LNG BUSINESS STRATEGIES : TRAINING FOR PARTICIPANTS FROM SAARC COUNTRIES

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Energy Environment : SAARC & Global

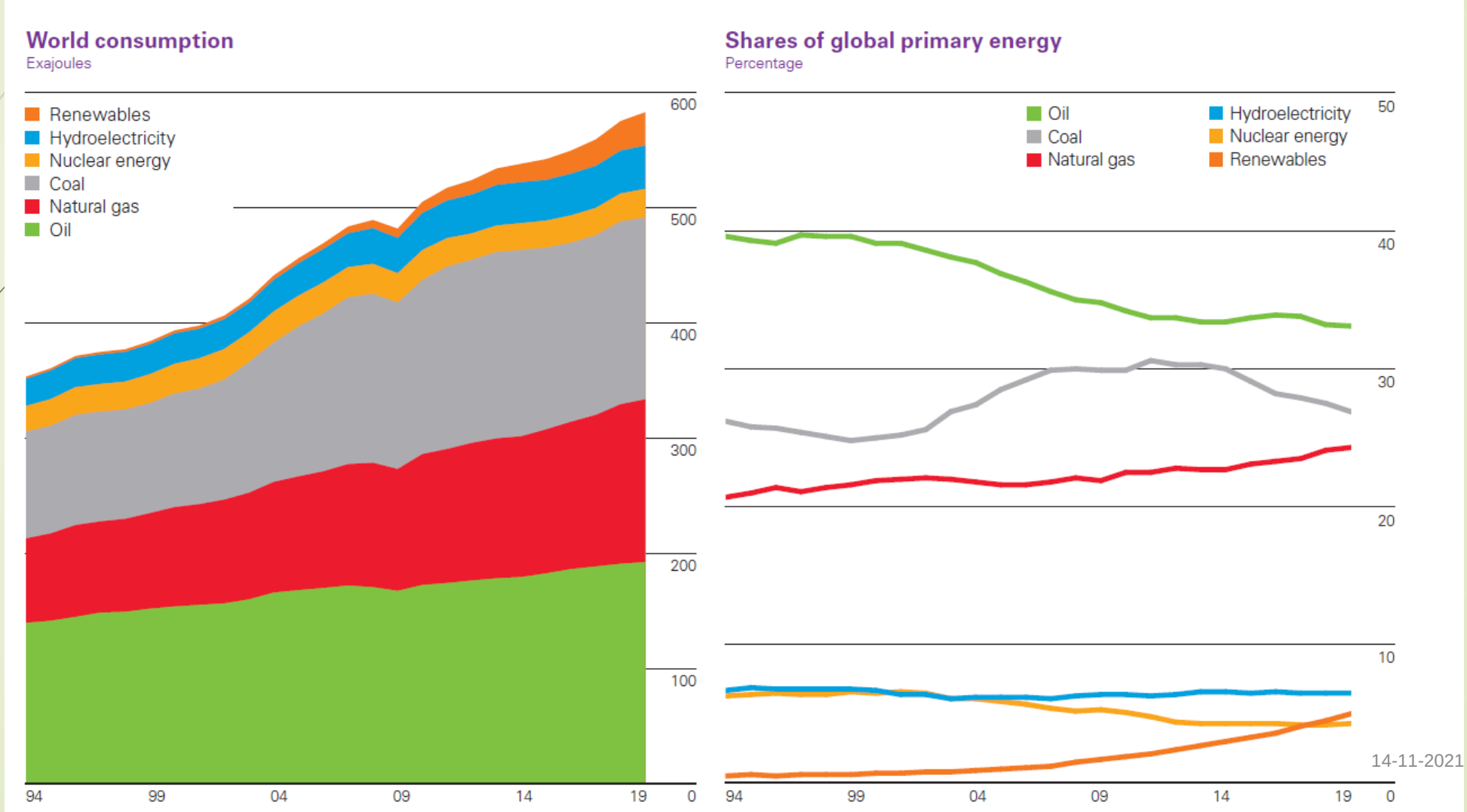
Session 2 : Outline

- Background of global energy consumption
- Expected share of different sources and Natural Gas (Piped & LNG)
- The growth potential of natural gas in SAARC Countries
  - Growth of energy
  - Dependence on Petroleum imports
  - Economic benefits of Natural Gas
  - Expected demand of Natural Gas

What have been the trend of consumption of different sources of energy ?

Share of energy sources : 1994 to 2019

(Source : BP Statistical Review 2021)



Emerging issues

- Excessive consumption of fossil fuels is resulting in
  - Global warming due to emissions leading to Climate Change
  - Rise in pollution and health hazards
- Huge disparity in energy consumption by the ‘developed’ and the ‘developing’ nations.
- The emerging technologies for energy sourcing are expensive.

Global commitments

- In 2015, the United Nations have come out with
  - **Sustainable Development Goals** to ensure inclusive growth across the globe by 2030.
  - Nation-wise **Nationally Determined Contributions (NDCs)** and Long Term Strategic Plans , popularly called the Paris Agreement (COP-21under UN FCCC)
  - 196 nations have overwhelmingly have endorsed the above

- **The future of fulfilling energy needs will be guided by our commitments to make affordable energy available to the developing and under-developed economies, and yet combat climate change,**

Natural Gas : The bridge fuel

The unfolding energy scenarios, which have also been shared, indicate that

- ***the share of Renewables are slated to increase***
- ***In almost all the energy scenarios, be that of Shell, EIA, DNV, or McKinsey, Natural Gas retains its share of about 23 – 25 % of global energy basket.***

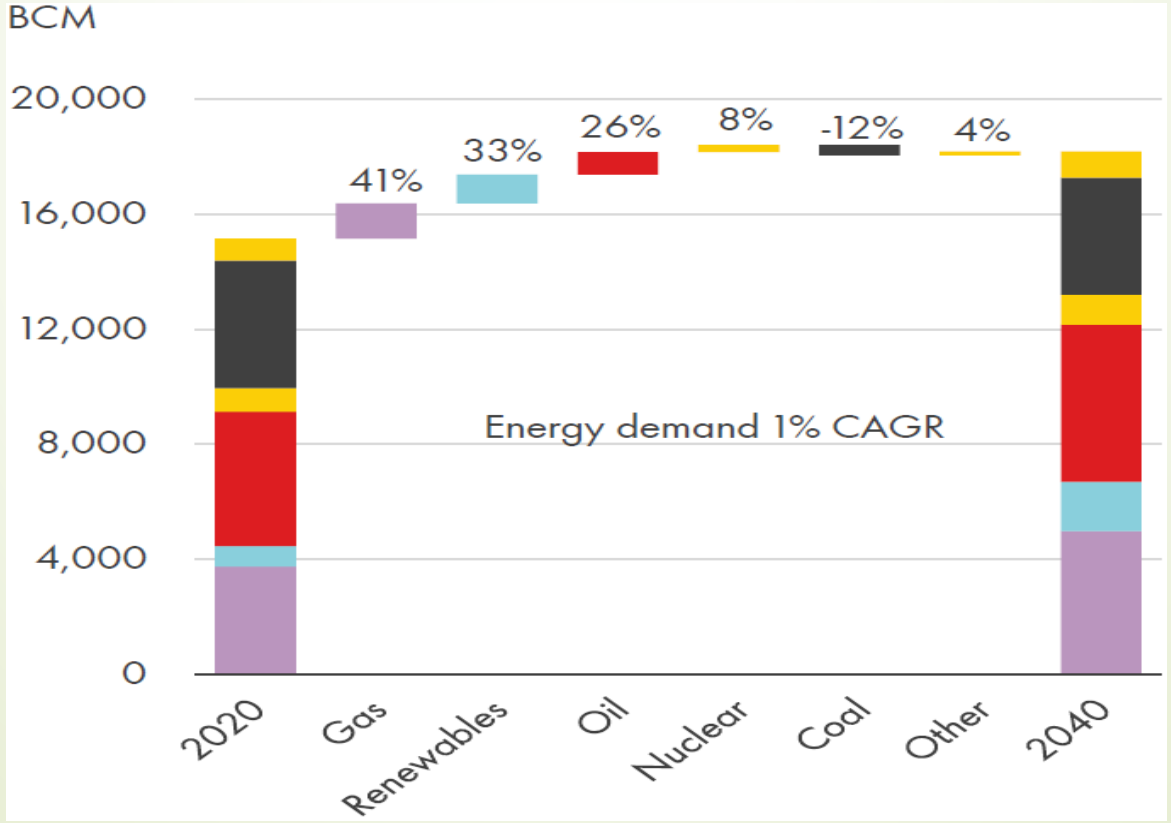
Lets have a look at

Global demand projections

for Natural gas

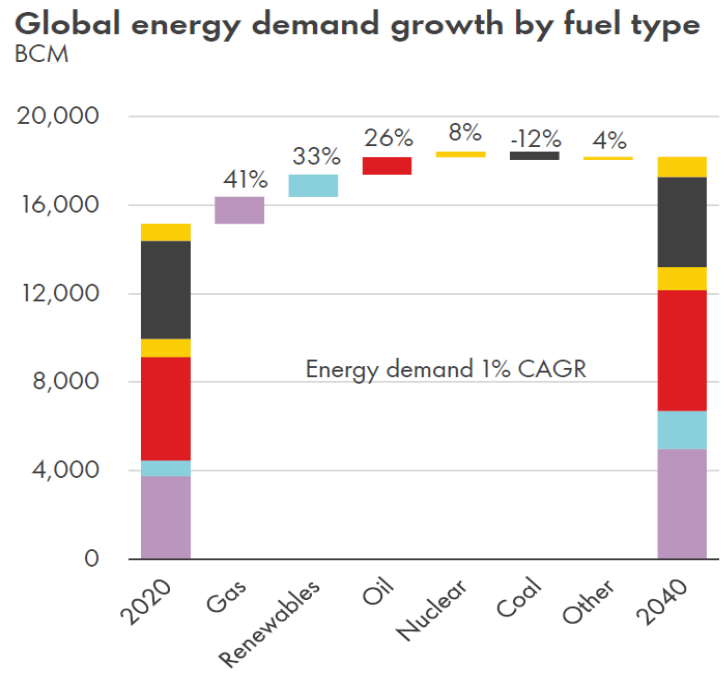
Global source-wise energy demand : Shell's LNG Outlook 2021
(Based on Wood Mackenzie data for H1 2020)

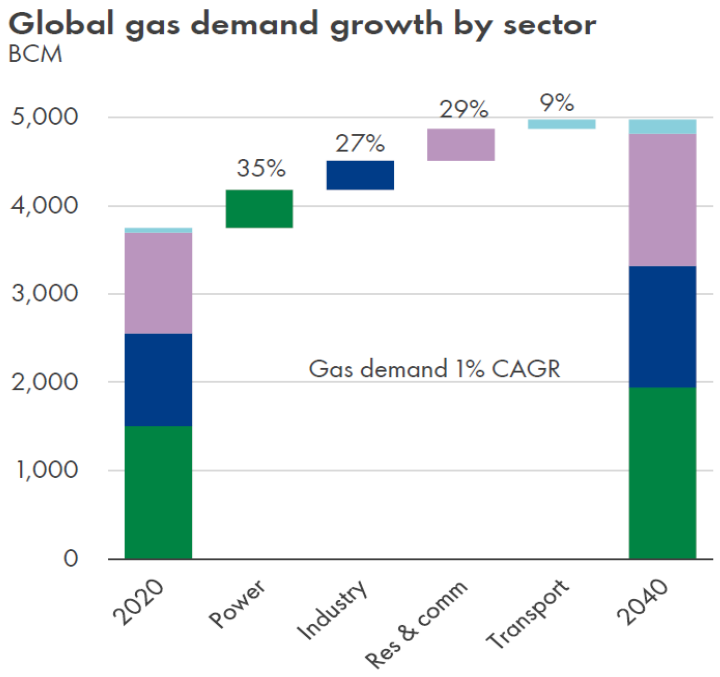
- The share of fossil fuels remains 80% in 2040
- Share of gas is higher than renewables between 2020 and 2040
- Demand for gas reaches 5000 BCM by 2040, and retains a share of about 24% in the energy basket

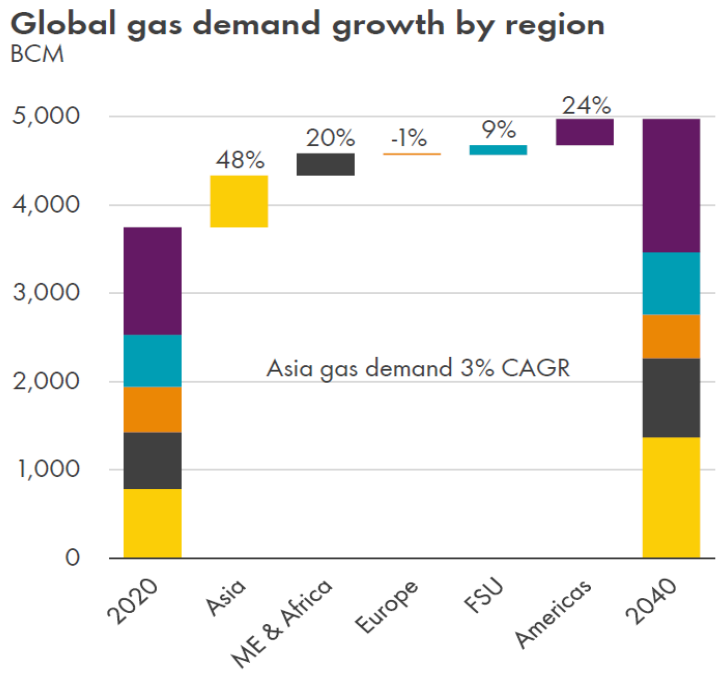


Global Gas demand : Shell's LNG Outlook 2021
(Based on Wood Mackenzie Data for H1 2020)

- Highest growth of gas is in the electricity sector
- Region-wise, the highest growth is in Asia

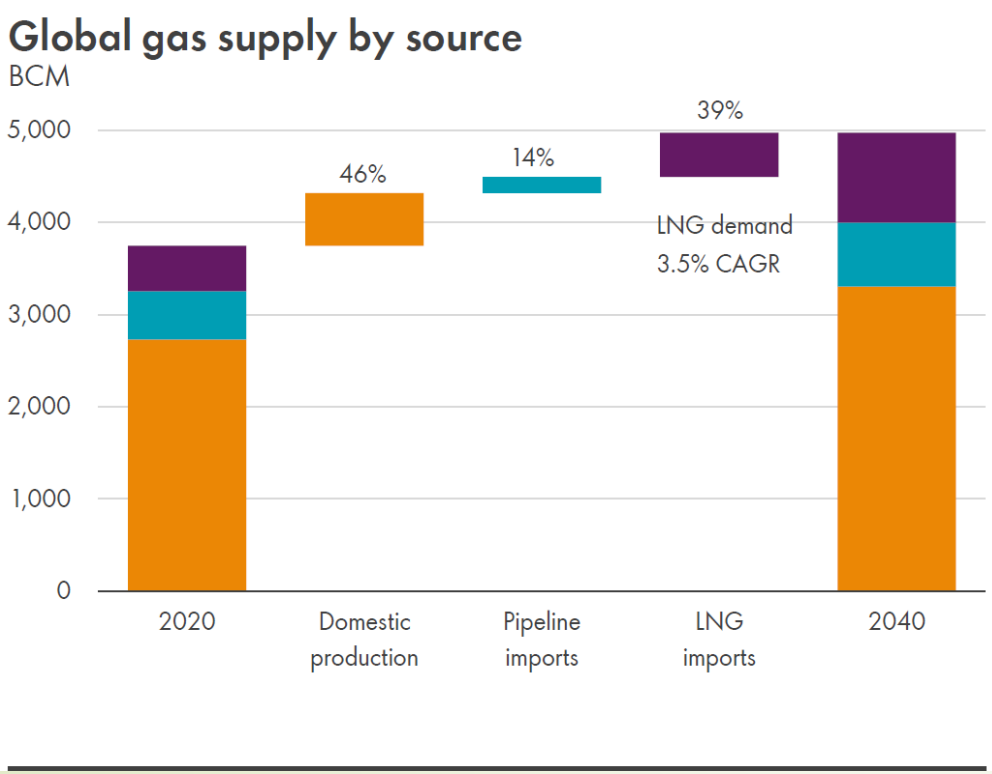


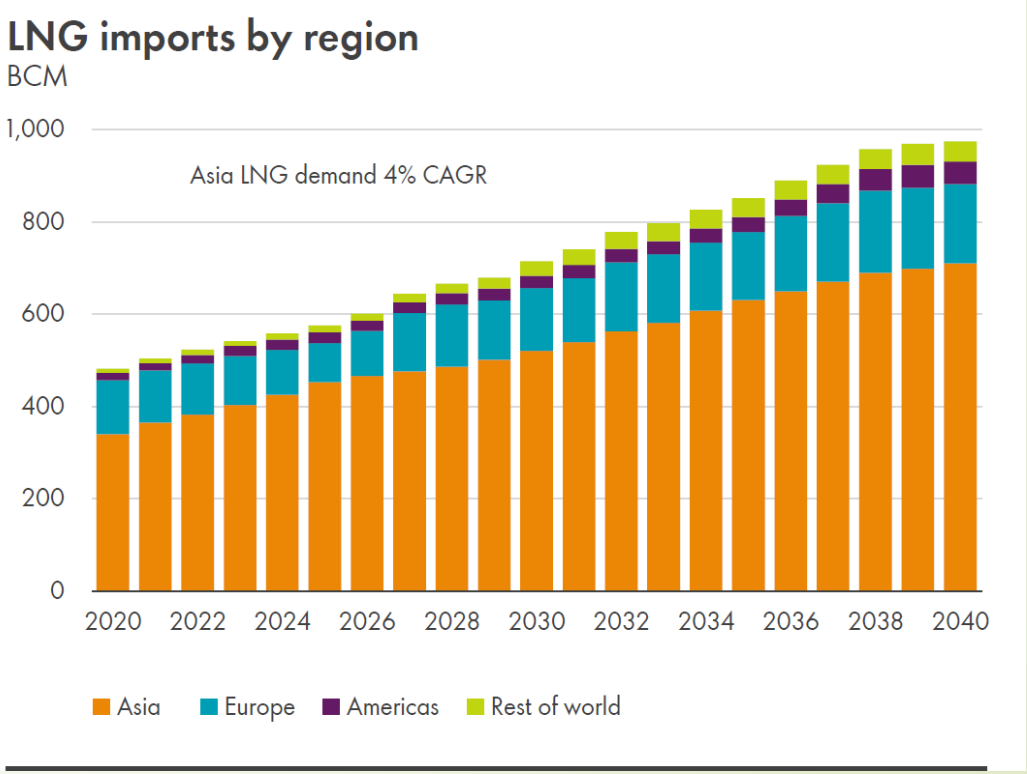




Global Gas demand : Shell's LNG Outlook 2021
(Based on Wood Mackenzie Data for H1 2020)

- Demand for LNG is more than that for piped imports
- LNG demand is expected to grow @ 3.5%





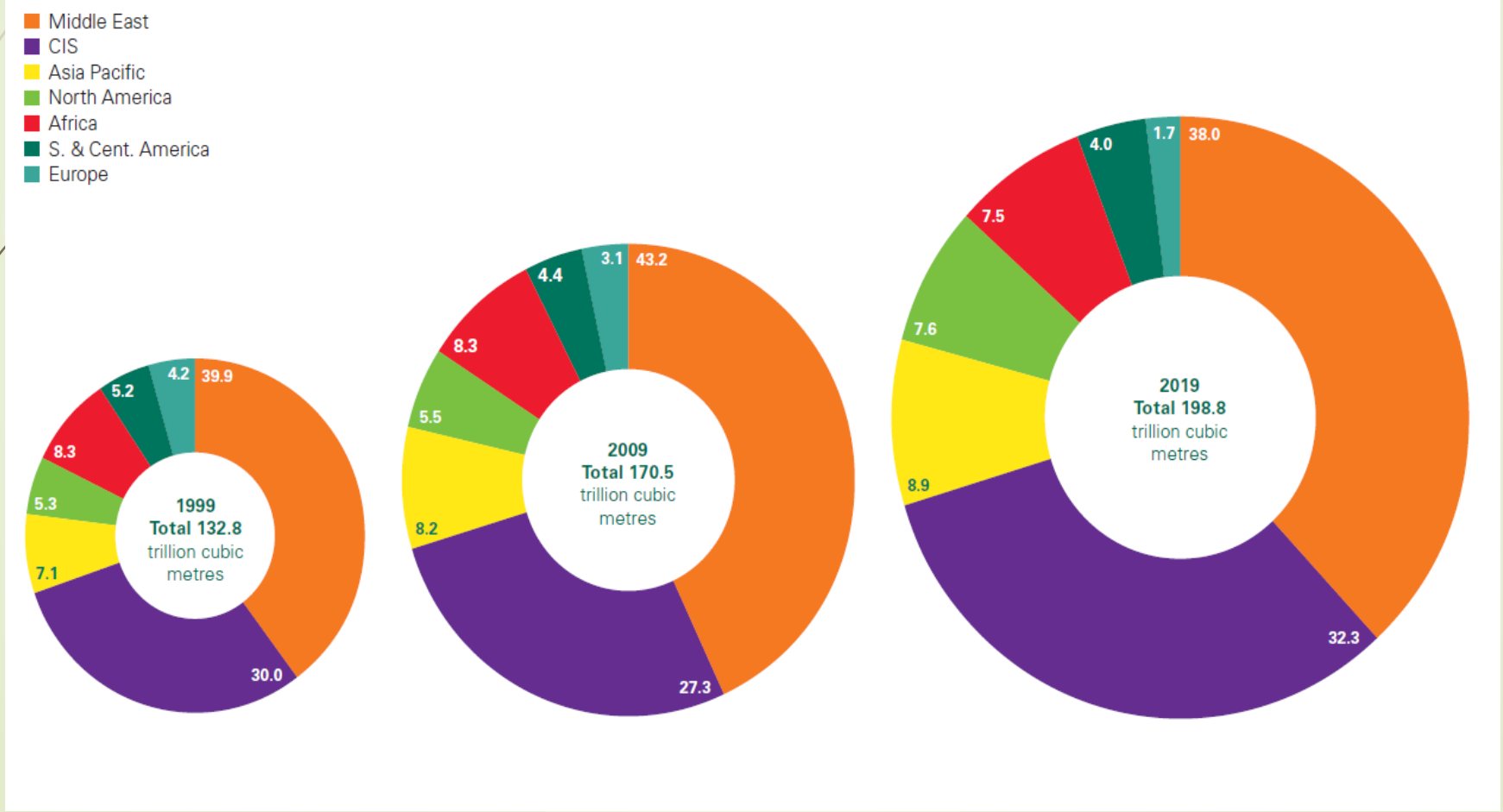
IEA – WEO 2019 : Natural Gas demand and consumption
(in BCM)

			Stated Policies		Sustainable Development		Current Policies	
	2000	2018	2030	2040	2030	2040	2030	2040
Power	908	1 571	1 708	1 936	1 580	1 248	1 823	2 197
Industrial use	644	909	1 229	1 474	1 108	1 114	1 243	1 527
Buildings	651	846	945	998	740	557	1 011	1 131
Transport	70	137	200	295	268	330	181	249
Other sectors	257	490	639	701	568	605	681	788
World natural gas demand	**2 530**	**3 952**	**4 720**	**5 404**	**4 264**	**3 854**	**4 940**	**5 891**
Asia Pacific share	*12%*	*21%*	*26%*	*28%*	*29%*	*34%*	*26%*	*28%*
Low-carbon gases	-	4	53	90	138	269	29	52
World total gases	**2 530**	**3 956**	**4 773**	**5 494**	**4 402**	**4 123**	**4 968**	**5 943**
Conventional gas	2 318	3 004	3 293	3 694	3 004	2 689	3 433	3 926
Existing fields	2 318	3 004	2 200	1 659	2 200	1 659	2 200	1 659
New fields	-	-	1 094	2 035	804	1 030	1 234	2 266
Tight gas	148	274	267	238	262	141	253	232
Shale gas	3	568	1 020	1 290	863	871	1 113	1 532
Coalbed methane	38	88	103	129	101	103	102	143
Other production	-	3	36	54	34	50	38	58
World natural gas production	**2 507**	**3 937**	**4 720**	**5 404**	**4 264**	**3 854**	**4 940**	**5 891**
Shale gas share	*0%*	*14%*	*22%*	*24%*	*20%*	*23%*	*23%*	*26%*
LNG	136	352	598	729	608	636	633	768
Pipeline	378	436	528	549	463	358	589	704
World natural gas trade	**514**	**788**	**1 126**	**1 278**	**1 071**	**993**	**1 222**	**1 472**
Share of production that is traded	*20%*	*20%*	*24%*	*24%*	*25%*	*26%*	*25%*	*25%*
Henry Hub price ($2018/MBtu)	**6.1**	**3.2**	**3.3**	**4.4**	**3.2**	**3.4**	**3.8**	**5.1**

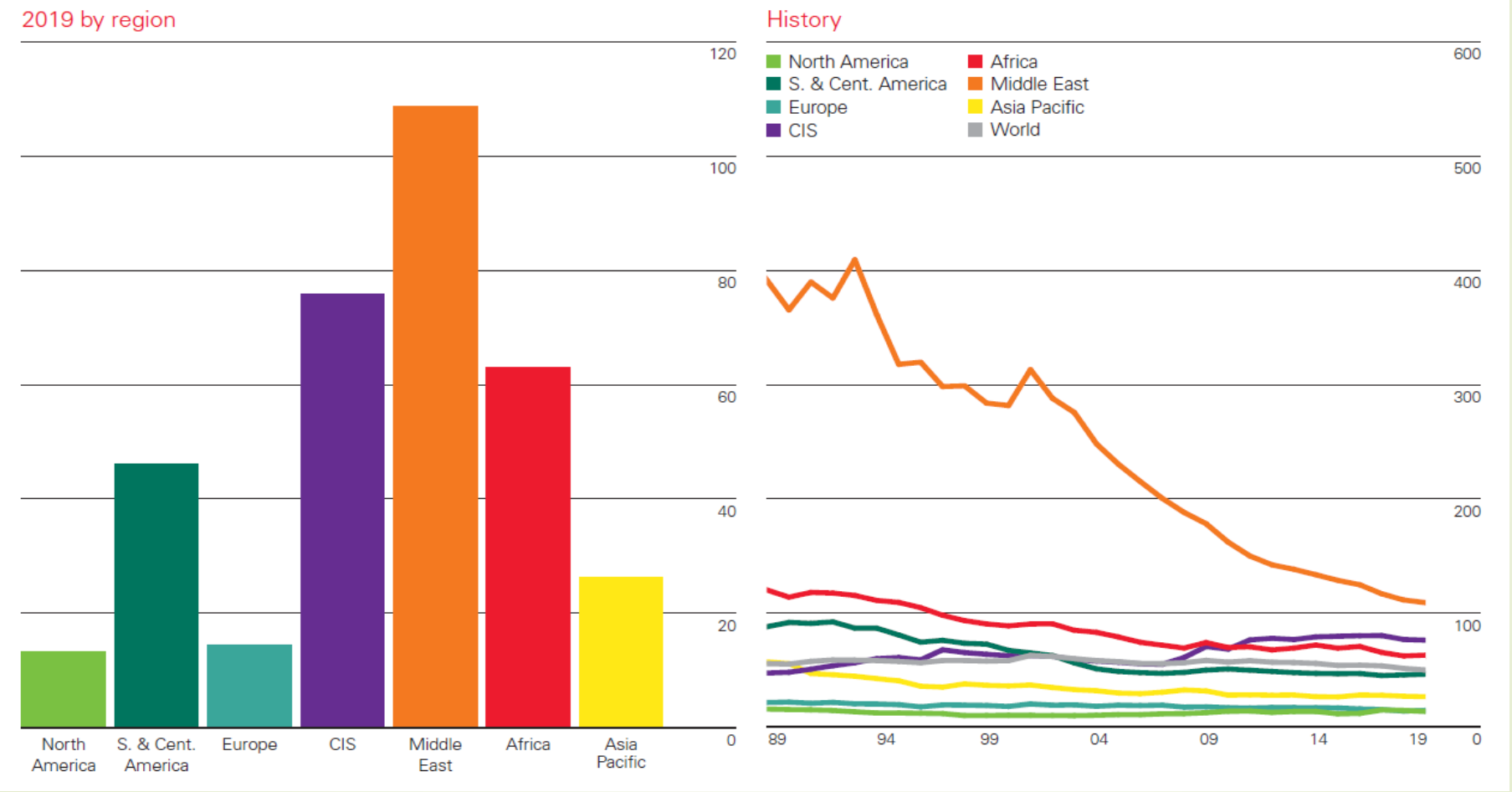
Does the world have enough natural gas reserves ?

Global Gas Reserves : 1999, 2009, 2019
(BP Statistical Review : 2020)

- As a result of intensive exploration, the reserves have grown over the years
- Between 1999 and 2019, the reserves have grown from 132 tcm to 199 tcm



Region-wise Reserves to Production ratios : 1989 - 2019
(Source : BP Statistical Review : 2020)



- We have adequate gas for meeting our future needs for this century.
- Some projections are even more optimistic and indicate that there is gas for nearly 200 years

Proven Natural Gas reserves and production -2018

Source : BP Statistical Review, IGU, others

Sl No	Country	Proven Reserves	Production in 2018	
		Trillion Cubic Metres (TCM)	Billion Cubic Metres (BCM)	LNG Export (in MTPA)
1	Russia	38.9	670	19
2	Iran	31.9	240	
3	Qatar	24.7	175	79
4	Turkmenistan	19.5	61	
5	USA	11.9	831	23
6	Venezuela	6.3	33	
7	China	6.1	161	
8	S Arabia	5.9	112	
10	UAE	5.9	64	6
11	Nigeria	5.3	49	21
12	Algeria	4.3	92	10
13	Iraq	3.6	13	
14	Indonesia	2.8	73	15
15	Australia	2.4	130	69
16	Malaysia	2.3	72	24
17	Europe (Excl Norway & CIS	2.3	130	
18	Egypt	2.1	58	2
19	Azerbaijan	2.1	18	
20	Kazakhstan	2.1	24	
21	Canada	1.9	184	
22	Kuwait	1.7	17	
23	Norway	1.6	120	5
24	India	1.3	27	
25	Oman	0.7	36	10.5
26	Peru	0.4	13	4
27	Trinidad & Tobago	0.3	34	12.5
28	Papua New Guinea	0.2	5	7
29	Cameroon	0.1	5	1
30	Eq Guinea	0.1	6	4
31	Yemen	0.1	3	Refer Footnotes
32	Angola	0.1	6	4
World		**196.5**	**3867**	**316**

- Countries with Reserves more than 1 tcm or exporting LNG
- Yemen's LNG capacity of 6.7 MTPA is shutdown since 2015 due to internal turmoil.
- Actual Gas-in-place reserves may be more.

What is the growth potential for **Energy and Natural Gas** in SAARC member countries

Key economic indicators in SAARC Nations

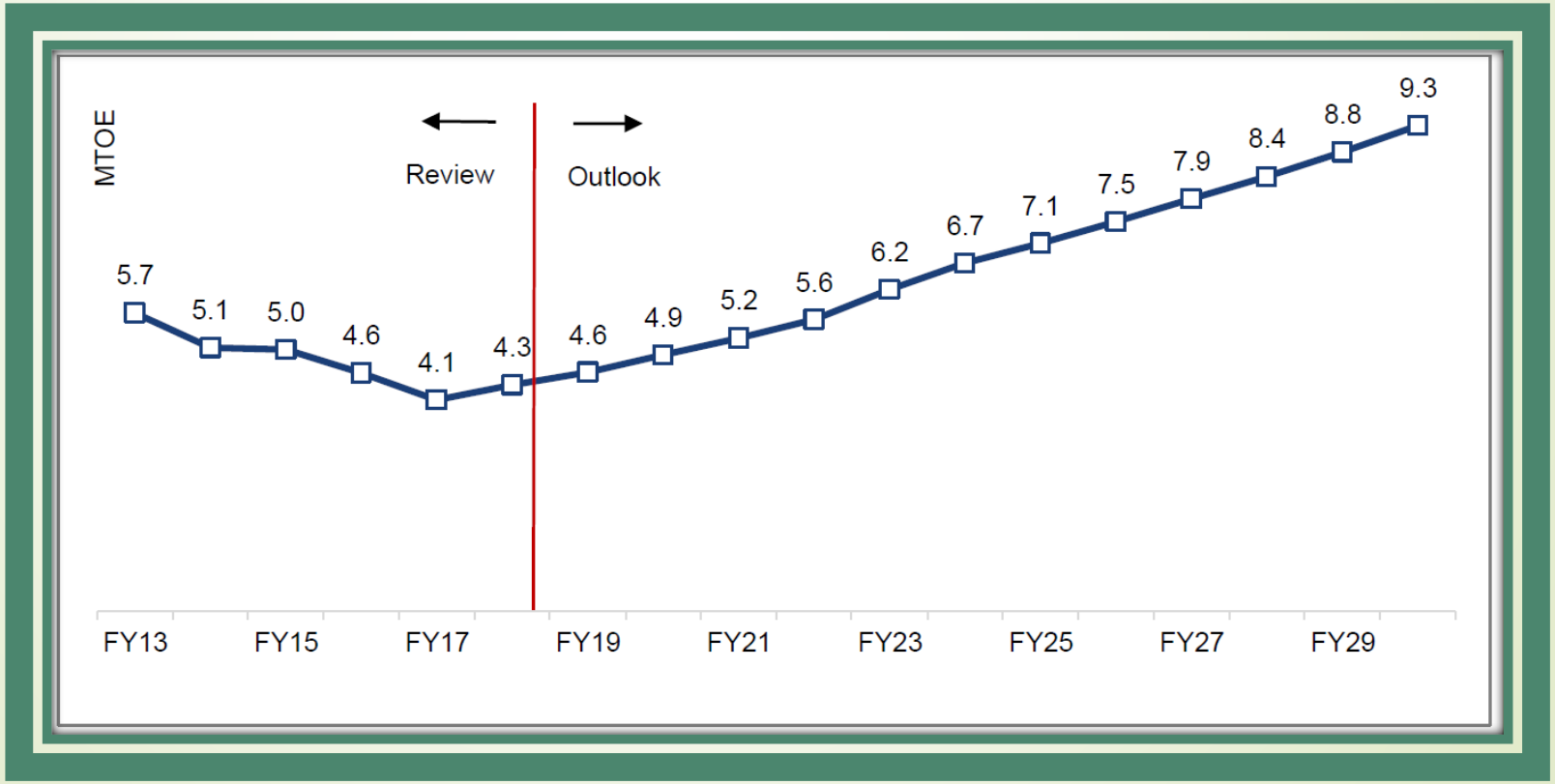
Country	GDP					Per Capita Energy Consumption	Urbanization	Population	
	Constant Prices	Current Prices		PPP	Growth			Growth	Share in Global
	NC	NC	USD	Dollars	%	ktoe	in %	Rate	% share
Afghanistan	1319	1469	18.9	81.8		139	26%	2.33%	0.55
Bangladesh	11057	25424	302.0	869.0	7.25 - 7.75%	236	38%	0.98%	2.11
Bhutan	69	173	2.5	8.9	5.7 - 6.1%	1075	42%	1.07%	0.1
India	145692	203510	2870.0	9562.0	6.5 - 7 %	610	35%	0.97%	17.69
Maldives	72	87	5.6	10.8	3 - 3.5 %	1508	41%	0.57%	0.01
Nepal	2339	3859	34.2	117.9	5 - 5.5%	486	21%	1.85%	0.38
Pakistan	12580	37972	276.0	1065.0	4.75 - 5 %	381	37%	1.95%	2.86
Sri Lanka	9883	15012	84.0	297.0	4 - 4.5%	511	19%	0.38%	0.27
						Share of World Population			23.97

Per Capita Consumption of USA - 6960, Canada - 7897, Australia – 5334, China - 2236 -

Data of GDP (2019), Population Data (2017) from World Bank
Energy Consumption (2017) from SAARC Energy Outlook 2030

SAARC Country Analysis : Afghanistan
(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)

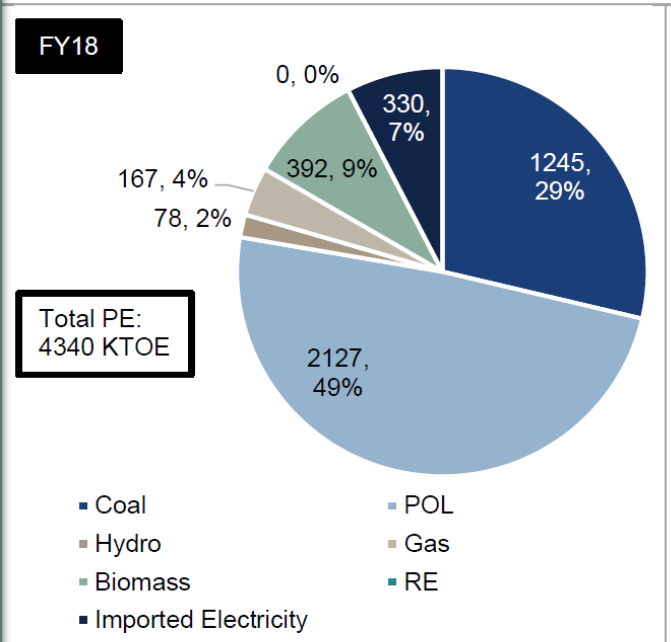
- Energy consumption expected to grow @ 7%

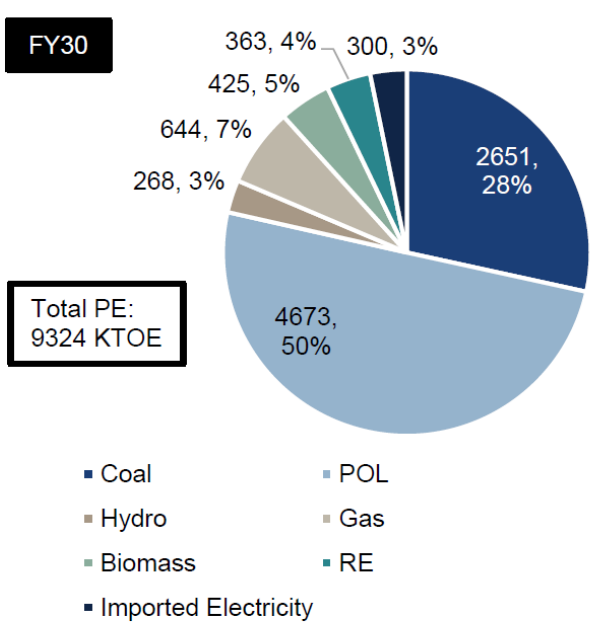


SAARC Country Analysis : Afghanistan

(Ref SAARC Energy Outlook 2030 SAARC /CRISIL)

AFGHANISTAN



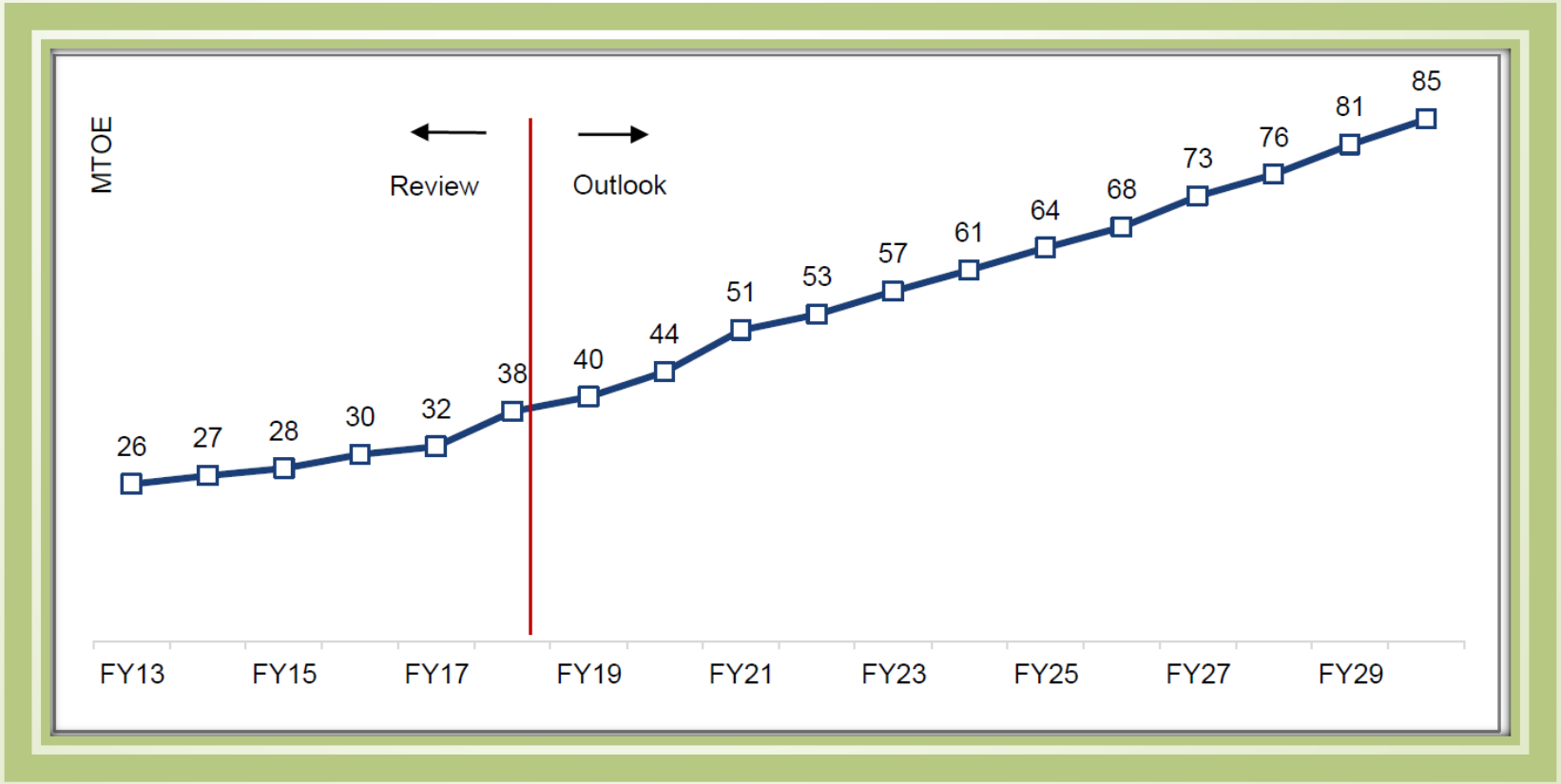


- **Hydro** to remain the major contributor in power generation; its contribution expected to rise 3.4 times by fiscal 2030
- Electrification expected to reach ~52% by fiscal 2030 from 35% now, thereby improving primary energy usage
- **Gas** usage to rise as ~650 MW gas-based power plants are expected 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

SAARC Country Analysis : Bangladesh

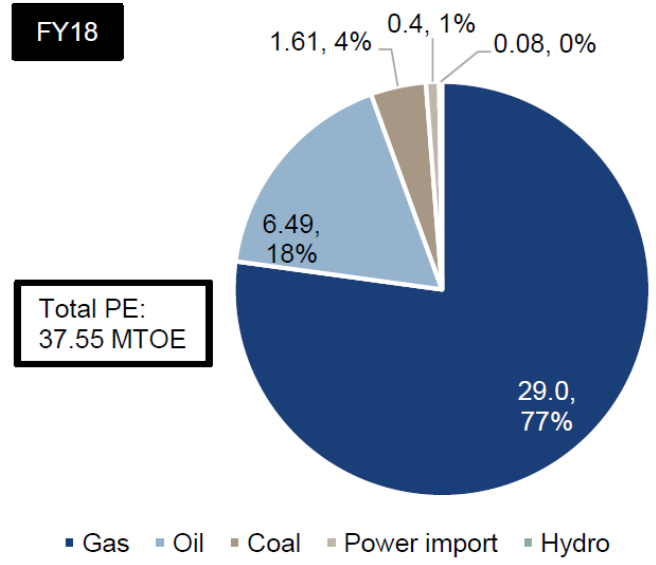
(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)

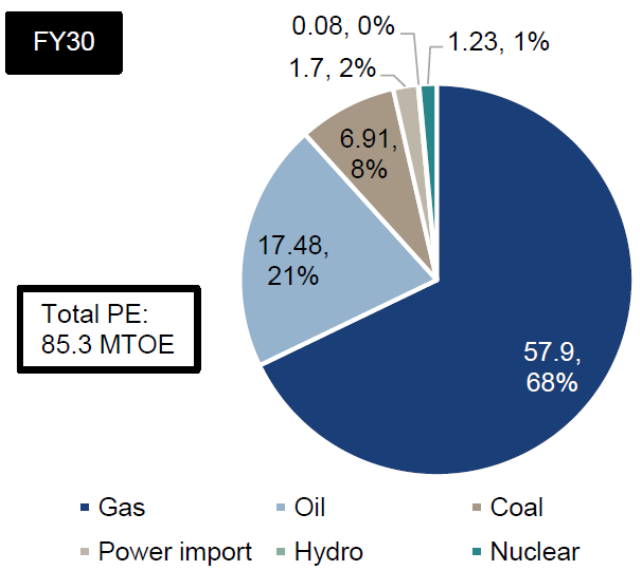
- The highest growth rate of 7% in its energy consumption



SAARC Country Analysis : Bangladesh
(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)

BANGLADESH

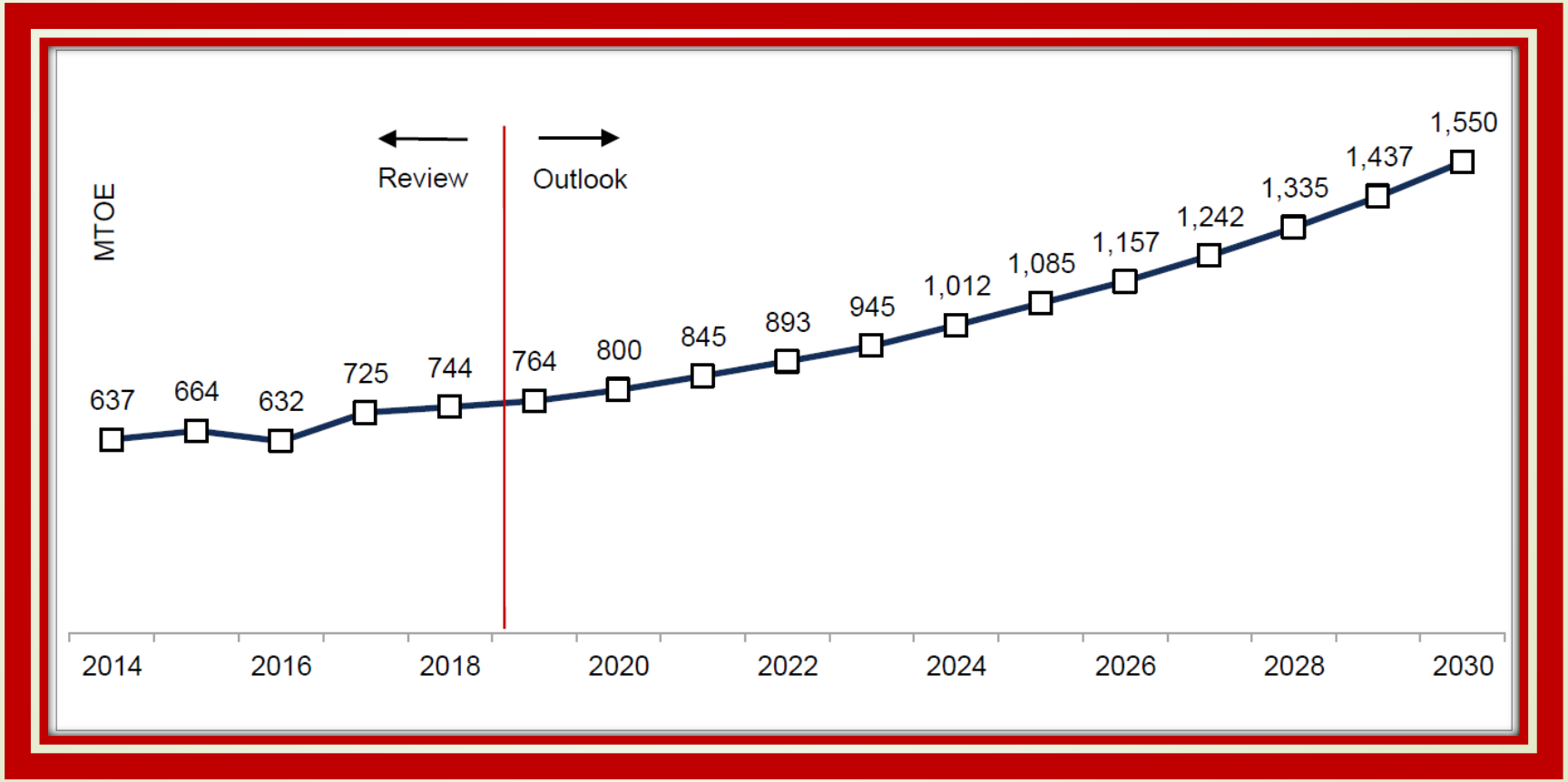




- **Gas**, which accounts for about two-thirds of the primary energy consumption in fiscal 2018, to remain the mainstay going forward; depleting domestic production to be substituted through LNG imports
- **Coal** usage will grow manifold to ~12 million tonne by fiscal 2030 owing to massive buildup of 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

SAARC Country Analysis : Bhutan
(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)

- The Himalayan kingdom of Gross National Happiness, is surplus in Electricity and is second, next to Maldives, in terms of highest per capita energy consumption in the region.



SAARC Country Analysis : Bhutan

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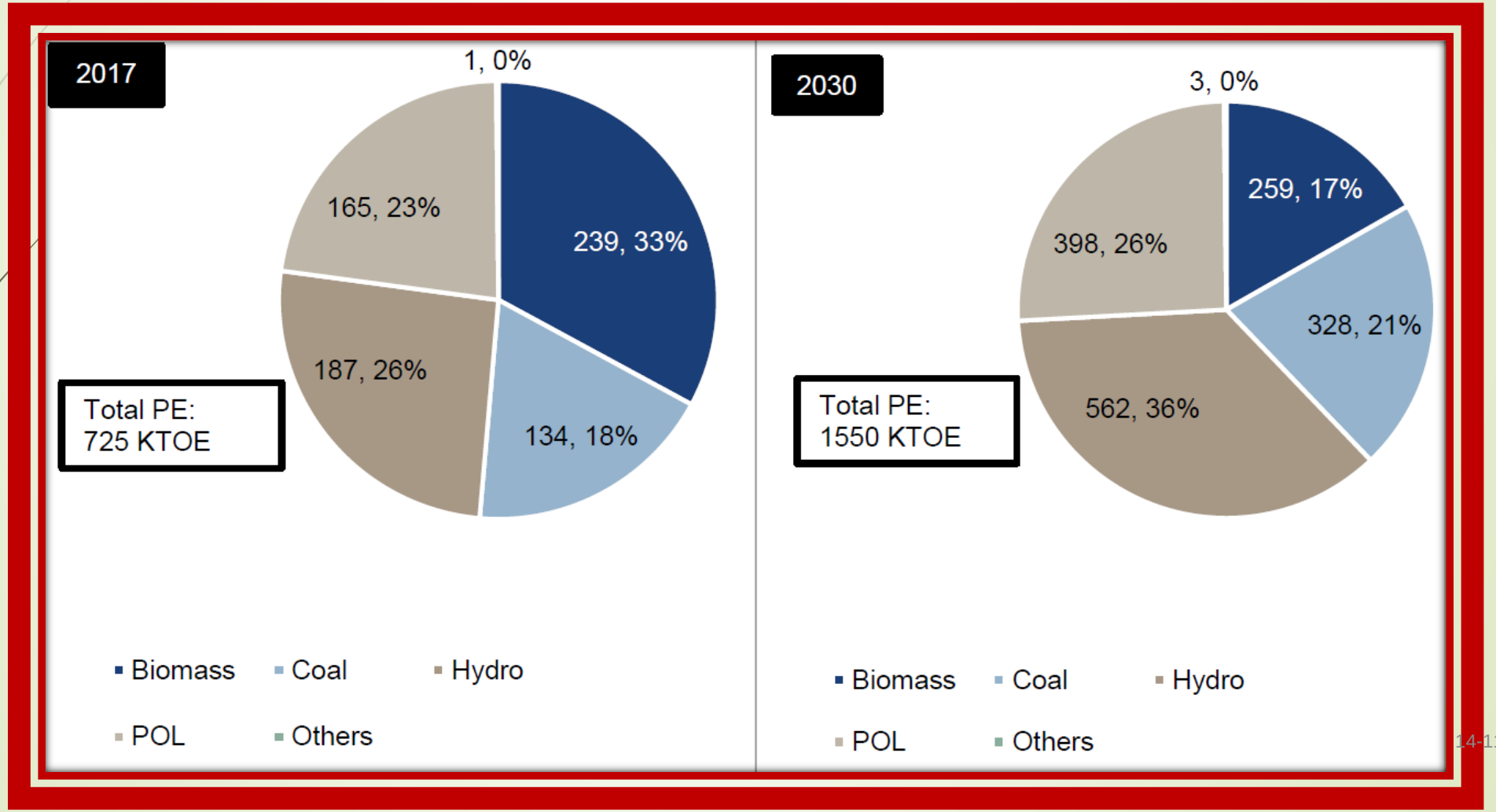
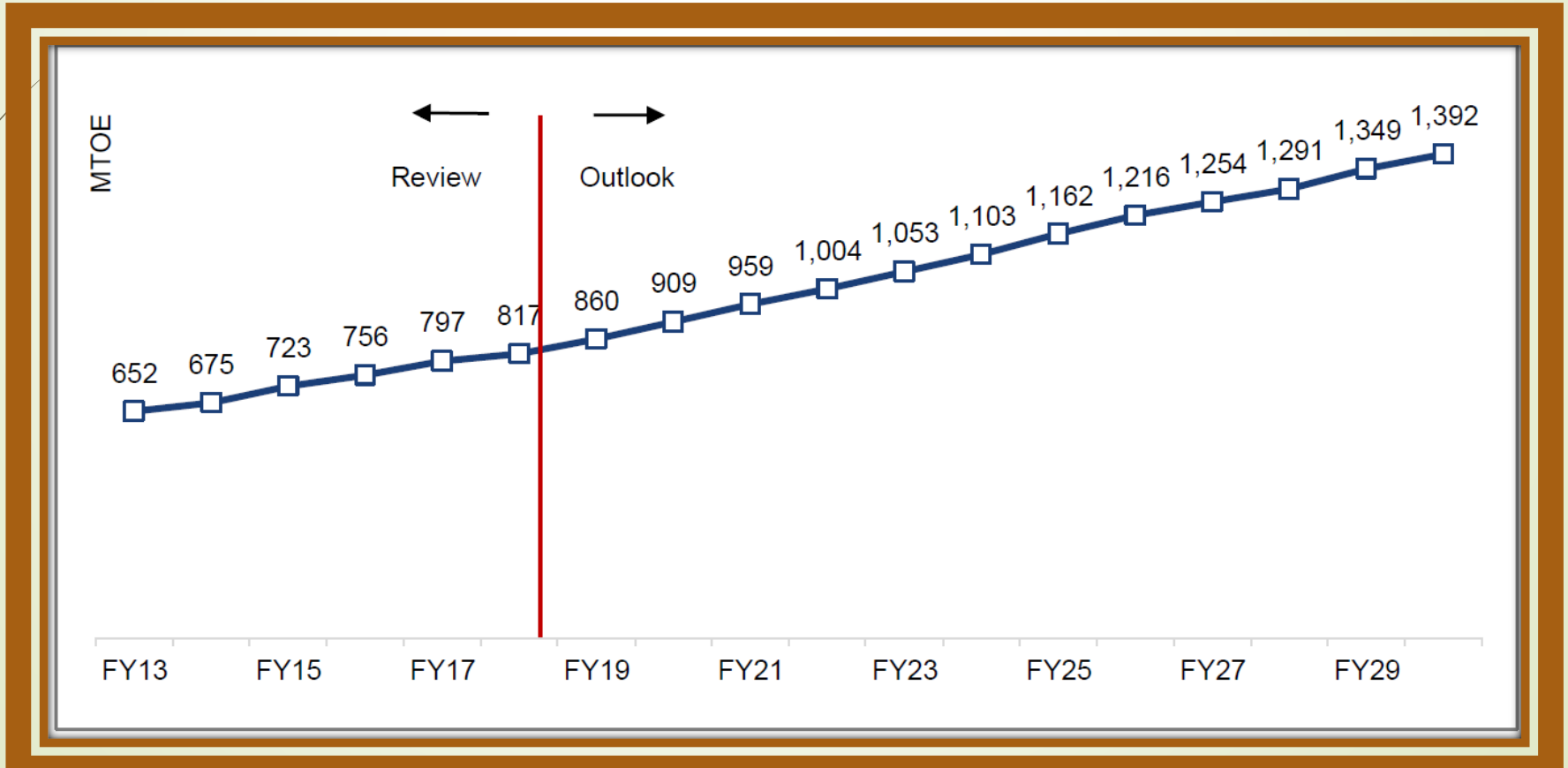


SAARC Country Analysis : India

(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)

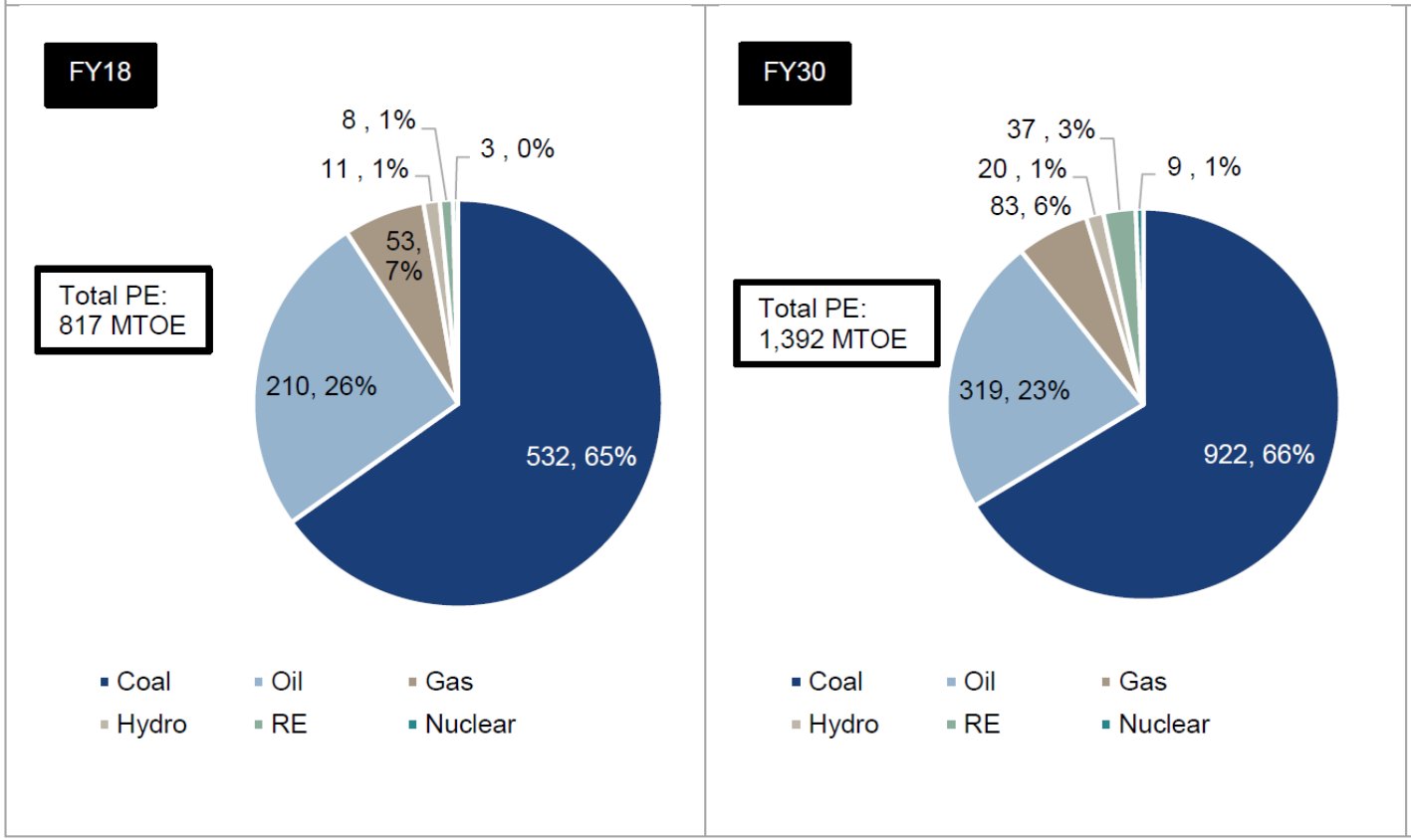
- Energy consumption expected to grow @ 4.5% till 2030



SAARC Country Analysis : India

(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)

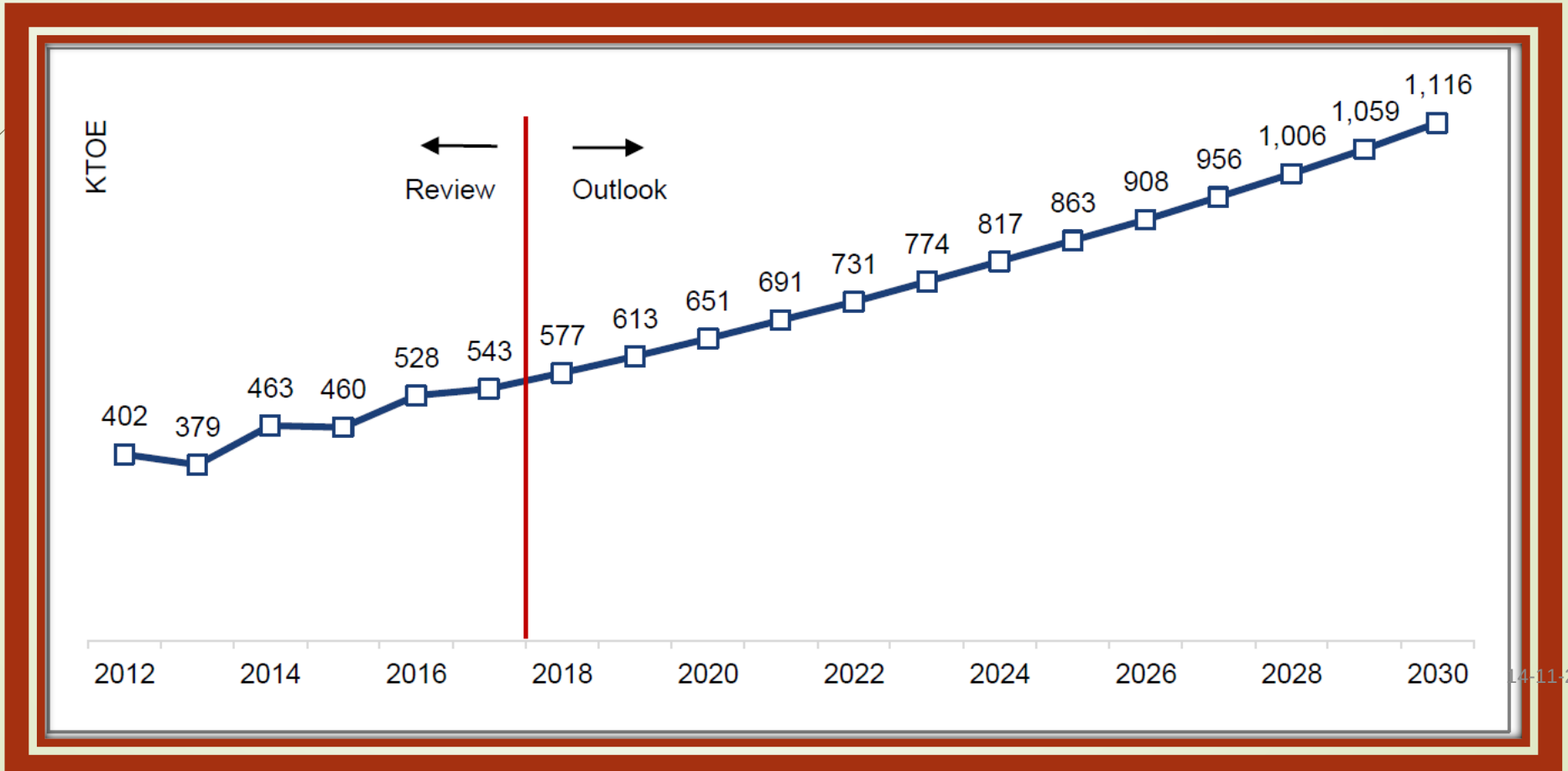
INDIA



- 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
- Robust capacity additions of ~150 GW of **solar** energy and ~70 GW of **wind** energy expected between fiscals 2018 and 2030
- 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

SAARC Country Analysis : Maldives
(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)

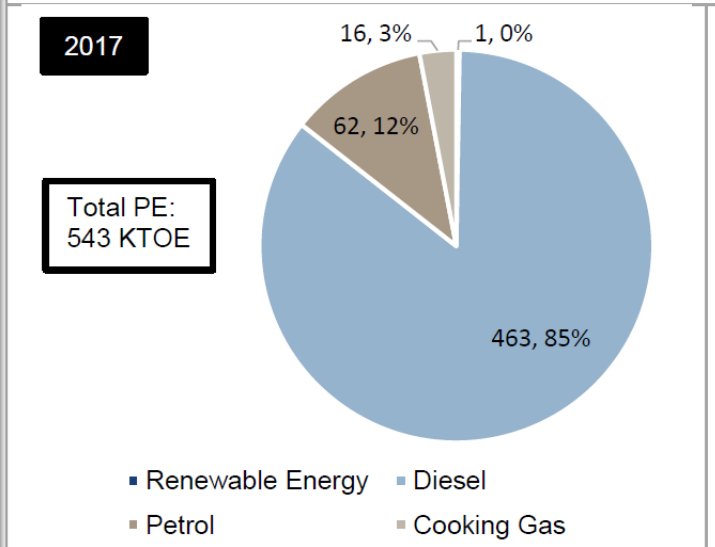
- Highest per capita consumption in the region
- Expected to grow @ 4.5 % till 2030

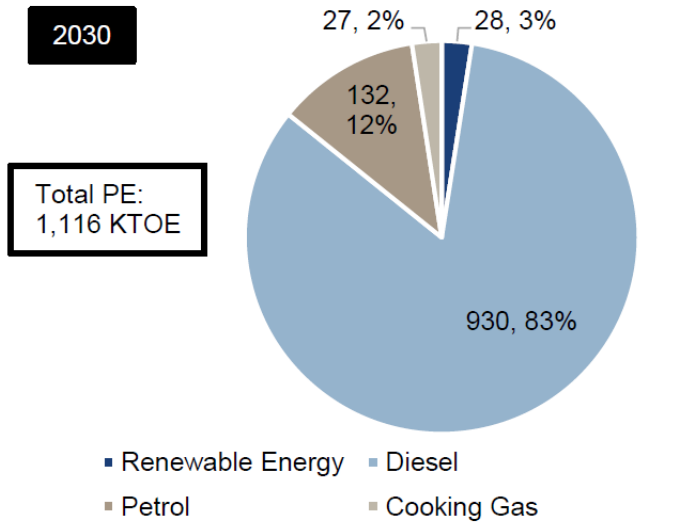


SAARC Country Analysis : Maldives

(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)

MALDIVES

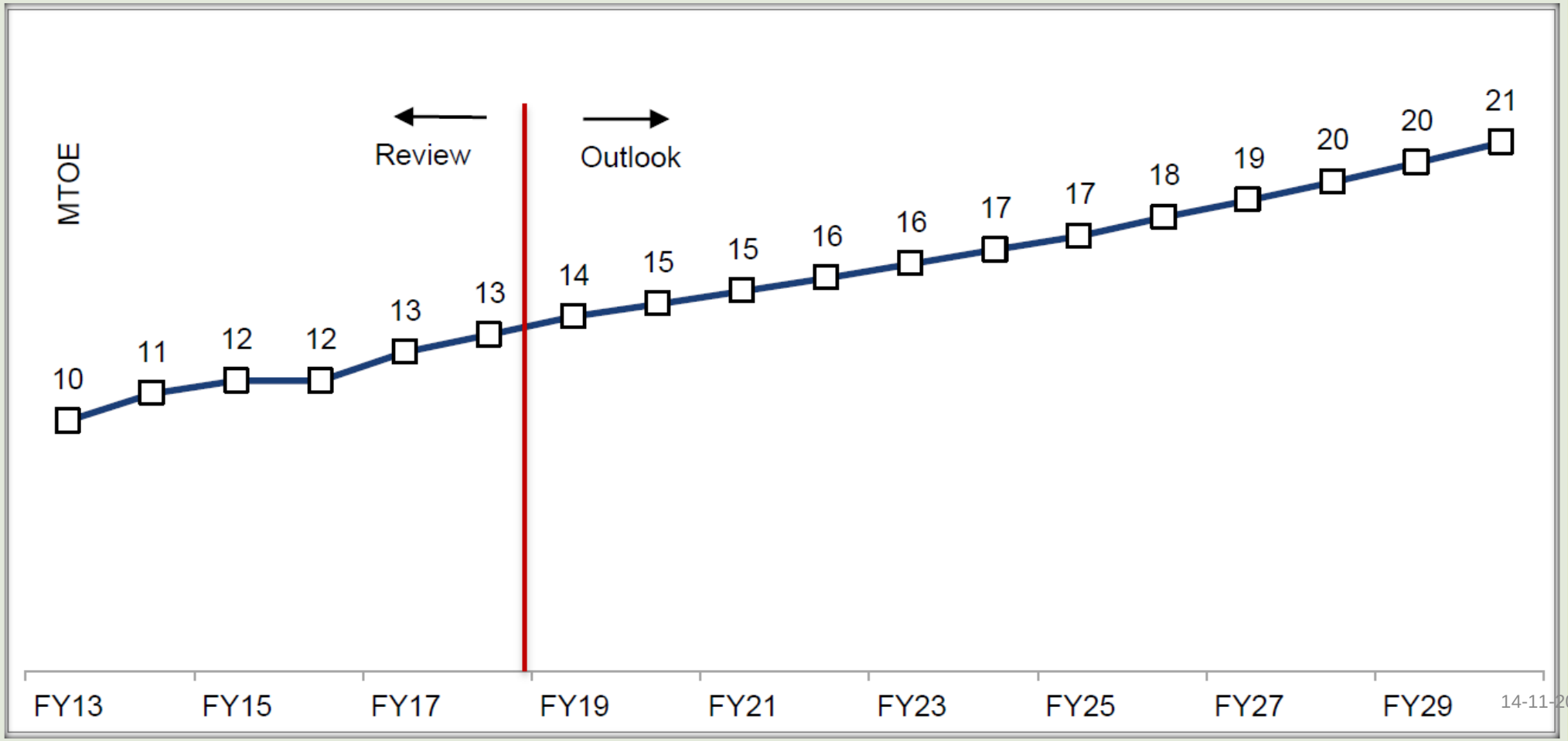




- **Diesel** is expected to remain the primary fuel for meeting the country's power demand. It is estimated that in addition to 214 MW of centralized installed diesel-based power capacity in inhabited islands, tourist resorts cumulatively have 260 MW of diesel-based captive power capacity
- Demand for **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 frm **RE** sources by 2030.

SAARC Country Analysis : Nepal

(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)



SAARC Country Analysis : Nepal

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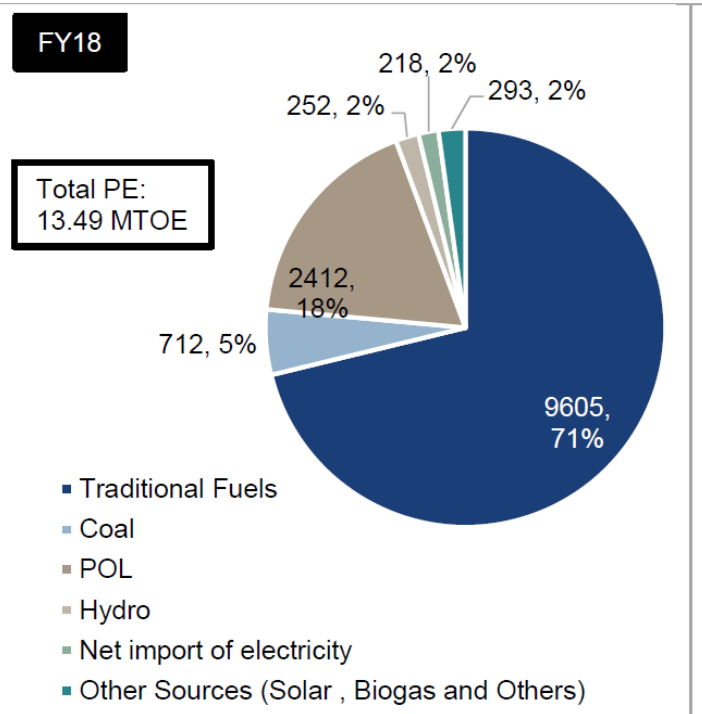
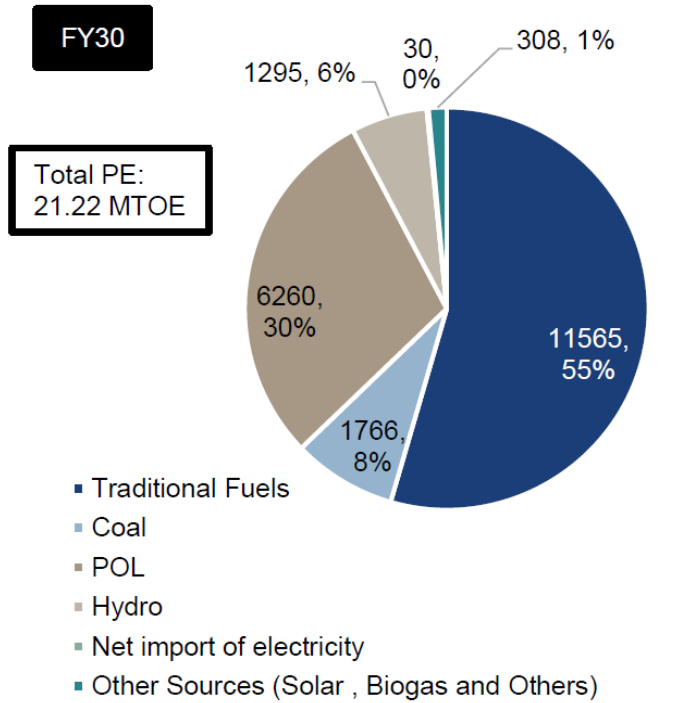
NEPAL



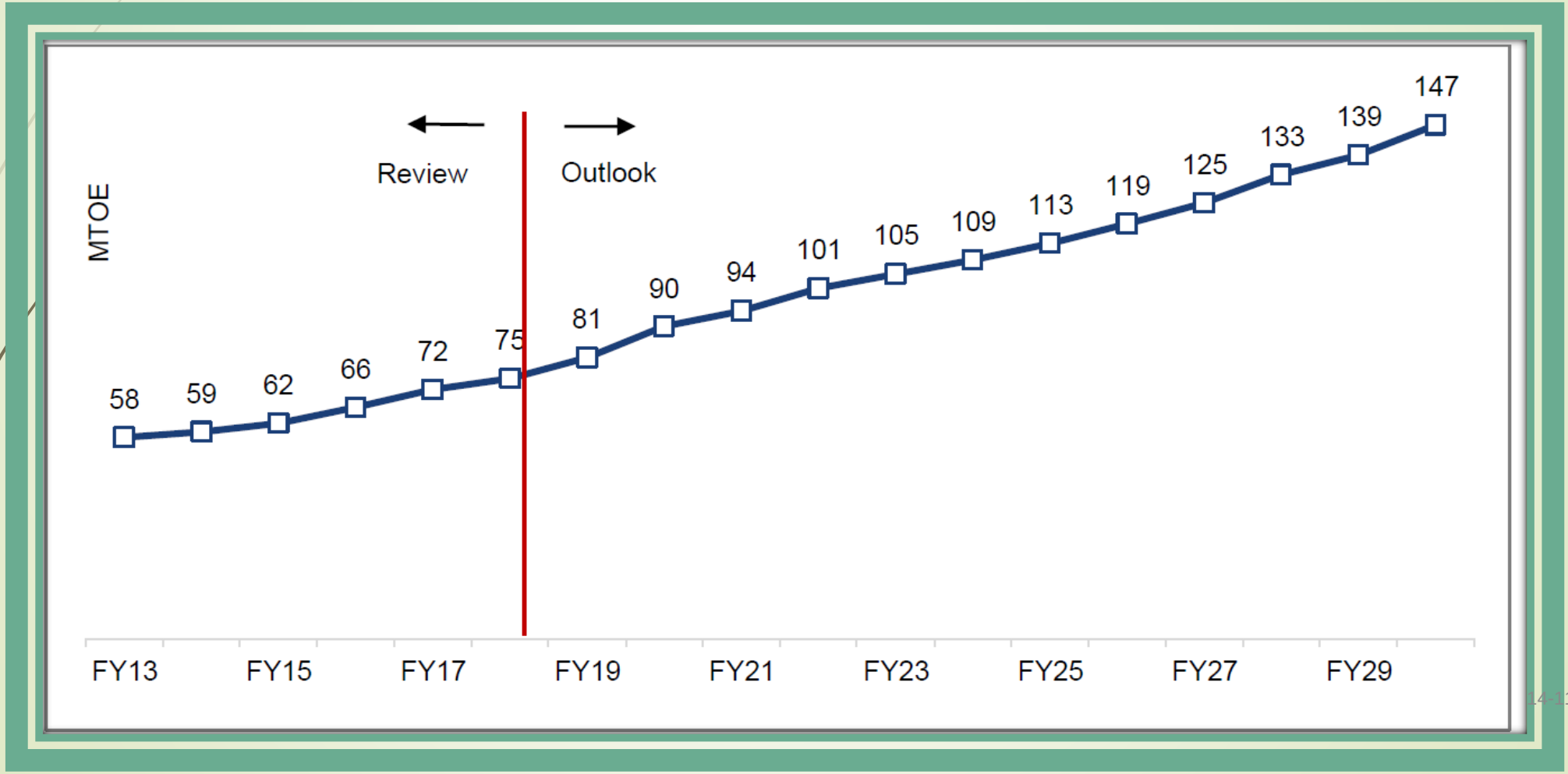


- **Traditional fuels,** which met around 71% of total primary energy requirement of Nepal in fiscal 2018, are expected to see their share decline to 54% by fiscal 2030 with the share of cleaner fuels rising
- Power supply, which is dominated by **hydro** power plants, is expected to grow by around 4.1 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%

SAARC Country Analysis : Pakistan

(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)

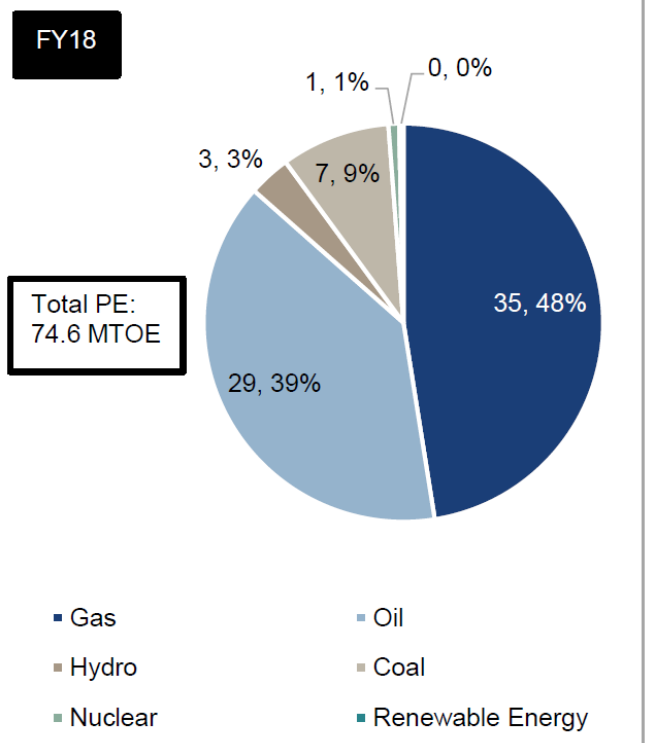
- Energy consumption expected to grow @ 5.8% % till 2030
- Plans to increase coal in its energy basket

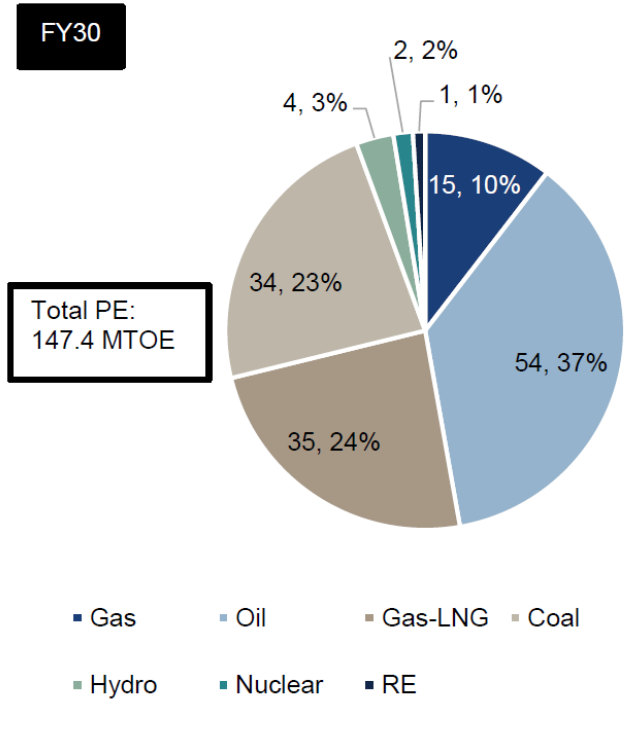


SAARC Country Analysis : Pakistan

(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)

PAKISTAN

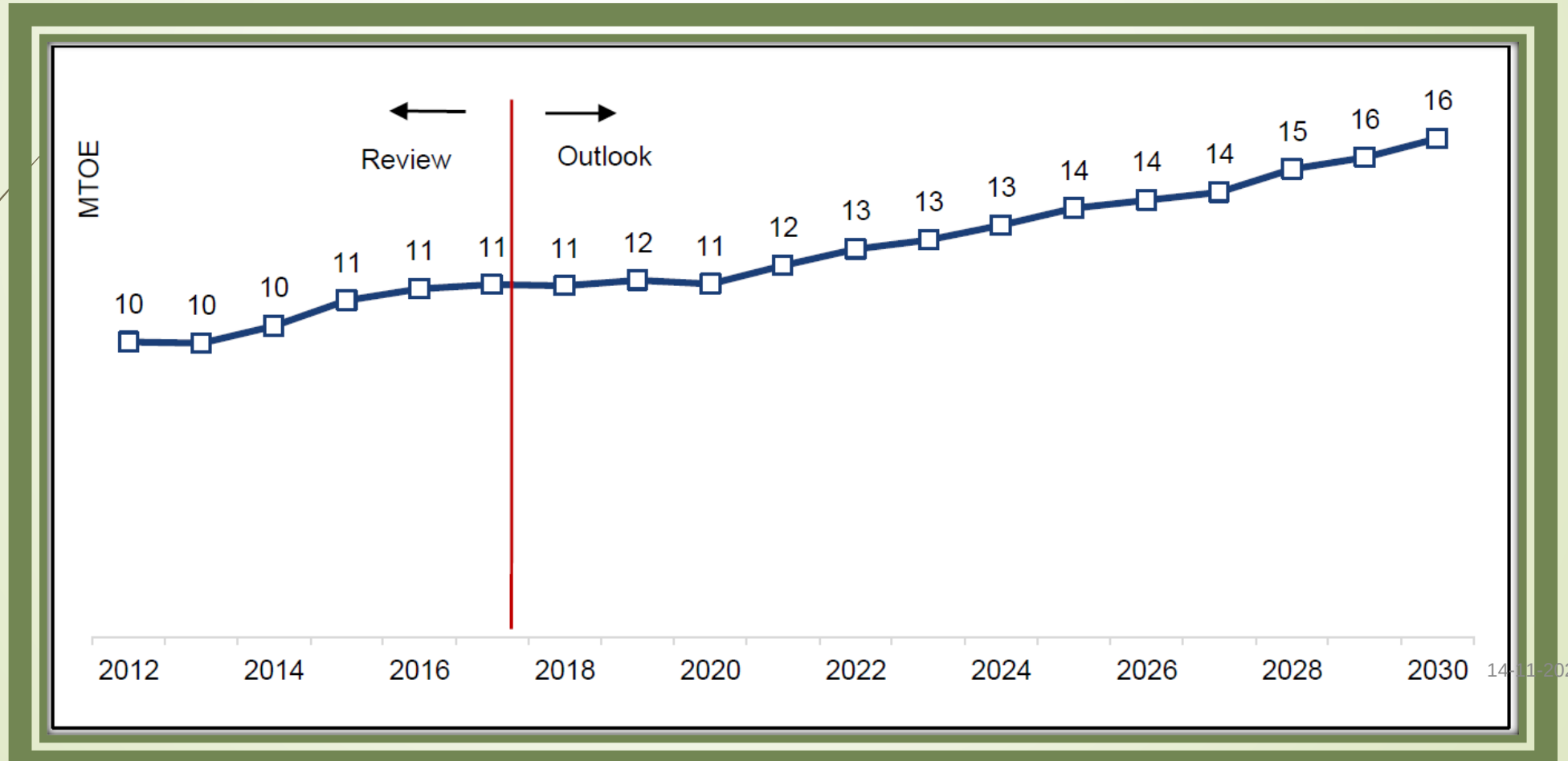




- Demand for **coal** has been growing steadily to 11.58 million tonne in fiscal 2018. With more than 10 new coal-fired power plants coming up, which would utilize produce from the Thar block, the usage of the fuel is expected to grow by 4.5 times to 60 million tonne in fiscal 2030
- **Gas** requirement (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

SAARC Country Analysis : Sri Lanka
(Ref SAARC Energy Outlook 2030 : SAARC / CRISIL)

- Energy consumption expected to grow @ 3 – 4 % till 2030



Dependence on

Petroleum Products and imports

in SAARC member countries

Source-wise share of Fossil Fuels (excluding Biomass) in SAARC member countries

Countries	Oil & LPG	Natural Gas	Coal
India	30%	6%	56%
Pakistan	29%	45%	14%
Bangladesh	26%	67%	7%
Sri Lanka	66%	0%	17%
Bhutan	34%	0	26%
Nepal	61%	0	16%
Afghanistan	35%	10%	19%
Maldives	100%	0	0

Dependence on imports of fossil fuels in SAARC member countries

Countries	Oil & LPG	Natural Gas	Coal
India	85%	50%	20%
Pakistan	75%	25%	65%
Bangladesh	95%	20%	90%
Srilanka	100%	0	100%
Bhutan	100%	0	90%
Nepal	100%		95%
Afghanistan	100%		
Maldives	100%	0	0

Dependence of fossil fuels in SAARC member countries

- SAARC member countries are overly dependent on Petroleum products
- Consumption of petroleum products, LPG and Natural Gas are slated to grow
- Dependence on imports of Petroleum products, LPG and Natural Gas are likely to rise

Does LNG offer economic respite in the increasing import bills ?

Is it ‘dependable’ and ‘affordable’ in the long-run ?

Economic Benefits of Natural Gas

India : Comparison of cost of thermal energy in Petroleum Fuels (1st Nov 2021)

Source - Industry / Author

- The landed price of Long-term LNG varies from 15 to 18 $/mmbtu at 80 $ / bbl

Fuel	Price	Unit	GCV	Unit	Price In INR/1000 Kcals	Price In USD/mmbtu
PNG Comml	55	Rs/ cm	10,000	Kcals/cm	5.5	19.0
CNG	75	Rs / kg	12,500	Kcals/Kg	6.0	20.7
14.2 kg LPG Non-Subsized	899	Rs/ Cyl	11,900	Kcals/Kg	5.3	18.4
19 Kg LPG Comml	2073	Rs / Cyl	11,900	Kcals/Kg	9.2	31.7
Petrol	110	Rs/ Litre	8269	K cals/litre	13.3	45.9
Diesel	100	Rs/ Litre	9185	Kcals/Litre	10.9	37.6
Naphtha	70	Rs/ Kg	11,500	Kcals/kg	6.1	21.0

Notes

1. GCV of Petrol is 11,100 Kcals/Kg and density is 0.745 Kg/litre

2. GCV of Diesel is 11,000 Kcals/Kg and density is 0.835 Kg/litre

3. GCV of CNG is 10,000 Kcals/cu metres or 12,500 Kcals/kg

4. GCV of LPG is 11,900 Kcals/kg

5. Exchange rate is 1 USD = 73 INR

6. Conversion of units : 1 K cal = 3.966 btu

Pakistan : Comparison of cost of thermal energy in petroleum fuels (1 Nov 2021

Source - Industry / Author

- As per OGRA Notification, the provisional prices for Distribution of LNG for SNGPL & SSGC for Sep 2021 were 15.34 & 15.09 $/mmbtu (excl GST)
- Prevailing prices of petroleum products as per available from published news / dailies

Fuel	Price	Unit	GCV	Unit	Price In PR/1000 Kcals	Price In USD/mmbtu
CNG Region1	81.8	Rs/kg	12,500	Kcals/Kg	6.5	**9.7**
CNG Region2	140	Rs/kg	12,500	Kcals/Kg	11.2	**16.6**
LNG Prices SNGPL						**15.34**
LNG Prices SSGC						**15.09**
11.8 Kg LPG Household	2403	Rs/Cyl	11,900	Kcals/Kg	14.2	**21.1**
45.4 Kg LPG Comml	9247	Rs / Cyl	11,900	Kcals/Kg	40.9	**60.7**
Petrol	137.65	Rs/Litre	8269	K cals/litre	16.6	**24.7**
Diesel	134.35	Rs/litre	9185	Kcals/Litre	14.6	**21.7**

Notes

1. GCV of Petrol is 11,100 Kcals/Kg and density is 0.745 Kg/litre
2. GCV of Diesel is 11,000 Kcals/Kg and density is 0.835 Kg/litre
3. GCV of CNG is 10,000 Kcals/cu metres or 12,500 Kcals/kg
4. GCV of LPG is 11,900 Kcals/kg
5. Exchange rate is 1 USD = 200 PR
6. Conversion from Kcals to btu : 1 K cal = 3.966 btu

Bangladesh : Comparison of cost of thermal energy in petroleum fuels (1st Nov 2021)

Source - Industry / Author

Fuel	Price	Unit	GCV	Unit	Price In BDT/1000 Kcals	Price In USD/mmbtu
LPG Cylinder (12 KG)	1259	Rs/ Cyl	11,900	Kcals/kg	8.8	26.46
CNG	43	BDT/cum	10000	Kcals/cum	4.3	12.91
Petrol	89	BDT/Litre	8269	K cals/litre	10.76	32.31
Diesel	80	BDT/litre	9185	Kcals/Litre	8.71	26.14

Notes

1. GCV of Petrol is 11,100 Kcals/Kg and density is 0.745 Kg/litre
2. GCV of Diesel is 11,000 Kcals/Kg and density is 0.835 Kg/litre
3. GCV of CNG is 10,000 Kcals/cu metres or 12,500 Kcals/kg
4. GCV of LPG is 11,900 Kcals/kg
5. Exchange rate is 1 USD = 84 BDT
6. Conversion from Kcals to btu : 1 K cal = 3.966 btu

Loss to BPC on HSD 1147.6 Crores Takas from June to Oct 2021

Sri Lanka : Estimated Landed Cost

(As per Industry Norms / Author)

Estimation of Landed LNG / NG Prices in Sri Lanka			
A) Crude Prices (in $/bbl)	50	70	80
B) DES at Crude Parity 12.5% (in $/mmbtu)	6.25	8.75	10
C) Regasification and Other	2	2	2
D) Pipeline Tpt Costs	1	1	1
E) Bulk Consumer Costs (B+C+D)	**9.25**	**11.75**	**13**
F) Retail Distribution Costs	4	4	4
G) Retail Consumers Costs (E+F)	**13.25**	**15.75**	**17**

Notes

1.Term contract prices are negotiable and downward prices can be explored

2. Liquefaction, Pipeline and Distribution costs can be higher if consumption is low

Sri Lanka : Cost benefit in LNG

(Source : Author / Industry data)

Fuel	Price	Unit	Price In SL Rs/1000 Kcals	Price In USD/mmbtu	Price of LNG for Retail		Price of LNG for Bulk	
					Crude @ 80 $/bbl	Benefit	Crude @ 80 $/bbl	Benefit
LPG Cyl 12.5	1493	Rs/Cyl	10.04	13.68	17	**-4%**	13	**44%**
Petrol 92	137	Rs/Litre	16.57	22.58	17	**37%**	13	**80%**
Petrol 95 Oct	161	Rs/Litre	19.47	26.54	17	**46%**	13	**89%**
Auto Diesel	104	Rs/Litre	11.32	15.43	17	**8%**	13	**55%**
Diesel (Euro 4)	132	Rs/Litre	14.37	19.59	17	**27%**	13	**72%**
HFO	96	Rs/Litre	8.57	11.68	17	**-22%**	13	**28%**
Industrial Kerosene	110	Rs/Litre	12.39	16.88	17	**16%**	13	**62%**

Notes

1. Densities(in Kg/litre) : Petrol - 0.745, Diesel 0.835, HFO - 0.95

2. Exchange rate is 1 USD = 185 SL Rupees

3. Landed price of LNG as per the estimates of author

4. Prevailing prices as per CEYPETCO as on 1st April 2020

Bhutan : Estimated Landed Cost

(Source : Author / Industry data)

Landed cost of Virtual LNG Supply Chain (by Road Transportation)			
A) Crude Prices (in $/bbl)	50	65	80
B) DES at Crude Parity 12.5% (in $/mmbtu)	6.25	8.125	10
C) Other costs (in $/mmbtu)	2	2	2
D) Road Transportation (in $/mmbtu)	3	3	3
E) Bulk Consumer Costs (B+C+D) (in $/mmbtu)	**11.25**	**13.125**	**15**
F) Retail Distribution Costs (in $/mmbtu)	5	5	5
G) Retail Consumers Costs (E+F) (in $/mmbtu)	**16.25**	**18.125**	**20**

Notes

1.Term contract prices are negotiable and downward prices can be explored

2. Transportation costs are for 1000 kms (Ex Dhamra), can come down Ex- Kukrahati / Haldia

3. Retail Distribution costs can be higher due to high cost of land and low consumer density

Bhutan : Comparison of cost of thermal energy in fuels

(Source : Author / Industry data)

Fuel	Price	Unit	GCV	Unit	Price In Nu/1000 Kcals	Price In USD/mmbtu
14.2 kg LPG Subsidized	997	Nu/Cyl	11,900	Kcals/Kg	5.9	20.4
14.2 kg LPG -Non Subsidised		Nu/Cyl	11,900	Kcals/Kg	0.0	27.1
19 Kg LPG Comml		Nu/Cyl	11,900	Kcals/Kg	0.0	27.1
Petrol	86	Nu/Litre	8269	K cals/litre	10.4	35.9
Diesel	83	Nu/litre	9185	Kcals/Litre	9.0	31.2
LNG (Virtual) Bulk (Crude Oil @ 80$/bbl)						15
LNG (Virtual) - Retail (Crude Oil @ 80$/bbl)						20

Notes

1. GCV of Petrol is 11,100 Kcals/Kg and density is 0.745 Kg/litre

2. GCV of Diesel is 11,000 Kcals/Kg and density is 0.835 Kg/litre

3. GCV of CNG is 10,000 Kcals/cu metres or 12,500 Kcals/kg

4. GCV of LPG is 11,900 Kcals/kg

5. Exchange rate is 1 USD = 73 Nu

6. Conversion : 1 K cal = 3.966 btu

Nepal : Estimated Landed Cost (Virtual)

Landed cost of Virtual LNG Supply Chain (by Road Transportation)			
A) Crude Prices (in $/bbl)	50	65	80
B) DES at Crude Parity 12.5% (in $/mmbtu)	6.25	8.125	10
C) Other costs (in $/mmbtu)	2	2	2
D) Road Transportation (in $/mmbtu)	3	3	3
E) Bulk Consumer Costs (B+C+D) (in $/mmbtu)	**11.25**	**13.125**	**15**
F) Retail Distribution Costs (in $/mmbtu)	3	3	3
G) Retail Consumers Costs (E+F) (in $/mmbtu)	**14.25**	**16.125**	**18**

Notes

1.Term contract prices are negotiable and downward prices can be explored

2. Transportation costs are for 1000 kms (Ex Dhamra), can come down Ex- Kukrahati / Haldia

3. Retail Distribution costs can be higher due to high cost of land and low consumer density

Nepal : Comparison of cost of thermal energy in fuels

(Source : Author / Industry data)

Fuel	Price	Unit	GCV	Unit	Price In NR/1000 Kcals	Price In USD/mmbtu
14.2 kg LPG	1400	NRs/Cyl	11,900	Kcals/Kg	8.3	17.4
Petrol	130	NRs/Litre	8269	K cals/litre	15.7	33.0
Diesel	113	NRs/litre	9185	Kcals/Litre	12.3	25.9
Coal	20	NRs/kg	4000	kcals/kg	5.0	10.5

Notes

1. GCV of Petrol is 11,100 Kcals/Kg and density is 0.745 Kg/litre

2. GCV of Diesel is 11,000 Kcals/Kg and density is 0.835 Kg/litre

3. GCV of CNG is 10,000 Kcals/cubic metre or 12,500 Kcals/kg

4. GCV of LPG is 11,900 Kcals/kg

5. Exchange rate is 1 USD = 120 NRs

6. Conversion from Kcals to btu : 1 K cal = 3.966 btu

Nepal : Comparison of cost of thermal energy in fuels

(Source : Author / Industry data)

Fuel	Price	Unit	Price In NR/1000 Kcals	Price In USD/mmbtu	Price for LNG for Retail (Crude@ 80 $/bbl)		Price for LNG for Retail (Crude @ 80 $/ bbl)	
					Price	Benefit	Price	Benefit
14.2 kg LPG	1400	NRs/Cyl	8.3	17.4	14	20%	18	-3%
Petrol	130	NRs/Litre	15.7	33.0	14	**58%**	18	**46%**
Diesel	113	NRs/litre	12.3	25.9	14	**46%**	18	**30%**
Coal	20	NRs/kg	5.0	10.5	14	-33%	18	-71%
Notes								
1. GCV of Petrol is 11,100 Kcals/Kg and density is 0.745 Kg/litre								
2. GCV of Diesel is 11,000 Kcals/Kg and density is 0.835 Kg/litre								
3. GCV of CNG is 10,000 Kcals/cubic metre or 12,500 Kcals/kg								

Analysis of

Demand – Supply for NG/LNG

in SAARC member Countries

(Ref : SARI –EI Report on Potential of Intra-regional trade in Natural Gas -2021 / Author)

Demand- Supply Analysis : India

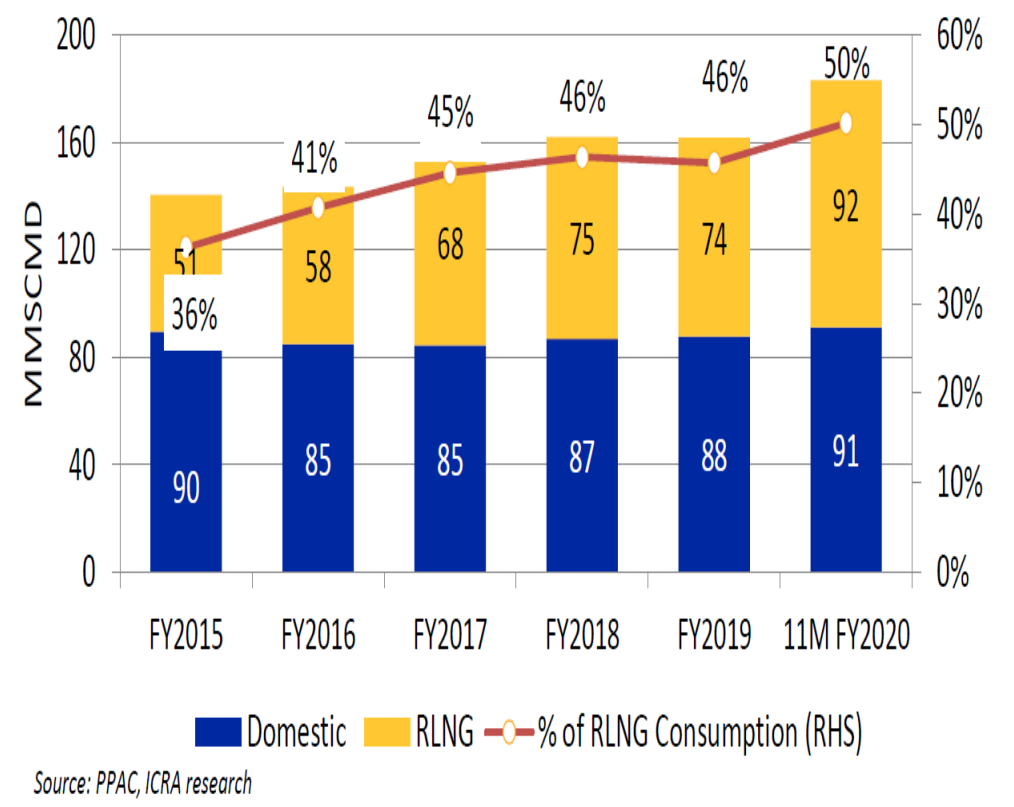
Gas Supply Analysis

- Government plans to increase its share of gas in India's energy basket from 6% to 15% by 2030.
- Strong policy support from the government / upstream regulator (DGH) to encourage E&P
- Present gas consumption -170 mmscmd (domestic plus Re-gasified LNG).
- Domestic production is likely to grow from 92 MMSCMD To 125 in 2025 and 137 by 2027
- **6 RLNG terminals are in operation with an effective capacity of 26.9 MTPA (nameplate capacity – 40.5 MTPA) and**
- **By 2025, the capacity expansion of existing and all 4 New terminals under construction are expected to be completed to reach an LNG capacity of 66.5 MTPA**

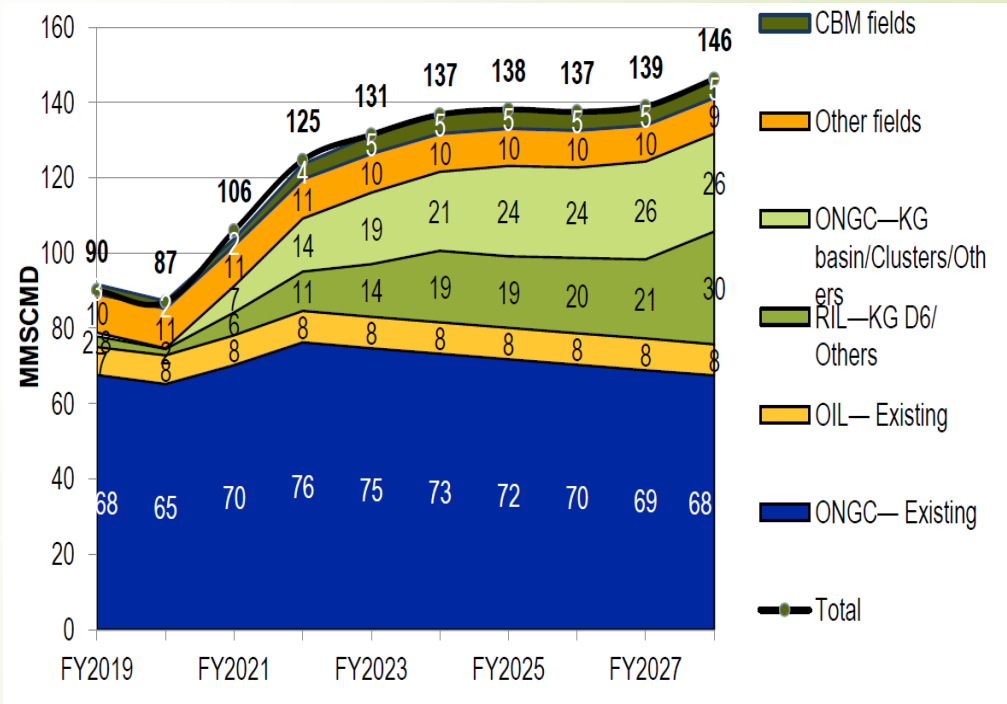
India : Gas supplies : Domestic

- **Domestic supplies in 2019 were 88 mmscmd.**
- **As per the industry sources indigenous gas supplies are likely to reach about 147 mmscmd by 2027**

Share of Domestic Gas & RLNG (MMSCMD)



Gas Supply Projections (MMSCMD)



Source: *ICRA Research*

PPAC: Petroleum Planning & Analysis Cell

India : Gas Supplies : RLNG

A capacity of 41 MTPA (about 150 MMSCMD) is expected to be available by FY 2021.

By 2025, the capacity is expected to reach 66.5 MMTPA (about 240 mmscmd).

Company Name, Location (MMTPA)	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25
PLL, Dahej	15	15	15	16.2	17.5	17.5	18.1	20.0	20.0
PLL Kochi – Effective	0.4	0.5	0.5	0.5	2	2.5	2.5	2.5	2.5
Shell, Hazira	5	5	5	5	5	10	10	10	10
RGPPL, Dabhol	3	3	3	3	3	5	5	5	5
GSPC-Adani, Mundra				0.5	5	5	5	5	5
IOC, Ennore				0.7	5	5	5	5	5
H-Energy-Jaigarh port, Ratnagiri					4	4	4	4	4
Adani Enterprises, IOC and GAIL - Dhamra						2.5	5	5	5
Swan Energy, Jafrabad						5	5	5	5
HPCL, Shapoorji Pallonji - Chhara							2.5	5	5
Total LNG Capacity (MMTPA)	**23.4**	**23.5**	**23.5**	**25.9**	**41.5**	**56.5**	**62.1**	**66.5**	**66.5**

India : Gas demand : Segment-wise

Segment – wise demand analysis

- **CGD :** Growth at 15% till 2027 and 10% thereafter
- **Refineries :** Growth driven by higher gross margins on gas and commensurate with pipeline connectivity due to substitution of fuel for self consumption.
- **Industry :** Driven by tighter emission norms, price arbitrage over diesel and connectivity in almost all important industrial belts by 2023.
- **Fertilizers :** Organic growth as per the domestic requirement, least dependence on imports
- **Power :** Demand potential depending on LNG prices. As per our analysis, Gas-based power offers lower-priced power than Battery system

Approximate Electricity Tariffs in India

Generation Source	Tariffs (in Rs /Unit)
Coal-based (Variable Charge)	
Pithead (with 100% linkage with notified domestic coal)	1.5 to 2.0
Rail-fed (with 100% linkage with notified domestic coal)	3.0 to 4.0
Rail fed (80% linkage coal with 20% imported coal)	3.5 to 4.25
100% Imported coal based (Landed price 70 $/t for 5000 GAR)	6.0 – 7.0
Gas-based (Variable Charge)	
Domestic APM Gas based (Gas price 2.39 $/mmbtu)	2.1 to 2.6
RLNG-based (Delivered Gas price at 12 $/mmbtu)	7.0 to 7.5
Competitive bid based (Levelised Tariffs)	
Wind plants (2018 & 2019)	2.6 to 2.8
Solar plants (2018-19)	2.6 to 2.7
Medium Term PPA (PTC) -2018	4.5
Medium Term PPA (PTC) -2020	3.4

PPA - Power purchase Agreement, PTC - Power Trading Corporation

India : Gas Supply Scenarios- Domestic + RLNG

Reference Scenario						
Source		**2019**	**2020**	**2025**	**2030**	**2040**
RLNG	**In MTPA**	23.5	25.9	66.5	76.5	96.5
	Terminal Utilization in %	87	85	85	80	80
	Gas (mmscmd)	74	79	203	220	278
Domestic Gas	**(mmscmd)**	90	87	138	154	155
Total Gas (in mmscmd)		**164**	**166**	**341**	**374**	**433**

India : Demand-Supply Gap & Analysis

Demand- Supply Gap : Reference Scenario (Low Crude, Soft LNG , High Demand)				
	2020	2025	2030	2040
Demand	197	278	382	530
Supply	166	341	374	433
Gap	31	(-)63	8	97

Demand- Supply Gap : Conservative Scenario (High Crude / LNG prices, low demand)				
	2020	2025	2030	2040
Demand	197	262	359	507
Supply	166	341	374	433
Gap	31	(-)79	(-)15	74

Demand- Supply Analysis : Pakistan

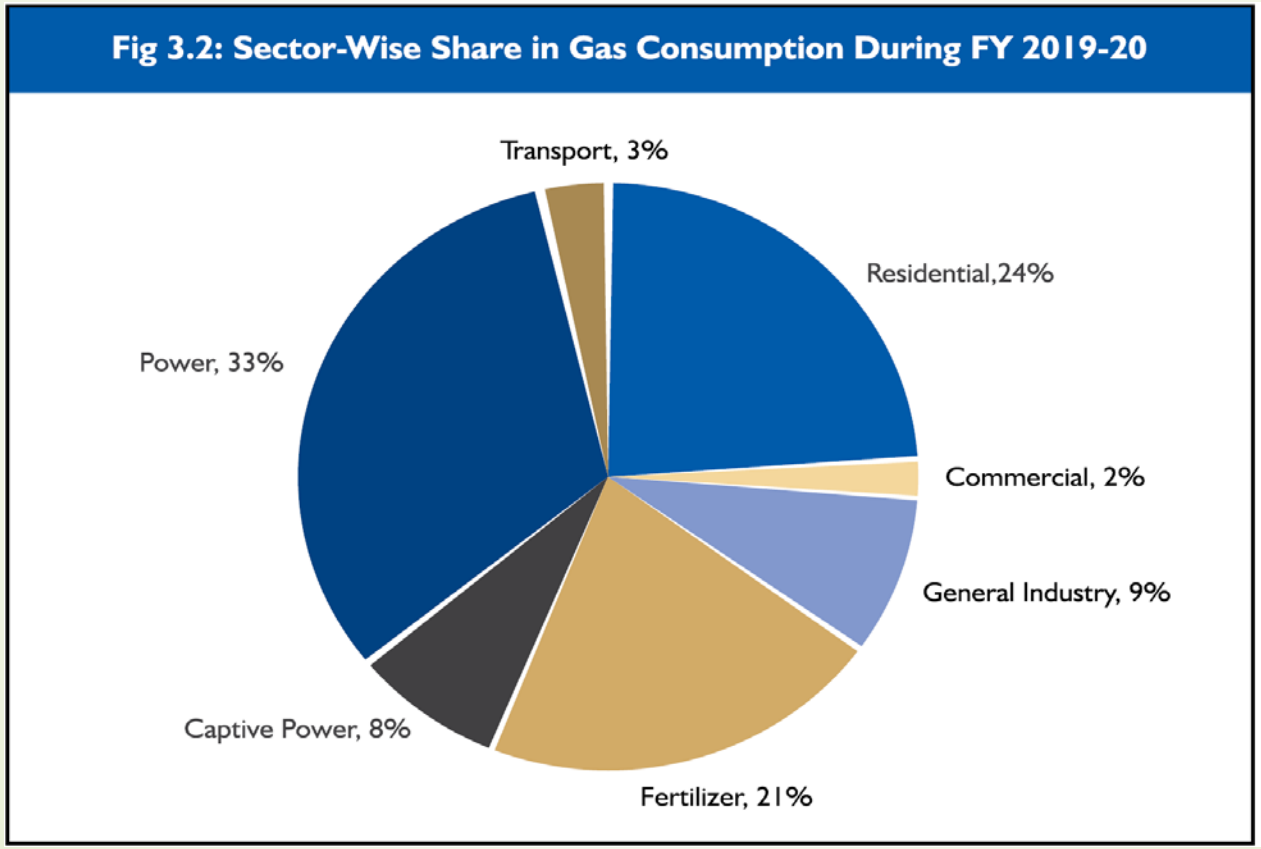
Assumptions for Gas Supplies

- Decline in the Domestic Gas production from existing 87 MMSCMD to 62 by 2025, 44 by 2030, 37 by 2035 and 34 MMSCMD by 2040
- Gas imports from Iran (I-P) and Turkmenistan (TAPI)to commence from 2024-25 and ramp up gradually
- Regasified LNG from existing and future LNG Terminals :
  - Existing : Engro Elengy Terminal (4.5 MTPA) and GasPort LNG (5.2 MTPA) with Terminal's utilization to grow gradually to 80% in 2025 and 90% by 2030
  - Future : Energas (5.2 MTPA) Tabeer (5.2 MTPA), Fatima (5.2 MTPA) Engro Expansion (1.05 MTPA), GasPort Expansion (0.63 MTPA) to come on stream between 2022 - 2024

Pakistan : Gas Demand Analysis

Sector-wise consumption

(Source : OGRA)



Demand- Supply Analysis : Pakistan

Assumptions for Demand

- Sector – wise bottom up approach was assumed
- Gas demand for the following sector was assumed as per the growth rates
  - **Power** : Growth rates of gas consumption for all existing Gas based power plants.
  - **Fertilizer** : Gas consumption growth as per the existing share in total gas
  - **Industry** : Gas consumption growth at CAGR of the Industrial GDP Growth
  - **Domestic & Commercial** : Growth of connections, consumption per connection
  - **CNG** : Prevailing growth of consumption as per the share in total gas

However, if the IGCEP 2018-40 is implemented, the Gas-based generation capacity would come down from 12,172 MW in 2020 to 8512 MW by 2030 and to 7965 MW by 2040. Demand for gas would come down to 30 MMSCMD

Demand- Supply Analysis : Pakistan

Demand -Supply Analysis - Pakistan					
					All figures in MMSCMD
YEAR	2020	2025	2030	2035	2040
GAS DEMAND	**120**	**150**	**179**	**207**	**237**
Power Sector	38	46	54	61	68
GAS SUPPLIES					
Domestic Production	**87**	**62**	**44**	**37**	**34**
RLNG	**15**	**75**	**90**	**90**	**90**
Iran - Pak		**1**	**7**	**14**	**20**
TAPI		**2**	**30**	**60**	**80**
TOTAL	**102**	**140**	**171**	**201**	**224**
GAP	**18**	**10**	**8**	**6**	**13**

Notes

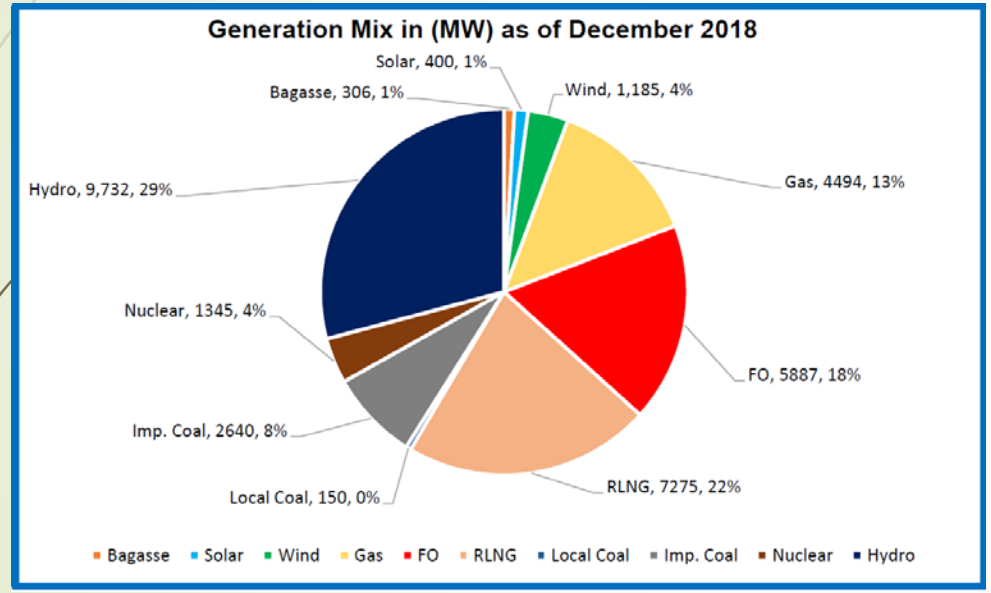
Gas demand includes Power, Fertilizers, CGD, Indusutry

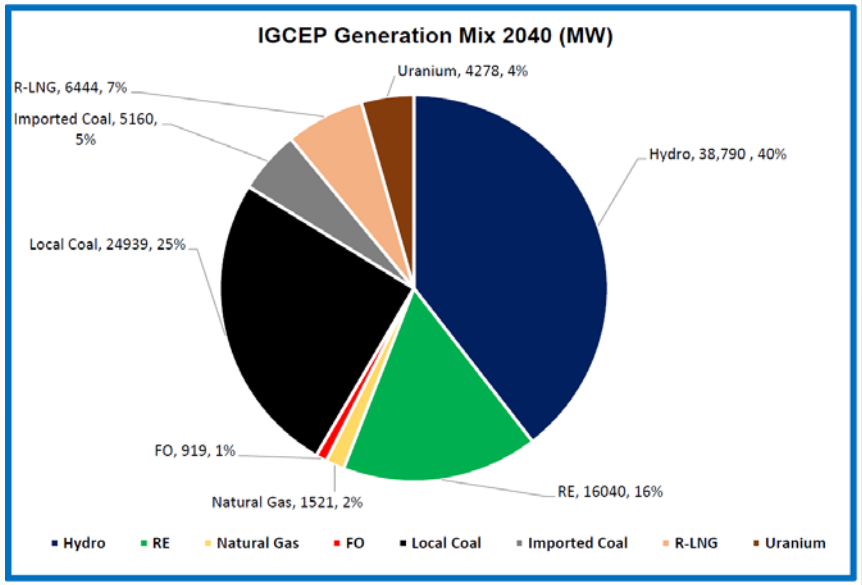
RLNG Terminals utilization has been takenas 80% in 2025 and increasing to 90% in 2030 and thereafter

As per the recent IGCEP projections, Power sector demand is to shift from gas to coal, (8512 MW by 2030 & 7915 MW by 2040)

Pakistan : Generation Mix

Indicative Generation Capacity Expansion Plan / NEPRA





Demand- Supply Analysis : Bangladesh

- Bangladesh is the only gas-based economy in the region. Its GDP growth rate is the highest in the SAARC region.
- Availability of cheap Natural Gas has helped the nation to withstand challenges of imports of petroleum & LPG, and register phenomenal growth.
- However, its domestic gas production is declining, compelling the country to plan for
  - Efficiency in demand side management , particularly in power generation
  - Intensive pursuit of its E&P projects in Off-shore shallow and deep sea basins.
  - Installation of two FSRUs at Moheshkhali, the most suitable site on its sea coast.
- **The country plans to be a developed economy by 2041.**
- The growth in demand and supply and its energy planning has been captured in the PSMP 2016, and GSMP 2017. These have been recently updated to chart a better course for fuelling its growth.

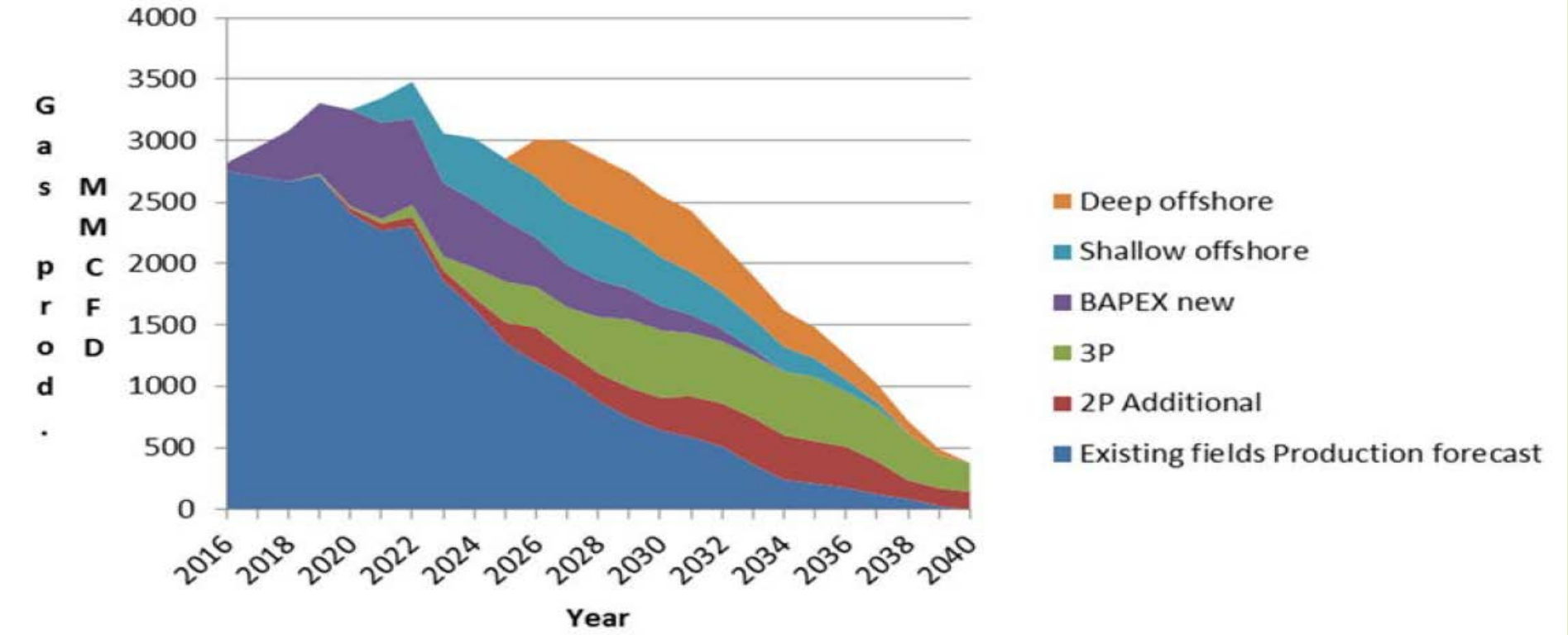
Demand- Supply Analysis : Bangladesh

- **Power System Master Plan (PSMP) 2016**
  - Prepared by Bangladesh Government / BPDB in cooperation with JICA
  - Segment-wise growth and decline in gas production.
  - ***The Reference PSMP 2016*** scenario advocates more coal-based capacity

- **Gas Supply Master Plan (GSMP) 2017**
  - Prepared by Bangladesh Govt / Petrobangla in consultation with Ramboll after PSMP 2016
  - Takes into account the delays in implementation of coal based capacity, and projects three scenarios,
    - ***Modified PSMP (Scenario A),***
    - ***High Growth (9%GDP) (Scenario B), and***
    - ***Climate Change scenario (Scenario C).***
  - ***Demand in Scenario C is considered as a more likely scenario.***
  - ***Actual demand projections shall be progressively fine-tuned by BPDB & Petrobangla.***
  - **Two domestic gas supply scenarios are projected after considering the unexplored reserves and projects**

Bangladesh : Gas Production

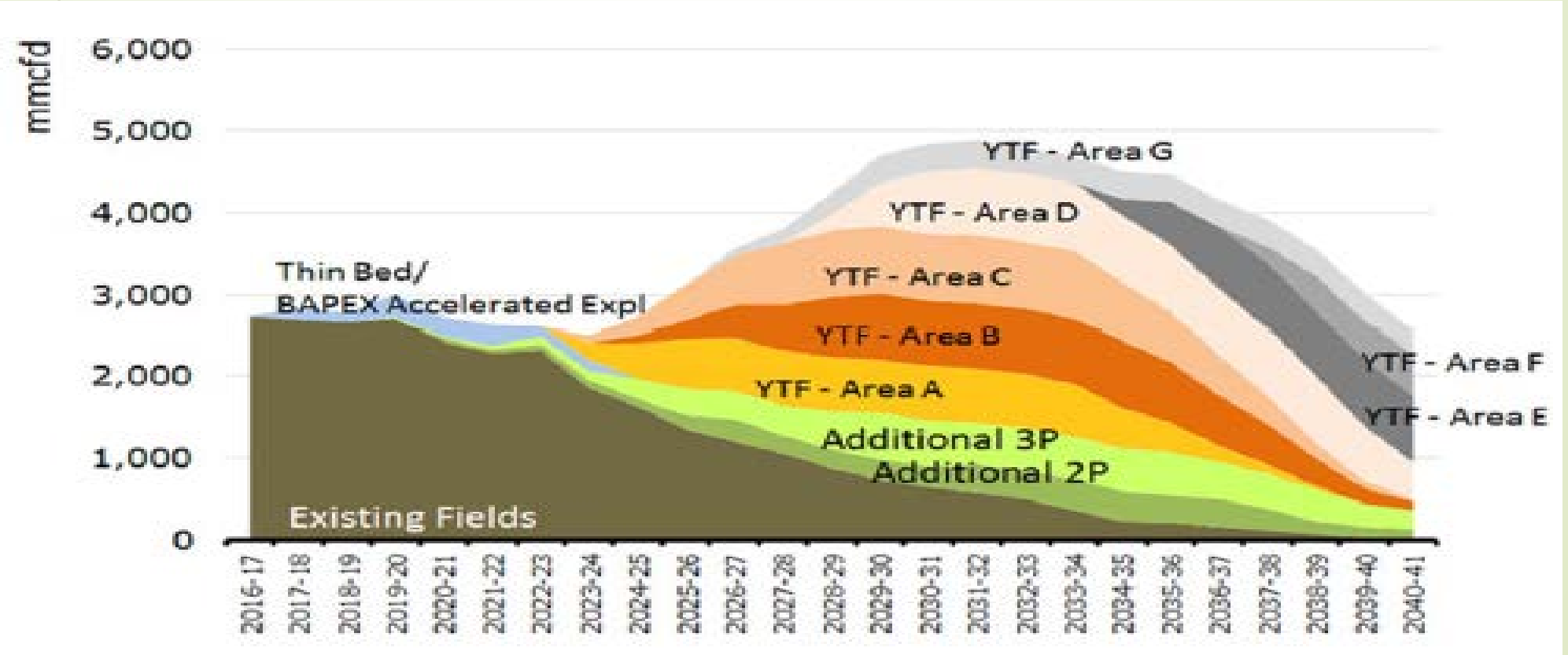
Realistic Scenario – Proven, Probable, Possible (3P) + 6.4 tcf of YTF(Yet to find) reserves



Source: GSMP 2017

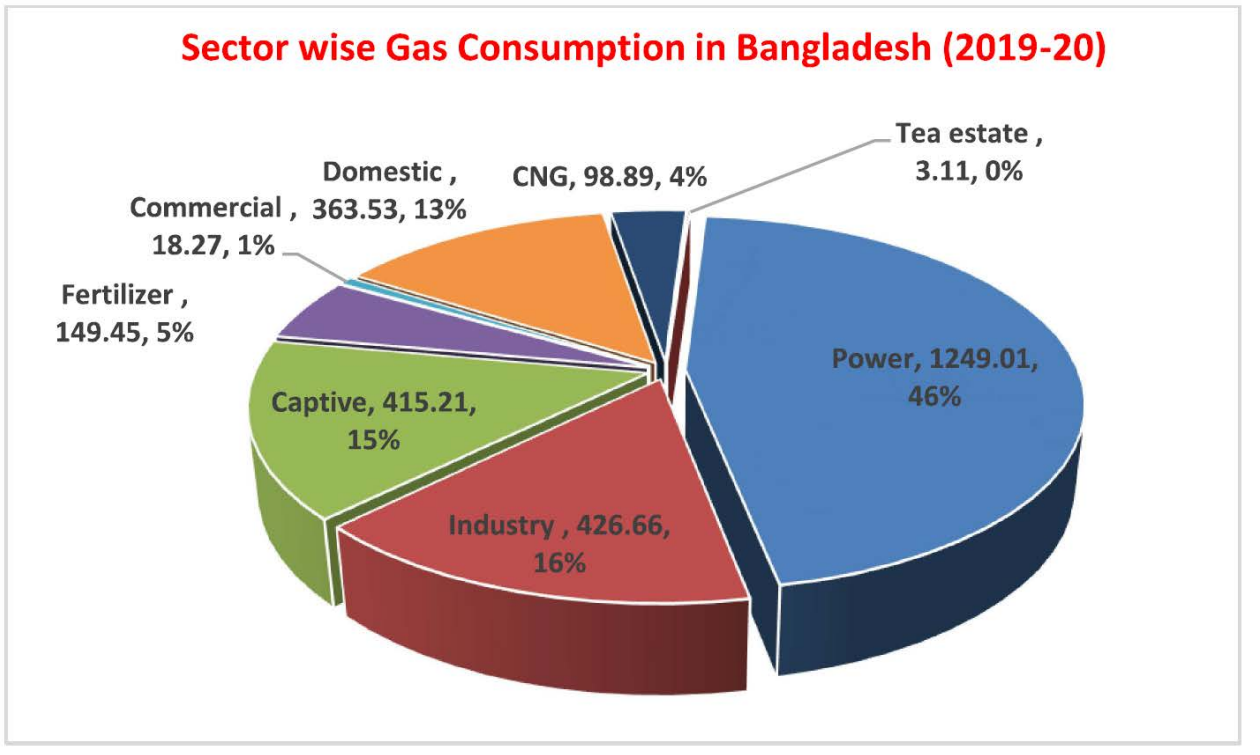
Bangladesh : Gas Production

High Production Scenario – Proven, Probable, Possible(3P) and 34 tcf of YTF

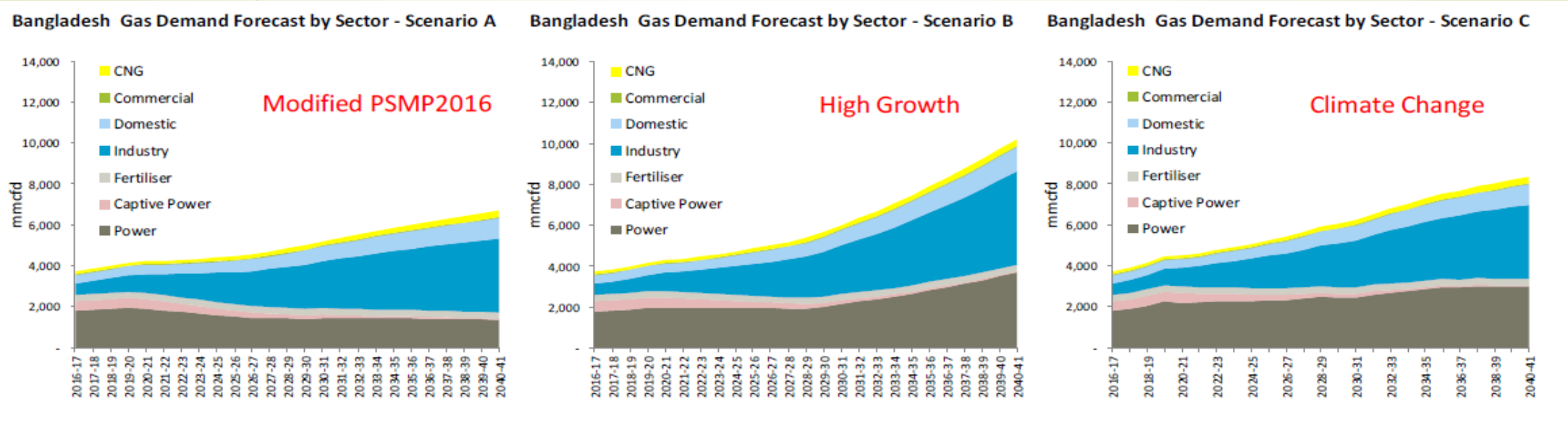


Source: GSMP 2017

Bangladesh : Sector-wise gas consumption



Gas Demand in the three scenarios in GSMP (Gas Sector Master Plan)



Gas Demand in mcfd (as per GSMP 2017)			
Year	Scenario A	Scenario B	Scenario C
2025	4467	4876	5257
2030	5207	6012	6228
2040	6713	10208	8346

Source: GSMP, 2017

DEMAND – SUPPLY GAP ANALYSIS

- **Scenario 1 : Demand as per 'Climate Change' and Supply as per Realistic (3P + 6.4 tcf of YTF)**
- **Scenario 2 : Demand as per 'Climate Change' and Supply as per High Exploration (3P + 34 tcf of YTF)**
- **Scenario 3 : Demand as per Modified PSMP and Supply as per Realistic (3P + YTF of 6.4 tcf)**
- **Scenario 4 : Demand as per Modified PSMP and Supply as per High Exploration (3P + YTF of 34 tcf**

Bangladesh : Expected Demand Supply Gap

Demand - Supply Gap Analysis									
	Year 2025			Year 2030			Year 2040		
	Demand	Supply	Gap	Demand	Supply	Gap	Demand	Supply	Gap
Scenario 1	5250	3000	2250	6250	2500	3750	8300	500	7800
Scenario 2	5250	3000	2250	6250	4750	1500	8300	2500	5800
Scenario 3	4450	3000	1450	5200	2500	2700	6700	500	6200
Scenario 4	4450	3000	1450	5200	4750	450	6700	2500	4200

Country Analysis : Sri Lanka

Gas Supplies : Sri Lanka is yet to strike gas from its basins

Upstream Oil & Gas : E&P Scenario

- The nation has three sedimentary basins : Mannar, Cauvery and Lanka basins.
- In 2012, Cairns made **two discoveries of gas in Mannar Basin, the 'Barracuda' and 'Dorado'** reservoirs, estimated to have the 'Gas Initially in Place' (GIIP) **reserves in excess of 2 tcf**, but it relinquished these blocks.
- Sri Lanka has planned to develop **a multi-client data repository**, which can be offered to prospective developers.
  - From 2016, it has tied up with **Total SA, Schlumberger and Bell Geospace** for collecting more exploratory and seismic data.
  - It claims to posses about **18,000 kms of Magnetic and Gravity data** and about **19,000 kms of 2D Seismic data** in its repository and has invited prospective E&P companies to commercially exploit its reserves.

Sri Lanka : Policy shift to Gas

- Sri Lanka is incurring **substantial subsidy** on Petroleum Products and LPG
- In its '***National Energy Policy & Strategies 2019***', gas is the fuel of preference
- A '***National Policy on Natural Gas (NPNG)'*** has also been drafted. The share of gas in the energy mix is targeted to grow to a third by 2030.
- Sri Lanka government has approved an ***Energy-mix policy***, wherein, two thirds of electricity generation is to be met by firm energy capacity mix comprising of LNG (30%), Coal (30%), Fossil Fuels (15%) and Large Hydro (25%).
  - The policy is the basis for the generation mix in the 20-year ***Long Term Generation Expansion Plan (LTGEP) 2020 – 2039.***

Demand- Supply Analysis : Sri Lanka

- The revised Long-term Generation expansion plan (LTGEP 2020-39) was analysed for demand for gas
- The growth of petroleum products and LPG were projected
- Based on the price arbitrage, the penetration of Gas in petroleum and LPG were nominally assumed
- Three scenarios were plotted for
  - Scenario 1 : Gas penetration only in the power sector
  - Scenario 2 : Scenario 1 + Gas penetration in petroleum and LPG segment
  - Scenario 3 : Scenario 2 + 25% higher penetration in Power sector replacing coal

Sri Lanka : LNG Demand Summation in Different Scenarios

LNG Demand Summation (in MTPA)					
	2020	**2025**	**2030**	**2035**	**2039**
Scenario 1 : Ref LTGEP	0.0	0.8	1.1	1.3	1.5
Scenario 2 : Ref LTGEP + Other segments	0.0	1.4	3.2	3.8	4.9
Scenario 3 : 25% Shift from Coal to Gas in reference LTGEP + Other segments)	0.0	1.7	3.6	4.4	5.6

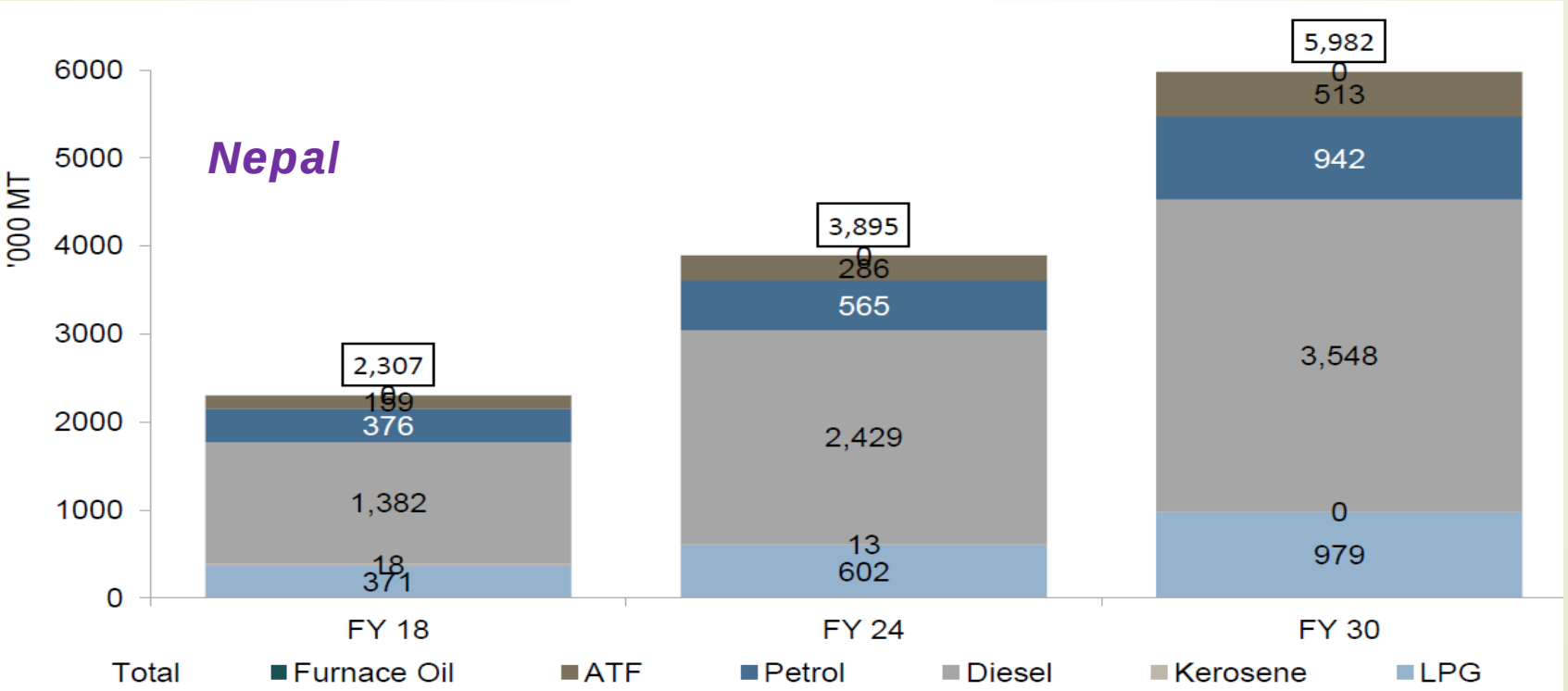
Sri Lanka : Exploring LNG Trade options : Hambantota LNG Hub

- The IMO 2020 regulations restrict the sulphur content in bunker fuels, and, there has been a spate of new orders for vessels with propulsion systems which include LNG also.
- Hambantota is a deep sea port, strategically located, mid-way in Asia-Pacific and Gulf sea trade route, and is also on the sea trade route between Asia-Pacific and Europe
- In Aug 2020, Sri Lanka's Board of Investments inked an agreement with Pearl Energy (Pvt) Ltd to launch an FSRU-based LNG trade terminal at Hambantota
- The terminal can have multiple use, refuelling vessels, help to meet Sri Lanka's future gas demand, and further, also offer sourcing options for LNG terminals in India & Bangladesh and vice-versa.

Country Analysis – Nepal

- Petroleum products comprise about 61% of Nepal's commercial energy basket.
- A major chunk of its population and industrial activity is in four provinces bordering India.
- The bordering areas in India are already awarded to entities under CGD bidding rounds of 2018 & 2019, and will have access to gas in a few years.
- Three gas supply options were considered
  - Option A : Trunk pipeline from India
  - Option B : Multiple 'small-diameter short-distance' pipelines' from India's adjoining CGD network
  - Option C : 'Virtual' or 'Small-scale LNG'
- Landed cost was worked out and Virtual LNG was preferred as its cost and gestation time is least.
- Later on, once penetration sets in, multiple small diameter and short distance pipelines can be laid connecting via the various entities of CGD in the bordering areas.

Nepal : Growth of Petroleum Products



Source : CRISIL SAARC Energy Outlook 2030

Nepal : Gas Penetration in Energy Consumption

	2018	2025			2030			2040		
	Consumption	Quantity	Level of Substitution	Eq Gas Quantity	Quantity	Level of Substitution	Eq Gas Quantity	Quantity	Level of Substitution	Eq Gas Quantity
A) Petrol	376	585	10%	59	942	20%	154	2,034	20%	334
B) Diesel	1,382	2,429		334	3,548		720	7,840		1,419
a) Transport	1,106	1,943	5%	80	2,838	15%	349	6,720	15%	827
b) Industry	152	267	75%	164	390	75%	240	648	75%	398
c) Others	124	219	50%	90	319	50%	131	473	50%	194
C) LPG	371	602	15%	90	979	30%	294	2,193	30%	658
D) Coal	1,198	1,892	5%	47	2,985	10%	149	6,444	10%	322
Total				530			1,318			2,732
Notes										

Petrol & Diesel in thousand KL, Coal in thousand MT, LPG in thousand MT, Gas in thousand MT

The estimated gas consumption has factored in the equivalent gas for different types of fuels.

Country Analysis – Bhutan

- Hydropower forms the bulk of energy source
- Petroleum products comprise about 34% in the commercial energy basket.
- Coal's share is about 26%, but mostly for its steel sector and substitution by gas may not be feasible.
- Like Nepal, all the bordering areas with India are covered under CGD bidding rounds of 2018 & 2019, and will have access to gas.
- Like Nepal, landed cost of three options were worked out.
- Laying a trunk pipeline was not found to be techno-economically feasible.
- **'Virtual' or 'Small-scale LNG' was found to be more economical.**
- **At the estimated landed cost of gas, retail petrol and subsidized LPG may not benefit in switch to gas at the prevailing price / taxes.**
- **Penetration opportunities do exist in bulk consumers of HSD and commercial LPG (Bhutan's quota of subsidized LPG from India is limited).**

Bhutan : Likely demand for LNG by Fuel Switch in Bhutan

Fuel	Growth Rate	2017	2018	2025		2030		2035		2040	
				Expected Demand	Switch Over	Expected Demand	Switch Over	Expected Demand	Switch Over	Expected Demand	Switch Over
Petrol	9% till 2030, 5% post 2030	0.02	0.04	0.07	0.00	0.11	0.00	0.14	0.00	0.18	0.00
Diesel	6.7% till 2030 and 4.5% thereafter	0.12	0.14	0.21	0.01	0.29	0.02	0.36	0.05	0.44	0.06
LPG	7.3% till 2025, 6% therafter	8	9.30	14.19	1.35	18.99	2.71	25.42	4.83	34.01	8.08
LNG Demand					0.009		0.025		0.046		0.059

The demand for Petrol and Diesel is in Million MT, for LPG in Kilo MT

Notes

1 Petrol switch over to LNG : Nil

2. Diesel switch over to LNG : 5% IN 2025, 10%-2030 and 15% thereafter

3 LPG switch over to LNG : 10% IN 2025, 15%-2030, 20% IN 2035 and 25% thereafter

4. Conversion of equivalent quantities of Liquid Fuels to LNG on thermal energy basis as per industry norms

Demand- Supply Analysis : Afghanistan

- Existing gas demand is mostly from the Gas-based Fertilizer at Kod-e-Barq
- Fertilizer's capacity utilization is expected to increase to 75% by 2030
- Gas-based capacity is planned at Mazar & Sherberghan
- Growth rate of gas consumption to gradually decline from 9% in 2030 to 2.5% in 2040.

Demand -Supply Analysis - Afghanistan					
					All figures in MMSCMD
YEAR	2020	2025	2030	2035	2040
GAS DEMAND	**0.55**	**0.85**	**2**	**2.75**	**3.25**
GAS SUPPLIES					
Domestic Production	**0.4**	**0.7**	**1.1**	**1.4**	**1.8**
TAPI		**0.2**	**0.85**	**1.3**	**1.3**
TOTAL	**0.4**	**0.9**	**1.95**	**2.7**	**3.1**
GAP	**0.15**	**-0.05**	**0.05**	**0.05**	**0.15**

Demand- Supply Analysis : Maldives

- The growth of petrol and diesel have been taken as 10% , Gradually declining to 5%.
- Growth of LPG at 5% over the past consumption
- Penetration has been assumed as 5% in petrol & diesel, gradually increase to 15% till 2040
- Penetration in LPG assumed as 10% with gradual increase to 25% till 2040

Gas Demand Analysis - Maldives					
					All figures in MMSCMD
YEAR	2020	2025	2030	2035	2040
GAS DEMAND		**0.15**	**0.5**	**0.9**	**1.2**

Conclusions

- To meet the SDG # 7 (Affordable energy for all), SAARC member countries would continue to depend on fossil fuels, albeit to a lesser share.
- The future trends indicate share of Natural Gas to be about 23 – 25%
- In global gas trade, the share of LNG is expected to grow at 3-4% growth rate.
- As per the key economic growth indicators (GDP Growth, Population growth, and low Urbanization and Per capita energy consumption) energy consumption is likely to grow between 5% to 7% amongst the SAARC Member Countries
- SAARC Member countries have a high dependence on Petroleum products, now as well as in future.
- LNG / Natural Gas offers significant price arbitrage over petroleum products.
- Expected demand of Natural Gas and dependence on LNG imports are likely to increase.

Thanks

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Q & A