

# World

## Following the Carbon for Clean Energy

Results from Knowledge Exchanges in Asia

July 2019

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## Following the Carbon for Clean Energy in Asia: Accelerating Energy Efficiency, Renewable Energy and Natural Gas Solutions among Middle-Income East and South Asian Countries

### Synopsis/Summary

Over 80% of worldwide new coal-fired power plants due to begin operating between now and 2020 will be in middle-income countries in Asia: China, India, Indonesia, Vietnam, Philippines and Pakistan. Together with the existing plants in operation in these countries, this will lock-in 260 gigatons of carbon dioxide emissions over their remaining lifetimes, which would exceed the carbon budget available to the power sector to be consistent with limiting global warming within 2 degrees. Support for policies and investments to maximize energy efficiency and clean energy in Asian countries will therefore not only benefit local populations through greater energy productivity and cleaner air, it will also contribute critically to the Paris Agreement targets.



As part of the Follow the Carbon/Energy Transition (FTC/ET) in Asia initiative, a programmatic South-South knowledge exchange (KE) was organized by the World Bank with funding support from the South-South Facility. Three KE activities around issues of renewable energy (RE) auctions, energy efficiency (EE), and grid integration of RE were successfully held in Singapore (first two) and Qinghai, China (final one), respectively in May 2017, January 2018, and September 2018. The main objective of this initiative was to transfer knowledge and best practices on the three topics to the six Asian countries under the FTC/ET initiative - China, India, Indonesia, Pakistan, the Philippines, and Vietnam. The workshops facilitated peer-to-peer networking and generated clients’ demand for follow-up technical assistance and capacity building on RE auction, EE, and grid integration of RE in each FTC/ET countries.

### Context/Challenge

While energy efficiency is known as the “First Fuel” of economic development due to its enormous potential and low cost, implementation progress has been slow, mainly due to the difficulties in finding scalable business models and attracting commercial capital to support these investments. For various institutional and technical reasons, countries around the world, especially middle-income countries in South, East and Southeast Asia, have been struggling to identify scalable mechanisms to promote it.

All these countries have a renewable energy portfolio, but the key is for policies to allow this to scale up at an affordable price. The investments are largely concentrated in a handful of countries, predominantly

in India, China, USA and Europe. Other countries in Asia are keen to develop their RE potential and learn about the experience from around the world on various RE policies, such as auctions, feed-in-tariffs, and RE portfolio standard. At the same time, China is experiencing serious difficulty integrating wind and solar energy into the grid and needs to handle the trade-off between coal/ natural gas and RE in the power system. In fact, over the last few years, a global trend has seen an increasing auction schemes which have rapidly driven down the price of electricity generation from solar PV and wind by reflecting the reducing technology cost and resulted in a massive scale up of investments. There is a pressing need, therefore, to understand and overcome constraints to least-cost generation, which include the absence of an enabling policy and regulatory framework, as well as lack of experience with auction design and risk mitigation mechanisms.

### **Solution/Approach**

To more rapidly translate the business models across countries for similar cross-cutting deals, three programmatic South-South knowledge exchange workshops were co-organized by the World Bank as part of the Follow the Carbon/Energy Transition (FTC/ET) in Asia initiative. The activities were designed to exchange good practices and lessons learned and to enhance connectivity among country peers leading to new and improved actions. It brought together resource expert and representatives of policy makers, private companies, and financial institutions from the six Asian countries. Each of the participating institutions has established practices for capturing and sharing knowledge.

The knowledge exchange workshops were composed by three major components, expert panels, site visits and knowledge exchange networks, which were conducted comprehensively during the events.

#### Expert panels

The programmatic workshops comprised three separate knowledge exchange events. The topics of the events were Renewable Energy Auction, Energy Efficiency, and the Grid Integration of Renewable Energy respectively. Resource experts from countries that have successfully implemented RE auctions, including Brazil, India, Peru, South Africa, and United Arab Emirates; have successfully implemented EE policies and programs, including China, India, Japan, Korea, Mexico, the United Kingdom and Singapore; and are successfully integrating RE into power systems including Australia, Denmark, Spain, the US, and the International Energy Agency (IEA) and General Electric (GE), shared their experience and lessons learned on the topics. Break-out group interactive discussions were followed at the end of the sessions.

#### Site visits

During the EE workshop, field visits were organized to the world's largest and most efficient district cooling facility, a green hotel and a green hospital, to first hand learn green buildings in Singapore. For the Grid Integration of RE workshop, the field trip comprised visits to the world's largest solar PV park (4.5 GW) in Qinghai, the largest power station of hybrid PV (850 MW) and hydropower (1 GW) at Long Yang Gorge by Yellow River Hydropower Company, and the dispatch center of Qinghai Grid Company in Xining to showcase their experience of 100 percent RE grid integration in nine consecutive days. The State Grid also outlined its challenge of RE grid integration that RE generation exceeded 1.5 times of the maximum local load in some regions, particularly Northwestern provinces.

#### Knowledge exchange network

The workshops were interspersed with knowledge exchange network between the FTC/ETC country representatives, resource experts, and the WBG staff as well. The workshop provided participants from the FTC/ET countries with the opportunity to learn first-hand experience from their peers, particularly the chance to interact with the resource experts and discuss the policies and tools around the RE and EE topics.

Apart from the three major activities, a camera crew was hired to document the workshop, and they also interviewed some of the participants to explore what they learned at the event and how they expect to use this knowledge upon their return to their home countries. Proceedings of the workshop were also produced after the workshops. Some countries outside the FTC/ET initiative also expressed interests in attending the workshop, and dissemination of these material was helpful to a wider audience.

## Results

The early results of the three knowledge exchange workshops are new knowledge gained and enhanced connectivity, while the long-term results triggered by the workshops are new and improved actions taken as well as new demand for lending or Advisory Services & Analytics (ASA) from the World Bank.

### New knowledge

During the three workshops, new knowledge regarding the specific issue and subject of each workshop was shared, which can be summarized respectively as follows.

#### **Renewable Energy Auction**

- Among the three RE policy options (feed-in tariffs, renewable energy portfolio standards, and auctions), the feed-in tariffs have delivered success to scale up RE in a short time period, given its price certainty. However, tariff levels tend to be high, which can result in extra burden on consumers or government for RE subsidies. A recent global trend has seen an increasing number of countries shifting from feed-in tariffs to auction schemes, which has led to an immediate price decline of 30-50 percent. Currently, 64 countries around the world have adopted RE auction schemes. Almost all the countries that successfully implemented the RE auction schemes that were presented at the workshop, have achieved solar PV tariffs around 3-6 US cent/kWh, which is competitive with conventional power generation even compared to coal as baseline fuel in India and South Africa.
- In addition to adequate tariff levels with long-term power purchase agreements, successful RE policies should also require mandatory grid access and incremental costs, if any, to be passed through consumers.
- Solar PV electricity prices are primarily driven by the investment costs, cost of financing, cost of land and labor, and solar resources. Current prices are sustainable over time, but rate of decrease could slow down.
- The key features of auctions include: (a) determining the volumes to be auctioned and the way it is shared between different technologies and project sizes; (b) setting qualification requirements for participants in the auction; (c) selecting winners; and (d) specifying rules to ensure high implementation rate of awarded projects in a timely manner.

#### **Energy Efficiency**

- Conducive policies are the essential driver to create market demand for catalyzing investments in energy efficiency. Successful EE experiences demonstrated that mandatory output-based policies are more effective than voluntary input-based approaches, and strong regulations must go hand in hand with financial incentives. China and India adopted mandatory EE targets for industries. China adopted a top down approach in allocating EE targets to each province and top 17,000 energy-intensive industrial enterprises and held the obligated parties accountable to achieving the targets. India's Perform, Achieve & Trade scheme is a market-oriented scheme where energy saving targets are allocated to industry sectors and allow trading of energy saving certificates to achieve the national targets at least cost. The UK and Europe's voluntary EE scheme is combined with strong financial incentives of tax rebates. Finally, standards and codes such as the green mark program in Singapore and top runner program in Japan are arguably the most cost-effective policy to save energy. The

Singapore government also provides 50% of the auditing and investment costs to incentivize building retrofit to achieve the green mark standards.

### **Grid Integration of Renewable Energy**

The ET countries are at various phases of variable renewable energy (VRE) grid integration (solar PV and wind). Most Southeast Asian countries are at the starting phase with very low share of VRE in the grid system. China and India have noticeable VRE share in the system, and some regions of China such as Northwest China have experienced very high share of VRE in the grid system. All have huge potential to scale up over time with proven technical solutions and institutional reforms. From a technical perspective, integrating high levels of VRE into traditional electric power grids poses distinct issues due to the intermittency nature of PV and wind power.

- In Phase 1, wind and PV have low shares in the grid system and are yet to pose significant issues for integration. Vietnam, Indonesia, Pakistan and the Philippines currently fall into this category.
- In Phase 2, wind and PV capacity becomes noticeable to grid system operators, which need to draw on existing flexibility in thermal and hydropower plants and the grid. China (at a national level) and India are in this phase, as are most developed countries.
- Higher shares of RE integration require investments in flexibility from all power plants, demand side, storage and grids, and increasingly advanced technologies to ensure grid reliability. Only a few European countries, notably Denmark (45 percent) and Ireland (20 percent) are at this level of development, though in parts of China wind and PV penetration far exceeds peak load. Whereas many participants asked what the limit of RE penetration in the grid system is, the clear consensus from experts is that there are no limits of RE penetration, but technical solutions come with costs.

### Enhanced connectivity

The workshops allowed for a dynamic exchange of knowledge between the FTC/ET country representatives, resource experts, and WBG staff. Participants particularly appreciated the networking opportunity among practitioner. Triggered by common needs and supported by the newly established network, new and improved actions were subsequently undertaken between the participants.

### New and improved actions

Following the workshops, the six countries began tailoring knowledge learned to their specific context and leveraging the newly established network for joint efforts in maximizing EE and clean energy. During the process, new and improved actions were undertaken.

- In Pakistan, the World Bank connected with the National Energy Efficiency & Conservation Authority (NEECA), a Department attached to the Ministry of Water & Power, to help the Government of Pakistan in achieving EE and conservation in all sectors of economy.
- In Indonesia, a dialog on EE has been initiated between the World Bank and the Ministry of Energy, after which the government has leveraged lessons learned to upgrade its grid code model and improved the policy for renewable energy.
- In Vietnam, following the EE study visit to China, the government has decided to replicate the mandatory EE system successfully rolled out in China where provinces are responsible for implementing EE targets.
- In Pakistan, Indonesia and Vietnam, WBG teams in the three countries have planned to mobilize trust funds to support the countries in piloting solar auction schemes. Potential funding sources have been identified.
- In China, knowledge gained from the practical experience and relevant policies of other countries was shared within the government to assist policymakers and implementors in future decision-making process. There is also a plan to implement solar auction scheme on a large scale at provincial level

- India started to implement marine spatial planning, based on the experience of Brazil. Moreover, increased knowledge sharing on EE is now happening with Vietnam.
- The Philippines also intend to pilot solar auctions.

### New demand for WB support

The KE workshops contributed to trigger country demands for new support from the World Bank. For example, the solar auctions project in Vietnam was partly triggered by the first KE event. Moreover, several on-going WB-funded projects were strengthened through the knowledge exchange, including the Integrated Coastal Zone Management Project in India.

### Evaluation from the participant’s perspective

The knowledge exchange yielded immediate results for participants. According to a survey conducted in April 2019 with selected participants that were involved in multiple activities over the two years (four from the World Bank, and five country participants), all of the country respondents agreed or strongly agreed that the knowledge exchange activities were useful to their organizations, as they have gained relevant knowledge for the design and implementation of the development project/policy they are working on. All respondent also indicated they were planning to apply the knowledge learned in designing/implementing their development policy/project.

Specifically, three most notable results of the KE are (i) increased awareness of new possibilities (such as auctions); (ii) enhanced understanding of pathways for problem-solving by learning from country examples; (iii) expanded network of specialists. The bar chart below provides an overview on how the KE has benefited participants:

#### In what way(s) was this knowledge exchange helpful for our client counterparts



### Lessons Learned

#### Renewable Energy Auction

- The workshop presented three RE auction design options: (i) the simplest and most common sealed bid auction, used in South Africa; (ii) the sophisticated descending clock auction, used in Brazil; and (iii) the e-tendering auction, used in India.

- The workshop allowed for a discussion on how to manage the transition from feed-in tariffs to auctions. The South African experience shed lights in this regard. At the beginning of such transition, developers were reluctant, as they were used to the high tariff levels under the feed-in tariff scheme. After South Africa implemented a series of RE auctions, solar and wind tariffs steadily dropped below Eskom<sup>1</sup>'s average cost of supply, and the number of received bids went up over time. In the end, investors are pleased with the expanded market of more than 6 GW of RE capacity auctioned that attracted US\$20 billion of private investments since the introduction of RE auction in 2011.
- One of the main concerns of the auction scheme is the “bid but not build” issue, that is, many of the winning bidders may not build, which happened when China and the UK implemented RE auction more than a decade ago. Brazil has taken a series of measures to ensure new projects will be built. First, they have stringent qualification criteria for participation, including ANEEL registry (Brazil Electricity Regulatory Agency), environmental license, transmission connection, energy production certificates, and land use contracts. Then, the bidders are required to demonstrate commitment to participate by deposit a bid bond equal to 1 percent of the investment value. Finally, the bidders are imposed penalties in case of delay in plant operation.
- The resource experts also shared other key success factors and lessons learned in their RE auction schemes and highlighted that it is essential to coordinate the RE auction schemes with transmission planning to avoid transmissions constraints.

### Energy Efficiency

Successful EE experience demonstrated that strong government support--combining regulatory policies with financial incentives--is critical to the success of ESCO<sup>2</sup> industry and create market demand for EE financing

- Many countries are interested in ESCO development as a delivery mechanism for energy efficiency, but global experience has shown mixed results. Countries with successful experience in ESCOs all have strong government support. Chinese government's financial incentives are the essential driver for the boom of the Chinese ESCOs growing from the initial 3 to 5800. The Indian government's super-ESCO EESL has achieved huge success in a short time period, which could be an interesting model to replicate in other Asian countries. The Korea government provides concessional financing to ESCOs, which is the deciding factor for the success of ESCO development in Korea.
- The World Bank Group (WBG) has funded a number of EE financing mechanisms worldwide, with IBRD and CTF resources, including credit lines, risk sharing, dedicated funds, program-for-results, and development policy loans. The selection of EE financing instruments needs to be tailored to market barriers and segments and the conditions of local financial sector. The most important factor for EE financing is to identify a strong pipeline for potential EE subprojects, while technical assistance is also essential. The China Energy Efficiency Financing Project has leveraged a total investment of \$2.6 billion (which equals to 8 times of IBRD investments) and avoided CO2 emissions of 11 million tons annually.

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<sup>1</sup> South African electricity public utility

<sup>2</sup> Energy Service Company

A key lesson learned is that the institutional capacity of participating banks (namely their internal organization, the commitment of their management, the presence of dedicated and capable teams, and the existence of incentives for staff members) is the most important success factor. The PforR program on Innovative Financing of Air Pollution Control in China's Jing-Jin-Ji metropolitan region has greatly strengthened the institutional capacity of participating banks on EE financing and mainstreamed EE financing. The Mexico Municipal Financing Project demonstrated an innovative business and financing model for a dedicated EE fund to provide energy service agreements to municipal public facilities for EE investments.

### **Grid Integration of Renewable Energy**

A diverse 'toolkit' of solutions, including power system planning, policies and regulations, and technical measures is available to improve VRE grid integration:

- Proactive power system planning is required from the outset to pave the way for increasing RE over time at least cost.
  - RE zones, pioneered in Texas, are a collaborative way to plan for expanding transmission to integrate renewables at low cost, for particular geographical areas where additional demand for RE is expected. Texas' experience demonstrated that proactive power system planning can significantly reduce RE curtailment and RE costs.
- Policies and regulations are essential to enable RE integration.
  - "Broad and fast" is a key principle for planning and operating RE-friendly systems – larger balancing areas and faster scheduling and dispatch – to support RE integration. The pathway to achieve "broad and fast" principle includes expanding balancing areas, coordinating dispatch with neighboring balancing areas, economic dispatch at 5-minute time steps, sub-hourly (15-min) interchange schedules, etc.
  - The "flexibility supply curve" is different in every power system, but often the most cost-effective changes to the power system are institutional (changes to system operations, contracts and market designs). China's Northeast balancing market and India's settlement system (in transition to a new reserve approach), are two examples of how to accommodate flexibility services.
  - Regulatory and institutional measures to enable VRE to provide grid services include grid codes, power purchase agreements, and operations and market rules. Grid codes and associated standards should be upgraded as early and as comprehensively as possible to reflect international best practice. Unique domestic requirements usually increase costs.
  - A key policy design is exposing wind and PV generators to prices that reflect their value depending on location and time of generation. In addition, ancillary services need to be valued and priced.
- Increasing system flexibility is the key for VRE grid integration
  - On the generation side, not just natural gas, hydropower and pump storage offer the most flexible options, even coal-fired power plants can be retrofitted to improve flexibility. For example, in Denmark, one coal plant is able to regulate at 3-4% per minute, with minimum 10% capacity factor. Denmark also showcased an excellent example of heat storage for coal-based co-generation plants.
  - China's Qinghai province demonstrated a good example of solar, wind and hydro hybrid systems to complement each other and achieve 100% RE in the grids.
  - Storage offers a wide variety of services and will become increasingly important as costs fall. The US saw a dramatic cost reduction of PV plus battery storage and wind plus battery to

\$38.3/MWh and \$20.63/MWh respectively in 2018 (including US tax incentives), and stand-alone battery storage to \$10.53/kW-mo.

- On the transmission side, inter-regional trading is essential as demonstrated by Demark in the Nordic power pool.
- On forecasting, there are trade-offs between the use of centralized vs. unit-level forecasting to commit units in day-ahead and hour-level schedules.

Furthermore, frequency control, voltage control and synchronous control are also important technical solutions, as demonstrated by Spain and Australia's experience.

### Areas for improvement

Although the knowledge exchanges were successful in many ways, there is still room for improvements and relevant recommendations were formulated in this regard. (Source: 9 selected participants that were involved in multiple activities over the 2 years - 4 from WB and 5 from ET countries – Survey results collected in April 2019)

#### Knowledge shared

- The knowledge shared should be more tailored to the specific context of FTC/ET countries.

#### Follow-up activities

- A long-term and stable bilateral or multilateral exchange mechanism should be established to ensure timely and smooth information exchange and promote effective knowledge dissemination.
- A global expert think tank in relevant fields should be established to provide intellectual support for effective information dissemination and project implementation.
- National experiences and lessons should be summarized and published in a timely manner in the form of annual progress reports to form an effective information dissemination system.
- Annually or half annually conference should be held with all participants.
- Further funding should be provided to support implementation. For example, as Vietnam decided to adopt a mandatory EE regime similar to the one adopted in China, funding to help Vietnam design and implement the program by hiring Chinese experts and to support further knowledge exchange between the two countries would be very helpful.

#### Selection of participants

- Only people who can bring value to the discussion should be selected as participants in the KE, otherwise it is a waste of money.

#### Logistics

- Materials should be sent to participants ahead of the KE events.

### What was the contribution of the World Bank?

With funding support from the South-South Facility (\$195,000), a World Bank team facilitated the knowledge exchange among the six target countries. The exchange was jointly facilitated by WBG teams from the Energy Global Practice and the South-South Facility Secretariat.

**Key Words (for Web Team)**

Energy Transition, Clean Energy, Energy Efficiency, Renewable Energy, Solar Energy, Grid Integration of Renewable Energy, Natural Gas Solutions, Energy Service Companies, Low Carbon Energy Development

**Multimedia**



### Appendix I: Context in each Asian country

	China	India	Indonesia	Pakistan	the Philippines	Vietnam
RE Capacity	<ul style="list-style-type: none"> <li>• 164 GW of wind</li> <li>• 130 GW of solar PV</li> </ul>	<ul style="list-style-type: none"> <li>• 34 GW of wind</li> <li>• 23 GW of solar PV</li> </ul>	<ul style="list-style-type: none"> <li>• 1.7 GW of geothermal</li> <li>• 7.5 GW of hydro</li> <li>• 1.7 GW of biomass</li> </ul>	<ul style="list-style-type: none"> <li>• 8 GW of hydropower, 30% of its power mix</li> <li>• 650 MW of wind</li> <li>• 400 MW of solar</li> </ul>	<ul style="list-style-type: none"> <li>• 2 GW of geothermal</li> <li>• 3.6 GW of hydro</li> <li>• 800 MW of wind, solar, and biomass</li> </ul>	<ul style="list-style-type: none"> <li>• 15 GW of hydropower, 37% of its power mix</li> </ul>
Target	<ul style="list-style-type: none"> <li>• 15% of RE in the primary energy mix by 2020 and 20% by 2030</li> <li>• 210 GW for wind and 110 GW for solar PV by 2020</li> </ul>	<ul style="list-style-type: none"> <li>• 175 GW of non-hydro RE by 2022</li> <li>• 100 GW of solar PV and 60 GW of wind by 2022</li> </ul>	<ul style="list-style-type: none"> <li>• 23% of RE in primary energy mix by 2025 with an installed capacity of 45 GW of RE</li> <li>• <u>reduce energy intensity by 1% per year until 2025</u></li> <li>• <u>final energy savings of 17% in 2025</u></li> </ul>	<ul style="list-style-type: none"> <li>• 12 GW of hydro and 3 GW of non-hydro RE by 2021-2022</li> </ul>	<ul style="list-style-type: none"> <li>• triple RE capacity by 2030 with a total RE installed capacity of 15 GW</li> <li>• <u>10 million total annual savings and 3% energy intensity reduction by 2040</u></li> </ul>	<ul style="list-style-type: none"> <li>• 6 GW for wind and 12 GW of solar by 2030</li> </ul>
Challenge	<ul style="list-style-type: none"> <li>• Insufficient RE subsidies</li> <li>• Severe curtailment of wind and solar for grid integration</li> </ul>	<ul style="list-style-type: none"> <li>• securing reserves and ancillary services</li> <li>• increasing the flexibility of conventional generation, especially within each state</li> </ul>	<ul style="list-style-type: none"> <li>• pilot solar auction schemes to achieve grid parity</li> </ul>	<ul style="list-style-type: none"> <li>• explore solar auction schemes</li> <li>• transmission bottlenecks, a lack of commercial flexibility under existing power purchase agreements, and inadequate forecasting</li> </ul>	<ul style="list-style-type: none"> <li>• identify sources of funding to pay for the high feed-in tariffs</li> <li>• pilot RE auction schemes</li> <li>• transmission backbone not available in high RE potential areas</li> <li>• limited spinning reserves for high share of VRE</li> <li>• traditional transmission planning not incorporating RE</li> </ul>	<ul style="list-style-type: none"> <li>• mobilize financing to pilot solar PV projects</li> <li>• establish local manufacturing industry to reduce costs of solar PV</li> <li>• RE capacity not being absorbed by the existing grids without expanding transmission grids, increasing spinning reserves, and adopting automated generation control and</li> </ul>

					• violation of system frequency limit	frequency response standards.
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### Appendix II: Beneficiaries/Participants

Name	Title / Position	Organization
Nguyen The Huu	Director	Power System Department, Vietnam Ministry of Industry and Trade
Phan Sy Binh Minh	Official	Power Business Department Vietnam Electricity (EVN)
Nguyen Thi Lam Giang	Official	International Relations, Vietnam Electricity (EVN)
Hoang Anh Tuan	Engineer	Power system analysis and planning, National Load Dispatch Centre, Vietnam Electricity (EVN)
Mehfooz Qazi	Director	Alternate Energy, Energy Department, Government of Sindh, Pakistan
Mazhar Iqbal Ranjha	Director Standards	National Electric Power Regulatory Authority (NEPRA), Pakistan
Arshad Khan	Chief	Energy Wing, Planning Commission, Pakistan
Abdi Dharma Saragih	Head Division of Business Services and Supervision	Directorate General of New Renewable Energy and Energy Conservation, Ministry of Energy and Mineral Resources (MEMR), Indonesia
Retno Dwi Lestari	Assistant Manager Operations of South Sulawesi and West Sulawesi Systems	Perusahaan Listrik Negara (PLN), Indonesia
Iswan Pradiptya	Assistant Analyst of Corporate Strategic Planning at Corporate Planning Division	Perusahaan Listrik Negara (PLN), Indonesia
Wahid Pinto Nugroho	Head Section for the Preparation of Rural Electricity Development	Directorate General of Electricity, Ministry of Energy and Mineral Resources (MEMR) Indonesia
Jiaming Wang	Senior Engineer	Power System Planning & Research Department, Electric Power Planning & Engineering Institute of China

Jie Ding	Deputy Director	New Energy Center, China Electric Power Research Institute, State Grid Corporation of China
Xie Hongwen	Director	New Energy Department, National Renewable Energy Engineering Institute, China
Lou Qihe	Director	Development & Planning Department, State Grid Corporation of China
Wang Weisheng	Director	New Energy Center, China Electric Power Research Institute, State Grid Corporation of China
Sun Xiaoqiang	Director	State Grid Corporation of China
Quan Fengqi	Deputy Director	Liaoning Company, State Grid Corporation of China
Hao Zhiqiang	Vice President	Inner Mongolia Power (Group) Co.,LTD
Tian Bin	Vice Director	Planning Department, Inner Mongolia Power (Group) Co.,LTD
Li Gang	Director	System Operation Department, Inner Mongolia Power (Group) Co.,LTD
Li Pingjun	Director	Electric Trade Center, Inner Mongolia Power (Group) Co.,LTD
Hang Chenhui	Deputy Director	System Operation Department, Inner Mongolia Power (Group) Co.,LTD
Zhou Baorong	Deputy Director	System Research Institute, China Southern Power Grid
Han Xiaoqi	Director	Electric Power Planning & Engineering Institute of China, Power System Planning & Research Department,
Li Lu	Director	Qinghai Electric Power Grid Company, State Grid China Co
Luo Zhihong	Director	CRESP PMO
Bingqi Jiao	Engineer	Energy Planning Center, Energy Research Institute, State Grid Corporation of China
Gao Lianna	Program Officer	World Bank China - Renewable Energy Scale-up Program

		(CRESP) Project Management Office (PMO)
Rowaldo Del Mundo	Vice President	Concession Contract Management Group, National Transmission Corporation (TransCo), Philippines
Rajiv Kumar Porwal	Dy. General Manager (System Operation)	Power System Operation Corporation Limited (POSOCO) India
Jiao Jian	Director of EE	China Energy Research Society
Mr. Sunil Agrawal	Vice President & Head, New Initiatives Vertical,	Tata Cleantech and Capital Ltd. India
Mr. Muhammad Saleem	Chief (A&A)	National Energy Efficiency & Conservation Authority (NEECA), Pakistan
Mr. Asad Mahmood	Manager Technical	National Energy Efficiency & Conservation Authority (NEECA), Pakistan
Mr. Adnan Mudassar	Managing Director	Punjab Energy Efficiency and Conservation Authority (PEECA) Pakistan
Mr. Alex Ablaza	President	Philippine Energy Efficiency Alliance
Mr. Trinh Quoc Vu	Deputy Director of Energy Efficiency	Ministry of Industry and Technology, Vietnam
Mr. Tran Viet Nguyen	Deputy Director of Business Dept	Electricity of Viet Nam (EVN)
Ms. Dinh Huong Thuy	Head of International Entrusted Funds Dept	Bank for Investment and Development of Vietnam JSC (BIDV)
Ms. Nguyen Sao Mai	Official	State Bank of Vietnam (SBV)
Pham Hung Cuong	Officer	Offshore Funding Department, Bank for Foreign Trade of Vietnam (VCB)
Mr. Edi Sartono	Deputy Director, Directorate of Energy Conservation, DG New-Renewable Energy and Energy Conservation	Ministry of Mineral and Energy Indonesia
Mr. Yudi Prabangkara	Assistant Deputy for Mining and Energy Infrastructure	Coordinating Ministry for Maritime Affairs (CMMA), Indonesia
Mr. Hari Kusmardianto	Deputy Director of Oil and Gas	Coordinating Ministry for Maritime Affairs (CMMA), Indonesia

Mr. Muhadi	Deputy Director of Electricity	Coordinating Ministry for Maritime Affairs (CMMA), Indonesia
Mr. Agus Suryanto	Senior Manager of Business Incubation and Investment Feasibility	PT SUCOFINDO (Persero) Indonesia
Ms. Miao Hong	Head, energy program	World Resource Institute, China