ANNUAL REPORT
2015-16

Integrated Research and Action for Development

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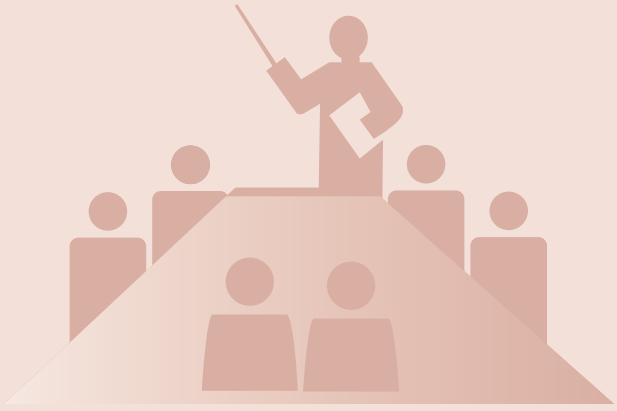
IRADe Integrated Research and Action for Development



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Preface

It is my great pleasure to present the 2015-2016 Annual Report of the activities of IRADe. This Annual Report provides an opportunity to reflect on the significance of research and development that makes an impact on economic growth and sustainable development by IRADe. This year, IRADe has worked on nine projects of which four are successfully completed and five are in different stages of accomplishment.

IRADe was one of the two institutions that provided inputs for India's Intended Nationally Determined Contributions (INDCs) prior to Paris negotiation on Climate Change. We also organized two events with French embassy on "Climate Change and Cities" and "Climate Finance".

IRADe flagship programe on South Asia Regional Initiative for Energy Integration (SARI/EI) is reaching crescendo in multiple dimensions. Engagement with the power managers and policy makers in the seven countries through task forces and studies, detailed analytical studies and modeling studies for bilateral trade issues and how can countries transform economies, especially through Nepal-India trade as well as a beginning of a new forum of think tanks in these South Asian countries. Many events and studies are enriching our understanding. Do visit IRADe and SARI/EI websites (www.sari-energy.org).

Our continuing stress on energy access and gender leads to several activities including research and surveys on subsidies through Energia-DFID project in Chhattisgarh and Jharkhand.

We are happy to complete the final reports of our projects on Marine National Park, Sustainable Energy Strategies for Gujarat and Smart Climate Resilient Cities.

This year we brought out IRADe highlights 2002-2015 giving account of 13 years of our work.

I take this opportunity to express my sincere thanks to all our sponsors, well-wishers and Governing Council of IRADe for their continued support and encouragement. I express my sincere appreciation to the IRADe team and thank them for their cooperation and devotion to work.

We welcome your suggestions and request you to visit www.irade.org.

Professor Jyoti Parikh, PhD
Executive Director, IRADe

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 organizations, 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. Therefore, IRADe research covers these, as well as 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 and Development Organization by the Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology (MoST). It has also been selected as a Centre of Excellence by the Ministry of Urban Development (MoUD) for urban development and climate change. In addition, it provides expertise to other ministries, national and international institutions and partners with other reputed organizations.

Our Mission

To explore new opportunities and promote paradigm shifts to provide optimum solutions in sustainable development to include vulnerable groups in decision making process.

Our Vision

To be a leading independent policy research organization and think tank that suggests implementable policies to focus on poverty alleviation, gender equity and inclusive growth, with a focus on energy, environment and climate change using multi-disciplinary, multi-stakeholder framework so as to integrate various perspectives and field-level understanding.

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.

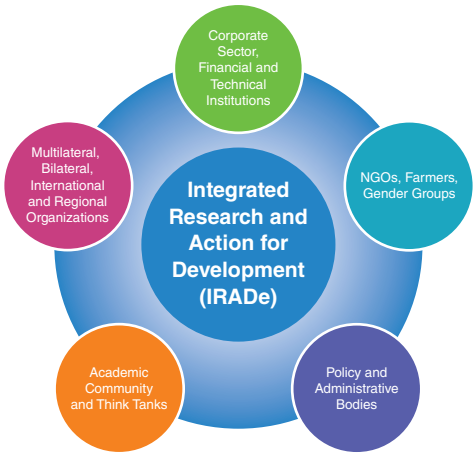
Thematic Areas of IRADe

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 Program

IRADe 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

1 Climate Change and Environment

1.1. Modeling Studies on Greenhouse Gas Emissions (GHG) and Emission Intensity of Indian Economy

The Ministry of Environment, Forest and Climate Change (MoEF&CC) assigned the tasks to answer key questions relating to climate negotiations. The Project focused on key sectors such as energy and power, transport buildings, industries, agriculture, land use and land use change and forestry (LULUCF) and wastes among others. Further, the project also includes assessment of implications of various developmental pathways, structural shifts or technological changes on national Greenhouse Gas Emission (GHG) trajectories in the time frames 2007-2050. The project carried out analysis of the ongoing and planned policies and assessment of their impact on the GHG emission intensity of Indian economy, including the cost/ economic implications thereof.

To achieve the project objectives, IRADe developed a model version **IRADe-Neg-50** which is a dynamic multi-sectoral, inter-temporal, linear programming activity analysis model based on an input–output framework. The model incorporates interventions in these areas to achieve low carbon pathways. Further, the household consumption along with Government consumption is a part of the final sector final consumption in the economy. The growth rate of household consumption and its composition over time is what drives the economy. The model projects the changing demand structure of the economy till 2050 in a dynamic manner using a combination of log normal population distribution and expenditure class specific linear expenditure systems which are consistent along classes as they reflect an underlying non-linear demand system.

The project work was monitored by the ministry in consultations with the project steering committee (PSC). There were seven meetings through a course of two years during which various scenarios were run to assess the possible GHG emissions and emissions intensity for 2020, 2030, 2040 and 2050. IRADe assessed the GHG emissions and emissions intensity and associated energy and power generation mix under various socio-economic scenarios of growth, low carbon measures in power and transport sector, energy efficiency, and fall in costs of renewables. Currently available calculations were used with expected as cost reductions in future as well as current policy for e.g. no more sub-critical coal power plant should be constructed after 2016. Additionally, through the scenarios, the IRADe team showed that India would not peak under any of the envisaged socio-economic pathways even by 2050. In the run up to the Paris COP, IRADe team summarized possible range for GHG emissions and emissions intensity through three scenarios, Dynamics as Usual (DAU), Determined actions scenario (DETA) and Ambitious Actions scenario (AMBA). The DAU scenario incorporated current policies and programs as well as current trajectories in falling costs, renewable penetration and energy efficiency. The DETA scenario is about increasing efficiency and achievable technological intervention. The AMBA scenario on the other hand is **about Increased Rate of Capacity Creation, Cost reduction** of technologies, drastic lifestyle change, and energy conservation with Ambitious targets. The results from IRADe's analysis showed that the emissions intensity target in the INDC is nearly realized in the DAU scenario itself while the non-fossil fuel capacity is only 30% in DAU. However, in the DETA & AMBA scenario India achieves an emissions intensity reduction of 39% and 43% by 2030 and a non-fossil fuel capacity of 40% and 51% in DETA and AMBA respectively. In addition to these scenarios, the PSC requested IRADe team to also do a sensitivity analysis of various policies to test for the robustness of the result that with determined actions India would be able to reach its INDC targets by 2030 and also suggest possible INDC targets for 2050. The IRADe team showed that through aggressive nuclear or even the renewable energy program or a combination

of both, INDCs can be achieved even if one or some of the other targets for technological options in power, transport and energy efficiency are not reached. Some of the more important conclusions arrived at by the study are summarized as under:

- India can bring down its per capita GHG emissions to less than 6 tonnes by 2050 where non fossil electricity generation would be 47% and 60% in the two scenarios.
- INDC's announced by India are achievable.
- This will require support from international community on two fronts: Financial support for meeting the additional investment needed and access to technology or international co-operation in technology development.
- Financial support as well as low interest long term loans with interest payment moratorium for 20 years.
- Technology access at low reasonable costs to advances in solar, wind and other power sector technologies as the installed capacity for solar and wind becomes 829 GW and 1064 GW in DETA and AMBA in 2050. Of these solar with storage is 135 GW and 360 GW in 2050.
- Thus, access to technology becomes critical including that for storage technologies, smart grid, ICT technologies for promoting energy efficiency and energy efficient transport technologies etc.

Supported by: MOEF & CC, GoI

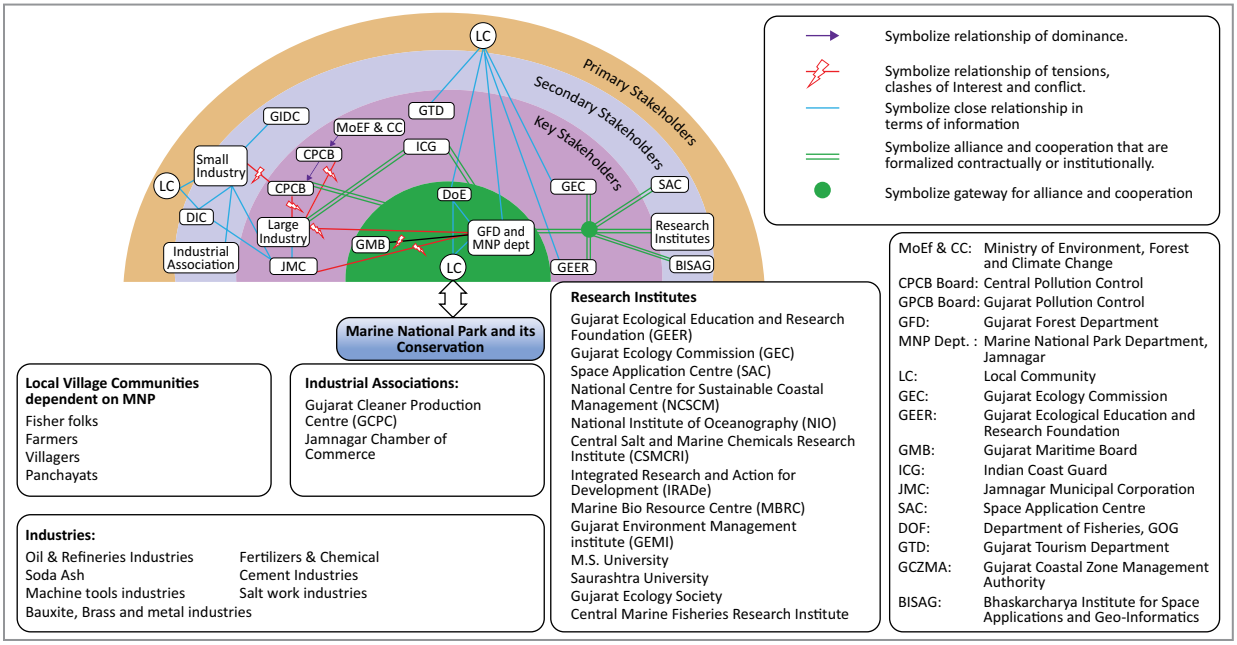
1.2. Review of Status of Marine National Park (MNP), Jamnagar and evolving vision statement for management of MNP

IRADe conducted a study for MoEF&CC to undertake macro assessment of the ecological status, governance structure, management plans of Marine National Park since its establishment in 1982 and the impacts of all the involved stakeholders by means of primary surveys, stakeholder consultations and mapping. Further focus of the study was to understand existing governance and management structure, review of the concerned policies, regulations and notifications and identification of the loopholes associated with MNP structure and policies.

Stakeholders perception survey

To identify the relevant actors and their relationships amongst each other, stakeholder mapping was done through extensive stakeholder's discussions and consultation. Stakeholders map below provides their relationship in diagrammatic form.

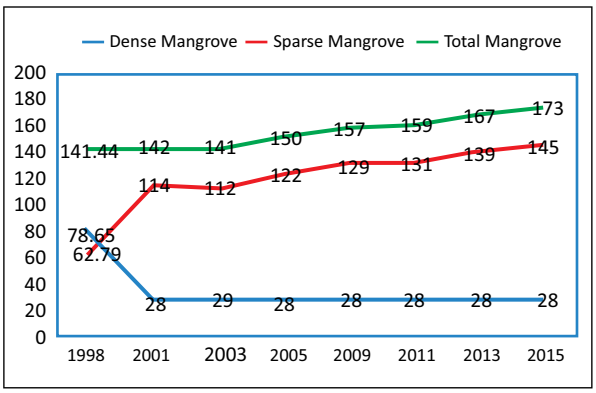
IRADe also conducted primary surveys to investigate perception of Local community (chiefly fisher folk) and to determine if the presence of well managed MNP has any positive effect on the adjacent fishing community. Fishermen at six sites (Sachana, Jodiya,



Stakeholder Map-Marine National Park, Jamnagar

Sikka, Salaya, Arambada and Bet Dwarka) were surveyed using structured questionnaires. Perception survey was conducted to investigate fisherfolk opinions and their acceptance of Marine Protected Areas in vicinity to fishing areas. Outcomes of the survey highlighted that the total fish catch has been observed to increase over the years, but there is a drop/decline noticed in total catch in recent years. Similarly, while the total fish catch data recorded an increasing trend, discussion with the fishermen revealed a sharp decline in 'catch per unit effort' in recent years. Fisherfolk from all the study sites show more of an interest and were keen to be involved in planning for conservation or management plan for MNP.

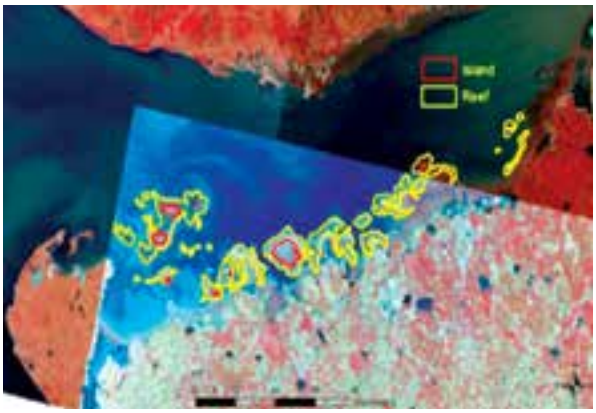
Collage of the biodiversity photographs, MNP, Jamnagar



Changes in mangrove (sq. km) cover in Jamnagar since 1998

The study found out that the mangrove cover has increased in MNP, but the diversity of mangroves has decreased. Mostly, the area comprises of Avicennia, with sporadic occurrences of Rhizophora and Ceriops.

The coral reefs have been subjected to intensive pressure of sedimentation, anthropogenic exploitation and climate change impacts.



Coral reef map of MNP, Jamnagar, Gulf of Kachchh, Gujarat for 2014

IRADe's team mapped the coral reefs along the Jamnagar coast using Landsat 8 Operational land Imager (OLI) data of 2014 and found the total area of reefs as 443.49 sq. km. In 2014, some of the coral colonies on Pirotan Island were found bleached. Increase in SST due to delay in onset of southwest monsoon and sedimentation were suggested to be the probable reasons for bleaching of coral colonies. Bleaching was also observed in some coral colonies of Narara reef when the team of researchers from IRADe visited the island in 2015.

Way Forwards and Recommendation

I. Management and Coordination

- Coordination: Role of all the authorities that are managing the protected area (Forest Department, MNP, GMB etc.) should be streamlined in order to avoid coordination issues and improve their accountability for the assigned responsibilities.
- Coastal governance mechanisms need to be strengthened through Gujarat State Coastal zone management authorities. Seascape approach should be designed for management along with a coordination mechanism among research groups working in Marine Protected Areas.

II. Monitoring, Regulation & Surveillance

- Monitoring and surveillance for protection – Base stations should be established at specified

islands such as Pirotan, Kalubar, Bural Chank, etc. for surveillance. Joint surveillance teams with involvement of forest department, navy, coastal guards, local communities need to be established.

- Urban Waste Management: There is need for improvement of trash and solid waste collection both in residential and industrial areas.
- Proper planning and regulation of the fishing activities. Monitoring mechanisms should be set to control the incidences of overfishing and illegal fishing in and around MNP.

III. Research

- Ensuring that scientific exercises are done for documenting the flora and fauna of Marine National Park. Assessment of the same would help to understand clearly the changes, associated reasons and devising measures for better management.
- Vulnerability assessment studies should be done for the Gulf of Kachchh region and Coastal Resilience Plan should be developed in wake of uncertainties arising due to climate change.

IV. Community Participation

- There is a need to increase the involvement of local communities and village Panchayats (assign them roles and responsibilities) in the management and conservation of framework of Marine Protected Areas.
- Alternate and sustainable livelihood options for local communities such as seaweed cultivation (involving endogenous species), aquaculture, mericulture and eco-tourism should be further explored in consultation with community should be promoted and supported.

Sponsored by Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH & Ministry of Environment Forests and Climate Change

2 Sustainable Urban Development

2.1. Policy Engagement for Developing Climate Resilient Smart Cities

IRADe, supported by the Rockefeller foundation has strived to position urban challenges in the larger policy framework provided by the state and national institutions. IRADe engaged decision makers and informed them on urban climate change resilience while integrating the concepts into wider planning discourses.

IRADe also proposed inclusion of climate resilience component in the recently landed smart city plans engagement at various levels in the Ministry of Urban Development, state and city level urban bodies for climate resilient smart city framework. IRADe engaged with two cities viz. Ahmedabad and Guwahati for integrating climate resilience in their smart city plans, the Ahmedabad Municipal Corporation welcomed IRADe's inputs and incorporated Climate Resilience component into their smart city plans. Also IRADe's Inputs for integrating disaster resilience in Master plans and Smart city plans were considered by 9 smart cities in India.

To put forth the importance of climate and disaster resilient urban development IRADe organized and participated in several events at city, national and international levels for building capacity of the related stakeholders and for stressing the mainstreaming of climate resilience in urban development, some of these are:

- **Roundtable in Ahmedabad:** With Ahmedabad Municipal Commissioner and other key city stakeholders at Ahmedabad Municipal Corporation (AMC), Ahmedabad on 22nd December 2015
- **Road to COP Dialogue: I -Cities Resilience to Climate Change;** in collaboration with the French Embassy in India on 30th October, 2015. Recommendations largely focused on the importance of mitigation technologies and adaptation which were largely attributed to sustainable planning for climate resilient infrastructure and thus addressed a significant issue in context of COP 21, Paris
- **Road to COP Dialogue: II -How can long-term and sustained financing be structured for mitigation and adaptation?** with French Embassy in India in collaboration with Integrated Research and Action for Development (IRADe) on 29th June, 2015
- **Session on Climate and Disaster Resilient Smart Cities -** in partnership with Technology, Information, Forecasting and Assessment Council (TIFAC), DST, GoI and International Society for Integrated Disaster Risk Management (IDRiM) on 28th October, 2015

Climate Resilient Smart City Reports have been prepared for city of Ahmedabad and Guwahati. The key recommendations of the study are:

- Master Plan/Development Planning and Town Planning Scheme mechanisms are instrumental for local level actions. To address climate change, urban resilience factor should also be incorporated in Smart Action Plans.
- Use of GIS and Remote Sensing for developing hazard assessment maps, spatial mapping of urban utilities/ critical support services and land use planning are essential tool for decision makers and should be used in prioritizing the City Climate Resilient Agenda and mobilizing the actions where needed
- Urban development must be inclusive, ecosystem based planning should be prioritized and Climate Resilience and Disaster Risk Reduction components should be essential components of city development plans and smart city plans
- **Prioritize a climate resilient agenda:** Cities need to identify priority activities that respond to their urgent needs for adaptation to climate change.
- **Rejuvenation of water bodies:** Restoration may also help overcome the growing water scarcity and also the risk of flooding can be reduced. Drought and floods can also be addressed simultaneously if cities look after urban lakes, ponds and wetlands.

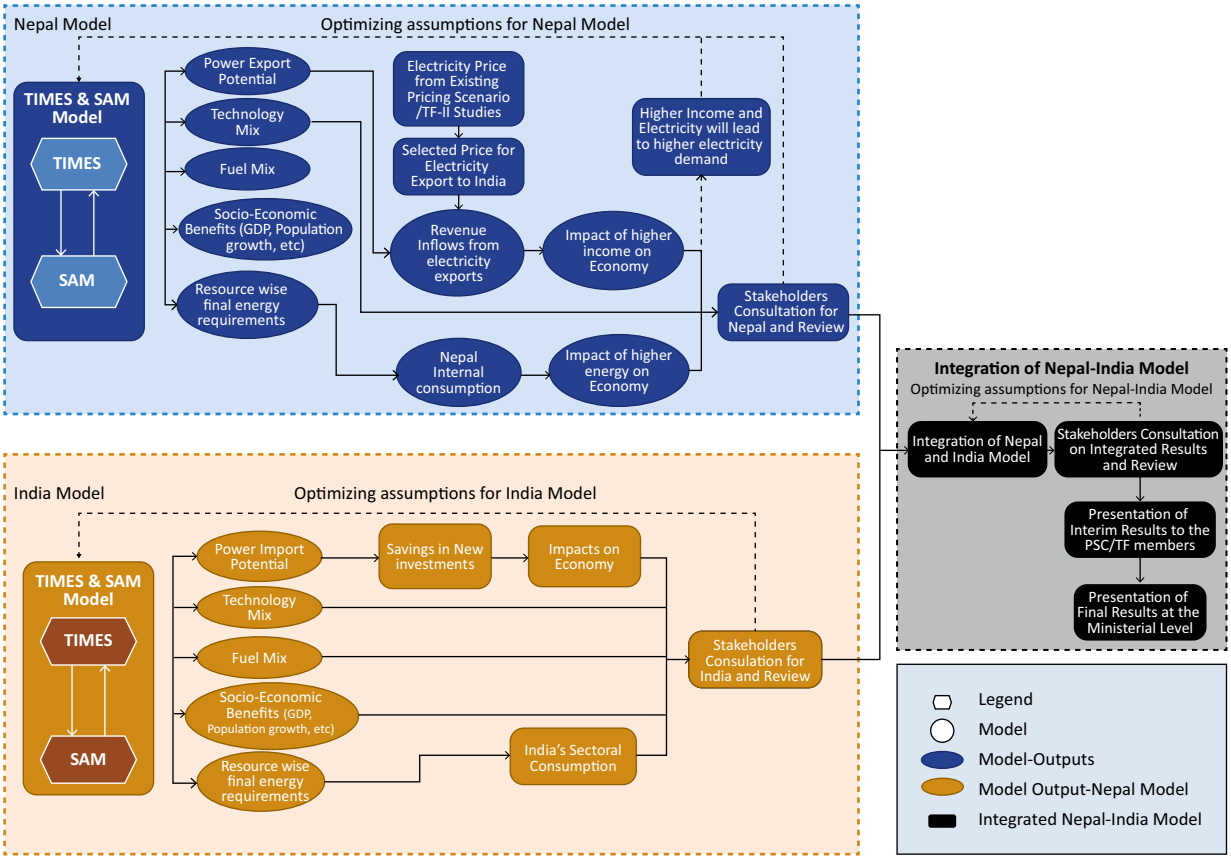
Sponsored by Rockefeller Foundation

3 Energy and Power Systems

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

3.1.1. The macroeconomic and analytic study focusing on benefits of electricity trade between Nepal-India

Under the USAID SARI/EI program IRADe has commenced ***"The macroeconomic and analytic study focusing on benefits of electricity trade between Nepal-India"*** with the primary purpose to build the consensus for Cross-Border Electricity Trade (CBET). The objective of the study is to critically assess the need for CBET among the nations of the South Asia region through comprehensive analytical studies that quantify the technical, economic, environmental and energy market benefits of cross-border interconnection in the region. The study involves multi-country analysis and bringing out the economic (macro and micro) importance of power trade besides other country benefits. The consensus building activities undertaken under this study are bringing together stakeholders from power sector, financial and diplomatic communities and other energy experts. The outcome of the studies will rigorously form estimates of benefits to inform the discussion by all three Task Forces of the SARI/EI and pave the path to prepare and develop regional energy markets and make them sustainable in order to foster economic growth of this region.



Nepal-India Macroeconomic and Analytic Study Modelling

Progress made so far: In the month of May the study was awarded to IRADe and in June Inception meeting for the project providing key insights and details of the study was organised at IRADe. In the months of July to September, Dr. Anjana Das provided 7 days training on Answer-TIMES to IRADe SARI/EI team, which was spread over 50 days starting. In addition, a five-day visit to Nepal by Dr. Pradeep Kumar Dadhich and Dr. Probal Ghosh was undertaken between 31 August 2015 to 4 September 2015 to meet potential stakeholders and data agencies of Nepal such as ADB, Central Bureau of Statistics, Ministry of Finance, National Accounts Statistics, Nepal Rastra Bank, World Bank, UNDP, etc. In December, the Reference Energy System of Nepal and India in the Answer-TIMES model were completed. Initial Nepal results were generated at various exogenous export prices with standalone Nepal Model without considering the absorption capacity of India. Dr. Pradeep Dadhich and Dr. Probal Ghosh conducted a stakeholder consultation workshops on the 18th and 19th January 2016 in Kathmandu wherein the preliminary results from Nepal TIMES model and Nepal Macroeconomic model were shared.

Answer TIMES Training by Dr. Anjana Das (in Centre)

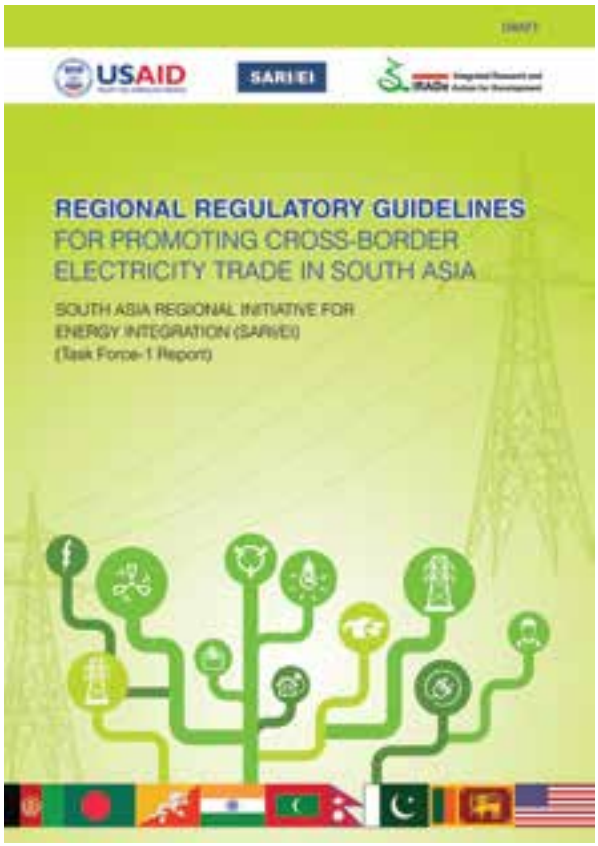
Subsequently same follow-up meetings with Ministry of Energy (MEA), Government of Nepal; Nepal Electricity Authority (NEA), Water and Electricity Commission Secretariat (WECS) and the World Bank were carried out. In the month of March, the integration of the two TIMEs model i.e. India and Nepal was successfully undertaken. This was followed by interaction between TIMES and macro-economic model of Nepal. The stakeholder consultation for India model and Nepal-India integrated model will be undertaken in the next financial year.

3.1.2. Regional Regulatory Guidelines for Promoting Cross-Border Electricity Trade in South Asia

IRADe is the implementing partner for USAID's South Asia Regional Initiative/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 fills 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 Interconnection and (iii) The establishment of South Asian Electricity Market. To this end IRADe has constituted three inter-governmental Task Forces and a Project Steering Committee with representations of 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.

Key Achievements

IRADe published the Regional Regulatory Guidelines (RRGs) to facilitate CBET in South Asia. RRGs were developed to primarily aid the national electricity regulators of the South Asian countries for developing a regional regulatory framework and for decision making on CBET in the South Asian Region. RRGs were developed under the study on Review of Electricity Laws, Regulations, Policies and Legal structures of South Asian Countries, which identified the critical ingredients for CBET, reviewed international power pools and regional trade arrangements to understand the good practices around the world and brought out the RRGs. The RRGs are set of guidelines on common regulations, rules and protocols in technical, operational and legal matters for harmonization/coordinating of electricity regulation from the perspective of promoting CBET in South Asia.

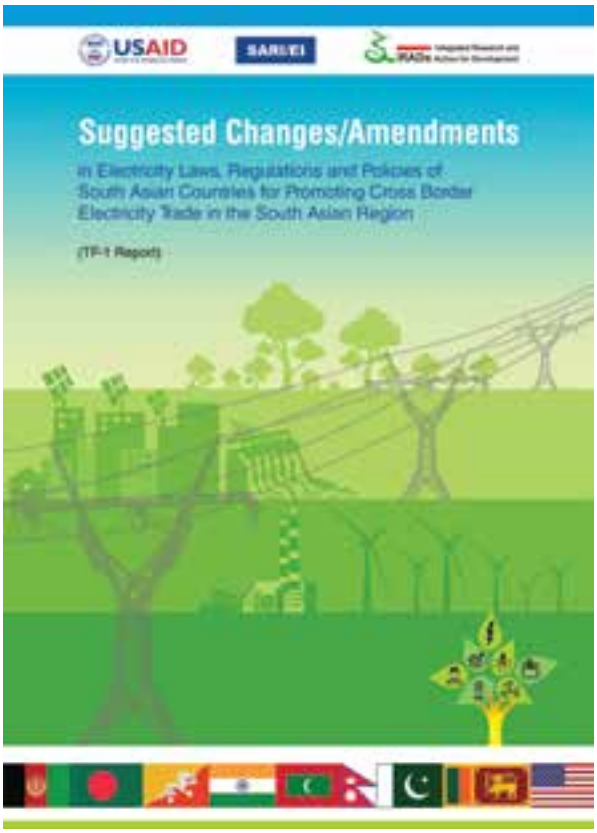


To take forward the implementation of RRGs and for coordination/harmonization of Electricity Laws, Regulation and policies of SA countries for promoting CBET, the study also came out with its 2nd report on **"Suggested changes/amendments clause/section wise in the existing Electricity Laws, Regulation and policies of SA countries for promoting CBET in South Asia Region across".**

These suggested changes/amendments can be considered by each South Asian Country Governments as a base for aligning the legal, policy and regulatory frameworks prevailing in each South Asian Countries for promoting CBET in the region. This report also covers country wise proposed long-, medium- and short-term roadmaps for implementation of these suggested changes and amendments.

Ongoing Studies

- **Investment friendly policy and investment framework for promoting investment in South Asian power sector and CBET:** The ongoing study reviews the prevailing investment friendly policies/ guidelines/frameworks/FDI regimes in each South Asian country and
- **Assessment of the Electricity Trading Potential of South Asian Countries:** The study now at its closure looks into the existing long term Demand-Supply projection scenarios of the participating countries and the expected developments in the next 10-20 years by taking into account the CBET potential as a means to meet the additional demand of power by each country and/or by exporting surplus power through CBET to other South Asian Nations.
- **Harmonization of grid codes, operating procedures and standards to facilitate/promote Cross-Border Electricity Trade in South Asia:** The almost completed study is identifying provisions in the Grid Codes and Operating Procedures that will have an impact on optimal, reliable and economic operation of CBET across the South Asian nations and developing recommendations for necessary changes or additions required in the operation procedures/ Grid codes/standards/institutional structure etc. in respective countries.
- **Assessment of commercial terms and conditions for CBET and suggested model of Power Exchange in South Asian region:** The study at the verge of its completion is assessing the preparedness of each South Asian country (Afghanistan, Bangladesh, Bhutan, India, Pakistan, Nepal, Sri Lanka and the Maldives) for CBET for selecting suitable models/ options a regional power exchange for the countries and to recommend commercial terms and conditions, principles and procedures for the short-term, medium-term and long-term CBET in the South Asian Regional Electricity Market.
- **Building consensus and developing a white paper on South Asian Forum of Electricity Regulators (SAFER)** is consulting stakeholders on initial feedbacks on SAFER.
- **Pilot Market Project - Mock exercise for South Asian Regional Power Exchange (SARPEX). A pilot market project has been conceptualized.** A mock exercise is planned towards establishing the desirability and the feasibility of a South Asian Regional Power Exchange (SARPEX). The project will bring out the benefits to various nations if SARPEX is established. The other objectives are developing a draft set of market rules and design of SARPEX and capacity building. The pilot project shall be run like a Day Ahead Spot Market.



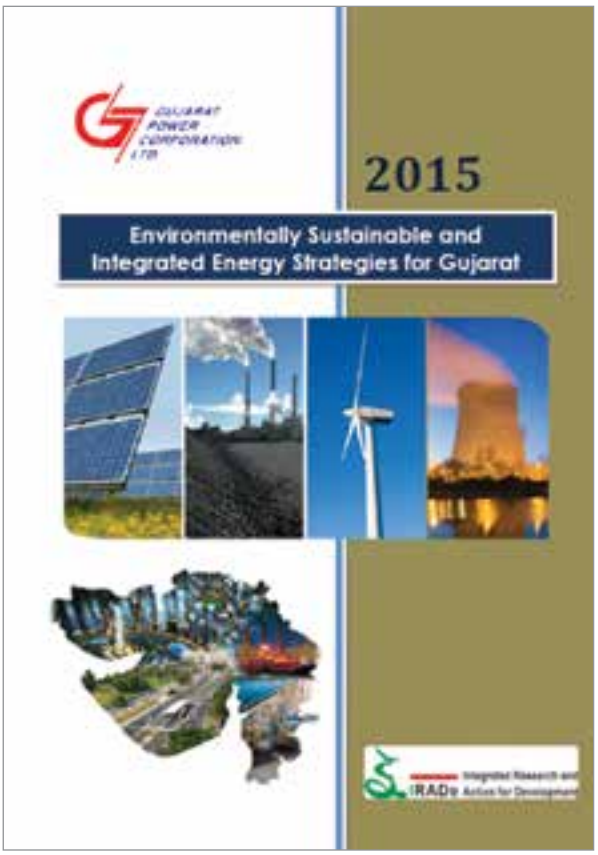
3.2. Sustainable Integrated Energy Plan for Gujarat

IRADe undertook the task of preparing the report on Environmentally Sustainable and Integrated Energy Strategies for Gujarat State. The report analyses the existing energy resources, energy supply and demand scenarios, environmental constraints, hazard risk vulnerability of the state's critical infrastructure, energy access issues and supply strategies to meet the energy security of the state with a perspective for the next two decades.

Under the project IRADe conducted three stakeholder meetings at Gandhi Nagar, Gujarat which were attended by around 100 participants from the entire energy and power sector of Gujarat. IRADe staff visited key power and energy sector installations to get a first-hand knowledge of issues in the state.

GTPS Ash Dyke, 1MW SPV Power Plant, Gandhinagar

Visits were made to all the major organizations in the energy, power, infrastructure sector in Gujarat to gather energy generation and consumption data and discuss critical issues being faced by these organizations in terms of fuel costs, fuel supply issues (coal, gas, lignite), environmental issues, fuel imports and costs, issues of grid stability on account of renewable energy. The draft report was circulated to all major power sector organizations and comments were received and incorporated in the final report.



Key Findings of the Project

Gujarat's energy sector is one of the most energetic in comparison to other Indian states. In 2011, over 90% of the households of the state were electrified and 38% had clean cooking fuels access whereas these figures were mere 67% and 28.5%, respectively for India. Per capita electricity consumption in 2013-14 was 1708 kWh in Gujarat compared to 957 kWh for all India despite the fact that there are limited energy resources in the state. The rural area also has 24x7 electricity

access. The state is very forward in terms of renewable energy and has one of the highest installations of solar power in India and among top three in wind energy.

Gujarat is the second highest coal consuming state in India, despite the fact that it has no domestic resources of coal. It handles 66% of the country's total imports of petroleum products, 98% imports of LNG; 77% of POL exports, 36% of imports of coal and 100% of coal exports pass through its ports. Vibrant Gujarat and other programmes have had an encouraging investment climate in the state, which would lead to further growth in energy demand.

It is thus challenging to develop scenarios for the future and make policy recommendations. In this context, IRADe has carried out a detailed analysis of energy demand for industry, agriculture and services sectors with perspectives up to 2035 and also suggested a supply strategy and made recommendations.

Energy projections have been made assuming 8% and 10% growth rates of the state GDP; it was also assumed in alternative scenarios that services and industry will lead the growth. It is noted that electricity requirement jumps from the present 68 bkWh to 243 and 324 bkWh in 2035 under the 8% and 10% growth rates with falling elasticity scenarios; the required installed capacity jumps to 3-4 times the present capacity of 21,500 MW. In the long run Gujarat will benefit from service led growth that will curtail demand for a state with meagre fossil fuel reserves and will also provide more jobs.

In terms of CO_2 emissions, the emission per unit generated is the highest in 8% growth scenario at 0.70 kg/kWh. Restricting supercritical coal to 20,000 MW lowers emissions to 0.39 kg/kWh even when natural gas is used as a balancing fuel. It is marginally lower at 0.38 kg/kWh when solar PV with storage is used.

- Peak electricity demand for the year 2035 will increase to 46,700 MW with 8% growth rate and to 69,000 MW with 10% growth, a margin of 48%. With Vibrant Gujarat mode of industry led 10% growth the peak demand will be 80,300 MW which is an increase of 16% due to change in the structure of the economy.
- With emphasis on renewable, mainly wind and solar, the share of renewable capacity can be 50% or more; 35,000 MW of wind and 60,000 MW of solar energy can be absorbed with gas based plants providing balancing power.
- Even when supercritical coal plants are restricted to 20,000 MW compared to 40,000 MW in other scenarios, Gujarat can meet its power requirement with some balancing by natural gas or solar PV with storage.
- Significant reduction of 30% in total power sector emissions is feasible, but with a 40% increase in the cost of electricity.
- Gujarat should push for the development of renewables. Its ability to restrict coal will depend on the availability of natural gas or development in electricity storage technology. It can adapt its strategy to evolving technology.
- If Gujarat is to progress as it aspires to and achieve double digit growth rate, led by industrial development, it faces a huge challenge to meet its energy needs.
- Gujarat's dependence on coal will continue for some time. Hence moving to more efficient supercritical and ultra-supercritical plants is necessary.
- Today Gujarat is paying more than what it should for coal because of the coal linkage and railway freight rate policies of the Government of India. It should strongly ask for tradable coal linkages and rationalisation of railway freight rates.
- With its limited resources of fossil fuels its emphasis must be on renewable power if it wants to restrict the level of energy imports.
- Gujarat has significant potential of wind and solar power as well as a good policy framework to attract investment in these areas.
- Model shows that it is possible to absorb significant amounts of solar and wind power by balancing with open cycle gas based plants. Also, if advancement in electricity storage technology brings down costs, solar PV with storage can provide the needed balancing power.
- While availability of natural gas is limited, coal gasification based on imported coal or in-situ gasification of lignite can provide gas.
- Apart from electricity, consumption of petroleum products has to be restrained. Here, development of mass transport, encouragement of non-motorised transport, discouragement of use of private vehicles

by providing the option of efficient and convenient public transport and imposing parking and congestion charges, are required.

- At the same time, increased fuel efficiency from vehicles, more stringent emission norms and facilitating electric vehicles by providing supporting public infrastructure are needed. Regular environmental impact studies, with modelling needs to be undertaken in major cities.
- While supply policies are important, demand side measures to promote energy efficiency are equally critical. The state should push hard for more efficient use of energy. Appropriate pricing of energy is a vital element of pushing energy efficiency. Education and encouragement for saving energy can be cost effective.
- With 24x7 electricity supply, Gujarat has come a long way in providing energy access to all its residents. Even then action is needed to provide clean cooking fuel to a large segment of the population. The spread of Gujarat gas grid to all urban areas should help replace LPG use in urban households with PNG. The freed cylinders and LPG should be used to provide them to rural households. With 24x7 electricity and significant expansion of solar power, it might be more practical to provide induction cookers where supplying LPG may be difficult or impracticable.
- We have also looked at the environmental consequences of energy use. With emphasis on energy efficiency, mass transport, efficient vehicles, stringent emission norms, promotion of electric vehicles and large thrust on renewable energy can provide a much cleaner environment.

To address the challenges arising from Gujarat's ambitious development plans, the report strongly recommends energy efficiency measures, aggressive efforts in renewable energy, clean coal technologies, time of day pricing, adopting ECBC more aggressively, while taking care of grid balancing and also at the same time providing energy access at affordable prices. In four of our projected scenarios, Gujarat would be able to meet or exceed India's INDC's commitments at the state level.

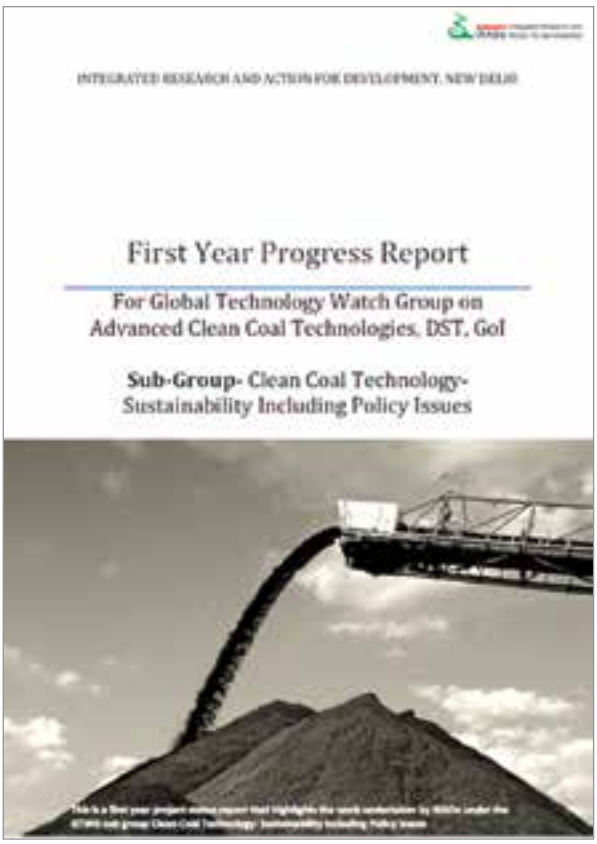
Supported by the Gujarat Energy and Petrochemicals Department and Gujarat Power Corporation Limited (GPCL)

3.3. Global Technology Watch Group (GTWG) on Advanced Coal Technologies (ACT) for Power Generation

Under the GTWG project IRADe is undertaking the sustainability issues of clean coal technologies that include power generation, mining and beneficiation and emissions. Sustainability issues with respect to cost-economics, social aspects and environment are being analysed for suitable technology options.

Under the project IRADe is a consortium partner along with IIT-Madras, IIT-Bombay and IIT-Delhi.

Coal plays an important role in electricity generation worldwide and its importance is even more pronounced in India, which relies heavily on coal. The present installed electricity generating capacity in India is around 300 GWe (as on 31 May 2016, CEA), of which coal accounts for about 61%. The power generation capacity is projected to increase to about 778 GWe by 2031-32, and a significant portion of the capacity addition is expected to come from coal.



Coal-fired power plants generate huge amounts of carbon dioxide (CO_2) which is widely considered as a major contributor to global warming and climate change. Other major areas of concern associated

with coal-fired power plants are other conventional pollutants such as Sulphur dioxide (SO_2), nitrogen oxides (NOx), particulate matter (PM), mercury (Hg), arsenic (As), flyash and other harmful elements. Another area of pollution is related with coal mining and beneficiation of the low grade Indian coal which contains a large amount of waste matter due to the drift origin of coal.

Though India's annual per capita CO_2 emission is only one-fourth of the world's average, India is the world's third largest CO_2 emitter, and there is tremendous pressure on India to reduce CO_2 emissions.

India has been operating lately very old power plants based on sub-critical technology, and only recently super-critical plants have started to get commissioned, these plants emissions are much less than the older plants. Recently globally lot of research work is going on in developing high efficiency low emissions technologies like Ultra-Super Critical, IGCC and CSS technologies to mitigate the impacts of GHG emissions from power sector.

Under this backdrop, the GTWG-ACT has discussed three scenarios for the country as mentioned below:

- Scenario 1 in which coal-based power generation continues with minimal changes in technology except for incorporation of already commercially-available technologies for removal of SOx, NOx, Hg and particulate emissions. This scenario is possible when new technological developments are not accessible or are prohibitively expensive and significant advances have been made in the induction of renewable energy sources (such as solar PV and wind) into the power generation.
- Scenario 2 in which a wide range of new and appropriate technologies delivering clean coal and high energy conversion efficiencies is implemented together with induction of control measures for conventional pollutants such as SOx, NOx, Hg and pollutants. Among the additional technologies envisaged in this scenario, compared to Scenario 1, would be for coal beneficiation technologies, ultra-supercritical steam parameters, coal gasification, IGCC and co-firing with biomass and other opportunity fuels. This scenario may unfold when induction of renewable energy sources is not as robust as anticipated and additional CO_2 mitigation is required through conventional power generation routes to meet with global warming obligations.
- Scenario 3 in which the full range of clean coal technologies, including carbon capture and sequestration (CCS), is brought into play to make a case for sustained use of coal for power generation. Among the additional technologies to be inducted in this scenario would be those related to pre-or post-combustion capture, oxyfuel and its supporting technologies, chemical looping and supporting technologies, coal-to-liquid fuels, coal-to-chemicals routes, mineral, biological sequestration of CO_2, reuse and recycling of CO_2, etc. This scenario is possible when steeper-than-anticipated reductions in CO_2 emissions become mandatory and the transition to hydrogen economy and electric vehicles does not happen to the extent needed.

The GTWG-ACT consortium comprising of IIT Madras, IIT Bombay, IIT Delhi and IRADe, New Delhi proposes to evaluate these technologies in terms of their feasibility and competitiveness in Indian context, and develop a viable Advanced Coal Technologies road map for sustainable, coal-based power generation within an appropriate policy framework.

The GTWG-ACT technology evaluation are categorized into four groups – Advanced Coal Mining and Beneficiation Technologies, Advanced Coal Utilization Technologies, Advanced Emission Control Technologies, Clean Coal Technology: Sustainability and Policy Issues – and are individually handled by IITD, IITM, IITB, and IRADe, respectively. The methodology being adopted for sustainability analysis is summarized schematically in Figure 1. The development and integration of assessment tools is under progress with specific reference to the following means of clean power generation using coal which offers the following:

- Oxyfuel combustion of pulverized coal in a tangentially-fired boiler.
- Powdered activated carbon injection for 90% removal of Hg.
- Operating on supercritical steam parameters
- Geological sequestration of CO_2
- Use seawater/wet-lime flue gas desulphurization for 95% removal of SO_2
- Compression, drying and low temperature flashing for CO_2 enrichment to 95% purity with 90% CO_2 capture.
- Selective catalytic reduction of NOx for 95% removal

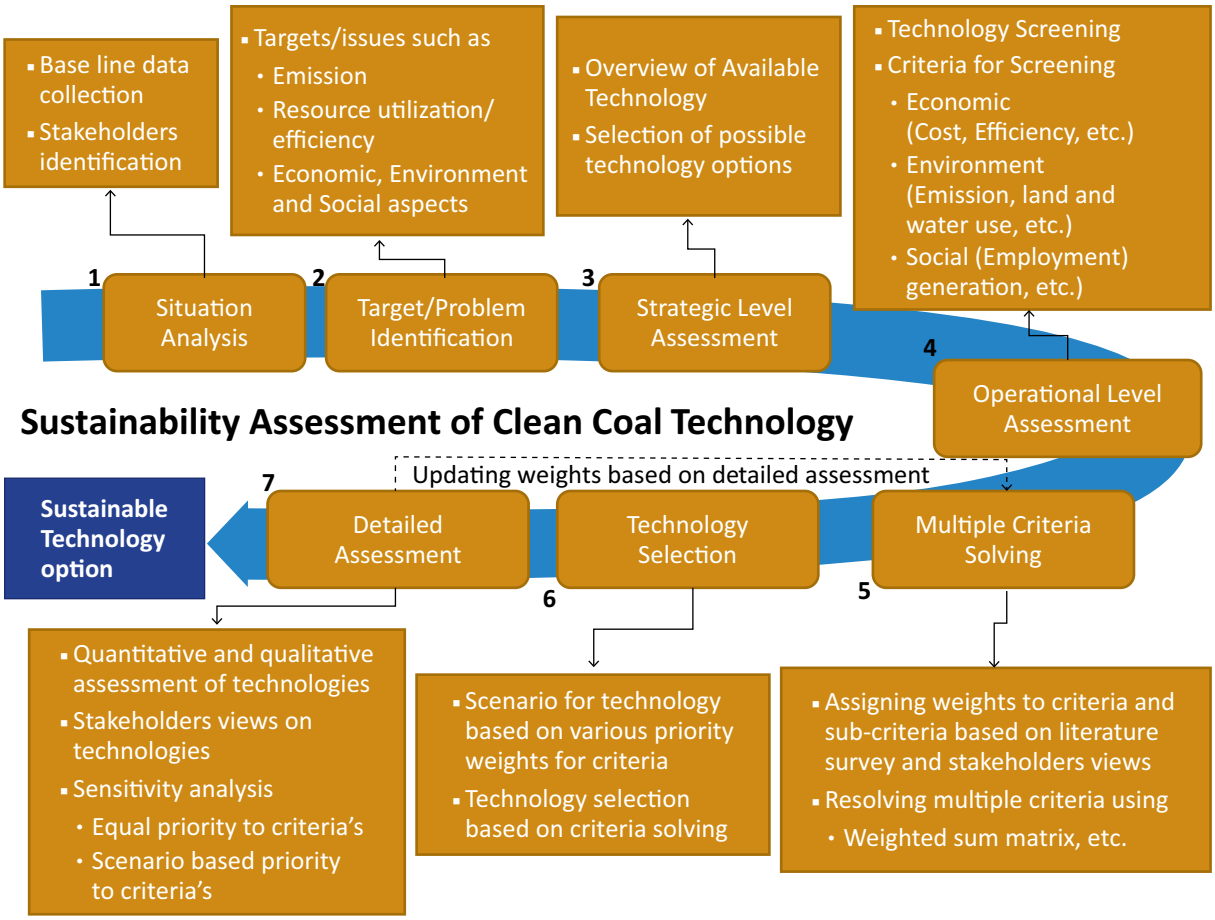


Figure 1: Schematic representation of the methodology for assessment

Under the project this year four review meetings were held this year among the project partners, on 13th June 2015 meeting was held at IIT-Mumbai, on 12th September 2015 at IIT-Delhi, on 25th February 2016 at IRADe and on 19th May 2016 a project review meeting was held at Delhi with DST, GoI. IRADe also organized the National Energy Policy Workshop on 6th November, 2015 in which project PI, IIT-Madras also participated along with other industry participants. IRADe has submitted its annual progress report to DST.

Supported by DST-SPLICE, GoI

3.4. Impact of Growth and Mitigation on Consumption Patterns and Sectoral Structure in Developing Countries: A Case Study of India

Developing countries need economic growth to take care of their human development deficit. Economic growth requires in these countries substantial development of infrastructure for electricity, roads, railways, ports for transport and airports, as also for providing services of water, health care and education. At the same time economic growth results in changed consumption patterns, which in turn affect the structure of production. Also developing countries cannot neglect the compulsion of climate change as the poorer persons and nations are most vulnerable as they have little capacities and means to deal with extreme events. They need to reduce their emission intensities as their economies grow. This calls for additional resources putting further stress on already scarce resources.

The issues that were addressed in this research projects were as follows:

- How would consumption patterns change with economic growth?
- What would be the impact on energy consumption both directly as energy and indirectly as embodied energy in the consumption basket?

- How does the energy ladder of the energy intensity of per capita real output evolve over time?
- How does the structure of value-added from different sectors such as agriculture, industry and services change over time?
- How would measures to reduce emissions intensity affect different sectors of the economy?

IRADe used the IRADe-IAM model to analyse the economic impacts of low carbon measure by comparing a Dynamics as usual scenario and a low carbon scenario up to 2050. The Report also analyses the Dynamics as usual scenario to illustrate the impacts of structural change in the economy on changing energy ladder of energy commodity intensities and patterns of energy consumption.

Supported by: Shell International

3.5. Udaipur Solar City Master Plan

IRADe is preparing Udaipur Solar City master plan for Udaipur Municipal Corporation under the Solar City Programe of MNRE. Urbanization and economic development are leading to a rapid rise in energy demand in urban areas leading to enhanced Green House Gas (GHG) emissions. The program aims at minimum 10% reduction in projected demand of conventional energy at the end of five years, which can be achieved through a combination of energy efficiency measures and enhancing supply from renewable energy sources.

The solar city master plan of the city will include the baseline for energy consumption during the baseline year, demand forecasting for the next five years, sector-wise strategies and action plan for implementation of renewable energy projects like solar, wind, biomass, small hydro, waste to energy etc. may be installed along with possible energy efficiency measures depending on the need and resource availability in the Udaipur city, so as to mitigate the fossil fuel consumption in the city and reduce the Green House Gas (GHG) emissions.

Fateh Sagar Lake, Udaipur

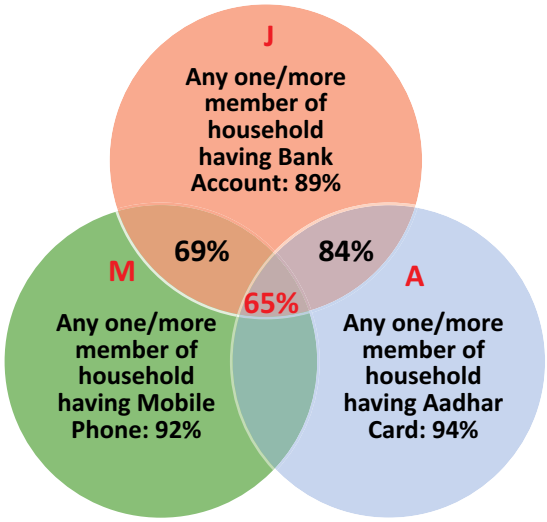
Supported by Udaipur Municipal Corporation, Government of Rajasthan

4 Poverty Alleviation and Gender

4.1. Providing Clean Cooking Fuel in India: Challenges and solutions

India has the largest concentration of population using biomass with inefficient stoves. When modern fuels are unavailable, women and children not only face health hazards due to smoke but also "time poverty". Freedom from smoke and the drudgery associated with biomass is the need of the hour to empower women and allow families to live purposeful lives. This report explored the issues and challenges of clean cooking in urban India through a case study of the Ghaziabad Municipal Corporation, Uttar Pradesh.

We conducted surveys of 250 households in Ghaziabad district using a structured household questionnaire that was delivered between August 5 and October 10, 2015. The detailed questionnaires included information on family structure, socio-economic conditions, energy-use patterns, housing characteristics, cooking behaviour, access to crucial infrastructure for subsidy transfer (JAM) and willingness to pay for liquid petroleum gas (LPG). The energy-use pattern included information on the consumption of solid fuels and commercial fuels for cooking, where cooking fuel is procured, the time and effort involved in procurement, the price at which it is procured, etc. Characteristics of housing and other assets included information on type of house and location of the kitchen. Further information was collected on cooking behaviour, including the number of meals cooked using different fuels in a day, hours of cooking, cooking involvement by male or female members of the household and type of involvement. Reasons for not using clean fuels, willingness to pay for an additional amount of clean fuel and desire to forego the subsidized kerosene quota were also captured.



Households can be reached through JAM

Source: IRADe household survey for LPG Ghaziabad, 2015

To receive benefits from the government under JAM, an individual member of the household has to have all three identities synced (bank account, mobile number and Aadhaar card). The survey in Ghaziabad

revealed that, though nearly 90% of the households had access to these three basic requirements, barely 65% households had at least one member with all three requirements in place that could access the JAM scheme. In some cases, it was possible that different members of the household had access to these three basic requirements, and any individual member of the household did not have these three mandatory things simultaneously in his/her name to qualify for benefits under JAM scheme.

To assess the choice between LPG and alternative cooking fuel by households a multinomial logit model (MNLM) is used. The response variable includes three distinct unordered alternatives: Traditional, mixed and modern cooking fuel. The goal of this model is to find the best fitting model to describe the relationship between outcome variables. Here the predictor variable is family size, highest year of female education in the family, gender composition (percentage of females in the family), monthly PCI, LPG price per MJ, household monthly energy demand and head of household.

The results suggest that increasing household size has a negative effect on household fuel choice, suggesting that increasing family size can result in the use of inferior quality fuel for cooking. Households with more years of female education are less likely to cook with traditional fuel. The household monthly per capita income also turns out to be an important determinant for fuel switching. The LPG price paid by the households is an important determinant of fuel switching. A one-unit increase in LPG price per MJ is associated with a 2.18 decrease in relative log odds of using mixed fuel versus traditional fuel. Similarly, a one-unit increase in LPG price per MJ is associated with a 2.93 decrease in relative log odds of using modern fuel versus traditional fuel.

The household energy demand improved fuel switching in GMC. The results suggest that a unit increase in log monthly household energy consumption is associated with a 3.23 increase in relative log odds of using mixed fuel versus traditional fuel. Moreover, a unit increase in log monthly household energy consumption is associated with a 2.06 increase in relative log odds of using modern fuel versus traditional fuel. The relative log odds of using mixed fuel versus traditional fuel will decrease by 0.34 if moving from male-headed households to female-headed households. Similarly, the relative log odds of using modern fuel versus traditional fuel will decrease by 0.67 if moving from male-headed households to female-headed households.

The recommendations largely focus on laying a path to eliminate unequal distribution of cooking fuels among the economically challenged and to further strengthen the availability and distribution to all, including those in the remote areas. We hope that the Government of India, oil companies, the state government and other related authorities will find the results and recommendations helpful in enhancing the access to clean energy for cooking, especially to poor households. The government can use this study to design a nationwide LPG distribution plan.

Sponsored by International Institute for Sustainable Development (IISD)

4.2. Gender and Energy Sector Reform

This research aims to look at the opportunities for and impacts from energy sector reform in India and the removal of fossil-fuel subsidies on gender, especially from the perspective of women and children. Research will be undertaken globally to identify examples of best practice of implementation of positive energy sector reform policies that have worked well for women, as well as those that have not worked well. The work will cover those research methods deployed to understand the impacts of energy sector reform on different sections of society and on the impacts of policy change on gender drawing from other sectors such as health and education. From this understanding a detailed national household level research will be undertaken in India.

This is a 4-year study starting from February 2015. As per the stated work plan scoping research report has been prepared and submitted to donor organization. The scoping report comprehensively cover the available literature on the subject and draw upon research methodology extensively. This study aims to provide gender based evidences in efforts to bridge the policy gap that exists between clean energy access and its impact on the role of women. For the purpose of this study, 2 streamlined research questions have been identified from scoping study to investigate in detail.

The research addresses following questions:

1. How do existing LPG subsidy policies affect the welfare, productivity and empowerment of women and girls in urban, peri-urban and rural low-income households in two districts—preliminarily identified as Ranchi (in the state of Jharkhand) and Raipur (in the state of Chhattisgarh)—taking into account
   - Impacts of the subsidy on LPG distribution?
   - The extent to which the subsidized price is actually reflected in LPG retail prices paid by consumers?
   - The extent to which lower LPG retail prices influence household fuel use?

2. How might the welfare, productivity and empowerment of women in low-income households change as a result of the following policy reforms:
   - Strengthening the existing LPG distribution network
   - EMI (earnest monthly instalment) facility for availing LPG connection
   - Implications of distribution of free LPG "connection" (registration and starter kit) to below poverty line (BPL) households

Two states—Jharkhand and Chhattisgarh—have been selected as locations to perform the case study. These are among the 4 most backward states of India in terms of access to clean cooking energy sources. Jharkhand and Chhattisgarh are two neighboring States with only 11.66% and 11.18% households using LPG as main cooking fuel and 86.90% and 87.74% households uses solid fuels for cooking. These states possess similar socio-economic characteristics but different policy and administrative environment. For instance, as per union government scheme any BPL category people wanting a new LPG official connection of 14.2 kg cylinder will be given a rebate of Rs. 1,600. The rebate includes Rs. 1,450 as security deposit for cylinder and Rs. 150 as cost of pressure regulator. This policy has been further enhanced in Jharkhand where the state government is providing an additional assistance of Rs. 918.50 per connection for other items (except hot plate), thus making the LPG startup cost virtually zero for the BPL families in Jharkhand.

The case study will be developed for two specific districts Ranchi from Jharkhand and Raipur from Chhattisgarh. Raipur (36% urban and 64% rural) and Ranchi (43% urban and 57% rural) represent a balanced mix of rural and urban population in the selected state will be useful to understand the major cooking fuel issues in both rural and urban areas. Moreover, 29.5% and 19.3% households use LPG as main source of cooking in Ranchi and Raipur district respectively (Census, 2011). Therefore, given the similar socio-economic characteristics and different level of LPG penetration in these 2 districts will be good case for a comparative study. The study will use combination of qualitative and quantitative approaches.

To collect gender disaggregated data household sample surveys will be conducted. The survey will be based on a stratified sampling design, using adequate sample size. With stratified sampling, the sample sizes within each stratum are controlled by the sampling technics rather than by a random determination through the sampling process. The study will collect information through one-on-one interviews with those who make or implement policy to understand their concerns. It will also help in defining a way to engage stakeholders, so that impact of research on policy can be maximised. Focus Group Discussions' (FGDs) of end-users to gauge energy access and supply status in the location and opinions on energy policy reforms and programs. Women stories will also be captured through FGD. This will provide an insightful understanding of complex issues and situations.

In the second year secondary data from various sources will be analyzed, and consultation will be carried out from stakeholders *inter alia* policy makers, decision makers and distributors.

Sponsored by ENERGIA, Department for International Development (DFID)

5 Events, Meetings and Workshops

5.1. COP 21 DIALOGUE – How can long term sustained financing be structured for mitigation and adaptation

The seminar on "How can long-term and sustained financing be structured for mitigation and adaptation" was organized by the French Embassy in India in collaboration with Integrated Research and Action for Development (IRADe) on 29th June, 2015. As events leading up to Paris, IRADe and the French Embassy held two dialogues to address significant issues in the context of COP 21. Seminar was held to provide greater visibility to the perspective of Indian stakeholders on issues pertinent to the global climate negotiations.

From L-R, Ms. Rajasree Ray, Mr. Dipak Dasgupta, Dr. Jyoti Parikh, Ms. Namita Vikas and Mr. K.S. Popli

COP 21 Dialogue: How can long-term and sustained financing be structured for mitigation and adaptation

The recommendations largely focused on the importance of mitigation technologies and adaptation which were raised during the Paris negotiations.

5.2. Stakeholder Dinner Meeting on "Catalysing Cross-Border Electricity Trade in South Asia: South Asia Forum of Electricity Regulators (SAFER)"

SARI/EI - IRADe organized a high-level meeting in New Delhi on August 5, 2015 to deliberate the role of the South Asia Forum of Electricity Regulators (SAFER). The meeting convened key stakeholders such as India's Central Electricity Regulatory Commission (CERC); South Asia Association for Regional Cooperation (SAARC), Energy Centre, Islamabad, Pakistan; Bangladesh Energy Regulatory Commission (BERC), Bangladesh, Ministry of Economic Affairs, Bhutan, Indian Renewable Energy Development Authority (IREDA), India; Power Trading Cooperation; India (PTC), Indian Energy Exchange (IEX); Power Finance Corporation, India (PFC); Rural Electrification Corporation (REC), India; National Hydro Electric Corporation Ltd. (NHPC), India; Power System Operation Corporation Ltd., India (POSOCO) among other dignitaries and guests.

From L-R Mr. Gireesh Pradhan, Dr. Jyoti Parikh, Ms. Monali Zeya Hazra and Mr. V.K. Kharbanda

Stakeholder Dialogue on "Catalyzing Cross-Border Electricity Trade in South Asia: SAFER", 5th August 2015, New Delhi

The meeting concluded with an agreement that emerged from the discussions that there is a need for a regional institutions to assume the role for regulatory coordination/harmonization for CBET.

5.3. The Combined Meeting of SARI/EI Task Forces, on 5-6 August, 2015 at New Delhi, India

IRADe convened all the three SARI/EI task forces, such that the 5th Meeting of Task Force-1 on Coordination

Combined Meeting of SARI/EI Task Forces, 5-6 August 2015, New Delhi

of Policy, Legal and Regulatory Framework, the 4th Meeting of Task Force-2 on Advancement of Transmission Systems Interconnections and the 2nd Meeting of Task Force-3 on South Asian Regional Electricity Market were held, creating a highly interactive meeting and deliberation of various aspects of CBET studies undertaken by SARI/EI-IRADe. The meeting also released the SARI/EI publication developed by IRADe, "Regional Regulator Guidelines".

(L-R) Dr. Jyoti Parikh, Dr. Kirit Parikh, Dr. Naeem Malik, Mr. Colin Dreizin, and Mr. V.K. Kharbanda

Launch of Regional Regulatory Guidelines

5.4. International Voluntary Leadership Program under the Theme of Climate Change

Dr. Probal Pratap Ghosh was selected by the US Government for visiting the United States of America under the International Voluntary leadership program under the theme of Climate Change in the background of the work that he has been doing in the field of climate change in the past few years. Dr. Ghosh was selected along with a group of 8 researchers working in the field of climate change to visit the US and interact with various organisations and researchers working in the field of climate change.

International Voluntary Leadership Program, USA

The tour took Dr. Ghosh and his colleagues to 5 different US cities spread across the country for 21 days from September 19, 2015 to October 20, 2015. The group was led during the tour by a liaison office appointed by the US state department with whom the group visited various researchers in Washington DC, Rhino Nevada, Los Angeles in California, Austin in Texas and finally to New York City. The Visit was organised by the State department of USA with help from the Graduate school, USA which did the coordination of the visits across different cities and overall administrative requirements for the visit.

5.5. "SAARC Perspective Workshop on the Past, Present and Future of High Voltage DC (HVDC) Power Transmission" at Lahore, Pakistan

SARI/EI delegation comprising Mr. V.K. Kharbanda, Project Director, SARI/EI, IRADe and Mr. Rajiv Ratna Panda, Senior Project Manager, SARI/EI, IRADe, participated as Resource Person in the SAARC Energy Centre's workshop titled "SAARC Perspective Workshop on the Past, Present and Future of High Voltage DC (HVDC) Power Transmission" held on 30th September - 01st October, 2015 at Lahore, Pakistan. The workshop

was inaugurated by Ch. Abid Sher Ali, Hon'ble Minister of State for Water and Power, Pakistan. The event was attended by around 70 participants from South Asian region. SARI/EI delegation made three paper presentations on following topics:

- South Asian Power Sector: Investment Prospects, Challenges and Issues
- Harmonization of Grid Codes, Standards and Operating Procedures for Transmission System Interconnections (both HVDC and HVAC) for facilitating/promoting CBET in South Asia Region.
- SARI/EI: Key Activities undertaken and the Way Forward.

5.6. Climate and Disaster Resilient Smart Cities

IRADe and ACCCRN in partnership with Technology, Information, Forecasting and Assessment Council (TIFAC), DST, GoI organized IDRiM TIFAC-2015 session on the theme "Climate and Disaster Resilient Smart Cities" under the 6th Conference of the International Society for Integrated Disaster Risk Management (IDRiM-TIFAC 2015) on "Disaster Risk Reduction: Challenges and Opportunities for Sustainable Growth" on 28th October, 2015.

From L-R, Mr. Ajit Kaliyath, Ms. Asha Kaushik, Mr. Rohit Magotra and Dr. Tomoko Okayama

IDRIM session on Climate and Disaster Resilient Smart Cities

The session aimed to bring together experts working in areas of Urban Resilience, Climate Change and Disaster Management for highlighting the issues related to mainstreaming climate change concerns into urban development planning framework for planning smart cities in India.

5.7. International Study to Nord Pool Power Market (Norway and Denmark), 12th – 16th October 2015

IRADe conducted an international study tour under the SARI/EI project to the Nord Pool Power Market from 12th October 2015 to 16th October 2015. The delegation that included government officials and other key energy sector entities were from Bangladesh, Bhutan, Nepal, and Sri Lanka as well as from India, besides SARI/EI-IRADe and USAID officials. The objective of this study tour was to give an insight to the members of the establishment, evolution, and growth etc. of the Regional power market so that the members can suitably apply the learnings to the growing Cross-Border Market in the South Asian Region. In the Nord Pool about 85% of all energy produced in the Nordic region is traded at the Nordic exchange.

SARI/EI delegates at Nord Pool Spot, Norway

The delegation visited the Nord Pool Spot market in Oslo, Norway and the Transmission System Operator (TSO) of Denmark, Energinet at Frederecia. Speakers from NASDAQ and Statekraft also addressed the delegates.

5.8. COP 21 DIALOGUE - Cities Resilience to Climate Change

The seminar on "Cities Resilience to Climate Change" was organized by the French Embassy in India in collaboration with Integrated Research and Action for Development (IRADe) and Asian Cities Climate Change Resilience Network (ACCCRN) on October 30th, 2015.

Event engaged with prominent experts including Ms. Thara, Municipal Commissioner of Ahmedabad

and Dr. Sudhir Krishna, Former Secretary, MoUD to share and direct discussions in the context of India's expectation aligned to the Paris text. These discussions were largely attributed to sustainable planning for climate resilient infrastructure. IRADe presented extensive work it has carried out on climate resilience in 20 cities.

Dr. Jyoti K. Parikh, Executive Director, IRADe concluded by saying that "If we are to meet future challenges with effective solutions and sufficient level of preparedness, we must begin today to devise mitigation and adaptation strategies for the cities which will lead way to development of climate resilient and low carbon cities''.

From L-R Mr. Mahesh Babu, Prof. Jagan Shah, Dr. Sudhir Krishna, Ms. D Thara, Mr. Rohit Magotra and Mr. François Richier

COP 21 Dialogue: Cities Resilience to Climate Change

5.9. National Stakeholder Consultation on New Energy Policy (NEP): Environment and Climate Change Perspectives

IRADe host a workshops/stakeholder consultation in partnership with NITI Aayog, Government of India on "Environment and Climate Change" themes to provide inputs to the National Energy Policy (NEP). on November 6, 2015 which served as a platform to gather and discuss their policy positions on various sectors including that of Energy and Climate Change, Transport and Air-Pollution and CAMPA. Following India's INDC submission to the UNFCCC for the Paris Climate Agreement 2015, this platform served as a discussion forum to plan further actions to achieve India's established INDC targets for 2030.

National Energy Policy Workshop

The main objective of the workshop was to understand the perspectives of various stakeholders for the NEP from the environment and climate change perspectives. The workshop provided an opportunity for a diverse group of stakeholders to come together and discuss inputs to the NEP which are futuristic, address the institutional mechanism to implement the policy and also cover issues of energy access, security and afford ability in the country. The findings of the workshop have wide-ranging implications for policy.

5.10. The 4th Meeting of Project Steering Committee, 9th December 2015, Mumbai, India

The 4th Project Steering Committee Meeting was held on 9th December 2015 at Mumbai, India. Members of the Project Steering Committee (PSC) from various South Asian countries along with representatives from IRADe, USAID attended the meeting. The PSC met to review the activities of SARI/EI in the year 2014-15 besides the key achievements and lessons learnt. The PSC discussed and finalized the Annual Work Plan for 2015-2016. SARI/EI reports on Regional Regulatory Guidelines and Regional Regulatory Institutional Mechanism were presented before the PSC.

The 4th meeting of SARI/EI Project Steering Committee

A detailed presentation on the updates and key findings of SARI/EI Demand Driven and Analytical Studies were held to seek the PSC's inputs. SARI/EI presented its consensus building agenda and took the Committee's inputs for SARI/EI outreach strategy. PSC Members including Mr. Dasho Yeshi Wangdi (Sec, MOEA, Bhutan), Dr. Sanjay Sarma (PSC Chair and Jt. Sec, MOE, Nepal), Mr. Major Singh (Member (Planning), CERC India), Mr. Vaqar Zakaria (MD, Hager Bailey, Pakistan), Dr. P.N. Fernando (Consultant, Sri Lanka) participated in the meeting. Mr. Colin Dreizin (Director, USAID), Ms. Monali Zeya Hazra (Regional Energy Manager, USAID), Ms. Vandana Vats (Acquisition Specialist, USAID), Dr. Jyoti Parikh (Exec Director, IRADe), Mr. V.K. Kharbanda (Proj. Director, SARI/EI-IRADe), Dr. Pradeep Dadhich (Dep. Director, IRADe), Mr. S.K. Ray (Tech Specialist, SARI/EI-IRADe), Ms. Reshmi Vasudevan (Project Coordinator, SARI/EI-IRADe), Mr. Rajiv Ratna Panda (Head Tech, SARI/EI-IRADe), Mr. Probal Gosh (Head Modelling, SARI/EI-IRADe) and Mr. Gaurav Jain (Sr. Research Associate, SARI/EI-IRADe) participated in the PSC meeting.

5.11. Sustainable Integrated Energy Strategies for Gujarat - Meeting with the Minister of Energy and other Stakeholders

From L-R, Sh. Govindbhai Patel, Shri Saurabhbhai Patel, and Sh.G.R. Aloria

Stakeholders meeting to present and discuss project report

A stakeholder meeting was organised by IRADe at Swarnim Sankul, Sachivalaya, Gandhinagar on December 21, 2016 in the auspicious presence of the Hon'ble Minister for Energy, Sh. Saurabhbhai Patel, Minister of State, Sh. Govindbhai Patel and Sh. G.R. Aloria, IAS, Chief Secretary, Gujarat. IRADe gave a detailed presentation on the energy plan prepared by it. Deliberations were held post presentation and suggestions were taken into consideration. Further the Minister thanked IRADe for their untiring efforts to prepare the plan and requested all the stakeholders to follow and implement the plan and the policies in line with Gujarat Government.

5.12. Workshop on Sustainable Development of Power Sector and Enhancement of Electricity Trade in the South Asian Region and the Way Forward: Policy, Regulatory Issues/Challenges

IRADe in association with the South Asia Forum of infrastructure Regulation (SAFIR) successfully organised a Workshop on "Sustainable Development of Power Sector and Enhancement of Electricity Trade in the South Asian Region: Policy, Regulatory Issues/ Challenges and the way forward" (under USAID's SARI/ EI Program), 15th January, 2016 in New Delhi, India.

Shri Pradeep K. Pudari, Secretary, Ministry of Power addresses the Workshop

The workshop discussed and deliberated on *inter alia*, key policy and regulatory frameworks, challenges and need for coordinated policies/regulation for sustainable development of regional energy resources and enhancement of CBET the South Asian region and lessons learnt from international experiences in power market development and Cross-Border Electricity Trade. The workshop was attended by regulators from all south Asian countries and the states of India, besides policy and decision makers, regulators, power utilities, private sector, MDBs, donor agencies, among others.

5.13. Gujarat Energy Strategies: Energy Report Release by Hon'ble Chief Minister of Gujarat Smt. Anandiben Patel

From L-R Dr. Jyoti Parikh, Smt. Anandiben Patel and Dr. Kirit Parikh

The final report on "Sustainable Integrated Energy Strategies for Gujarat" was released by Hon'ble Chief Minister of Gujarat, Smt. Anandiben Patel on 19th January 2016 at Gandhi Nagar, Gujarat along with Dr. Jyoti Parikh and Dr. Kirit Parikh. The report was discussed with the Chief Minister along with Principal Secretaries of energy, climate change and CM's secretariats.

5.14. Stakeholders Consultation Workshop: Review of Status of Marine National Park, Jamnagar and Evolving Vision Statement for Management of MNP, Jamnagar, Gujarat

A stakeholder's consultation workshop on "Review of status of Marine National Park, Jamnagar and Evolving vision statement for Management of MNP", was organized by IRADe on March 08th, 2016 at Jamnagar, Gujarat. The workshop was supported by GIZ (Gesellschaftfür Internationale Zusammenarbeit), Germany and coordinated by the Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India (GoI).

The workshop, through the process of dialogue and knowledge sharing, is aimed at identifying the most suitable practices for the conservation of Marine National Park in harmony with sustainable development of community's dependent on it. It will also highlight the interventions needed from different stakeholders to ensure that these practices are actually streamlined into ground realities. The purpose of the workshop is to share the findings of the review and discuss with all the stakeholders the steps needed for the conservation of Marine National Park.

From L-R Mr. Bharat Pathak, Dr. Micheal Vakily, Dr. H.S. Singh, Mr. Shyamal Tikadar and Mr. Rohit Magotra

Marine National Park Stakeholders Consultation Workshop, Jamnagar, Gujarat

Ultimately, it was recognized that industrial activity do harm the environment however, industrial representatives were eager to support the conservation efforts towards sustaining the marine diversity. It was also recognized that proper management of Marine National Park require a seascape/landscape approach which will incorporate the study of impact of different activities in the entire Gulf on MNP.

5.15. Stakeholder Consultations for "Macroeconomic and Analytic Study Focusing on Benefits from Nepal-India Electricity Trade"

A Stakeholder's consultation was undertaken on 19-20 January 2016 in Kathmandu, Nepal with NEA, WECS, Ministry of Energy, Nepal Planning Commission, Nepal Rashtriya Bank, IBN, IIDS, ADB, World Bank representatives etc. for **"Macroeconomic and analytic study focusing on benefits from Nepal-India electricity trade"** under the South Asia Regional Initiative for Energy Integration (SARI/EI). Presentations on them were made to the various stakeholders.

The workshop primarily focused on consultation with the stakeholders to undertake:

- **Consultation on Key Inputs to Nepal TIMES Model and Macro Economic Model:** Initial results of Nepal Answer-TIMES and on multipliers showing the economic impact of injection of one unit of electricity in Nepal power system using the 2007 SAM matrix were discussed.
- **Consultation on Results from Preliminary Work:** Preliminary results such as energy generation, trade and shortages were shared with the participants. Supply curve that highlights the potential of various technologies at various export prices were also discussed during the workshop.

Stakeholder Consultations workshop in Kathmandu, Nepal

- **Inputs of Experts on Energy Scenarios:** For building various scenarios for Nepal Model, expert advice were taken through the stakeholder consultation.

Workshop concluded with stakeholder's suggestions on Nepal TIMES Model and Nepal's Macro Economic Model. They further suggested the integration of Nepal TIMES Model with India TIMES model.

5.16. SARI/EI Delegation to the 2nd Meeting of SAARC Energy Regulators, 8th February 2016, Colombo, Sri Lanka

The SAARC Secretariat, Nepal, invited SARI/EI in the Second Meeting of SAARC Energy Regulators held on 08th-09th February 2016 at Colombo, Sri Lanka. Key Findings of the SARI/EI Study on a) Harmonization of Grid Codes, Operating Procedures, Standards for promoting Cross-Border Electricity Trade (CBET) in South Asia Region and b) Regional Regulatory Guidelines (RRGs) were presented during the meeting. The SAARC Energy regulators and members acknowledged and appreciated the work being carried out by SARI/EI.

A delegation comprising of Mr. V.K. Kharbanda, Project Director, SARI/EI-IRADe and Mr. Rajiv Ratna Panda, Head-Technical, SARI/EI-IRADe participated in the workshop.

SARI/EI Delegation presented at the second meeting of Energy Regulators, 8th Feb 2016

6 Professional Activities

Dr. Jyoti Parikh

- Chaired the session "**Recent Initiatives on Climate Finance set up and what move needs to be done**" at the workshop on "Climate Change Finance in India", organized by Department of Economic Affairs of the Ministry of Finance and GIZ, 23rd April, 2015, New Delhi.
- Speaker at the 16th Annual India Tech Triple Expo 2015. Topic "**Disaster and Climate Resilient Planning for Smart Cities**", Organized by India Tech Foundation, 30th April, 2015, Mumbai.
- Speaker at Brainstorming session on Climate Change. Organized by National Academy of Sciences, India (NASI), 19th May, 2015, Jammu.
- Speaker at the Seminar on the theme "**Could Technology partnerships catalyse climate negotiations?**" Organized by French Embassy in preparation for COP 21 meeting at Paris, 21st May, 2015, New Delhi.
- Speaker at Think-20 Turkey Workshop. Organized by TEPAV G20 Studies, 12th June, 2015, in Izmir and Bodrum, Turkey.
- Attended the launch Ceremony of Flagship program on Smart cities by the Prime Minister Shri Narendra Modi. Organized by MoUD, 25th June, 2015, New Delhi.
- Speaker at 2nd Power Southeast Asia Conference and Exhibition, 14th September, 2015, Yangon, Myanmar.
- Panelist at Workshop on Growing Coal, Growing Renewables, Discom Realities and carbon implications. Organized by Brookings India, Sept, 2015, New Delhi.
- Attended Research Council Meeting of NEERI Organized by NEERI, 5th October, 2015, Nagpur.
- Participated in Summit on Global Agenda 2015. Invitation from World Economic Forum, 26th October, 2015, Abu Dhabi, UAE.
- Chaired the session on Climate Change Impacts on other Sectors. MoEFCC, 29th October, 2015, New Delhi.
- Speaker at Smart City Expo World Congress, 17th November, 2015, Barcelona, Spain.
- Lead Speaker at session III, EU-India Cooperation. Invitation from Delhi Policy Group, 22nd January, 2016, New Delhi.
- Participated in the event on "Empowering Women & Girls". Organized by Bill & Melinda Gates Foundation, 11th March, 2016, New Delhi.

Mr. Sharad Verma

- Participated in Sustainability Partnerships roundtable at SPA, New Delhi, organised by IIT-D, and Arizona State University, USA on 16th October, 2015.
- Attended the India-UK Technology Summit, Knowledge Expo at Le Meridien, New Delhi, organised by RCUK, UK Govt. on 9th December, 2015.

Dr. Probal Ghosh

- Participated in the India Modelling workshop at the NITI Aayog under US-India energy dialogue on June 2, 2015.
- Visited Nepal to meet government ministry representative and to establish contacts for data on Analytical studies for India Nepal Energy Trade from 31st August to 5th September.
- Participated in Stakeholder conference for India Nepal Analytical studies, 19-20th January, 2016 at Hotel Radisson, Kathmandu.
- Participated in a Workshop on "Regional Power Trade with special focus on Nepal-India" on 28th April, 2016 at Hotel Radisson, Kathmandu.

Mr. Rajiv Ratna Panda

- Presentation on "Harmonization of grid codes, operating procedures and standards to facilitate and promote CBET in the south Asia region "in the SAARC Perspective Workshop on the Past, Present and Future of High Voltage DC (HVDC) Power Transmission held on 30th September - 01st October, 2015 at Lahore, Pakistan organized by SAARC Energy Center.

Dr. Ashutosh Sharma

- Participated in CEEW-IISD National Dialogue on Subsidies for Energy Access on 4th May 2016 at Imperial Hotel New Delhi.

Mr. Chandrashekhar Singh

- Participated in India Clean cooking forum conference on 6th October 2015 at Sangri-La Hotel New Delhi.

IRADe's outreach and partners

IRADe networks with the government, ministries/departments, international organizations, public and private sectors, academic experts, NGOs, and consultants to work on projects awarded by them. IRADe provides decision support to eleven ministries include Ministry of Environment and Forests and Climate Change, Ministry of New and Renewable Energy, Niti Aayog (formerly Planning Commission), Ministry of Power, Ministry of External Affairs, Ministry of Earth Sciences, Ministry of Urban Development, Department of Science and Technology, 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 organization like the World Bank, Asian Development Bank (ADB), U.S. Agency for International Development (USAID); United Nations Development Programme (UNDP); California and United States Environmental Protection Agency (USEPA), Wuppertal Institute for Climate, Environment and Energy, (WISION) Germany; Deutsche Gesellschaftfür Internationale Zusammenarbeit (GIZ), Germany; Rockefeller Foundation; British High Commission; International Institute for Applied Systems Analysis (IIASA), Austria; British High Commission (BHC), 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 sectors, multinational organizations, think tanks and NGOs. These include Shakti Foundation, Indian Council of Social Science Research (ICSSR), SEWA, Petroleum Federation of India, Pricewaterhouse 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 in agriculturally vulnerable flood prone areas.

List of Projects

S.No.	Title	Funding Agency	Status
1.	Modelling Studies on Greenhouse Gas Emissions (GHG) and Emission Intensity of Indian Economy	Ministry of Environment Forest and Climate Change (MoEF&CC), GoI	Completed
2.	Review of status of Marine National Park (MNP), Jamnagar and evolving vision statement for management of MNP	GIZ and the Ministry of Environment, Forests and Climate Change	Completed
3.	Environmentally Sustainable and Integrated Energy Strategies for Gujarat	Gujarat Energy and Petrochemicals Department and Gujarat Power Corporation Limited (GPCL)	Completed
4.	Clean Cooking fuel: Issues and Challenges	International Institute for Sustainable Development (IISD)	Completed
5.	South Asian Regional Initiative For Energy Integration (SARI/EI)	United States Agency for International Development (USAID)	Ongoing
6.	Global Technology Watch Group (GTWG) on Advanced Coal Technologies (ACT) for Power Generation	Ministry of Science and Technology, Department of Science and Technology, Government of India	Ongoing
7.	Energy Sector Reforms and impact on Gender	ENERGIA	Ongoing
8.	Policy engagement work in India to educate decision makers at national/ state/city level to urban climate change resilience and integrate the concepts into wider planning discourse	Rockefeller Foundation under ACCCRN Project	Ongoing
9.	Udaipur Solar City Master Plan	Udaipur Municipal Corporation, Government of Rajasthan, MNRE funded scheme	Ongoing

Partners and Sponsors

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