SOUTH ASIAN ASSOCIATION FOR REGIONAL COOPERATION (SAARC)

SAARC ENERGY CENTRE

ISLAMABAD

THE REPORT

Programme Activity: PRG-157/2019/PREPA

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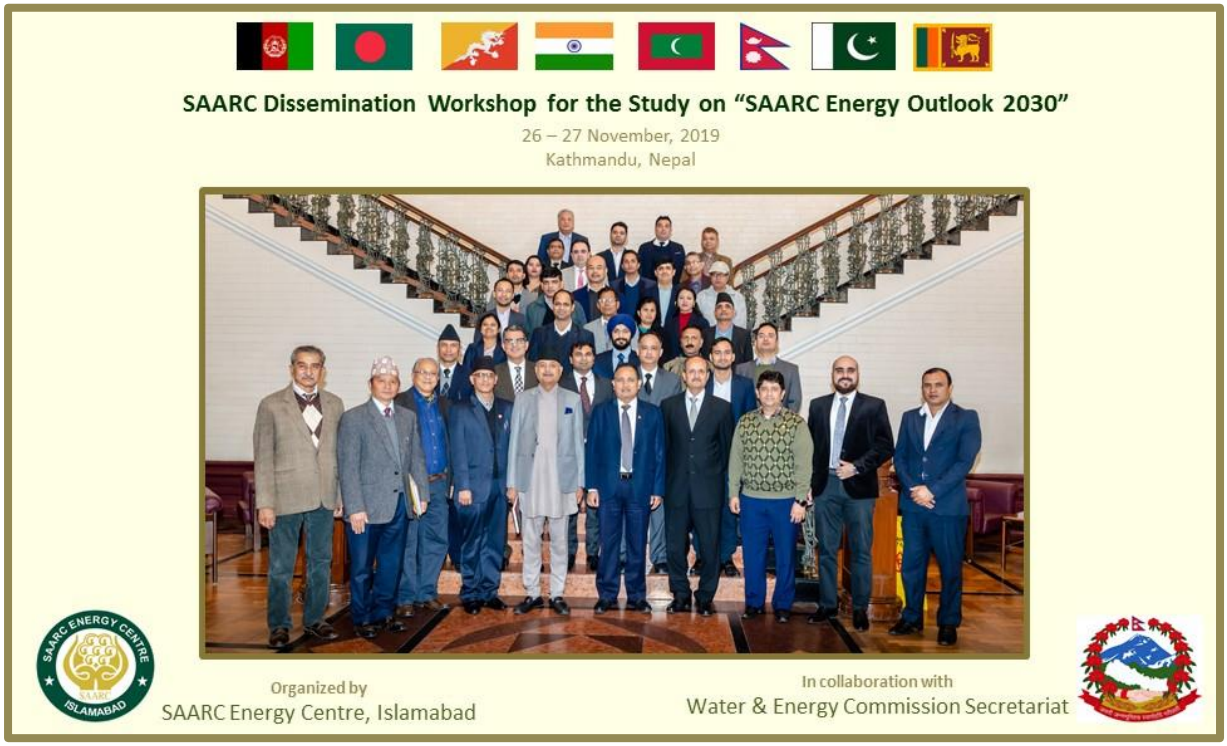
SAARC Dissemination Workshop for the Study on "SAARC Energy Outlook 2030"

26th - 27th November, 2019 | Yak & Yeti Hotel, Kathmandu, Nepal



The Report

Introduction

South Asia region is one of the fastest growing regions in the world with economic growth forecasted to 7.0 percent in 2020. The demand for all types of Energy is growing rapidly. Thus, improved energy supply is a key to sustaining economic growth and improving social services. Each Member State of SAARC Region is pursuing all available measures to counter the energy deficit problem which has hampered the economic growth in their respective country.

2. Along with the issue of Energy Deficit, Energy Security is an important consideration for peace and prosperity of the region. The demand forecast and identification of potential energy sources in long time horizon are very important for securing and maintaining the energy security in the region. Energy sector in SAARC countries has grown rapidly in recent years. The economic and population growth along with urbanization and industrialization tends to continue rapid expansion in demand for energy. Realizing the need for energy, policy makers are putting lots of efforts to remove obstacles to investment in energy supply.

3. One such obstacle is the lack of long-term forecast of energy or the demand and supply projections of different kinds of energy. The development of Energy Outlook of individual member countries and consolidation at the whole South Asia level will help in combating the energy security challenges prevailing in the region. Such data projections not only facilitate policy / decision makers and planners of energy sector, but these can also be used to help guide long-term investments. In this context, SEC conducted a study on "SAARC Energy Outlook 2030" in 2018.

4. In order to disseminate the study, SEC under its approved programme activity for FY 2019 organized a two-day **Dissemination Workshop for the Study on "SAARC Energy Outlook 2030"** in Kathmandu, Nepal on 26th – 27th November 2019. The event was arranged in Hotel Yak & Yeti, Kathmandu in collaboration with the Water and Energy Commission Secretariat (WECS), Government of Nepal. The workshop was inaugurated by the Chief Guest, Mr. Krishna Prasad Oli, Hon' Member, National Planning Commission, Government of Nepal.

5. Following were the objectives of the workshop:

a) Dissemination of the Study and its findings/recommendations to the larger audience including policy/decision makers, planners and other stakeholders of energy sector.
b) Value addition and further improvement of the Study based on feedback and comments of the delegates from each Member State.
c) Awareness building among the stakeholders including policy and decision makers, relevant manufacturers, private sectors, etc. for the future energy scenarios.

6. The workshop helped to obtain feedback on the study report, establish communication, facilitate professional exchange and initiate cooperation between policy makers, experts, and other stakeholders from public and private sectors.

Participation

7. A total of 39 participants including the delegates from Member States Afghanistan, Maldives, Nepal and Pakistan; Resource persons from Nepal and India; and officials from SEC participated in the workshop. The list of the participants is available at Annexure II. Due to the efforts of the SEC Officials and the collaborating partner WECS, especially the Focal Person Mr. Sagar Kumar Rai, Joint Secretary WECS, the workshop attracted an overwhelming participation from 16 different public institutions in Nepal. The resource persons delivered presentations on different topics of the study report, such as analysis of current energy scenarios, comparison of different energy sources in SAARC countries, outlook forecast of each energy type for each SAARC member state, assessment of conventional and region moves towards a sustainable energy future. The participants had a very open and interactive discussion with the resource persons regarding feedback and comments on various sections of the report and an interactive feedback session towards the end of the workshop helped capture all the value additions from the participants.

Workshop Agenda

8. The Workshop programme comprised of an Inaugural session, four technical sessions spread over two days, and a valedictory session. The technical sessions included country presentations as well as presentations delivered by the Resource Persons. Moreover, a Welcome Dinner was also organized by the SEC as a networking opportunity for the delegates in order to facilitate professional exchange and foster cooperation. A copy of the Workshop Agenda is available at **Annexure I**.

Inaugural Session

9. The Inaugural Session of the workshop was Chaired by Mr. Dinesh Kumar Ghimire, Secretary Ministry of Energy, Water Resources and Irrigation, Government of Nepal, and the session was graced by the Chief Guest, Mr. Krishna Prasad Oli, Honourable Member, National Planning Commission, Government of Nepal. The session started with the Programme Coordinator Mr. Muhammad Umar Mukhtar welcoming the Chief Guest, Chair of the Session, delegates and the resource persons for attending the workshop. He introduced the aims and objectives of the workshop, and gave a brief overview on the need for having reliable and long-term energy outlook for SAARC Member States.

Welcome Address by Deputy Director, SEC

10. **10. Dr. Shoaib Ahmad, Deputy Director, SAARC Energy Centre** delivered Welcome address to the participants of the workshop. He especially thanked Chief Guest and the Chair of the Session for their gracious presence at the workshop and for encouraging the SAARC Energy Centre's endeavors in Energy Sector. He welcomed the resource persons and all the delegates from SAARC Member States for attending the workshop.

11. In the address, he introduced SAARC Energy Center and its initiatives for promoting energy cooperation among member states. He highlighted the importance of energy demand and supply forecasts and identification of potential energy sources in the long-time horizon for securing and maintaining the energy security in the region. He mentioned that SAARC region is blessed with tremendous amount of renewable energy, such as hydel, wind and solar energy, and these could be utilized to provide energy to the population to increase their overall quality of life and to decrease reliance on imported fossil fuels. He also stressed the development of Energy Outlook of individual member countries and consolidation at the whole South Asia level to combat the energy security challenges prevailing in the region.

12. He acknowledged the great cooperation extended by the Collaborating Partner Water and Energy Commission Secretariat (WECS) and especially thanked Mr. Sagar Kumar Rai in facilitating SEC to organize this workshop. He expressed his satisfaction, as the real stakeholders had joined hands for common goal of providing feedback on a study of regional importance. He also thanked the high-level officials of the Government of Nepal and the delegates and participants for their presence and for their interest and commitment to the cause of energy cooperation.

Inaugural Address by the Chief Guest

13. **Mr. Krishna Prasad Oli, Hon' Member, National Planning Commission** in his inaugural address as Chief Guest appreciated the initiatives taken by SAARC Energy Centre in facilitating and coordinating programmes to enhance energy security, to remove barriers and to build confidence and consensus for sustainable energy use across the SAARC region. He emphasized that provision of reliable energy is a big issue for the whole SAARC region, and in order to provide sufficient supplies of electricity and other forms of energy, significant effort should go into developing reliable energy demand and supply projections. He emphasized that there are profound shifts already underway in the global energy system, but unless greater ambition is shown by the countries, the world's CO2 emissions will keep on rising. Therefore, along with reliable energy demand and supply projections, the policy makers also need to design policies in such a manner so that CO2 emissions are reduced.

14. He, in his final remarks, wished for active participation of all delegates from SAARC member countries and resource persons of the workshop, and for sharing information and learnings from each other's experiences. He wished all the participants of the workshop a very pleasant stay in Kathmandu.

Keynote Address by the Chair

15. **Mr. Dinesh Kumar Ghimire, Secretary Ministry of Energy, Water Resources and Irrigation, Government of Nepal** in his keynote address stated the initiatives taken by Water and Energy Commission Secretariat to overcome energy scarcity in Nepal. He also presented the role that WECS has been performing to promote the use of sustainable energy in Nepal. He stated that all Member States have a lot of potential to generate energy using their own indigenous resources for fulfilling the energy needs of their people. He stated that each SAARC member state has very good resources of different types of renewable energy which is not expensive in long run, doesn't cause pollution and is abundantly available.

16. In his remarks, he stated that the goal towards meeting energy requirements must be based on developing Renewable Energy resources within coming years. This requires all Member States to plan effectively through sources like SAARC Energy Outlook, adopt new technologies and promote development of RE technologies all over the SAARC region. At the end of his address, he appreciated the role of SAARC Energy Centre in arranging workshop, and thanked all the delegates and resource persons for participating in the workshop. The photographs taken during the Workshop are available at **Annexure III.**

Technical Proceedings

17. The Workshop proceedings were initiated with Technical sessions, designed on specific chapters of the Study Report and started with country presentations by each of the participating Member States. All the presentations delivered in the technical sessions are available at the SEC official website (www.saarcenergy.org) and placed in **Annexure IV**.

a) ***Country Presentations***

This Day-1 technical session started with the introductory presentation by Mr. Muhammad Umar Mukhtar, Programme Coordinator, SEC. In his presentation, he shed light on the background, objectives and expectations of this two-day workshop. He also informed the audience about the mandate, objective and efforts of SEC in fostering energy cooperation within the SAARC region. In the end, he gave an overview of recent programme activities undertaken by SEC.

This was then followed by the country presentations delivered by the delegates from the member states, presenting the situation of electricity/energy sector, and the long-term national projections of energy demand and supply of their respective member states.

b) ***SAARC Energy Outlook 2030: Introduction***
Team CRISIL

Team CRISIL consisting of Mr. Pinal Mehta and Mr. Guranchal Singh started the dissemination of the report by first giving a detailed background of the Study Report. The background included the scope of the report, the TORs, and the approach and methodology that was used to arrive at the results. Afterwards, they gave a bird-eye overview of each SAARC member state, which included the energy sector overview, power demand and supply review, the power demand and supply outlook till 2030, and the overall energy outlook till 2030. They concluded the presentation by focusing on the need of having concerted efforts to tap renewable energy as well as indigenous oil and gas reserves.

c) ***Assessment of Conventional Energy Sources in SAARC Member States***
Team CRISIL

Team CRISIL consisting of Mr. Pinal Mehta and Mr. Guranchal Singh gave a detailed assessment of the various conventional energy sources being used in each SAARC member state. They provided energy profile of member states and compared how the use of conventional sources of energy stacked up. The energy profile consisted of country-wise and fuel-wise review and the participants were informed that POL (petroleum, oil and lubricants) is the most dominant fuel in all SAARC member states except Bhutan, Nepal and Sri Lanka. In line with the energy profiling of member states, Team CRISIL informed the participants that according to their assessment, the use of conventional sources of energy will rise 4.7% per annum between 2018 and 2030 in the SAARC region.

d) ***Assessment of Renewable Energy in SAARC Member States***
Team CRISIL

This presentation, delivered by Mr. Pinal Mehta and Mr. Guranchal Singh from CRISIL followed the same structure as the previous one; whereby the presenters gave a detailed assessment of the various renewable energy sources being used in each SAARC member state. Each country's detailed use of renewables as well as future outlook till 2030 was presented. All the major renewable energy technologies for each country were presented. For Afghanistan

Bhutan and Nepal, the most significant increase is predicted to be in the use of hydro energy, while for Bangladesh, India, Pakistan and Sri Lanka, solar energy is predicted to be the major RE contributor. However, for Maldives, no significant rise in the use of renewables is predicted till 2030. The participants were informed that overall, there will be very small growth in the use of renewable energy vis-à-vis the growth in primary energy.

e) ***Use of Solar Energy for Cooking Food in Nepal***
Prof. Dr. Jagannath Shrestha, Nepal

Prof. Dr. Jagannath Shrestha presented a case in favour of the use of solar energy for cooking food in Nepal, and argued that the use of solar energy via batteries for powering induction cookers is cheaper than the use of firewood or coal for cooking purposes. During his presentation, he provided numerous models of solar induction cookers, and presented the cost-benefit analysis vis-à-vis conventional ways of cooking food. He also discussed case studies regarding the actual use of such cookers in Nepal. Finally, he stressed the need for the government and the private sector to raise awareness among consumers regarding the use of solar energy for cooking purposes.

Day-2 Proceedings

f) ***CRISIL Introduction***
TEAM CRISIL

Mr. Pinal Mehta and Mr. Guranchal Singh from CRISIL Limited started the second day's proceedings by giving an overview of CRISIL Limited and the range of services it provides. They highlighted that CRISIL is India's leading rating agency, and is majority owned by S&P Global Inc., a leading provider of transparent and independent ratings, benchmarks, analytics and data to the capital and commodity markets worldwide. They also informed the participants that CRISIL's industry research covers 86 sectors and is known for its rich insights and perspectives. They concluded the presentation by providing a brief overview of the local and global clientele of CRISIL.

g) ***Moving towards a sustainable energy future: Opportunities and Challenges***
TEAM CRISIL

The study authors discussed each SAARC member state one by one in order to highlight the opportunities and challenges that each country has been facing so far regarding its shift towards a renewable energy economy. For each country, Team CRISIL first presented its federal targets for renewable energy additions and then provided expected additions till 2030. Furthermore, they then discussed the RE Potential vs Exploitation matrix for each member state to highlight why the exploitation had been low/high vis-à-vis the potential. Afterwards, they discussed the regulatory targets and investment climate of each member state in great detail. Finally, they comprehensively highlighted the barriers to RE adoption in each member state.

h) ***Energy Demand Forecast in Nepal***
Prof. Dr. Amrit Man Nakarmi, Nepal

Dr. Amrit Man Nakarmi is a leading energy consultant from Nepal, and he gave a detailed overview of his assessment regarding the energy demand forecast of Nepal, and the use of sustainable power development to meet that demand. He highlighted major issues facing the energy sector in Nepal, and then provided interesting figures on the final energy consumption in the Kathmandu valley. He highlighted that the import of petroleum products constituted only 24% by value of goods export of Nepal in 2004, however, the import of petroleum products has been consistently increasing over the years and in 2019, the import of petroleum products alone is equal to 204% of the total exports of Nepal. He claimed that this is a serious problem that can cause balance of payments crisis for the government. Afterwards, he provided his argument in favour of the increased use of hydropower and other RE sources, and discussed pathways through which this could be achieved. He concluded his presentation with suggestions for the Nepal government to cope up with the challenges in the energy sector.

i) ***Cross Border Energy Trade for SAARC Member States***
Team CRISIL

In this presentation, Team CRISIL consisting of Mr. Pinal Mehta and Mr. Guranchal Singh argued the benefits of cross border energy trade for the whole SAARC region. They informed the participants that the dominance of a single fuel in overall energy mix has led to skewed energy profile of the member states, for example Bangladesh has 70% reliance on natural gas, India has 65% reliance on coal, while Pakistan has 48% reliance on natural gas and LNG. They then presented the power sector profile of each member state and highlighted various deficiencies. Subsequently, the presented the prevalent cross border electricity trade as well as the petroleum products trade in SAARC. Based on the Outlook 2030 study and assessment carried out by CRISIL, they then highlighted various opportunities of cross border energy trade for member states. Finally, the discussed the Energy Trade of member states taking place outside the SAARC region, and highlighted its outlook and the upcoming investments.

j) ***Interactive Feedback Session for the Report***
Team CRISIL

Team CRISIL, in the last technical session of the day, conducted an interactive feedback session in order to gain the feedback from member states on the study report. All the participants were divided intro groups of 5, and based on the thematic areas of the study report, they were given various sections of the report in order to discuss within the participants of that table. The study authors visited each table and answered their questions regarding the study report. After intense discussion on each table, the group leaders were required to present their feedback/value additions to all the participants. This session helped in gaining valuable insights and recommendations from the member states, which were

afterwards presented in a concise form by the Programme Coordinator in the Valedictory Session of the Workshop.

Valedictory Session

18. Mr. Muhammad Umar Mukhtar, Programme Coordinator, SAARC Energy Centre shared thanked Water & Energy Commission Secretariat (WECS), Government of Nepal for their contribution in successful culmination of the workshop. He then read out the following conclusions and recommendations which emerged from the deliberations of the workshop:

a) Report needs to consider the changing dynamics of the past couple years. Some data is outdated regarding government policies and initiatives.

b) As the report will be presented to policy makers, some of which are not technical, so the structure and recommendations of the report should be simpler and less complex/technical for better ease of understanding.

c) HDI along with energy consumption should also be considered in the Outlook.

d) Awareness, capacity building and training regarding the energy outlook should be taken at all levels, from policy makers to the persons who are implementing the policy.

e) Emerging technologies like Electric Vehicles and Smart Grids will have significant impact on future energy demand, so they need to be considered in the energy outlook.

f) Legislation will be the main driving force in order to implement the government policies and to achieve sustainable energy targets. Therefore, SAARC Member states should be encouraged through the SEC platform to undertake relevant legislation.

g) SEC should organize trainings/exchange programmes in

    a. Installation of solar projects and net metering

    b. Smart grid and demand side management

    c. Emerging areas like EVs and hybrid RE powerplants

    d. Logistics/transportation through inland waterways to reduce energy demand in transport sector

19. Dr. Shoaib Ahmad then distributed certificates among the workshop delegates and resource persons. He thanked the participants and informed them that it is increasingly important for key stakeholders to examine existing regional dynamics and develop synergies for enhancing knowledge sharing and technology transfer in order to develop energy resources. He stated that the workshop has helped to establish communication, facilitate

professional exchange and initiate cooperation between policy makers, experts, project developers and other stakeholders from public and private sectors. Dr. Shoaib Ahmad concluded by extending his special appreciation to all the delegates and resource persons who had travelled to Kathmandu and to the local delegates for participation in the workshop.

20. Mr. Wahidullah Tawhidi from Member State Afghanistan offered vote of thanks on behalf of all the delegates to the Chief Guest, Resource Persons, SEC, and hotel staff for successfully organizing the workshop and managing high enthusiasm and involvement on the part of delegates throughout the event. She also appreciated the role and efforts of SAARC Energy Centre in conducting the workshop.

Dinner Reception

21. SAARC Energy Centre hosted welcome dinner on Wednesday, 27th November 2019 for the workshop delegates providing an informal opportunity for close interaction and networking.

Program Agenda

Dissemination Workshop for the Study on "SAARC Energy Outlook 2030"

Kathmandu, Nepal | 26th – 27th November 2019

Monday, 25th November 2019	
Arrival of Delegates and Resource Persons: Hotel Yak & Yeti, Kathmandu, Nepal	
Tuesday, 26th November 2019	
Inaugural Session at The Hotel Yak & Yeti, Kathmandu, Nepal **Chair:** *Mr. Dinesh Kumar Ghimire, Secretary Ministry of Energy, Water Resources and Irrigation*	
Time	**Description**
0930 – 1000	Registration
1000 – 1015	Welcome address *Dr. Shoaib Ahmed, Deputy Director SAARC Energy Centre*
1015 – 1025	Address by the Chair *Mr. Dinesh Kumar Ghimire, Secretary Ministry of Energy, Water Resources and Irrigation*
1025 – 1035	Address by the Chief Guest *Mr. Krishna Prasad Oli, Hon' Member, National Planning Commission*
1035 – 1100	Group photo & Refreshment
Technical Session 1	
1100 – 1215	**Country Presentations** *Presentations by the delegates of SAARC Member States*
1215 – 1300	**SAARC Energy Outlook 2030: Introduction** *Team CRISIL*
1300 – 1400	Lunch Break
Technical Session 2	
1400 – 1445	**Assessment of Conventional Energy Sources in SAARC Member States** *Team CRISIL*
1445 – 1530	**Assessment of Renewable Energy in SAARC Member States** *Team CRISIL*

1530 – 1600	**Use of Solar Energy for Cooking Food in Nepal** *Prof. Dr. Jagannath Shrestha*
1600 – 1630	Coffee/Tea
Welcome Dinner	
1800 – 2000	Welcome Dinner hosted by SAARC Energy Centre at Hotel Yak & Yeti
Wednesday, 27th November 2019	
Technical Session 3	
0930 – 1015	**CRISIL Introduction** *Team CRISIL*
1015 – 1100	**Moving towards a sustainable energy future: Opportunities and Challenges** *Team CRISIL*
1100 – 1130	Coffee/Tea
Technical Session 4	
1130 – 1215	**Energy Demand Forecast in Nepal** *Prof. Dr. Amrit Man Nakarmi*
1215 – 1315	**Cross Border Energy Trade for SAARC Member States** *Team CRISIL*
1315 – 1430	Lunch Break
1430 – 1515	**Interactive Feedback Session for the Report** *Team CRISIL*
Valedictory Session	
1515 – 1530	Summing-up Recommendations and Conclusions by Program Coordinator, SEC
1530 – 1600	Distribution of Certificates
1600 – 1610	Vote of Thanks by Mr. Hassan Zareer, Delegate of Maldives
1610 – 1630	Coffee/Tea
Thursday, 28th November 2019	
Departure of Foreign Delegates and International Resource Persons	

List of Participants

Dissemination Workshop for the Study on "SAARC Energy Outlook 2030"

26th – 27th November 2019 in Kathmandu, Nepal

#	Name	Designation	Department	Country	Contact	Email
Delegates						
1.	Mr. Wahidullah Tawhidi	Head of Publications and Public Awareness	DABS	Afghanistan	+93729003444	Wahid.tawhidi@dabs.af
2.	Mr. Hassan Zareer	Business Consultant	State Trading Organization	Maldives	+9607777056	captzareer@stomaldives.net
3.	Mr. Adnan Javed Khan	DCM	Embassy of Pakistan	Pakistan	+984025130	hocparepkathmandu@gmail.com
4.	Mr. Sagar Kumar Rai	Joint Secretary	WECS	Nepal	9841377170	raisagarkumar5@gmail.com
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6.	Mr. Abian Marasini	Mechanical Engineer	WECS	Nepal	9860016853	marasiniabian@yahoo.com
7.	Mr. Arun Jha	Senior Divisional Engineer	Ministry of Energy	Nepal	9841747693	arun65_us@yahoo.com
8.	Mr. Raju Maharjan	Senior Divisional Engineer	Ministry of Energy	Nepal	9841494539	rmaharjan024@hotmail.com
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10.	Mr. Gopi Prasad Sah	Senior Divisional Engineer	Department of Electricity Development	Nepal	9851213794	gopi.sah@nepal.gov.np
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12.	Mr. Sishir Koirala	Joint Secretary	WECS	Nepal	9841446340	ccrkoirala@hotmail.com
13.	Mr. Sukdev Chaudhary	Senior Divisional Engineer	WECS	Nepal	9851149203	sukdevchaudhary@gmail.com
14.	Dr. Uttam Kumar Kunwar	Head of Energy and Environment Division	Federation of Nepalese Chamber of Commerce and Industry	Nepal	9841454330	uttam.kunwar@gmail.com
15.	Mr. Karshan Maharjan	Engineer	WECS	Nepal	9849763192	karshanmaharjan@gmail.com

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16.	Mr. Post Raj Poudel	Engineer	National Natural Resources and Fiscal Commission	Nepal	9849977929	prpoudel99@gmail.com
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18.	Ms. Deepa Shrestha	Deputy Manager	Nepal Electricity Authority	Nepal	9841767781	deeps.stha@gmail.com
19.	Mr. Roshan Pandey	Program Chief	Nepal Academy of Science and Technology	Nepal	9803481302	roshanpandey2010@gmail.com
20.	Ms. Nisha Tripathee	Engineer	Investment Board Nepal	Nepal	9851212159	nisha.tripathee@ibn.gov.np
21.	Dr. Shree Raj Shakya	Director	Center for Energy Studies, Institute of Engineering	Nepal	9818714954	shreerajshakya@gmail.com
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24.	Mr. Arun Rajauria	DGM	HIDCL	Nepal	9851062613	arun@hidcl.org.np
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27.	Mr. Ishwar Chandra Khanal	Planning Officer	AEPC	Nepal		
28.	Mr. Komal Nath Atreya	Project Manager	WEA	Nepal	9841390193	komalatreya@wea.org.np
29.	Sulo Chana Khanal	S. Officer	MOEST	Nepal	9841393067	
Resource Persons						
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#	Name	Designation	Department	Country	Contact	Email
32.	Dr. Jagannath Shrestha	Professor	Center for Energy Studies	Nepal	9849246889	shresthajn@gmail.com
33.	Prof. Dr. Amrit Man Nakarmi	Energy Expert		Nepal	9840059114	nakarmiamrit@gmail.com
SEC Officials						
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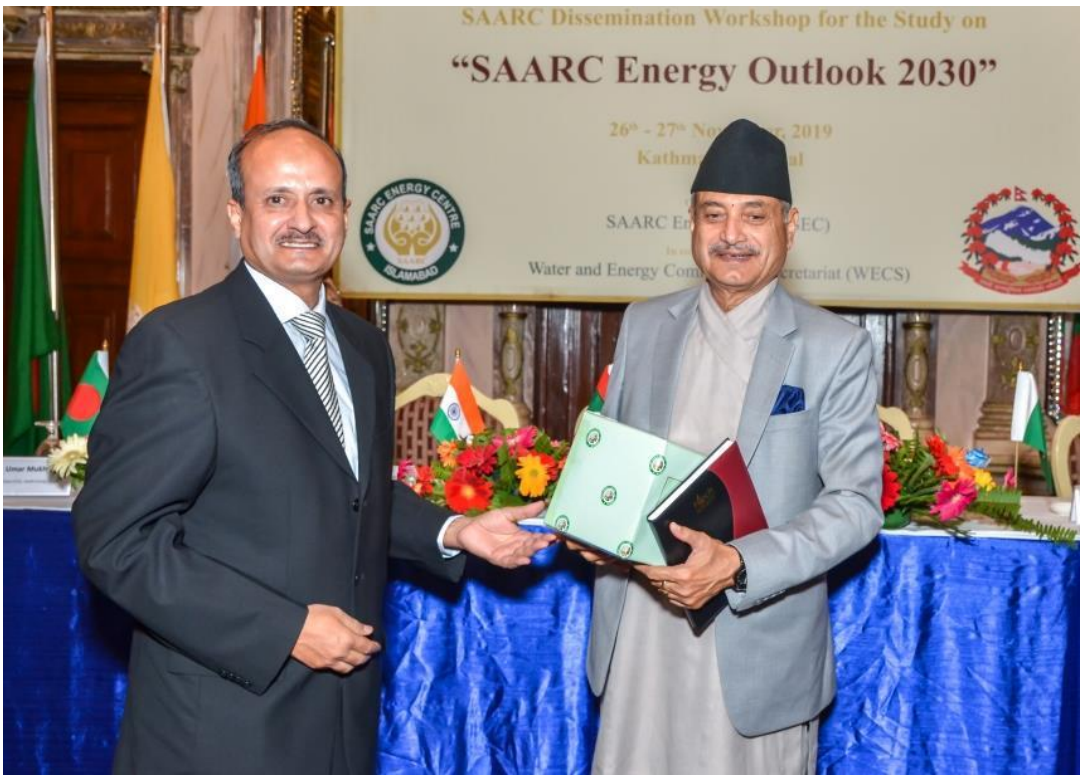
Photographs of the Workshop

Mr. Umar Mukhtar, Programme Coordinator and Master of the Ceremony, welcoming guests at the Inaugural Session

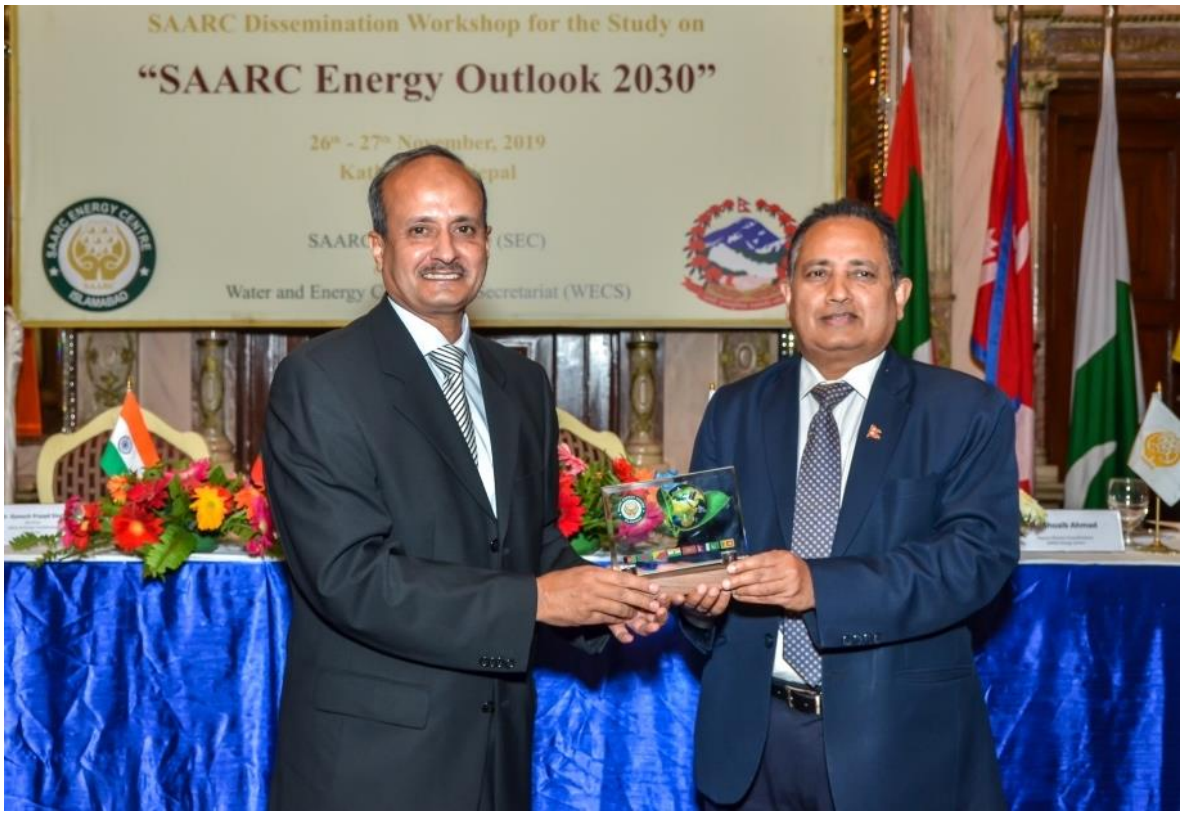
Opening of the Workshop by the Chair and the Chief Guest

Dr. Shoaib Ahmad, Deputy Director, SEC delivering his Welcome address



Dr. Shoaib Ahmad, Deputy Director, SEC presenting souvenir to Chief Guest Mr. Krishna Prasad Oli, Hon' Member, National Planning Commission

An overview of the Workshop venue



Dr. Shoaib Ahmad, Deputy Director, SEC presenting shield to Chair of the Session, Mr. Dinesh Kumar Ghimire, Secretary Ministry of Energy, Water Resources and Irrigation

Mr. Guranchal Singh, the Resource Person of the workshop delivering his Presentation

Snapshot of workshop participants

Group photograph of workshop participants

Dr. Shoaib Ahmad, Deputy Director, SEC distributing certificate to Afghanistan delegate Mr. Wahidullah Tawhidi

Presentations delivered during the Workshop

Presentation on "SAARC Energy Outlook 2030: Introduction" by Team CRISIL

SAARC Dissemination Workshop for the Study on "SAARC Energy Outlook 2030"

Presentation 1: SAARC Energy Outlook 2030: Introduction

Presenter: CRISIL Research

Research

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Scope of the report

Terms of reference of the study:

- Country-wise profiling, detailing factors impacting the energy sector:
  - Population, GDP, industrial activity, and availability of energy sources
  - Overview of the existing regulatory and policy framework in the energy sector
  - Overview of the existing energy mix and assessment of end-use sectors driving demand
- Existing cross-border energy trade (global and intra-SMSs, including SAARC framework agreement for energy co-operation)
- Development of energy outlook until 2030
  - Country-wise assessment of key factors expected to drive energy demand, including:
    - Macro-economic indicators (GDP, population growth, per capita income, etc.)
    - Growth of end-use industry (transportation, power generation)
  - Country-wise assessment of demand, supply growth and deficit/surplus scenario
    - Assess the requirement for future cross-border energy trade

Research

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Approach and Methodology

5-step framework towards energy outlook 2030

Data collection
Annual government data, energy reports for multilateral funding agencies, press releases

Long-term demographic and economic trends
Economic and demographic forecasts and impact on energy requirement due to impending changes

Sector deep dives: Power, residential, industrial, transport
Demand outlooks and forecasts, underlying factors leading to change

Fuel supply outlook
Domestic production and import of fuels, changing fuel mix owing to supply constraints, price rises, government policies

Recalibrating unconstrained demand in line with fuel supplies
Changing fuel mix, matching demand with constrained supply

Data-driven bottom-up and top-down approach, to derive demand and supply outlook of SAARC member-states until 2030

Research

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Energy Outlook of SAARC Member States (SMS)

Research

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Primary Energy Consumption in SMS: Review and Outlook

Country	Total Primary Energy in 2012/ FY13 (MTOE)	Total Primary Energy in 2017/ FY18 (MTOE)	Total Primary Energy in 2023/ FY24 (MTOE)	Total Primary Energy in 2030/ FY30 (MTOE)
Afghanistan	5.7	4.3	6.7	9.3
Bangladesh	25.7	37.5	60.6	85.3
Bhutan	0.6	0.7	0.9	1.5
India	651.2	816.8	1,102.7	1,391.3
Maldives	0.4	0.5	0.8	1.2
Nepal	10.0	13.5	16.3	21.2
Pakistan	57.7	74.6	108.6	147.3
Sri Lanka	9.6	11.4	12.9	16.2
Total	**760.9**	**959.3**	**1,309.5**	**1,590.5**

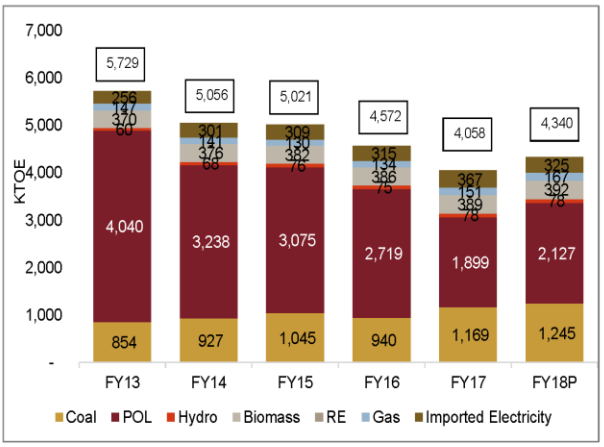
Afghanistan: Introduction

COUNTRY OVERVIEW

- Afghanistan development has been hindered by years of armed conflict and war;
- With a per capita income of $1,824, the country is amongst the lowest in the world;
- Increasing political stability and international aid flowing in to revive the war-ravaged nation, economic growth is expected to rebound.

ENERGY SECTOR OVERVIEW

- Primary energy consumption in Afghanistan is low. More than 75% of power and 100% of POL requirements are imported
- Lack of access to affordable energy has resulted in high usage of biomass as primary energy (~9% as of fiscal 2018)
- Despite high gas and coal deposits and large RE potential, the country's electrification rate is low and a majority of population lack access to energy
- Primary energy consumption in the country has reduced from 5.73 MTOE in fiscal 2013 to 4.34 MTOE in fiscal 2018 at CAGR of 5%, owing to sizeable fluctuation in POL demand, led by changing demand from the government and coalition forces.



Afghanistan: Power Demand-Supply Position

POWER DEMAND SUPPLY REVIEW

- Only ~9% of the rural population and 30% of the urban population have access to electricity
- Constrained demand has grown from 3,953 MUs in fiscal 2013 to 4,981 MUs in fiscal 2018, at CAGR of 8.9%.
- As much as ~80% of total power requirement is imported from Central Asian republics (CARs), such as Tajikistan, Uzbekistan and Turkmenistan, and Iran. As of fiscal 2018, imports from Tajikistan and Uzbekistan comprised 27% and 23% of total power requirement.
- Domestic power plants, with a cumulative capacity of ~623 MW installed in the country, generated 1,076 MUs in fiscal 2018.
- There are at present 14 Hydro Power Plants (HPPs), 14 diesel power plants, and two oil-based plants operating in the country. Hydropower accounted for ~86% of total power produced in the country in fiscal 2018.

POWER DEMAND SUPPLY OUTLOOK

- Gross demand is expected to grow to ~11,028 GWH in 2030. Grid electrification levels are expected to reach ~52% by fiscal 2030, from current levels of 35%, thereby bringing an additional 1.15 million households onto the power grid.
- Installed capacity in the country is expected to reach 2,377 MW by fiscal 2030, thereby increasing domestic power generation to 5,020 MU from current levels of 1,076 MU.
- Reliance on imports will continue throughout the period, albeit to a lower extent. The transmission line network is expected to expand with additional interconnections and cross-border infrastructure
- 15 HPP, eight solar power plants, and three wind power projects are expected to come up by fiscal 2030. Also, new gas-based plants at Mazar-i-Sharif and Sheberghan are expected to be set up in fiscals 2020 and 2022, respectively, which will utilise domestic gas.

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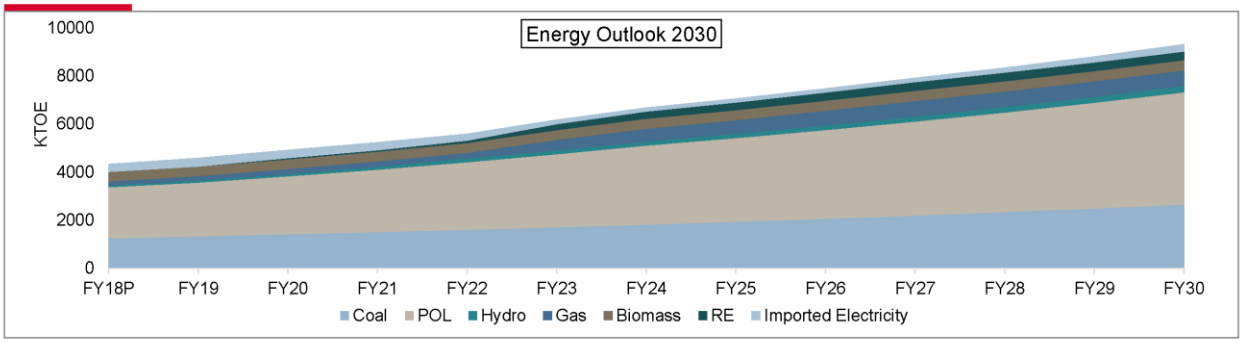
Afghanistan: Energy Outlook 2030



- Overall energy requirement in Afghanistan shall rise from 4,340 KTOE in fiscal 2018 to 9,324 KTOE in fiscal 2030
- **Hydro** to remain the major contributor in power generation; its contribution expected to rise 3.4 times by fiscal 2030
- Electrification expected to reach ~52% by fiscal 2030 from 35% now, thereby improving primary energy usage
- **Gas** usage to rise as ~650 MW gas-based power plants are expected to be set up
- **Coal** usage to increase as additional 2,000-3,000 tonne per day (TPD) of cement capacities come on stream
- End-use LPG demand and transport sector growth to result in strong **POL** growth of ~7.2% CAGR
- Consumption of **biomass,** which is used extensively by households, for heating and cooking will continue to rise due to strong rural usage as power supply is intermittent

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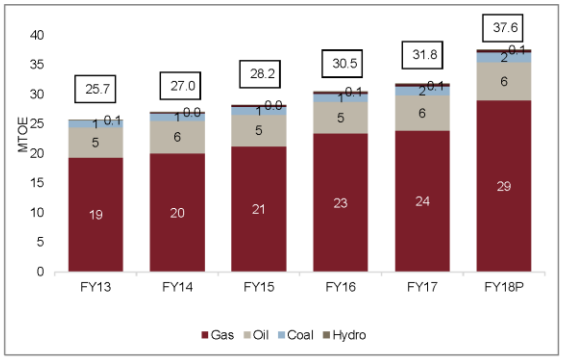
Bangladesh: Introduction

COUNTRY OVERVIEW

- Bangladesh is one of the fastest-growing economies in South Asia, clocking a CAGR of 6.6% fiscal 2013 onwards.
- The government aims to achieve the status of a middle-income country by 2021 and a high-income country by 2041, which means the country would need to achieve consistent economic growth, poverty eradication, infrastructure development and energy security.

ENERGY SECTOR OVERVIEW

- Rapid urbanisation and social development have steadily increased energy demand in Bangladesh.
- Through long-term power generation plans and power system master plan 2016, the country is planning capacity additions and fuel diversification.
- Gas, which constitutes around two-third of the nation's primary energy, is facing depletion. Efforts have been put in place to enhance domestic gas production in addition to installing LNG terminals for augmenting gas imports.
- The country is implementing a massive electrification program to bring every household into the grid.
- Overall, the nation's primary energy demand has grown from 25.7 MTOE in fiscal 2013 to 37.6 MTOE (provisional) in fiscal 2018 at a CAGR of 7.4%.



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Bangladesh: Power Demand-Supply Position

POWER DEMAND SUPPLY REVIEW

- Gross power demand has grown from 37,441 MU in fiscal 2013 to 64,990 MU in fiscal 2018 at a CAGR of 11.7%.
- With the government's thrust and sound monitoring, more than 72% of rural areas have already been added to the electricity grid. Under the 'upazila-wise 100% electrification' programme, the REB aims to provide 100% electricity to 460 upazilas under its jurisdiction by 2021.
- The total installed capacity in the country as of fiscal 2018 stands at 15,559 MW, of which BPDB holds the highest ownership (~5300 MW).
- More than 70% of the gross power generation is from gas-based plants with thermal (coal + oil)-based power accounting for only 20% of the total. The total gross energy generation in fiscal 2018 was 62,925 GWH (provisional), ~9.8% higher than the previous year.
- Around 4,656 GWH of power was imported from India by connecting Bheramara and Tripura.

POWER DEMAND SUPPLY OUTLOOK

- The power demand will continue to show strong growth until 2022 as the country is expected to be 100% electrified by then, in line with the government's 'Electricity for all by 2021' vision.
- Gross power demand is expected to reach 95.88 billion units in fiscal 2024 and 123.9 BUs in fiscal 2030 growing at a CAGR of 5.5%.
- On the supply side, majority of the additions will be coal-fired plants (~6,000 MW) with at least eight new projects in the pipeline.
- With domestic gas production expected to deplete, new LNG-based plants will come up, taking power generation from LNG to ~11% of the total power mix.
- Gross electricity generation from domestic sources is expected to reach 79.8 BUs in fiscal 2024 and 101.2 BUs in fiscal 2030 with the remainder expected to be imported from neighboring countries such as India, Bhutan and Myanmar.

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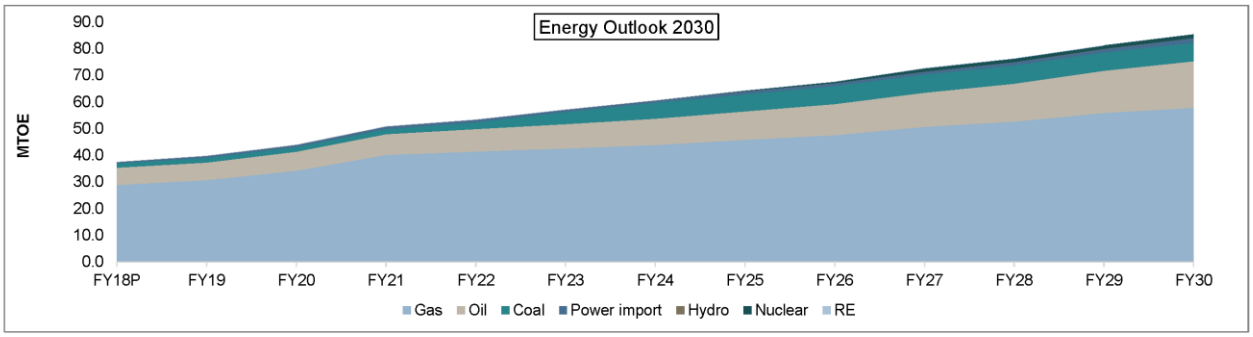
Bangladesh: Energy Outlook 2030



- Overall energy requirement in the country shall rise from 37.6 MTOE in fiscal 2018 to 85.3 MTOE in fiscal 2030.
- **Gas**, which accounts for about two-thirds of the primary energy consumption in fiscal 2018, to remain the mainstay going forward; depleting domestic production to be substituted through LNG imports.
- **Coal** usage will grow manifold to ~12 million tonne by fiscal 2030 owing to massive buildup of coal-fired thermal plants in the country (~6,000 MW).
- Increased transportation activity to boost **POL** demand by a healthy 6.4%.
- **Renewable energy (RE)** usage to remain small; no new large-scale hydro projects planned; distributed solar and wind power projects negligible.

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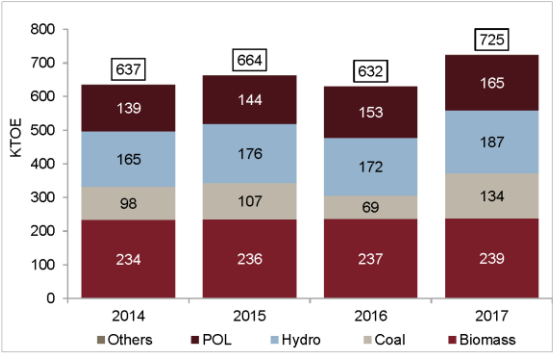
Bhutan: Introduction

COUNTRY OVERVIEW

- The Kingdom of Bhutan, a small landlocked country between China and India, spreads over 38,394 square km, of which approximately 70% is covered with forests.
- Bhutan's GDP over the past has grown at ~6% CAGR from 2012 to 2017 led primarily by investments in construction, mining and quarrying. In 2016, agriculture, construction, electricity and water supply and manufacturing accounted for more than 50% in the GDP of the country.

ENERGY SECTOR OVERVIEW

- Bhutan's overall energy consumption grew steadily at ~4.6% CAGR from 2005 to 2014 after which the growth slowed down marginally to ~4.4% CAGR from 2014 until 2017.
- Overall primary energy consumption of Bhutan was ~725 KTOE in 2017 with building (including residential consumption) and industrial sectors cumulatively accounting for ~79% of it. The balance 21% was consumed mainly by the transport sector.
- Biomass, primarily fuel wood, forms the major source of primary energy.
- Hydropower is the main resource of electricity, which is mostly consumed by the industrial and building sectors.
- The country also imports petroleum oil products, mostly from India, which is used by all the sectors of the economy



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Bhutan: Power Demand-Supply Position

POWER DEMAND SUPPLY REVIEW

- Overall power demand from the industrial, building and other sectors rose at a slower ~2.9% CAGR from 2014 to 2017. Power demand in Bhutan was ~2,186 MUs in 2017.
- The industrial sector is the single-largest consumer of electricity, accounting for ~78% of total power demand, followed by the building sector at ~20% share, and remaining being consumed by the agriculture sector and other areas.
- Bhutan had total installed capacity of ~1,623 MW in 2017, with hydro capacity constituting ~99% share
- Overall, the country's power capacity has increased only ~124.8 MW from 2014 to 2017, with the commissioning of 126 MW Dagachhu hydro power plant and slight reduction in diesel generator capacity.
- In 2017, Bhutan net exports were ~70% of the total electricity produced.

POWER DEMAND SUPPLY OUTLOOK

- Overall power demand is expected to increase at ~8.8% CAGR, from 2,186 MUs in 2017 to 6,572 MUs in 2030, led by power demand from the industrial and building sectors.
- Electricity demand in the industrial sector is expected to grow at ~9.3% CAGR from 2017 until 2030 while demand from the building sector is expected to grow at ~7.2% CAGR from 2017 till 2030 to ~1,100 GWH.
- Gross power demand is expected to reach 95.88 billion units in fiscal 2024 and 123.9 BUs in fiscal 2030 growing at a CAGR of 5.5%.
- The country is expected to add 3,658 MW of hydro power generating stations by 2027.
- Bhutan's total installed capacity is expected to reach 5,291 MW by 2030 resulting in an increase of net power exports by 213% over 2017.

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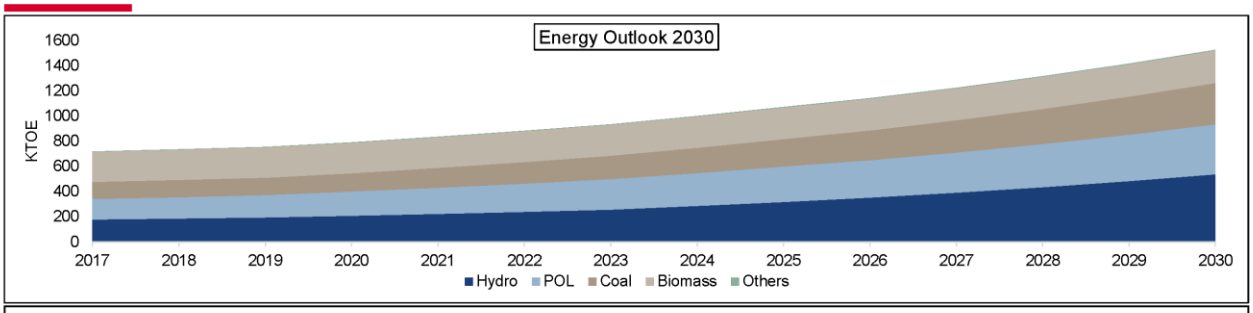
Bhutan: Energy Outlook 2030



- The total primary energy consumption of Bhutan is expected to grow at ~6.3% CAGR over 2018-2030 to 1,550 KTOE, led by energy consumption demand in the industrial and transport sectors.
- Biomass and electricity generated from hydro projects have around 60% share in the total primary energy consumption of Bhutan
- Power generated from **hydro** projects, which comprised more than 99% of the total installed capacity (1,614 MW) of the country in 2017, is expected to increase to 5,272 MW by 2030.
- **Biomass** demand is expected to grow at a rate of less than 1% to reach around 259 KTOE by 2030.
- Overall demand for **POL products**, which are mainly consumed by the transport sector, is expected to increase 2.4 times at a CAGR of around 7% from 2017 until 2030 with growing population of conventional vehicles.
- **Coal**, which is mainly consumed by sectors such as heavy cement and ferro-alloy-based industries, is expected to see an increase in demand from 284 kilo tonne in 2017 to around 744 kilo tonne in 2030, growing at 7.7% CAGR

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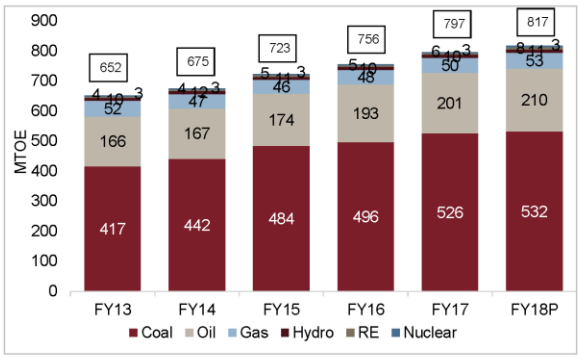
India: Introduction

COUNTRY OVERVIEW

- India, the largest economy among SAARC nations, has seen its economy grow at steady ~7% CAGR over the last five years.
- Rise in domestic consumer demand and surge in domestic and foreign investments have contributed to the country's growth momentum.

ENERGY SECTOR OVERVIEW

- The Indian energy sector has been evolving rapidly. More than 120 GW of power generation capacities have been added over the past five years, with thermal power contributing a majority share at ~73 GW.
- The government has set the renewable energy target at 175 GW by 2022.
- However, overarching dominance of fossil fuels continues to drive the energy basket of the country. Coal, oil and gas are the major contributors of primary energy.
- India's primary energy has grown steadily, from 652 MTOE in fiscal 2013 to 817 MTOE in fiscal 2018 (provisional), which is a CAGR of 4.6%.



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India: Power Demand-Supply Position

POWER DEMAND SUPPLY REVIEW

- Base demand (sum of actual consumption and T&D losses) for power rose at 5.2% CAGR to 1,230 BUs in fiscal 2018, from 953 BUs in fiscal 2013.
- Growth has been the fastest in the domestic segment, at a CAGR of 8% over fiscal 2013 to 2018 owing to strong electrification rates, rise in consumption and urbanisation. Industrial and agricultural consumption have grown at CAGRs of 4% and 6%, respectively.
- Power supply has increased to 1308 BUs from 963 BUs over a period of fiscal 2013 to fiscal 2018 at 5.6% CAGR with coal-based plants contributing to two-thirds of the total (73%).
- The total installed capacity in the country stood at ~342.7 GW as of fiscal 2018 with 56% of the plants being coal fired.
- RE penetration in the country improved from 13% in fiscal 2013 to ~20% in fiscal 2018 due to conducive policies, the government's push

POWER DEMAND SUPPLY OUTLOOK

- Power demand is expected to rise at ~6% CAGR between fiscals 2018 and 2030 led by the pick-up in industrial activity, rising disposable income and infrastructure growth.
- Demand drivers like electric vehicle penetration, expansion/new construction of metro rail projects and intensive electrification under Saubhagya scheme will improve electricity demand going forward
- India is expected to see ~327 GW of net capacity additions (new capacities minus retirement) from fiscals 2019 to 2030 with the majority coming from solar plant installations (~128 GW)
- Wind and hydro will also show strong additions with 73 GW and 34 GW, respectively
- Thermal-based projects will see strong capacity additions (~81 GW up to fiscal 2030). Gas-based plants will show bleak growth (~7.7 GW)

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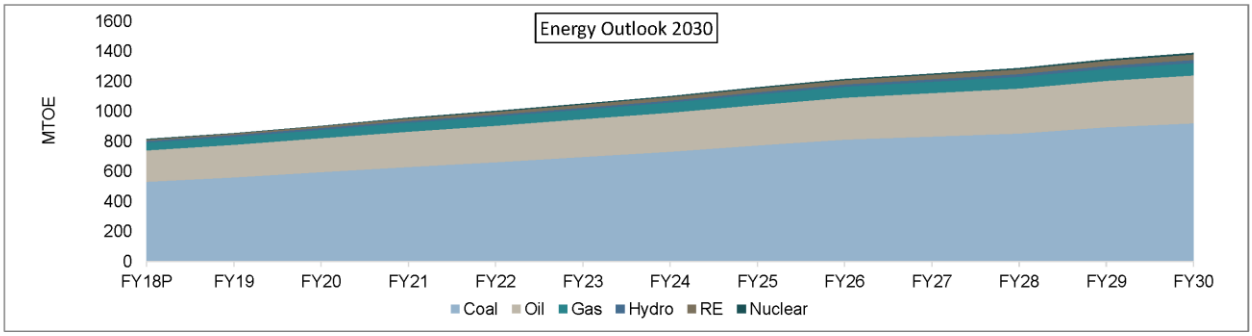
India: Energy Outlook 2030



- The overall energy requirement in India shall rise from 817 MTOE in fiscal 2018 to 1,392 MTOE in fiscal 2030.
- Demand for **coal,** which at present accounts for about 65% of the country's total primary energy needs, will continue to rise manifold; its usage in power is set to rise to ~1,220 million tonne by fiscal 2030.
- **Gas** demand in the country is expected to reach ~217 million metric standard cubic meter per day (mmscmd) by fiscal 2024 at a CAGR of 5% and ~252 mmscmd by fiscal 2030 at a CAGR of 2.5%, driven primarily by fertilizer and city gas distribution (CGD) sectors.
- Additional ~12 GW of **nuclear** plants expected to come up by fiscal 2030, increasing its contribution in the generation mix to 4.5-5.0% from the present 4.3%.
- **Petroleum product** consumption expected to log a subdued CAGR of 4.1% as demand gets crimped on account of rising substitution by CNG, ethanol blending, and greater focus on electric vehicles.

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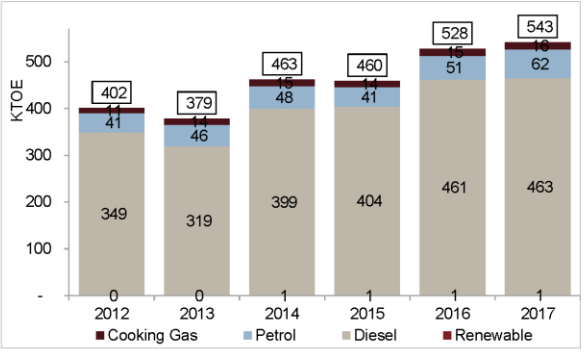
Maldives: Introduction

COUNTRY OVERVIEW

- Maldives is an island nation comprising 1,192 dispersed tropical islands grouped into 26 geographical atolls, spread over an area of 115,300 sq km and occupying 224 km with an estimated population of 352,795 in 2016.
- The real GDP of Maldives witnessed clocked 6% CAGR from 2012 to 2017 to reach MVR 66,000 million ($4,281 million), primarily led by the construction sector growth.

ENERGY SECTOR OVERVIEW

- Maldives' energy requirement, driven by a strong GDP growth of 6% CAGR, has risen from 401 KTOE in 2012 to 542 KTOE in 2017 (excluding aviation gas), or at 6.2% CAGR.
- At present, the energy mix of Maldives comprises oil as the single largest source of energy, which includes consumption of POL products (diesel, petrol and cooking gas), with insignificant contribution from RE
- Among POL products, diesel forms the single largest energy source, accounting for ~85% of energy supply in 2017.
- The power sector is the largest consumer of diesel, with no other power generating sources in the country.



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Maldives: Power Demand-Supply Position

POWER DEMAND SUPPLY REVIEW

- Maldives, unlike other SAARC nations, has the distinction of having achieved provision of 24 hours electricity supply throughout the country by 2008. However, till date, diesel continues to serve as the singular source of power generation.
- Electricity generation and consumption, like the nature of the islands, happens in a dispersed manner. The country capital Malé (Malé, Villingili, and Hulhumale) is the single largest electricity producing and consuming region.
- It is estimated that the power demand for Maldives has grown at 6.8% CAGR, from 1,010 MUs in 2012 to 1,400 MU in 2017.
- The total installed capacity of the inhabited islands of Maldives stood at 223 MW in 2016, including 214 MW of diesel-based capacity and 6.7 MW of renewable energy capacity.

POWER DEMAND SUPPLY OUTLOOK

- it is estimated that power demand will grow at 6.5-7% CAGR to reach 3,171 MUs in 2030 from 1,400 MUs in 2017.
- Power generating capacity from RE plants is expected to reach 140-150 MW by 2030.
- The remaining power demand is expected to be met from diesel-based power generation which is expected to reach 930 MW.
- Electricity demand in the industrial sector is expected to grow at ~9.3% CAGR from 2017 until 2030 while demand from the building sector is expected to grow at ~7.2% CAGR from 2017 till 2030 to ~1,100 GWH.

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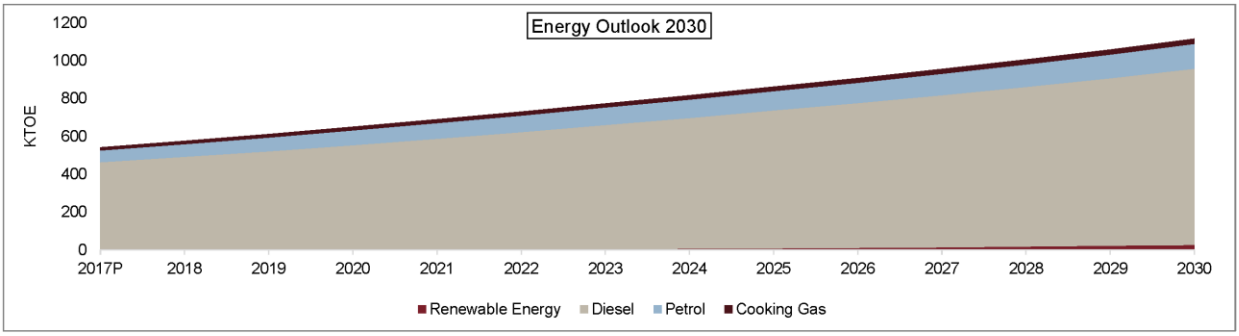
Maldives: Energy Outlook 2030



- The overall energy demand in Maldives is expected to rise at 6% CAGR, from 543 KTOE in 2017 to 1,116 KTOE in 2030.
- **Diesel** is expected to remain the primary fuel for meeting the country's power demand. It is estimated that in addition to 214 MW of centralized installed diesel-based power capacity in inhabited islands, tourist resorts cumulatively have 260 MW of diesel-based captive power capacity.
- Demand for **cooking gas** is expected to rise, with the fuel effectively replacing kerosene as the primary energy source for cooking
- Only 10% of total electricity demand is estimated to be met from **RE** sources by 2030.

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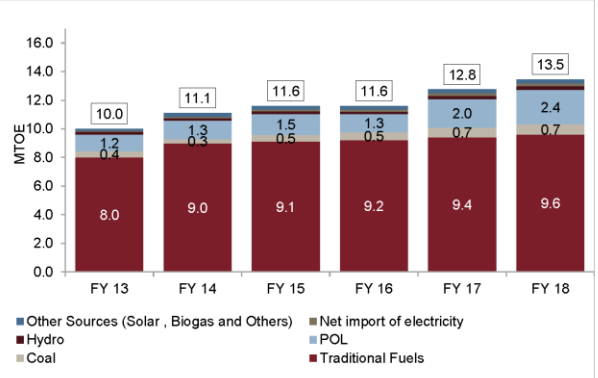
Nepal: Introduction

COUNTRY OVERVIEW

- Landlocked between India and China, Nepal's area measures ~147,181 sq km. Its population has grown at ~1.7% CAGR between fiscals 2013 and 2017. In this period, GDP has grown ~ 4.3% CAGR.
- Nepal's economy saw significant rebound from a growth rate of 0.4% in fiscal 2016 to ~7% in fiscal 2019 (provisional).

ENERGY SECTOR OVERVIEW

- Nepal's per capita energy consumption grew at ~4.5% CAGR between fiscals 2013 and 2017, to ~0.44 TOE.
- The energy supply is dominated by traditional fuels such as fuelwood, animal dung, and agricultural residue.
- Overall primary energy consumption demand grew ~7.7% CAGR between fiscals 2013 and 2015, to ~11.6 MTOE.
- Consumption stagnated in fiscal 2016. This was mainly owing to a decline in POL product imports and consumption, owing to road blockage issues. Subsequently, consumption picked up to grow at ~5.5% in fiscal 2018 on-year.



Nepal: Power Demand-Supply Position

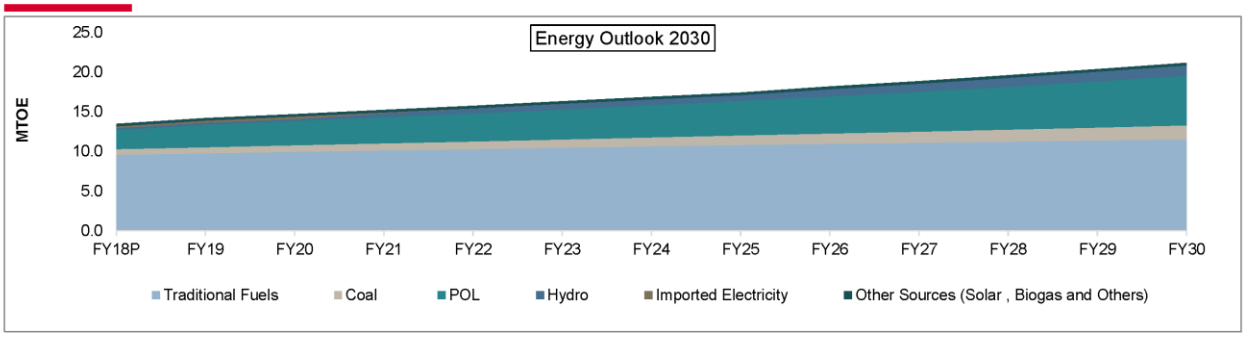
POWER DEMAND SUPPLY REVIEW

- Electricity sales in Nepal have grown ~12% CAGR between fiscals 2013 and 2018 (estimates). About 5,557 MU were sold in fiscal 2018, with residential and industrial categories accounting for ~45% and ~36% share, respectively, in the total power sales.
- Hydro stations are the key source for electricity supply, accounting for ~95% of the total power installed capacity of the country.
- In addition to hydro, solar (0.1 MW) and oil-based thermal power plants (53.4 MW) also contribute to total electricity production in Nepal
- Nepal's total power installed capacity stood at 1074.14 MW. At present, Nepal has an installed capacity of 1,020.6 MW of hydro power stations. IPP hydro power plants contribute to 512.6 MW of hydro capacity

POWER DEMAND SUPPLY OUTLOOK

- Power demand is expected to increase from ~5,557 MUs in fiscal 2018 to ~15,836 MUs in fiscal 2030, driven by rising demand from residential and industrial sectors.
- As against the total demand of ~15,836 MUs in fiscal 2030, total domestic power supply (minus system losses) is estimated at ~15,646 MUs, with total installed power capacity of ~4,457 MW
- About 3,256 MW of new hydro capacity is expected to be commissioned by Nepal by fiscal 2030. Hydro power plants to contribute ~96% share in the total installed capacity
- Present installed hydro capacity is only ~2% of the country's total potential of 43,000 MW. Development of more hydro plants will not only help Nepal meet the increasing power demand from existing consumers, but also help supply to consumers who do not have any access to electricity (which was ~40% of the population in 2017)

Nepal: Energy Outlook 2030



- The country's overall primary energy consumption is expected to reach ~21.2 MTOE by fiscal 2030, an increase of 1.6 times as compared with fiscal 2018.
- **Traditional fuels,** which met around 71% of total primary energy requirement of Nepal in fiscal 2018, are expected to see their share decline to 54% by fiscal 2030 with the share of cleaner fuels rising.
- Power supply, which is dominated by **hydro** power plants, is expected to grow by around 4.1 times to 4,457 MW during the period, mainly driven by the addition of new hydel plants.
- Growth in industrial activities is expected to increase the total **coal** demand by around 2.5 times to 2,993 kilo tonne by fiscal 2030 compared with 1206 kilo tonne in fiscal 2018.
- Consumption of **POL** products is expected to grow at a CAGR of 8.3% between fiscals 2018-2030 to reach ~6 million tonne, mainly driven by strong growth in the transport and industrial sectors led by a GDP growth of 4.5-5.0%.

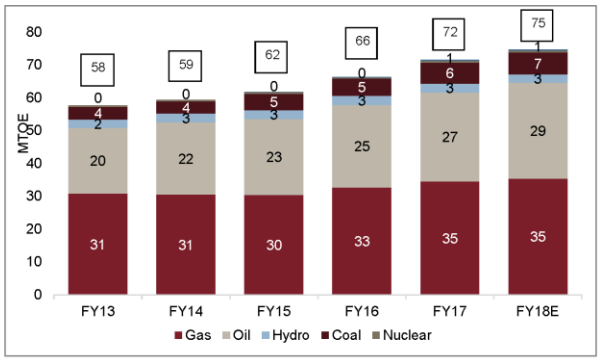
Pakistan: Introduction

COUNTRY OVERVIEW

- Pakistan has witnessed strong growth among South Asian economies, most of it is fuelled by foreign debt.
- Overdependence on fossil fuel imports has led to a weakening of its domestic currency, thereby increasing its current account deficit from 1.1% of GDP in fiscal 2013 to 2.4% of GDP in fiscal 2017).

ENERGY SECTOR OVERVIEW

- Pakistan's primary energy requirement has steadily grown from 58 MTOE in fiscal 2013 to 73 MTOE in fiscal 2018 at 5.2% CAGR.
- Domestic gas, the most significant energy source, is on the decline, making the country increasingly dependent on LNG imports to curb deficits. Pakistan has signed a 15-year agreement with Qatar to import up to 3.75 million tonne of LNG annually.
- The country is also heavily dependent on fossil fuel imports (85% of the nation's crude oil and petroleum products are imported), thereby exposing itself to global price and supply shocks.
- The country's abundant renewable energy sources continue to be unexploited with installed capacity of only ~1400 MW against a potential of >120 GW.



Pakistan: Power Demand-Supply Position

POWER DEMAND SUPPLY REVIEW

- Power demand has grown from 96,496 MUs in fiscal 2013 to 120,392 MUs in fiscal 2018 at a CAGR of 4.52%.
- A majority of power consumers (85%) belonged to the domestic category, and 12.2% to the commercial category as of fiscal 2018.
- The total installed capacity of Pakistan stood at 29,573 MW as of February, 2018 and is expected to reach 32,027 MW by the end of fiscal 2018.
- The country has significantly added fuel oil (FO) and nuclear-based power plants whereas gas-based capacity additions have remained slow. Natural gas and FO are the major fuels presently contributing ~29% each to the total mix.
- Overall annual generated electricity reached ~119,416 MUs in fiscal 2018.

POWER DEMAND SUPPLY OUTLOOK

- Overall gross power demand is expected to grow to 191,546 MUs in fiscal 2030 at a CAGR of 4%.
- Coal-based power plants are expected to contribute the maximum to new capacity additions with as many as 10 plants with a combined capacity of ~8000 MW to come up by fiscal 2030.
- ~4,700 MW of gas-based plants are expected to come up over the next decade.
- RE-based power is expected to increase six times from fiscal 2018 levels while electricity imports are expected to rise to ~1000 MUs annually

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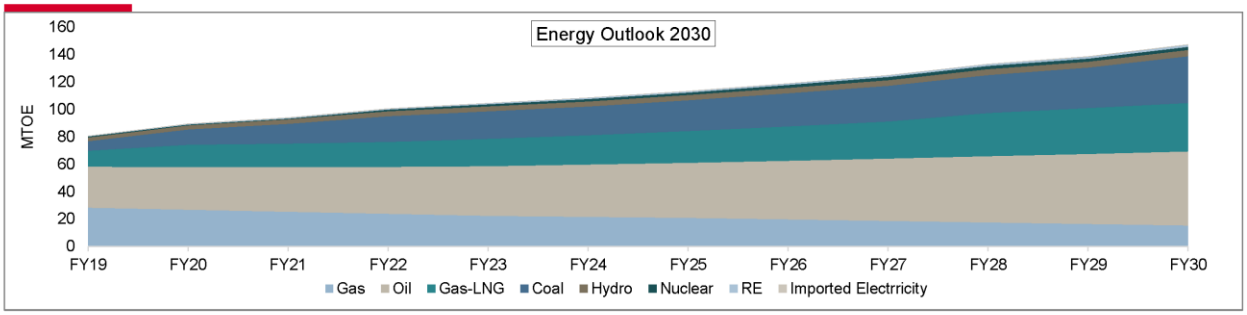
Pakistan: Energy Outlook 2030



- The overall energy requirement in Pakistan shall rise from 73 MTOE in fiscal 2018 to 147 MTOE in fiscal 2030.
- Demand for **coal** has been growing steadily to 11.58 million tonne in fiscal 2018. With more than 10 new coal-fired power plants coming up, which would utilize produce from the Thar block, the usage of the fuel is expected to grow by 4.5 times to 60 million tonne in fiscal 2030.
- **Gas** requirement (constrained) will increase marginally from 5,174 million cubic feet per day (mmcfd) in fiscal 2019 to ~5,900 mmcfd in fiscal 2030 on the back of power production, domestic and industrial use.
- Three new **nuclear** plants are expected to come up in the next decade, increasing power generation from 7,897 million units (MUs) in fiscal 2019 to ~27,850 MUs in fiscal 2030.
- **POL** demand will grow at a healthy 5.2% CAGR driven mainly by the transportation segment and improved economic activity.
- An additional ~8,000 MW of **solar, wind and biomass**-based power projects are expected to come up, improving RE's share in power generation to ~9% in fiscal 2030 from 2% in fiscal 2018.

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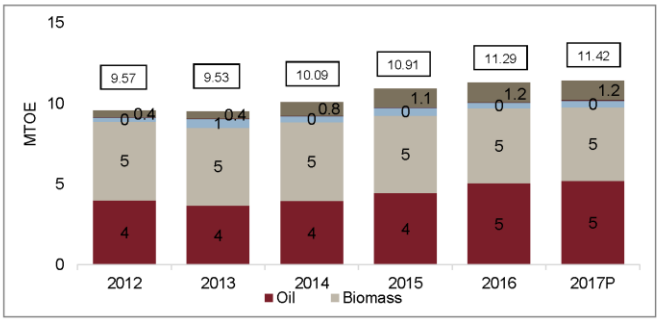
Sri Lanka: Introduction

COUNTRY OVERVIEW

- Sri Lanka is a small island nation, off the southern tip of India. The country's GDP has been growing steadily at a CAGR of 4.1% from 2013 to 2017.
- Like any other developing nation, the country's energy requirement has been rising steadily.

ENERGY SECTOR OVERVIEW

- The country is majorly dependent on imports to meet the primary energy requirement.
- On the demand side, per-capita energy use has grown from 434 TOE in 2013 to 510 TOE in 2017, a CAGR of 4.12%, which is in line with the real GDP growth of 4.15% during the same period.
- Sri Lanka's primary energy requirement has steadily grown from 9.57 MTOE in 2012 to 11.42 MTOE in fiscal 2018 at 3.6% CAGR.



Sri Lanka: Power Demand-Supply Position

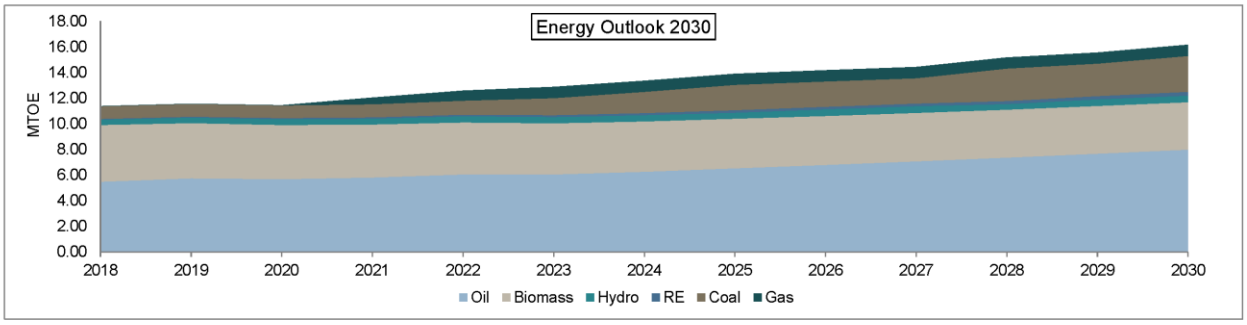
POWER DEMAND SUPPLY REVIEW

- The demand load curve grew from 11,898 MUs in 2012 to 15,258 MUs in 2017 at 5.1% CAGR.
- Sri Lanka's total installed capacity was 4,109 MW (including 50 MW of net-metered power projects) as in 2017.
- Sri Lanka transitioned from being a hydropower nation to a hydrothermal nation. However, the country has been lowering its oil-fired thermal generation from 2013 given rising global oil prices and lack of domestic oil production.
- RE generation is small in the country, with ~500 MUs produced in 2017.
- Overall, power generation rose at 5.1% CAGR from 11898 BUs in 2012 to 15239 BUs in 2017.

POWER DEMAND SUPPLY OUTLOOK

- Demand load is estimated to grow at 28,188 MUs by 2030, at a healthy 4.9% on-year.
- On the supply side, more than 3,500 MW of net installations are expected by 2030. Coal-fired thermal power will likely grow significantly, with an additional 1,000 MW of committed plants.
- Renewable generation will increase to ~12% of the generation mix by 2030 from the current 3%. Gas-based plants of ~1,000 MW will come up, with the country planning to set up import facilities, domestic storage, and regasification unit of 1.4 MTPA LNG.
- Hydro generation will improve significantly up to 2024, beyond which growth would be slow.

Sri Lanka: Energy Outlook 2030



- The overall energy requirement in Sri Lanka would rise from 11.4 MTOE in 2017 to 16.2 MTOE in 2030.
- With the entire country being electrified and no significant outages, power supply is not expected to grow significantly. Most of the electricity is sourced through hydro and gas.
- Owing to more than 1000 MW of coal fired power plants expected to come up, **coal** usage is expected to rise to ~4.91 million tonnes in fiscal 2030 from 2.08 million tonnes in 2017.
- **Natural gas** usage is expected to reach ~37.5 bcf by FY30 on the back of ~1000 MW of new gas based power plants.
- **Hydro power**, the main stay for Sri Lanka, accounted for ~33% of total generated power in 2017, however significant future growth is unlikely.
- The country is a very big consumer of **bioenergy** with ~12 million tons of bio fuel used in 2017. However, due to expected drawdowns in household and commercial use, cumulative biofuel usage will drag to ~9.7 million tonnes by fiscal 2030.

Conclusion

Energy Outlook of SMS

- Energy production in the SAARC region is predominantly sourced from fossil fuels. Coal will dominate energy production in India and Pakistan whereas Bangladesh will continue to rely on natural gas.
- Bhutan, Nepal and Sri Lanka do not produce any significant quantities of fossil fuels and hydro power is the only domestically produced energy source.
- Maldives solely relies on imports to meet its energy needs. Afghanistan (as well as Pakistan) continue to have poor energy access despite being endowed with ample renewable energy potential

Need of concerted efforts to tap RE potential and indigenous oil, gas reserves

- Efforts are being made to shift the energy mix towards cleaner fuels. With the SAARC region being rich in hydropower and renewable energy, there is ample scope for extraction of this untapped potential
- Although, discoveries of gas have been made in India, Sri Lanka and Bangladesh, more cross country engagement is required to assess commercial viability and resource exploration
- Improved sub regional energy ties through technology development, resource sharing, building energy infrastructure can enhance energy trade manifold
- Legal, policy and regulatory risks emanating from cross-border trade may be dealt with by setting up a common framework among the nations
- A regional trade treaty will help promote long-term energy cooperation. A sub regional policy agenda may be developed keeping in view future energy needs and sustainable development goals

Presentation on "Assessment of Conventional Energy Sources in SAARC Member States" by Team CRISIL

SAARC Dissemination Workshop for the Study on "SAARC Energy Outlook 2030"

Presentation 2: Assessment of conventional energy sources in SAARC Member States

Presenter: CRISIL Research

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Energy Profile of SMS- Review: How Conventional energy stack up

Country	Total Primary Energy in 2012/ FY13 (MTOE)	Conventional and non conventional energy mix (2012/ FY13)	Total Primary Energy in 2017/ FY18 (MTOE)	Conventional and non conventional energy mix (2017/ FY18)	Major non conventional energy sources
Afghanistan	5.7		4.3		POL, Coal
Bangladesh	25.7		37.5		Gas, POL
Bhutan	0.6		0.7		POL
India	651.2		816.8		Coal, POL
Maldives	0.4		0.5		POL
Nepal	10.0		13.5		POL
Pakistan	57.7		74.6		Gas, POL
Sri Lanka	9.6		11.4		POL

■ Conventional Energy ■ Non-Conventional Energy

Conventional includes coal, oil, gas, nuclear

- Except Sri Lanka, Nepal and Bhutan, all other SMS are heavily dependant on CE
- Countries with very high CE usage include India (97%), Pakistan (96%), Maldives (100%) and Bangladesh (>99%)

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Energy Profile of SMS: Country-wise, Fuel-wise Review

Country	Total Conventional Energy (FY13/ 2012) (MTOE)	Conventional energy mix (FY13/ 2012)	Total Conventional Energy (FY 18/ 2017) (MTOE)	Conventional energy mix (FY18/ 2017)
Afghanistan	5.3		3.8	
Bangladesh	25.6		37.5	
Bhutan	0.2		0.3	
India	637.4		797.8	
Maldives	0.4		0.5	
Nepal	1.7		3.3	
Pakistan	55.2		71.8	
Sri Lanka	4.4		6.4	

Coal POL Gas Imported Electricity Nuclear

- POL is the most dominant fuel among conventional energy sources in most SMS
- Gas continues to be the most important fuel in Bangladesh and Pakistan due to large reserves
- India, the largest among SMS, is heavily reliant on coal while Bhutan and Afghanistan continue to meet significant PE requirements through imported coal

Energy Profile of SMS – Outlook: Conventional energy usage rises at 4.7% in line with primary energy growth between fiscals 2018 and 2030

Country	Total Primary Energy in FY18/ 2017 (MTOE)	Total Conventional Energy (FY 18/ 2017) (MTOE)	Total Primary Energy in FY30/ 2030 (MTOE)	Total Conventional Energy (FY 30/ 2030) (MTOE)	Growth in primary energy vis-à-vis conventional energy
Afghanistan	4.3	3.8	9.3 6.6%↑	8.3 6.5%↑	
Bangladesh	37.5	37.5	85.3 7.1%↑	85.2 7.1%↑	
Bhutan	0.7	0.3	1.5 6.0%↑	0.7 7.1%↑	
India	816.8	797.8	1,391.3 4.5%↑	1,334.4 4.4%↑	
Maldives	0.5	0.5	1.2 5.7%↑	1.1 5.5%↑	
Nepal	13.5	3.3	21.2 3.8%↑	8.1 7.6%↑	
Pakistan	74.6	71.8	147.3 5.8%↑	141.4 5.8%↑	
Sri Lanka	11.4	6.4	16.2 2.7%↑	11.7 4.7%↑	

- All SMS continue to be strongly dependant on conventional energy sources despite focus of RE and sustainable energy basket
- Expected Rise in PE between fiscals 2018 and 2030 is 4.75% on-year while rise in CE during the same time is 4.65%

Energy Profile of SMS: Country-wise, Fuel wise outlook

Country	Total Conventional Energy (FY24/ 2023) (MTOE)	Conventional energy mix (FY24/ 2023)	Total Conventional Energy (FY 30/ 2030) (MTOE)	Conventional energy mix (FY30/ 2030)
Afghanistan	5.8		8.3	
Bangladesh	60.5		85.2	
Bhutan	0.4		0.7	
India	1,065.9		1,334.4	
Maldives	0.8		1.1	
Nepal	5.2		8.1	
Pakistan	104.0		141.4	
Sri Lanka	8.3		11.7	

Coal POL Gas Imported Electricity Nuclear

- Coal and POL usage rises at the expense of depleting gas reserves and cheaper alternatives
- Most CE is served through imports while countries like Pakistan and Bangladesh is expected to expedite new coal blocs in the country to service incremental demand and displace gas usage

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Coal-based PE: Review and Outlook

Country	Coal Based Primary Energy in 2012/ FY13 (MTOE)	Percentage of primary energy met through coal in 2012/ FY13 (%)	Coal Based Primary Energy in 2017/ FY18 (MTOE)	Percentage of primary energy met through coal in 2017/ FY18 (%)	Coal Based Primary Energy in 2023/ FY24 (MTOE)	Percentage of primary energy met through coal in 2023/ FY24 (%)	Coal Based Primary Energy in 2023/ FY24 (MTOE)	Percentage of primary energy met through coal in 2023/ FY24 (%)
Afghanistan	1	15	1	29	2	27	3	28
Bangladesh	1	5	2	4	6	10	7	8
Bhutan	0.1	15	0.1	18	0	20	0	21
India	417	64	532	65	733	66	922	66
Maldives	0	0	0	0	0	0	0	0
Nepal	0.4	4	1	5	1	7	2	8
Pakistan	4	7	7	9	21	19	34	23
Sri Lanka	0.4	4	1	10	1	10	3	17
Total	**424**	**56**	**543**	**57**	**764**	**58**	**971**	**58**

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Coal-based demand-supply across SMS

Country	Major Usage	Demand Growth*	Supply Position	Consumption Outlook**
Afghanistan	Cement, construction	High	High; No import necessitated	0.9 1.2 1.8 2.7
Bangladesh	Power, industry	High (13%)	Low; ~60% demand to be serviced through imports	1.2 1.6 6.0 6.9
Bhutan	Ferro alloy and cement industries	High (8%)	Low, entire demand to be serviced through imports post 2020	0.10 0.13 0.19 0.33
India	Power, industry	High (5%)	Low; ~12% of non-coking coal and ~79% of coking coal to be serviced through import	417 532 733 922
Maldives	No coal used	Nil	Nil	NA
Nepal	Industry (cement, brick, metal)	High (8%)	Very Low; >99% of coal demand to be serviced through import	0.4 0.7 1.1 1.8
Pakistan	Cement, brick kiln, power	Very high (15%)	High; ~6% of coal demand to be serviced through imports	4 7 21 34
Sri Lanka	Power, cement and steel plants	High (7%)	Nil; all coal demand to be serviced through imports	0.4 1.2 1.3 2.8

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*Growth in demand outlook between FY18 and FY30 given brackets

**Consumption given for the following years: FY13/2012, FY18/2017. FY24/2023, FY30/2030; all figures in MTOE

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Oil-based PE: Review and Outlook

Country	Oil Based Primary Energy in 2012/ FY13 (MTOE)	Percentage of primary energy met through oil in 2012/ FY13 (%)	Oil Based Primary Energy in 2017/ FY18 (MTOE)	Percentage of primary energy met through coal in 2017/ FY18 (%)	Oil Based Primary Energy in 2017/ FY18 (MTOE)	Percentage of primary energy met through coal in 2017/ FY18 (%)	Oil Based Primary Energy in 2017/ FY18 (MTOE)	Percentage of primary energy met through coal in 2017/ FY18 (%)
Afghanistan	4	71	2	49	3	49	5	50
Bangladesh	5	20	6	17	10	16	18	20
Bhutan	0.1	22	0	22	0.2	26	0.4	26
India	166	25	210	26	260	24	319	23
Maldives	0.4	100	0.5	94	1	99	0.8	69
Nepal	1	12	2	18	4	24	4	19
Pakistan	20	35	29	39	38	35	54.	37
Sri Lanka	4	42	5	46	6	47	8	49
Total	**201**	**26**	**256**	**27**	**323**	**25**	**409**	**24**

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Oil-based demand-supply across SMS: Consumption continues to soar despite limited domestic supply

Country	Major Usage	Demand Growth*	Supply Position	Consumption Outlook**
Afghanistan	Transport, domestic cooking	High (7%)	Nil; 100% imported	4.0, 2.1, 3.3, 4.7
Bangladesh	Transport, industrial, agricultural	High (9%)	Low; ~36% POL demand to be imported	5.1, 6.5, 10, 17
Bhutan	Transport, domestic fuel	High (7%)	Nil; 100% imported	0.1, 0.2, 0.2, 0.4
India	Power, industry	Moderate (4%)	Low; ~89% of crude to be imported while the country is surplus in refined POL	166, 210, 260, 319
Maldives	Residential, sea and land transport	High (6%)	Nil; 100% imported	0.4, 0.5, 0.8, 1.1
Nepal	Transport, residential cooking	High (8%)	Nil; 100% imported	1.2, 2.4, 4.1, 6.3
Pakistan	Transport, industry, power	High (5%)	High; ~56% of crude and 51% of POL to be imported	20, 29, 38, 54
Sri Lanka	Transport, industry	Moderate (3%)	Low; ~85% of crude to be imported	4.0, 5.2, 6.1, 8.0

*Growth in demand outlook between FY18 and FY30 given brackets

**Consumption given for the following years: FY13/2012, FY18/2017. FY24/2023, FY30/2030; all figures in MTOE

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Gas-based PE across SMS

Country	Gas Based Primary Energy in 2012/ FY13 (MTOE)	Percentage of primary energy met through gas in 2012/ FY13 (%)	Gas Based Primary Energy in 2017/ FY18 (MTOE)	Percentage of primary energy met through gas in 2017/ FY18 (%)	Oil Based Primary Energy in 2023/ FY24 (MTOE)	Percentage of primary energy met through oil in 2023/ FY24 (%)	Oil Based Primary Energy in 2030/ FY30 (MTOE)	Percentage of primary energy met through coal in 2030/ FY30 (%)
Afghanistan	0.1	3	0.2	4	1	8	0.6	7
Bangladesh	19.3	75	29.0	77	44	72	0.1	0
Bhutan	0.0	0	0.0	0	0	0	0	0
India	52.2	8	52.5	6	67	6	82.8	6
Maldives	0.0	0	0.0	0	0	0	0	0
Nepal	0.0	0	0.0	0	0	0	0	0
Pakistan	30.8	53	35.5	47	43	40	50.7	34
Sri Lanka	0.0	0	0.0	0	1	7	0.9	5
Total	**102.4**	**13**	**117**	**12**	**156**	**12**	**135**	**8**

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Gas-based demand-supply across SMS: Gas usage reduces in SMS owing to constrained demand

Country	Major Usage	Demand Growth*	Supply Position	Consumption Outlook**
Afghanistan	Power, fertilizer	Very high (12%)	High; 100% demand to be met through domestic production	0.1, 0.2, 0.5, 0.6
Bangladesh	Power, fertilizer, industry	High (6%)	Low; ~45% of gas requirements to be imported	19, 29, 44, 58
Bhutan	No gas usage in the country	NA	NA	
India	Fertilizer, power, CGD, refineries	Moderate (4%)	Low; ~44% of demand to be met through imports	52, 53, 67, 83
Maldives	No gas usage in the country	NA	NA	
Nepal	No gas usage in the country	NA	NA	
Pakistan	Power, industry, domestic, commercial	Moderate (3%)	Moderate; ~14% of gas requirements to be imported	31, 35, 43, 51
Sri Lanka	Domestic, industry, power	High (Will grow to 0.9 MTOE in 2030 from 0 presently)	Low; ~90% of gas requirements to be imported	0.0, 0.0, 0.9, 0.9

**Growth in demand outlook between FY18 and FY30 given brackets*
***Consumption given for the following years: FY13/2012, FY18/2017. FY24/2023, FY30/2030; all figures in MTOE*

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Presentation on "Assessment of Renewable Energy in SAARC Member States" by Team CRISIL

SAARC Dissemination Workshop for the Study on "SAARC Energy Outlook 2030"

Presentation 3: Assessment of non conventional energy sources in SAARC Member States

Presenter: CRISIL Research

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Energy Profile of SMS – Review : How non conventional energy stack up

Country	Total Primary Energy in 2012/ FY13 (MTOE)	Conventional and non conventional energy mix (2012/ FY13)	Total Primary Energy in 2017/ FY18 (MTOE)	Conventional and non conventional energy mix (2017/ FY18)	Major non conventional energy sources
Afghanistan	5.7		4.3		Biomass
Bangladesh	25.7		37.5		Hydro
Bhutan	0.6		0.7		Hydro, biomass
India	651.2		816.8		Solar, hydro
Maldives	0.4		0.5		Solar, wind
Nepal	10.0		13.5		Hydro
Pakistan	57.7		74.6		Hydro
Sri Lanka	9.6		11.4		Biomass, hydro

Conventional Energy Non-Conventional Energy Non conventional includes solar, wind, hydro, biomass

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Afghanistan : Non-Conventional Energy (1/2)

		Present (FY18)	Outlook (FY30)
Hydro	• The country has developed more than 5,000 mini- and micro-hydro plants that feed power to mini-grids located in areas that are not yet connected to the national grid, thereby creating an islanding system • Most of the micro- and mini-hydro projects are installed on irrigation canals, where the villagers divert water to the plant for generating electricity at night. This power has been very important to local people and communities who had to rely on kerosene lamps for lighting • Major large hydro projects in the country include Naghlu HPP (100 MW), Mahipar HPP (66 MW), Salma HPP (42 MW), Sarobi HPP (22 MW) and Darunta HPP (11.2 MW).	~200 MW	~ 1,000 MW
Solar	• There is no significant installed solar capacities in the country. Major upcoming solar plants are: 1. Kabul (10 MW) (FY19) 2. Nagarhar (100 MW) (FY20) 3. Kandahar Phase 1 (10 MW) (FY20) 4. Daikundi (10 MW) (FY21) 5. Baghdara (240 MW) (FY22) 6. Saruni-II (180 MW) (FY23) 7. Kandahar Phase 2 (20 MW) (FY25) • Several off-grid solar projects providing power to schools, shops, communities that are currently not grid connected are expected to come up	*<10 MW*	~580 MW

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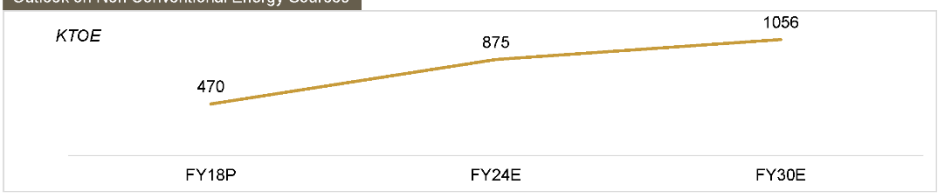
Afghanistan : Non-Conventional Energy (2/2)

		Present (FY18)	Outlook (FY18-FY30)
Wind	• Currently there is no major wind turbine generation in operation in Afghanistan. Only the Pandshir small wind farm which operates ten wind turbines of 10 kW each is presently operational	*<10 MW*	*~100 MW*
Biomass	• Biomass is being used extensively in Afghanistan for heating homes and cooking purposes. With electricity eluding the majority of the country's population, biomass usage in the rural areas is widespread • The primary resources available are crop residue, animal manure, firewood, and municipal waste. According to the Afghanistan Living Conditions Survey (ALCS), 74% of all households and 90% of rural households relied on biomass as their primary fuel for cooking, while 82% of households and 90% of rural households used it as their primary source of heat. • Per capita biomass consumption has reduced marginally from 14.51 KTOE in fiscal 2013 to 13.9 KTOE in fiscal 2018 (provisional). However, dependence on biomass continues to be strong and comprises ~10% of the total primary energy consumption in the country (as of fiscal 2018)	*~392 KTOE*	*~425 KTOE*

Outlook on Non Conventional Energy Sources



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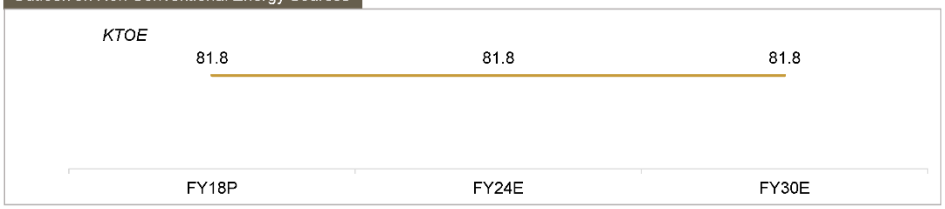
Bangladesh : Non-Conventional Energy (1/2)

		Present (FY18)	Outlook (FY18-FY30)
Hydro	• There is just one hydro power plant in the country, Karnafuli Hydro, with an installed capacity of 230 MW (2x40 MW+3x50 MW). Hydropower generated in fiscal 2018 was 982 MU, a meagre 1.6% of total power production • The governments of Bangladesh, Bhutan and India have signed an MoU for constructing 1,125 MW Dorjilung hydro project with prospects of future exports of power from Bhutan to India and Bangladesh. However, the project has not received much traction and there is uncertainty over commencement of commercial production • Bangladesh has no plans to set up hydropower projects owing to high capital expenditure. With the country already reeling under incessant floods and change in rainfall patterns, it does not intend to build new dams for power projects	~230 MW	~230 MW
Solar	• There is no significant installed solar capacities in the country. The government is not planning any large scale solar projects. Major upcoming solar plants are: 1. Solar Park on BOO basis at Teknaf, Cox's Bazar (200 MW) 2. Solar Park at Dharmapasha, Sunamganj (32 MW) 3. Solar Park at Sutiakhali (50 MW) 4. Solar PV Power Project at Shekhgach (50 MW) 5. Solar PV Power Project at Sundarganj (200 MW) 6. Grid Tied Solar PV Power Project at Bora Durgapur, Mongla (100 MW) • The BPDB has installed solar systems of 270 kWh in its offices with another 500 kWh in the pipeline. Eight cities are installing solar street lights and solar charging stations are being set up in Sylhet and Chittagong	*<10 MW*	~850 MW

Bangladesh : Non-Conventional Energy (2/2)

		Present (FY18)	Outlook (FY18-FY30)
Wind	• Several companies, including Vestas have been conducting Wind Resource Assessments (WRA) at several sites to assess wind velocities and prospective power production possibilities. The mapping is being conducted in coastal zones, onshore and inland areas, such as Inani Beach of Cox's Bazar, Sitakunda and Anwara of Chittagong, Khepupara of Patuakhali, Morelganj of Bagerhat, Chandpur, and Rajshahi • Letters of Intent have been given to two projects (a) 60MW wind turbine power plant in Cox's Bazar (b) 100MW wind-based power plant in Anwara. However, implementation was delayed and progress is slow. Going forward, ~250-300 MW of wind plants is expected to come up by 2030	*<10 MW*	*~300 MW*
Biomass	• There is no significant usage of biomass of biogas in the country. • Biogas can be used for home cooking fuel, especially in rural areas where increasing LPG prices may see some shift from gas to this affordable and clean energy. However, consumers are unlikely to shift in large numbers as gas prices are expected to be subsidised for low income households.	*<10 MW*	*<10 MW*

Outlook on Non Conventional Energy Sources



Bhutan : Non-Conventional Energy (1/2)

		Present (2017)	Outlook (2030)
Hydro	• Hydro power projects constituted ~99% share of Bhutan's total installed power capacity in 2017 • Going forward, with the commissioning of hydro power plants, the share of hydro power in the overall primary energy consumption in Bhutan is expected to reach 36% by 2030 from 26% in 2017 • Bhutan is expected to add 3,658 MW of hydro power generating stations by 2030. Besides new hydro capacities, solar and wind power installed capacities are expected to reach 5 MW each by 2025, as per the target of the Alternative Renewable Policy 2013. Major hydel plants expected to come up include: 1. Mangdechhu Hydro Project (720 MW) 2. Nikachhu Hyropower Project (118 MW) 3. Punatsangchhul I and II Hydropower Project (2,200 MW) 4. Kholongchhu Hydropower Project (600 MW)	1.6 GW	5.3 GW
Solar	• There are no major solar installations in the country. • As per targets set by Alternative Renewable Policy 2013 and based on realistic estimates, solar installed capacities are expected to reach 5 MW by 2030	*<1 MW*	~5 MW
Wind	• There are no major wind installations in the country • As per targets set by Alternative Renewable Policy 2013 and based on realistic estimates, wind installed capacities are expected to reach 5 MW by 2030	*<1 MW*	*~5 MW*

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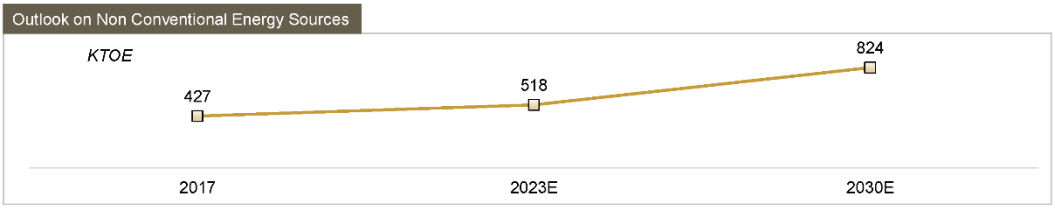
Bhutan : Non-Conventional Energy (2/2)

		Present (2017)	Outlook (2030)
Biomass	• Biomass, mostly in the form of fuel wood, is mainly consumed for heating and cooking purpose by the building sector, which comprises residential, commercial and institutional segments • The industrial sector also consumes a small amount of biomass (1-2%) for heating applications. • The building sector derived ~82% of its energy demand in 2017 from biomass. Overall consumption of biomass rose at ~0.6% CAGR from 2014 till 2017(E). Per capita consumption of biomass (mostly fuel wood) in Bhutan was ~0.8 tons in 2017(E) and contributed ~33% of the total energy consumption of Bhutan in 2017 • Overall consumption of biomass is expected to increase at a marginal ~0.64% CAGR over 2017(E) -2030 to reach 259 KTOE. With the shift towards cleaner fuel, biomass share in overall fuel-wise primary energy consumption of Bhutan is also expected to decline from ~33% in 2017(E) to ~17% by 2030 • Decline in biomass share is also critical from the perspective of maintaining a minimum of 60% of total land cover under forest. However, the low biomass consumption trend is subject to increase in electricity supply from new hydro power projects.	*239 KTOE*	*259 KTOE*

Outlook on Non Conventional Energy Sources



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India : Non-Conventional Energy (1/2)

		Present (FY18)	Outlook (FY30)
Hydro	• As of fiscal 2018, only 45 GW of hydro projects have been set up in the country, contributing ~13% of the power generation mix • Several problems like replacement and rehabilitation (R&R) issues, land acquisition problems, clearance and approval procedures, and capability of developers have been hindering development. Hydropower projects are capital intensive with long payback periods. This makes developers wary of investing • Additional ~34 GW of additional hydro projects are expected to come up by fiscal 2030. The government is striving to stem investor confidence by creating a conducive environment and removing impediments through sound policy formulation.	45 GW	~79 GW
Wind	• As of fiscal 2018, wind power constituted ~10% of the total installed power generation capacity in India and 49% share in renewable energy capacities (69 GW). Wind power is estimated to have accounted for about 4.3% of the country's total power generated in fiscal 2018 • India is expected to see capacity additions of ~70 GW over the next 12 years (fiscals 2018-2030s) driven by rising participation of the central government (SECI) and other relatively stronger off-takers like PTC • Going forward, no significant wind capacity additions are expected due to mountainous terrain and technological challenges	*34 GW*	*107 GW*

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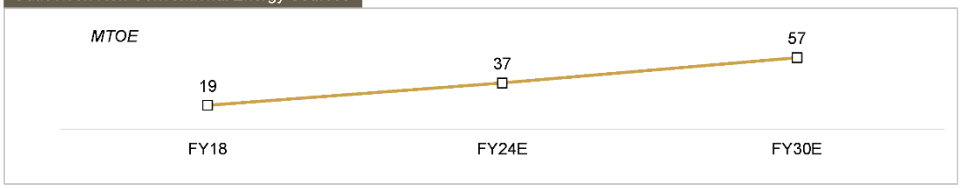
India : Non-Conventional Energy (2/2)

		Present (FY18)	Outlook (FY30)
Solar	• India had an installed solar capacity of ~22 GW as of fiscal 2018. Annual capacity additions rose to 9,363 MW in fiscal 2018 compared with 5,526 MW in fiscal 2017 with Karnataka and Telangana leading the pack • It is expected that India will see robust solar capacity additions of ~60 GW over fiscals 2019-2023 and ~70 GW over fiscal 2024-2030	*21.7 GW*	150.1 GW
Biomass	• As of fiscal 2018, the total installed capacity for biomass ((bagasse cogeneration power) based power was ~8 GW. • The country intends to achieve 40% of power installed capacity from non-fossil fuel (wind power, solar, hydropower, biomass, waste to energy and nuclear power) by 2030 as per its INDC commitments. Going by current capacity addition trends, India is expected to reach its goal by as early as 2020	*8 GW*	*~12 GW*

Outlook on Non Conventional Energy Sources



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Pakistan : Non-Conventional Energy (1/2)

		Present (FY18)	Outlook (FY30)
Hydro	• As of fiscal 2018, Pakistan has an estimated installed capacity of 9,500 MW of large hydro projects, of which over 95% is owned by WAPDA, while the remainder is owned and operated by IPPs. • However, on the generation front, power production has been reducing from 2016, due to the lack of water availability and diversion of water from large reservoir-based power plants towards irrigation • Major hydro projects under operation include: 1. Tarbela (3,478 MW) 2. Ghazi Barotha (1,450 MW) 3. Mangla (1,000 MW) 4. Warsak (243 MW) 5. Chashma (184 MW) • WAPDA and private concessionaires have a healthy lineup of hydel projects, which are under construction or awaiting clearance. More than 12,500 MW of hydro projects are expected to be set up by fiscal 2030. However, the share of large hydro projects in the power generation mix in fiscal 2030 is seen at 28%, in line with fiscal 2018 levels of 26%	*9.5 GW*	*12.8 GW*
Solar	• The sector is taking off following the completion of 400 MW of solar PV projects in 2015-2016. Meanwhile, 24 additional letters of intent issued by AEDB, amounting to a total installed capacity of 556.5 MW, are at an advanced stage of completion • Based on LOA or LOI signed, upcoming installations, the country is expected to add ~2.4 GW between fiscals 2018 and 2030	*~650 MW*	*~3,100 MW*
Biomass	• Four sugar mills had bagasse power generation units with a combined installed capacity of 145.1 MW. In addition, 216.4 MW of capacity are close to completion, with plants expected to start operation by 2018 • Furthermore, owing to extensive agricultural activity and a well-established sugar-refining industry, large amounts of agricultural residues can also be used for energy purpose	*~200 MW*	*2,570 MW*

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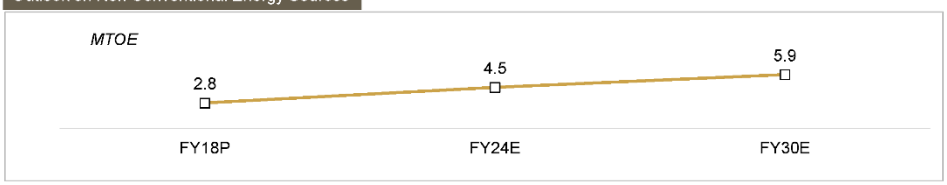
Pakistan : Non-Conventional Energy (2/2)

		Present (FY18)	Outlook (FY30)
Wind	• To date, all of Pakistan's wind power development has been in the Gharo-Keti Bandar corridor in the south of the country which has a theoretical potential of around 50 GW of wind energy. This corridor combines good wind resources with relative proximity to load centres and national grid connectivity • AEDB has issued 35 letters of intent for wind power projects, with a cumulative capacity of 1, 747.5 MW. A further five projects with a cumulative capacity of 297.6 MW had achieved financial closure and were in various stages of construction, aiming to start up on a commercial basis by 2020 • The Sindh provincial government is actively trying to maximise wind power. Through the Sindh Energy Department, it has issued 23 letters of intent for wind power projects with a combined capacity of 1 710 MW • Based on LOA or LOI signed and upcoming installations, the country is expected to add ~2.9 GW between fiscals 2018 and 2030	*800 MW*	*3,650 MW*

Outlook on Non Conventional Energy Sources



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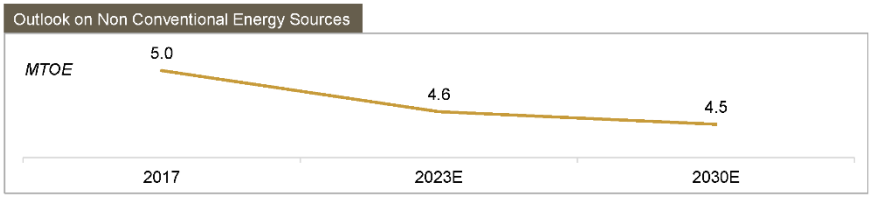
Sri Lanka : Non-Conventional Energy (1/2)

		Present (2017)	Outlook (2030)
Hydro	• Hydropower was the major source of power for Sri Lanka in the past owing to the abundance of water resources in the country. Presently, it produces one-third of the total power demand • Major hydro plants include: 1. Kotmale (201 MW) 2. Victoria (210 MW) 3. Upper Kotmale (150 MW) 4. Samanalawewa (120 MW) 5. Kukule (70 MW) 6. Randenigala (122 MW) • As per estimates, an additional 300-500 MW of major hydro plants are expected to come up by 2030. However, hydro power generation would reduce from 33% of the power mix in 2017 to 21% in 2030 • Major upcoming hydro plants include: 1. Uma Oya (122 MW) 2. Broadlands (35 MW) 3. Moragolla (30 MW) 4. Seethawaka (20 MW)	~1.8 GW	2.3 GW
Solar	• There are no major solar installations in the country. • Based on targets set up by renewable energy targets, LOI/ LOA issued and realistic estimates, solar installed capacities are expected to reach ~750-800 MW by 2030	*~20 MW*	~780 MW
Wind	• There are no major wind installations in the country • Based on targets set up by renewable energy targets, LOI/ LOA issued and realistic estimates, wind installed capacities are expected to reach ~750 MW by 2030	*~130 MW*	*~750 MW*

Sri Lanka : Non-Conventional Energy (2/2)

		Present (2017)	Outlook (2030)
Biofuel	• Sri Lanka consumed ~12 million tonne of biofuel in 2017. The biggest consumers of biofuel are the household and commercial segment followed by the industrial segment • Biomass-based energy production is being promoted in the country in association with the UNDP. Agriculture and industrial waste power plants are being set up in line with LTGEP targets to increase RE generation. • Going forward, industrial biomass usage is expected to rise. The industrialised districts of Colombo, Gampaha and Kalutara are the major consumers of biomass and fuel wood for thermal energy. • With increasing fossil fuel prices, more than 350 industrial biomass energy conversion systems (BECS) have been operationalised. BECS are primarily used to provide industrial services such as steam, hot water, hot thermic oil, and electric power. Most BECS have been using woodlogs and multifuels as feedstock. • Feasibility studies are also underway to set up municipal waste-to-energy plants and wood gasification technology is being developed for thermal energy applications	*4.5 MTOE*	*3.7 MTOE*

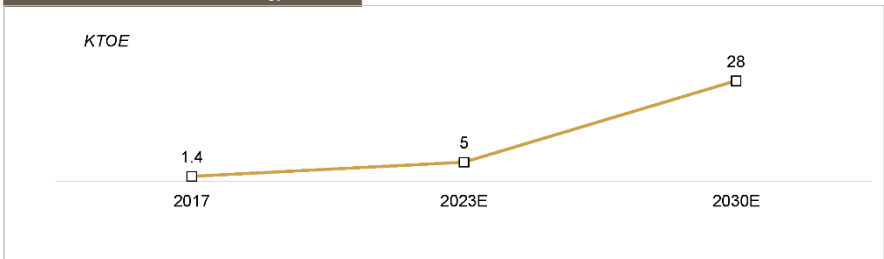
Outlook on Non Conventional Energy Sources



Maldives : Non-Conventional Energy

	Present (2017)	Outlook (2030)
• There is miniscule RE usage in the country. The estimated primary energy generated through RE sources (solar, wind and biomass) is ~1.4 KTOE in 2017 against total primary energy consumption of ~543 KTOE, accounting for ~0.25% • Going forward, some traction is expected in the RE space, especially in the solar segment, taking RE usage to ~28 KTOE in 2030, however, contribution to primary energy will fall to as low as 0.002%	1.4 KTOE	28 KTOE

Outlook on Non Conventional Energy Sources



Nepal : Non-Conventional Energy (1/2)

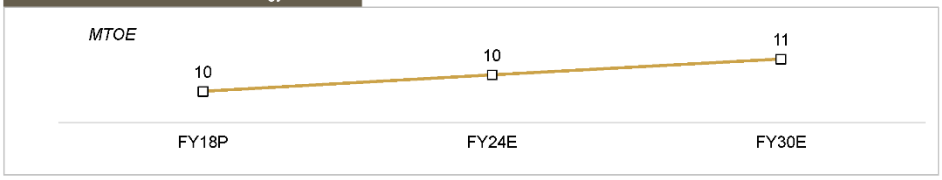
		Present (FY18)	Outlook (FY30)
Hydro	• Power generation from hydropower plants accounted for ~99.9% of total power generation in fiscal 2018. • Hydro power plants are expected to remain a significant contributor to power generation, with ~96% share in the total installed capacity. About 3,256 MW of new hydro capacity is expected to be commissioned by Nepal by fiscal 2030. • Going forward, with the commissioning of the new hydropower capacity, the share of hydro energy in the overall primary energy consumption of the country is expected to grow from ~2% in fiscal 2018 to ~6% by fiscal 2030.	~1,020 MW	~4,300 MW
Solar	• There are no major solar installations in the country. • Based on targets set up by renewable energy targets, LOI/ LOA issued and realistic estimates, solar installed capacities are expected to reach ~125 MW by 2030	*<10 MW*	~125 MW
Wind	• There are no major wind installations in the country • Going forward, no significant wind capacity additions are expected due to mountainous terrain and technological challenges	*<10 MW*	*<10 MW*

Nepal : Non-Conventional Energy (2/2)

	Present (FY18)	Outlook (FY30)
Biomass	*9.6 MTOE*	*11.6 MTOE*

- Traditional fuels, in the form of fuel wood, animal dung and agricultural residue, contributed ~71% of the total primary energy consumption of Nepal in fiscal 2018 (E). Overall, traditional fuel consumption clocked ~3.7% CAGR over fiscals 2013-2018
- Traditional fuels are mostly consumed by the residential sector for heating and cooking purposes. In fiscal 2018 (E), the residential sector accounted for more than 85% of total traditional fuel consumption, the rest by the commercial and industrial sector
- Fuel wood is the largest contributor to the primary energy demand of the commercial sector. At present, fuel wood accounts for ~55% of the overall energy consumption of the commercial sector.
- With increased availability of clean energy in the form of electricity, traditional fuel consumption is expected to witness slow growth of ~1.6% CAGR from fiscal 2018 to 2030. The overall share of traditional fuels in the total primary energy consumption of Nepal is expected to decline, but not significantly so, as this fuel is cheap and easily available, especially in rural Nepal.

Outlook on Non Conventional Energy Sources



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Energy Profile of SMS – Outlook: No significant growth in non-conventional energy

Country	Total Primary Energy in FY18/ 2017 (MTOE)	Total Non-Conventional Energy (FY 18/ 2017) (MTOE)	Total Primary Energy in FY30/ 2030 (MTOE)	Total Non-Conventional Energy (FY 30/ 2030) (MTOE)	Growth in primary energy vis-à-vis non-conventional energy
Afghanistan	4.3	0.5	9.3 6.6%↑	1.1 7.0%↑	
Bangladesh	37.5	0.1	85.3 7.1%↑	0.1 0.0%	
Bhutan	0.7	0.4	1.5 6.0%↑	0.8 5.2%↑	
India	816.8	19.0	1,391.3 4.5%↑	56.9 9.6%↑	
Maldives	0.5	0.0	1.2 5.7%↑	0.03 25.8%↑	
Nepal	13.5	10.1	21.2 3.8%↑	13.2 2.2%↑	
Pakistan	74.6	2.8	147.3 5.8%↑	5.9 6.5%↑	
Sri Lanka	11.4	4.9	16.2 2.7%↑	4.5 -0.8%↓	

- Growth in Total PE: 4.75% on-year; growth in total NCE: 6.72% on-year
- Scenario in 2030: PE-> 1,673 MTOE, NCE: 83 MTOE

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Presentation on "Moving towards a sustainable energy future: Opportunities and Challenges" by Team CRISIL

SAARC Dissemination Workshop for the Study on "SAARC Energy Outlook 2030"

Presentation 4: Moving towards a sustainable energy future: Opportunities and Challenges

Presenter: CRISIL Research

Research

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Afghanistan: RE Targets vs. adoption

Country	Federal RE Targets	Expected Additions by 2030
Afghanistan	350-450 MW by 2032	Biomass: 425 KTOE, Wind: 100 MW, Solar: ~580 MW

	Potential	Exploitation
Hydro	Afghanistan has significant potential to generate hydropower. It has river catchment area of 677,900 sq km and recoverable hydro potential of more than 23,000 MW. The vast majority of this potential (~20,000 MW) is located in the northeast on the Amu Darya, Panj and Kokcha rivers	LOW
Solar	The country has abundant solar energy. Blessed with arid terrain and with more than 300 days per year counted as sunny, there is potential to generate ~222 GW of solar power	LOW
Wind	More than 67,000 MW can be produced through wind power in the country (estimated by MEW study), with at least 12,000 MW exploitable in the Herat province, 10,000 MW in Nimruz and 1,800 MW in Farah.	LOW
Biomass	As per Afghanistan Renewable Energy Policy, the country has a biomass potential of 4000 MW with 91 MW of municipal solid waste, 3090 MW agriculture waste and 840 MW animal waste. An estimated 350 small biogas digesters have been installed in different parts of the country	LOW

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Afghanistan: Regulatory targets and investment climate

- The National Renewable Energy Policy (ANREP) aims to mainstream renewable energy in the national energy sector planning so deploying them in different capacities and through different projects in various parts of the Country. The Policy sets a target for deploying 350-450 MW of REN capacity by 2032. The Policy will be implemented in two terms- TERM 1 (2015- 2020) will create and support an atmosphere and activities for the development and growth of REN sector particularly in the PPP mode, and TERM 2 (2021-2032) will deploy REN in full commercialization mode
- The existing official Plan (Afghanistan Power Sector Master Plan [APSMP]) for power system expansion puts a heavy focus on RE, in the form of large-scale hydro, as a source of supply

Most of the investments in the country are through donors and institutions (the likes of ADB, USAID). Some of the projects undertaken are as listed below:

- National Solidarity Program (NSP): Installation of small PV systems ranging from 20–40 W. According to the "Afghan Rural Renewable Energy Strategy" ([MIN_006]), about 103 kW of capacity in total has been installed up to now. Hybrid systems of a larger scale are under development.
- Government of New Zealand – Development of a 1 MW solar system to support an installed diesel generator in Bamyan province
- World Bank – Afghanistan Rural Solar Electrification of the provinces Bamyan and Daikundi
- The Afghan government's rural development ministry in collaboration with the United Nations Development Programme (UNDP) and USAID has been working towards development of such micro solar power plants and mini hydel plants

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Afghanistan: Barriers to RE Adoption

1 Costly hydro power	The country has an installed hydro with cumulative capacities of only ~280 MW. However, hydropower is seasonal and capacity factors of HPPs are below 40%. Factoring in operation and maintenance costs, power generation from hydro projects is costlier than imported power for Afghanistan
2 Seasonality in hydel power supply	With hydro projects not having have extensive storage, they deliver most of their output during April-October, leaving the country with a capacity shortfall during the winter months, which are also the months for peak power demand. Therefore, development of HPP would need to be backed up by adequate thermal power development for base load power generation and/or commitments from neighbouring countries for sufficient imported power during times of intermittency emanating from hydro generation.
3 Lack of water sharing agreement	All of the country's river basins are transnational and usage of water and building of dams may give rise to inter-regional water sharing disputes. Barring Iran, Afghanistan has no water-sharing agreement with any country. This has hindered development of large-scale hydropower in the country
4 Weak Distribution systems	Distribution network in the country is weak and susceptible to voltage and load fluctuations. In many cases, inter-regional transmission systems are not present. They require upgradation to accommodate intermittent RE power sources. Several RE rich regions like Nimruz do not not have any connections either with the Afghanistan network and therefore require substantial capital investments in transmission lines and substations
5 Lack of private participation	Political instability, lack of strong government has hindered private investments in the country. The private sector has been yearning for a more facilitating environment to boost investments. Partnerships with the international communities have helped spark investment, however, they are dependant on foreign funds and donors which hinder fast tracked development

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Pakistan: RE Targets vs. adoption

Country	Federal RE Targets	Expected RE Capacities by 2030
Pakistan	~18 GW of renewable capacity (except large hydro) by 2030	Hydro: 12.8 GW, Solar: 3.1 GW, Wind: 3.6 GW, Biomass: 2.6 GW

	Potential	Exploitation
Hydro	As per WAPDA, Pakistan is estimated to have a cumulative hydropower potential of 60,000 MW. The Indus River Basin contains ~75% of the entire hydropower potential of the country	LOW
Solar	Pakistan has some of the highest values of solar irradiance in the world (5.3 kWh/m²/day), with eight to nine hours of sunshine per day, ideal climatic conditions for solar power generation. Areas of high solar radiation include the Thar desert, south and southwestern parts of the country. The country has an overall 1,600 GW solar power potential	LOW
Wind	The theoretical potential for wind power in Pakistan estimated is about 340 GW, but this estimate does not consider technical and economic constraints. The Gharo-Keti Bandar wind corridor in southern Pakistan has a theoretical potential of over 50 GW	LOW
Biomass	The technical biomass feedstock potential is ~ 25,255 thousand tonnes/ year. An World Bank study indicates that around 26 000 tonnes of municipal waste is produced across the country every day (World Bank, 2016). Converting this waste into energy could generate up to 360 MW of power	LOW

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Pakistan: Regulatory targets and investment climate

- As per NEPRA State of the Industry Report 2017, the country's targets for non conventional energy sources by 2030 are (a) Hydro: 20.6 GW (b) 2.5 GW (c) Wind: 1.6 GW. Apart from that, no federal renewable targets have been set
- Recently, as part of the Renewable Energy Policy 2019, the government in Pakistan plans to increase the share of renewable energy (wind, solar, small hydro and biomass) in total power generation to 30% by 2030. This translates to ~18 GW of RE target by 2030. In addition, there is a target of 30% large scale hydropower (more than 50 MW). The new policy, whose guiding principles have already been approved by The Cabinet Committee on Energy (CCoE) and is being reviewed by different stakeholders before formal implementation

The country has been inviting multilateral funding and expertise to set up renewable energy plants in the country. A few notable examples include:

- Introduction of Clean Energy by Solar Electricity Generation System is a special grant aid project by the Japan International Cooperation Agency (JICA) under the Coolio Earth Partnership. This project includes the installation of two 178 kW photovoltaic (PV) systems at the premises of the Planning Commission and Pakistan Engineering Council
- In southeast Pakistan, Sindh Province has initiated its' Sindh Solar Energy program (SSEP) that will see utility-scale, distributed and residential solar installed, including up to 400 MW of capacity in solar parks. The World Bank has committed US$100m to the program

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Pakistan: Barriers to RE Adoption

1 Constraints on grid and transmission infrastructure	Renewable energy growth in the country has been concentrated in a few geographical locations. Such large clusters need anticipatory grid planning and extensive infrastructure improvement, requiring dedicated 132 kV and 220 kV substations. However, NTDC's limited financial resources have been creating a serious challenge to meeting the sector's requirements. Due mainly to the limitations of public funding and the private sector's absence from this sector, the transmission infrastructure in Pakistan remains weak.
2 Technical challenges and lack of experience	Government bodies and private entities do not have experience in setting up large scale RE projects. This poses project implementation challenges
3 Lack of government oversight	Guidelines have been framed to improve investments in the RE space by devising effective and efficient auctioning framework, setting targets. However, policy gaps remain and targets are non binding. A supporting ecosystem can help address barriers

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Maldives: RE Targets vs. adoption

Country	Federal RE Targets	Expected RE Capacities by 2030
Maldives	No targets set	28 KTOE

	Potential	Exploitation
Hydro	There is no major hydro potential in the country	NA
Solar	The country has a solar potential of ~43.5 GW with the majority concentrated in the Greater Male region	LOW
Wind	Considering only onshore wind capabilities, the country has an estimated wind potential of ~100 MW. While Greater Male has wind potential of 20 MW, islands in the Malé Atoll 5-12 km away from the islands of Greater Malé and have a cumulative wind potential of 80 MW	LOW
Biomass	As per the SREP Report, 2-5 MW of biomass potential exists in Maldives owing to limited land mass and the low fertility of its coral soils	LOW

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Maldives: Regulatory targets and investment climate

- State Electric Company Limited (STELCO), the country's main utility, aims of meeting 30% of daytime peak demand on each island
- The Renewable Energy Framework (REM) plan also proposes a shift to wind, batteries and biomass to complement solar power, while retaining existing diesel generators for reserve power. However, no specific targets have been given

- Although there has been multilateral funding towards improving power sector and energy security in the island nation, investments towards RE development has been small
- The Asian Development Bank (ADB) has been a significant contributor to the power sector of the Maldives, extending four loans totalling over $30 million and seven technical assistance projects totalling $1.7 million
- The World Bank has provided Maldives with support in developing its energy sector regulatory framework while ADB has provided support on capacity building on grid codes and tariff mechanisms

Maldives: Barriers to RE Adoption

1 Lack of adequate landmass	Due to limited land availability, large scale RE plants are difficult to be set up. Despite having high biomass potential, constrained land usage hinders adoption. for biomass based power generation to take shape in Maldives, large quantities of biomass may be required to be imported, possibly from other countries in South Asia. it will be a challenging task for Maldives to import biomass and ensure long term biomass fuel contracting to mitigate the price volatility Land availability limits the deployment potential for established low-cost renewable energy technologies like PV and onshore wind
2 Technical challenges	Islands beyond Greater Male have large solar and wind potential. However, setting up PV or wind installations in those areas would require undersea electrical cables. This can be technologically challenging and financially prohibitive
3 Lack of regulatory policies	Although the government of Maldives recognises the importance of RE benefits, regulatory frameworks and policies are not completely clear. There is a lack of policy targets for different RE technologies while tariff structures are missing. As a result initial pilot projects for RE projects in the Maldives have met with mixed success

Nepal: RE Targets vs. adoption

Country	Federal RE Targets	Expected RE Capacities by 2030
Nepal	No overall RE targets set, 10,000 MW of hydro target by 2020	Hydro: 4.3 GW, Solar: 125 MW, Wind: <10 MW, Biomass: 11.6 MTOE

	Potential	Exploitation
Hydro	As per UNDP assessment, the total technical potential of hydropower is 45 GW from which 42 GW is economically realisable. At a capacity factor of 60 percent, those dams would generate 221,451 GWH.	MEDIUM
Solar	As per UNDP assessment, the total technical potential of solar power is 2.1 GW. At a capacity factor of 17 percent, these solar facilities can generate 3,127 GWH.	LOW
Biomass	Owing to high deforestation rates, and Over-exploitation of wood resources, the Biomass Energy Strategy (BEST) intends to bring down biomass usage and develop sustainable methods of biomass usage	HIGH

Nepal: Barriers to RE Adoption

1 Reports of unfriendly investment climate	International investment is key for renewable energy development at large scale. However, in some cases, international investors complained of non-cooperation. A Korean company has been struggling to get started and a few Norwegian companies have left the country due to unfriendly investment environment.
2 Lack of basic power access	As much as 30% of the country's population still do not have access to electricity. It is due to lack of transmission infrastructure owing to high mountainous terrain. This necessitates the requirement mini and micro grids, solar housing systems to improve access in far flung areas. In such a scenario, large-scale grid-tied RE technology is not suitable and conducive
3 Deep-rooted hydro-dominant electricity policy	Although the Alternative Energy Promotion Centre intends to make all RE based energy (solar, wind, biomass) mainstream, necessary subsidies and government support is not channelized adequately. Nepal continues to expedite additional hydro projects that already has an established market.

Presentation on "Energy Demand Forecast in Nepal" by Prof. Dr. Amrit Man Nakarmi

SUSTAINABLE POWER DEVELOPMENT FOR MEETING NEPAL'S ENERGY DEMAND

SAARC Dissemination Workshop
"SAARC Energy Outlook 2030"
27 November 2019

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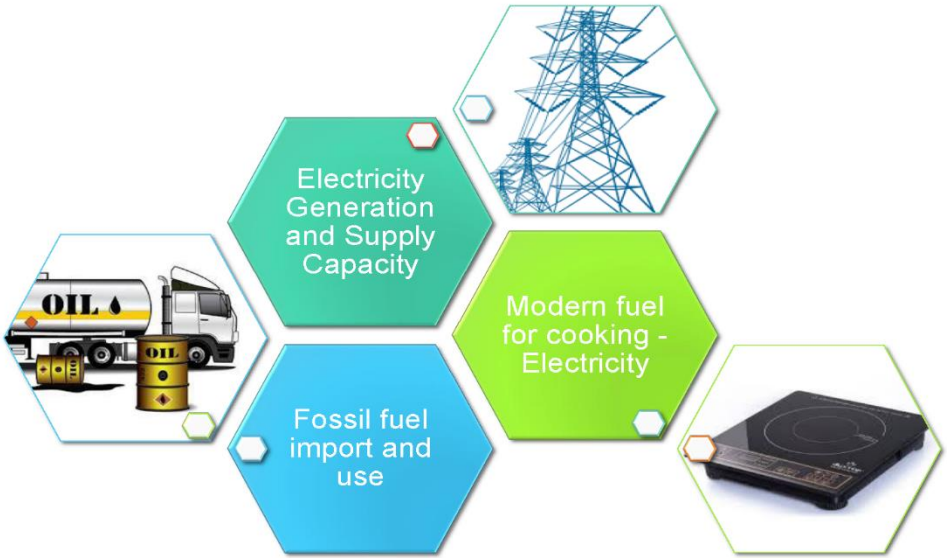
&
Member, Energy & Environment Committee, FNCCI
Member, Advisory Committee, Energy Development Council

2

Main Energy Issues/Challenges



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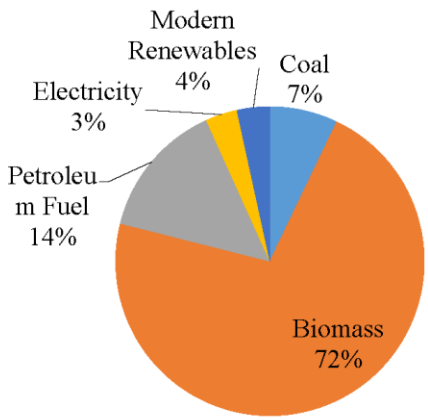
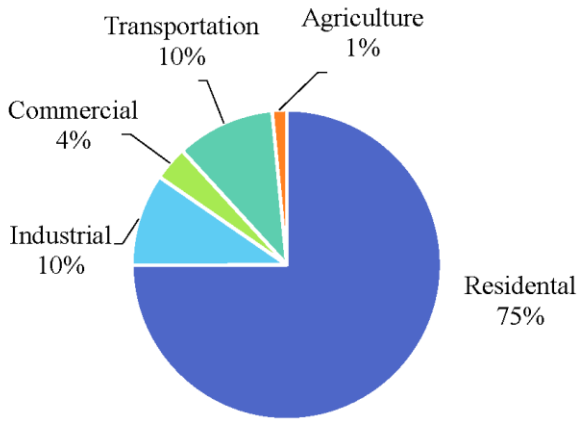
Energy Consumption in 2017





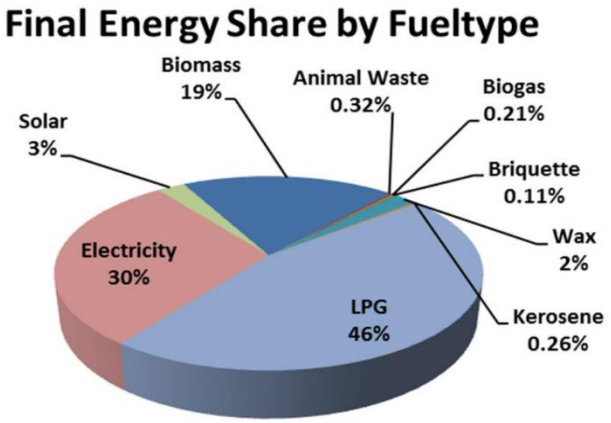
544 PJ

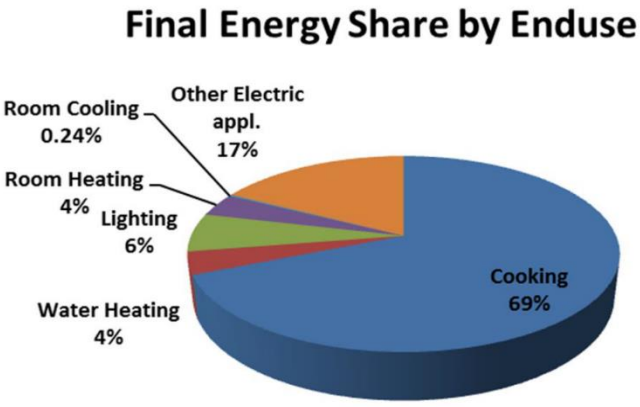
I PJ = 23,890 toe

(MOF, 2017; WECS, 2010)

4

Primary data results in Kathmandu Households in 2014



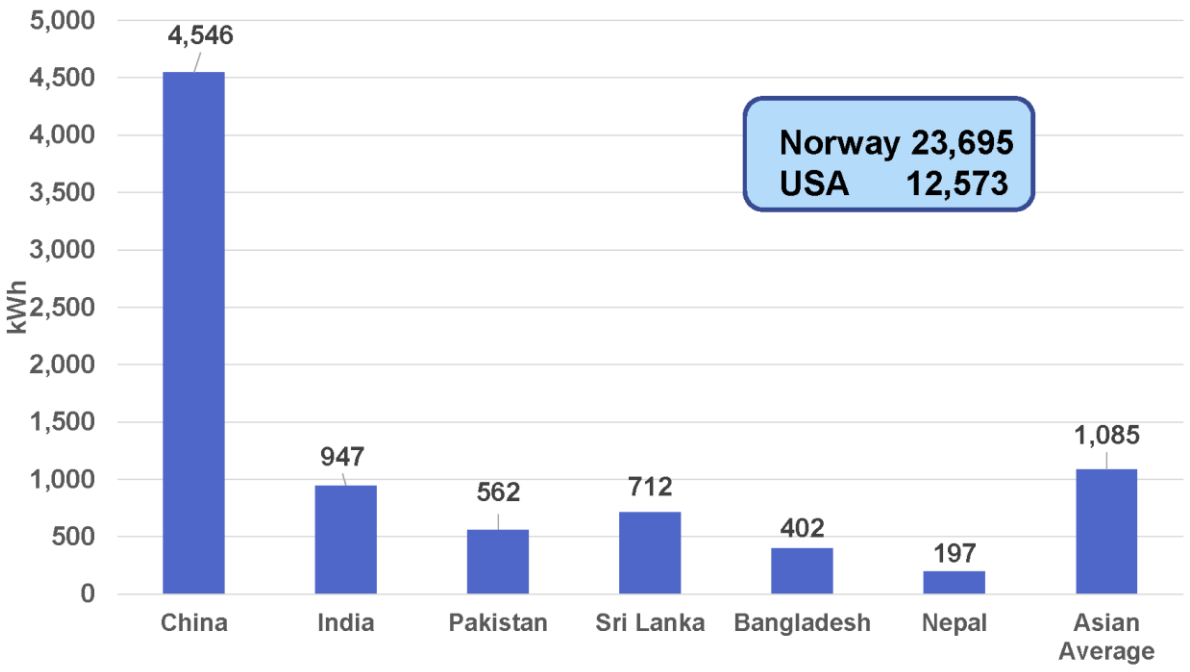


7,400 TJ

(Nakarmi and Rajbhandari, 2015)

5

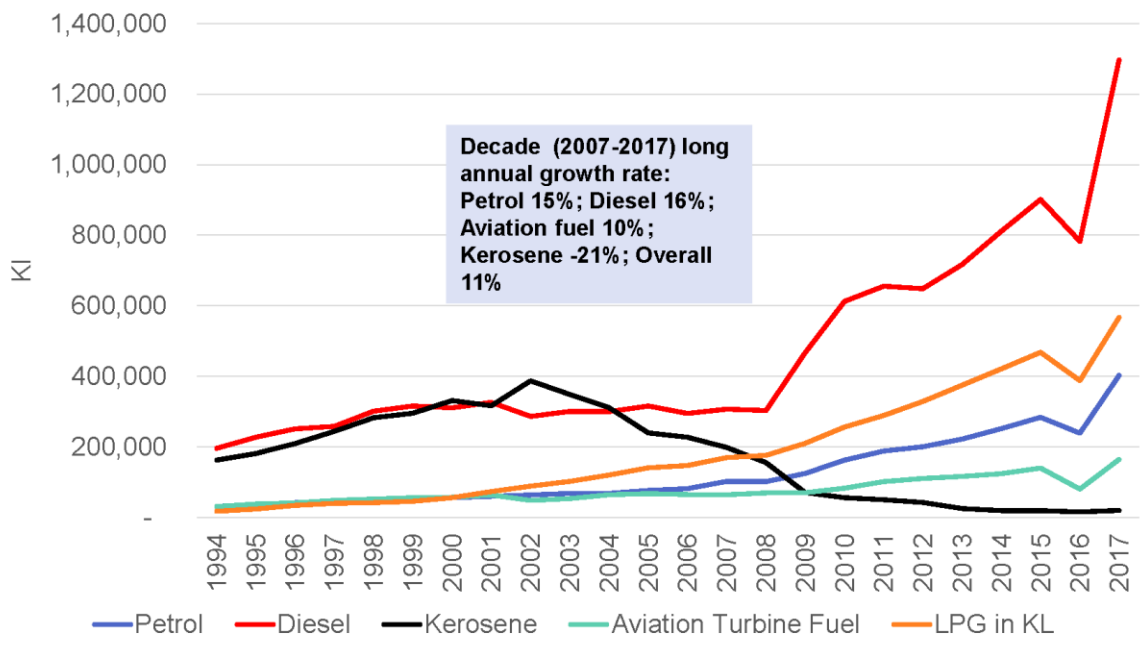
Per capita electricity consumption in 2017



Key World Energy Statistics, IEA, 2019

6

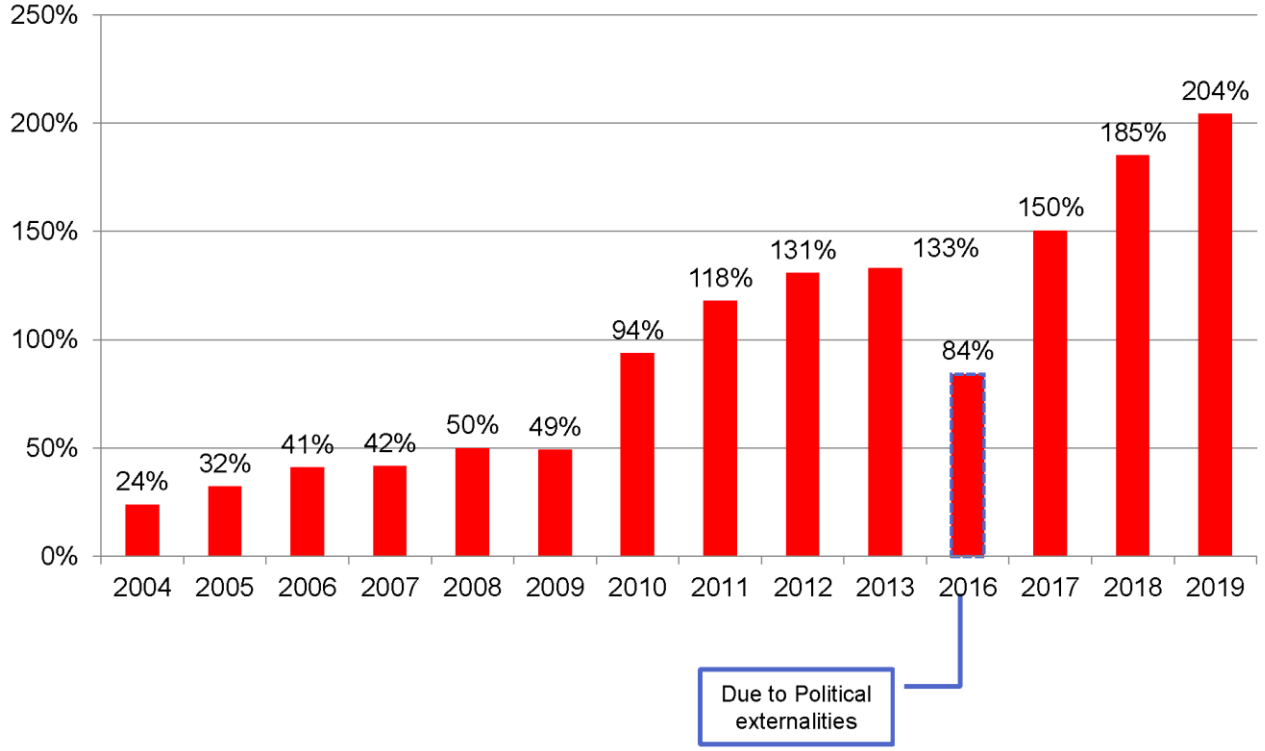
Sales of Petroleum Products (kL)



NOC, 2017

7

Historical trend of Petro Imports vs. Goods Exports



(Source: MOF, 2019;NOC, 2019)

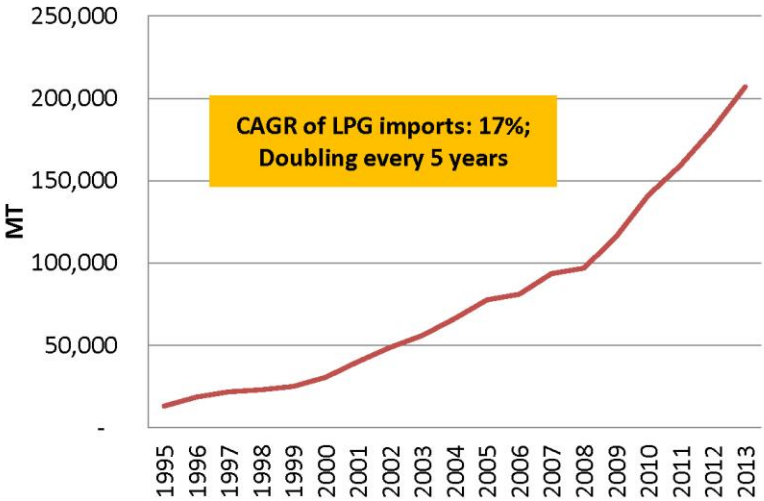
8

Petroleum products: Growth Rate

Growth rate	%
2007 - 2017	11
2015 -2017	16
2017 - 2018	21

Growth rate 40% in monetary terms to NPR 151 Billions

Penetration of LPG in remote rural areas as well.



9

REGIONAL SCENARIO

Panoramic view of West Rongbuk Glacier and Mount Everest,
- in 1921 (top) by Major E.O. Wheeler and
- in 2009 (bottom) by David Breashears.

(Photo courtesy of the Royal Geographical Society)

http://e360.yale.edu/images/features/breashears-mongbuk-compare-350.jpg

10

Air Pollution in Kathmandu

- Dense concentrations of aerosols transported from places like India and Nepal
  - Warms the Himalayas as much as greenhouse gases

(Rose, 2012)

- Reduced albedo (2 to 10%) and increased surface radiative forcing (0 to 28 W/m^2) in HKH
  - Enhance melt of snow and ice

(Gertler et al., 2016)

- Air pollution in South Asia is likely to worsen without actions firmly grounded in science and yet based on local specifics.

https://i.guim.co.uk/img/static/sys-images/Guardian/Pix/pictures/2014/3/21/1395396185663/9afde41a-e773-405d-9524-fc1c1b472629-1024x768.jpeg

11

Air Pollution

Country data on	2013 (World Bank, 2016)	2015* (LEAP - IBC result)
$PM_{2.5}$ concentration ($\mu g/m^3$)	46.09	47.33
Total deaths from air pollution	22,038	26,035

In 2013, 5.5 million premature deaths worldwide, or 1 in every 10 total deaths, were attributable to air pollution.

*: Calculations based on study (ICIMOD, 2017)

12

WHY HYDRO POWER & OTHER RENEWABLE ENERGY??

Energy security

Energy Price stability

….and Environmental sustainability

13

Energy Trilemma Index in 2018

- Index by World Energy Council
- Ranks countries on their ability to provide sustainable energy through 3 dimensions (DDC):
  - Energy security,
  - Energy equity (accessibility and affordability),
  - Environmental sustainability

	Energy security	Energy Equity	Environmental sustainability	Overall Rank
Rank	125	104	84	118 (out of 125)
Hydro power/ RE in Nepal	National indigenous resources	More reliable and cheaper than petroleum products	Clean energy	More sustainable& secure future

=2018

14

Fuel economics in urban/rural areas (cost of cooking/month for a household of 5 members) ***with electricity tariff increased by 20% since Aug 2016***

Year	Kerosene stoves	LPG stoves	Electric hotplates
2000	270	430	680
2003	340	535	790
2014	1,760	1,082	960
2019	1,240	1,453**	1,114

(Banerjee, M. et al., 2016; Narasimha Murthy & Antonette D'Ssa, 2004)

For induction heater NPR 990

**: Household has 2 cylinders in use and it includes capital cost of them (10/11/2019, NOC)

15

Fuel economics study in Mandan Deupur, Kavre (cost of cooking/month for a household) ***in 2019 conducted by Leaders Nepal for Clean Cooking Initiative (CCI), Washington DC and author's calculation***

Particular	Cooking on LPG	Cooking on Fuelwood	Cooking on Electric Induction cooktop
Monthly cost of stove	90	13	81
Fuel qty/month kg, unit	7	60	56
Fuel Costs/kg, unit	95	10	5.70
Monthly cost of cooking Rs	755**	613	400

**: Household has 2 cylinders in use and it includes capital cost of them (Does not include under recovery of NOC: 10/11/2019, NOC)

16

- Cooking
  - accounts for more than 60% of consumption of primary energy supply in the country.
  - LPG sales growth rate (totally imported) increasing annually at 16% in 2019.

- LPG import cost in 2018-19 — 33 Billion NR
  - Household usage 50% — 16.5 Billion NR

- Electric cook stoves, especially induction cooktops are *50% more energy efficient than LPG gas stoves*, and have also become economically efficient (nearly 50%) in the past few years

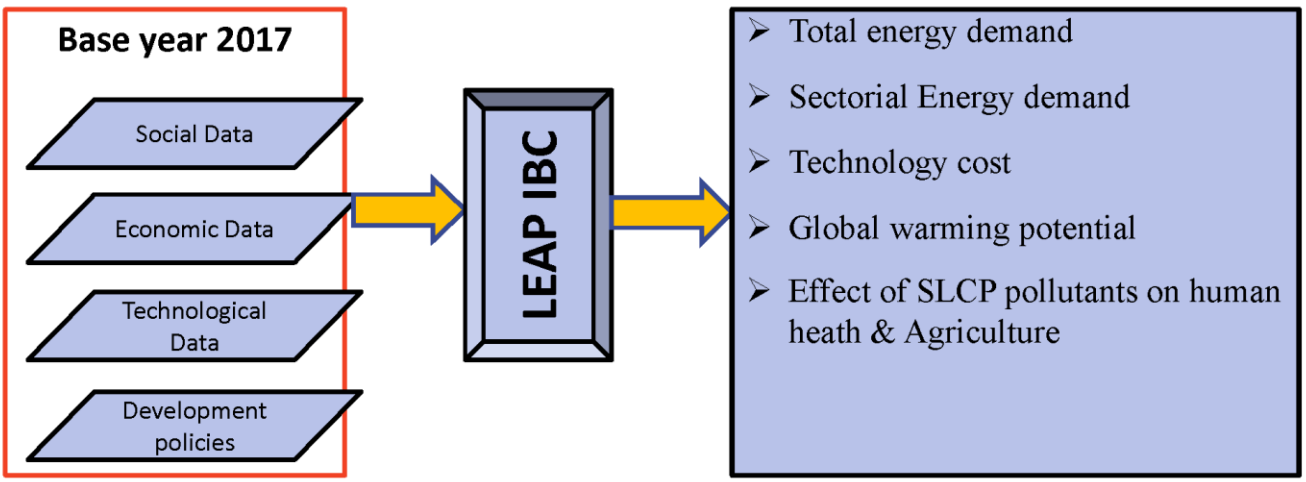
17

WHICH PATHWAY TO TAKE FOR FUTURE SUSTAINABLE ENERGY DEVELOPMENT AND ENERGY SECURITY ?

Pathway that provides

- Security of Supply
- Cost effectiveness
- Environmental sustainability

Scenario Analysis Framework



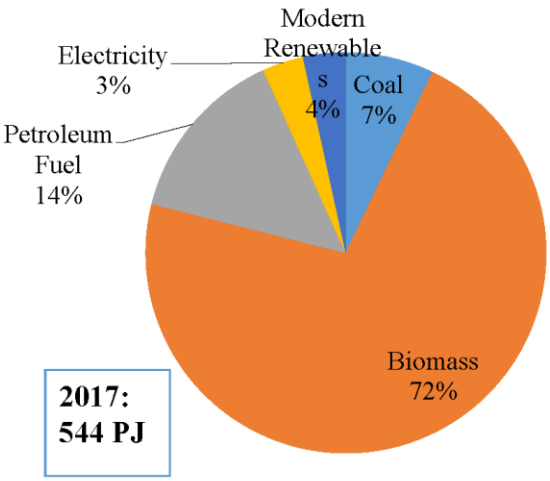
19

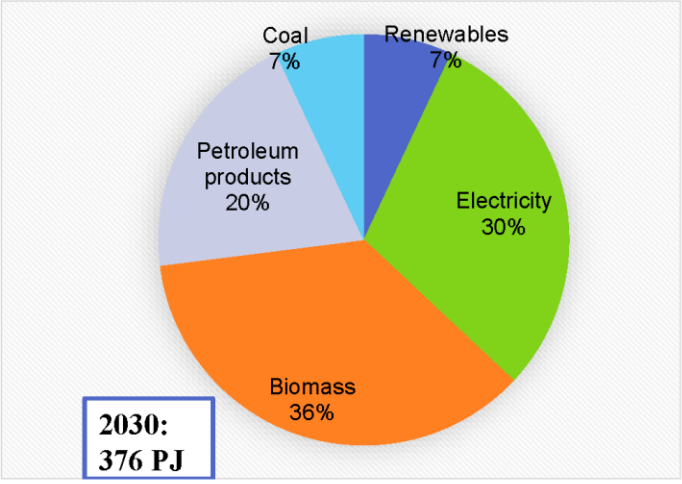
Policy Intervention in Energy Sector

Based on Low Carbon Economic Development Strategy and INDC of Nepal, SE4ALL, SDGs and World Energy Outlook, IEA, 2017 in the Long-Range Energy Alternatives Planning System (LEAP) modeling framework (ICIMOD, 2017)

20

Fuel Portfolio in SED scenario





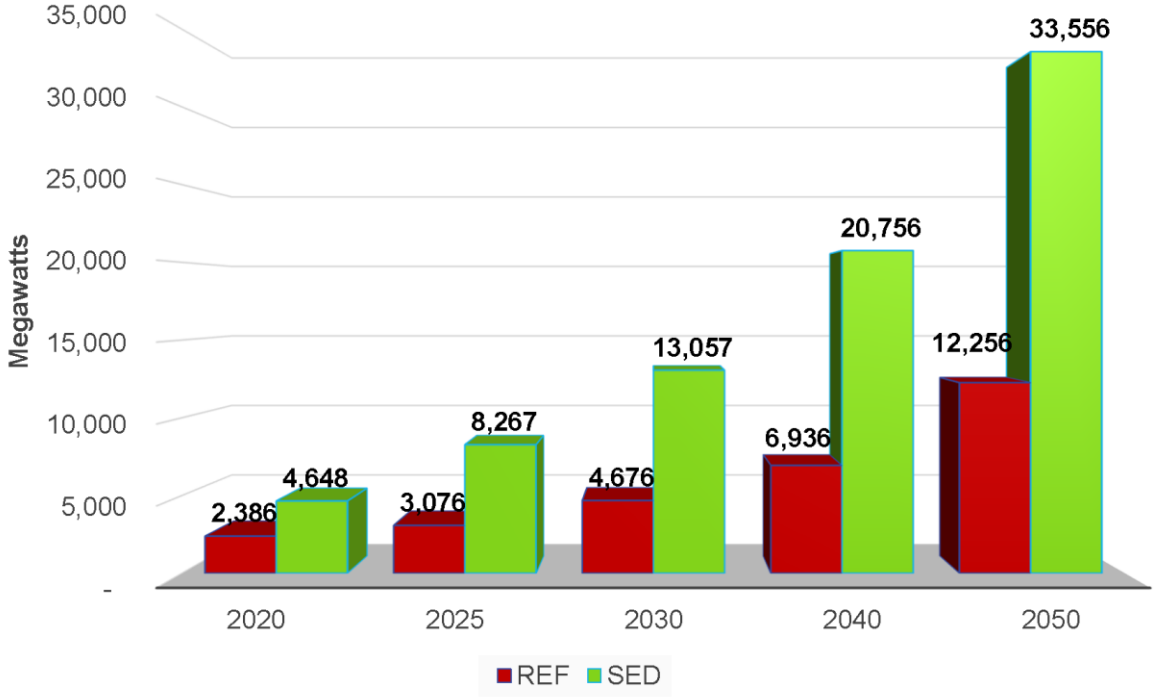
-Share of electricity increased from 3% in 2017 to 30% by 2030.

-SE4ALL Goals target:

- Access to cleaner form of energy
- Efficiency improvement
- Increased share of renewable energy

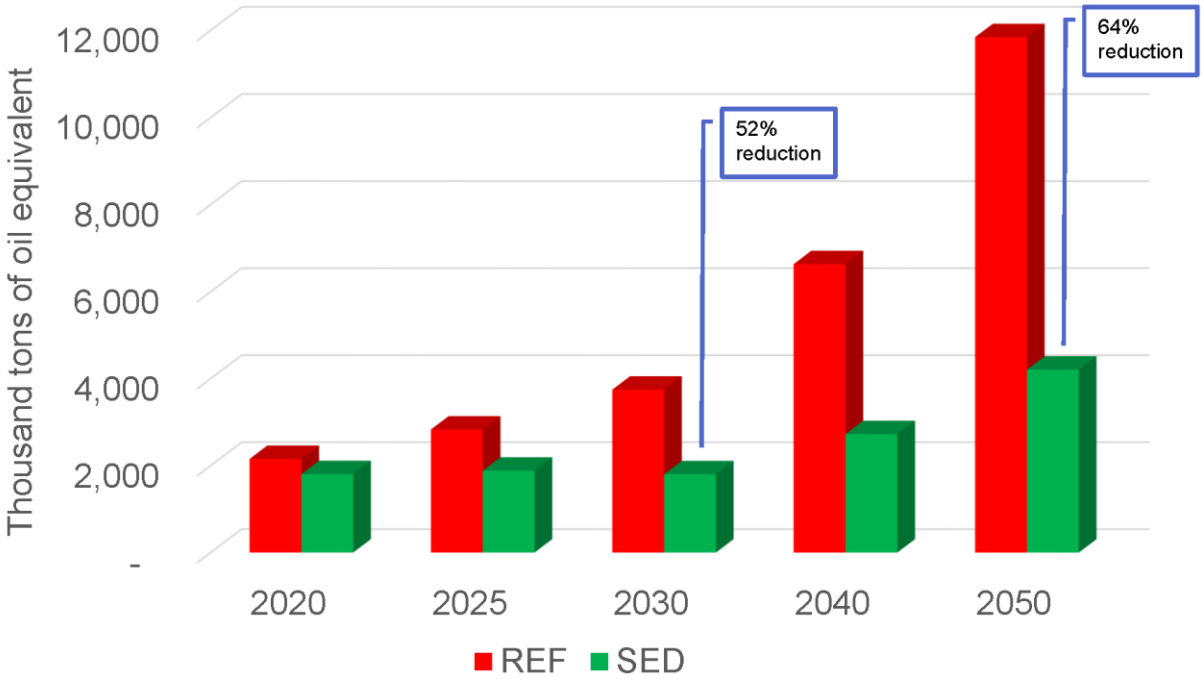
21

Power plant requirements



22

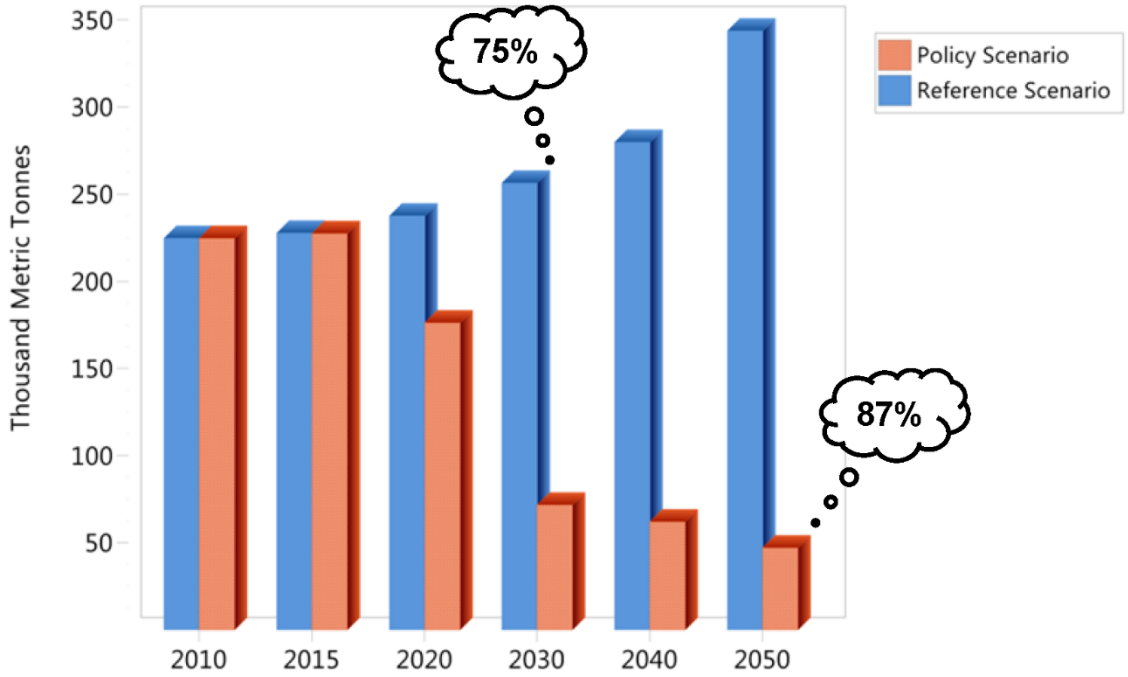
Demand for petroleum products



23

$PM_{2.5}$

Reference and policy scenario

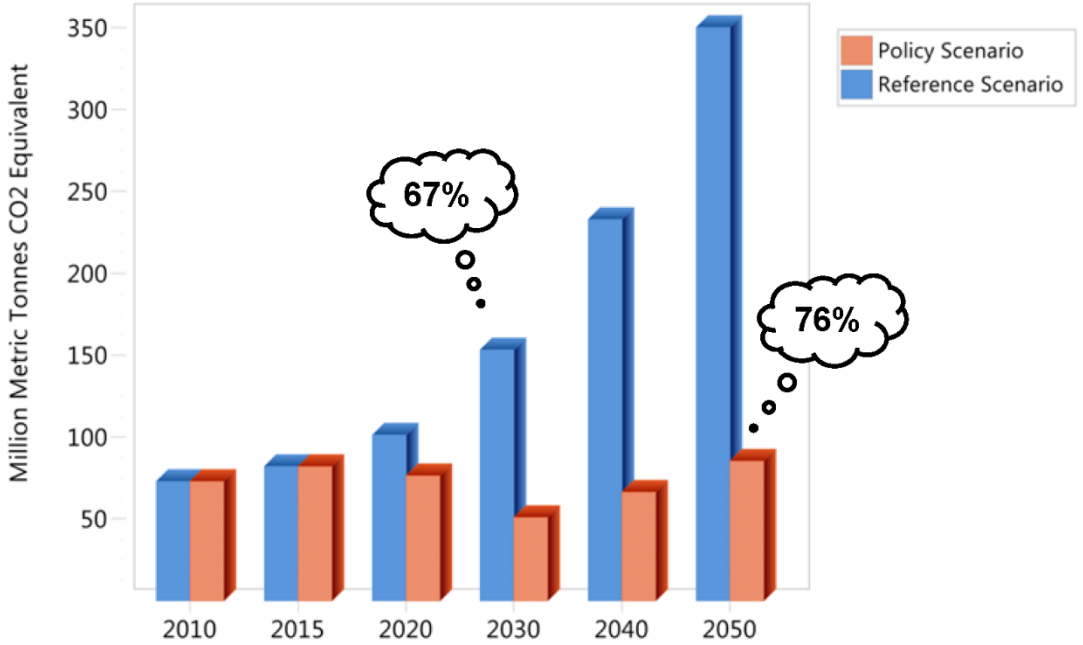


(ICIMOD, 2017)

24

GHG emissions (20 years GWP)

Reference and policy scenario



(ICIMOD, 2017)

25

Current efforts by Nepal Government

- For the past couple of years, things are moving in the positive direction in Nepal especially in the power sub-sector.
- Emphasis will be given to the development and expansion of hydroelectricity and all types of renewable energy to provide clean energy to all Nepali households.
- Projects will be implemented to match ***2018-2028 declared as Energy Decade***.

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Which Pathway is Nepal heading on?

- Ministry of Energy, Water Resources and Irrigation (MOEWRI) 2018 white paper focuses on supply side and electrification of residential sector with campaign of
  - "***One house, One energy house***" and
  - "***One house, one electric cook stove***".
- These campaigns need concrete steps for implementation. ***Electrification is a systems solution, so both demand side must be considered along with supply solutions***
- Paris Accord 2015 discourages use of fossil fuels and rapid promotion of renewable sources for meeting energy demand
- Are we moving towards green or brown ***economy?***

27

- GoN should take proactive actions
  - NEA gets around 50% of its sales revenue from domestic consumers
    - but almost 70% of them cannot cook on electricity, because they have low ampere connection (5 A) (induction cooktops need higher than 1.5 kW power and at least 15 A connection)
  - Upgrading the connection is technically feasible and can also substantially increase NEA's revenue generation

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Some Suggestions for coping up with the challenges

For substituting fossil fuels by clean energy from hydro and non-hydro renewables

- First, marketing activities to attract consumers to induction cooktops by NEA or private DisCos, if formed under electricity regulatory commission
- Second, NEA or the private DisCos have to upgrade the distribution and transmission network
- Third, It must start digitization and optimization in its network using smart meters, net metering, smart distribution and transmission systems.
- Residential rooftop solar PV will be cheaper than electricity even from hydropower by 2025 as per IRENA.
- Hence, possibility of strong grid-load defection and prosumers coming into the electricity markets and initiation of consumer to consumer payment through blockchain technology

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Some Suggestions (contd.)

- Fourth, NEA, once digitization activity is completed, can have time of the day tariff systems for even domestic consumers and services sector
- Fifth, NEA or Private power traders can consider supply of power in the regional markets once it has met the internal demand with reliable and resilient supply.
- Make the integrated energy regulatory commission that encompasses, power, oil, and renewable energy for integrated approach

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Thank you !!!

Presentation on "Cross Border Energy Trade for SAARC Member States" by Team CRISIL

SAARC Dissemination Workshop for the Study on "SAARC Energy Outlook 2030"

Presentation 6: Potential of Cross Border Energy Trade for SMS

Presenter: CRISIL Research

Research

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SAARC Energy Sector Overview: Overarching dominance of a single fuel in the energy mix of SMS has led to skewed energy profile

- Primary energy (PE) consumption pattern (by fuel mix) varies widely from one country to the other.
- India, the largest consumer of primary energy, is heavily dependent on coal (~65% of PE as on FY18). Increasing federal push and private participation towards RE adoption has been reaping benefits, however, share of RE in the final PE pie is still a meagre 1%.
- India's eastern neighbor, Bangladesh, is highly reliant on gas with more than 70% of PE consumption being met through it. High domestic gas reserves coupled with cheap fuel costs and widespread pipeline infrastructure has led to high usage of gas across all segments (industry, domestic, commercial, power plants).
- Pakistan also highly relies on gas (~48% of PE as on FY18), although growth in usage has tempered due to domestic supply constraints and rising reliance on imported LNG.
- Bhutan and Nepal are predominantly hydro based energy generators.
- Limited exploitation of renewable energy resources, increasing energy deficits and rising imports dependence have paved the way for higher cross border energy trade with SAARC and non-SAARC nations

Research

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SAARC Present Power Sector Overview: Bhutan and India net exporters of electricity, Afghanistan and Nepal face deep deficits

Countries	Electricity [GWH]		Surplus/ Deficit Position	Deficit/ Surplus %
	Gross Demand	Domestic Supply		
Afghanistan	4,981	1,076	Deficit	-78%
Bangladesh	65,124	58,300	Deficit	-10%
Bhutan	2,094	7,629	Surplus	264%
India*	1,205,266	1,202,099	Deficit	-0.3%
Maldives	1,405	1,405	Self-Sufficient	0%
Nepal	5,071	2,645	Deficit	-48%
Pakistan	120,392	118,916	Deficit	0%
Sri Lanka	15,763	15,763	Self-Sufficient	0%

**Excluding exports to Bangladesh and Bhutan, although India has a power deficit, it is a net exporter of electricity*

- SAARC region is in a net deficit position of power supply with ~14700 GWH (0.85%) of domestic power shortage (as of FY18/CY17)
- Afghanistan and Nepal have very poor domestic power supplies, Sri Lanka and Maldives are self-sufficient

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SAARC Power Sector Profile

Countries	Power Sector Profile
Afghanistan	• 70% of power imported through interconnections with Central Asia • Proposed interconnection with Pakistan
Bangladesh	• Small power system with majority being gas based • Declining gas reserves puts pressure to look towards coal, oil and LNG • Limited RE potential
Bhutan	• Very small power system with a surplus of >200% • High hydro potential • Net exporter of power to India
India	• Largest power consumer in the region • Heavily dependent on coal • Interconnections with Bhutan, Bangladesh and Nepal • Huge coal reserves and high RE potential
Maldives	• Very small power system with high dependence on diesel • Limited scope of interconnection as the nation is isolated
Nepal	• Small power system with underutilized hydro • Importer from India
Pakistan	• Gas and oil dependent power generation • High power deficits • Proposed interconnection with Central Asia
Sri Lanka	• Self-sufficient in power production • Under development of hydro potential • High scope of interconnection with India

Research

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SAARC POL Overview: All nations except India in deficit position for POL

Countries	POL ('000 tonnes)		Surplus/ Deficit Position	Deficit/ Surplus %
	Gross Demand	Domestic Supply		
Afghanistan*	2,019	0	Deficit	-100%
Bangladesh*	6,384	1,166	Deficit	-82%
Bhutan	158	0	Deficit	-100%
India	204,922	252,839	Surplus	23%
Maldives	561	0	Deficit	-100%
Nepal	2307	0	Deficit	-100%
Pakistan	29037	10,741	Deficit	-63%
Sri Lanka	5168	1867	Deficit	-64%

**Excluding LPG*
All data as of FY18/CY17

SAARC Trade with SAARC Member States (SMS)

Prevalent cross border SAARC electricity trade

Electricity trade presently happens between Bhutan-India (1450 MW), India-Bangladesh (600 MW) and India-Nepal (300 MW)

BHUTAN-INDIA

- Under inter-governmental agreement between the two countries, India has developed hydropower plants of cumulative capacity 1416 MW (Tala- 1020 MW, Chukka- 336 MW, Kurichi- 60 MW)
- Punatsangchhu-1 (1200 MW, expected commissioning by 2022) and Punatsangchhu-II (1020 MW) are being developed by India with 30% grant and 70% interest. As per the terms and conditions of the project, all excess power generated will be exported to India

INDIA-BANGLADESH

- Cross Border Electricity Trade (CBET) has increased between India and Bangladesh with the commissioning of 500 MW of capacity through 400 KV back-to-back HVDC link with West Bengal.
- Subsequently, 100 MW of power transfer from Tripura in India to Comilla in Bangladesh was commissioned from Feb, 2016. An additional 500 MW capacity on the existing interconnection is slated to be completed in FY19

INDIA-NEPAL

- Power exchange between Nepal and India begun in 1971 from the Indian side exporting 5 MW of power to its neighbor
- Power exports to Nepal has gone up from 790 GWH in FY13 to 2175 GWH in FY17 led by the commissioning of a 400 kV transmission line in 2016 from Dhalkebar in Nepal to Muzzafarnagar in India
- The present capacity of 80 MW is proposed to be enhanced to 1000 MW

Estimated Power Trade Volumes within SMS in FY18/CY2017

Country Pair	Power Traded (in GWH)
Bhutan -India	5306
India-Bhutan	84
India-Nepal	2175
India- Bangladesh	4625
TOTAL >>	**12190**

SAARC POL Trade: India-Bhutan and India-Sri Lanka constitute major quantum of SMS POL Trade

- **Bhutan** presently imports 100% of its POL requirement from India. Bhutan doesn't have any POL based midstream infrastructure in terms of refineries and pipelines. POL products are directly imported from India and are distributed through road tankers. Small and medium sized tankers with a carrying capacity of 9-12 Kiloliters are utilized due to mountainous terrain and narrow roads. These tankers are used by distributors for the transportation of fuel from their regional depots, where the imported product is stored, to the retail outlets across the country
- In case of **Nepal**, 100% of POL products are also directly imported from India and are distributed through road tankers
- India currently exports some diesel to **Bangladesh** via rail route with a total distance of 510km
- **Sri Lanka** imports ~45%-50% of its diesel requirement from India
- All other countries import their POL requirements from regions beyond SAARC

Estimated POL Trade Volumes within SMS in FY18/CY17

Country Pair	POL Traded (in '000 tons)
India-Bhutan	160
India-Nepal	2307
India-Bangladesh*	453
India-Sri Lanka*	1056

**Diesel only*

SAARC Power Outlook: India, Bhutan, Nepal, Sri Lanka to be power surplus by 2030, SMS net power deficit to narrow to 0.4% of total demand

Countries	FY24/ CY23		Deficit/Surplus	FY30/ CY30		Deficit/Surplus
	Demand (GWH)	Domestic Supply (GWH)		Demand (GWH)	Domestic Supply (GWH)	
Afghanistan	7,428	5,466	-26%	11,028	7,473	-32%
Bangladesh	91,093	79,825	-12%	123,941	101,212	-18%
Bhutan	3,000	22,173	639%	6,257	25,049	300%
India*	1,769,609	1,776,224	0%	2,449,070	2,444,781	0%
Maldives	2046	2046	0%	3172	3172	0%
Nepal	8,489	8,234	-3%	14,656	14,716	0%
Pakistan	151,583	150,301	-1%	191,828	190,781	-1%
Sri Lanka	20,996	22,303	6%	28,188	29,366	4%

AVENUES TO IMPROVE POWER TRADE WITHIN SMS

1. Through increased inter connectivity of power systems by setting up inter-country transmission lines, continuity in supply can be ensured, thereby reducing deficits and ensuring supply in case of contingencies
2. In cases where loads of one country are in close proximity with generation facilities of a neighboring country as compared to its own generation facilities, power evacuation will be easier and more economical for inter-country trade. Such arrangements may be further expedited in case of India-Bangladesh, India-Nepal, India-Nepal, India-Pakistan, Nepal-Bhutan
3. The interconnected nations within the region may set up a cross-border power exchange, whereby generators/ consumers of one country may seamlessly sell/ buy power in short-term or long term basis

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SAARC POL Outlook: Only India expected to reach surplus position, others to lag

The trade balance for Diesel in 2030, the single largest POL product based on consumption in SAARC Member States, comes out to be negative with net surplus only in India

'000 tonnes	Petroleum product demand	Domestic production of POL	Deficit/surplus
Afghanistan	4,673	4,132	-541
Bangladesh (excludes LPG)	13,435	11,250	-2,185
Bhutan	381	0	-381
India	316,119	348,475	32,356
Maldives	1,121	0	-1,121
Nepal	5,982	0	-5,982
Pakistan (excludes LPG)	50,735	24,617	-26,118
Sri Lanka	7,844	5,976	-1,868
	Net deficit in the region		**-5840**

UPCOMING INVESTMENTS IN POL

1. **Sri Lanka** is discussing a 100,000 bpd refinery in partnership with Indian Oil Corp.
2. **Nepal** Oil Corporation (NOC) and Indian Oil Corporation (IOCL) in Joint venture are laying a 69 km long, 2 million tonnes, cross country POL product pipeline from Motihari in Bihar to Amlekhgunj in Nepal at an estimated cost of $48 million.
3. India is also planning to build a product pipeline of 136km from India's Numaligarh refinery (NRL) to **Bangladesh**. Once the pipeline comes into operation, NRL can supply diesel to Bangladesh in a swap arrangement with the West Coast Refinery

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SAARC Trade outside SAARC Member States (SMS)

Research

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Prevailing Energy Trade: Afghanistan, Maldives, Nepal major recipients of trade outside SMS

- Afghanistan imports electricity from Central Asian Republics (CAR) of Tajikistan, Uzbekistan and Turkmenistan. Pakistan also imports ~0.4% of its power requirement from Iran
- All gas imports are sourced from nations beyond SAARC as none of the nations are surplus in gas production. Currently, there is no inter-regional gas pipelines
- Coal demand in all countries far surpass domestic production in all SAARC countries. India is the 2nd largest importer of coal in the world (after China). Pakistan, Bangladesh and Sri Lanka source coal from several countries like Indonesia, China, Australia and South Africa
- Most of the POL imports for SAARC nations (except Bhutan and Nepal) is sourced from regions beyond SAARC. UAE, Iran, Kuwait, Singapore are the major exporters of crude and POL to the SAARC region

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Afghanistan has strong Cross Border Infrastructure for power with CAR, all SMS reliant on Middle East for Crude

POWER TRADE

- After a decade long war with Taliban, Afghanistan's power systems was almost non-existent. Through funding from ADB and Government of India, transmission lines of more than 3600 km have been set up from neighboring Uzbekistan to Kabul in Afghanistan, thereby bringing power to the capital city. The transmission lines traverse through inhospitable terrain of Hindu Kush, towering more than 3800 meters above sea level. The Emergency Infrastructure Rehabilitation and Reconstruction Project— Power Component has been completed at an investment cost of ~$40 million. This included setting up of switching stations and double circuit 220 kV transmission lines from Uzbekistan border and hinterlands of Afghanistan. Completion of this project in 2007 enabled power to be imported from Uzbekistan and supplied to major load centers, including Kabul.

- The Regional Power Transmission Interconnection Project, set up at an investment cost of $109.5 million, allowed power to be transmitted from Tajikistan to Afghanistan by construction of a 220 kV interconnection between the Afghan and Tajik power grids. Under a 20 year power purchase agreement, 500 GWH is being imported annually from Tajikistan through this line.

CRUDE AND POL TRADE

All countries have set up ports to manage imports of crude and POL from other countries. Afghanistan, being a landlocked country, imports POL products through road transport from its neighboring nations mainly Turkmenistan, Uzbeksitan and Russia. It has 7 major land ports that facilitate import and storage of petroleum products of which Herat, Nimrooz and Andkhoi form the major ones.

Energy Trade Outlook and Upcoming Investments

CASA 1000 PROJECT

The CASA 1000 project, supported by the World Bank, intends to set up an electricity transmission system between Kyrgyz Republic, Tajikistan, Afghanistan and Pakistan, spanning 477 km. The project is expected to come up in 2019 at an investment of $1.16 billion. Power would be supplied through hydropower plants in Kyrgyzstan and Tajikistan with a 1300 MW AC-DC convertor station in Tajikistan and another 1300 MW DC-AC convertor station in Pakistan

TAP-500 LINE

Turkmenistan, Afghanistan and Pakistan have entered into a tripartite agreement to set up TAP- 500 line (500 denoting 500 kV) with Turkmenistan expected to make available 3500 MW of excess power by 2020 to be transmitted through the line.

TAPI GAS PIPELINE

The Turkmenistan, Afghanistan, Pakistan and India (TAPI) gas pipeline has begun construction and is expected to pump 33 billion cubic meters of natural gas from Turkmenistan's Galkynysh gas fields by 2022. The 1840 km pipeline will bring easy access of gas deprived nations (especially India) to gas rich Turkmenistan.

Energy Trade Outlook and Upcoming Investments

IRAN PAKISTAN PIPELINE	The Iran-Pakistan gas pipeline is expected to come up in the next 2-3 years with Iran completing laying of the pipeline on its side of the project
COAL IMPORTS	Coal will continue to be used in SAARC countries owing to low prices and easy availability. India, Bangladesh and Pakistan have significant coal deposits and domestic production will ramp up in the future. Coal based power plants will continue to grow in Bangladesh, Pakistan, India and Sri Lanka whereas rise in industrial usage will improve coal requirement in Afghanistan, Nepal and Bhutan.
NEW LNG AND POL TERMINALS	To facilitate additional POL imports, all SAARC nations have been investing heavily in building and augmenting terminals to unload imported crude and finished petroleum products.

Thank You