments and authorities to inform and increase understanding of solar auction benefits, identify potential areas, and conduct field visits to determine sites that met requirements. Sites were secured in two provinces for the solar pilot auction after clarifying protocols between central and provincial governments to set aside land for governmental use for the auction. The site selection information is included in Annex 1 of the auction announcement package.

Another key component of the solar auction is a set of standard legal documents which include the Head of Agreement (HOA), Concession Agreement (CA), and Power Purchase Agreement (PPA), which are provided to all interested bidders at the launch of the auction. Similar to the reference price, terms and conditions specified in the legal documents need to satisfy both potential bidders and government. Program staff worked closely with legal advisor DFDL to draft and finalize the legal documents with terms and conditions reflecting standard market practice for solar projects while being acceptable to the government. Program staff also held private consultations with financial institutions to gather feedback on the draft legal documents ensuring their bankability. The final reference price and the legal documents were submitted to the WC in the final auction announcement package in December 2020.

Given that there is a gap in technical regulations for Laos, particularly for grid-connected power offtake for solar PV and the necessity to have technical regulations in place to conduct the auction, USAID Clean Power Asia, in partnership with HNEI, GGGI, and subcontractor Chulalongkorn University, developed technical connection requirements for solar auction projects, solar PV plant technical specifications and standards, and guidelines for feasibility studies for solar PV projects. All of these technical documents provide necessary regulations for the solar pilot auction. The technical connection requirements specify the process and requirements to connect the solar PV project to the EDL grid, while the solar PV plant technical specifications and standards provide minimum requirements for equipment to construct the solar PV plant, ensuring quality and reliability. The guidelines for conducting feasibility studies inform solar PV developers of the needed requirements and streamline the review and approval process by IREP.

In September 2020, the complete auction announcement package was submitted to IREP and the WC for consideration by MEM, an inter-ministerial committee, and/or the national assembly for approval and implementation. This submission was a culmination of support for the solar pilot auction pushing it closer to implementation. As of March 2021, the auction announcement package had been preliminarily approved by MEM and submitted to MPI and the Prime Minister's Office for comment. USAID Clean Power Asia, GGGI, and HNEI convened a final workshop to provide an overview of the auction and present site selection results, an auction timeline, bid submission protocol, bid evaluation process, and post-auction procedures for all participants involved in the auction.

Once the auction announcement package has been approved, a public announcement will follow and officially start auction implementation. An Auctioneer will be established and IREP will continue implementation preparations, potentially including Auctioneer capacity building as required and/or holding a bidders' conference. There remain opportunities to support solar pilot auction implementation and post-auction assessment which could be done through the USAID Laos Energy Security program and/or an upcoming USAID regional program. There remains much work to be done for RE competitive procurement and utility-scale projects in Laos, and despite lagging behind other countries in the region in terms of supporting RE policies, Laos is accelerating its developmental pace for implementing a market-based mechanism with USAID's support.

In addition to solar pilot auction support for Laos, USAID Clean Power Asia organized, presented, and/or shared and exchanged knowledge on RE auctions in various regional events to promote the trend in moving away from subsidized incentives such as FIT to market-based mechanisms. Building on the results of USAID Clean Power Asia's study on RE incentives and auctions completed in 2017, program staff delivered multiple RE auction presentations, and in June 2018, USAID Clean Power Asia, in collaboration with USAID/E3 and USAID CEADIR, also implemented by Abt Associates, organized a full-day deep-dive workshop on RE auctions as a new paradigm for ***Asia at the Asia Clean Energy Forum*** (ACEF). In October 2019, USAID Clean Power Asia and USAID Scaling Up Renewable Energy (SURE) hosted an Asia Enhancing Development and Growth through Energy (EDGE) competitive procurement dialogue, a 3-day workshop that provided capacity building on auction design and bankability issues to participants from South and Southeast Asia. After the event, participants came away with a greater understanding of auction benefits and how to design an energy auction suitable to their country context.

LESSONS LEARNED

The solar pilot auction presented USAID Clean Power Asia with a set of unique challenges that were gradually addressed and overcame to achieve preliminary approval for the auction announcement package by MEM. To move forward, program staff required flexibility, relationship management, and creativity to handle and address issues, and while there are many lessons to be learned from this intervention, these three lessons are worth highlighting.

Buy-in must be followed by commitment: As this will be the first energy procurement of any kind in Laos, the concept is new to many people and required several rounds of discussion to raise awareness and emphasize the benefits of a market-based mechanism. The key first step also is to provide the right information to the right decision-maker in order to initiate the interventions and obtain initial buy-in. Particularly when working with government staff in this region, access to decision-makers and obtaining buy-in allowed program staff to work with an assigned team from the counterpart.

Align understanding of solar project development and competitive procurement: For the solar pilot auction in Laos, members of the WC and relevant agencies were not familiar with the requirements for a transparent and best-value competitive procurement process and the different nature of solar power projects as compared to hydro projects, which are an important part of the Laos power system. Therefore, in order to obtain feedback during the preparation of auction documents, it was necessary to first enhance and align all relevant parties' understanding of solar project development and competitive procurement. This required the organization of multiple meetings and workshops with WC members and other relevant authorities.

Anticipate and factor in additional time: With the solar pilot auction spanning more than two years, it is not uncommon to have different WC representatives attending meetings. Although it is ideal to have continuity with the same individuals throughout capacity building, discussions, and meetings, it may be difficult to align each representative's availability and certain individuals may change positions. Internal government protocol often takes longer than initially planned, so it is advisable to factor additional rounds of discussion and time for the government's internal processes. In some cases, program staff reached out to and organized a separate session with new participants to help inform and clarify questions to move the activity forward.

As for regional RE auction events, the challenge for organizing a renewable energy auction lies in understanding the protocols for coordination between different counterparts in each country, USAID missions, and a regional entity like ACE. Approval time constraints are another factor to consider and were accounted for during planning. After limitations and restrictions due to the COVID-19 pandemic, program staff adapted and migrated all meetings and workshops to virtual online platforms. Workshops requiring multiple days were split into a series of webinars to reduce audience fatigue and maximize active participation. These required multiple sessions and took longer to achieve the same results, and even though virtual events reached more participants, the impact is more limited compared to in-person events with interactive exercises.

2 RENEWABLE ENERGY REGULATIONS

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

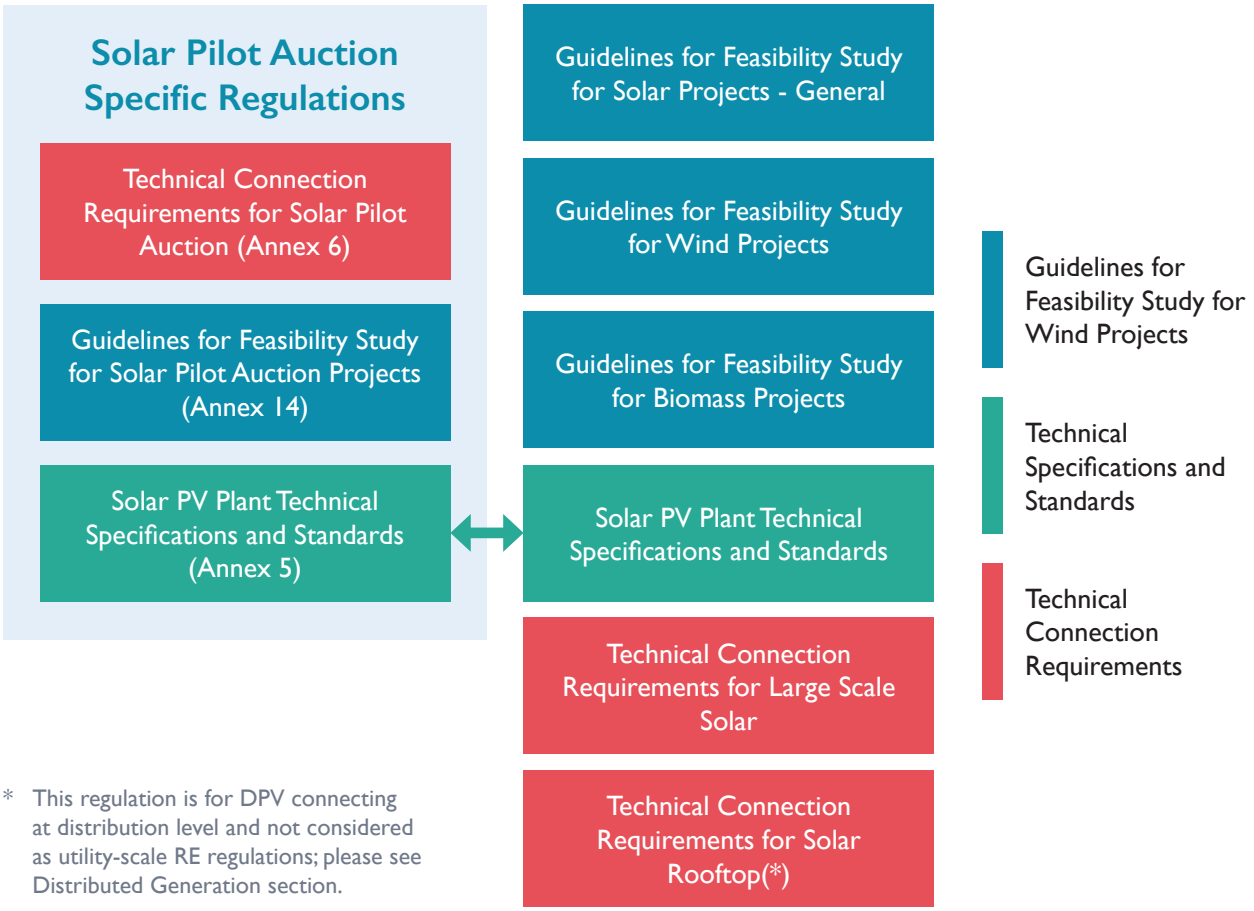
Based on policies proposed and/or adopted with USAID support

almost	over	over
$7.5	**8,700**	**90**
billion USD mobilized	MW financially closed	million tons CO_2 emissions avoided

Grid connection regulations are one of the barriers to scaling up RE and integration and development of required technical standards and grid codes for RE is critical to increase grid-connected RE deployment. Building on the study conducted by USAID Clean Power Asia on a ***Review of Supporting Regulations for Solar PV Integration in ASEAN Member States***, the targeted countries for support were those that have limited or lacking RE regulations, Cambodia and Laos. In Cambodia, program staff initiated activities to raise awareness for solar PV development and regulations, but were unable to proceed due to uncertainties including political will and a general election in summer 2018, suspending all work in the country. The focus on utility-scale RE development then shifted to Laos with initiatives to support the development of RE grid connection regulations, RE technical standards, and guidelines for conducting feasibility studies for RE projects. While some of these activities overlap with competitive procurement under the solar pilot auction, it is worth clarifying relevant regulations that are part of the auction and those applicable beyond the auction.

The auction announcement package includes several utility-scale RE regulations, including technical connection requirements (Annex 6), solar PV plant technical specification and standards (Annex 5), and guidelines for conducting a feasibility study (Annex 14). Details for these regulations are mentioned in the Supporting Regulations under the Solar Pilot Auction section. While the other two regulations are specific to the solar pilot auction, the solar PV plant technical specification and standards are applicable to all solar PV plants to be constructed in Laos whether through auctions or bilateral negotiation. MEM may adopt this document to supplement the Lao Electric Power Technical Standards (LEPTS) which are existing technical standards for hydropower projects.

Supported RE Regulations for Laos



* This regulation is for DPV connecting at distribution level and not considered as utility-scale RE regulations; please see Distributed Generation section.

While priority is on the development of RE regulations to support the solar pilot auction, IREP and EDL made additional requests to address gaps in regulations in Laos. Program staff discussed the priorities and identified support for the guidelines for conducting feasibility studies for solar (general), wind, and biomass projects and technical connection requirements for solar rooftop and large-scale solar. All the supported regulations for Laos are grouped into three types, including feasibility study guidelines, technical specifications and standards, and technical connection requirements. USAID Clean Power Asia successfully achieved three policies with an additional policy forthcoming as submission to the Lao counterpart was made at the time of writing this report in March 2021. All of these supported regulations will provide Laos with RE regulations that were previously missing to help establish a necessary foundation to promote RE.

USAID Clean Power Asia and subcontractor Chulalongkorn University started developing the regulations in 2019 and submitted to IREP four guidelines for conducting feasibility studies for utility-scale solar (general)[2], wind, and biomass projects and for solar projects under solar pilot auction in September 2020. The objective of this technical assistance was to leverage international best practices and standards to develop a standardized

[2] Utility-scale solar projects not part of the solar pilot auction

feasibility study format for RE projects (solar, wind, and biomass) ensuring the proper quality and completeness as well as streamlining the review process by IREP.

Three feasibility study guidelines for solar (general), wind, and biomass projects were submitted as standalone documents and presented to provincial staff at their annual conferences. The fourth set of guidelines, feasibility study guidelines for the solar pilot auction, was revised to be more specific for projects to be awarded under the solar pilot auction. These guidelines clarify requirements needed from project developers, simplify and streamline RE project approval process for IREP, reduce time and costs for investors, and facilitate a thorough and thoughtful government review.

Program staff collaborated with GGGI to submit solar PV plant technical specifications and standards as part of the auction announcement package, to ensure equipment used in the construction of solar power projects, including those awarded under the solar pilot auction, meet minimum quality requirements as well as ensuring installation and operational safety for solar PV plants.

USAID Clean Power Asia and HNEI supported EDL to develop technical connection requirements for projects under the solar pilot auction and large-scale solar farms connecting to a substation or transmission-level networks. The technical connection requirements for solar leverage best practices applicable for Laos, ensuring power quality delivery and reliability of EDL's grid through proper connection, equipment characteristics, protection schemes, and operation guidelines. The government may adopt this document to supplement the Laos Grid Code, which is the existing regulation governing the connection, planning, operation, control, maintenance, rehabilitation, and expansion of the Laos transmission system.

The support for grid connections regulations started in 2019 after a request from IREP which later connected USAID Clean Power Asia to EDL to continue the work. Since EDL is the sole electricity utility in Laos, it is responsible for system operations and grid connections for all domestic power generation. Program staff and HNEI met to discuss the required data necessary for developing the technical connection requirements which were completed in mid-2020. The technical connection requirements for solar pilot auction was completed and submitted to IREP and the Working Committee as part of the auction announcement package in September 2020. For utility-scale solar farms, program staff collaborated with HNEI to draft technical connection requirements by adding necessary provisions to the Laos Grid Code. The added connection requirements are based on the soon-to-be-released IEEE P2800 standards covering connections from inverter-based generation and functionalities of advanced inverters. The technical connections requirements for large-scale solar projects were completed and submitted in March 2021.

All of the RE regulations developed for Laos helped address the glaring need to fill regulation gaps, facilitate more RE integration, and increase more utility-scale RE deployments. With these regulations, Laos is catching up to other countries in the region in terms of technical RE regulation readiness that leverages international standards and best practices. Looking ahead, IREP and EDL still require additional support for RE regulations for wind and biomass as well as technical training on RE regulations.

LESSONS LEARNED

Developing RE regulations in a country with a limited existing framework can be both a challenge and an advantage. Proposed regulations can use the most updated international standards with minimal impact to existing users. On the other hand, the challenge is that there is a need to continually build capacity for those involved as well as potential limited data availability.

Access the right contacts for data: Significant time was spent to collect necessary data from EDL to develop technical connection requirements, taking over six months from initial request. The main reason, discovered later, was that program staff did not request the data from the correct department. As soon as the right contacts were identified, data collection went more smoothly.

Factor in language barriers: Even if RE regulations are technical in nature, there are some limitations to understanding English for some government representatives. To fully comprehend the drafted regulations, several meetings were necessary to conduct a page-turn explanation of the proposed provisions, helping improve understanding of the regulation and facilitating a technical discussion. A translated version of the regulation to the local language or including simultaneous translator would also help address any language barriers. Luckily, similarities in the Thai and Lao language helped program staff to communicate more effectively with counterparts.

Meeting is the best way to follow up: Many government staff do not use email regularly as a means of communication as evidenced by the lack of organizational email addresses. The most effective way to clarify, follow up, and/or discuss any issues is to set up a meeting with the relevant group. Social communication applications such as WhatsApp and LINE can also be useful to reach out informally.

Three main policy objectives for solar pilot auction

1. Determine tariff level that triggers private solar development to discover cost of commercial utility-scale projects in Laos.
2. Learn about auctions as a viable mechanism for procurement and stimulating private sector investment in solar power.
3. Assess the potential for scaling up solar investment through auctions.

DISTRIBUTED GENERATION

Rooftop solar system with a capacity of 1 MW at Big C store in Pathum Thani, Thailand.

Photo credit: Michael Wykoff Abt Associates/ USAID Clean Power Asia

Over the past few decades, the cost of clean energy technology has declined dramatically, with the lower cost of solar being particularly pronounced, largely due to increased efficiency of solar photovoltaic (PV) modules, economies of scale, and improvements in the supply chain. The price of solar PV generation today is less than 1% of what it was in 1977[3], and between 2014 and 2018 alone, global PV module prices dropped by more than 55%[4].

This has driven the evolution of the energy market from a centralized model to a more distributed one, transforming ways that end-users or customers interact with the electric grid such as by providing distributed generation. Distributed generation describes electricity to be consumed by the load (demand for electricity) within the same area rather than transmitting energy from a centralized facility located further away. Typically distributed generation refers to smaller scale generation installed by consumers and often located behind the meter. Distributed generation covers multiple technologies, but the focus for USAID Clean Power Asia was on distributed photovoltaics (DPV) and behind-the-meter storage, including new business models relevant to DPV such as prosumers, electricity consumers who produce or generate electricity to offset their own consumption and export excess energy back to the grid (producer + consumer = prosumer), and peer-to-peer energy trading.

For distributed generation, USAID Clean Power Asia successfully supported Thailand, Vietnam, and the Philippines to develop policies promoting deployment of DPV resulting in two and a half policies achieved. In Thailand, utility review and rate impact analysis contributed to the draft DPV self-consumption policy in 2018 with a proposed target of 300 MW. Despite not passing the draft stage, the DPV policy did influence Thailand's Power Development Plan 2018-2037 (PDP 2018), officially announced in April 2019 with a solar rooftop target of 100 MW/year up to 1 GW. In Vietnam, USAID Clean Power Asia, in collaboration with USAID V-LEEP, conducted customer economic analyses to influence DPV policy resulting in astonishing success with over 8,700 MW of solar rooftop deployed or that have reached financial close, and over $7.5 billion USD invested. While resulting numbers in the Philippines may not be as large as in Vietnam, the support for net-metering policy led to an increase of nearly 31 MW and over $39 million invested. Additionally, USAID Clean Power Asia produced the first DPV interconnection regulation for Laos that laid a foundation for connecting solar rooftop to the grid. USAID Clean Power Asia's distributed generation interventions have made a tremendous impact in promoting rapid deployment of DPV in the region.

Underlying the program's success with distributed generation support was the focus on DPV policies and regulations. The DPV policy support, as previously described, concentrated on promoting DPV deployment through influencing policy in Thailand, Vietnam, and the Philippines. As for DPV regulations, the emphasis was on providing Laos with solar rooftop regulations and building capacity for distribution utilities and the Energy Regulatory Commission (ERC) in the Philippines.

[3] National Geographic, 2017
[4] Ran Fu, 2018

1 DISTRIBUTED PHOTOVOLTAICS POLICY

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

In 2016, Thailand launched its first rooftop solar pilot project, allowing customers to install DPV for self-consumption. Connection to the grid was allowed, but exporting energy to the grid was not compensated, lowering the attractiveness of DPV for residential and commercial customers. At the forefront of stakeholder concerns was the impact DPV could have on utility revenues and retail electricity rates. To investigate this, USAID Clean Power Asia partnered with Chulalongkorn University's Energy Research Institute (ERI), NREL, and the Lawrence Berkeley National Laboratory (LBNL) to analyze the impact from DPV on utility revenues and retail electricity rates. Published in 2017, the analysis found that the deployment of DPV under a targeted scenario of 3,000 MW by 2020 would have no impact on utility revenues in the medium to long-term, given the forward-looking nature of Thailand's ratemaking process.

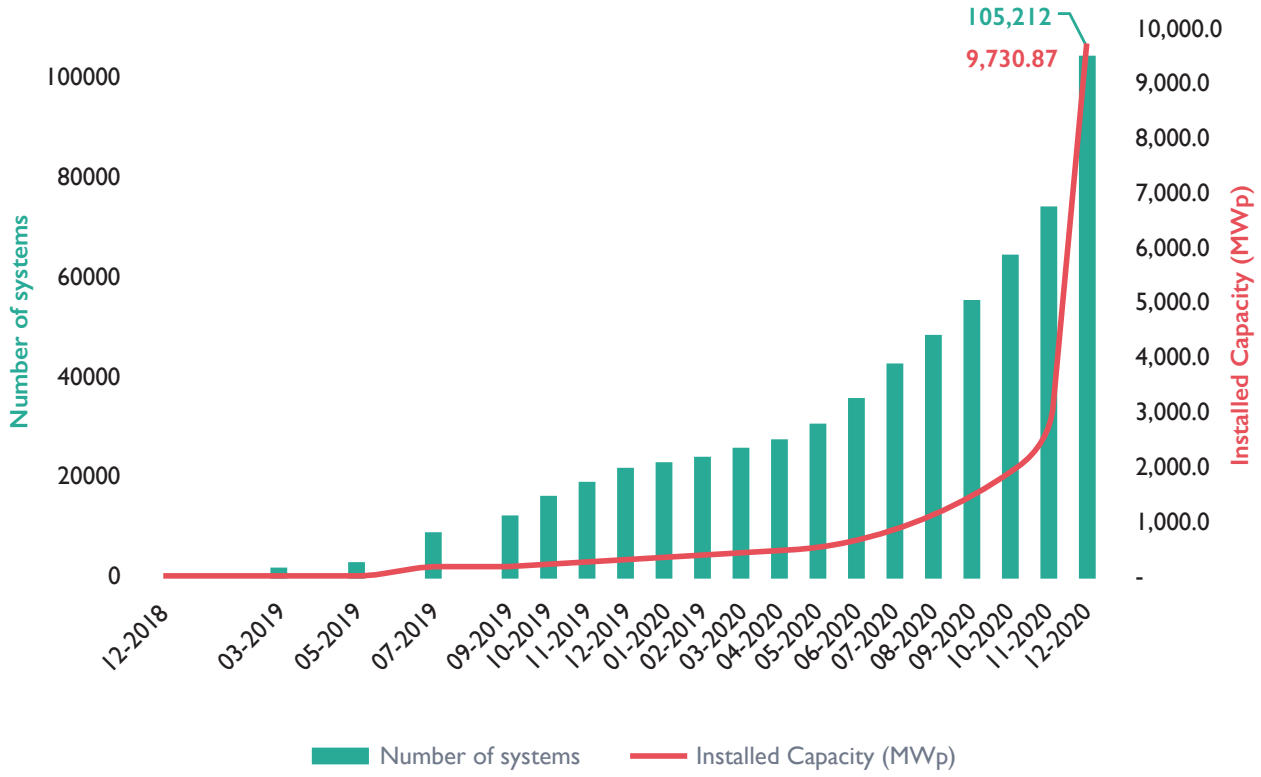
The study findings, along with technical impact analysis of DPV on the grid and customer economics analysis conducted by ERI, were published in a policy brief. The joint analyses by USAID Clean Power Asia, NREL, LBNL, and ERI helped to put into perspective the flexibility that Thailand has in scaling up DPV deployment without adversely affecting utilities and customers. USAID Clean Power Asia also published the ***White Paper: Addressing Remaining Concerns on Increasing Solar Rooftop for Self-Consumption in Thailand*** for the Federation of Thai Industries to address concerns beyond impact on utility rates and revenues. All of USAID Clean Power Asia and partners' efforts contributed to the consideration of a DPV self-consumption policy in Thailand and later influenced a more open regulation that allow DPV systems to sell excess energy to the grid under the PDP 2018.

Vietnam represents a recent solar success story, having experienced exponential market growth over a short period of time. A solar policy was first introduced in April 2017, allowing the sale of solar generation (both from solar farms and rooftop projects) to the state-owned utility, Vietnam Electricity (EVN), at a FIT rate of 9.35 cents/kWh. Despite initial

Under Decision 13, the new FIT includes

1. Floating solar power projects: VND 1,783/kWh (equivalent to 7.69 US cents/kWh)
2. Ground-mounted solar power projects: VND 1,644/kWh (equivalent to US 7.09 US cents/kWh)
3. Rooftop solar power systems: VND 1,943/kWh (equivalent to 8.38 US cents/kWh)

Development of Rooftop Solar Systems and Installed Capacity in Vietnam



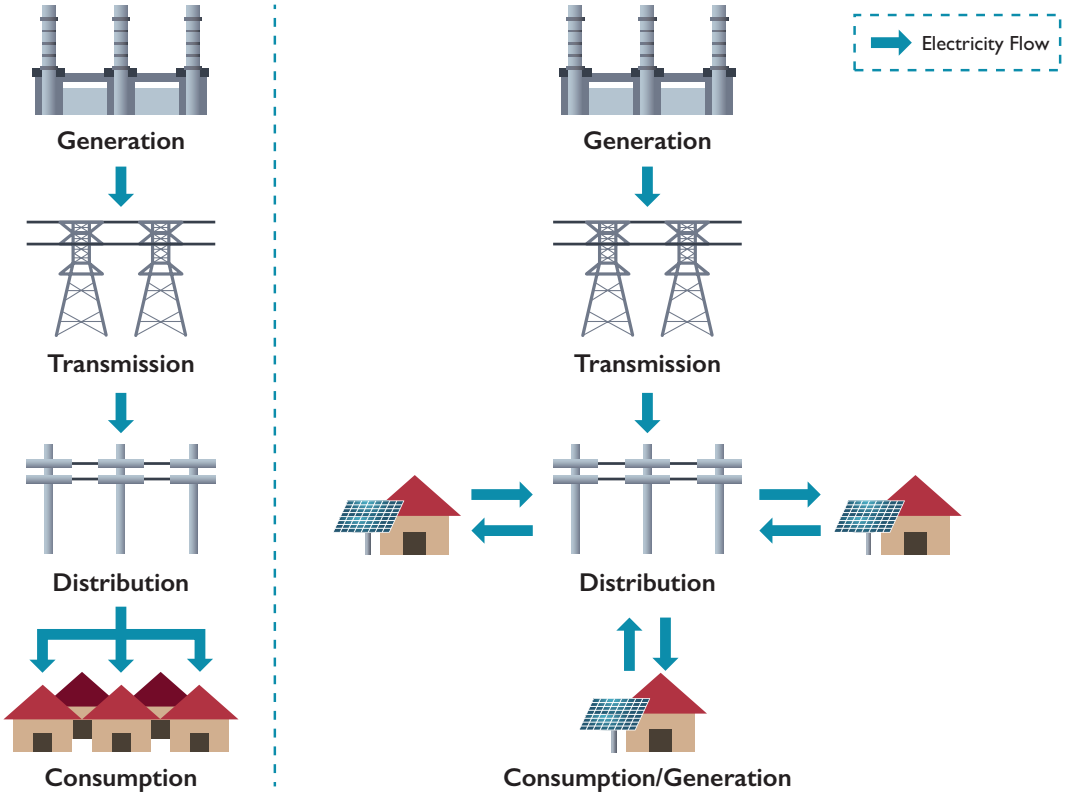
concerns over the bankability of the PPA, by the time Decision 11 expired in June 2019, Vietnam had amassed nearly 190 MW of rooftop solar.

Building on the support for Thailand, USAID Clean Power Asia partnered with USAID V-LEEP and NREL in 2019 to compile an international review of solar rooftop programs and analyze customer economics of DPV in Vietnam under different compensation mechanisms. The study concluded that self-consumption of DPV benefited residential and commercial customers the most, since they face the highest retail rates and stand to gain the most from replacing grid electricity with self-generated DPV. On the other hand, industrial customers enjoy lower retail rates, resulting in the longest payback periods and lowest internal rates of return compared to other customer groups.

The Electricity and Renewable Energy Authority (EREA) incorporated the results of this customer economic analysis as input to determine an updated FIT under Decision 13 announced in April 2020, specifying different FIT levels depending on the solar project type and providing eligibility details to solar projects. Under this decision, rooftop solar power systems are allowed to sell part or all of the electricity produced not only to EVN (as regulated the previous decision), but also to other purchasers for non-grid connected projects.

With many project developers missing the deadline for Decision 11, there was a rush to get the projects enlisted under Decision 13 before the end of the 2020 FIT eligibility period, resulting in a huge surge in solar rooftop deployment of over 8,700 MW of solar rooftop deployed and $7.5 billion USD invested. Despite the success story for the Vietnamese solar market under Decision 13, it is viewed as an interim measure until the competitive mechanism of auctions are in place from 2021 onwards.

Central Utility Model *(Left)* vs. Distributed Generation Model *(Right)*



The Philippines has been trying to promote DPV deployment since 2013 with the first attempt in implementing net-metering that allowed qualified end-users[5] to off-set consumption and sell excess generation to the utility at blended generation cost[6]. Despite the supporting regulations, the uptake in DPV deployment was less than expected with approximately 13 MW total between July 2013 to June 2018 due to numerous economic and non-economic barriers. To help address this issue, USAID Clean Power Asia and partners NREL, LBNL, and Chulalongkorn University, conducted a ***Distributed Photovoltaic Economic and Technical Impact Analysis*** in 2019 for the Philippines' Department of Energy (PDOE). Analysis results were incorporated in PDOE's draft Department Circular (DC) ***Promulgating Policies to Enhance the Net-Metering Program for Renewable Energy*** and ERC's ***Amended Net Metering Rules (ERC Resolution No. 6, Series of 2019)***. Upon request from PDOE, program staff provided technical support in collaboration with NREL, LBNL, HNEI and the Clean Energy Investment Accelerator (CEIA)[7] on standards and guidelines for a net-metering program for PDOE and ERC which include technical inputs for a net-metering guidebook, capacity building for distribution utilities, assistance with fixed charge calculation, and a low-income solar program, some of which are described in the Distributed Photovoltaics Regulations section below.

With USAID Clean Power Asia's support, the Philippines experienced an increase of nearly 31 MW for DPV, more than doubling DPV installed capacity in 2018, with $39 million USD invested.

LESSONS LEARNED

The significant achievements by USAID Clean Power Asia under distributed photovoltaics policy provide many lessons that were learned.

Political will drives policy changes: Through conducting DPV impact analyses in Thailand, Vietnam, and the Philippines, it became apparent that political will is the single most important factor in driving policy changes. In Thailand, even after stakeholder concerns were comprehensively addressed in the impact study and white paper, DPV deployment remains restricted. Not until PDP 2018 were DPV systems allowed to sell to the grid under net-metering (essentially net-billing), albeit at a low tariff rate. On the other hand, in Vietnam, the DPV market has expanded at a staggering pace, catalyzed by policymakers' aggressive push to increase RE via Decision 11 and then Decision 13. Decision 13 also allowed for direct PPAs between private entities, making Vietnam the first country with this type of mechanism in the region.

Impact analyses are critical for policymaking: The program's efforts supporting Thailand, Vietnam, and the Philippines were all initiated by conducting analyses to address concerns from relevant stakeholders relating to DPV impacts. Even though the end result varied between these countries, the common theme is the result of such impact analyses are important when considering policy, whether to provide financial incentives like in Vietnam, address utilities' concern with revenue in Thailand and the Philippines, or the easing of restrictions and streamlined processes in the Philippines. A key lesson is that an integrated approach that addresses technical, economic, institutional, and political concerns, and incorporates diverse energy resources including, but not limited to DPV, is likely to be the most effective.

Solar expert and consultant Sopitsuda Tongsopit leads a discussion on preliminary DPV impact analysis results at the workshop ***Presenting Preliminary DPV Impact Analysis Results for the Philippines*** in Manila in December 2018.

Photo credit: Thanawat Keereepart Abt Associates/ USAID Clean Power Asia

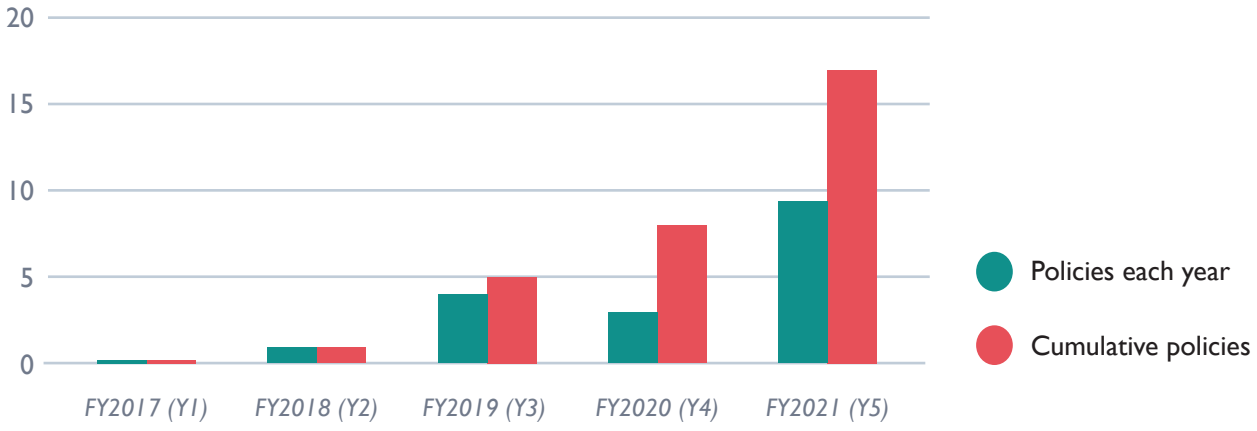
[5] Net-metering rules in the Philippines define qualified end-users as customers in good credit standing in the payment of electric bills to distribution utilities.

[6] Blended generation cost is the weighted average of the cost of wholesale electricity.

[7] CEIA supported the technical input to the net-metering guidebook bringing on-the-ground expertise in the Philippines and assured that the guidebook can be easily applied to its intended target audience.

Supported Policies and Regulations

No.	Country	Policy/Regulation
1	Thailand	DPV Self-Consumption Policy
2		Standard PPA template and financial model
3a	Vietnam (*)	Energy Storage System Policy
3b		Solar Rooftop Policy
4	Philippines	Net-Metering for Renewable Energy Policy
5	Laos	Guideline for conducting feasibility study for solar project
6		Guideline for conducting feasibility study for wind project
7		Guideline for conducting feasibility study for biomass project
8		Solar Pilot Auction Policy
9		Solar pilot auction announcement
10		Solar PV Plant Technical Specifications and Standards
11		Technical Connection Requirements for Solar Pilot Auction projects
12		Head of Agreement (HOA) Template
13		Concession Agreement (CA) Template
14		Guidelines for Conducting Feasibility Study for Lao PDR's Solar Pilot Auction Projects
15		Power Purchase Agreement (PPA) Template
16		Distributed Solar Photovoltaic Generating Facility Interconnection Standard



(*) USAID Clean Power Asia collaborated with USAID V-LEEP and thus shared both policies equally for a total of 1 policy.

2 DISTRIBUTED PHOTOVOLTAICS REGULATIONS

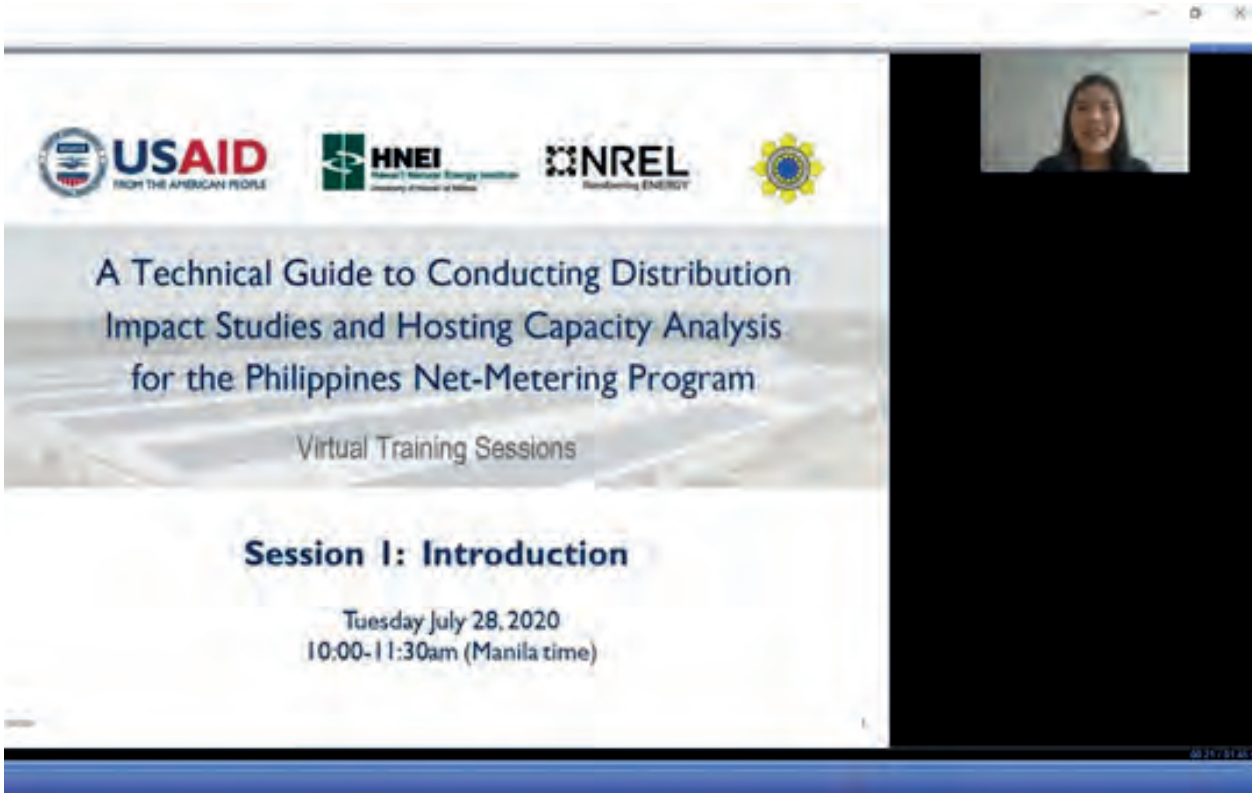
MAJOR HIGHLIGHTS AND ACHIEVEMENTS

Among the concerns of utilities, system operators, and regulators over higher DPV penetration levels are potential adverse effects to grid stability, including large voltage and frequency fluctuations. Since DPV is an inverter-based technology, meaning it requires an inverter to convert direct current from a solar generation system into alternating current that is transmitted to power outlets, these challenges, in large part, can be addressed by updating grid codes with inverter requirements. USAID Clean Power Asia's support for DPV regulations, therefore, focused on addressing the lack of DPV interconnection regulations in Laos and to provide capacity building for stakeholders including Distribution Utilities and the ERC in the Philippines to understand the DPV policy and streamlining the net-metering processes.

In addition to technical connection requirements for projects under the solar pilot auction, USAID Clean Power Asia collaborated with HNEI to develop technical connection requirements for solar rooftop systems connecting to the distribution grid. For this activity, program staff and HNEI worked closely with EDL, the state-owned utility, to develop analogous connection requirements for DPV, submitted in December 2020. The large-scale version has been developed as well and is described under RE regulations in the utility-scale section of this report.

The DPV technical connection standards were based on the requirements of the IEEE 1547-2018 Standards, which at the time were the latest international standards for connecting distributed energy resources to the power system. The document, which has since been officially proposed for adoption by EDL, circumscribes essential inverter functions to ensure safe interconnection of DPV systems to the distribution grid. Based on first-hand experience at the Hawaiian Electric Company, HNEI's experts also laid out a process for EDL to efficiently evaluate applications for connecting DPV systems to the grid, including criteria for technical screens that would reduce the need to conduct individual interconnection requirement studies for each application, which are costly and time-consuming. While DPV in Laos is currently limited to self-consumption, the DPV technical connection standards help prepare and position EDL for when the market matures, and Laos introduces a DPV policy.

In contrast to Laos, and much of the Southeast Asia region, dominated by a single-buyer model, the Philippines' electricity market is highly liberalized, with over 150 private distribution utilities serving the vast archipelago. The relatively low DPV adoption rate since the net-metering program was introduced in 2013



USAID Clean Power Asia leads a virtual training on A Technical Guide *to Conducting Distribution Impact Studies and Hosting Capacity Analysis for the Philippines Net-Metering Program* in July 2020.

Photo credit: Dr. Supawan Saelim Abt Associates/ USAID Clean Power Asia

is in part due to insufficient standards and guidelines for distribution utilities and electricity cooperatives to implement a net-metering policy, a complicated permitting process, and a restrictive capacity limit of 100 kW per system.

In supporting the implementation of a net-metering program, USAID Clean Power Asia leveraged expertise from NREL and HNEI, to include technical capacity building for distribution utilities via six webinar sessions on distribution impact studies and hosting capacity analysis. The training series introduced the fundamentals and tools of these analyses, which utilities can conduct to streamline processing of net-metering applications and determine the level of DPV that the distribution system can accommodate. These trainings built the capacity of distribution utilities and electricity cooperatives, particularly smaller ones that may lack resources, so that they can more readily facilitate DPV scale up. In addition, USAID Clean Power Asia and LBNL organized five webinar sessions for ERC in February and March 2021, with the aim to inform ERC of the cross-substation issues and introduce various rate designs, analysis methods, and case studies to help ERC consider when designing a net-metering rate for the Philippines.

The capacity building provided by USAID Clean Power Asia enabled better understanding of the steps needed to reduce the net-metering application approval time while providing confidence to DUs on grid reliability as DPV penetration increases. The rate design webinars equipped ERC with knowledge to determine the appropriate rate for various classes of consumers to promote DPV deployment under the promulgated *Amended Net Metering Rules*.

LESSONS LEARNED

In scaling up DPV, lowering regulatory barriers is critical. When a new DPV policy is introduced, utilities and regulators must implement the policy. From the perspective of utilities, in addition to concerns over lost revenues, the question of how to manage potentially large volumes of DPV coming online without negative consequences is a practical one. Power systems were not designed to absorb generation at the distribution level, but there are measures that can be taken to minimize adverse impacts to grid stability.

Build technical capacity for distribution utilities: A key lesson has been that capacity building and distribution of information resources to better equip practitioners can, and should, be done even in the absence of an enabling environment. Utilities and regulators who have access to adequate training and tools are better positioned to implement policies that accommodate higher levels of DPV. Distribution utilities in the Philippines and Laos, having received support from USAID Clean Power Asia and partners, are able to prepare for a larger volume of net-metering applications when the enabling environment for DPV becomes more attractive. Leveraging valuable experience and sidestepping the trial and error faced by early DPV adopters is the fastest and surest way to proceed.

Compatibility of inverter based DPV with battery energy storage: A positive externality of developing standards and regulations for DPV was its degree of applicability to battery energy storage systems (BESS). Due to USAID Clean Power Asia's support on BESS technical standards in Thailand, as described in the Advanced Technologies section, many of the same inverter function requirements were applicable since both DPV and BESS use inverters to connect to the grid. Program staff and HNEI were able to reference DPV technical connection requirements developed for EDL in conjunction with other international standards for BESS in developing recommendations for Thailand. Therefore, for future support, it may be valuable not only to strategize interventions on the basis of technology, but also to identify and exploit any overlap between technologies where interventions can achieve multiple objectives.

> Capacity building and distribution of information resources to better equip practitioners can, and should, be done even in the absence of an enabling environment.

ADVANCED TECHNOLOGIES

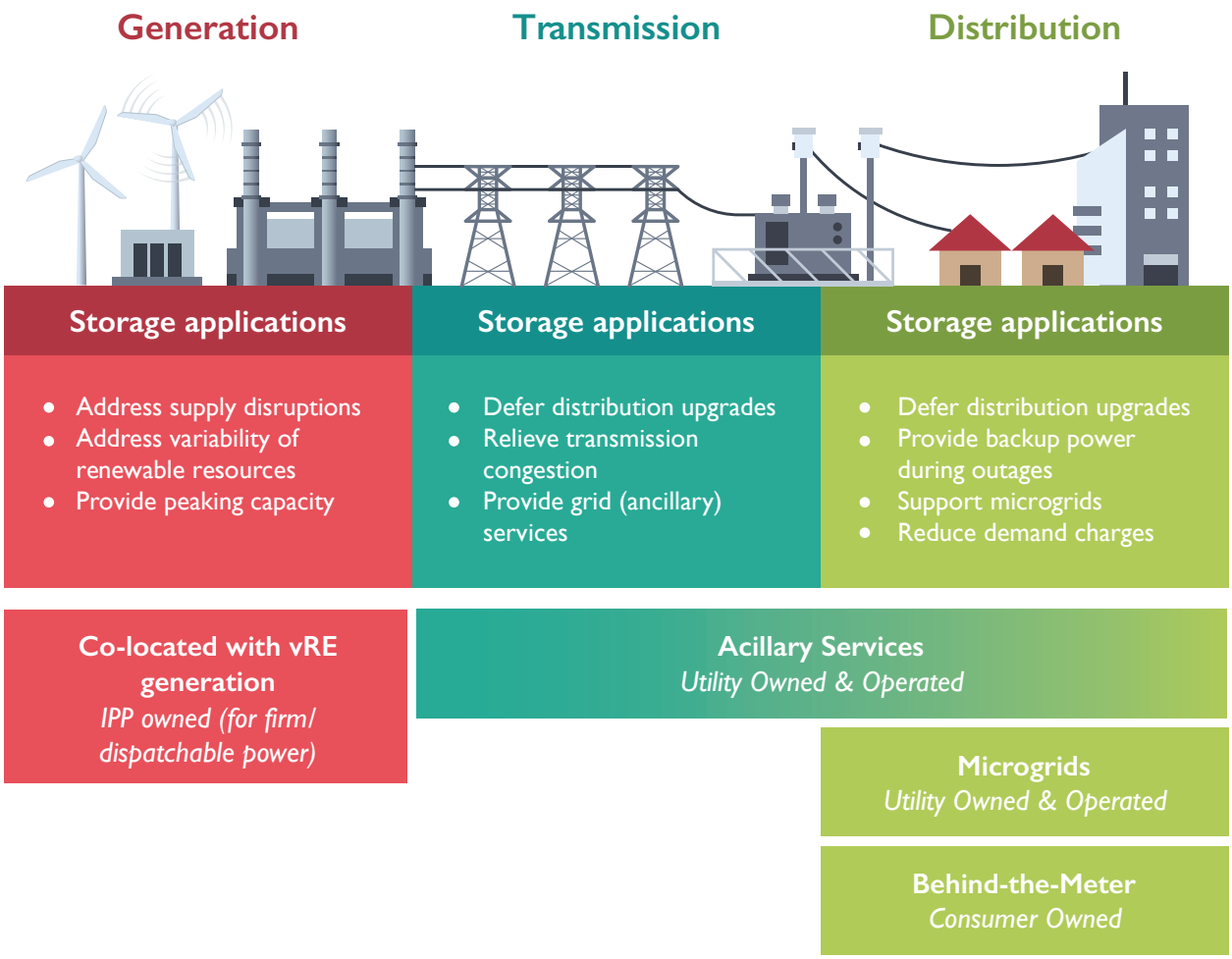
MAJOR HIGHLIGHTS AND ACHIEVEMENTS

Disruptive technologies in the power sector are reshaping the landscape of how electricity is produced, transmitted, and consumed around the world. Recent trends show that many countries are transitioning from traditional, one-directional, and centralized generation toward distributed, decentralized, digitalized, and multi-directional electricity systems propelled by these technologies. Disruptive technologies are considered part of advanced technologies and are often used synonymously when referring to technological breakthroughs that impact the sector.

Disruptive technologies significantly change, and to a certain extent, revolutionize the way consumers, industries, and businesses operate forever. Recent examples include e-commerce, social media, and ride-sharing apps. In the power sector, disruptive technologies are often associated with innovations relevant to distributed energy resources (DER) such as DPV, behind-the-meter (BTM) battery energy storage systems (BESS), and electric vehicles (EV). While definition of DERs may vary, the common theme is an electricity generating system connecting to the distribution system that serves the local load or supply to the grid, while also giving rise to new opportunities and business models

Under initiatives from USAID to support, promote, and accelerate deployment of clean energy technologies, USAID Clean Power Asia's activities included conducting energy storage system (ESS) analysis for Vietnam, supporting the development of BESS technical standards for Thailand, conducting a disruptive technologies regulatory review for Thailand, and sharing findings on disruptive technologies with other countries in the region via regional events. Program achievements in this area include influencing recent RE policy in Vietnam to promote solar energy project development, completing the guidelines to help Thailand develop BESS technical standards, and leveraging disruptive technologies regulatory experiences in the U.S. to assist Thailand with the energy transition.

Curtailment risks and grid integration limitations remain primary challenges for the growth of solar PV in Vietnam despite an attractive FIT program announced under Decision 11 in April 2017 and later amended in January 2019, which provided attractive incentives for solar PV development. With expiration of Decision 11 in June 2019, EREA expressed interest in addressing technical challenges through the application of ESS and potential incorporation of additional incentives for ESS in a new decision expected to replace Decision 11. Accordingly, MOIT requested USAID V-LEEP to conduct an analysis for utility-scale solar PV energy storage systems as an input to a new decision for solar PV incentives.



Source: GAO illustration based on studies and documents. / GAO-18-402

Through collaboration with USAID V-LEEP, program staff, NREL, and subcontractor Chulalongkorn University identified the scope of ESS analysis for MOIT, and completed and submitted the ***Technical Report: Energy Storage System Study***[8] to EREA in May 2019, with USAID Clean Power Asia conducting technical analysis of ESS applications to address grid congestion and curtailment issues in the provinces of Ninh Thuan and Binh Thuan. With many existing and upcoming solar projects in the pipeline including quantifiable benefits of ESS at the system level, NREL incorporated input from the ESS technical analysis for an economic analysis and provided policy recommendations on potential compensation schemes. In addition, Tesla supported the ESS analysis by providing the configurations and use cases of product offerings that are already commercially available.

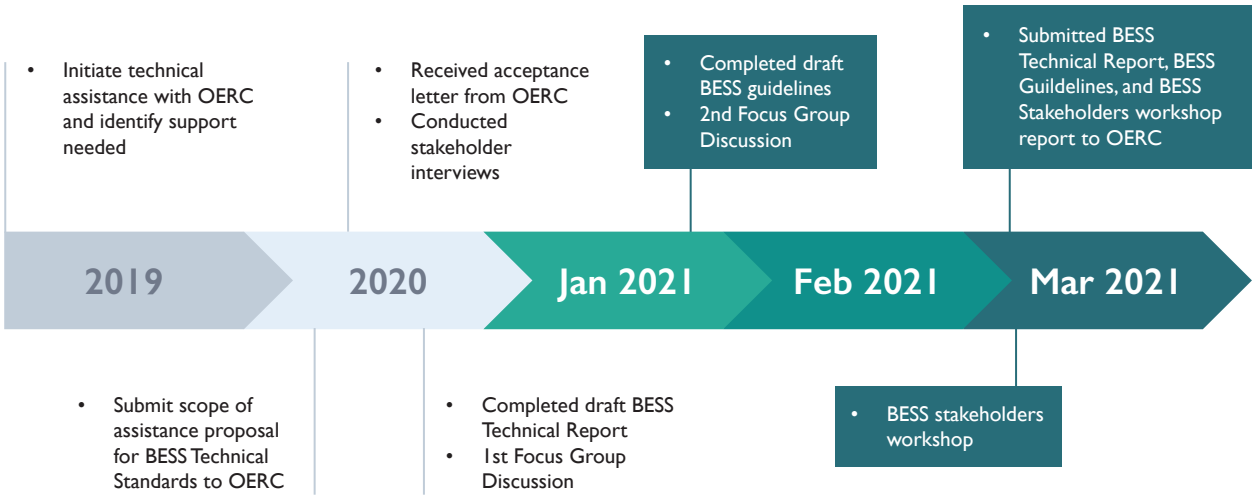
Thailand is implementing policies and regulations to support modern, disruptive technologies in the energy sector. The Office of the Energy Regulatory Commission (OERC) initiated an OERC sandbox program (an isolated environment for experimenting with technology and regulatory impacts)

[8] The Technical Report: Energy Storage System Study contains four chapters with USAID V-LEEP responsible for Chapter 1 – 3 and USAID Clean Power Asia and NREL responsible for Chapter 4 Techno-Economic Assessment of Battery Energy Storage Systems in Ninh Thuan and Binh Thuan which comprised the technical (USAID Clean Power Asia and Chula) and economic (NREL) analysis.

to test energy innovations under five broad categories[9]: energy trading, energy pricing mechanisms, storage technologies, power systems (such as microgrids), and new energy business models, such as supply and load aggregators. In 2019, USAID Clean Power Asia identified BESS as a potential area for support to the OERC on topics related to advanced technologies since there are currently no regulations in place to ensure the quality and safety of BESS installations, operations, and decommissioning. Potential areas of BESS deployment for Thailand were identified as independent power producer owned and operated to co-locate with VRE for firm/dispatchable power; utility-operated for ancillary services; utility-operated for microgrids; and consumer-owned BTM for self-consumption and/or export to the grid.

Based on agreement with OERC, USAID Clean Power Asia provided the OERC guidance on key considerations for developing BESS technical codes and standards and, with support from HNEI, guidelines on developing BESS technical standards for Thailand including technical recommendations on relevant grid codes. After technical assistance proposed to OERC in January 2020, program staff and NREL conducted a review of international practices and existing BESS-related laws and regulations in Thailand. Once the proposal was approved by OERC in May 2020, program staff conducted stakeholder interviews with policymakers, utilities, and relevant entities with findings incorporated into the technical report, ***Key Considerations for Adoption of Technical Codes and Standards for Battery Energy Storage Systems in Thailand***, developed by NREL. The first focus group in August 2020 presented interview findings and collected stakeholder feedback. Building on the technical report, program staff and HNEI completed the first draft of ***Guidelines for Developing BESS Technical Standards for Thailand*** and presented the guidelines during the second focus group in January 2021, followed by a BESS stakeholder workshop in February 2021 to present the output to a broader audience and obtain the private sector perspective to

BESS Technical Standards for Thailand Timeline



[9] Five categories are defined by regulated areas in energy industry operations under the responsibilities of OERC.

overcome barriers and promote BESS deployments in Thailand, with the final guidelines submitted to OERC in March 2021.

With BESS guidelines, OERC and other entities in Thailand have a way to easily find the technical requirements and provisions relevant to BESS from the latest international standards and currently available best practices. The BESS guidelines were developed based on IEC Standard 62933, NFPA Standard 855, AS/NZS Standard 5139, New York Batter Storage Guidebook (2020), California Safety Inspection Checklist, IEEE P2800 (forthcoming), IEEE 1547-2018, and NERC 2018/2019[10]. This work equipped OERC with the necessary tools to develop BESS technical standards for Thailand which will save time, enable minimum technology standards, level the playing field, and promote quality and safety of installed technologies.

The deployment of disruptive technologies, including DPV, BESS and EV, is changing the way electricity is produced and consumed and creating opportunities for new business models. Thailand, being a leader in RE deployment in Southeast Asia, faces the need for changes in regulations to enable new business models driven by the growth of disruptive technologies and policy drivers for energy transformation including decarbonization, decentralization, digitalization, deregulation, and electrification. To that end, USAID Clean Power Asia conducted a review of key regulatory designs supporting the growth of disruptive technology in the U.S., with recommendations for implications in Thailand. Program activities included surveys on the future of regulations to promote disruptive technologies followed by interviews with stakeholders, including Thai utilities, OERC, DEDE, Federation of Thai Industries, and Chulalongkorn University. These were conducted to understand existing barriers and challenges so as to provide recommendations to encourage adoption of appropriate policy and regulatory designs to influence the direction of changes shaping the market and enable new business opportunities with fairness, maintain grid safety and reliability, and enhance transitioning utilities' business models.

After discussions with key stakeholders and researchers at Chulalongkorn University[11], program staff refined the scope of the study in early 2020 to provide regulatory review of U.S. experiences on disruptive technologies and conducted a survey on future regulations to understand existing barriers and challenges in mid-2020. Program staff prepared the report ***Regulatory Design for Disruptive Technologies in the Power Sector: Examples from the U.S. and Implications for Thailand*** for review by experts and stakeholders in Thailand in September 2020 and presented the report findings in a workshop organized by Chulalongkorn University's Energy Research Institute (ERI) in January 2020. The final report was completed in April 2021 and will be used as input to ERI's project to ultimately result in Thai government counterparts proposing and implementing policies and regulations that help smooth the energy transition towards the era of digitalization with disruptive technology.

[10] IEC – International Electrotechnical Commission, NFPA – National Fire Protection Association, AS/NZS – Australian/New Zealand Standard, IEEE – Institute of Electrical and Electronics Engineers, and NERC – North America Electric Reliability Corporation.

[11] Chulalongkorn University, through the Energy Research Institute, is tasked under the OERC power development fund to study impacts of disruptive technologies including peer-to-peer electricity trading under different scenarios.

Future Trends with Disruptive Technologies

Key Drivers

Decentralization

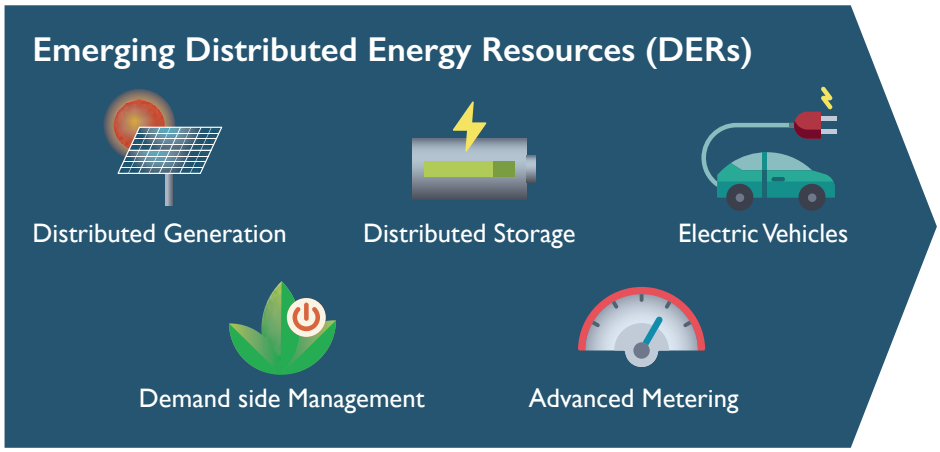
Makes customers active elements of the system, though requires significant coordination

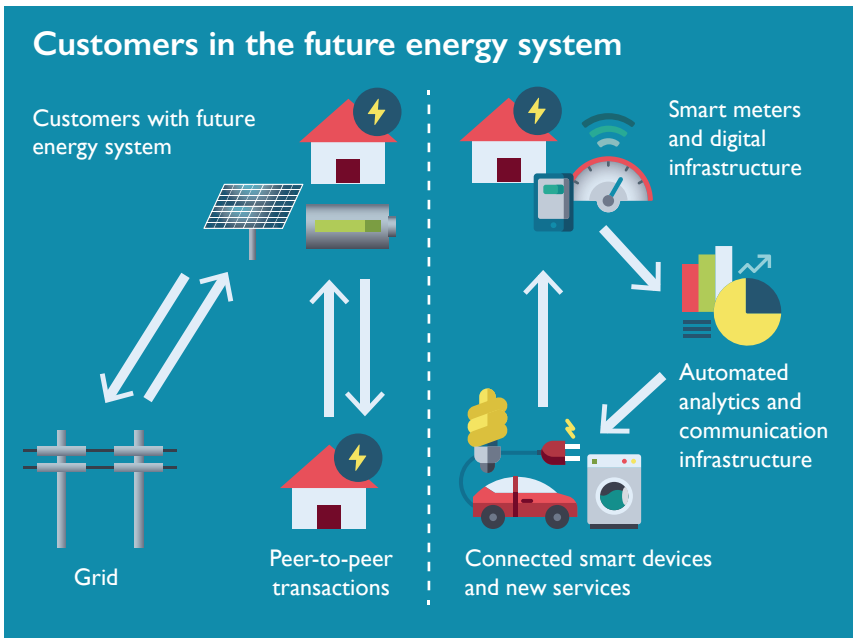
Digitalization

Allows for open, real-time, automated communication and operation of the system

Electrificaiton

Critical to long-term carbon goals and will be a relevant distributed resource





Source: Illustration adjusted from World Economic Forum (2017)

USAID Clean Power Asia promoted understanding and deployment of advanced technologies in the clean energy sector through many regional activities. In October 2019, USAID Clean Power Asia and NREL hosted a 3-day regional event in Bangkok on energy storage that informed participants about the available energy storage technologies and applications, technical requirements for deploying grid-connected energy storage, and considerations of behind-the-meter storage. In June 2020, USAID Clean Power Asia, USAID India, and NREL organized a deep-dive workshop on distributed resources and a sustainable energy transition in Asia at the virtual Asia Clean Energy Forum, covering trends in policy and planning for DERs in Asia, electric vehicle deployment, and distributed storage regulations, featuring speakers from JICA, PDOE, USAID V-LEEP, and Chulalongkorn University. In March 2021, program staff delivered a webinar as part of the Asia EDGE Power Sector Learning Series that included key findings from the report on ***Regulatory Design for Disruptive Technologies in the Power Sector: Examples from the U.S. and Implications for Thailand*** with speakers from USAID CEADIR, NREL, and Chulalongkorn University.

LESSONS LEARNED

Supporting policy and regulatory interventions for advanced technologies presented a unique set of challenges relating to technical applications and impacts of these new technologies. There are common issues facing all countries and entities interested in new technology adoption, and the main lessons learned focus on intervention implementation and process rather than the technical aspects of advanced technologies.

Meetings are an effective way to gather feedback from stakeholders: From program staff experience, after sending a document or invitation that requires feedback or response from stakeholders, only a few responded. A more effective way to obtain feedback is to organize meetings, like the focus group discussions for BESS technical standards, and invite relevant stakeholders to join. During this process, program staff provided a summary of the feedback to stakeholders for confirmation, enabling the activities to move forward and avoiding lengthy delays for feedback submitted via email.

Successful collaboration leads to new opportunities: Although initial buy-in is critical to start any collaboration and interventions, it is worth noting that once the collaboration begins, counterpart relationship management coupled with satisfactory outcomes, or even making good progress, led to discussions on additional support and further collaboration. The BESS technical standards collaboration led to a request for support on rate design for EV charging stations and prosumers. This is also true for activities conducted in Laos where program staff received additional requests for RE regulations and capacity building.

USAID, USAID Clean Power Asia, and Thai government officials participated in the ***First Focus Group on Development of Thailand's BESS Technical Standards*** in August 2020 in Bangkok.

Photo credit: Dr. Supawan Saelim Abt Associates/ USAID Clean Power Asia

III MOBILIZING FINANCE AND INVESTMENT

- *Implementation*
- *Capacity Building on Project Finance for Renewable Energy*
- *Tools and Guidelines for the Private Sector*

Photo credit:
Richard Nyberg
USAID/RDMA

In parallel to work on improving power sector planning and fostering supportive policy frameworks for grid-connected renewable energy, USAID Clean Power Asia mobilized finance and investment by supporting private sector investment in the current regulatory environment.

While solar and wind have made significant inroads in the region over the last few years, there are limited opportunities to develop and implement projects in the program's target countries in the Lower Mekong region. This is largely due to regulatory restrictions in power markets that are dominated by state-owned utilities, who maintain a monopoly over power purchase and distribution, restricting the opportunity to sell utilities electricity generated by utility-scale RE projects.

Opportunities for selling RE-based electricity to the grid typically depend on short-term windows that energy authorities and regulators open for a limited time period, and which are often restrictive and come with tight deadlines. These limited windows of opportunities mean that project development in most countries tends to go through boom-and-bust cycles, from periods with high development activity to periods of waiting for the next window to open. In some countries, these windows open at regular intervals following an established long-term plan, while in other countries there is long-term uncertainty about when there will be new opportunities.

In this environment, USAID Clean Power Asia worked with private sector stakeholders to overcome challenges in the development of grid-connected RE projects and support them in the preparation, design, and financing for their projects, covering both those that sell electricity to the grid and ones that sell to private offtakers. To achieve this outcome, program staff largely worked across three main streams: support to developers and investors in project implementation; capacity building for developers and banks on financing renewable energy projects; and the development of tools and guidelines for private sector stakeholders.

IMPLEMENTATION

Among the program's target countries, Vietnam and Thailand had the most potential for project development and implementation over the past five years, due to government incentives and a growing market for rooftop solar for self-consumption. Vietnam launched several incentives for solar and wind, which generated considerable interest among local, regional, and international investors.

Over the past decade, Thailand was known as a regional leader in renewable energy, but the country had not created major opportunities for utility-scale RE during the period of the program, and thus development of such projects has largely stalled since 2015. Nevertheless, over the last five years, Thailand experienced a large uptake of rooftop solar for onsite use at commercial and industrial facilities, albeit limited to self-consumption only.

Since the ability of USAID Clean Power Asia to increase the opportunities for RE projects under the given regulatory framework was limited, program support aimed to overcome specific hurdles in RE project development and financing. Program staff worked directly with project developers, investors, and financial institutions, covering rooftop solar, utility-scale solar, and wind power. In addition, program staff supported companies operating commercial and industrial (C&I) facilities, with an interest in sourcing their electricity needs from renewable energy.

Program support included supporting the identification of suitable financing options for rooftop solar, utility-scale solar and wind, supporting RE procurement by corporate energy consumers, and facilitating partnerships between local developers and international investors.

1 ROOFTOP SOLAR DEPLOYMENT IN THAILAND AND VIETNAM

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

USAID helped Big C prepare terms of reference, evaluate bidder proposals, and create a financial model resulting in

$40 ***million USD*** mobilized	***Over 35 MW*** installed on rooftops of stores	***253,000*** CO_2 avoided

Over the five-year lifespan of USAID Clean Power Asia, rooftop solar grew significantly in Southeast Asia, particularly in Thailand and Vietnam. With rapidly decreasing costs of solar installations, this has become an increasingly attractive option for companies particularly because of the electricity demand from large C&I operations with ample rooftop space. While there were limited opportunities in Thailand to develop new projects for selling to the grid due to the lack of open procurements, there were no restrictions on installing rooftop solar for self-consumption. In Vietnam, the government provided incentives to stimulate the uptake of rooftop solar, leading to significant interest among C&I companies. USAID Clean Power Asia was instrumental in helping four companies in Thailand and Vietnam understand suitable business models, financing options, and contracting structures. This helped them implement their first rooftop solar projects for 55 installations with a total capacity of 54 MW.

In 2017, USAID Clean Power Asia worked with Big C Supercenter, an operator of retail hypermarkets located in shopping malls throughout Thailand, to explore options for rooftop solar at its stores. Big C aimed to reduce greenhouse gas emissions from its operations and considered rooftop solar as a way to achieve their goal. Program staff helped the company understand suitable business models to implement projects at its facilities and supported contract negotiations with solar developers. Big C chose to contract a solar service provider for the installation, operation, and maintenance of the solar system, and purchase the electricity output under terms specified in a PPA between the two parties. USAID worked with Big C

A garment factory in Bangkok's Bang Na district is harnessing the power of the sun and saving on electricity bills.

Photo credit: Madura Watanagase Abt Associates/ USAID Clean Power Asia

executives to validate key terms in the PPA and lent their expertise to create a negotiating strategy, and also developed a business model that focused on the aggregation of electricity demand for Big C's multiple stores.

Subsequently, Big C awarded a contract to Impact Solar to install solar PV systems of 1 MW each on the rooftops of 16 of its stores throughout Thailand, with a total investment estimated at THB 880 million (USD $25 million). The first system to come online in 2018 supplied 20 percent of the store's electricity consumption in the first month, representing cost savings of nearly five percent. Following this first phase, Big C expanded the rooftop solar program to several more of its stores, and to date, these efforts have led to more than 35 MW of installed capacity at 46 stores throughout Thailand. Big C plans to install additional rooftop solar with a target to produce more than 100,000 MWh of electricity per year from solar by 2025, equivalent to the electricity consumption of nearly 55,000 households in Thailand. With the installations so far, the company is already halfway to meeting that target.

Besides Big C, USAID Clean Power Asia also advised Thai Union Group PLC, a Thailand-based global producer of seafood products, on rooftop solar opportunities. In 2015, the company developed a CO_2 emissions reduction roadmap to prepare for a carbon-constrained future, and set a target to reduce overall CO_2 emissions by 30% by 2020. Program staff supported the company in the assessment of various financing options for rooftop solar at its facilities, which helped the company implement the first installations at six factories with a total capacity of nearly 8 MW.

Big C Supercenter in Pathum Thani, Thailand, was one of the first of 16 rooftops to have a 1 MW solar rooftop installation.

Photo credit: Michael Wykoff Abt Associates/ USAID Clean Power Asia

Following the successes with Big C and Thai Union in Thailand, USAID Clean Power Asia expanded its work on rooftop solar to Vietnam. To support to the development of rooftop solar, the program formed a partnership with the Clean Energy Investment Accelerator (CEIA), jointly led by Allotrope Partners, World Resources Institute (WRI), and NREL. CEIA organized regular RE buyers working group meetings in Vietnam, together with USAID V-LEEP, bringing together various stakeholders in promoting rooftop solar in the country. Program staff and CEIA jointly provided direct support to multiple companies by conducting initial economic feasibility studies, supporting companies to design the procurement for solar PV systems, and demonstrating the commercial viability of solar PV rooftop investments. The partnership provided advice to several businesses to implement rooftop solar at their facilities.

With support from the partnership in 2018, Amata, a leading industrial estate developer in Thailand and Vietnam, solicited proposals for a 104 kW solar system at its office premises at the Amata City Bien Hoa industrial estate in Dong Nai province, installed and commissioned in 2019. A few other companies also solicited proposals for initial systems at their facilities, but for a variety of reasons these have not resulted in installations to date. Lastly, program staff and CEIA successfully supported the national supermarket chain MM Mega Market, an operator of hypermarkets and convenience stores in Vietnam and owned by the same parent company as Big C, to implement rooftop solar at its facilities. Program staff initially began supporting MM Mega Market on solar rooftop in 2018, based on their work with Big C in Thailand. In 2020, the company solicited proposals for installations at multiple stores, and in coordination with CEIA, program staff provided advice on the draft power purchase agreement (PPA), leading the company to sign a private PPA with a solar developer for 12 sites across Vietnam, with a total capacity of 10 MW.

LESSONS LEARNED

Rooftop solar installations in Thailand: At a time when the solar rooftop market in Thailand was still in its infancy, the cooperation with Big C and Thai Union demonstrated the technical feasibility and economic benefits of using solar technology and provided a clear business case for the C&I sectors in Thailand to install rooftop solar systems. Since the first systems were installed on Big C stores, other major retailers have also signed private PPAs with solar service providers for rooftop solar installations at their stores. The manufacturing sector is also interested and many factories currently obtain part of their electricity needs from rooftop solar. While there are no official statistics for rooftop solar installations in Thailand, program estimates show that total installations in the country have reached nearly 1 GW.

Private sector partners: These experiences show the importance of working with private sector partners that make commitments to reducing climate impacts, early on recognize the business case for the adoption of RE solutions, and employ innovative financing and technology solutions. Both Big C and Thai Union had already set sustainability goals and targets to reduce emissions from their operations, which made them highly receptive to the program's advice on suitable business models and financing options.

Limitations and restrictions: Despite the regulatory restrictions for rooftop solar in Thailand, the Thai solar rooftop market has grown to be highly active with multiple developers offering long-term PPAs at competitive discounts to the grid tariff. At the same time, because of the restrictions, the market is not able to reach its full potential. The current regulations only allow for rooftop solar for onsite use and do not allow the sale of electricity to the grid or a potential buyer in another location. This means that the attractiveness of rooftop solar is largely restricted to facilities that operate every day and have a sufficiently high electricity consumption during sunlight hours. Facilities that operate only on weekdays would not be able to sell any electricity generated during the weekend to the utility or another offtaker, so this reduces the optimal size of a rooftop solar system and affects the return of investment.

Regulations and incentives in Vietnam: In contrast, the case of Vietnam shows the importance of regulations in developing a private sector driven market. Since the Government of Vietnam issued new regulations and incentives for the sale of electricity from rooftop solar to the grid in April 2020, the country experienced an unprecedented development of rooftop solar. To be eligible for the incentives, projects had to complete installation and connect to the grid before the end of the year, leading to the addition of more than 9 GW of rooftop solar capacity in only a few months.

Experience shows importance of collaborating with companies that make a commitment to reducing climate impacts and recognize business case for adopting renewable energy and using innovative financing and technology solutions.

2 UTILITY-SCALE SOLAR AND WIND IN VIETNAM

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

By the numbers

257 MW

from B.Grimm Power solar project that mobilized

$283 million

48 MW

from Sermsang wind project that mobilized

$115 million

Over the program's lifetime, Vietnam had the best potential in the Lower Mekong region for the development and implementation of utility-scale solar and wind projects. In 2017, the Ministry of Industry and Trade (MOIT) launched incentives for utility-scale solar and in 2018 enhanced incentives for wind power. The incentives included a standard PPA for selling electricity to Vietnam Electricity (EVN), the national utility, at attractive, USD-indexed tariffs for a period of 20 years. This attracted significant interest from both local and international developers and investors, and led to the rapid development of multiple projects, particularly in southern Vietnam because of its higher solar irradiation and wind speeds.

Despite the attractive tariffs offered, most international investors and lenders considered utility-scale solar and wind project development in Vietnam risky because of certain provisions in the standard PPA, which is non-negotiable. Because under the PPA, EVN is the sole buyer and projects cannot sell to other offtakers or add storage, it is crucial for investors that EVN buys all the electricity a project can generate. However, the PPA allows EVN to restrict purchases when demand is low, or the electricity grid is experiencing issues. This is known as curtailment, which can significantly affect a project's revenue over its lifetime and makes it difficult to estimate the profitability of the project. For lenders it also means that they have limited confidence that a project would be able to repay a loan. Because of the limited capacity of the transmission grid, the risk of curtailment is high and some projects have already experienced curtailment since starting operations. Other clauses in the PPA related to contract termination

USAID Clean Power Asia supported B.Grimm Power in identifying and finalizing a financing structure for its 257 MW Phu Yen solar project in Vietnam.

Photo credit: B.Grimm Power Public Company Limited

and arbitration are also not acceptable to most international investors and lenders. In case of PPA termination due to a default by EVN, the termination payment would be limited to the project's electricity output during the previous year, while mediation and resolution of any disputes between EVN and the project would be handled by MOIT agencies.

Before the construction of a particular project can start, its developer needs to secure financing from different sources to cover the total costs of construction. This may include equity capital from the project developer, loans from a bank or other types of lenders, as well as short-term financing from the equipment supplier or the construction contractor, often called vendor financing. Because of the curtailment risk and other limitations, project developers were restricted in ways that they could finance their projects.

To overcome some of these barriers, USAID Clean Power Asia worked with several developers in their efforts to secure financing for their projects in Vietnam under the circumstances. Program staff provided support to identify appropriate financing structures for their projects, which relates to the different types of financing instruments involved in reaching financial close, including loans, equity, vendor financing, guarantees and letters of credit. Financial close refers to the stage when all the financing agreements have been signed, and funds are made available to start construction. All financing needs to line up in a way so that all parties including banks, investors, equipment suppliers, and contractors are satisfied with how major risks are covered.

USAID Clean Power Asia's 2019 success story featured Mrs. Preeyanart Soontornwata, CEO of B.Grimm Power, as a leading example of how women can find success in the energy sector.

Photo credit: B.Grimm Power Public Company Limited

Program staff supported the Thai company B.Grimm Power PLC, Thailand's oldest infrastructure developer and one of the largest private power producers in Southeast Asia, in identifying and finalizing a financing structure for its first solar project in Vietnam, the 257 MW Phu Yen project, jointly developed with its local partner Truong Thanh Viet Nam Group (TTVN). The partners planned to finance the project with equity from both partners and a loan from the equipment supplier. Program staff supported B.Grimm Power and TTVN to explore several possible alternatives to unlock the full amount of vendor financing required for the total project size. Discussions with several banks, RE developers, private equity funds, and investors allowed the partners to identify the most suitable financing structure, thus enabling financial close and implementation up to the total planned capacity and allowing the project to complete construction and start operations in June 2019.

Similarly, program staff worked with Sermsang Power Corporation PLC, a renewable energy-focused independent power producer from Thailand, to identify a suitable financing structure for its 48 MW wind power project in Vietnam. To overcome bankability constraints, program staff engaged with multiple banks and private equity funds and advised Sermsang on options, which helped the company to reach financial close and sign the engineering, procurement, and construction (EPC) contract for the project, with construction beginning in August 2020 and commercial operations scheduled to begin in October 2021.

LESSONS LEARNED

Partnerships and engagement: USAID Clean Power Asia's support to utility-scale solar and wind in Vietnam facilitated 305 MW of installed capacity. Program staff worked closely with two Thai companies to identify suitable financing structures so project construction could begin. In addition, program staff engaged with local developers and international investors to facilitate potential partnerships on investment opportunities in solar and wind in Vietnam. Additional opportunities arrived via conferences, referrals, industry associations, as well as developers contacting the program directly.

Rapid development of utility-scale solar and wind in Vietnam: Despite concerns of international developers and lenders, Vietnam witnessed a rapid development of utility-scale solar. At the end of June 2019, when the first set of regulations expired, over 4 GW of solar had been installed. Furthermore, the launch of new incentives in April 2020 for projects already under construction led to the completion of an additional 1 GW by the end of 2020. All of this occurred in less than four years since the launch of the initial incentives and made Vietnam a leader in utility-solar in Southeast Asia. Similarly, wind power is also experiencing a rapid uptake in Vietnam, albeit to a lesser extent, due to the longer timeline and higher investment required. This shows that the tariffs offered by the Government of Vietnam were sufficiently attractive for investors to overcome their concerns about the risk of curtailment. Nevertheless, curtailment is affecting projects that have started operations, especially in areas with a high concentration of solar and wind projects and limited grid capacity.

Regional investors: While most international developers and investors choose not to participate in the Vietnam solar market, investors from other Southeast Asia countries were less risk averse and played an important role in the rapid development of the solar market. In particular, multiple Thai companies actively sought partnerships with Vietnamese developers to implement large-scale projects, partially due to the lack of project opportunities in Thailand and a drive to expand their operations across the region. For example, B.Grimm Power invested in two large projects, with a total capacity of 677 MW, accounting for nearly 80% of the company's solar investment in Southeast Asia. Besides its wind project, Sermsang Power Corporation also invested in a 50 MW solar project in Vietnam.

Limited financing options: As mentioned, most international lenders consider the Vietnamese solar and wind market too risky, and as a result, few renewable energy projects in Vietnam have been financed by international banks. Despite this restriction, the high number of installations shows that developers were able to finance their projects. Multiple Vietnamese banks provided loans, but mostly to Vietnamese companies and secured by corporate guarantees.

Innovative finance structures: Regional investors like B.Grimm Power and Sermsang Power Corporation, unable to obtain loans from Vietnamese banks, had to rely on innovative finance structures such as vendor finance. This means that the EPC contractor provides a short-term loan to purchase the contractor's products and services. The project will need to repay the loan at a predetermined point of time, usually at or after the start of operations. While this allows companies to build their projects, the short-term nature of vendor finance means that they will need to obtain long-term debt to replace vendor financing, with a risk that they may not able to do so or only at a high cost. ADB has provided long-term financing for a few projects that have started operations, including B.Grimm's Phu Yen solar project.

CAPACITY BUILDING ON PROJECT FINANCE FOR RENEWABLE ENERGY

USAID Clean Power Asia and USAID V-LEEP collaborated on a training event on the fundamentals of financing for solar PV projects in Vietnam in June 2018.

Photo credit: James Grall Abt Associates/ USAID Clean Power Asia

Following the launch of incentives for solar and wind projects in Vietnam, developers and investors started to seek financing for their projects, typically from a combination of equity from investors and debt from banks or other lenders.

At the launch of incentives, Vietnamese banks were largely unfamiliar with solar and wind, so there was a lack of understanding of the elements and risks of financing renewable energy, making banks reluctant to provide loans without guarantees from the project developer.

To maximize the potential returns on investment from a particular project, project developers aim to maximize the portion of the investment costs that is financed by debt. To do so, developers will typically seek to finance their projects via a project finance structure. Project finance is a special method of raising long-term debt financing commonly used for capital intensive projects with high upfront costs, such as power plants and other infrastructure projects. Under a project finance structure, a lender's decision whether to provide a loan to a project is largely based on the cash flow that the project is expected to generate, without really considering income streams from other projects that the project developer may own. This means that the lenders will have no or limited recourse to the project sponsors in case the project performs below expectations, so a lender needs to clearly understand the risks involved in providing a project loan and how risk can be minimized.

Local banks and project developers in Vietnam are still relatively unfamiliar with the concept of project finance for solar and wind. To overcome this barrier and to facilitate increased financing, USAID Clean Power Asia partnered with organizations on multiple training workshops on financing solar and wind projects in Vietnam. These workshops were designed to be practicable and interactive, with case studies and financial modeling exercises so that participants could gain hands-on experience in project assessment. Program staff provided training to local banks and project developers, totaling more than 400 participants, of which over 30% were women.

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

By the numbers

54
participants
(37 men/17 women) attended 2019 project finance workshop with GWEC

200
loan officers
trained in Vietnam in 2019

335
people
attending virtual business matchmaking session in 2020 with GWEC

5
Local developers
who presented and proposed wind power projects at Virtual Wind Power conference in June 2020

For capacity building on financing solar projects, USAID Clean Power Asia collaborated with USAID V-LEEP, and in 2018, held the first in a series of training workshops on the fundamentals of financing solar projects in Vietnam, targeting local banks, investors, and project developers. Following a training workshop for 200 loan officers from VietinBank in Hanoi in 2019, two additional training workshops were held in Hanoi for the Saigon-Hanoi Commercial Joint Stock Bank (SHB) and the Bank for Investment and Development of Vietnam (BIDV). All three banks provided the training facilities at their headquarters for the workshops. For each of the workshops, USAID V-LEEP coordinated with banks and presenters from local organizations, and USAID Clean Power Asia staff delivered a half-day session on project finance and financial modeling for solar projects. The sessions began with the characteristics of project finance, elements of cash flow analysis, and critical success factors when lending to utility-scale solar projects, then moved to a demonstration of a financial model as typically used by banks to analyze the potential financial performance for solar projects. Lastly, workshop participants worked on a case study and financial modeling exercise allowing them to gain hands-on experience in solar project analysis. For the case study, workshop


Photo credit:
iStockphoto

Participants at the ***Vietnam Wind Power 2019*** conference work together in a training session on financing wind power projects in June 2019.

Photo credit: Global Wind Energy Council

participants had a project case and an Excel-based financial model, and worked in small groups to analyze the potential project and make a loan recommendation.

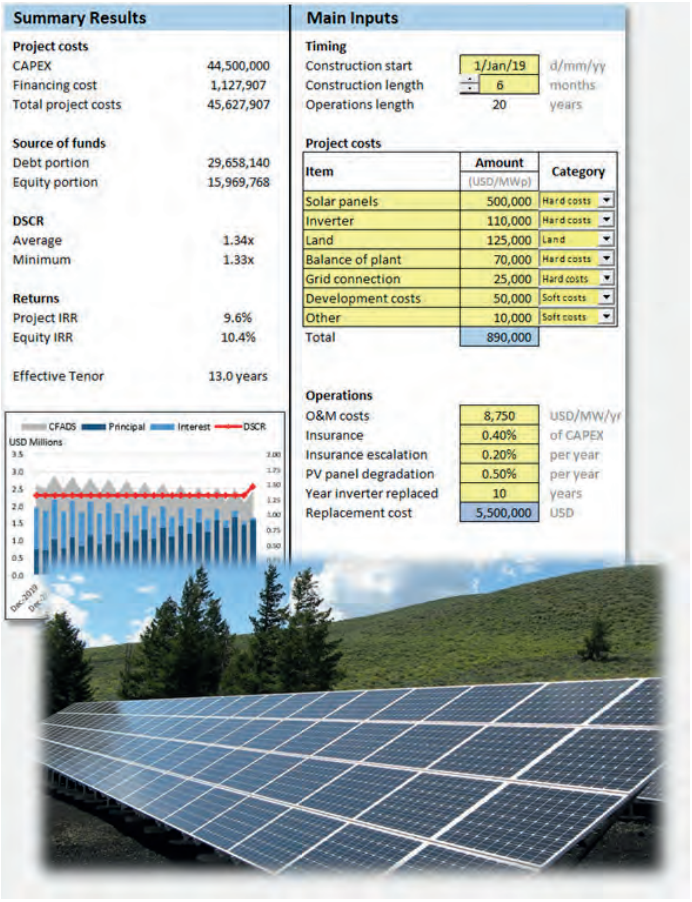
With regard to training on financing wind projects, USAID Clean Power Asia partnered with the Global Wind Energy Council (GWEC), and in 2019, organized a half-day training session during GWEC's ***Vietnam Wind Power*** conference in Hanoi. The program also co-sponsored the Finance Workshop, gathering experts to discuss how the industry could overcome project financing challenges in Vietnam's wind market, as discussed previously. The training session followed a format similar to the solar training workshops for local banks, starting with characteristics and critical elements of project finance for wind projects, followed by a financial model demonstration, and concluding with a case study and financial modeling exercise, in which participants assessed key risks of a potential wind project.

Because this training session was accessible only to conference delegates, there were only a few participants from local Vietnamese wind developers. To reach more local Vietnamese players, program staff and GWEC worked together to organize a follow-up workshop, specifically targeted to local project developers. Initially scheduled for February 2020 in Ho Chi Minh City, the event was canceled due the uncertainty surrounding the COVID-19 outbreak. Therefore, program staff adapted the workshop to an online format and held a virtual training workshop later in the year. Representatives of eight local wind project developers participated in the workshop, working on a case study and financial modeling exercise to enhance practical understanding of project finance. Because the online format limited the interactive nature of the workshop as compared to in-person events, program staff also recorded a separate session focusing on the case study and financial modeling exercise and shared this with all participants after the workshop.

LESSONS LEARNED

Interactive training workshops on project finance: The highly interactive and practical nature of the various training workshops was well received by participants. The case study and financial model exercises provided them with an opportunity to gain hands-on experience with the financial analysis and risk assessment of solar and wind projects. This allowed participants to consider project and risk assessment beyond financial performance. For many developers in Vietnam, still relatively new to the concept of project finance, it also provided a perspective on how banks approach project assessment when considering a loan application. The positive feedback from the financial modeling exercises during training workshops also provided the basis for developing and releasing the standard financial models for utility-scale solar, wind and biomass power in Southeast Asia (see next section).

Close engagement with key stakeholders: Conversely, the workshops provided program staff with opportunities to closely engage with local and international banks, developers, and investors. This allowed a better understanding of the nature of the solar and wind markets in Vietnam and identified opportunities to provide support to companies.



In 2020, USAID Clean Power Asia published standard financial models for utility-scale solar, wind, and biomass power.

Image credit: Kwanta Norkum Abt Associates/ USAID Clean Power Asia

> Positive feedback from financial modeling exercises during training workshops provided basis for developing standard financial models for utility-scale solar, wind and biomass power in Southeast Asia.

TOOLS AND GUIDELINES FOR THE PRIVATE SECTOR

MAJOR HIGHLIGHTS AND ACHIEVEMENTS

By the numbers

6
tools and guidelines
published

over
3,000
downloads

In order to impact the private sector's ability to develop, finance, and implement grid-connected RE projects beyond the life of the program, USAID Clean Power Asia developed and released several tools and guidelines to support developers, investors, and lenders in their activities.

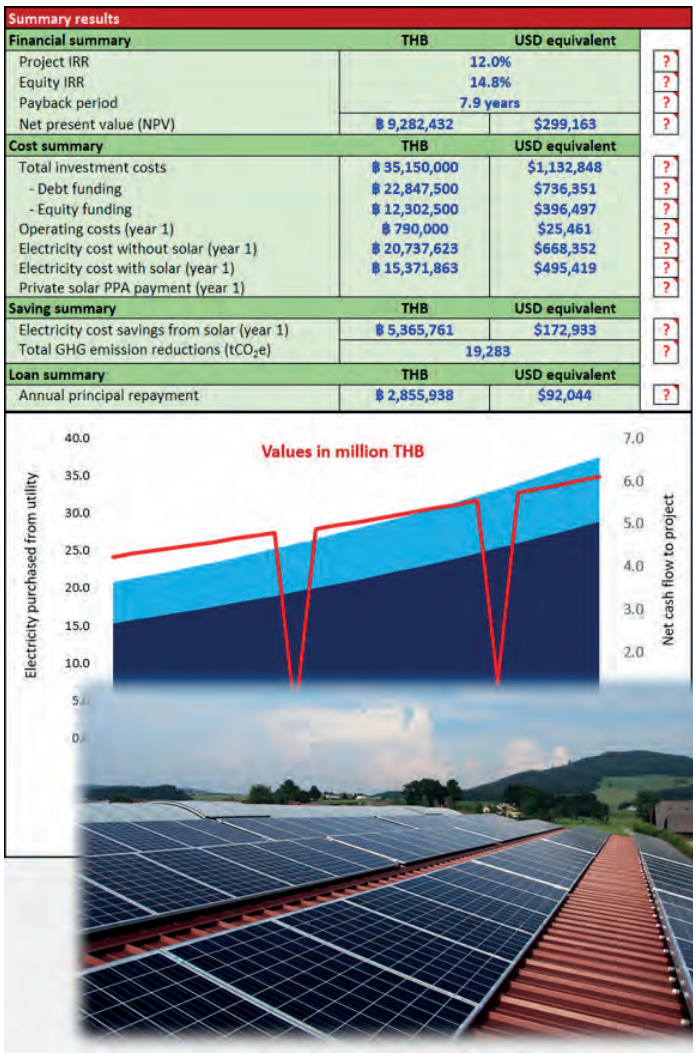
Based on lessons learned from support to Big C and Thai Union on rooftop solar, in 2018, USAID Clean Power Asia worked with GIZ to develop and publish guidelines for solar rooftop project development in Thailand. The ***Renewable Energy Guidelines on Solar PV Rooftop Implementation: Thailand*** provide easy to follow step-by-step guidelines on how to implement a rooftop solar project in Thailand. It is an interactive guidebook, using Gantt charts and flow charts to visualize the processes and documentation required for a project, covering site evaluation, contractual agreements, financing, permitting and licensing, construction and installation, grid connection and commissioning, and lastly, operation and maintenance. The guidelines are packaged with a financial model and a template for a private PPA that companies can use in project preparation and negotiation with solar service providers.

To enhance understanding of the regulations and financing for utility-scale solar in Vietnam among a wider audience, in 2019 USAID Clean Power Asia published ***Bankability Guidelines for Utility-Scale Solar Projects in Vietnam*** and an accompanying financial model. The guidelines provide an overview of bankability aspects of solar projects in Vietnam, aiming to support developers

USAID Clean Power Asia and GIZ jointly released guidelines for rooftop solar in Thailand to help companies navigate the development and permitting process.

to improve project bankability and assist lenders and investors in the evaluation of potential opportunities. The financial model was provided as a tool for evaluating utility-scale solar projects in Vietnam, allowing users to conduct a preliminary assessment of a project's ability to service the debt and to analyze the most critical factors that impact profitability and bankability of a solar project. The guidelines provided an overview of the regulations for utility-scale solar, as issued by the Government of Vietnam in 2017. In April 2020, the government issued new regulations for solar, so program staff released a revised version of the guidelines, incorporating the new regulations.

In 2020, USAID Clean Power Asia published standard financial models for utility-scale solar, wind and biomass power, as tools for preliminary financial assessment of projects in Southeast Asian countries with a potential for grid-connected RE (Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand, and Vietnam). The models allow users to conduct an initial financial analysis of a project's ability to service the debt under a variety of debt structures. They also serve to analyze and identify the most critical factors that impact profitability and bankability of a project. The models were introduced in a webinar on ***Financial Modeling for Utility-Scale Solar, Wind and Biomass Power in Southeast Asia***. The webinar discussed the role of financial models in project finance for RE, explained the mechanics of the financial models, and demonstrated how to use them. Program staff also provided insight into how lenders use financial models to assess the viability of a renewable energy project and how participants can use the three financial models to identify a financing structure acceptable to both lenders and equity investors.



In late 2020, USAID collaborated with CEIA to publish a standard financial model for rooftop solar at C&I facilities for companies to assess financial feasibility of rooftop solar at their facilities.

Image credit: Kwanta Norkum Abt Associates/ USAID Clean Power Asia

Feedback from the webinar showed that there was significant interest in a similar financial model for rooftop solar projects. Therefore, program staff started working with CEIA to develop a financial model for rooftop solar at C&I facilities, provided as a tool to companies to assess the financial feasibility of rooftop solar at their facilities. USAID Clean Power Asia and CEIA officially launched the final model during a webinar on ***Evaluating Rooftop Solar Opportunities at Commercial and Industrial Facilities in Southeast Asia*** in December 2020. The webinar also discussed market challenges and opportunities for C&I rooftop solar in Southeast Asia and the need for tools to assess projects opportunities and included a live demonstration of the financial model.

In 2019, USAID Clean Power Asia launched the monthly ***Renewable Energy Transaction Update*** with updates specifically relevant to the private sector. The e-newsletter provided a concise update of market transactions and major developments at project level (e.g., the provision of loans, the signing of PPAs, mergers and acquisitions, and start of project construction and operations). At the beginning of each month, USAID Clean Power Asia sent the update by email to its over 5,000 subscribers. Since the launch of the newsletter, program staff received positive feedback and multiple requests to be added to the mailing list, showing a clear need for concise updates on RE projects and transactions in the region. In addition, program staff learned that an international investor used the updates to gauge investments in wind power in Vietnam.

To improve power sector planning, USAID Clean Power Asia collaborated with NREL and ACE to create the Southeast Asia Renewable Energy Data Explorer, a web-based analysis tool that uses geospatial and spatiotemporal data to visualize, execute, and support analysis of RE potential. To promote the tool among the private sector, program staff worked with USAID, NREL, and the Private Financing Advisory Network (PFAN) to launch the tool at the ***Asia Clean Energy Forum*** in 2019 in Manila, during a deep-dive workshop focusing on challenges in utility-scale wind energy and solar project development according to project developers, investors, and governments.

In early 2021, NREL launched an enhanced version of the Southeast Asia Renewable Energy Data Explorer, which provides high-quality, robust, and reliable renewable solar data, including 10-minute temporal resolution and 2-kilometer spatial resolution resource data. To promote the updated version, program staff supported NREL on a webinar targeted specifically to private sector stakeholders, held in April 2021.

LESSONS LEARNED

Need for quality RE information: Total downloads for the four financial models total over 3,000, and other tools and guidelines also saw high download numbers, with the two implementation guidelines downloaded more than 1,400 times. Feedback from surveys and direct communication indicated the tools were well received and appreciated. This positive feedback and high number of downloads shows there is a clear need for RE information in Southeast Asia specifically targeted toward the private sector.

Tools for the private sector: While there is sufficient general information available on RE technologies, tools that are relevant to project developers and other private sector stakeholders are less readily available. Based on extensive previous experience working with private sector companies in the region, program staff made a concise effort to provide tools and guidelines that are succinct, specific, and practicable.

> Positive feedback and high download numbers show that there is clear need for RE information in Southeast Asia specifically targeted towards private sector.

After an RE incentives workshop in July 2017, participants visited a solar farm in Nakhon Ratchasima, Thailand.

Photo credit: Michael Wykoff Abt Associates/ USAID Clean Power Asia

IV PROMOTING ENHANCED REGIONAL COLLABORATION

- *Covid-19 Pandemic Adaptation*
- *Communications*
- *Gender*
- *Partnerships*

Photo credit:
Joost Siteur
Abt Associates/
USAID Clean Power Asia

Promoting greater deployment of renewable energy was a primary objective of USAID Clean Power Asia, and the program took advantage of unique opportunities that existed to engage with both public and private sector actors across Southeast Asia and the globe.

Supporting enhanced collaboration built a foundation for sharing knowledge, leveraging resources, and replicating best practices, and over the past five years, USAID Clean Power Asia worked closely with partners and stakeholders across the region to build strategic relationships with organizations whose missions aligned with and complemented the program. USAID Clean Power Asia collaborated with the U.S. National Renewable Energy Laboratory, the Heads of ASEAN Power Utilities and Authorities (HAPUA), and the ASEAN Centre for Energy as a partner and subcontractor to increase grid integration of renewables and expand regional power trade, while international bodies like the International Energy Agency and the International Renewable Energy Agency engaged in program events to share lessons learned and best practices from across Southeast Asia. The program promoted enhanced regional cooperation by encouraging government counterparts and private sector actors to view one another as partners and collaborators, to gain an appreciation of each other's needs and capabilities, and to begin to understand how to utilize the wealth of resources among them.

Critical to enhanced regional collaboration was the promotion of program activities, resources, and success stories. USAID Clean Power Asia leveraged the program website to expand outreach by publishing toolkits, guidelines, and resources; kept partners and beneficiaries updated on program progress; and shared lessons learned. Program staff also presented at and participated in key regional conferences like the ***Asia Clean Energy Forum, Singapore Clean Energy Week***, the ***ASEAN Energy Business Forum***, and the ***Sustainable Energy Technology Asia*** conference.

ASEAN member states have more to gain from coordinated efforts and knowledge sharing than they do going it alone in this rapidly evolving space, so the program employed regional and international partners to share knowledge and lessons to benefit those contemplating similar steps in their power systems. USAID Clean Power Asia ensured that coordination and learning were built into all activities and provided value to USAID and the many actors along the renewable energy value chain.

COVID-19 Pandemic Adaptation

A hybrid event for the ***Stakeholder Workshop on the Development of Thailand's BESS Technical Standards*** took place in February 2021 in Bangkok.

Image credit: Kwanta Norkum Abt Associates/ USAID Clean Power Asia

The emergence of the COVID-19 global pandemic in early 2020 presented the USAID Clean Power Asia team with unprecedented implementation challenges. The appearance of the first imported case in Thailand occurred in mid-January, with confirmation of local transmission by February and rapid spread throughout the region, culminating in the designation of a pandemic by the World Health Organization on March 11. This global event significantly impacted the timing and design of activities in the Year 4 work plan, both across the region and in the countries where USAID Clean Power Asia was implementing activities.

The impacts of COVID-19 caused postponements and delays across tasks due to restrictions on travel and large gatherings, including meetings with government counterparts. By mid-2020, the Southeast Asian countries where USAID Clean Power Asia worked formalized immediate restrictions causing program staff to adapt. In Thailand, universities moved to online classes and government employees began to work remotely. In Laos, the government prohibited meetings with foreigners, postponed any large gatherings, and moved to remote work. In Vietnam, the government stopped issuing visas for

foreigners and Manila, Philippines, was on lockdown. These restrictions forced USAID Clean Power Asia to implement all activities without staff, consultant, and subcontractor travel, and with the support of local consultants, all events moved to a virtual environment.

Travel in the region became impossible due to widespread border closures. The inability of program staff to travel in the region was compounded by requirements for government counterparts and other partners working from home, some with insufficient access to necessary IT infrastructure. These twin actions meant that USAID Clean Power Asia had to postpone many activities that were to take place which resulted in lingering impacts to subsequent activities. To the extent USAID Clean Power Asia was able, program staff supplemented delays with additional virtual activities. USAID Clean Power Asia program staff finalized development of a detailed plan, adjusting work plan activities and schedules to the new working environment. Counterparts in Laos working from home were challenged by a lack of access to computers or laptops, as well as slow internet connections. For Thai government employees, requirements depended on their organizations, though most counterparts worked from home. By the second half of 2020, bans on foreign travel remained in place in Thailand, Cambodia, Laos, and Vietnam, though travel restrictions within countries eased and business began to resume, with limitations on the numbers of meeting participants and social distancing requirements in place. Despite national level restrictions slowly being relaxed as the pandemic came under greater control, normal program operations including regional and international travel for conferences and workshops did not resume for the remainder of the program. Delays experienced due to COVID-19 often caused a chain reaction throughout subsequent sequenced activities that relied on completion of previous steps and as the pandemic continued, delays compounded despite the best efforts of program staff to predict and mitigate them.

The AIMS III study was completed with all meetings of ASEAN member states' representatives held virtually. This, combined with challenges in obtaining data, resulted in completion of the study a year later than originally planned. The completion of the IRRP in Laos was delayed a full year due to COVID-19 related travel restrictions for subcontractor SEI, while the technical connection regulations also fell behind due to a delay in gathering required data. The completion of the design for the Laos solar pilot auction was extended a full year due to delays in finalizing decisions about available land and the auction design; implementation now awaits official approval by the Government of Laos. The completion of the planned work in Thailand on BESS technical standards was delayed due to interruptions in the approval process caused by COVID-19 and continuing work on DPV net metering policy in the Philippines was delayed due to a lockdown in Manila in early 2020.

Several regional workshops were converted to an online platform and additional webinars were added under the Asia EDGE Power Sector Learning Series, including a planned regional workshop on rooftop solar which was converted to a series of three webinars and GWEC's ***Vietnam Wind Power*** Conference, which became a virtual event co-hosted by the program. While typical opportunities for face-to-face partnership meetings did not occur due to COVID-19, especially with regard to new relationships, the pandemic did provide opportunities to support activities implemented by USG agencies, including USTDA and DFC. The Asia Clean Energy Forum, a partnership with ADB, moved to a virtual platform while still providing opportunities to collaborate with NREL and USAID India on side events.

Communications

USAID Clean Power Asia's program website launched in 2017 and is hosted on the web architecture of USAID partner ASEAN Centre for Energy.

Image credit: Kwanta Norkum Abt Associates/ USAID Clean Power Asia

Over the past five years, USAID Clean Power Asia communications and outreach utilized various channels to reach as wide an audience as possible, utilizing an email marketing platform to promote program events and activities; distributing a weekly news digest; and publishing monthly renewable energy transaction updates and the e-newsletter **RE*brief***, while also cross-promoting program events and publications with USAID/ RDMA and other partners. The USAID Clean Power Asia website, an easily accessible portal optimized for laptop, tablets, and mobile phones, sits on a web architecture operated by partner and subcontractor ACE, and was utilized to disseminate program news and information and resources to download, especially from major program events. Apart form working with journalists, communications staff used USAID's social media channels as communications platforms to reach a wider audience. In mid-2019, communications staff created and administered an **RE*Champions*** Facebook group as an additional channel to engage with RE leaders to strengthen collaboration within the region.

Since the start of the program in July 2016, communications highlights and achievements include many successes. The USAID Clean Power Asia website attracted an average of 1,300 visitors per month in Year 4, and during the life of the program, there were over 350 resources published with 140,000

page-views and 37,000 new users. More than half of users were female and the most frequent users were those aged 25-34 years, followed by people aged 35-44. Growing the subscriber list to over 5,000 subscribers; publishing 39 monthly newsletters; developing and updating program collateral, including program factsheet, four task factsheets, and a private sector marketing piece; and publishing four full-lenth success stories to promote USAID's energy work in Southeast Asia as part of Asia EDGE were among notable achievements. Success stories covered topics featuring work on DPV in Thailand; the success of Big C and solar rooftop; how a woman-led company, B.Grimm Power, the largest independent power producer in the region, won solar project of the year for a plant in Vietnam; and the success of completing the first step on a solar pilot auction in Laos. Communications products, including regular biweekly program updates to the Mission, yearly success stories, and impact statements, were aligned with a structure to best align with USG objectives including the Indo-Pacific Strategy, Asia EDGE, and the Journey to Self-Reliance.

Supporting program staff on event collateral, including production of all required documents, social media toolkits, and all other necessary materials, ensured compliance with USAID branding and marking requirements. Activities included creating an event page on the website with photos and presentations to download, and following up with all attendees with outreach directing them to the event page, ensuring they had a fruitful experience and offering the opportunity to provide additional feedback. Communications staff assisted in the successful launch of webinars in the **RE*learning*** series and in the Asia EDGE Power Sector Learning Series, and cross-promoted the webinars with partners. Working with investment mobilization staff to launch a monthly renewable energy transaction updates proved highly effective, as did publishing multiple resources including four financial models for utility-scale solar, rooftop solar, wind, and biomass power, which had well over 3,000 downloads.

USAID Clean Power Asia collaborated with USAID/RDMA to develop and publish an article in the March 2020 issue of ***Forbes Thailand***, with over 3,000 online views, to promote USAID Clean Power Asia's financial advisory services and USAID's energy sector work in general. In Year 3, USAID Clean Power Asia launched two phases of a paid outreach program using short solar rooftop videos in Vietnam, garnering over 88,000 views with 350,000 impressions, and in Thailand, with over 44,000 views and 200,000 impressions, via YouTube advertisements to promote USAID Clean Power Asia and seek additional transaction advisory clients for rooftop solar investment. The program held a successful closing event accompanied by a video highlighting program achievements and legacy.

There were many communications lessons learned during the life of the program, including how to increase success with outreach and communications by being proactive, responsive to queries and requests, and maximally flexible with unforeseen circumstances. With program staff following an official telecommuting policy due to the COVID-19 pandemic, the communications team still worked effectively to support program activities and technical staff to accomplish work plan activities.

As the program ends, USAID Clean Power Asia will migrate the website content and share web elements with ACE for their permanent library. The database of subscribers will be shared with USAID, so they will continue to receive useful updates on activities from USAID and partners, and the suite of videos published on USAID/RDMA's YouTube page will be available for use after the end of the program.

Gender

Madura Watanagase leads a discussion with the USAID Clean Power Asia RE*Champions*, convening for the first time at ACEF in Manila in June 2019.

Photo credit: Dr. Supawan Saelim Abt Associates/ USAID Clean Power Asia

Gender equality is fundamental for the full enjoyment of human rights by women and men alike. Women are underrepresented in the energy sector and face disparities in access to training, financial resources, and technology to be equitable generators and users of renewable energy. Promoting gender equality while improving the status of women and girls is vital to achieving USAID's development objectives. At the beginning of the program, USAID Clean Power Asia put in place a ***Gender Implementation Plan*** to guide integration of gender equity considerations into work planning. To ensure technical assistance would achieve the greatest results in reducing gender disparities in the energy sector, in August 2017, the program published a white paper, ***Gender Assessment and Strategy: Promoting Gender Equality in the Energy Sectors of Thailand, Cambodia, Lao PDR and Vietnam, Options and Opportunities for USAID Clean Power Asia***, providing an overview of the RE landscape in Lower Mekong countries; assessing gender issues and gender equality in the renewable energy sectors; and making recommendations for improving gender equality and responsiveness in the renewable energy sector.

Mainstreaming gender perspectives is a process of assessing implications for women and men of any planned intervention or action, and is a strategy for making the concerns and experiences of women and men alike an important part of design, implementation, and monitoring and evaluation of activities to prevent the continuation of gender inequality. USAID Clean Power Asia developed a ***Gender Mainstreaming Strategy and Checklist*** in August 2017, documenting gender issues and measures relevant to program tasks; specific activities to address systemic gender issues in the power sector; and a roadmap for gender-sensitive design in program activities, incorporating critical interventions to ensure inclusive stakeholder engagement and equitable benefits-sharing. A gender lens was not trained just outward in actitivies, but also inward, with program staff participating in intensive gender training in May 2017, learning key principles of gender inclusion and gender equality in development; working to better understand how implementing partners and government counterparts can be gender blind; and how staff could collaborate to ensure program tasks were doing no harm with regard to gender, but instead educating, informing, and ensuring women and men alike are considered in energy-related decision-making. .

In June 2019, USAID Clean Power Asia launched the **RE*Champions*** initiative by sponsoring women speakers and participants to attend the annual ***Asia Clean Energy Forum*** in Manila, creating a community of professionals in the region who could advocate for RE in their organizations and countries and build critical relationships among women in the energy sector. In February 2020, USAID Clean Power Asia published a profile of Mrs. Preeyanart Soontornwata, CEO of B.Grimm Power, one of few high-ranking women in the traditionally men-dominated energy sector. In the success story, ***Unleashing the Power of Women in Energy: A B.Grimm Power Success***, USAID highlighted how Mrs. Preeyanart navigated through crisis to lead one of the largest independent power producers in Thailand, and how she encourages women to seek knowledge, build coalitions, bring their unique capacities and perspectives to the table, and take on expanded technical roles in engineering and fieldwork.

In mid-2020, program staff completed a new ***Gender Equality and Inclusion Action Plan***, an impact-driven effort to raise awareness of gender equality and inclusion via outreach and capacity building activities; to facilitate networking and professional development opportunities for women in the region's RE sector; and ensure the inclusion of gender stories and information in program communications. Program staff implemented activities in the plan, including integration of gender awareness-building protocols into interventions, routine communications, and operations, and built gender inclusion into all Year 5 activities.

In late 2020, with nearly all activities virtual due to the global pandemic, USAID Clean Power Asia collaborated with partners to launch the Asia EDGE Power Sector Learning Series. Attended by hundreds of participants from around the world, this webinar series covered topics from distributed solar policy and regulations, to emerging trends and technologies and the evolution of policy frameworks. As a result of events going virtual, USAID Clean Power Asia saw participation by women increase for all webinars and online events. Through key interventions, USAID Clean Power Asia attempted to empower women in the energy sector, increasing participation in planning, policy, and decision-making processes; providing critical skills through trainings; and establishing networks of prominent women for increased access to information, reforms, and benefits that address gender disparities and improve their status as generators and users of energy.

Partnerships

Participants from around Southeast Asia participated in an RE incentives workshop co-hosted with ACE in Bangkok in July 2017.

Photo credit: Michael Wykoff Abt Associates/ USAID Clean Power Asia

In Southeast Asia, the investment necessary to serve growing demand, whether through conventional or renewable power sources, cannot be met with only public funds. Building partnerships was necessary for the program to achieve its objectives to leverage funding for RE investments and facilitate the close of projects. Throughout the life of the program, USAID Clean Power Asia staff attended and participated as speakers or panelists at forums, conferences, and exhibitions, providing opportunities to market the program, establish credibility, and allow for introductions to leading energy sector companies. Through a partnerships strategy, the program enabled greater development impact by building local capacity to sustain outcomes, mobilizing resources across partners, and bringing innovative ideas and technologies to interventions. Strategic partnerships with regional and global partners and other donors contributed to USG strategic regional goals, leveraged funding, and expanded the reach of technical assistance and capacity building, contributing to program results.

At the regional level, Abt Associates maintained a partnership and subcontract with the ASEAN Centre for Energy (ACE), providing a framework to collaboratively share knowledge, resources, and networks to advance objectives of both parties.

USAID Clean Power Asia built on the reputation and credibility of ACE within ASEAN member states to convene meetings and workshops and to complete AIMS III. Together with NREL and ACE, the program promoted regional use of the RE Data Explorer, an innovative web-based tool to visualize, execute, and support analysis of RE potential under user-defined scenarios. As part of an ongoing partnership with NREL, ACE also proved indispensable in the creation of the Southeast Asia RE Data Explorer. The program also collaborated with NREL to conduct policy analyses and regional knowledge-sharing on rooftop PV and battery energy storage systems to leverage NREL's deep technical expertise, complementing the in-country presence of program staff and consultants.

In partnership with ACE and NREL, as well as IRENA, HNEI, and IEA, regional workshops leveraged resources and expertise to address topics of interest to stakeholders including planning approaches to accommodate RE, battery storage systems, and RE incentives and auctions. Aligning efforts to enhance regional energy security and economic development, USAID Clean Power Asia supported RDMA's cooperation with JICA, in line with strategic goals prioritizing partnerships with regional allies under Asia EDGE and in support of the Japan-U.S. Mekong Power Partnership. In Laos, the program worked with JICA to seamlessly integrate their power system masterplan with the IRRP, by sharing data and analytical results and ensuring analytical frameworks were aligned, contributing to a more robust power development plan. Program staff collaborated with HNEI and GGGI in Laos to complete the auction site assessment and develop the necessary regulations to support the solar pilot auction, as well as future development of wind, solar, small hydro, and biomass projects. These organizations' technical expertise, experience, and funding complemented program resources, enabling development of grid codes, technical connection requirements, and technical standards. In Vietnam, collaboration with USAID V-LEEP, CEIA, and GWEC advanced program goals with on-the-ground support for investment mobilization activities, including cooperation on multiple seminars and workshops on fundamentals of financing for solar PV projects and a finance workshop at the ***Vietnam Wind Power Conference 2019***. As a result, program staff established new and expanded partnerships with developers and investors to complete rooftop PV, solar, and wind projects in the country.

The COVID-19 pandemic required in-person workshops to be converted into virtual events, resulting in a wind project training webinar with GWEC and a webinar with CEIA to launch the rooftop solar financial model, one of four financial models that allow developers to gauge potential project profitability and bankability. These partnerships yielded significantly greater participation in online events than USAID Clean Power Asia would otherwise bring and enabled a greater number of trainings and events through cost-share agreements. The GWEC partnership included the ***Thailand Wind Energy Roundtable***, which brought together high-level energy officials and wind industry representatives to discuss revisions to the country's wind target in the PDP, resulting in Thailand increasing a commitment to wind power in the latest plan.

In the last year of program activities, USAID Clean Power Asia continued to foster partnerships with HNEI, GGGI, CEIA, and GWEC, and solidified new collaborations with ClimateWorks Foundation and C40 Cities. These partnerships leveraged funding to expand program reach, tapped into additional technical resources, and aligned activities towards program objectives. During the past five years, USAID Clean Power Asia leveraged over $1 million USD in direct and in-kind resources from program partners and supporting governments to enhance activities designed to achieve common goals.

4 MONITORING, EVALUATION AND LEARNING

Led by the Chief of Party (COP), Deputy Chief of Party (DCOP), and Monitoring, Evaluation and Learning (MEL) Specialist, the MEL system was systematically managed based on the official MEL Plan.

Over the past five years, a considerable number of MEL activities were undertaken to ensure the quality of data planning and collection, as well as regular data quality assessments and verification, and to respond to emerging issues related to the execution of the MEL plan including learning components. Data managed through the MEL system includes quantitative and qualitative data used to inform program achievements as regularly reported to USAID/RDMA and most importantly, to improve program activities and direction.

Throughout the life of the program, key achievements from implementing program activities have had many benefits, and can be divided into four discrete levels: Regional, Country, Organizational, and Individual, as summarized below.

Regional Level

- Under the ASEAN Plan of Action for Energy Cooperation 2016-2025, **RE target was improved** by increasing RE power capacity contribution to target from 30% to 35% by 2025.
- Over **93 million tons of carbon dioxide** are estimated to be avoided for the next 15 years.
- Through **knowledge sharing** among regional actors, over 5,000 subscribers have received RE knowledge/information through over 50 electronic outreach/ communication products such as the monthly e-newsletter.

Country Level

- **16 measures** (policies/guidelines/standards) were proposed and/or adopted and/or implemented to increase development of grid-connected renewable energy in Thailand (2 measures), Vietnam* (2 measures), Philippines (1 measure), and Laos (12 measures).
- Under Thailand's PDP, **the wind target was improved** by foreseeing the procurement of 90 MW each year between 2022 and 2024, for a cumulative amount of 270 MW, whereas the previous PDP did not foresee any new wind procurement before 2034.

* USAID Clean Power Asia collaborated with USAID V-LEEP and thus shared both policies equally for a total of 1 policy.

Organizational Level

- More than USD **$7 billion was invested** in building rooftop solar systems in Thailand (0.8%) and Philippines (0.5%), and rooftop solar and wind systems in Vietnam (98.7%).
- **Nearly 10,000 megawatts of renewable energy capacity achieved financial closure** and completed installation.
- **Networking** among program stakeholders was increased.
- Over 3,000 downloads of financial tools and guidelines.

Individual Level

- Over **30 regional and local training/ workshops** were conducted. **Nearly 1,000 participants** including policymakers, government officials, private companies, and utilities from Vietnam, Laos, Thailand, Philippines, and other countries were trained. In addition, the majority of participants reported increased knowledge and skills.

Specifically concerning life of project achievements, the targets for all key program indicators (9 indicators) were successfully met while two non-key indicators were accomplished to a degree as described in the table.

	Indicators	Target	Actual	% achievement
1	Number of laws, policies, regulations, or standards addressing clean energy formally proposed, adopted, or implemented as supported by USG assistance (EG.12-3)	15	16	**106.67%**
2	Amount of investment mobilized (in mUSD) for clean energy as supported by USG assistance (EG.12-4)	677.82	6,688.21	**986.72%**
3	Clean energy generation capacity (in MW) supported by USG assistance that has achieved financial closure (EG.12-5)	824	9,125	**1,107.42%**
4	Greenhouse gas (GHG) emissions, estimated in metric tons of CO2 equivalent, reduced, sequestered, or avoided through clean energy activities supported by USG assistance (EG.12-6)	843,100	3,094,754.27	**367.07%**
5	Projected GHG emissions reduced or avoided through 2030 from adopted laws, policies, regulations, or technologies related to clean energy as supported by USG assistance (EG.12-7)	29,100,000	93,134,014.89	**320.05%**
6	Number of renewable energy zones (REZ) designated and/or under development (Custom)	3	2	66.67%
7	Number of grid-connected renewable energy targets established and/or improved (Custom)	7	2	28.57%
8	Clean energy generation capacity (in MW) that has achieved commercial operation as supported by USG assistance (Custom)	492	9,038.05	**1,837.00%**
9	Number of people trained in clean energy topics supported by USG assistance (EG.12-1)	500	880	**176.00%**
11	Amount of investment mobilized (in mUSD) for climate change adaptation as supported by USG assistance (EG.11-4)	112.18	1,245.94	**1,110.66%**
12	Number of people using climate change information or implementing risk-reduction actions to improve resilience to climate change as supported by USG assistance (EG.11-6)	12	12	**100%**

As seen in the table, due to unexpectedly high numbers of MW from rooftop solar systems that achieved financial closure, which consist of contributions made by DPV policy implementation in Vietnam (Decision 13), the amount of MW achieving financial closure (indicator 3) was higher than the target. The high MW achievement in Vietnam was unplanned and is a unique scenario which is not likely to occur in other countries. In addition, the high deployment of MW in Vietnam also impacted the higher results of other associated indicators including amount of investment (indicators 2 and 11) and amount of actual GHG reductions (indicator 4). Another indicator that achieved results higher than the target is projected GHG emissions reduced or avoided for 15 years (Indicator 5). These higher results were mostly attributable to Laos where 5,445 MW identified under the signed MOU between the GOL and solar project developers was used to calculate projected GHG reductions. For numbers of people trained (indicator 9), the primary reason for the overachievement is that the original number of people trained was planned based on in-person training and workshops. However, due to the COVID-19 pandemic which shifted many trainings/workshops to online platforms, USAID Clean Power Asia was able to reach a wider training audience through these virtual engagements.

The COVID-19 pandemic posed certain challenges that affected the program's ability to achieve the target for non-key Indicator 7 (number of grid-connected RE targets established and/or improved). As in-person meetings and workshops were restricted, virtual platforms prolonged and complicated the process of agreeing on ASEAN targets. The overall ASEAN target was increased just before the end of the program, but the process of translating the ASEAN target into specific RE targets for each participating country could not be conducted. Absent the impact of COVID-19, the program would have been able to determine the RE targets for each participating country in line with the ASEAN target before the end of the program, and the increased RE targets of each country would have been reported under Indicator 7. Another non-key indicator that performed slightly lower than the target is the number of REZs designated or under development (Indicator 6). During the program timeframe, out of 21 zones in Laos, 7 zones were chosen to go through the screening process, using the LEAP model study. However, only 2 zones were designated as renewable energy zones, Savannakhet and Khammouan, and are expected to generate electricity to supply the domestic electricity system and export power to Vietnam by 2040. For the other 5 zones, the study identified challenges and therefore, these other 5 zones will be further considered by the Laos government after the end of the program.

Quantitative and qualitative data managed through MEL system informed program achievements and improved program activities."

ANNEXES

SUCCESS STORIES

ACRONYMS

SUCCESS STORIES

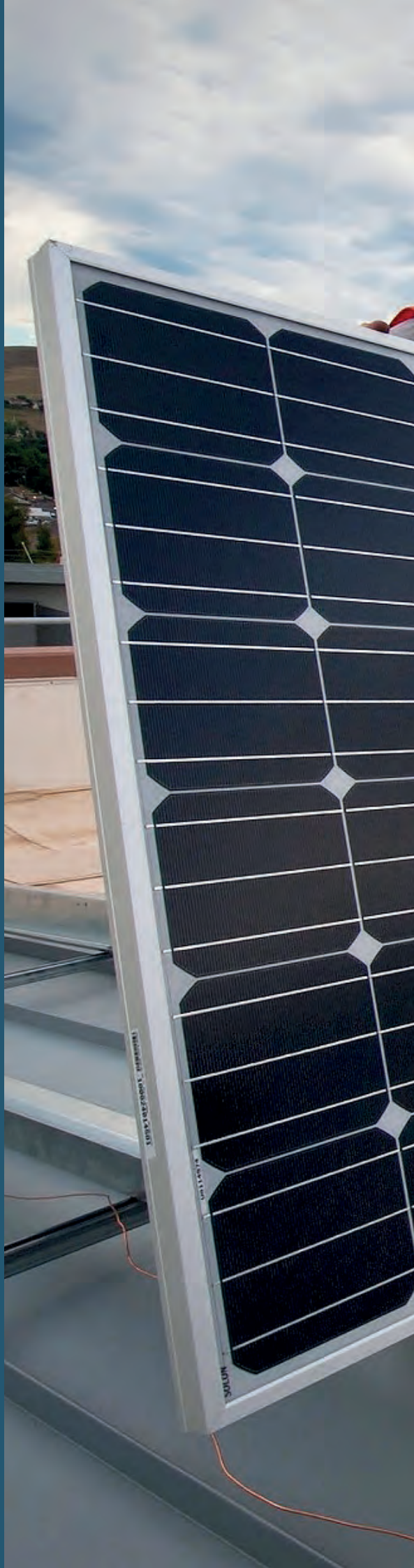


Photo credit:
https://pxhere.com/en/photo/1028805

Up on the Rooftop: **Thailand Lifts Solar Power Prospects to New Heights**

Photo Credit:
Richard Nyberg/USAID Regional Development Mission for Asia

In recent years, many consumers across Asia have watched in disbelief as their energy costs have soared through the roof. But homeowners in Thailand, with some support from USAID, have a new vantage point – on the roof, where installed solar panels can help bring energy costs down, way down.

Consumers in Thailand will soon be able to install rooftop solar panels and sell excess energy back to the grid. According to Ms. Thanyalak Meesap of the Department of Alternative Energy Development and Efficiency,

"Understanding the utility revenue and rate impacts was a critical step in getting past barriers to a policy to promote greater investment in rooftop PV."

There are challenges to this approach, and so far, not everyone has seen the light. Solar costs have dropped dramatically in recent years, prompting many countries to expand their solar capabilities. However, utilities are concerned that rooftop solar will slash profits as more customers produce their own electricity.

Enter the United States Agency for International Development Clean Power Asia (USAID Clean Power Asia) program, the National Renewable Energy Laboratory (NREL), and Chulalongkorn University's Energy Research Institute (ERI). They collaborated with Thailand to tackle these financial concerns and help advance Thailand's solar regulatory policy. At forums throughout 2017, USAID Clean Power Asia, NREL, and ERI met Thai distribution utilities, including the Metropolitan Electricity Authority and the Provincial Electricity Authority, to address their concerns.

NREL and ERI worked with USAID Clean Power Asia on an economic analysis of the effects of increased distributed photovoltaics (DPV) penetration in the country. The results proved that higher penetration levels would have no impact on utility revenue and a limited impact on rates, due to the existing regulatory structure that is well suited for greater investment in DPV.

USAID Clean Power Asia's participation in this analysis brought the process to a tipping point, helping spur action by policymakers. In time, this will lead to greater investment in solar energy.

In September 2017, the Thai Energy Minister announced additional support for rooftop solar investment in order to meet Thailand's goal to have 20 percent of the country's electricity come from renewable energy by 2036. Rooftop solar will allow owners to reduce their electricity bills, produce power for their consumption, and sell excess power back to the grid.

According to Ms. Thanyalak Meesap of the Department of Alternative Energy Development and Efficiency, "Understanding the utility revenue and rate impacts was a critical step in getting past barriers to a policy to promote greater investment in rooftop PV, as well as finalizing policy recommendations to the decisionmakers." The official solar rooftop policy is expected to be launched in October 2017, with the Office of the Energy Regulatory Commission regulating the licensing of solar rooftop installations whose owners wish to sell to the grid.

USAID Clean Power Asia is sharing lessons learned from Thailand's DPV experience across the Lower Mekong and with Association of Southeast Asian Nations (ASEAN) member states. Beginning with a solar workshop in March that resulted in the removal of barriers to DPV self-consumption in Cambodia, Thai bankers and developers then shared their experiences with DPV at a workshop in late August to broker investment in solar energy under Vietnam's new net metering policy.

So as Thailand steps up its solar energy policymaking, consumers in neighboring countries will be watching carefully to learn how they can aim high to lower their costs.

Lowering Electricity Costs and Saving the Planet: **How the Sun is Working for Big C**

Photo Credit:
Richard Nyberg/USAID Regional Development Mission for Asia

Nearly four years have passed since Thailand's retail giant Big C Supercenter and the United States Agency for International Development (USAID) became partners. Big C's stores across Thailand are cost efficient and profit generating, and with an average store size of 12,000 m2, electricity is the second-greatest expense. But Big C's carbon footprint was at odds with a desire to be an industry leader in corporate social responsibility, and to reduce greenhouse gas emissions from fossil fuels that power operations across the region.

"USAID, through PFAN and USAID Clean Power Asia, provided invaluable assistance to us when we started the project, which enabled us to make a well-reviewed decision to install rooftop solar on 33 of our stores,"

said Mrs. Vipada Duangratana, Deputy CEO and Executive Director of Big C.

Big C had long considered renewable energy sources to lower electricity costs while making its business more environmentally friendly. However, in the rapidly-evolving clean energy sector, reliable information can be hard to come by. A major move to incorporate renewable energy into operations requires due diligence, complex financial modeling, and analyzing projected impacts on a wide range of business functions.

In 2015, the USAID Private Financing Advisory Network Asia (PFAN-Asia) program engaged with Big C to support the pilot installation of a solar PV system on the roof of one of its stores. USAID PFAN-Asia provided technical assistance at a pivotal moment for Big C and, acting as an independent advisor, USAID experts assisted in preparing a terms of reference, evaluating bidders' proposals, and creating a financial model, all of which gave the management team at Big C the information they needed to develop a business model for the pilot rooftop installation.

A year later, as USAID PFAN-Asia wrapped up operations, USAID Clean Power Asia stepped in to ensure continued momentum for solar rooftop. As USAID's flagship renewable energy program for the region, USAID Clean Power Asia worked with Big C executives to validate key terms in the private power purchase agreement and lent their expertise to create a negotiating strategy. USAID Clean Power Asia staff developed a business model that focused on aggregation of electricity demand for Big C stores, and with so many outlets as potential future solar rooftop sites, Big C sought out favorable pricing.

"USAID, through PFAN and USAID Clean Power Asia, provided invaluable assistance to us when we started the project, which enabled us to make a well-reviewed decision to install rooftop solar on 33 of our stores," said Mrs. Vipada Duangratana, Deputy CEO and Executive Director of Big C. "While we excel at providing consumers with high quality, fairly priced goods, and we understand our business and supply chain better than anyone, the teams from USAID know the renewable energy market, the players across the region, and the most suitable project model that maximizes profit while reducing negative impacts on the environment."

Big C subsequently contracted Impact Solar to install and operate rooftop solar systems across 33 stores in Thailand. This first-of-its-kind deal for a major Thai retailer was valued at 1 billion THB ($31 million) and has a total installed capacity of 27 MW. The first store to come online is in Pathum Thani, just outside Bangkok, where in early September, staff from USAID's Regional Development Mission to Asia and USAID Clean Power Asia joined Mrs. Vipada Duangratana of Big C and representatives from Impact Solar at a ribbon-cutting ceremony.

The rooftop system at Pathum Thani has an installed capacity of just under 1 MW, and in its first month of operation, the system supplied 20 percent of the store's electricity consumption, representing cost savings of nearly 5 percent, in line with estimates.

USAID engages with companies committed to reducing their carbon footprint while lowering electricity costs and realizing greater profits. A long-time leader in the retail business in Thailand, Big C is now ahead on the environmental front and, with technical assistance from two USAID programs, will soon have the largest combined solar rooftop system in Thailand generating much of their power needs. Big C benefits economically from employing renewable power sources, and Thailand and the world win through the reduction of greenhouse gas emissions estimated at 390,000 tons of carbon dioxide equivalent over 20 years.

Unleashing the Power of Women in Energy: **A B.Grimm Power Success**

Photo Credit:
USAID Regional Development Mission for Asia

Mrs. Preeyanart Soontornwata is the Chief Executive Officer (CEO) of B.Grimm Power, one of the leading independent power producers in Thailand. She took the job just before the Asian financial crisis of 1997 when the company focused mainly on manufacturing and construction, and was not yet a big player in power generation. In the midst of crisis, she helped navigate the firm toward new opportunities with the construction of their first power plant in 1998. Since then, and under her leadership, B.Grimm Power has grown significantly.

B.Grimm Power is a key partner helping to achieve USAID's mission in Asia. At USAID, we recognize that development outcomes are strengthened when women bring their unique knowledge and capacity to the table. Inclusion across the entire power sector—from producing and distributing household energy to leading the clean energy transformation—is key to a sustainable and innovative industry.

Mrs. Preeyanart is an example of how savvy CEOs guide companies to succeed and grow in Asia's competitive energy sector. Currently, her company manages 45 power plants generating nearly 3,000 megawatts (MW) of power, and expects these numbers to grow to at least 56 plants generating 3,245 MW by 2025. "We welcome everyone," she explained. "Women are now more interested in doing the kind of business that requires fieldwork and going onsite. We have several female engineers and they can do anything."

B.Grimm Power is a key partner helping to achieve USAID's mission in Asia. At USAID, we recognize that development outcomes are strengthened when women bring their unique knowledge and capacity to the table. Inclusion across the power sector—from producing and distributing household energy to leading the clean energy transformation—is key to a sustainable and innovative industry.

That is why USAID works to empower women like Mrs. Preeyanart and the companies they lead. Earlier this year, with support from the USAID Clean Power Asia program, B.Grimm Power launched a 257 MW solar project in Vietnam. Because the renewable energy market in Vietnam is relatively new, local developers often lack the financial experience and knowledge to implement large-scale projects. To address that hurdle, USAID explored a number of financing options and identified a financing structure to support project development between B.Grimm Power and their local partner TTVN Group in Phu Yen Province. The project closed in June 2019, earning B.Grimm Power the year's Best Solar Power Plant Project Developer award.

B.Grimm Power's renewable energy work isn't limited to solar power or utility-scale projects. In Lao PDR, they are working on two small environmentally-friendly hydro-electric plants, both less than 25 MW, and in Thailand, they are deploying smaller rooftop solar systems, including at the new ICONSIAM shopping center along Bangkok's Chao Praya River.

When Mrs. Preeyanart talks about her accomplishments and what gives her satisfaction, she says her success as a woman in the upper echelons of power in the energy industry is her life's greatest achievement. One of the best parts of her job, she says, is being a role model for the women with whom she works.

And while she doesn't have a background in science or engineering, her degrees in business and finance have propelled her to a position of power in a traditionally male-dominated field. She says this diversity of background has helped her advocate for other women in the energy sector. "I can be a role model, because I'm not an engineer," she said. "I have a finance background, but it's not only [my] educational background that matters." To grow in your career, she explained, "You must continuously seek new knowledge, listen, learn, build coalitions and trust, and always maintain a positive attitude. I never seek credit for myself and always recognize all credit belongs to our talented team."

Thanks to Mrs. Preeyanart and other women leaders in the energy sector, B.Grimm Power continues to set the standard for independent power production in Southeast Asia, and will remain a corporate leader for women's empowerment across the region and sector. "Asia is a region that continues to grow," she said. "I know that there are many more opportunities to invest in clean energy generation using natural gas and advanced renewable energy technologies"

USAID's energy sector work in Southeast Asia is part of the U.S. Government's Asia Enhancing Development and Growth through Energy (Asia EDGE) initiative, a whole-of-government effort to support sustainable and secure energy markets across the region and level the playing field for private sector firms. Asia EDGE furthers the U.S. vision for a free and open Indo-Pacific to ensure peace, stability, and growing prosperity. Under Asia EDGE, USAID plays a leading role helping its Indo-Pacific partners expand energy access, promote energy diversification and trade, and strengthen energy security. Learn more at www.usaid.gov/energy/asia-edge

Paving the Way to a Brighter Future: **Laos' First Solar Energy Auction**

Photo Credit:
Pitoon Junthip, Abt Associates/USAID Clean Power Asia

Recognizing declining reserves of non-renewable energy and the growing importance of clean energy, Laos has made significant strides in hydropower, helping transition away from dirty coal power plants. Still, hydro dams are drought-vulnerable and may cause negative impacts on vulnerable populations and the environment. Fully taking advantage of ample renewable energy resources requires solar power, offering lower emissions; energy security and independence through reduced energy imports; and less reliance on polluting power sources. Solar power also provides the flexibility and reliability for Laos to start exporting energy to neighboring countries.

"Thanks to USAID for supporting the first solar auction in Laos from the beginning of auction design to implementation. This solar auction in Laos will improve fair and transparent power project procurement, obtain the most competitive tariff, and reduce project approval time."

Boualom Saysanavong Head of the Solar, Wind and Biomass Power Generation Promotion Division
Institute of Renewable Energy Promotion

But planning for solar power generation is no easy task, and Laos has traditionally built plants through a non-competitive approach with energy providers directly proposing projects. This has helped address some energy demand but provides the government with less control over power planning. Laos' 2011 Renewable Energy Development Strategy lays out ambitions to make non-hydro renewable resources one-third of total energy demand by 2025, but recent years have been challenging for renewable energy in Laos. An ill-designed subsidy scheme made solar and wind expensive, and the energy procurement process was uncompetitive, lacked transparency, and was prone to corruption, resulting in a dry landscape for private investment and missing opportunities to create a thriving market.

To overcome these challenges, USAID Clean Power Asia has worked with the Government of Laos since 2017 to embrace open, transparent, and best-value energy procurement practices through the country's first-ever solar auction. With support from USAID Laos and the U.S. Embassy Laos, responsibility for the solar auction resides with the Institute of Renewable Energy Promotion and a Working Committee from various ministries and departments, with the crucial duty of overseeing auction design and implementation. Drawing from in-depth knowledge and experience in renewable energy auctions in the region and with expertise from Guidehouse, USAID provided the committee with the essential tools, models, and insights, and working in collaboration with partners Global Green Growth Institute and Hawaii Natural Energy Institute, drafted an auction announcement package, the main reference point for potential auction bidders, including key documents such as technical standards, grid connection requirements, and a reference price.

Despite the COVID-19 pandemic, USAID on-the-ground staff and government stakeholders conducted an auction site selection process with survey visits to Khammouane and Savannakhet provinces. The provincial authorities agreed on five sites with a total potential auction capacity of 45 megawatts. These site visits yielded the necessary preliminary results for the Working Committee to move towards land acquisition and clearance and marked the first steps in the implementation phase and finalization of the auction announcement package.

With the auction announcement expected in mid-2021, USAID Clean Power Asia will continue to support the Government of Laos through the current phase, specifically with bid evaluation criteria, key to selecting solar providers. Competitive solar power auctions will bolster local industry competition and strengthen the economy, indigenous innovation, and locally-sustained renewable energy sources, while the construction of solar plants will bring additional clean energy production capacity and open the door for more renewable energy to be competitively procured.

Mr. Boualom Saysanavong, Head of the Solar, Wind and Biomass Power Generation Promotion Division at the Institute of Renewable Energy Promotion, said, "Thanks to USAID for supporting the first solar auction in Laos from auction design to implementation. Major achievements and milestones for our solar auction so far are the completion of all required documents and auction site selections. This solar auction in Laos will improve fair and transparent power project procurement, obtain the most competitive tariff, and reduce project approval time."

This first solar auction in Laos will expand access to affordable and reliable energy and create an open, efficient, rule-based, and transparent energy market. Increased power procurement through competitive bidding puts the Government of Laos in the driver's seat for power generation planning, and on the road to a more comprehensive renewable energy policy environment. The auction will offset pollution and carbon emissions that impact health and welfare in cities and communities; will create green jobs and market competition with opportunities for U.S. companies; and will help spur the continued scaling-up of renewable energy throughout Southeast Asia and the Indo-Pacific.

ACRONYMS

A

ACE
ASEAN Centre for Energy

ACEF
Asia Clean Energy Forum

ADB
Asian Development Bank

AEDP
Alternative Energy Development Plan

AEO6
6th ASEAN Energy Outlook

AIMS
ASEAN Interconnection Master Plan Study

APAEC
ASEAN Plan of Action for Energy Cooperation

APG
ASEAN Power Grid

API
Application programming interface

ASEAN
Association of Southeast Asian Nations

Asia EDGE
Asia Enhancing Development and Growth through Energy

B

BESS
Battery energy storage system

BIDV
Bank for Investment and Development of Vietnam

BTM
Behind-the-meter

C

CA
Concession Agreement

CEIA
Clean Energy Investment Accelerator

CEADIR
Climate Economic Analysis for Development, Investment, and Resilience

CO_2
Carbon dioxide

COP
Chief of Party

C&I
Commercial and industrial

D

DC
Department Circular

DCOP
Deputy Chief of Party

DEDE
Department of Alternative Energy Development and Efficiency (Thailand)

DEPP
Department of Energy Policy and Planning (Laos)

DER
Distributed energy resources

DPV
Distributed photovoltaics

DU
Distribution utilities

DWG
Demand Working Group (Laos)

E

E3
USAID's Bureau for Economic Growth, Education, and Environment

EDL
Électricité du Laos

EDL-Gen
EDL-Generation Public Company

EPC
Engineering, procurement, and construction

EPPO
Energy Policy and Planning Office (Thailand)

ERC
Energy Regulatory Commission (Philippines)

EREA
Electricity and Renewable Energy Agency (Vietnam)

ERI
Energy Research Institute

ESIA
Environmental and Social Impact Assessment

ESS
Energy storage systems

EV
Electric vehicle

EVN
Vietnam Electricity

F

FIT
Feed-in tariff

G

GE MAPS
GE Multi Area Production Simulation Software

GGGI
Global Green Growth Institute

GHG
Greenhouse gas

GIS
Geographic information system

GIZ
Deutsche Gesellschaft für Internationale Zusammenarbeit

GOL
Government of Laos

GW
Gigawatt

GWEC
Global Wind Energy Council

H

HAPUA
Heads of ASEAN Power Utilities/Authorities

HNEI
Hawai'i Natural Energy Institute

HOA
Head of Agreement

I

IEA
International Energy Agency

IREP
Institute of Renewable Energy Promotion (Laos)

IRRP
Integrated Resource and Resilience Planning

IRP
Integrated Resource Planning

J

JICA
Japan International Cooperation Agency

K

kW
Kilowatt

kWh
Kilowatt hour

L

LBNL
Lawrence Berkeley National Laboratory

LCOE
Levelized cost of electricity

LEPTS
Lao Electric Power Technical Standards

LM
Lower Mekong

M

MEL
Monitoring, Evaluation, and Learning

MEM
Ministry of Energy and Mines (Laos)

MOIT
Ministry of Industry and Trade (Vietnam)

MOE
Ministry of Energy (Thailand)

MPI
Ministry of Planning and Investment (Laos)

MW
Megawatt

MWG
Modeling Working Group

MWh
Megawatt hour

N

NEMO
Next Energy Modeling System for Optimization

NDA
Non-disclosure agreement

NREL
National Renewable Energy Laboratory

O

OERC
Office of Energy Regulatory Commission (Thailand)

P

PDA
Project development agreement

PDOE
Philippines' Department of Energy

PDP
Power development plan

PFAN
Private Financing Advisory Network

PPA
Power purchase agreement

PV
Photovoltaics

R

RDMA
USAID's Regional Development Mission for Asia

RE
Renewable energy

RE-SSN
Renewable Energy Subsector Network

REZ
Renewable energy zone

S

SA
Study Areas

SE
Southeast

SEI
Stockholm Environment Institute

SHB
Saigon-Hanoi Commercial Joint Stock Bank

SURE
Scaling Up Renewable Energy

SWG
Supply Working Group (Laos)

T

TAC
Technical Advisory Committee

ThaiWEA
Thai Wind Energy Association

THB
Thai Baht

TRG
Technical Review Groupv

TTVN
Truong Thanh Viet Nam Group

U

USAID
United States Agency for International Development

USEA
United States Energy Association

U.S.
United States

USD
United States Dollar

USG
United States Government

V

V-LEEP
USAID Vietnam Low Emissions Energy Program

VA
Vulnerability Assessment

VRE
Variable Renewable Energy

W

WC
Working Committee (Laos)

WRI
World Resources Institute

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