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Prospects for Reduction of Energy Use and GHG Mitigation in Four South Asian Countries

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Key Research Questions

- Identification of no-regret energy efficient technologies
- How big is their energy saving potential?

- How big is the potential for reduction of TPES in each country?

- Energy Implications of selected TPES reduction targets for
  - Sectoral contributions in the reduction of TPES – Major sectors to be targeted
  - Energy mix of TPES
  - Energy mix of final energy consumption

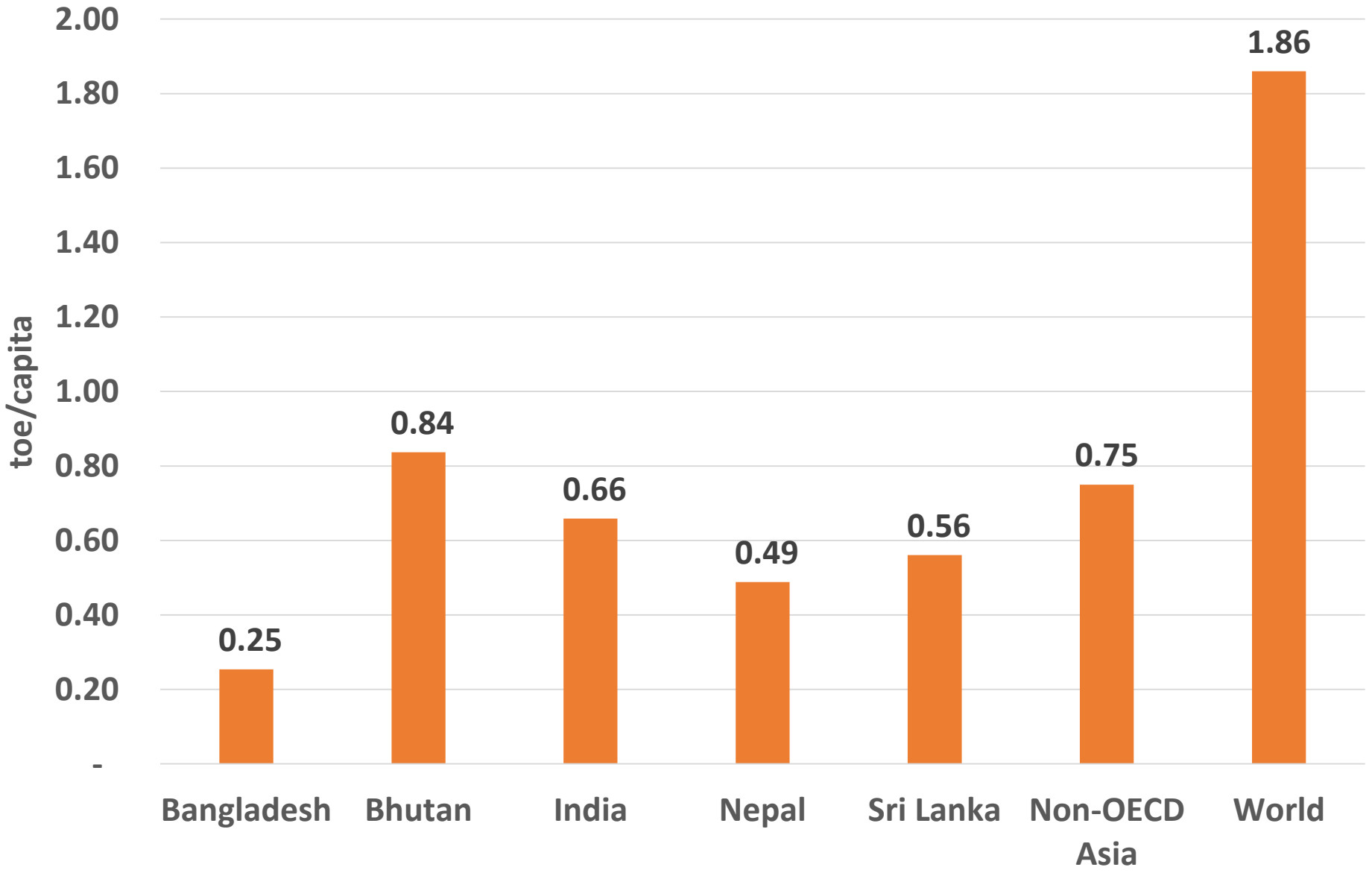
- GHG Implications of the energy reduction targets
  - How much GHG would be reduced?
  - Role of different sectors in GHG reduction

Some Energy and GHG Indicators

Energy Resource Endowments

- Bhutan and Nepal:
  - Hydro-rich, biomass, no fossil fuel resource
- Bangladesh:
  - Natural gas and low grade coal
- Sri Lanka:
  - Hydropower limited - almost all exploited, biomass, some wind, no fossil fuel resource

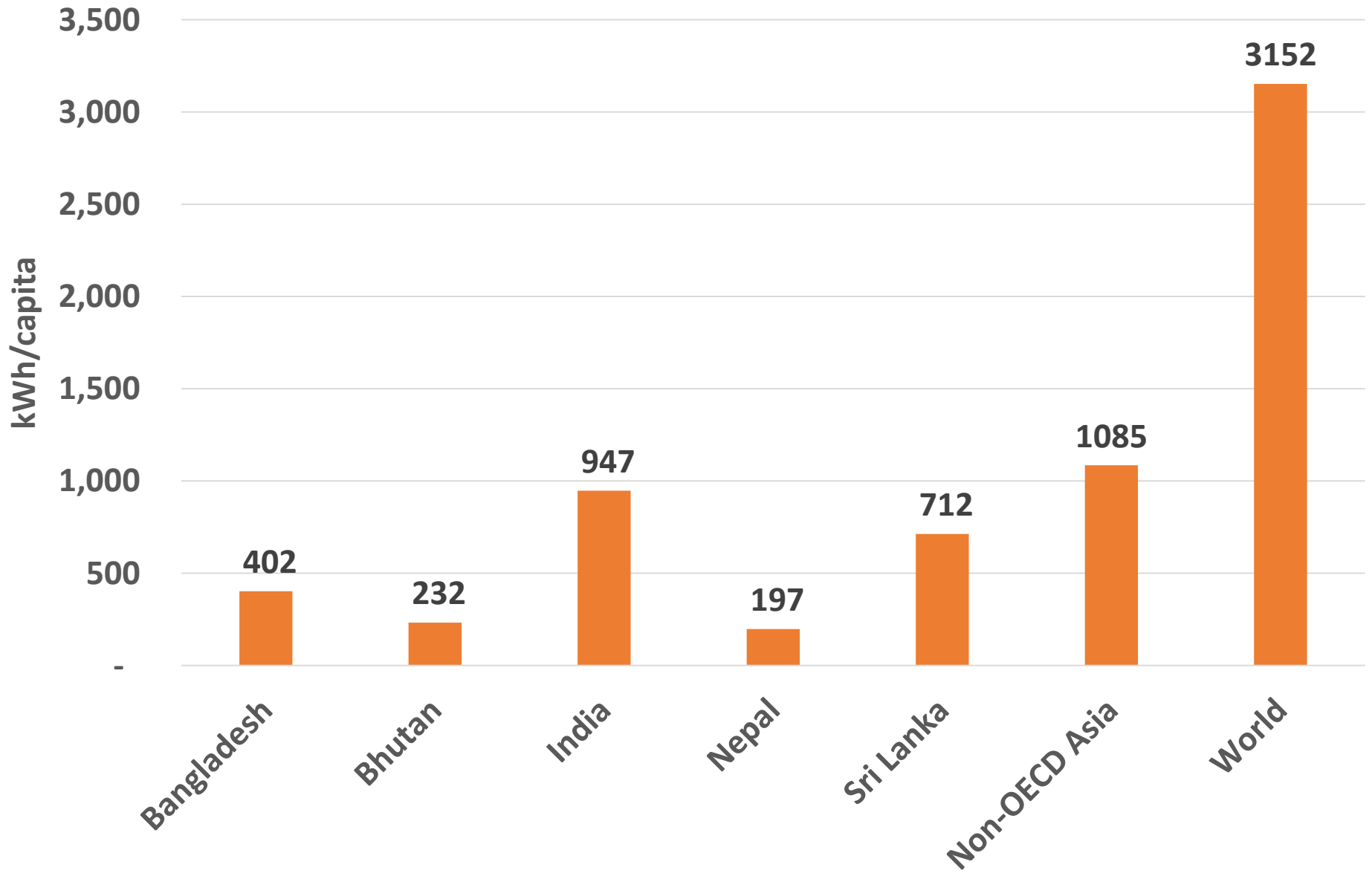
Total Primary Energy Supply per Capita, 2017



*Data for Bhutan is for 2014 (DoRE, 2015)

Source: IEA database and World Bank

Electricity Use per Capita, 2017



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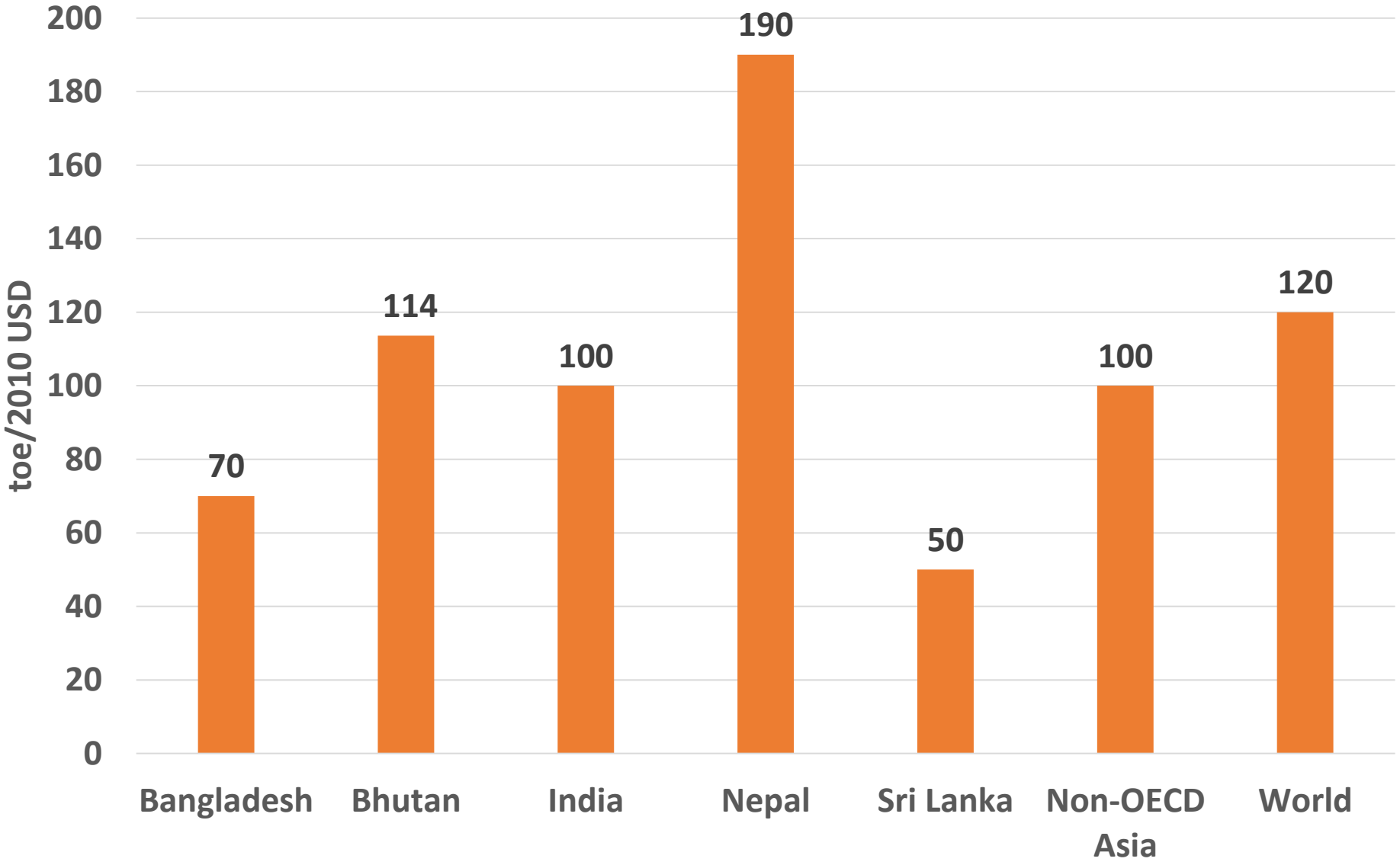
Source: IEA database and World Bank

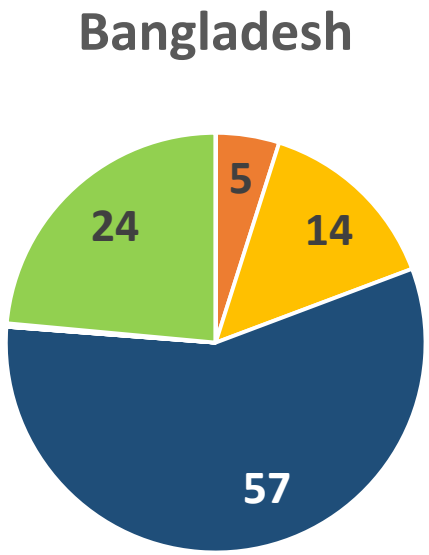
Energy Intensity of GDP (PPP), 2017

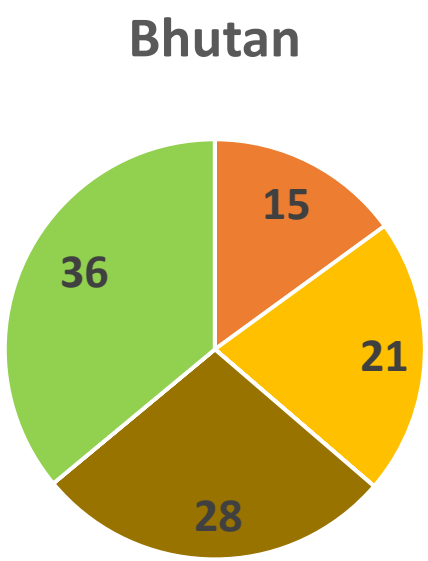


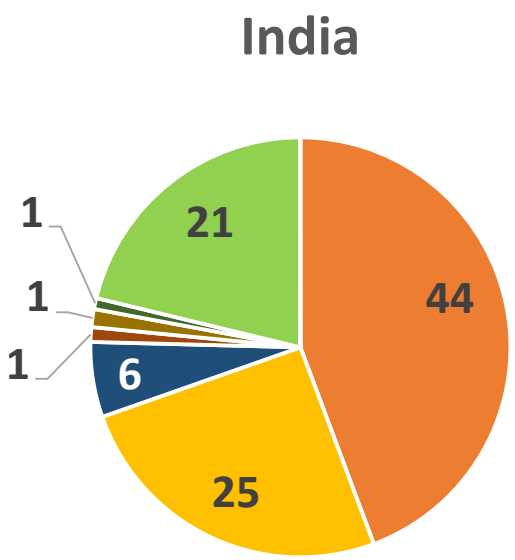
*Data for Bhutan is for 2014 and its unit is toe/ 2011 USD (DoRE, 2015)

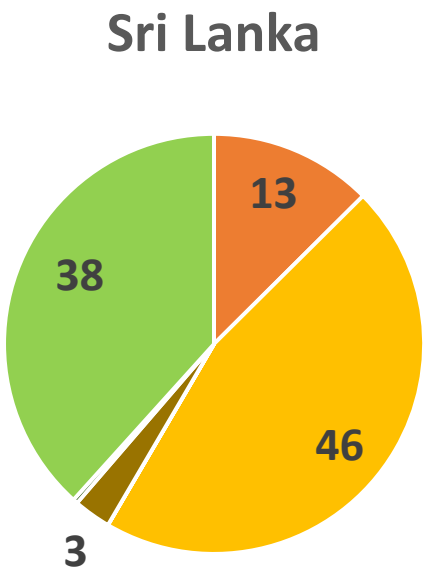
Source: IEA database and World Bank

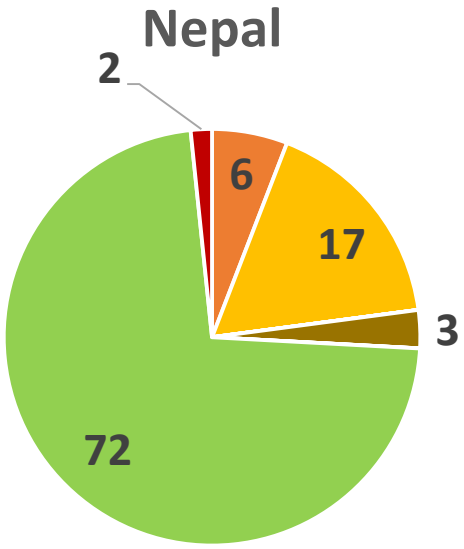
Shares of different types of energy in TPES (in %), 2017

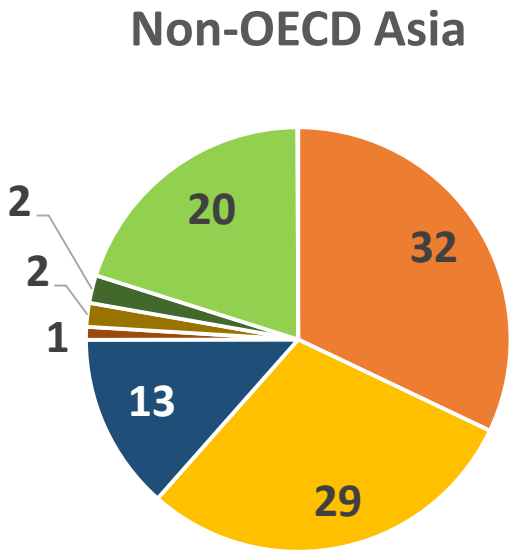


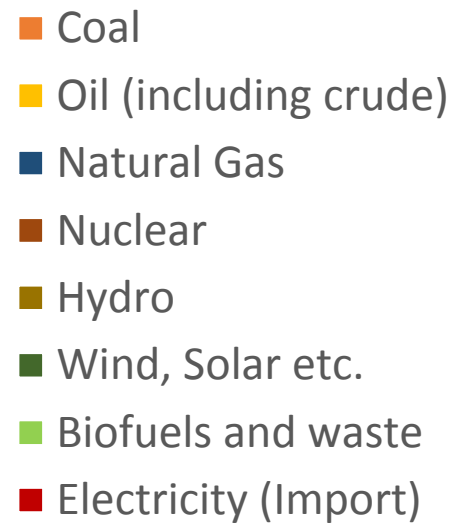












*Data for Bhutan is for 2014 (DoRE, 2015)

Source: IEA database

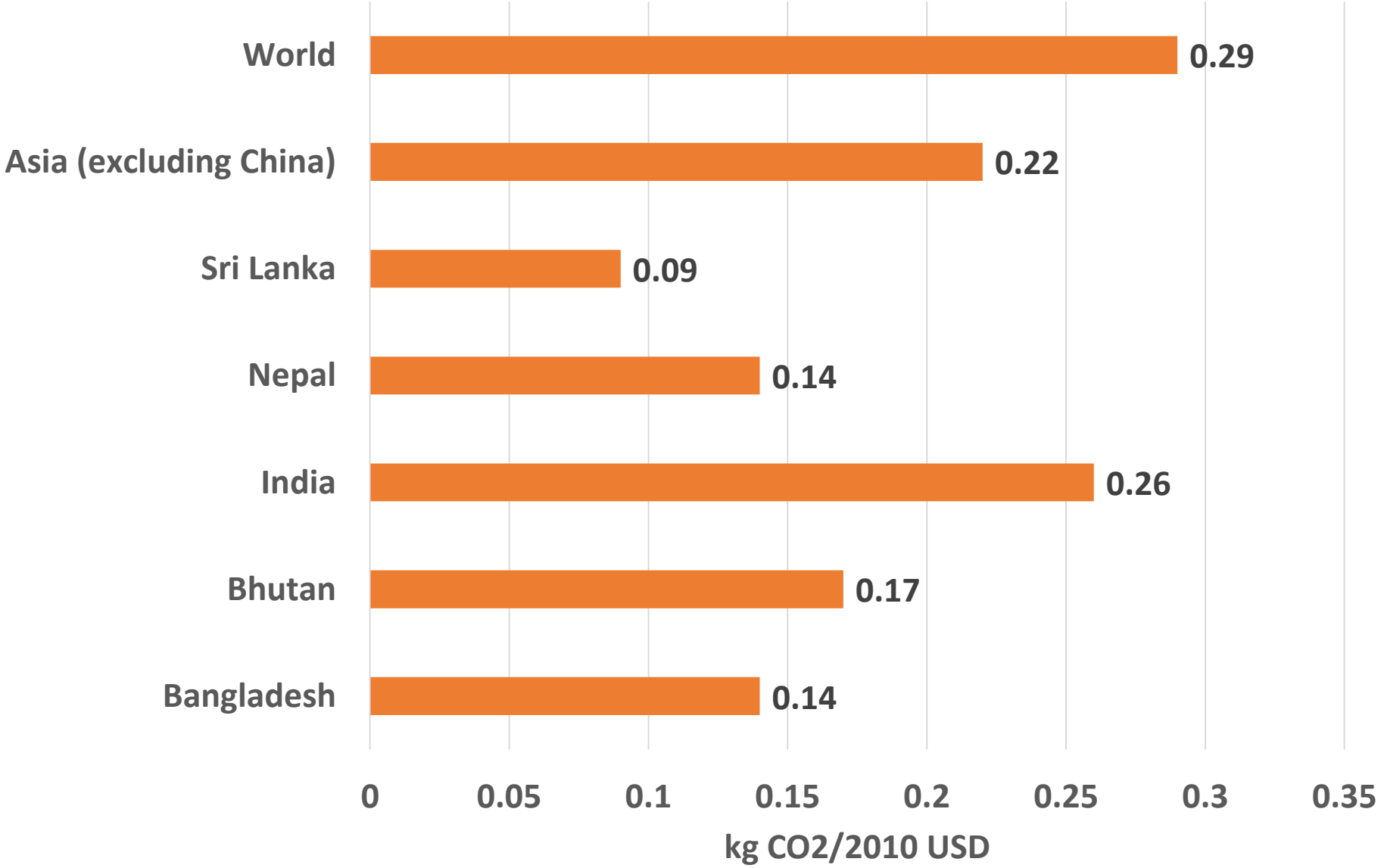
Transmission and Distribution Losses, 2017

Country	Transmission and Distribution Loss (%)
Bangladesh	18
Bhutan	4*
India	24
Nepal	21
Sri Lanka	15
Asia (Excluding China)	18
World	17

*Data for Bhutan is for 2014 (DoRE, 2015)

Source: IEA database

CO_2 emission per unit of GDP PPP, 2017



*Data for Bhutan is for 2014 (World Bank Database)

Source: IEA database

Annual Growth Rate (CAGR) of CO_2 emission from fuel combustion during 2000-2017

	CAGR, %
Bangladesh	8
Bhutan	4
India	6
Nepal	7
Sri Lanka	5

*Data for Bhutan is for 2014 (World Bank Database)

Source: IEA database

Energy Efficiency Gap (EEG) and No-Regret Technologies

Economic definition of EEG,

- EE Gap = $EE_{Actual} - EE_{Socially\text{-}optimal}$

An alternative (empirical) approach:

- EE Gap = $EE_{Actual} - EE_{least\text{-}cost}$

Energy Efficiency Gap and Energy Saving Potential of No-regret Technologies

- EE Gap = $(\text{Energy Intensity})_{REF} - (\text{Energy Intensity})_{BAU}$
- Total Energy Saving Potential =

  $(\text{Total Energy Requirement})_{\mathbf{BAU}} - (\text{Total Energy Requirement})_{\mathbf{REF}}$

  - BAU Case: Technology types and their shares are fixed except in the case of cooking in the residential sector
  - REF Case: Technology shares not fixed

No-Regret Technologies in Residential, Commercial and Transport sectors

	Bangladesh	Bhutan	Nepal	Sri Lanka
RESIDENTIAL/ COMMERCIAL SECTOR				
Lighting	LED	LED	LED	LED
Air conditioning (SEER BTU/Watt.hr)	AC SEER 13	AC SEER 20.5	AC SEER 20.5	AC SEER 20.5
Cooking	ICS, NG Stove	Efficient Electric Stove	ICS, AICS, Efficient LPG Stove	ICS, Efficient LPG Stove
Water Heating			Efficient LPG Geyser	
TRANSPORT SECTOR				
Passenger Transport	LPG 3Ws, CNG vehicles			
Freight Transport	CNG Truck			

No-Regret Technologies in Industrial sector

Type of Industry	Bangladesh	Bhutan	Nepal	Sri Lanka
Motive Power	√	√	√	√
Process Heat	√	√	√	√
Alloy		√		
Textile & Garment	√			√
Carbide		√		
Fertilizer	√			
Tea				√
Brick	√		√	√
Cement			√	
Silicon		√		
Iron and Steel	√			

Energy Saving Potential of No-Regret Technologies (as % of TPES in BAU)

Year	Bangladesh	Bhutan	Nepal	Sri Lanka
2015	17.3 (Res. & Ind.)	11.7 (Res., Ind., Com.)	11.3 (Res., Ind. Com.)	20.3 (Res. Com., Ind.)
2030	17.7 (Res., Ind., Trans.)	17.9 (Ind., Com., Res.)	6.7 (Ind., Trans, Com., Res.)	31.7 (Ind., Trans, Res. Com)

ESP in the range of 11 to 20% in 2015 and 7 to 31% in 2030

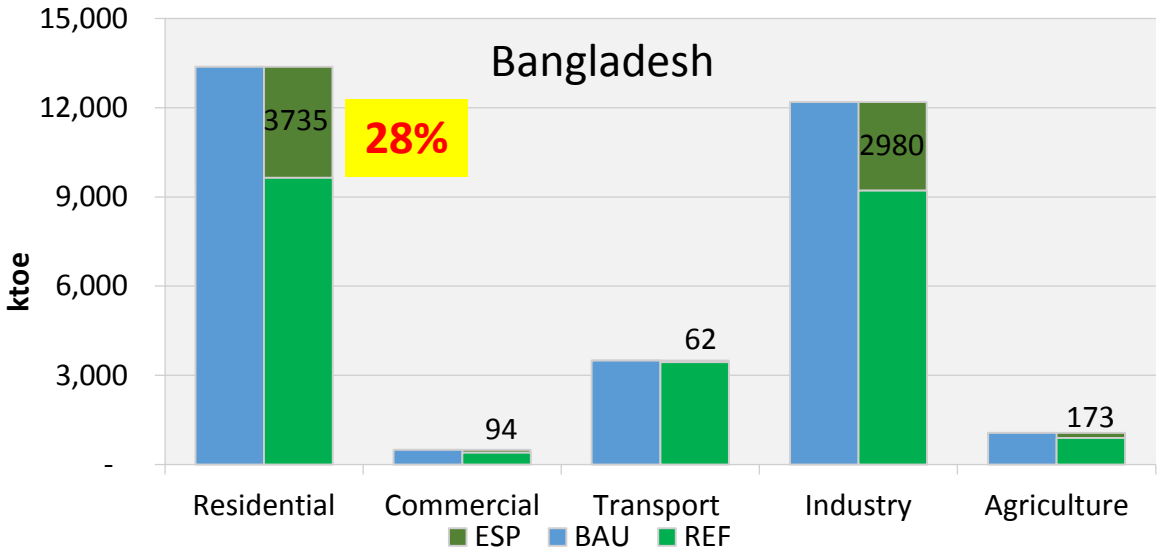
Energy Efficiency Gap in Different Sectors in 2015: Bangladesh

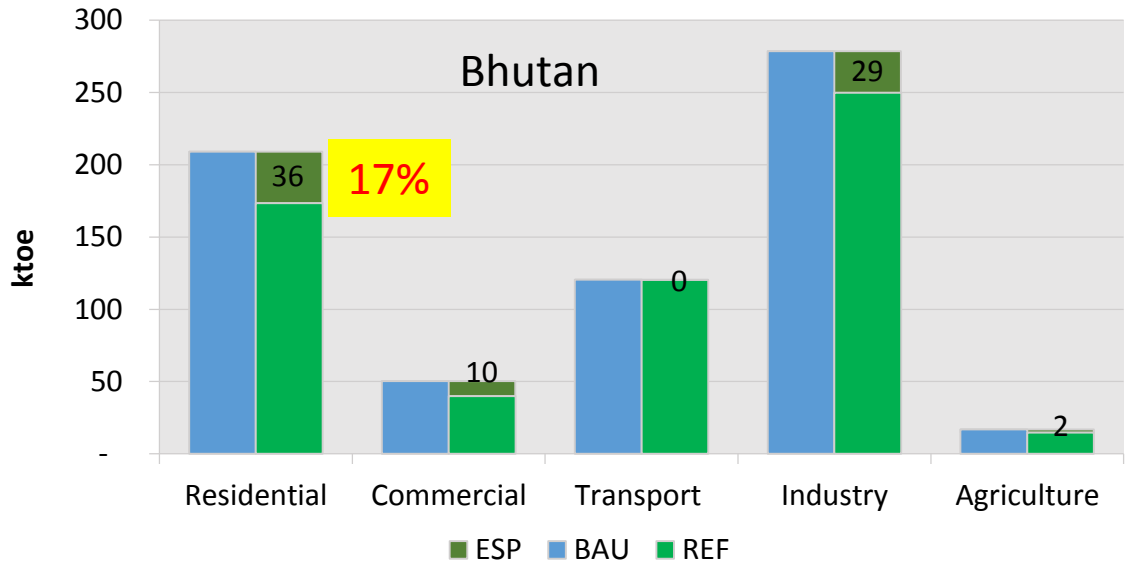
Sector	Type of End use or product	Technology in BAU	No-regret Technology	Energy Intensity (Energy Input/Output)			EE gap	Energy saving potential (ktoe)
				BAU	REF	Unit		
Residential	Lighting	Incandescent bulb	LED	6.3	0.9	toe/billion lumen-hour	5.4	138
		CFL[1] bulb		1.9	0.9		1.0	24
		Fluorescent bulb		1.9	0.9		1.0	43
	Cooling	Air-conditioner SEER 13[2]	Air-conditioner SEER 20.5	0.26	0.17	BTU/ Watt.hr	0.1	71
	Cooking	TCS[3]	ICS[4]	7.7	4.3	toe/toe	3.3	3294
		Kerosene stove	NG stove	2.9	1.7	toe/toe	1.2	45

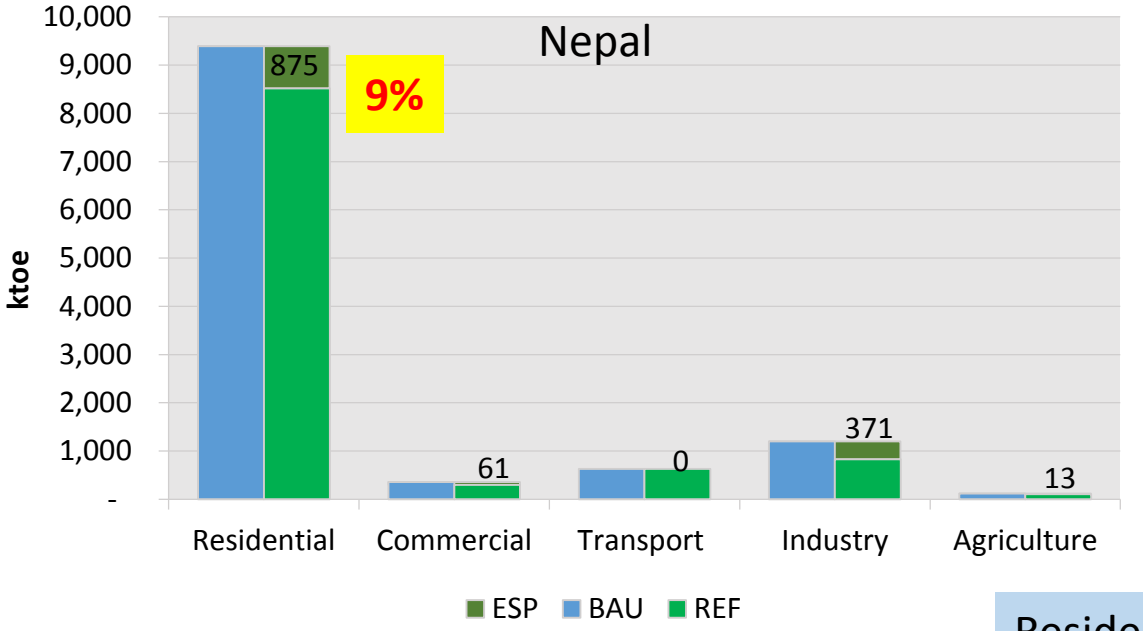
Energy Efficiency Gap in Different Sectors in Bangladesh

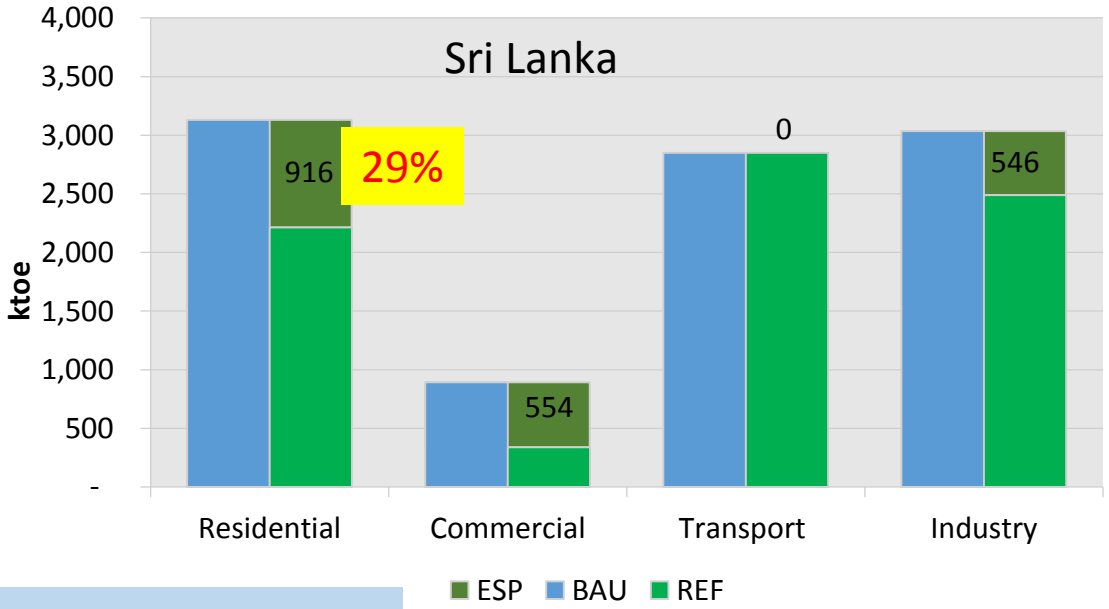
Sector	Type of End use or product	Technology in BAU	No-regret Technology	Energy Intensity (Energy Input/Output)			EE gap	Energy saving potential (ktoe)
				BAU	REF	Unit		
Transport		CNG 3Ws	LPG 3Ws[6]	7.0	4.8	toe/million pass-km	2.2	11
	Passenger transport	Diesel 3Ws	LPG 3Ws	7.1	4.8		2.4	27
		Diesel bus	CNG bus[7]	5.9	5.7		0.14	13
		Diesel Mini-bus	CNG Micro-bus	4.0	3.9		0.1	3
		Diesel Micro-bus	CNG Mini-bus	11.1	10.8		0.3	5
		Gasoline car	CNG car	16.7	16.3		0.4	3
	Freight transport	Diesel pick-up truck	CNG pick-up truck	12.5	12.2	toe/million ton-km	0.3	1

Energy Saving Potential of No-regret Technologies in 2015









Residential and Industrial sectors

Potential for TPES Reduction

Potential for TPES Reduction (%)

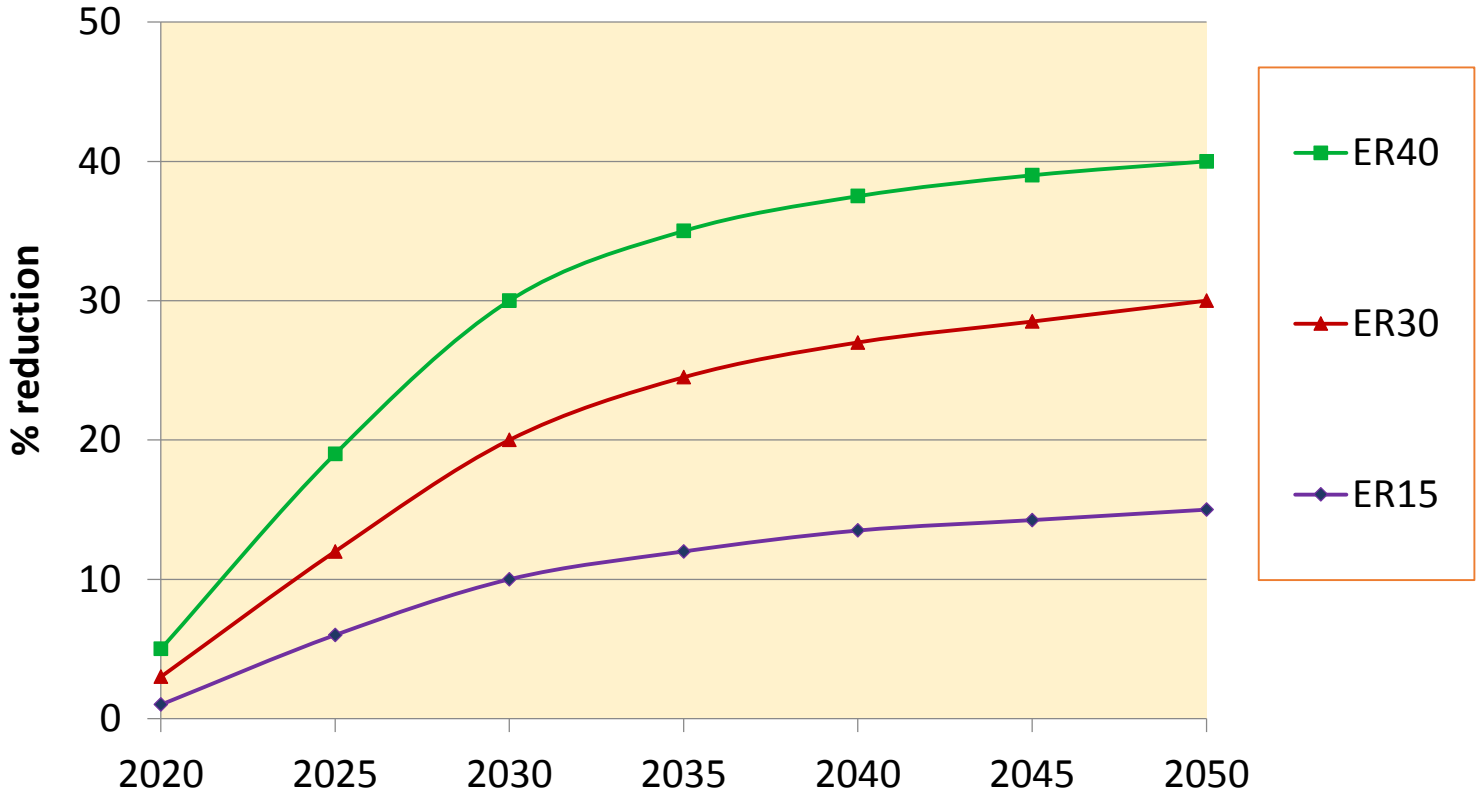
Year	With lower minimum car share in passenger transport than in BAU+				With minimum car share in passenger transport same as in BAU*			
	Bangladesh	Bhutan	Nepal	Sri Lanka	Bangladesh	Bhutan	Nepal	Sri Lanka
2030	47	40	54	53	46	38	51	52
2050	40	43	54	56	38	41	50	53

*Minimum car share in 2050 35%

+ Minimum car share in 2050 20%

Implications of Energy Reduction Targets

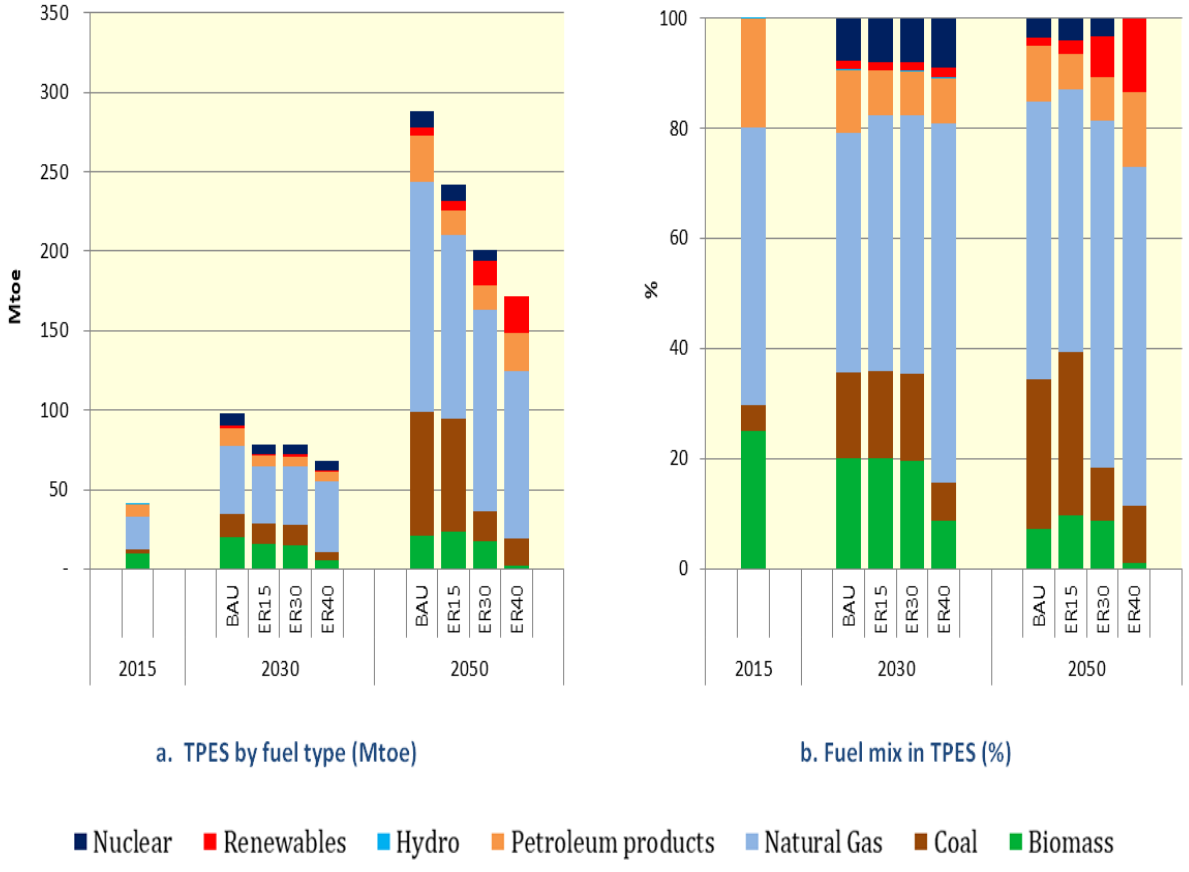
Three Energy Reduction Scenarios



i) ER15: minimum 15% reduction in total primary energy supply (TPES) by 2050,
ii) ER30: minimum 30% reduction by 2050
iii) ER40: minimum 40% reduction by 2050

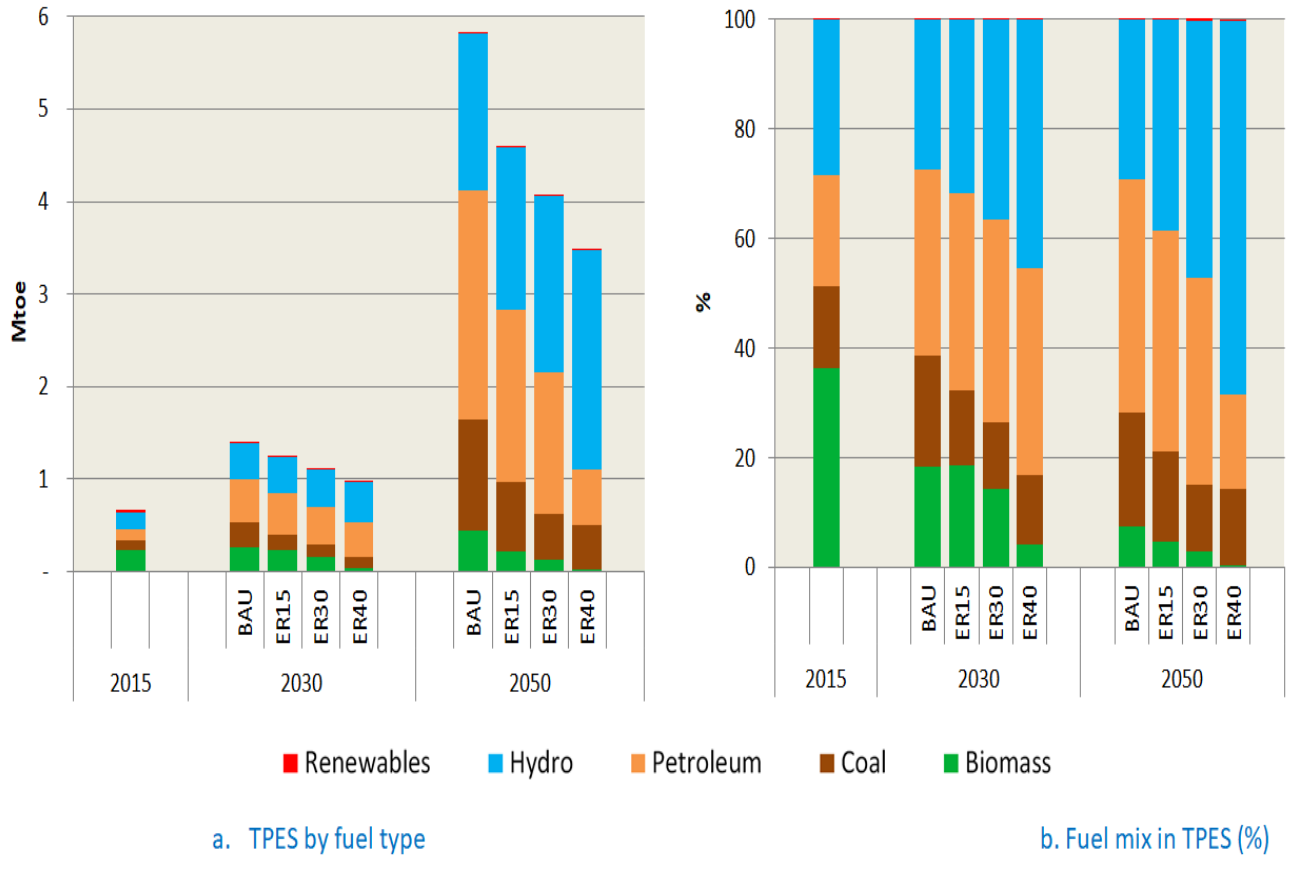
Energy-Mix of TPES and Role of RE and Cleaner Fossil Fuels

Bangladesh



Increased role of Natural gas; RE role after 2030

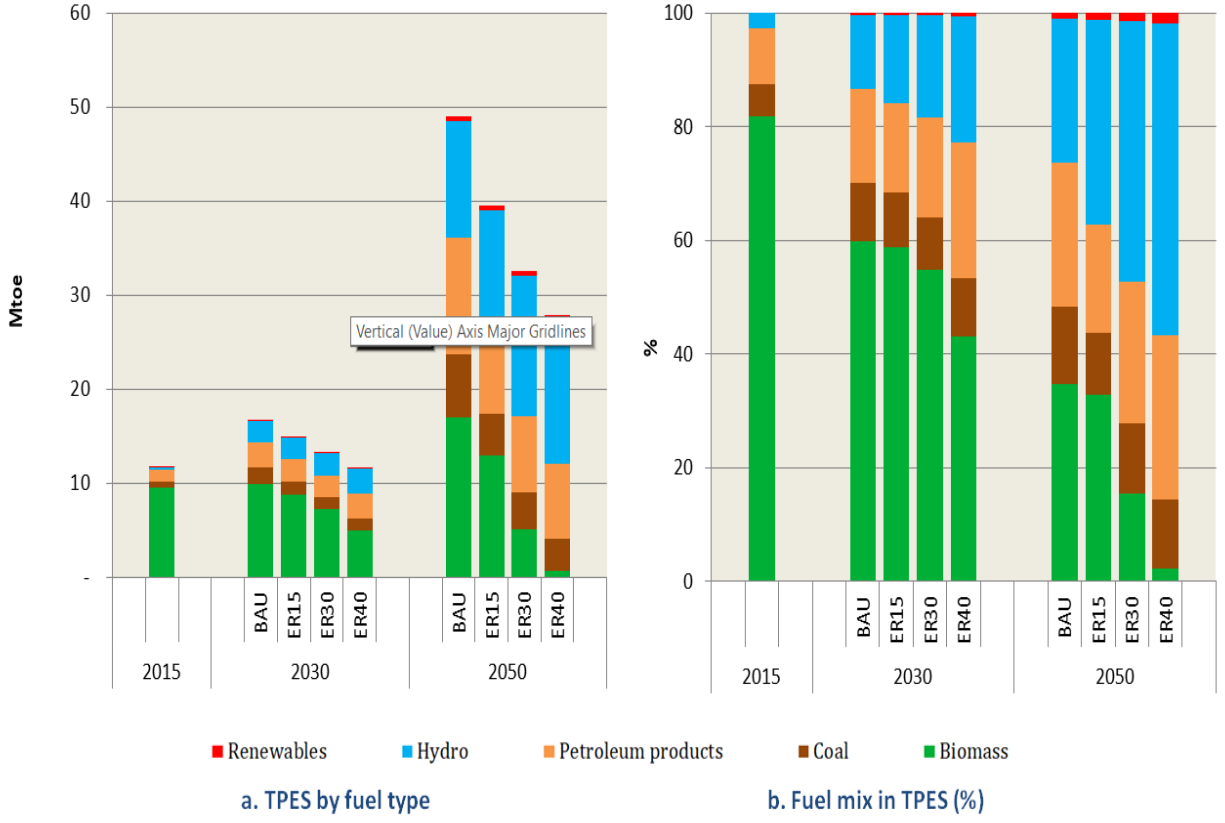
Bhutan



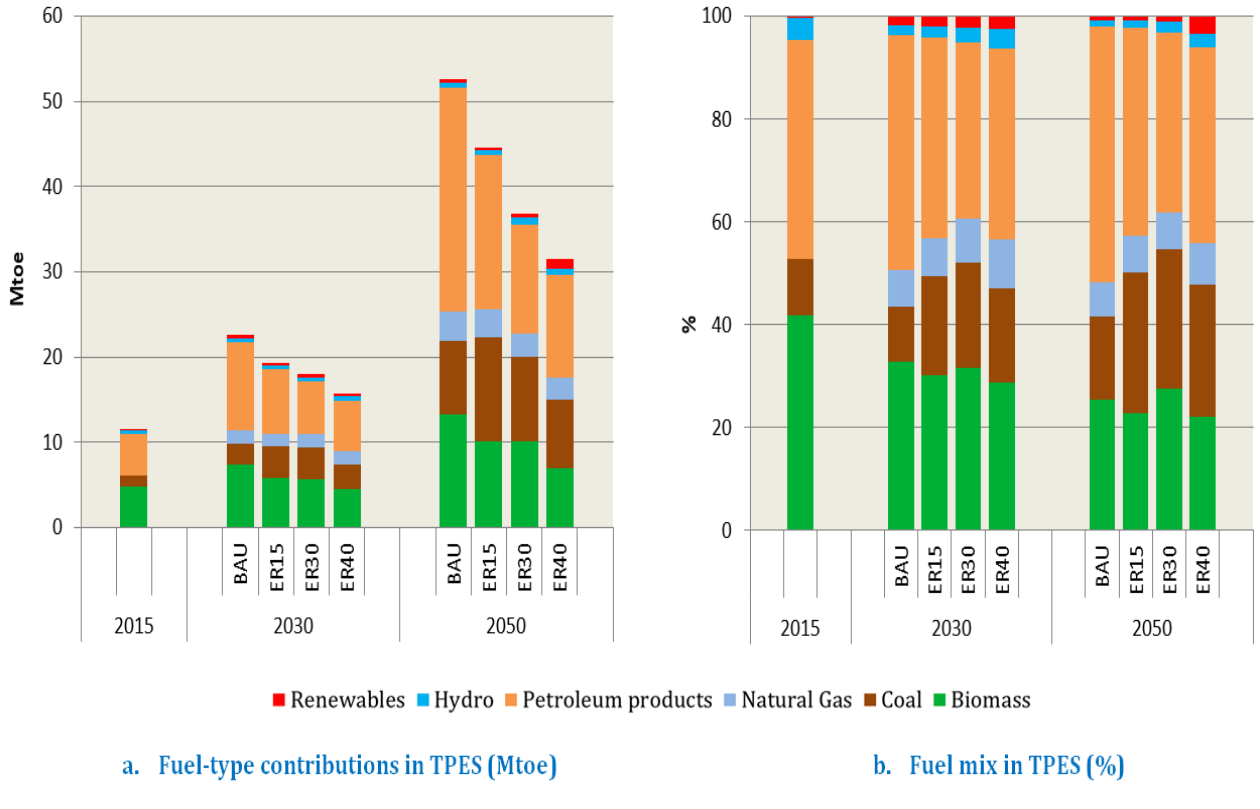
Increased role of hydroelectricity

Energy-Mix of TPES- Role of RE and Cleaner Fossil Fuels

Nepal

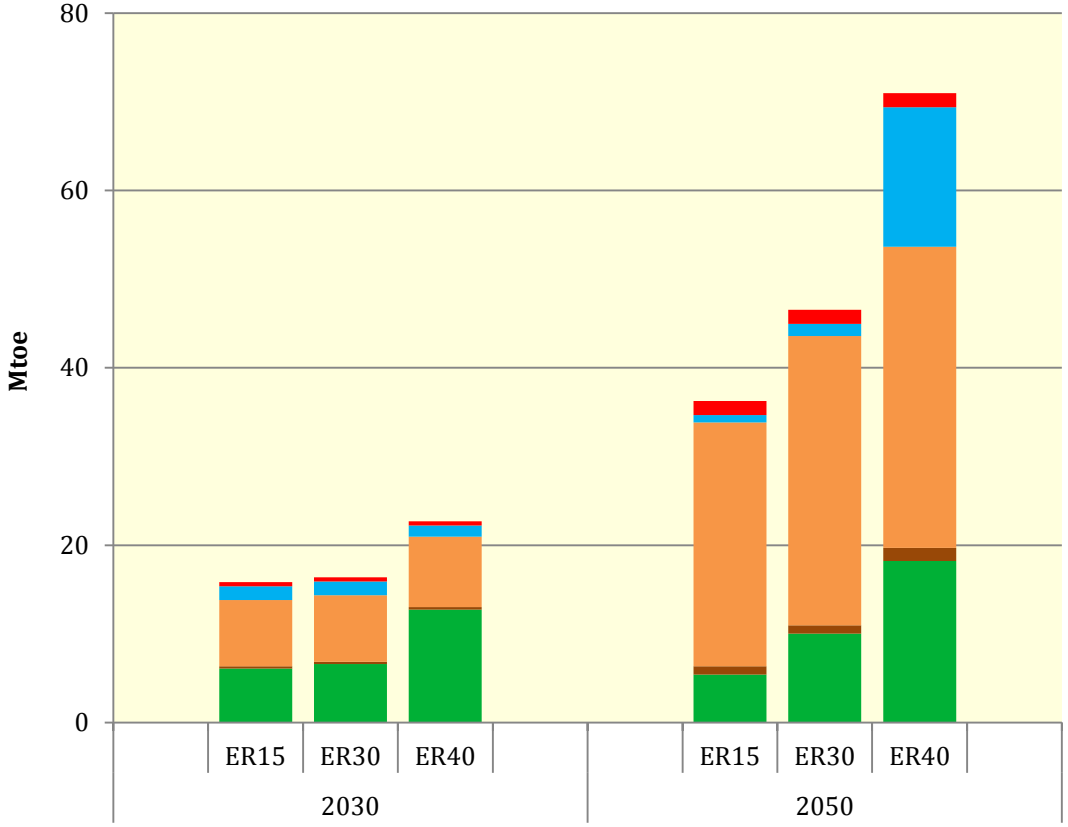


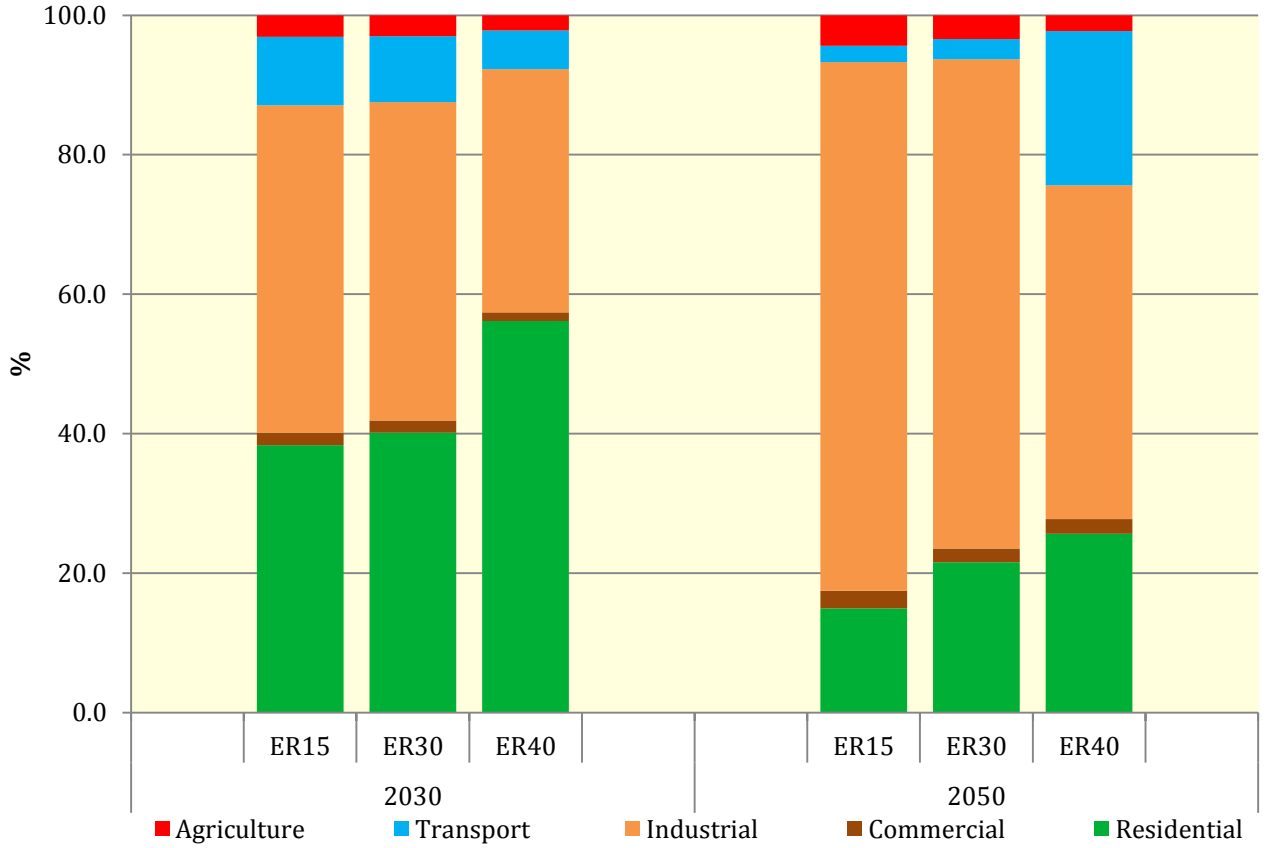
Sri Lanka



Increased role of hydroelectricity, decreasing biomass share

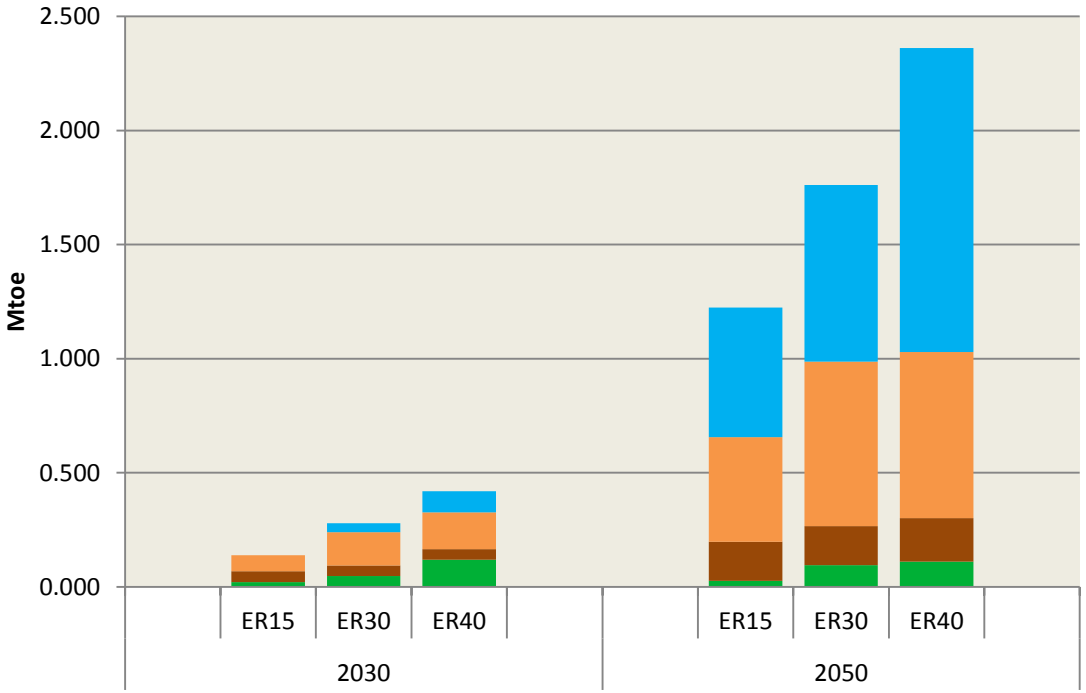
Sectoral Contributions in TFEC Reduction in Bangladesh

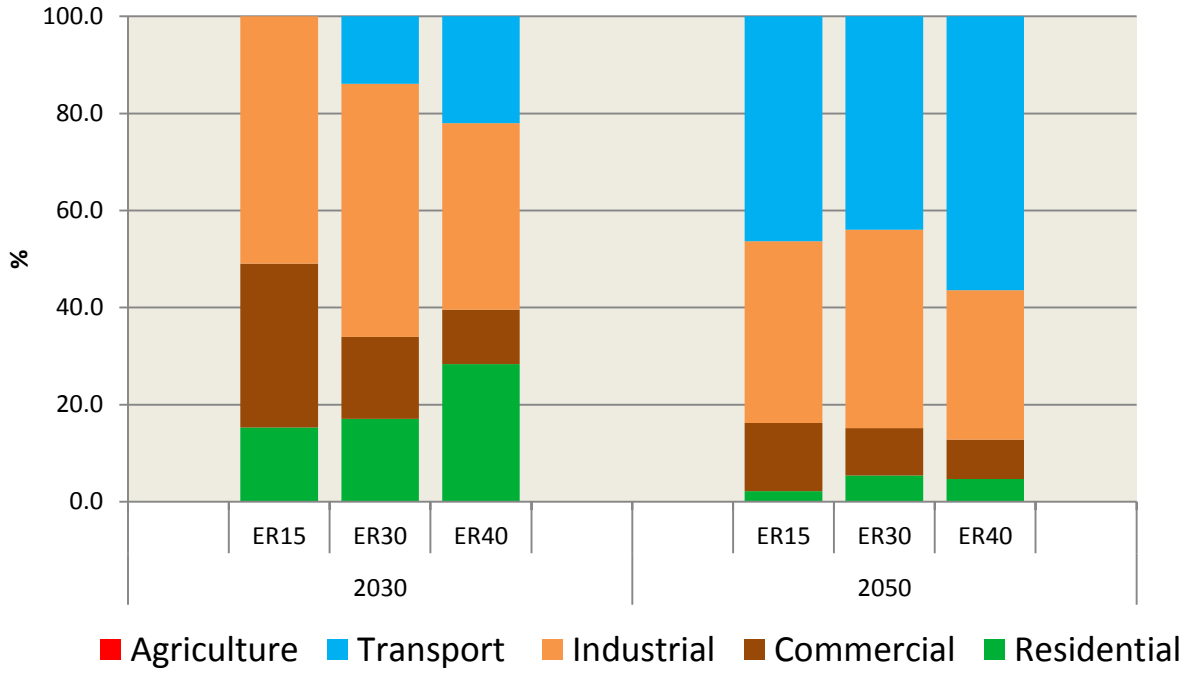




Residential and Industry sectors

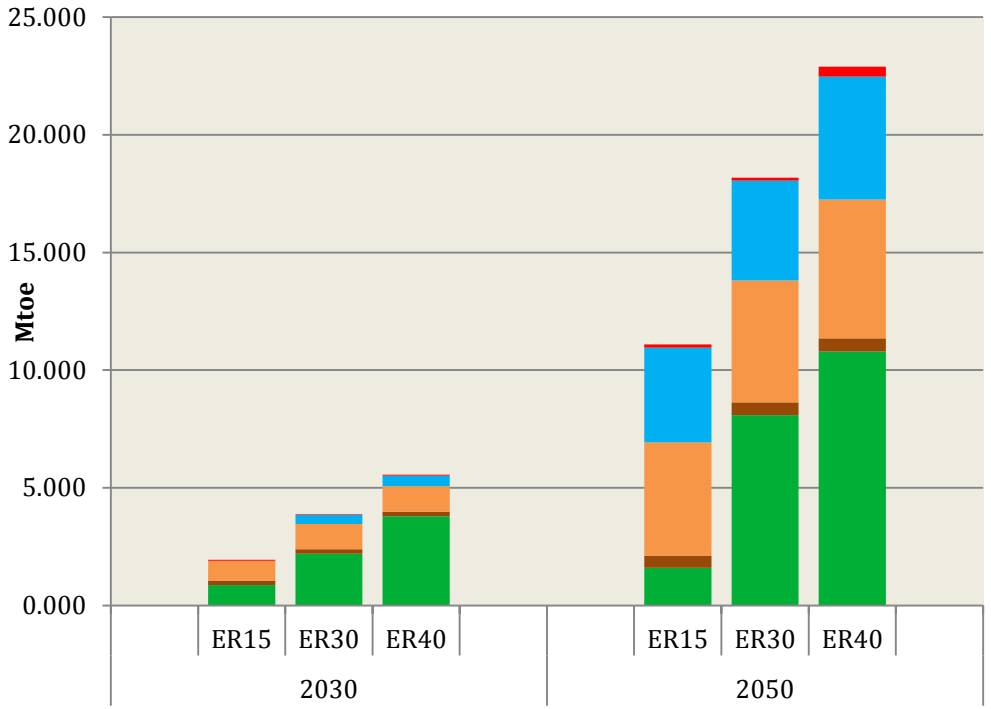
Sectoral Contributions to TFEC Reduction in Bhutan

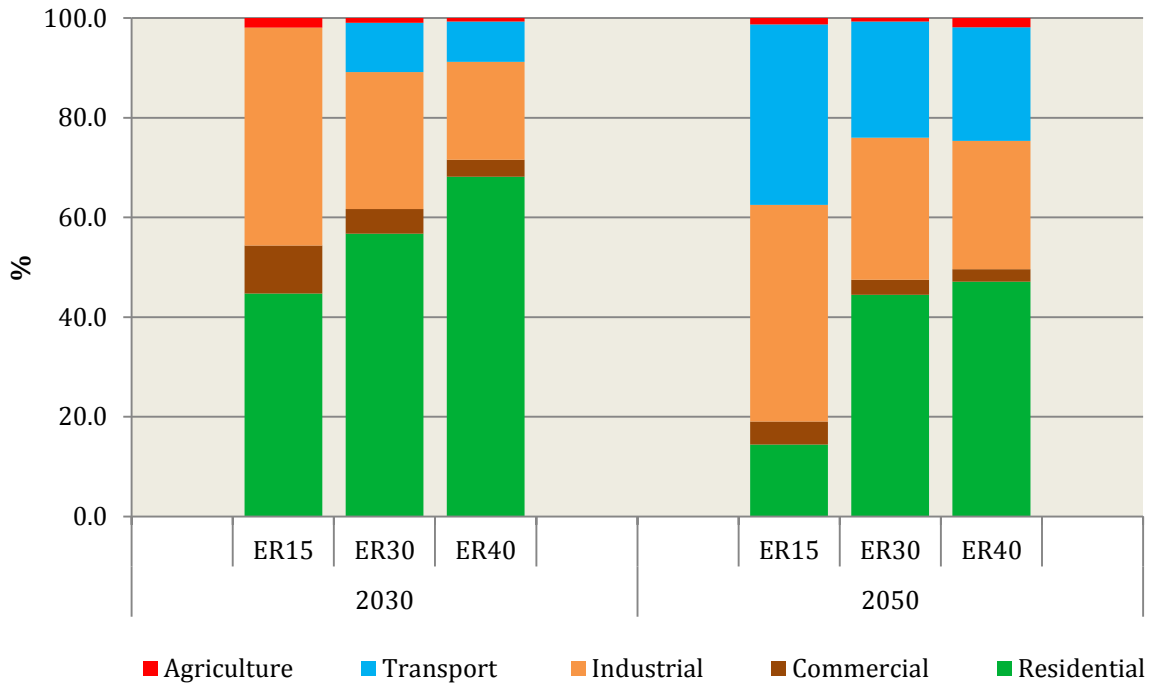




- Industry and residential sectors in 2030
- Transport and industry sectors by 2050

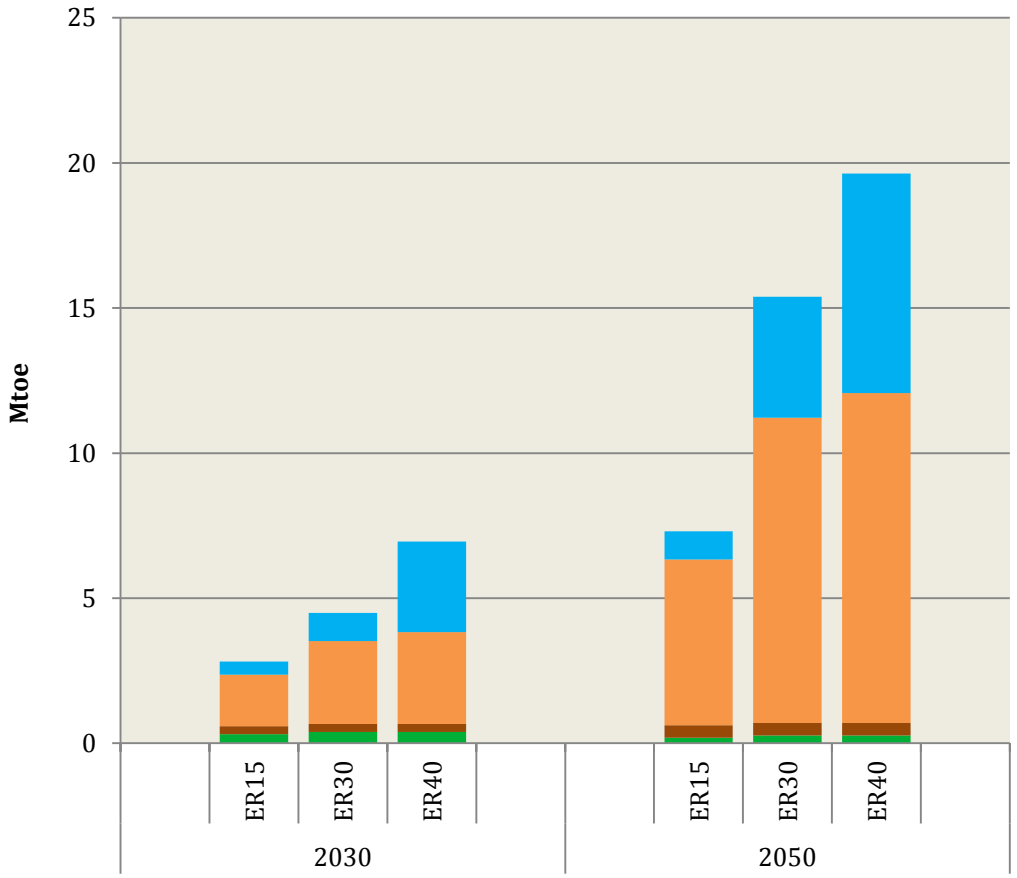
Sectoral Contributions to TFEC Reduction in Nepal

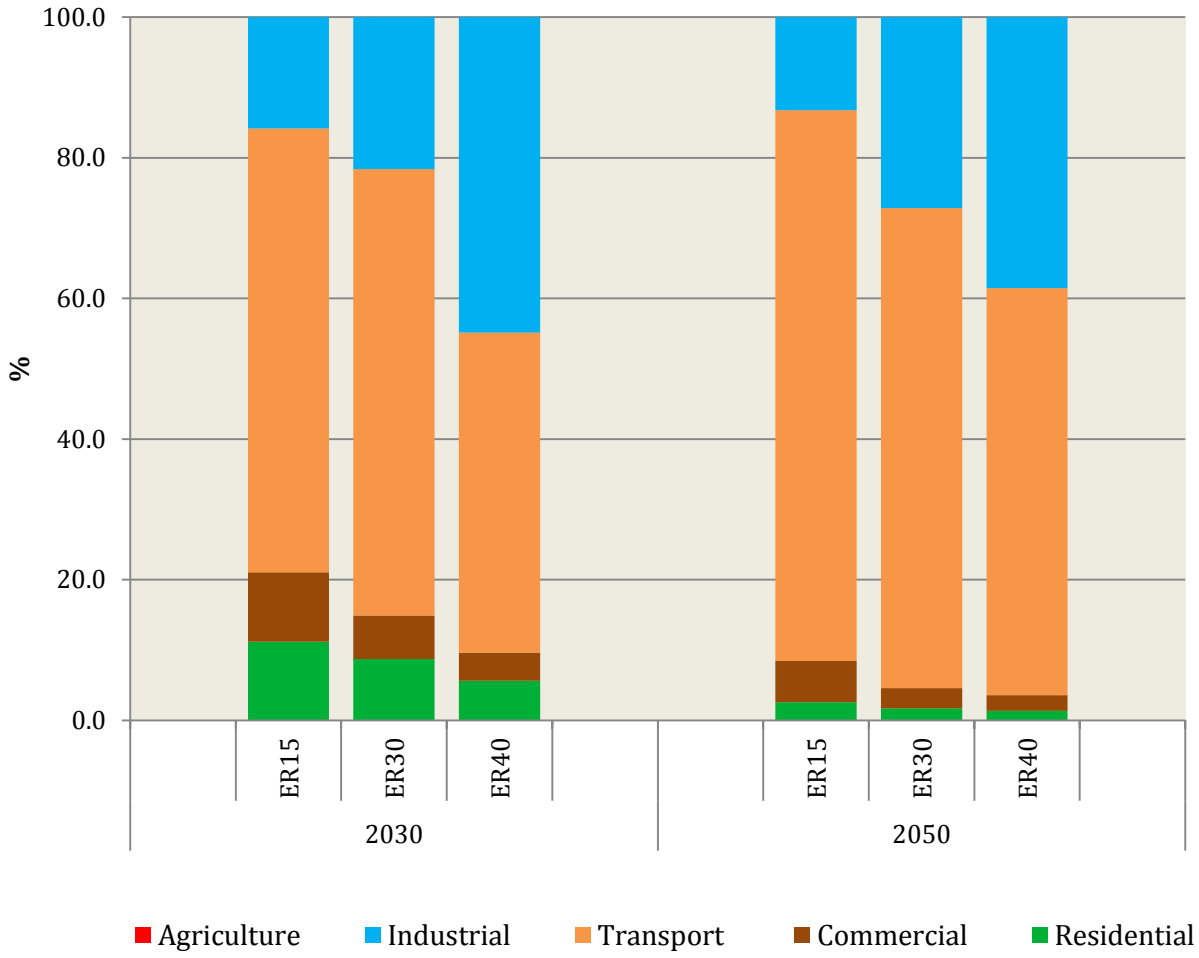




Residential and Industry sectors in 2030
Transport sector's role more prominent by 2050.

Sectoral Contributions to TFEC Reduction in Sri Lanka

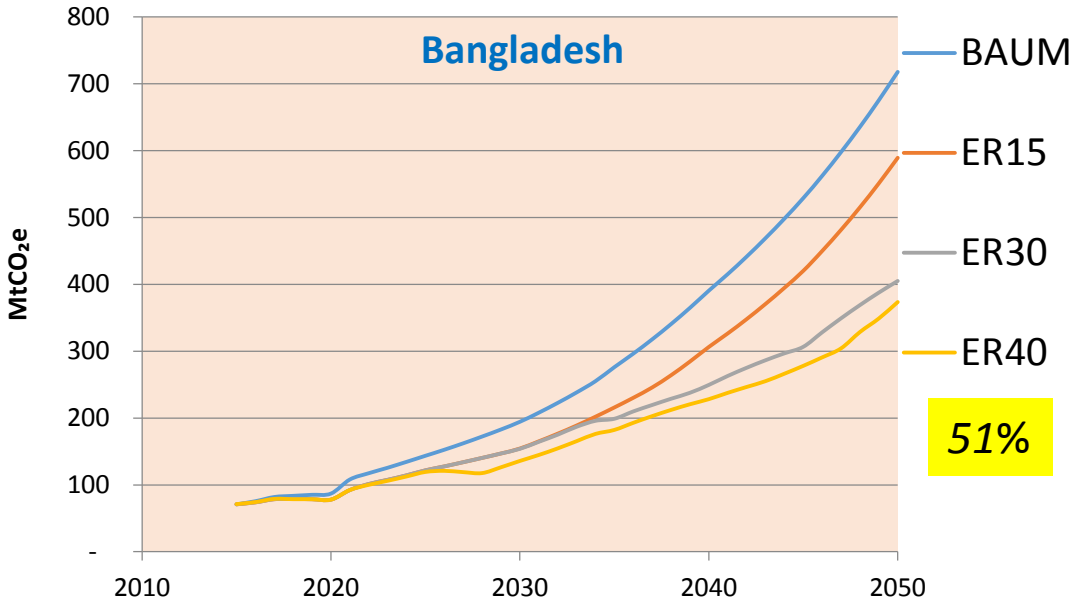


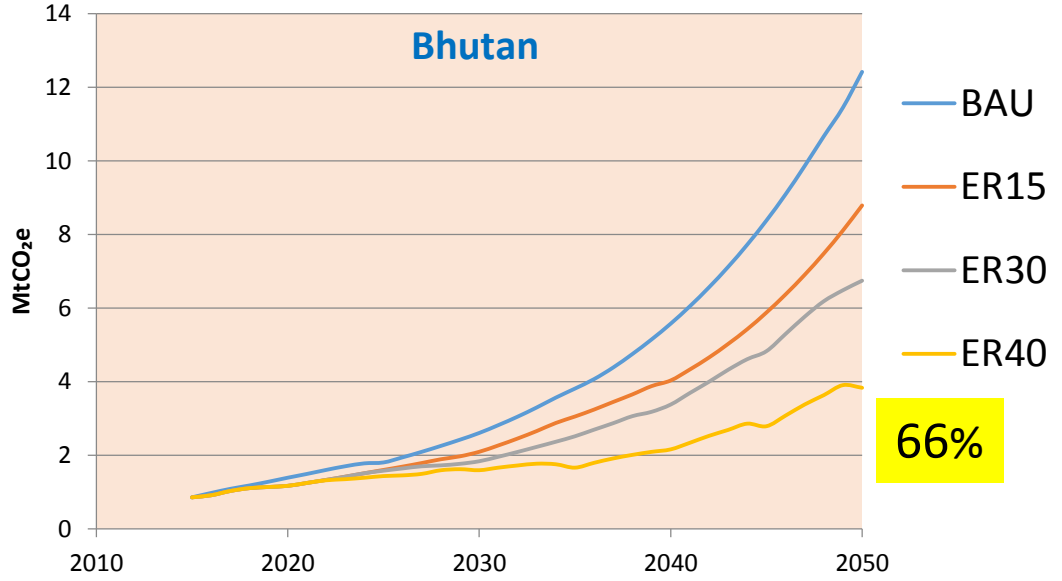


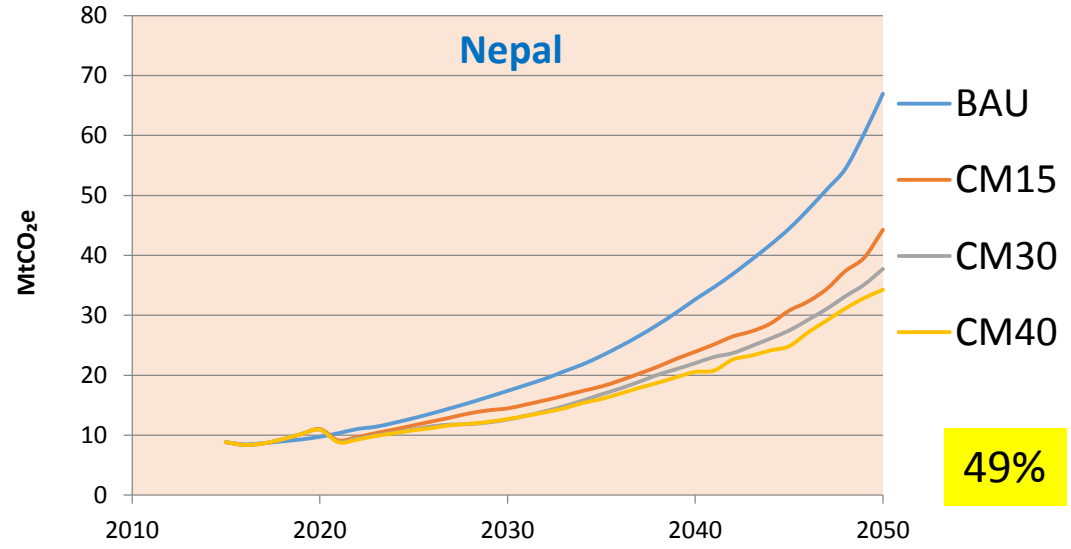
Transport and Industry sectors

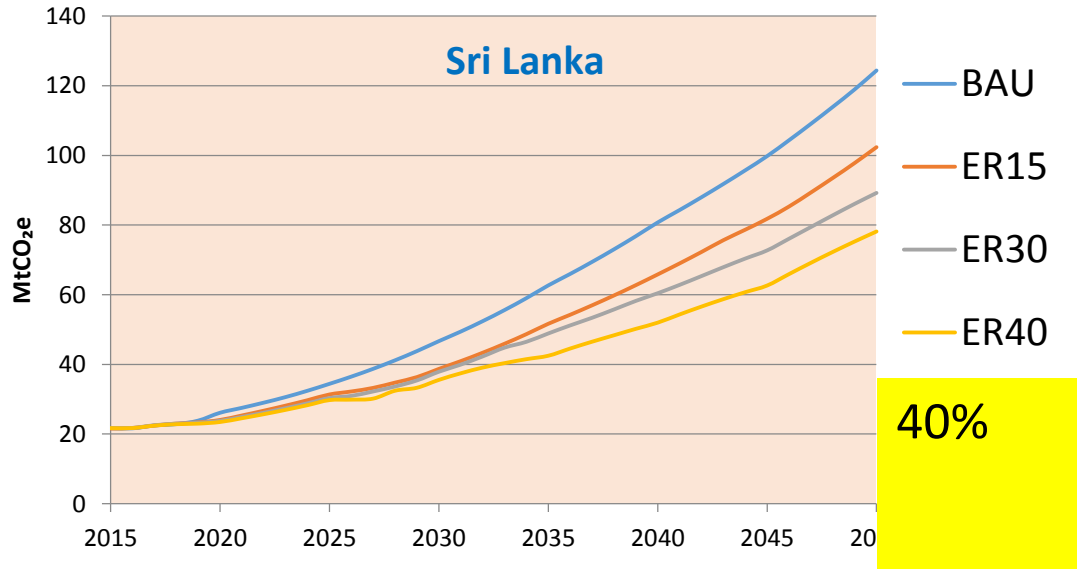
GHG Implications of Energy Reduction Scenarios

GHG Emission during 2015-2050 under Different Scenarios

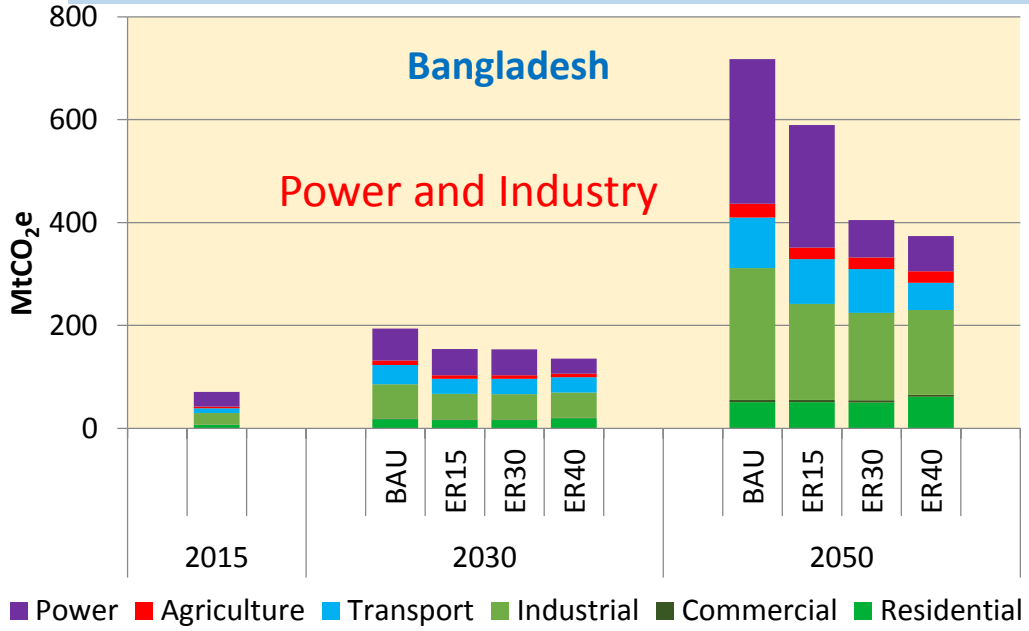


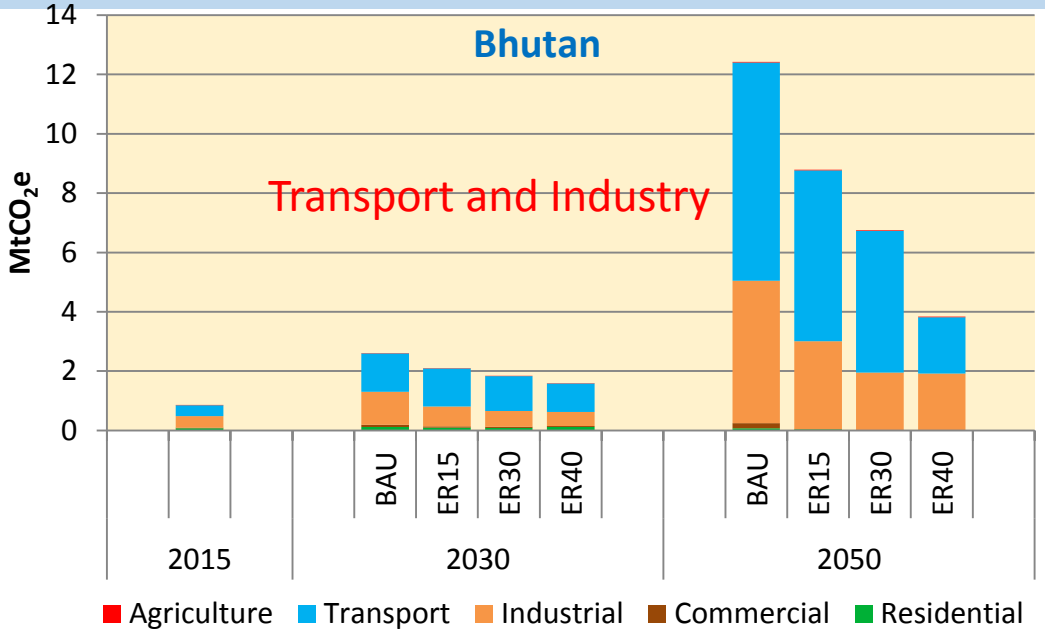


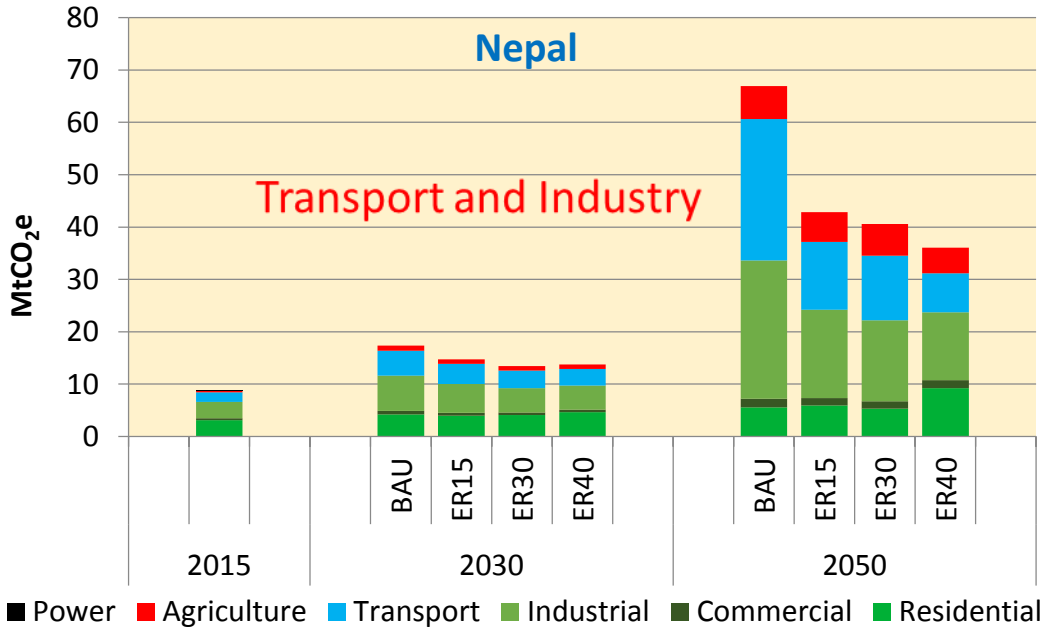


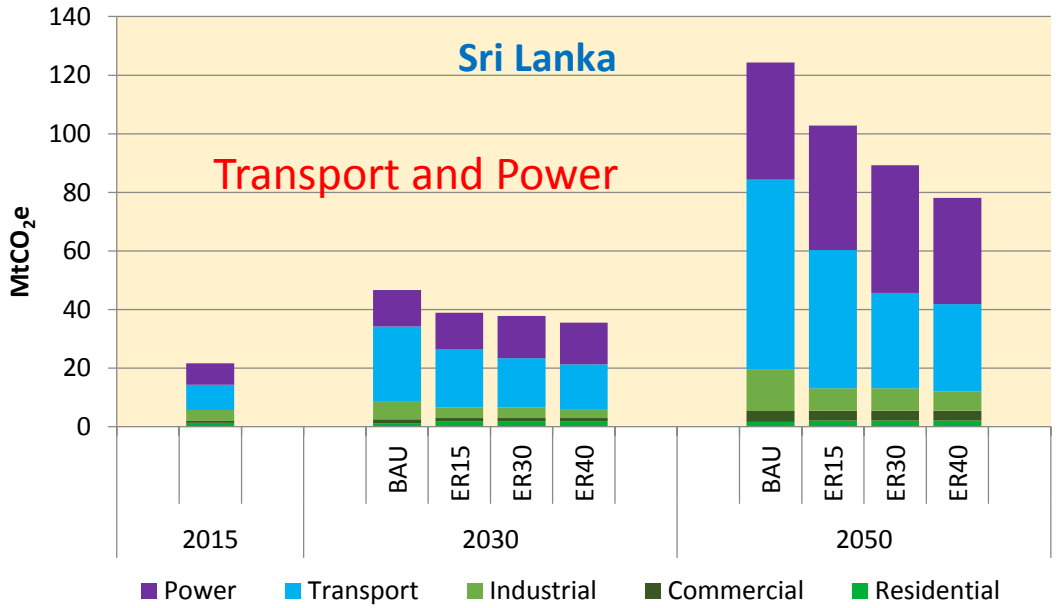


GHG Emission during 2015-2050 under Different Scenarios









Key Findings and Concluding Remarks

- Potential for reduction of total primary energy requirement should be higher than estimated here when modal shift in passenger and freight transport is fully considered.
- RE (excluding hydro) seem to play more noticeable role after 2030.
- There are some uncertainty about the accuracy of technology data; scope for further refinement of analysis and results remains.

Thank you

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