

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

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)



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).

Present (FY18)

~200 MW

Outlook
(FY30)

~ 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

Afghanistan : Non-Conventional Energy (2/2)



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

Present (FY18)	Outlook (FY18-FY30)
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<10 MW	~100 MW
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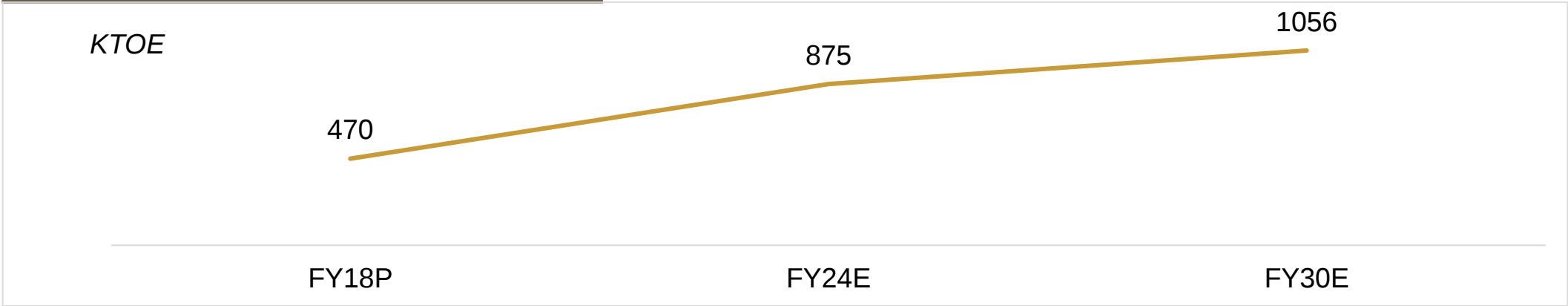


Biomass

- 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
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Outlook on Non Conventional Energy Sources



Bangladesh : Non-Conventional Energy (1/2)



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

Present (FY18)

~230 MW

Outlook
(FY18-FY30)

~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)



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

Present (FY18)	Outlook (FY18-FY30)
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<10 MW ~300 MW

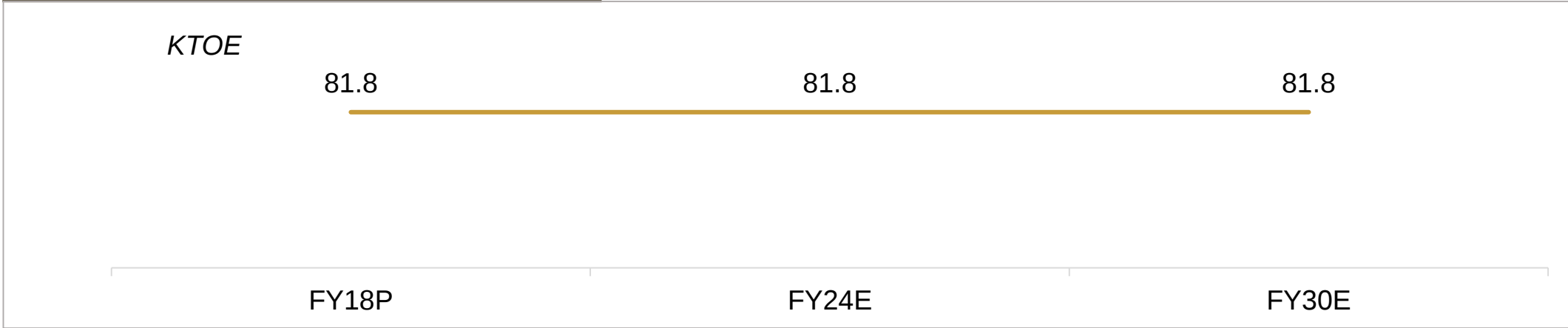


Biomass

- There is no significant usage of biomass or 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)



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. Punatsangchhu I and II Hydropower Project (2,200 MW) 4. Kholongchhu Hydropower Project (600 MW)

Present (2017)

1.6 GW

Outlook
(2030)

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

Bhutan : Non-Conventional Energy (2/2)



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.

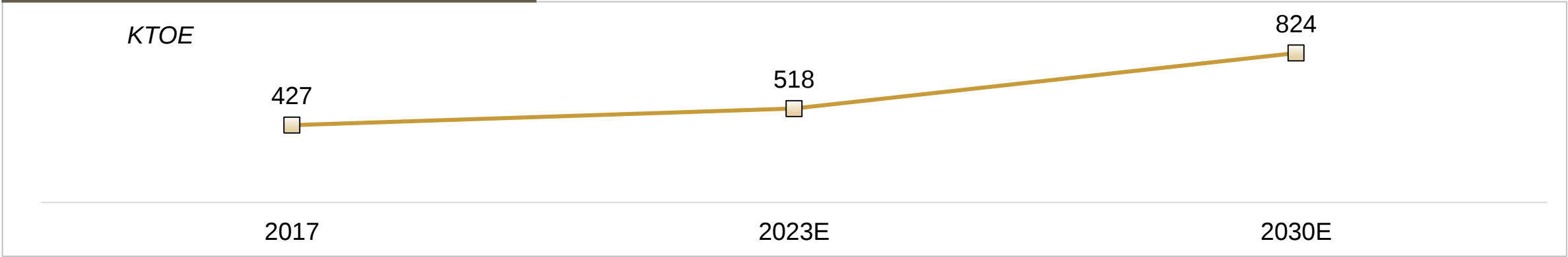
Present (2017)

239 KTOE

Outlook (2030)

259 KTOE

Outlook on Non Conventional Energy Sources



India : Non-Conventional Energy (1/2)



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.



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

Present (FY18)	Outlook (FY30)
45 GW	~79 GW
34 GW	107 GW

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India : Non-Conventional Energy (2/2)



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

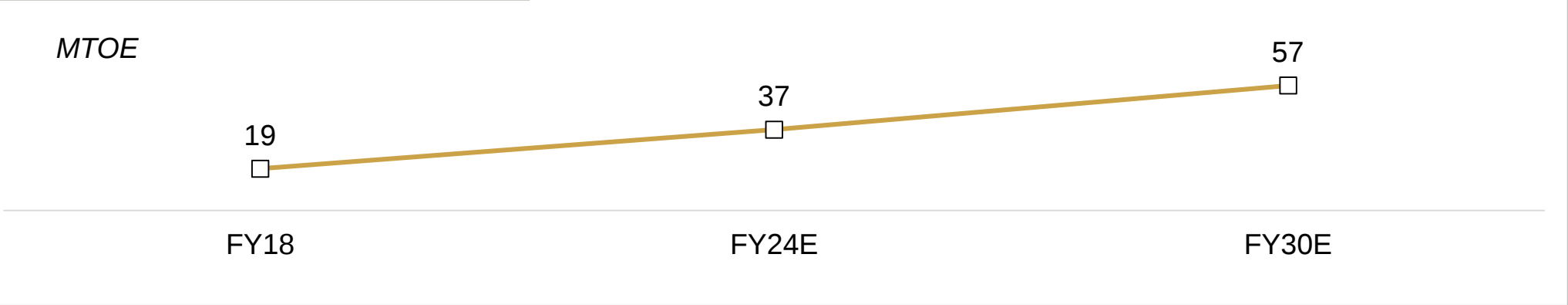


Biomass

- 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

	Present (FY18)	Outlook (FY30)
Solar	21.7 GW	150.1 GW
Biomass	8 GW	~12 GW

Outlook on Non Conventional Energy Sources



Pakistan : Non-Conventional Energy (1/2)



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%

Present (FY18)

9.5 GW

Outlook
(FY30)

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

Pakistan : Non-Conventional Energy (2/2)

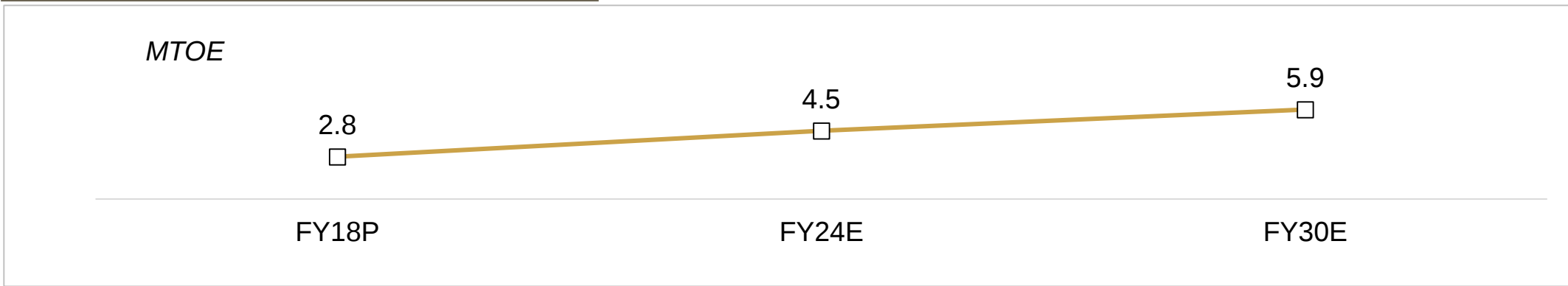


Wind

- 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

Present (FY18)	Outlook (FY30)
800 MW	3,650 MW

Outlook on Non Conventional Energy Sources



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



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)



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



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

Present (2017)

~1.8 GW

Outlook
(2030)

2.3 GW

~20 MW

~780 MW

~130 MW

~750 MW

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

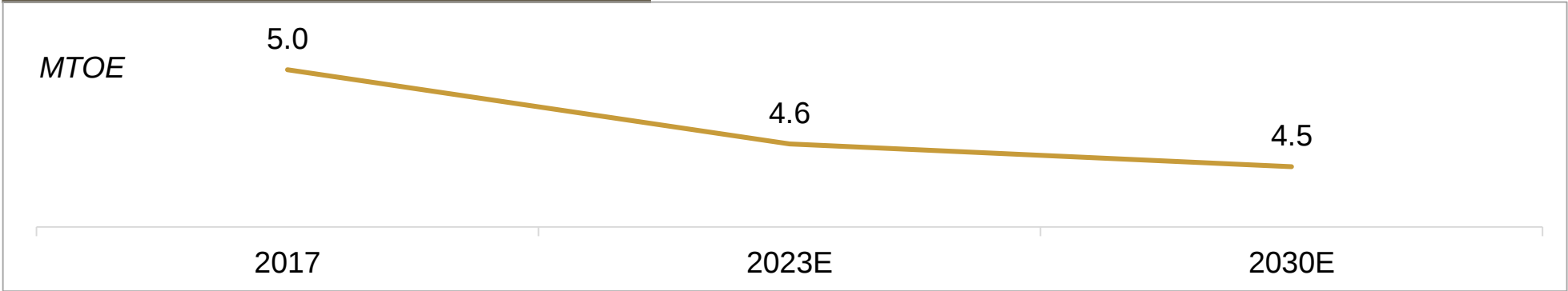


Biofuel

- 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

Present (2017)	Outlook (2030)
4.5 MTOE	3.7 MTOE

Outlook on Non Conventional Energy Sources



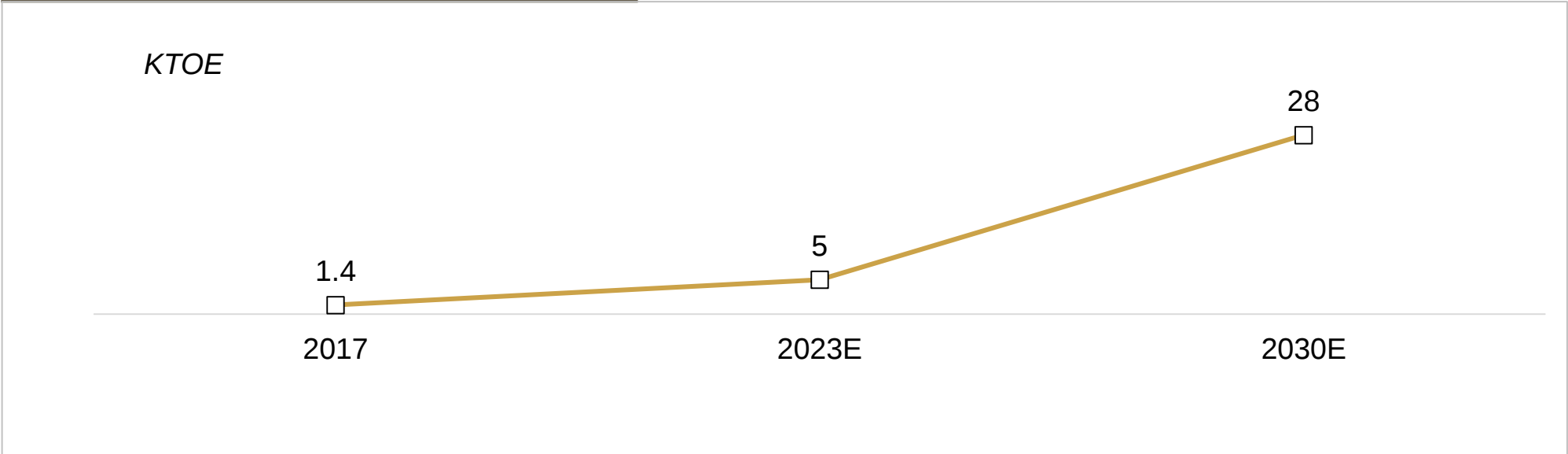
Maldives : Non-Conventional Energy

Present (2017)	Outlook (2030)
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- 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
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Outlook on Non Conventional Energy Sources



Nepal : Non-Conventional Energy (1/2)



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.

Present (FY18)	Outlook (FY30)
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~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)

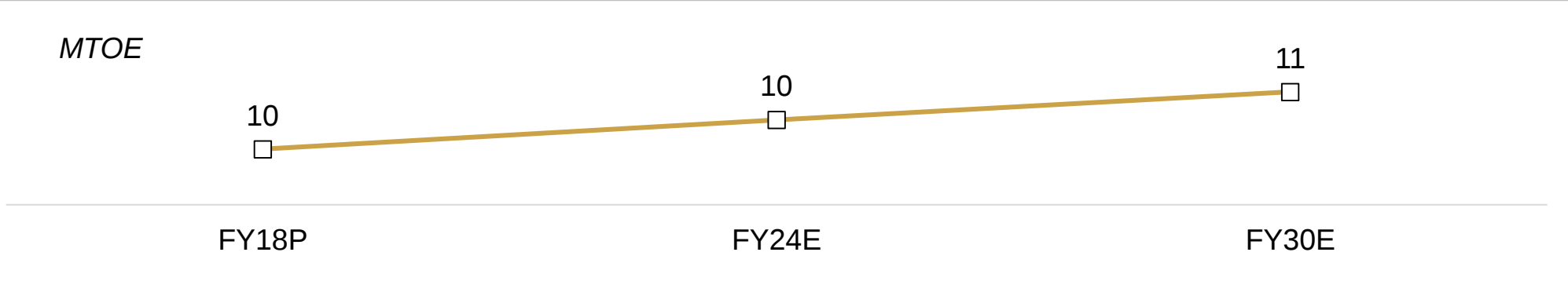


Biomass

- 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.

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

Outlook on Non Conventional Energy Sources



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

Thank You