IRADe Integrated Research and Action for Development

ANNUAL REPORT 2016-17

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About IRADe

IRADe is an independent advanced research institute which aims to conduct research and policy analysis to engage stakeholders such as government, non-governmental organisations, corporations, academic and financial institutions. Energy, climate change, urban development, poverty, gender equity, agriculture and food security are some of the challenges faced in the 21st century, IRADe's research covers these issues, as well as the policies that affect them. IRADe's focus is effective action through multi-disciplinary and multi-stakeholder research, to arrive at implementable solutions for sustainable development and policy research that accounts for the effective governance of techno-economic and socio-cultural issues.

IRADe was established under the Society's Act, in 2002 at New Delhi. It is certified as a Research & Development Organisation by the Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology (MoST), Government of India. It has also been selected as a Centre of Excellence by the Ministry of Urban Development (MoUD), Government of India for urban development and climate change. In addition, it provides expertise to other ministries, national and international institutions and partners with other reputed organisations.

Our Vision

To be a leading Global independent policy research Think Tank that provides and enables implementable policy solutions for sustainable and inclusive development.

Our Mission

To promote development using multi-stakeholder and multi-disciplinary perspectives for decision makers and vulnerable groups in thematic areas of climate change and environment; energy and power systems; sustainable urban development; agriculture and food security; poverty alleviation and gender through policy research and analysis, consensus building & dialogues, capacity building, monitoring and evaluation.

Our Objectives

- Integrate multi-disciplinary and multi-stakeholder perspectives concerning issues of development.
- Promote wider consensus, through research and analysis, on effective policies.
- Engage and work at local, district, state, national, South Asia regional and global levels.
- Provide research support to developing countries for development and for negotiation process for international agreements.
- Carry out policy research that accounts for the political economy of the society and effectiveness of governance.

Thematic Areas of IRADe

Key Programme Areas or Thematic Area of IRADe are:

1. Climate Change and Environment
2. Sustainable Urban Development
3. Energy and Power System
4. Poverty Alleviation and Gender
5. Agriculture and Food Security

IRADe's activities in the above areas have cross-cutting themes such as technology assessment and policy reforms. The key activities are:

1. Policy Dialogues and Dissemination
2. Training and Capacity Building
3. Research and Analysis for Decision Support
4. Research in Action, Monitoring and Evaluation Projects

Our Partners in Development

Preface

I express great pleasure in presenting IRADe's Annual Report of the activities undertaken for the year 2016-17. This report highlights the research and development work, as well as the activities conducted for various projects of the organisation.

After contributing to the Paris Agreement Dialogue on Climate Change through IRADe modelling work, we discussed its implementation in a Conference with the representatives of private sector, public sector and Government officials. We were fortunate to have the dynamic ministers: Shri Prakash Javadekar, currently the Minister for Human Resource Development who spearheaded the negotiations in his capacity as the Minister for Environment, Forest and Climate Change; and Shri Suresh Prabhu, currently the Minister of Commerce & Industry, and IRADe Council member who addressed the valedictory session.

For IRADe, this year marked the completion of some old projects and many new beginnings. For example, we are working on addressing the problems of air pollution and the adverse impact on human health due to climate change. Our interest in technology assessment remains a strong and critical factor leading to work on electric vehicles, modernisation of railways, development of early warning system for dengue, electricity induced cooking and grid integration of renewable energy. Some of these key initiatives are in the exploratory stage, while we have received a pilot project from NABARD for cooking using electricity.

IRADe's flagship program *"South Asia Regional Initiative for Energy Integration (SARI/EI)"* is at its peak, culminating in many activities such as completion of reports, stakeholder consultations, consensus and consortia building. The Think Tank Forum (TTF) was initiated leading to cooperation and convergence among South Asian Think Tanks, interested in inter-state energy trade. The Nepal-India modelling exercise provided many insights around the macro-economic impact on South Asia power trade and the final report was released with praise for the state-of-the-art modelling approach used by IRADe. Meanwhile, the Government of India has come out with guidelines for South Asia power trade.

I take this opportunity to express my sincere gratitude to all our sponsors, collaborators, the Governing Council of IRADe and our well-wishers for their continued support and encouragement. I express my sincere appreciation to the IRADe's staff and thank them for their cooperation and dedication to work.

My special thanks to Mr. Mohit Kumar, Senior Research Associate, IRADe for completing the task of preparing this report.

Jyoti Parikh

Professor Jyoti Parikh, PhD
Executive Director, IRADe

Energy & Power Systems

Climate Change & Environment

Poverty Alleviation and Gender

Agriculture and Food Security

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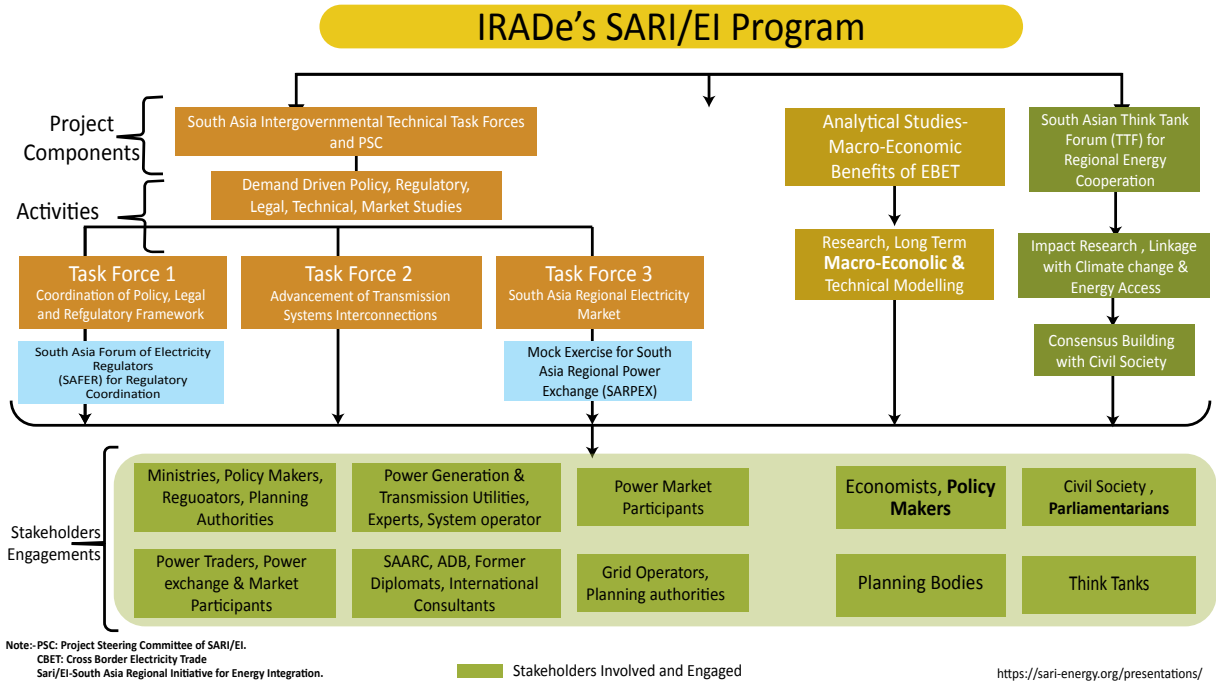
1 Energy & Power Systems

1.1 South Asian Regional Initiative for Energy Integration (SARI/EI)

Integrated Research and Action for Development (IRADe) is the implementing partner for the fourth phase of USAID's South Asia Regional Initiative for Energy Integration (SARI/EI) program for advancing regional energy integration and Cross Border Energy Trade (CBET) in eight South Asian countries (Afghanistan, Bangladesh, Bhutan, India, Pakistan, Nepal, Sri Lanka and the Maldives).

The SARI/EI program critically plays the important role of advancing regional energy integration and thus increasing CBET through focus on (i) Coordination of Policies and Regulatory Mechanisms, (ii) Advancement of Transmission Interconnections and (iii) Establishment of South Asian Electricity Market. To this end, IRADe has constituted three inter-governmental Task Forces and a Project Steering Committee with representations from SAARC country governments, where in-depth analysis/studies are being completed with specific recommendations on policies/regulatory mechanisms, technical grid standards and market rules for promoting electricity trade between South Asian countries. The findings and outcomes are used towards gaining consensus and support from the key decision-makers and stakeholders. In addition to three inter-governmental task forces, last year analytical studies were added and this year the Think Tank Forum (TTF) was formed to engage with civil society institutions. The South Asia Regional Power Exchange (SARPEX) capacity building program for grid operation was also floated. Overall the SARI/EI approach framework is as follows:

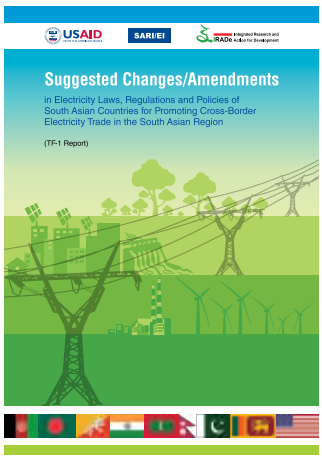


Various activities which were carried out are briefed as follows:

1.1.1 SARI/EI Task Force Activities

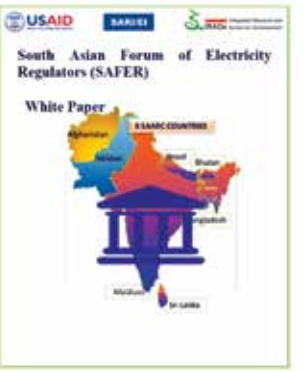
A. Task Force-1 Report on "Suggested changes/amendments clause/section wise in the existing electricity laws, regulation and policies of SA countries for promoting CBET in the South Asia Region"

IRADe had earlier published the Task Force-1 Report on "Regional Regulatory Guidelines (RRGs) to facilitate CBET in South Asia". To take forward the implementation of RRGs and for the coordination/harmonisation of electricity laws, regulation and policies of South Asian (SA) countries for promoting CBET, the Task Force-1 has come out with its 2nd report on "Suggested changes/amendments clause/section wise in the existing electricity laws, regulation and policies of SA countries for promoting CBET in South Asia Region". This report breaks new ground by suggesting changes/amendments in electricity laws, policies and regulation on the various aspects challenging cross-border trade by addressing issues such as trading licenses, non-discriminatory open access, transmission pricing, transmission planning, settling the imbalance by energy accounting and scheduling, harmonising of codes in the existing electricity laws, policies and regulation. The report has also come out with country wise proposed short, medium and long-term roadmaps for implementation.



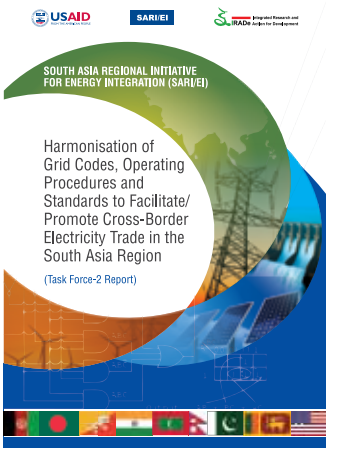
B. White Paper on South Asian Forum of Electricity Regulators (SAFER)

To address various policy, regulatory and legal issues with respect to CBET, under Task Force 1, SARI/EI has commissioned a demand driven study on "Review of Electricity Laws, Regulations, Policies and Legal Structure of South Asia countries (SACs) to identify areas that can hinder CBET and to recommend changes/amendments therein to promote CBET. The study has recommended a regional regulatory institutional mechanism i.e., the formation of South Asian Forum of Electricity Regulators (SAFER) to manage the process of harmonisation of regulations in close coordination with various regional bodies such as the SAARC Secretariat, technical committees, forums and other relevant SAARC entities. The proposed SAFER will be a neutral body and will be critical for the success of CBET and harmonisation/coordination of regulatory frameworks among SACs. A detailed White Paper on SAFER covering its role and responsibilities, functions etc. has been finalised after consultation with various stakeholders in each South Asian country. The study has also recommended that such a forum be initiated under the aegis of an existing regional forum /authority that has been working on a similar agenda in the South Asia region.



C. Task Force-2 Report on "Harmonisation of grid codes, operating procedures and standards to facilitate/promote cross-border electricity trade in the South Asia region: Framework grid code guidelines"

The SACs envisage a manifold increase in the quantum of CBET by the end of the next decade with several new transmission interconnections being proposed across SACs, which will enable greater integration of power systems. For the smooth, optimal, secure and reliable power system operation of CBET across the SA nations, the Study on harmonisation of grid code covering - power system operating procedures, protection code,



metering code, connection code, planning code, system security, scheduling and dispatch, frameworks, open access was undertaken. The Task Force-2 report on "Harmonisation of grid codes, operating procedures and standards to facilitate/promote CBET in the south Asia region has been finalised in three volumes. The Framework Grid Code Guidelines (FGCG) provides basic design criteria and operational rules and responsibilities to be followed by the generating stations, transmission utilities, distribution utilities, and traders. The study has recommended the creation of a Regional Technical Institution/Body such as the South Asia forum of transmission system utilities of SACs or South Asian Forum of Transmission Utility (SAFTU), which shall be mandated for coordinated, reliable and secure operation of the interconnected transmission network as well as for coordinated system planning and integrated system/ network development and grid code harmonisation.

D. Task Force-3 Study on assessment of commercial terms and conditions for CBET and suggested model of power exchange in South Asian region

The Task Force-3 Study on assessment of commercial terms and conditions for CBET and suggested model of power exchange in South Asian region has been completed and has recommended commercial terms and conditions, principles and procedures for the short term, medium-term and long-term CBET in the South Asian Regional Electricity Market. This report has come out with Model PPAs and TSAs, South Asia power Pricing Mechanism & Recommendations for CBET and will be released soon.

1.1.2 Ongoing Studies under South Asia Regional Initiative for Energy Integration (SARI/EI) program

- **Regional investment policy guidelines and regional investment framework for promoting investment in South Asian power sector and CBET:** The draft report of the study has been completed and stakeholder's consultation are being undertaken from different south Asian countries to get their views on the key findings of the study
- **Assessment of the Electricity Trading Potential of South Asian Countries:** The study on the assessment of trading potential covers the existing long term demand-supply projection scenarios of the participating countries and the expected developments in the next 20 years by the year 2034 by taking into account the CBET potential as a means to meet the additional demand for power by each country and/or by exporting surplus power through CBET to other South Asian Nations. The additional scope of study on the economic benefits and CO2 emission reduction of electricity trading among SACs is under progress.
- **BIMSTEC Energy Outlook:** The study is to prepare the BIMSTEC energy sector outlook covering seven countries that are part of BIMSTEC. The study will analyse mapping the past, present and future trends in the energy value chain including the generation and transmission sector. The study will also review and analyse the reforms in the energy sector in each of these countries.

1.1.3 Mock exercise of South Asian Regional Power Exchange (SARPEX) Project

Currently in the SA regional power market, there is long and medium term power trading through bilateral agreements. However, to extract the full benefit of regional power trade of day ahead nature, a regional power exchange is essential. In line with the above, SAR/EI, IRADe has developed a Roadmap of South Asian Regional Power Exchange (SARPEX). Starting with an internally developed concept of SARPEX, the ultimate path to the establishment of SARPEX is dwelt upon. At present, Bangladesh, Bhutan, Nepal and India can participate in the exchange as they are grid connected. The market operates as a Day Ahead Spot Market.

One of the key feature of the concept is the two modes of operations of the exchange. In unified mode, the bids of the neighbouring countries are cleared along with the Indian bids. In the sequential or the residual mode, the bids of the neighbouring countries are cleared along with the Indian bids which are not cleared in the domestic exchanges. A mock exercise for SARPEX is currently being conducted. The results of the mock exercise shall be analysed in order to recommend a suitable mode of operation for SARPEX.

Stakeholder consultations workshops and meetings have been held in Bangladesh, Nepal and Bhutan. In

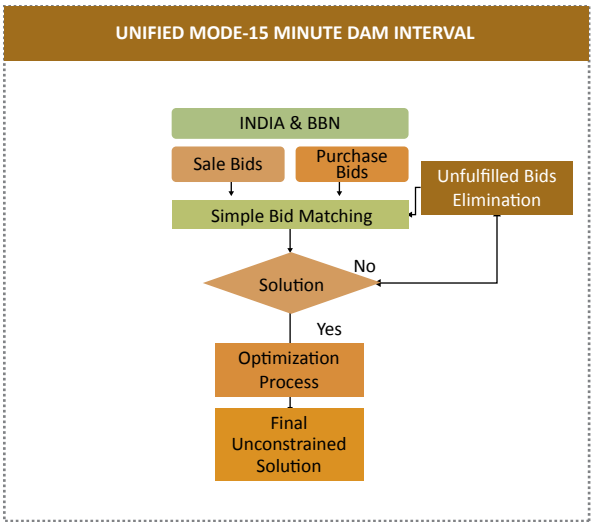


Figure: Unified mode of operation

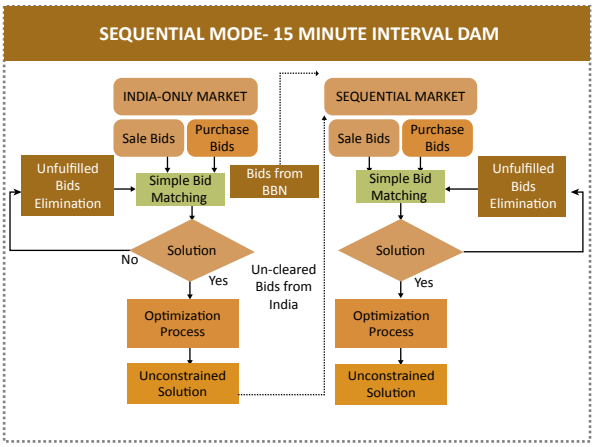


Figure: Sequential mode of operation

India also meetings were held with Central Electricity Authority (CEA), Central Electricity Regulatory Commission (CERC) and Power System Operation Corporation Limited (POSOCO) for the same. After the completion of the mock exercise, the benefits of such an exchange for each of the participating nation shall be quantified. Additionally, a draft market rule and design for SARPEX will be available for further developing the market rules and design for an actual SARPEX. The results of the mock exercise shall be disseminated among all stakeholders. It is felt that these activities will culminate in the establishment of an actual Regional Power Exchange in the South Asian Region.

Core teams from Bangladesh, Bhutan and Nepal governments have been nominated for participating in all

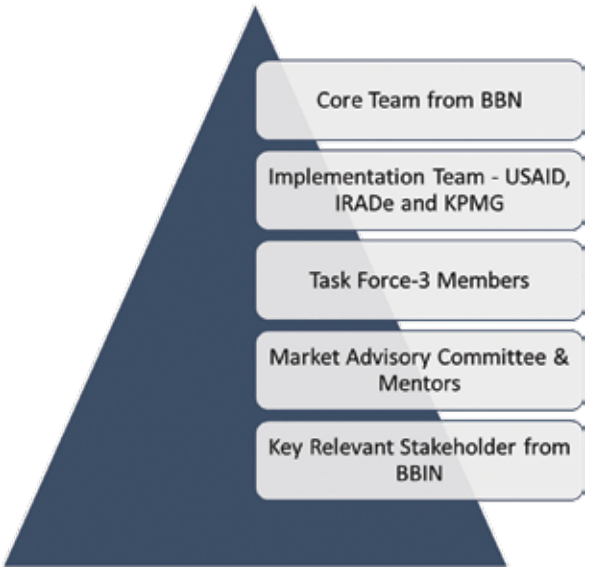
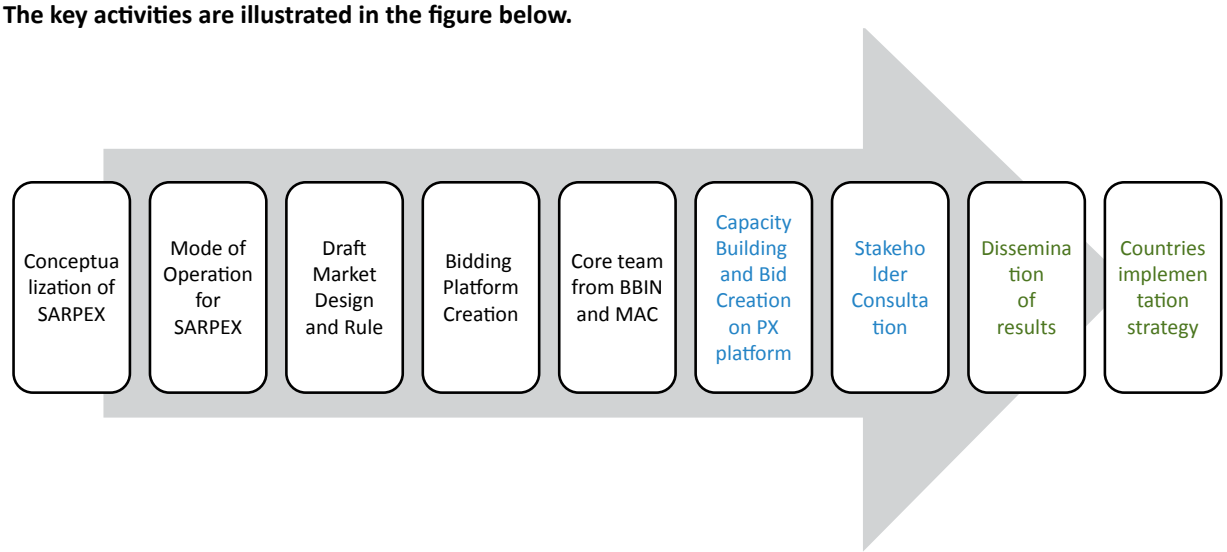


Figure: SARPEX Team for execution of exercise

The key activities are illustrated in the figure below.



the activities. A Market Advisory Committee (MAC) has been formed. Members of MAC are prominent persons from the power sector in India, Norway, Denmark and South Africa. MAC is providing guidance in all the activities in the key activities including the mock exercise.

SARI/EI, Task Force 3 works for the establishment of South Asian Regional Electricity Markets. All these activities are being conducted under the guidance of the TF-3, which will finally give recommendations on all regional market related activities including SARPEX.

1.1.4 SARI/EI Think Tank Forum for South Asia Regional Energy Co-operation

The SARI/EI Think Tank Forum, which is a network of leading Think Tanks in India, Pakistan, Sri Lanka, Butan, Bangladesh and Nepal, has been created for initiating a discourse on the role of CBET in addressing energy demands for economic development among the civil society community. The local Think Tanks are an important channel for positioning CBET in the national priorities of respective countries. They will play a key role in engaging politicians, government institutions, media and civil society, to engrave CBET's role in the realm of energy security and clean energy agendas of these nations.

SARI/EI as a part of its outreach and stakeholder engagement strategy commissioned short-term assignments with four Think Tanks in Bangladesh, India, Nepal and Sri Lanka for activities related to research/ impact studies, stakeholder engagement and media engagement which areas follows:

- Slycan Trust, Sri Lanka for Implementation of NDCs for Renewable Energy in Sri Lanka: Addressing Gaps in Policies & Regulation.
- Independent University, Bangladesh for Research/ Impact Research on CBET and National Events (meetings/workshop) for encouraging CBET.
- Institute for Integrated Development Studies (IIDS), Nepal for Media Engagement for Creating Awareness on Benefits of CBET between Nepal and India.
- CUTS International, India for Assessment of Impact of CBET on Livelihoods and Gender Concerns: Case Study Approach.

1.1.5 Analytical Studies

Under the USAID's SARI/EI program IRADe is undertaking comprehensive analytical macroeconomic studies to critically assess the need for CBET between countries such as Bangladesh, Bhutan, India and Nepal. However, before undertaking CBET a few points need to be considered, such as:

- Why do we need to trade? Are there economic benefits of electricity trade (adequate energy supply to achieve higher economic growth target, less investment on a country energy infrastructure)?

TTF Members

Nepal	Bangladesh	Sri Lanka	Bhutan	India
▪ Institute for Social and Environmental Transition Nepal (ISET) ▪ Institute for Integrated Development Studies (IIDS) ▪ International Center for Integrated Mountain Development (ICIMOD) ▪ Samriddhi Foundation ▪ Niti Foundation	▪ Bangladesh Centre for Advanced Studies (BCAS) ▪ Bangladesh Institute of Developmental Studies (BIDS) ▪ Bangladesh Enterprise Institute (BEI) ▪ International Centre for Climate Change and Development (ICCCAD)	▪ SLYCAN Trust ▪ University of Paradeniya ▪ Climate and Development Research, Munasinghe Institute for Development (MIND)	▪ QED Group ▪ Royal Society for Protection of Nature (RSPN)	▪ Consumer Unity & Trust Society (CUTS) ▪ Centre for Study of Science, Technology & Policy (CSTEP) ▪ Observer Research Foundation (ORF)

- What would be the quantity of hourly tradable electricity and a price agreeable to both buyer and seller?

The study helps to answer the above questions through quantification of the technical, economic, environmental and energy market benefits from cross border interconnections in the region. It is undertaken in phases with the first phase focusing on India- Nepal, which has been completed in the current fiscal year. India- Bangladesh is being considered in the second phase and is an ongoing study.

The study involves multi-country analysis and brings out the economic (macro and micro) importance of power trade besides other benefits. The study is being implemented in two steps. In the first step, power system models quantify the trade potential and tradable electricity price. Whereas, taking them as inputs, macro-economic models in the second step quantify the macro-economic benefits accrued to both the countries. An overview of the methodology adopted for the analytical study is provided below.

Four sub models have been developed for each pair of countries chosen for the study:

a) A macro model and detailed power technology model for each country, which balances power demand-supply on an hourly basis with limited or expanded trade.

b) Iterations between Macro and Technology Models are undertaken that give consistent results such as resources to invest, impact on growth and electricity demand, surplus for trade etc.

As part of consensus building activities carried out under this study, different stakeholders from the power sector, financial and diplomatic communities and other energy experts were brought together. The study meticulously estimates the benefits of providing information to all three task forces of SARI/EI and paves the path for development of sustainable regional energy markets to foster this region's economic growth.

A. Analytical Studies: Macroeconomic and analytical study focusing on benefits of electricity trade between Nepal-India

The study has been completed and a report titled Economic Benefits from Nepal-India Electricity Trade was released in Kathmandu, Nepal on January 19, 2017. The study used three scenarios for analysis. The BASE scenario assumes no increased interconnections across countries beyond what are currently in place (as in 2011–12). The Accelerated Power Trade (APT) scenario allows full potential of electricity trade. Third scenario was a Delayed Capacity Addition (DCA) scenario on delay in hydropower project implementation by five years in Nepal. The delay in projects may not only postpone the earning from exports, but may even increase the imports until the projects are implemented. Key results from the study are highlighted below:

Gains to Nepal

- GDP reaches a level of NPR 13,100 billion at 2007–08 prices in 2045 with APT, which is 39 percent higher than in the BASE

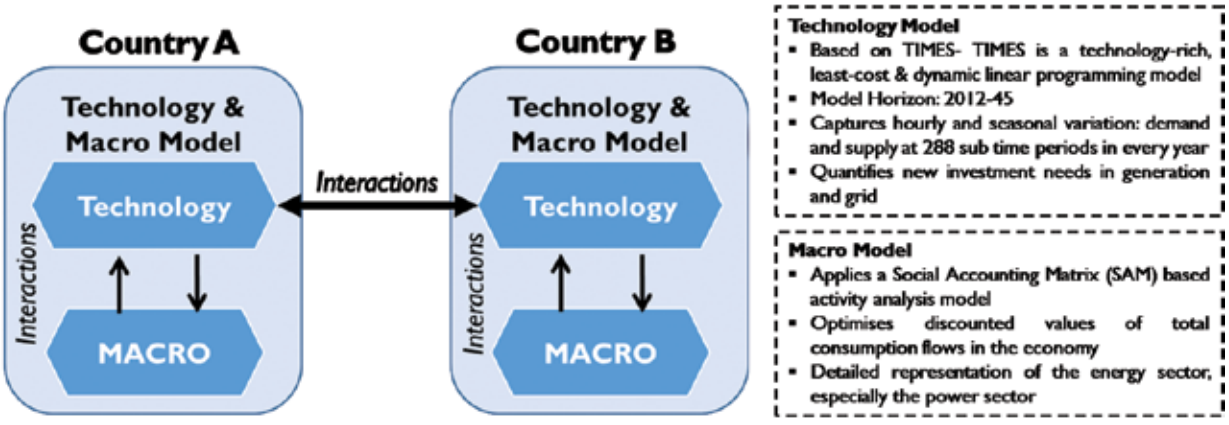


Figure: Approach and Methodology for Analytical Study

- APT leads to significant growth of household consumption, which increases by 23 percent over the BASE. Per capita consumption in 2045 reaches a level of NPR 2,84,000 at constant 2007–08 prices, as against just NPR 27,000 in 2012
- Per capita electricity consumption increases by 50 percent in APT (1500 kWh per capita) by 2045 compared to BASE (1010 kWh per capita)
- Nepal's power generation capacity increases to 34.4 GW in 2045 with APT compared to only 8.9 GW in BASE
- Net export revenues from electricity exports are 1,069 billion NPR in APT and 998 billion NPR in DCA scenario in 2045 (at 2011–12 prices).

Gains to India

- Trade reduces coal and gas-based generation and hence reduces the use of coal and gas in power generation resulting in a decrease in the production and import of these fuels.
- Reduction in fossil fuel use results in lower cumulated CO2 emissions from Indian power generation.
- Trade causes marginal increase in per capita consumption and decline in GDP, as investment and production decline due to imports.

B. Macroeconomic and analytic study focusing on benefits of electricity trade between Bangladesh -India

The second phase of the SARI Analytical Study focuses on India- Bangladesh in the current fiscal year. Given the scarcity and complexity around domestic resources for power generation, Bangladesh faces serious problem of meeting its burgeoning electricity demand to fuel its much needed economic growth. Already a small quantity of import (600 MW) from India has resulted in some temporary relief in dealing with the acute power shortage that causes economic losses and difficulties in daily life. The analytical study applying mathematical

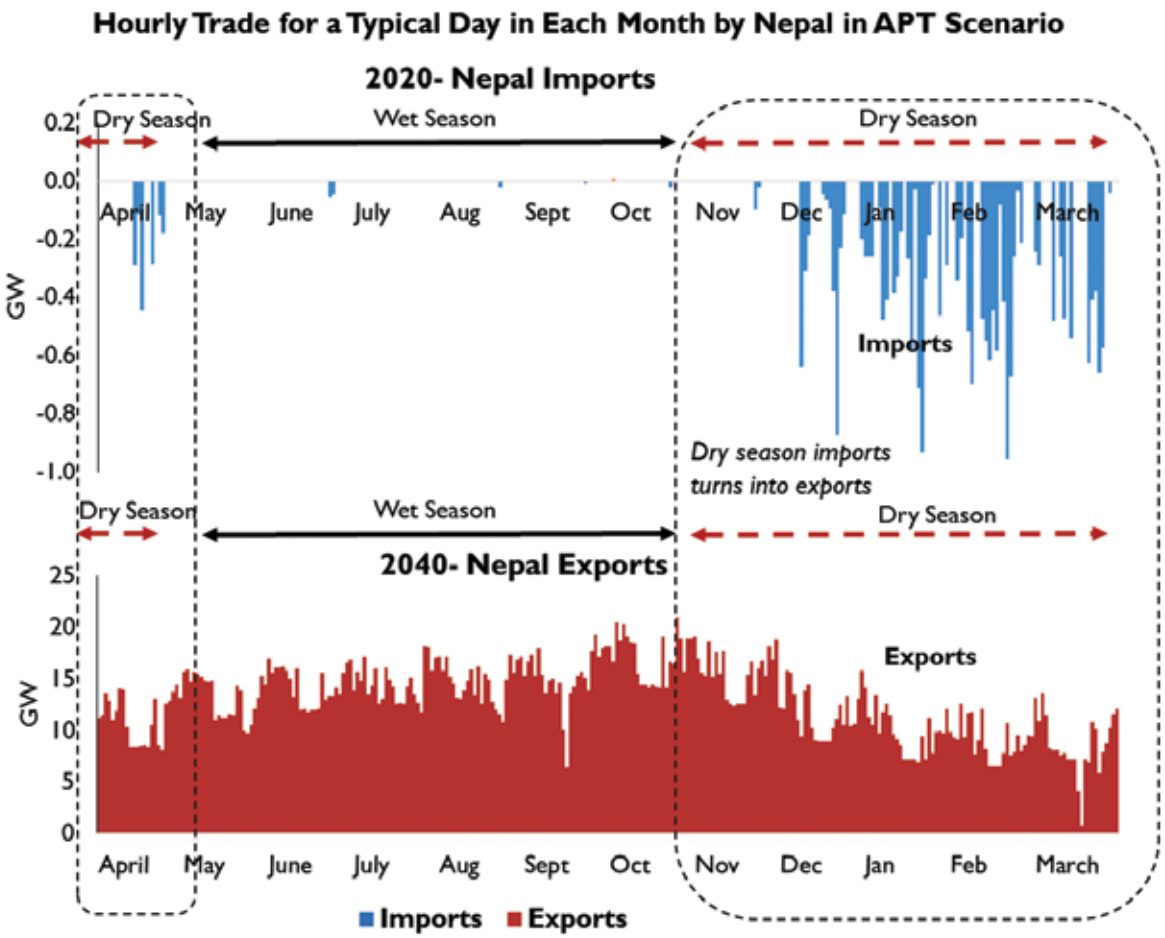


Figure: Hourly Trade for a Typical Day in Each Month by Nepal in APT Scenario

models, explores the different scenarios of future expansion of Bangladesh's power sector, the role of power trade in its future power supply challenges and its macro-economic benefits as it would help to achieve high economic growth with lower investment in the power sector as well as in the development of fuel import infrastructure. The study's primary objective is to produce the information needed for socio-political dialogues and negotiation across and within countries to promote and enhance CBET.

The present activities of the India- Bangladesh study include data collection, model development, model validation, scenario development and analyses. Work is carried out in close association with Bangladesh stakeholders. A stakeholder's consultation workshop involving policy makers, development institutions, and research organisations has been conducted where initial findings have been presented to get their feedback. That feedback has been incorporated and the remaining work is being carried out.

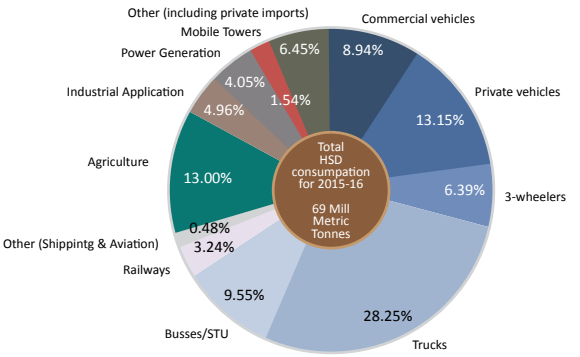
1.2 Converging the Divergence between Diesel and Petrol Pricing

The key objective of this study is to analyse the impacts on various stakeholders, if the price distortions between diesel and petrol were to be eliminated through revenue neutral policy level interventions.

In India, diesel accounted for the largest share (40%) in petroleum product consumption for the year 2015-16 while petrol accounted for 12 percent being the second largest. It is expected that the share of diesel consumption is going to rise to approximately 45 percent and that of petrol marginally to 13 percent.

In this study, our objective was to assess the impact on state finances, transport sector (70% share in consumption) and agriculture (13% share in consumption). Further, we have compared the price differentials existing in other developed and developing nations to provide recommendations for the 'National Petroleum Pricing Policy'.

Diagram below presents the all India sectoral end use analysis of diesel consumption for 2015-16:



Source: 2015-16 data from PPAC (Ready Reckoner - November, 2016)

Three scenarios of petrol and diesel price change that can occur due to price changes in crude oil are considered, viz, 10 percent, 20 percent and 30 percent increase in crude prices. Following were the key results:

1. Diesel Petrol Price Differential – Evolution & Analysis

Analysis of the diesel and petrol price build up reflected key issues, viz, taxes account for 52 percent of the total Retail Selling Price (RSP) in the case of petrol and 46 percent in the case of diesel. Excise duty and VAT contribute majorly (85%) to the price differences at the retail level, excise duty is the common cause of price difference across all the states while inconsistent VAT rates cause significant price differences across states.

2. Impact on State Finances

Taxes on petro products provide a major source of revenue for the states and Centre in India. This analysis is focused on excise duty, as VAT is a state subject.

- The corresponding drop in demand for diesel and petrol resulted in total excise revenue loss at four percent, eight percent and 11 eleven percent.
- Maintaining the revenue neutrality principle, the price difference between petrol and diesel at the given state VAT/Sales Tax rate, is minimised.
- Decline in excise revenue from petrol is compensated by an increase in excise revenue from diesel.
- Net increase in VAT/Sales Tax revenue at a pan India level for all the states together.

These price scenarios have been considered for conducting a further impact analysis of various stakeholders, to ensure a consistent approach.

3. Impact on Diesel Car Manufacturers

The trend of vehicular growth in India would impact the consumption of petrol and diesel. Earlier, petrol cars were preferred however today diesel cars are getting preference over petrol cars due to price differential between diesel and petrol. The preference of diesel cars would decrease when the gap between petrol and diesel price closes. Our analysis compares the discounted cost of buying and using a diesel car and a petrol car of same model. The costs are computed using data on initial costs of buying, annual fuel costs and salvage value of the cars. We use two different discount rates, three different annual kilometre use rates, three different values for life of a car and two sets of prices before and after excise duty equalisation. Our analysis indicates that the rationalisation of excise duty will not change the economics from the consumer's perspective in the selection of a diesel or petrol car. The current pricing of car manufacturers, particularly sedans and SUVs, already make the diesel models an economically unattractive choice. In the case of hatchback car, the sales of diesel vehicles would be only marginally affected by a rationalisation of excise duty. However even if diesel car sales reduce petrol car sales would increase and on the whole sales of cars would not reduce. The cost of controlling effectively carcinogenic emissions from diesel cars will make them even more expensive. Diesel car emissions are estimated to cause thousands of additional deaths. Thus diesel price rationalisation should not have much impact on the car demand.

4. Impact on State Transport Undertakings (SRTU) and Bus Travellers

Buses and State Transport Undertakings (SRTU) account for 9.55 percent of the diesel consumption share at a pan India level. Our approach was therefore to assess the diesel price impact at two levels:

Analysis 1 - Impact of deregulation of the diesel price: Overall revenues of SRTUs went up by 35 percent from 2011-12 to 2013-14 and the profitability was down by 48 percent, mainly due to the fact that the SRTUs were able to compensate for the increase in diesel price through the incremental revenue and reduction in operating costs, while some could not due to operational issues.

Analysis 2 - Comparative analysis of SRTU profitability at the base price level and revenue neutral scenario price: Six years' data for 49 SRTUs in the bus sector, covering the whole country was considered and both financial and physical parameters were calculated based on the SRTU financial performance reports. Based on these calculated parameters, a counter factual scenario for the year 2015-16 was created and this projected the revenue, costs and profitability for the year 2015-16.

The state level impact reflected a two percent incremental fuel cost, while a reduction in profitability was reflected in the range of one percent to 12 percent across states.

5. Impact on Farmers

The impact on farmers is a critical part of this study as the share of agriculture in diesel consumption at the pan India level is 13 percent (PPAC). In order to assess the diesel price impact in the key states, the impact on diesel cost for agriculture was calculated using constant quantity of diesel consumed for 2015-16, End Use Percentage Share in Agriculture (agriculture pump sets, agriculture implements and tractors) as per the PPAC Nielsen Report 2013 and base price and revenue neutral scenario price. Overall and state level impact reflected a two percent incremental cost.

6. Impact on Truckers

Road transport is an important sector of the Indian economy, contributing about 5% to the annual GDP. Trucking industry forms the backbone of this sector, accounting for 28 % of total diesel consumption by the sector. Specifically fuel costs constitute 55% of an average trucks total trip expenses when considered without overheads and about 50% when considered with overheads. With an increase in price of diesel of 2% when excise duties are rationalised, the impact on freight rate will be just 1%. This 1% increase in the freight rate is negligible compared to the many sources of inefficiencies in the trucking operations with much larger impact. Thus, this small increase should not raise much of opposition from the truckers particularly if other measures are taken to reduce trucking costs.

1.3 Advanced Coal Technologies (ACT) for Power Generation

IRADe is a member of the Global Technology Watch Group, a consortia comprising of IRADe and three IITs (Madras, Bombay and Delhi) for the continuous monitoring of the status of coal technology in India and abroad, its evaluation for use in India, and to facilitate the development of a road map for Advanced Coal Technologies for Sustainable Power Generation.

The group has had a series of meetings and has finalised some technology aspects for the country. The main purpose of the meeting was to arrive at a consensus on the evaluation of technologies and arriving at a draft coal road map and technology road map for coal utilisation in India. IIT-M reported on the recent estimates of reductions in CO2 emission intensity (in terms of g/kWh of energy produced from a coal power plant) possible through improvement in steam parameters in pulverised coal boilers, gas turbine inlet temperatures in IGCC and through oxy-fuel combustion based carbon capture and storage (CCS) in PC boilers and IGCC. Based on these calculations, IIT-M have suggested that one could analyse these with respect to sustainability including:

(a) Achievable measures on PC boilers (current power generation technology) providing up to 10 percent reduction in CO2 emission intensity without requiring CCS.

(b) Upto 25 percent reduction in CO2 emission intensity through IGCC, which is yet to be done on a large scale in India, again without requiring CCS.

(c) Upto 80 percent reduction in CO2 emission intensity possible with CCS coupled to PC boiler/IGCC based power generation.

IIT-B has suggested some environmental control technologies for the power plants that would be required to meet norms for CCS (SOx, NOx, PM, Hg, Fly ash control) though desulphurisation, selective catalytic and non-catalytic reduction, ESP and bag filters, activated carbon, etc.

Under the project,IRADe has undertaken a detailed analysis of the country's energy sector, its resources particularly coal, coal policies, coal based power generation scenario, efficiencies for different thermal power generation technologies, namely sub-critical, super critical and ultra-super critical technologies. IRADe critically examined the various technologies in power generation, beneficiation and mining and developed a technology index based on multiple evaluation criteria such as capital cost, O&M cost, CO2 & other emissions, socio-economic and water food print evaluation and in meeting India's INDCs.

IRADe analysed sub-critical, super critical and ultra-super critical technologies with eight different technology scenarios ranging from the addition of environmental control technologies like electro static precipitator (ESP), Fluidized Gas Desulphurisation (FGD), Selective Catalytic Reduction (SCR) and super critical power generation technologies with CCS technologies.

While in the case of environmental control technologies excluding CCS there is an energy penalty of around Rs.1/kWh in case of CCS it goes up to Rs.4-5/kWh. IRADe has made broad recommendations, which have been shared with the GTWG group for the finalisation of the country's road map.

2 Climate Change & Environment

2.1 SAMANVAY: Synthesis of Traditional and Modern India's Approach to Sustainable Low-Carbon Development Pathways

Unsustainable consumption leads to pressure on natural resources and long-term impacts on the environment. While a section of the globe and society suffers from lack of basic necessities, the high consuming and unsustainable lifestyles of another section places immense stress on the environment. This imbalance in global consumption patterns is reflected in a situation where the richer sections over exploit the available resources, and the poorer segments are unable to even meet their food, health, housing and education needs.

During COP21 at Paris, the Honourable Prime Minister Shri Narendra Modi released the 'Parampara' catalogue showcasing India's traditional climate friendly practices. This project is a step in the direction of providing a glimpse of the consumption patterns, carbon emissions, efforts to balance rich heritage and modernity, roots of India's frugal lifestyle and future challenges. It focuses upon the possibilities of leapfrogging through which we can achieve the same level of development, prosperity and wellbeing without necessarily going down the path of reckless consumption. It does not mean that economies will suffer; it means that our economies will take on a different character.

In India, traditional practices that are sustainable and environment friendly continue to be a part of people's lives. India has a history of low carbon footprint and lifestyle. These need to be encouraged, rather than replaced by more modern but unsustainable practices and technologies. Changing our lifestyle and creating consciousness can help us deal with climate change and create a more balanced world.

2.2 Inter-model comparisons of different transportation sector policies in India

This project was supported by Shakti Foundation. The Sustainable Growth Working Group (SGWG) was formed under the US-India Energy dialogue in which the NITI Aayog is representing the Government of India. NITI Aayog has set up an Advisory Board on transportation and air quality. It had representatives of relevant ministries including the Ministry of Environment, Forest and Climate Change, several transportation ministries, Bureau of Energy Efficiency and others. The project team comprises of four Indian modelling teams: Integrated Research and Action for Development (IRADe), Centre for Study of Science, Technology and Policy (CSTEP), Council on Energy, Environment and Water (CEEW) and The Energy Research Institute (TERI) and involves building a set of technology and policy options to reduce energy consumption and emissions, increase access and solve mobility issues in the transport sector. This will also help to evolve a roadmap for the transport sector in the light of the Nationally Determined Contribution (NDCs). The policy scenarios to be modelled will be in consultation with the Advisory Board. This modelling exercise will result in initiating a dialogue between various ministries to understand the implication of a policy scenario or a combination of multiple policy scenarios.

The purpose of bringing together the four Indian teams and US team is to bring out some robust policy analysis and suggestions for the Government of India to reduce air pollution caused by road transportation.

India has committed through its NDC to reduce CO2 intensity by 33-35 percent by 2030 as compared to 2005 levels. As India's per capita income grows, ownership of motorised vehicles will expand rapidly. India's transport sector contributed to 14 percent

(75 Mtoe) of final energy consumption as of 2013. The road transport sector consumes 90 percent of the total transport sector fuel and passenger transport contributes to 60 percent of the total fuel consumed by road transport (68 Mtoe, 2013). India's transport sector contributes about 10 percent of Greenhouse Gas (GHG) emissions in 2013. Of the total emission of 188 MT of CO2 equivalents, road transport sector contributes to 87 percent of the total transport emissions. This will have implications for energy and GHG emissions from the transportation sector. The problem of worsening air quality, particularly in Indian cities has received much attention recently. Understanding the linkages between air quality and transportation and modelling would be helpful in designing policies to mitigate the health and economic impacts of the ever-expanding transport sector.

Policymakers in the U.S., Asia and Europe increasingly rely on inter model comparisons because it helps simultaneously build modelling capacity and capacity for integrating modelling results into planning. Modelling of identical policy problems on different platforms and tools is the gold standard for model development because it yields a more robust consideration of likely impacts than those available from one model. It also allows for focused vetting and peer review. Vetted results, in turn, help policymakers understand why different models present different results, and the range of results increases the robustness of the findings. Different models typically can answer different aspects of a question. Recognising the importance of energy modelling in effective policy making for low-carbon growth, the Governments of India and the United States have formed a Sustainable Growth Working Group (SGWG) as a part of the bilateral energy dialogue. The proposed research effort builds on technical collaboration and relationships established over the past few years through energy modelling and analysis between Indian and U.S. Government partners and modelling teams under the SGWG. The modelling teams are engaged in a multi-year research collaboration seeking to build on this foundation to assist in decision making through analysis on the critical issue of transport and air quality.

The project involves building a set of technology and policy options to reduce energy consumption and emissions and increase access and solve mobility issues in the transport sector. This will also help to evolve a roadmap for the transport sector in the light of the NDCs. The policy scenarios to be modelled will be in consultation with the Advisory Board. This modelling exercise will result in initiating a dialogue between various ministries to understand the implication of policy scenario or a combination of multiple policy scenarios.

The work on this project is in progress. IRADe has contributed to a joint paper by the four teams on transport sector modelling.

3 Sustainable Urban Development

3.1 Preparation of Solar City Master Plan for Ajmer

Ajmer is a city in Rajasthan rich in heritage and a favourable destination for tourists from around the world. Ajmer has qualified as a Smart City along with funding from MoUD's AMRUT and HRIDAY schemes. IRADe is preparing the Ajmer Solar City Master plan for the Ajmer Municipal Corporation, Rajasthan under the Solar City Programme of MNRE and MoUD's Smart City programme.

The Solar City Program aims at a minimum 10 percent reduction in projected demand for conventional energy at the end of five years for the city, which can be achieved through a combination of Demand Side Management (DSM) energy efficiency measures and enhancing the supply from renewable energy sources. The city's Solar City Master Plan includes the base line energy consumption, demand forecasting for the next five years, sector-wise (residential, commercial, institutional, industry) strategies and action plan for implementation of renewable energy projects like solar, wind, biomass, small hydro, waste to energy etc. that may be installed along with possible energy efficiency measures [LED (Light-emitting diode) bulbs, Star rated appliances, etc.] depending on the need and resource availability in the city, so as to mitigate the fossil fuel consumption and reduce the GHG emissions. The city has formed the Special Purpose Vehicle (SPV) for implementation of smart city projects and also replaced all the streetlights with energy efficient LED lights. Three field visits have been made to the city to meet the various stakeholders (Corporation, electricity, supply, statistics, development) and energy data collection from relevant departments has been completed. Data analysis is in progress and the report is likely to be submitted in March 2017.

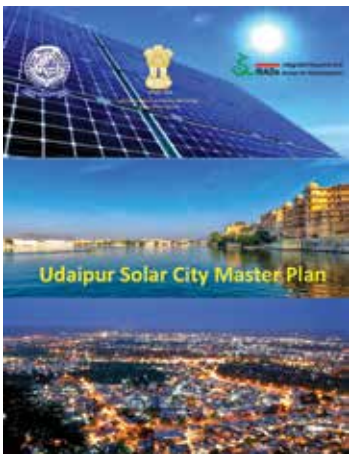
Ajmer Municipal Corporation Heritage Building

Solar Power Plant at AMC Office

3.2 Preparation of Solar City Master Plan for Udaipur

Udaipur the city of lakes and palaces is an important tourist destination in Rajasthan;it is surrounded by the Aravalli hills and dotted with lakes. IRADe has submitted the draft Udaipur Solar City Master Plan to Udaipur Municipal Corporation under the MNRE's Solar City Programme. IRADe submitted the Draft Report after undertaking extensive field surveys and meetings

with various stakeholders. Discussing the report requirements with Commissioner UMC and Additional Commissioner SPV (Special Purpose Vehicle) Solar City and city engineers. The energy requirements for the city were projected by IRADe for the next five and ten years and was able to reduce the energy requirements by five percent through energy efficiency, recommending EE (Energy Efficient) devices and it also recommended five percent renewable energy interventions through RE (Renewable Energy) devices. IRADe also recommended a few pilot projects that could be implemented in the city like the 8.5 MW Solar power plant at Tiger Hills, one MW WtE plant for MSW. The city has already formed its City Solar Cell that would oversee implementation of projects along with the SPV for the implementation of smart city projects. The next step is a stakeholder consultation meeting to discuss the draft report of the Solar City Master Plan. The final report will be submitted after receiving comments from the stakeholder consultation on the Draft Report.



Tiger Hill site for solar power plant

Fateh Sagar Lake, Udaipur

3.3 Development of Urban Climate Vulnerability Index

IRADe will develop an urban vulnerability index for five Indian cities, which will be selected based on the population, city location and ecosystem type (coastal region, hilly region & arid regions). The Urban Vulnerability Index may serve as a decision support system to the Government of India for devising adaptation and mitigation strategies for the urban sector in India. The objectives of the research study are: to design a framework for assessment of the cities' urban climate vulnerability and to prepare climate vulnerability profiles of the selected cities using identified indicators and bring forth the areas of adaptation which cities should prioritise for improving its resilience and integrate it in to their developmental initiatives.

The extent of climate vulnerability for the cities will be measured based on five principles viz., risks due to climate change, infrastructure status, governance, socio-economic condition and adaptive capacity. A replicable methodology for assessing urban vulnerability/climate resilience of the cities will be the major outcome of the project.

4 Poverty Alleviation & Gender

4.1 Energy Sector Reforms in India

The study aims to provide gender-based evidence in an effort to bridge the policy gap that exists between clean cooking energy access to LPG (Liquefied Petroleum Gas- assumed to be the clean and convenient cooking fuel in India) for cooking and its impact on the role of women. The scoping report comprehensively covers the available literature on the subject and draws upon research methodology extensively. It also identifies the research issues, which need to be explored.

To explore the impact of cooking fuel use-change on women, the impact was categorised across the three broad groups, 'welfare', 'productivity' and 'empowerment'. Indicators were developed to collect household level data across each theme (see Table below) from sample households in Raipur- Chhattisgarh and Ranchi-Jharkhand. The primary survey of households using structured questionnaires and focus group discussions at selected villages in these two districts was also completed.

Gender impact and energy interventions

Gender goal	Types of needs/issues addressed	Possible energy intervention
Welfare Reduce drudgery associated with collection and use of biomass fuel Reduce health problems associated with biomass fuel	Practical need Health Quality of life	Improve access and affordability of clean cooking alternatives—possible link to energy subsidies Reduce time taken to collect fuel Reduce load to be carried
Productivity Free up women's time for income-generating activities Improve women's economic output and thereby incomes	Productive need Economic power	Free up women's time by improving access and affordability of energy related to time-intensive, non-economic and menial activities-possible link to energy subsidies Improve access and affordability of energy related to women's employment needs—possible link to energy subsidies
Empowerment Promote women having an equal voice in decision-making Promote women's ownership and/or control of assets Safeguard women from violence and harassment	Representation need Equality in governance Ownership	Introduce minimum requirements for female members of decision making bodies Provide capital or transfers related to energy use—possible link to energy subsidies Improve street lighting

Training for surveyors being conducted in Ranchi

4.2 Electricity as a clean cooking option for rapidscale cooking

The National Bank for Agriculture and Rural Development (NABARD) has given IRADe the work to explore the possibilities of using electricity for cooking as a way of providing access to clean cooking options in rural areas. Under this project IRADe would carry out studies in the States of Rajasthan and Chhattisgarh using field level surveys and technology demonstrations and monitoring of the households, which would be provided with electric induction cookers. The study will help to understand consumer/stakeholder behaviour towards the new technology/device, cooking habits and reasons for its adoption or otherwise. The project will involve a multi stakeholder approach to address all the issues and will work with the Ministries of Petroleum, Renewable Energy and the Electricity Departments. The project will help in meeting the UN's SDGs (Sustainable Development Goals) of access to clean energy and gender issues and suggest suitable policy recommendations so that the goals are achieved effectively.

5 Agriculture & Food Security

5.1 Assessment of food security and livelihoods due to climate change in Uttar Pradesh, Himachal Pradesh and Odisha

Food security is attained when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. The four pillars of food security are availability, access, utilisation and stability. The nutritional dimension is integral to the concept of food security. Availability refers to the total food stock in a country/ region (macro level) or within a given population or household (micro level); 'a measure of food that is, and will be, physically available in the relevant vicinity of a population during a given period'. Apart from other factors, availability may be limited by climatic factors such droughts, floods, rising temperature etc. Climatic changes and increasing climatic variability are likely to aggravate the problem of future food security by exerting pressure on agriculture. The agriculture sector is sensitive to short-term changes in weather and to seasonal, annual and longer-term variations in climate.

- The present study aims to assess the impacts of climate change on food security and associated livelihoods in three states namely Himachal Pradesh, Uttar Pradesh and Odisha. The broad objectives of the study are as follows:
- To assess the vulnerability of food security and livelihoods due to socio-economic and other environmental stresses in the current climate and its likely exacerbation due to climate change for a short, medium and long term time period
- To devise the adaptation options and prioritise the same
- To develop a framework for adaptation.

The project is supported by the Ministry of Environment, Forest and Climate Change (MoEFCC) of Government of India.

5.2 Analysis of Energy, Food & Water Nexus in a Macroeconomic Consistency Framework

Water demand from the power sector has been increasing owing to the increase in power generation capacity in recent years. Water for cooling requirements in thermal power generation technologies like coal based sub critical, super critical, ultra-super critical and IGCC (Integrated Gasification Combined Cycle), gas based thermal generation, solar thermal and nuclear have significant water requirements. The demand for power would increase with growth, which would be accompanied by an expansion of the agricultural sector, industrial sector and urbanisation led water demand from the affluent households. However, the availability of water remains constant based on historical levels of precipitation and might decrease due to the impact of climate change. This makes water a scarce commodity whose requirement in the production process is very critical and therefore imposes a major constraint on growth. This project aims to see if India's stated climate goals in the power sector and its growth ambitions are impacted by the competing demands for water from all the sectors. The IRADe-IAM model developed under several projects for Government of India has been used to analyse the water use based trade-off between agriculture and energy in the long-term perspective up to 2050.

This project was supported by NITI Aayog.

Objectives of the research study

1) Projection of water demand scenario for the Power Sector up to 2050 under existing and optimised water use policies.

2) Projection of water demand scenario for agriculture and other sectors up to 2050 under existing and optimised water use policies.
3) Impact of the decrease in the water availability on energy food nexus.

Scope of the research study

1) To comprehensively assess the nexus between energy, food and water and provide policy based suggestions on the most optimal strategy for energy sector growth and water conservation and water use efficiency.
2) To project the changing water requirements in to the future up to 2050 accounting for changing cropping patterns due to changing food consumption patterns and urbanisation.
3) To incorporate the impact of climate change on water availability and hence increasing reliance on ground water irrigation.
4) To assess the water requirement of the industry and power generation technology wise.
5) To assess the reduction in water use due to water conservation policies for the power generation sectors.

The IRADe team has projected water demand in the power sector and analysed the impact of low carbon policies and water conservation policies on water demand from the agriculture, industry, household and power sectors to assess the trade-off between food, and energy due to water and the impact that climate change has on this nexus due to a reduction in water availability.

6 Conferences, Workshops and Meetings

6.1 "National Conference on Post Paris Climate Action", held in New Delhi, India on July 12th, 2016

At COP 21 in Paris, Parties to the UNFCCC reached a historic agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement requires all Parties to put forward their best efforts through "Nationally Determined Contributions" (NDCs) and to strengthen these efforts in the years ahead. Against this backdrop the "National Conference on Post Paris Climate Action" was organized by IRADe on July 12th, 2016 at New Delhi, India. Shri Prakash Javadekar, Hon'ble Minister for Human Resource Development, Government of India inaugurated the event and Shri Suresh Prabhu, the then Hon'ble Minister for Railways, Government of India chaired the valedictory session. Senior Government officials from Ministry of Power, Ministry of Environment, Forest and Climate Change, Ministry of New and Renewable Energy, Department of Science and Technology and Ministry of Finance, CMD's and Senior officials of public and private sector organisations participated and shared their insights. The purpose of the conference

Glimpses from "National Conference on Post Paris Climate Action", held in New Delhi, India

Glimpses from "National Conference on Post Paris Climate Action", held in New Delhi, India

was to discuss how to implement the INDC's, what are the obstacles and its requirements, what are the challenges of technology and availability of finance. The representatives discussed how to meet the two promises given at Paris viz; reducing Green House Gases (GHG) intensities by 35% by 2030 from 2005 values and 40% share of non-fossil energy sources in power capacity. The focus was on power sector, transport sector, especially railways. In addition to the Inaugural Session there were also four technical sessions. GAIL, NABARD, IREDA, PFC, NTPC, REC, and PTC India Limited were the partners for the support, cooperation and sponsorship of the event.

6.2 Launch of Task Force-1 report on "Suggested Changes/Amendments in Electricity Laws, Regulations and Policies of South Asian Countries for promoting Cross-Border Electricity Trade in the South Asian Region" at Dhaka, Bangladesh on 21 April 2016

Mr. Nasrul Hamid, Hon'ble State Minister, Ministry of Power, Energy and Mineral Resources (MPEMR), Government of Bangladesh released an important SARI/EI report on suggested changes/amendments in electricity laws, regulations and policies of SACs for

Release of report on "Suggested Changes/ Amendments in Electricity Laws, Regulations and Policies of South Asian Countries for Promoting CBET in the South Asian Region " by Mr. Nasrul Hamid,MP, Hon'ble State Minister, MPEMR, Govt. of Bangladesh on 21 April, 2016 at Dhaka.

promoting CBET in the South Asian region. The report is a first of its kind for South Asia and breaks new ground by suggesting changes/amendments in electricity laws, policies and regulation on tricky aspects challenging cross-border trade by addressing issues such as trading licenses, non-discriminatory open access, transmission pricing, transmission planning, settling the imbalance by energy accounting and scheduling, harmonising of codes in the existing electricity laws, policies and regulation. These suggested changes/amendments can be considered by the government of each SAC as a base for aligning the legal, policy and regulatory frameworks in their respective countries. The report also has come out with country wise proposed short, medium and long-term roadmaps for implementation.

6.3 Workshop on "Power Markets Development in India: Key Lessons Learnt", held at Mukti Hall, Bidyut Babhan (Power Cell premises, Power Division), Dhaka, Bangladesh on 21st April 2016

On the request of the Power Division (under MPEMR), a workshop on "Power Markets Development in India: Key Lessons Learnt" was held at Mukti Hall, Bidyut Babhan (Power Cell premises, Power Division), Dhaka, Bangladesh on 21st April 2016. The workshop shared the lessons and learnings from the evolution of the Indian Power Sector covering key laws, policies and regulations, besides the role of transmission agencies and power exchanges in the development of the Indian Power Market. Mr. Nasrul Hamid, Member of Parliament and Hon'ble State Minister, MPEMR, Government of Bangladesh, the Chief Guest, in his inaugural speech acknowledged the timely relevance of the workshop given the country's interest in developing a local power market and the significant energy opportunity it sees in regional markets. To this end, he stressed on the need for capacity building of power sector professionals and pointed out that this critical gap was of high priority. He also used the forum to share some of the key investments planned for CBET, like the USD one billion that Bangladesh would be investing in Bhutan for power-infrastructure development, along with India. He shared that Bangladesh plans to increase the import of electricity from India to 2,000 MW in the

Mr. Nasrul Hamid, MP, Hon'ble State Minister, Govt. of Bangladesh, graces as the chief guest of SARI/EI Workshop on Power Market Development in India: Key Lessons Learnt, at Dhaka on 21st April 2016.

coming years. The workshop concluded with a high-level panel discussion that brought forward the views on power market development and the importance of policies and regulations and the government's role. The panel unanimously recommended the benefits of a competitive power market for Bangladesh, which would strengthen the power sector and its entities.

6.4 Combined meeting of SARI/EI Task Force-2 and Task Force-3, Hotel Pan Pacific Sonargaon, Dhaka, 20th April 2016.

The combined meeting of Task Force-2 and Task Force-3 was held on 20th April 2016 in Dhaka, Bangladesh. The meeting was inaugurated by Mr. Masum-Al-Beruni, Managing Director, Power Grid Company of Bangladesh (PGCB). The meeting had members of Task Forces 2 and 3 from Bangladesh,

Combined meeting of SARI/EI Task Force-2 and Task Force-3, 20th April 2016, Dhaka, Bangladesh

Bhutan, Nepal, India, Sri Lanka, SAARC Energy Centre, Islamabad along with the SARI/EI team members and consultants. The SARI/EI Project Secretariat presented the objective and the key deliverables of the proposed "Pilot Market - Mock Exercise for South Asian Regional Power Exchange (SARPEX) and formation of Market Advisory Committee". The SARI/EI Project Secretariat also presented the terms of reference for the proposed "Model framework guidelines for non-discriminatory open access regime in transmission and on trading license regime and guidelines for grant of trading license in South Asian Countries (except India)" for deliberation by the members. Members appreciated the efforts being made by SARI/EI to promote CBET.

6.5 Workshop on "Regional Power Trade with special focus on Nepal – India" held in Kathmandu, Nepal, on 28th April, 2016.

A Workshop on "Regional Power Trade with special focus on Nepal – India" was organised on 28th April, 2016 at Hotel Radisson, Kathmandu wherein results of the Nepal-India Modelling study were presented to the stakeholders. The workshop was marked bythe presence of eminent people from Nepal such as Mr. Suman Prasad Sharma, Secretary, Ministry of Energy, Government of Nepal; Prof. Dr. Govind Nepal, Former Member, National Planning Commission, Nepal; Mr. Shankar Khagi, Environment and Energy Specialist, USAID Nepal; Mr. Jeebache Mandal, Joint Secretary, Water and Energy Commission Secretariat, Ministry of Energy, Nepal; Mr. Sher Sigh Bhat, Deputy Managing Director, Nepal Electricity Authority; Dr. Biswo Poudel, Assistant Professor, Kathmandu University; Dr. Bishnu Dev Pant, Executive Director of IIDS, Nepal; Mr. Surendra Raj Bhandari, Deputy Managing Director, NEA, Nepal; and energy economist, Mr. Devendra Adhikari. Representatives from IBN, ADB and World Bank were also present at the workshop.

Group photograph: Workshop on "Regional Power Trade with special focus on Nepal-India

6.6 Focus Group Discussion on "India TIMES Electricity Model" with Central Electricity Authority (CEA), India held at CEA, New Delhi, on 1 July 2016

A focus group discussion on "India TIMES Electricity Model" was held on 1 July 2016 at Central Electricity Authority, New Delhi, India. The participants were members of CEA- Mr. S.D. Dubey (Chairman), Mr. H.R. Arora (Director), Mr. Vikram Singh (Director), Ms. Sharda Prasad (Director HPP&I), Mr. J.S. Bawa (C.E.), Mr. Pankaj Kumar Verma, Mr. Raj Singh Tomar, Mr. Pawan Gupta, Mr. Joydeb Bandyopadhyay, Mr. S. Mandilwar, Mr. Pradeep Jindal (C.E.), Mr. Pankaj Batra (C.E.) and Ms. Shivani Sharma (Deputy Director). From IRADe, Dr.Kirit Parikh (Chairman) also participated in the focus group discussion and briefed the CEA members about SARI/EI. Mr. Vinay Saini (IRADe), gave the presentation on India TIMES Model prepared for the SARI/EI Nepal

Focus Group Discussion on "India TIMES Electricity Model" with Central Electricity Authority, India

India Analytical Study. He shared the key assumptions and outputs of India TIMES model with the CEA representatives.

6.7 Stakeholder Consultation for White Paper on Regional Regulatory Institutional Mechanism with Bhutan Stakeholders, Ministry of Economic Affairs, Royal Government of Bhutan, 14th July, 2016.

A stakeholder consultation meeting on the White Paper "South Asia Forum of Electricity Regulators" was held on 14th July, 2016 with Bhutan stakeholders on structure, functions, roles and responsibilities of the forum. Senior officials from the Ministry of Economic Affairs, Royal Government of Bhutan, BPC, DGOC, and BEA attended the meeting. The consultants Ernst & Young made a presentation to the gathering on the key findings of the White Paper focusing on the structure, functions, roles and responsibilities of the Forum of Electricity Regulators to get their inputs and suggestions for charting a roadmap with a clear action plan for the formation of the Regional Electricity Regulatory Institutional Mechanism: South Asia Forum of Electricity Regulators (SAFER).

6.8 Stakeholder Consultation on White Paper on Regional Regulatory Institutional Mechanism for South Asia Forum of Regulators with Nepal Stakeholders, Ministry of Energy, Government of Nepal, 16th September, 2016.

A Stakeholder Consultation on the White Paper on the South Asia Forum of Electricity Regulators was held with Nepal stakeholders on 16th September, 2016. The workshop was attended by senior officials from MOE, Nepal, NEA, Tariff Fixation Commission, and USAID Nepal. The presentation on the "Key findings of the white paper on structure, functions, roles and responsibilities of South Asia Forum of Electricity Regulators" was made by consultants Ernst & Young to the gathering to get inputs and suggestion from stakeholders to chart a roadmap with a clear action plan for formation of the Regional Electricity Regulatory Institutional Mechanism: SAFER.

6.9 Launch Workshop of SARI/EI Think Tank Forum for South Asia Regional Cooperation, Hotel Shangri-La, Kathmandu, Nepal, 16th September 2016.

IRADe organised the meeting of the Think Tank Forum on 16th September at Kathmandu. The Think Tank Forum is a network of leading Think Tanks for initiating a discourse on the role of CBET in addressing energy demands for economic development in each participating SAC. The local Think Tanks are an important channel for positioning CBET in the national priorities of the respective countries. There was a diverse and dynamic group of participants from 13 Think Tanks and six SACs namely, Bangladesh, Bhutan, Pakistan, Sri Lanka, Nepal and India. Representatives provided insights, as well as, actionable and practical suggestions, which would be considered for further evolving the Think Tank Forum.

Launch workshop of SARI/EI Think Tank Forum for South Asian Regional Cooperation, 16th September, 2016 at Kathmandu, Nepal

6.10 SAFER Stakeholder Consultation Meeting-White Paper on Regional Regulatory Institutional mechanism, Dhaka, Bangladesh, 19th October, 2016

The SAFER Stakeholder Consultation Meeting on the White Paper on Regional Regulatory Institutional mechanism was organised in Dhaka, Bangladesh. During the meeting key findings from the White Paper on Regional Regulatory Institutional mechanism on SAFER were deliberated upon and discussed with Bangladesh Energy Regulatory Commission (BERC). Valuable inputs and suggestions were made by BERC to chart a roadmap with a clear action plan for formation of the Regional

SAFER Stakeholder Consultation Meeting, Bangladesh Energy Regulatory Commission, Dhaka, Bangladesh

Electricity Regulatory Institutional Mechanism. Senior officials from BERC attended the meeting.

6.11 Meeting with Honourable Secretary General of Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), BIMSTEC SECRETARIAT, Dhaka, Bangladesh, 20th October, 2016.

A meeting was held with Honourable Secretary General of Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) on 20th October, 2016 at the BIMSTEC Secretariat, Dhaka, Bangladesh. Mr. V.K. Kharbanda made a brief presentation on the Overview of SARI/EI Program Progress, Key Achievements and Way Forward. Various SARI/EI Task Force studies being conducted under SARI/EI were highlighted and discussed. How these studies can be useful to BIMSTEC was also discussed. Mr. Rajiv Ratna Panda, suggested that BIMSTEC may consider publishing a biennial flagship publication titled "BIMSTEC Energy Outlook" which would not only improve the energy literacy among BIMSTEC member states but also bring cohesion and sustenance about the energy cooperation initiatives among BIMSTEC member states over a long period of time. The idea of publishing the "BIMSTEC Energy Outlook" was considered positively by the BIMSTEC Secretariat.

Meeting with Honorable Secretary General, BIMSTEC SECRETARIAT, Dhaka, Bangladesh

6.12 Round Table Stakeholder Consultation on Regional Investment Framework in South Asia, Dhaka, Bangladesh, 20th October 2016.

SARI/EI organised a Round Table Stakeholder Consultation on Regional Investment Framework and Policy Guidelines for promoting investment in the South Asian Power Sector on 20th October, 2016 in Dhaka, Bangladesh. The meeting stressed on the need for an appropriate investment and policy framework to promote regional investments for CBET. The meeting reflected on the key concerns of investors, lenders, multilateral development banks (MDBs), and project developers for promoting investment. The objective behind this was to develop the Regional Investment Framework and Policy Guidelines for promoting investment in the South Asian Power Sector and in CBET in the region. Policymakers, investors, bankers, private development, senior officials of the Energy and Power Ministries, senior officials of the Investment Board of Bangladesh, Public Private Partnership Authority and Bangladesh Investment Development Authority participated in the event.

Round Table Stakeholder Consultation meeting, Regional Investment Framework and Policy Guidelines for promoting investment in South Asian Power Sector and in Cross-Border Electricity Trade (CBET) in South Asia, on 20th October 2016, Dhaka, Bangladesh

6.13 SARI/EI Think Tank Forum India Workshop for South Asia Regional Co-operation

SARI/EI Think Tank Forum India Workshop for South Asia Regional Co-operation was organised on 27th October, 2016 at Hotel Le Meridian, New Delhi, India. Representatives of four leading Think Tanks -- Observer Research Foundation (ORF), CUTS International (Consumer Unity & Trust Society), Centre for Study of Science, Technology & Policy (CSTEP) and the National Council of Applied Economic Research (NCAER) attended the workshop. The participants deliberated on ideas for engagement to promote the issue of power trade through the lens of economic development, climate change and energy security.

SARI/EI Think Tank Forum Workshop for South Asia Regional Co-operation, New Delhi, India

6.14 5th Meeting of Project Steering Committee-Maitland State Room Mount Lavinia Hotel, Colombo, Sri Lanka, 9th and 10th November, 2016

The 5th meeting of the Project Steering Committee (PSC) was held on 9th and 10th November, 2016 at Mount Lavinia Hotel, Colombo, Sri Lanka. Members of the PSC from various SACs along with representatives from IRADe and USAID attended the meeting. Dr. B.M.S Batagoda, Secretary, Ministry of Power and Renewable Energy, Government of Sri Lanka delivered the keynote address. Mr. V.K. Kharbanda, Project Director, SARI/EI, IRADe presented an overview of the South Asian Power Sector. Dr.Kirit Parikh, Chairman, IRADe, presented the analytical study on macroeconomic benefits of CBET between India and Nepal and updated the gathering on the Bangladesh Analytical Study. Mr. Rajiv Ratna

5th Meeting of Project Steering Committee, Colombo, Sri Lanka

Panda, Head-Technical SARI/EI, IRADe presented the "Annual Work Plan (AWP) for 2016-2017 and strategies for synthesis of SARI/EI Recommendations-Preparation of Combined Task Force Report". Members deliberated on the AWP 2016-17 and the members agreed that the implementation by SARI/EI/IRADe be carried on. Ms. Monali Zeya Hazra, Regional Energy Manager, USAID,India made a presentation on the role of SARI/EI in capacity building in South Asia for promoting CBET in the region. She highlighted various activities being conducted by the United States Energy Association (USEA) under the project to enhance capacity.

6.15 4th Meeting of Task Force-3, Kathmandu, Nepal, December 7th, 2016.

The 4th meeting of the Task Force-3 was held on 7th December 2016 at Kathmandu, Nepal. Mr. Michael Boyd, Senior Energy Advisor, USAID Nepal welcomed the participants. The inaugural session was addressed by Dr Kirit Parikh, Chairman, IRADe while the Chief Guest, Mr. Chiranjiwee Chataut, Joint Secretary, Ministry of Energy, Government of Nepal delivered the keynote address. The vote of thanks was given by Mr S.K Ray, Technical Specialist, SARI/EI. The meeting was attended by Task Force-3 members from different South Asian Nations and core team members from Nepal along with core team nodal officer from Bhutan. After the inaugural meeting, Ministry of Power (MoP) guidelines on CBET were discussed in detail by the country representatives.

The Task Force member's concurrence has been received on the SARPEX market rules, design and the selection of days based data sampling methodology.

4th Meeting of Task Force-3, Kathmandu, Nepal

The key recommendation of the first study and implementation plan has been discussed in detail and agreed on. The action plan and strategy for engaging the country governments and ensuring buy-in from governments for the pilot market including stakeholder consultation was discussed. Mr. Shankar Khagi, Environment & Energy Specialist, SEED Office, USAID/ Nepal delivered the vote of thanks.

6.16 Report Release for Nepal-India Analytical Study "Economic Benefits from Nepal-India Electricity Trade" held in Kathmandu, Nepal, on 19th January, 2017

A report titled Economic Benefits from Nepal-India Electricity Trade was released in Kathmandu, Nepal on January 19, 2017 by Michael Gonzales, Chargé d'Affaires, US Embassy, Dr. Swarnim Wagle, Member, National Planning Commission, Government of Nepal and Smt. Mala Narendra, Second Secretary, Indian Embassy, Nepal.

Report Release event for Nepal-India Analytical study "Economic Benefits from Nepal-India Electricity Trade" held in Kathmandu, Nepal

The report analyses the potential of CBET between Nepal and India, and its feasibility and impact on the economy, power systems and power infrastructure of both countries. The report was widely covered by Nepal's media in more than eight national newspapers.

6.17 Stakeholders' Consultation Workshop on the study "Economic Benefits of Bangladesh-India Electricity Trade" held in Dhaka, Bangladesh, February 2nd, 2017.

A Stakeholders' Consultation Workshop was organised at Dhaka on February 2, 2017. The workshop was inaugurated by Dr. Ahmad Kaikaus, Honourable Secretary, Power Division, Ministry of Power, Energy and Mineral Resources, Bangladesh. Some high-level participants included Mr. Nathan Sage, Deputy Director, Economic Growth Office, USAID, Bangladesh, Mr Mohammad Hossain, Director General, Power Cell, Mr. Abul Baser Khan, Member, Planning and Development, Bangladesh Power Development Board (BPDB), Mr. K. M. Abdus Salam, Member, Renewable Energy, Sustainable and Renewable Energy Development Authority (SREDA), Mr. Sk. Md. Abdul Ahad, Joint Chief, Power Division, Planning Commission, Mr Arun Kumar Saha, Chief Engineer, Project Monitoring, Power Grid Company of Bangladesh Ltd. A panel discussion chaired by Prof Kirit S. Parikh was held and some important points were raised.

Stakeholders' Consultation Workshop on Bangladesh-India electricity trade study, Dhaka, Bangladesh

7 Professional Activities

Dr. Jyoti Parikh, Executive Director

- Panelist in the session "GESI Enabling Policy, Regulatory and Institutional Environment" at ADB Sub-Regional Conference. Organised by Asian Developing Bank (ADB), on 11th April, 2016 at Jaipur, India.
- Distinguished Speaker at the 17th CONSTRUTECH India Conclave & Expo 2016. Topic "Smart City-Governance & Climate Change", Organised by India Tech Foundation, on 26th April, 2016 at Mumbai, India.
- Panelist on "Policy Talk-Food, Water, Energy and Communication" at Knowledge Forum on "Climate Resilient Development in Himalayan & Downstream Regions". Organised by ICIMOD, on 16th June, 2016 at New Delhi, India.
- Panelist on "Road to 2030". Organised by Asian Development Bank (ADB), on 2nd August, 2016 at New Delhi, India.
- Panelist on "Smart Urbanisation local solutions for local issues", at CII Conclave, Organised by CII, on 8th August, 2016 at New Delhi, India.
- Panelist at National Conference on "Energy Data, Energy Modelling and GEO Spatial Analysis." Organised NITI Aayog, on 10th August, 2016 at New Delhi, India
- Panelist at India Energy Access Summit, Organised by The Climate Group, on 11th August, 2016 at New Delhi, India.
- Panelist on "How to build on efficient technology framework under the Paris Agreement?", at Seminar on Technology Partnership after COP 21.Organised by French Embassy, on 9th September, 2016 at New Delhi, India.
- Panelist on "Financing Sustainable Development", at India Think Tank Dialogue on Rising Policies. Organised by ORF & RIS, on 19th September, 2016 at Goa, India.
- Panelist on "Trade, Investment & Regional Value chains" at Regional Consultations of the BIMSTEC Network of Policy Think Tanks (BNPTT). Organised by RIS, on 27th September, 2016 at New Delhi, India.
- Participation in BRICs Civil Forum. Organised by RIS, on 4th October, 2016 at New Delhi, India.
- Panelist on "The Regional Approach Emerging New Opportunities through Regional Initiatives.", at a Discussions on "Road Maps for Accelerating Nepal's Economic Progress, organised by IIPP, Chennai, on 11th November, 2016 at New Delhi, India.
- Panelist on "Poverty & Low Carbon Development Strategies" at Consultation on Energy titled "How is a Decarbonized & Decentralized Energy Future Possibility for India? The Energy Equity Work. Organised by INECC, on 30th November, 2016 at New Delhi, India.
- Panelist on "South Asia Power Trade: Benefits & Challenges" at Conference on Establishing the Research Platform for Energy Cooperation & Governance in Asia. Organised by Northeast Asia Research Institute, Beijing, on 7th December, 2016 in Beijing, China.
- Participation at T-20 Task Force, Preparation on Climate Policy & Finance/material and decisions for G-20.Organised by Mercator Research Institute on Global Commons and Climate Change, Berlin, Germany, on 27th February, 2017 in Berlin, Germany.

Dr Parikh speaking at the India Energy Access Summit

- Participation in World Energy Outlook 2017, High Level Workshop on Energy and Development. Organised by International Energy Agency (IEA), Paris, on 27th March, 2017 in Paris, France.

Mr. V. K. Kharbanda, Project Director

- Presented and Chaired the Session on "Opportunities through facilitating bilateral or multilateral cooperation" In the workshop organised by USAID-LEAD at Hanoi, Vietnam during 30th June-1st July 2016.
- Speaker for "Financial Consideration: Investment for Energy Cooperation in South Asia" and Panelist for Panel discussions on "Global Best Practices: Lessons for South Asia" organised by IPAG and ADBI at Hotel Raddisson, Dhaka, Bangladesh during 21st-22nd October2016.
- Speaker for "Regulatory Issues and Challenges in Cross Border Electricity Trade–Role of Regional Regulatory Guidelines & Way Forward" in the 3rd SAARC Energy Regulator meeting held at Islamabad, Pakistan during 22nd-23rd September 2016.

Mr. Rohit Magotra, Assistant Director

- Speaker in Session on "Emerging Prospects of Sustainable Development Goals and Climate change" at The Human Settlement Institute (HSMI) on 22nd Nov., 2016 at HSMI, New Delhi.
- Speaker in Session in ACCCRN Learning Forum 2016 on "Sharing Knowledge and Sustaining Partnerships for a More Resilient Urban Future" at Semarang, Indonesia on May, 23rd - May 25th 2016.
- Speaker at conference on Climate Change and Disaster Risk Management in Planning and Investment Projects organised by Asian Development Bank and Asia Pacific Adaptation Network on 28th June, 2016 in New Delhi, India

Mr. Sharad Verma, Assistant Director

- Speaker and presented IRADe activities at the 2nd India International Science Festival (IISF-2016), NGO Conclave at CSIR - National Physical Laboratory, New Delhi, 7-11 December 2016.

Mr. Rajiv Ratna Panda, Head-Technical

- Spoke on "Regional Energy Cooperation for Promoting Cross Border Electricity Trade(CBET)& Hydro Power Development in South Asia" -SAARC workshop- 9th-10th May, 2016 at Kathmandu, Nepal.
- Spoke on "South Asian power sector and CBET" Power gen India & Central Asia conference-18th -20th May, 2016-New Delhi-India.
- Spoke on "Accelerating the development of South Asian Power Sector through CBET", Nepal Power Investment Summit- May 31-June 3, 2016-Kathmandu, Nepal.
- Panelist on "Strengthen South Asia Power Grid Interconnection", Nepal Investment Summit -May 31-June 3, 2016-Kathmandu-Nepal.
- Spoke on "Harmonization of grid codes, operating procedures and standards to facilitate/promote CBET in south Asia ", 3rd Meeting of SAARC Energy Regulators- 21st -22nd September 2016- Islamabad, Pakistan.
- Spoke on "Harmonization of grid codes, operating procedures and standards to facilitate/promote CBET in south Asia region"-SAARC video conference- 18th and 19th October, 2016.
- Spoke on "Accelerating CBET and Hydro Power Development between Myanmar and South Asia" in the Myanmar Green Energy Summit- 15th -16th August, 2016-Yangon.

Ms. Asha Kaushik, Senior Research Associate

- Presented a paper titled "Integrating climate resilience in smart cities: case study of Ahmedabad city" at Smart City World Congress, held at Barcelona, Spain during 15-17 November 2016.

List of Publications

Papers in Journals

- Kirit Parikh and Jyoti Parikh (2017) Strengthening India's Position in Climate Change Negotiations. **Economic and Political Weekly.** Vol. 52, Issue No. 10.
- Shweta Srinivasan, Nazar Kholod, Vaibhav Chaturvedi, Probal Pratap Ghosh, Ritu Mathur, Leon Clarke, Meredydd Evans, Mohamad Hejazi, Amit Kanudia, Poonam Nagar Koti, Bo Liu, Kirit S. Parikh, Mohd. Sahil Ali and Kabir Sharma (2017) Water for electricity in India: A multi-model study of future challenges and linkages to climate change mitigation. **Applied Energy.** (DOI: http://dx.doi.org/10.1016/j.apenergy.2017.04.079).
- Kirit Parikh and Jyoti Parikh (2016) Paris Agreement: Differentiation without Historical Responsibility? **Economic and Political Weekly.** Vol. 51, Issue No. 15.
- Kirit Parikh and Jyoti Parikh (2016) Realizing Potential Savings of Energy and Emissions from Efficient Household Appliances in India. **Energy Policy.** Vol. 97.

Papers in Conferences

- Kirit Parikh, Jyoti Parikh and Mohit Kumar (2016). "Vulnerability of Surat, Gujarat to Flooding from Tapi River: A Climate Change Impact Assessment", TROPMET 2016 National Symposium on Tropical Meteorology: Climate Change and Coastal Vulnerability, held at Shiksha 'O' Anusandhan University, Bhubaneshwar, Odisha, India during 18-21 December 2016.
- Rohit Magotra, Jyoti Parikh, Asha Kaushik and Sonali Vyas (2016) Integrating Climate Resilience in Smart Cities: Case Study of Ahmedabad City. Smart City Expo World Congress, Barcelona,Spain 2016.

Newspaper and Magazine Articles

- Jyoti Parikh and Kirit Parikh (2016) Making odd-even work better. Business Standard, dated 10 April 2016.
- Jyoti Parikh and Kirit Parikh (2016) Still Up in the Air. Indian Express, dated 09 May 2016.
- Jyoti Parikh (2016) Constant Consultation is Key. Energy Next, July 2016.

Project Reports

- Jyoti Parikh, Rohit Magotra, Mohit Kumar, Pushkar Pandey, Asha Kaushik, Sonali Vyas and Mohit Kumar Gupta (2016) Review of Status of Marine National Park, Jamnagar: Evolving a vision statement for Management of MNP. Project Report. IRADe-PR-54(2017).
- IRADe (2017) Economic Benefits from Nepal-India Electricity Trade. Project Report. IRADe-SARI/EI-2017-01

Workshop Proceedings

- IRADe (2016) Launch of SARI/EI Think Tank Forum for South Asian Regional Energy Co-operation. Workshop Proceedings. IRADe-SARI/EI-2017-WP-01.
- IRADe (2016) SARI/EI Think Tank Forum India Workshop for South Asia Regional Energy Co-operation. Workshop Proceedings. IRADe-SARI/EI-2017-WP-02.

Paris Agreement
Differentiation without Historical Responsibility?

KIRIT S PARIKH, JYOTI K PARIKH

The Paris Agreement on Climate Change has reiterated the principle of Common but Differentiated Responsibilities and Respective Capabilities, but has not referred to historical responsibility. How important is historical responsibility and what does it imply? How is one going to differentiate without historical responsibility? What would

India submitted its Intended Nationally Determined Contributions on 1 October 2015 to the Nations Framework Convention on Climate Change (UNFCCC) (Government of India 2015). Countries were asked to submit their own INDCs before the Conference of Parties (COP).

The process of INDC preparation involved modelling studies by different groups—Integrated Research and Action for Development (IRADe) and Energy and Resources Institute (

Indian Express

Still up in the air

The odd-even programme is no long-term solution to pollution. It can only be the beginning of the search for one

JYOTI PARIKH AND KIRIT PARIKH

Even without the odd-even programme, congestion can be reduced by technological measures and economic incentives. A computerised and automated signalling system can move the traffic faster. Synchronised signals can also help. There is poor lane discipline in traffic and stricter enforcement of rules can reduce many gridlocks. Steep congestion charges can be introduced as has been done in Singapore and London. Parking fees should also be raised to reflect the scarcity of road space. Some important short-term options within Delhi government's ambit are the reducing of biomass burning, minimising road dust and controlling construction dust.

[EXPERT SPEAK]

'Constant consultation is key'

The Delhi Solar Power Policy 2016 is evoking mixed reactions. Although a welcome step, the Government will do well to ensure a foolproof mechanism by taking into confidence all the stakeholders, writes *Jyoti Parikh.*

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[IN CONVERSATION]

'Solar cell efficiency is important'

If we want to push Make In India, we need to complement it with determined efforts in R&D, says *Kirit Parikh* in an interview with *Shitanshu Shekhar Shukla.*

Q How do you view the renewable energy sector in India?

The Union Minister for Railways Suresh Prabhu was quoted by a newspaper as saying that the solar panels would be installed on all stations.

What do you think of the renewable portfolio obligation?

It requires enforcement and uniformity.

According to REN21 report, the rich countries have been outspent by the developing countries. Do you see any paradigm shift? Developing countries are spending more and rich countries are spending less. What is your opinion?

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Sunday Business Standard, 10 April 2016

Making odd-even work better

Even if pollution does not decline due to the odd-even rule, Delhi residents' exposure could decrease as a result of reduced congestion and travel time on the roads

JYOTI PARIKH & KIRIT PARIKH

IRADe's Outreach and Partners

IRADe networks with the government, ministries/ departments, international organisations, public and private sectors, academic experts, NGOs, and consultants to work on projects awarded by them. IRADe provides decision support to eleven ministries that include Ministry of Environment, Forests and Climate Change (MoEFCC), Ministry of New and Renewable Energy (MNRE), NitiAayog (formerly Planning Commission), Ministry of Power, Ministry of External Affairs, Ministry of Earth Sciences (MoES), Ministry of Urban Development (MoUD), Department of Science and Technology (DST), Central Statistical Organization under Ministry of Statistics and Programme Implementation, Technology Information, Forecasting and Assessment Council (TIFAC), etc. for many national level projects.

At the international level, IRADe has worked with bilateral and multilateral organisations like the World Bank, Asian Development Bank (ADB), U.S. Agency for International Development (USAID); United Nations Development Programme (UNDP); United States Environmental Protection Agency (USEPA), Wuppertal Institute for Climate, Environment and Energy Germany; Deutsche Gesellschaftfür Internationale Zusammenarbeit (GIZ), Germany; Rockfeller Foundation;International Institute for Applied Systems Analysis (IIASA), Austria; British High Commission (BHC), Department for International Development (DFID); Centre for Clean Air Policy (CCAP), USA; International Institute for Sustainable Development (IISD), South South North Trust (SSNT) etc. IRADe has partnered with academic, private and public sectors, multinational organisations, think tanks and NGOs. These include Shakti Foundation, Indian Council of Social Science Research (ICSSR), SEWA, Petroleum Federation of India, Gujarat Power Corporation Limited (GPCL), National Bank for Agriculture and Rural Development (NABARD), Pricewater House Coopers, ICF International, Rockefeller Foundation, Institute for Social and Environmental Transition (ISET), Center for Clean Air Policy (CCAP), Indian Council for Research on International Economic Relations (ICRIER), InsPIRE Network for Environment, Stanford University and Sir Dorabji Tata Trust (SDTT) among others.

IRADe has also developed strategic partnerships and is part of global networks like the USAID's Low Emissions Asian Development (LEAD) program - ASIA-LEDS, ENERGIA-International Network for Gender and Sustainable Energy, Netherlands; Global Clean Cook Stoves Forum, UN Foundation; Asian Cities Climate Change Resilience Network (ACCCRN), Global Technology Watch Group (GTWG-DST), Climate Action Network South Asia (CANSA).

IRADe has carried out some pioneering work in the field of state level energy planning, city level climate resilience planning, other climate change studies and livelihood studies.

List of Projects

Sr No.	Title of the Project	Funding Agency	Status
1	SAMANVAY: Synthesis of Traditional and Modern India's Approach to Sustainable Low-Carbon Development Pathways	MoEFCC	Completed
2	Inter-modal Comparisons of Different Transportation Sector Policies in India	Shakti Foundation	Ongoing
3	Preparation of Solar City Master Plan for Ajmer	Ajmer Municipal Corporation	Ongoing
4	Preparation of Solar City Master Plan for Udaipur	Udaipur Municipal Corporation	Completed
5	Developing Urban Climate Vulnerability Index	MoEFCC	Ongoing
6	South Asian Regional Initiative for Energy Integration (SARI/EI)	USAID	Ongoing
7	Diesel Price Rationalization: Converging the Divergence between Diesel and Petrol Pricing	Shakti Foundation	Ongoing
8	Advanced Coal Technologies for Power Generation	DST/GTWG	Ongoing
9	Energy Sector Reforms in India	DFID/ENERGIA	Ongoing
10	Electricity as a Clean Cooking Option for Rapid Scale Cooking	NABARD	Ongoing
11	Assessment of Food Security & Livelihoods due to Climate Change in UP, HP and Odisha	MoEFCC	Ongoing
12	Analysis of Energy, Food and Water Nexus in a Macroeconomic Consistency Framework	NITI Aayog	Ongoing

Partners and Sponsors

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