



***“Demand –side Energy Management - Ongoing initiatives,  
issues and opportunities”***

Renewables Readiness Assessment of Bhutan  
Expert Consultation Workshop

Thimphu, Bhutan  
*25<sup>th</sup> December 2018*

Research and Development Division  
Department of Renewable Energy  
Ministry of Economic Affairs  
Royal Government of Bhutan

# Energy Resources



## Restricted Development Power Generation Potential

Hydropower - **22,419 MW** **117,836 GWh** per annum  
Wind Power – **761 MW** **308 GWh** per annum  
Solar PV – **12,018 MW** **20,025 GWh** per annum  
Wood &  
Wood residues – **2,680 MW** **749 GWh** per annum

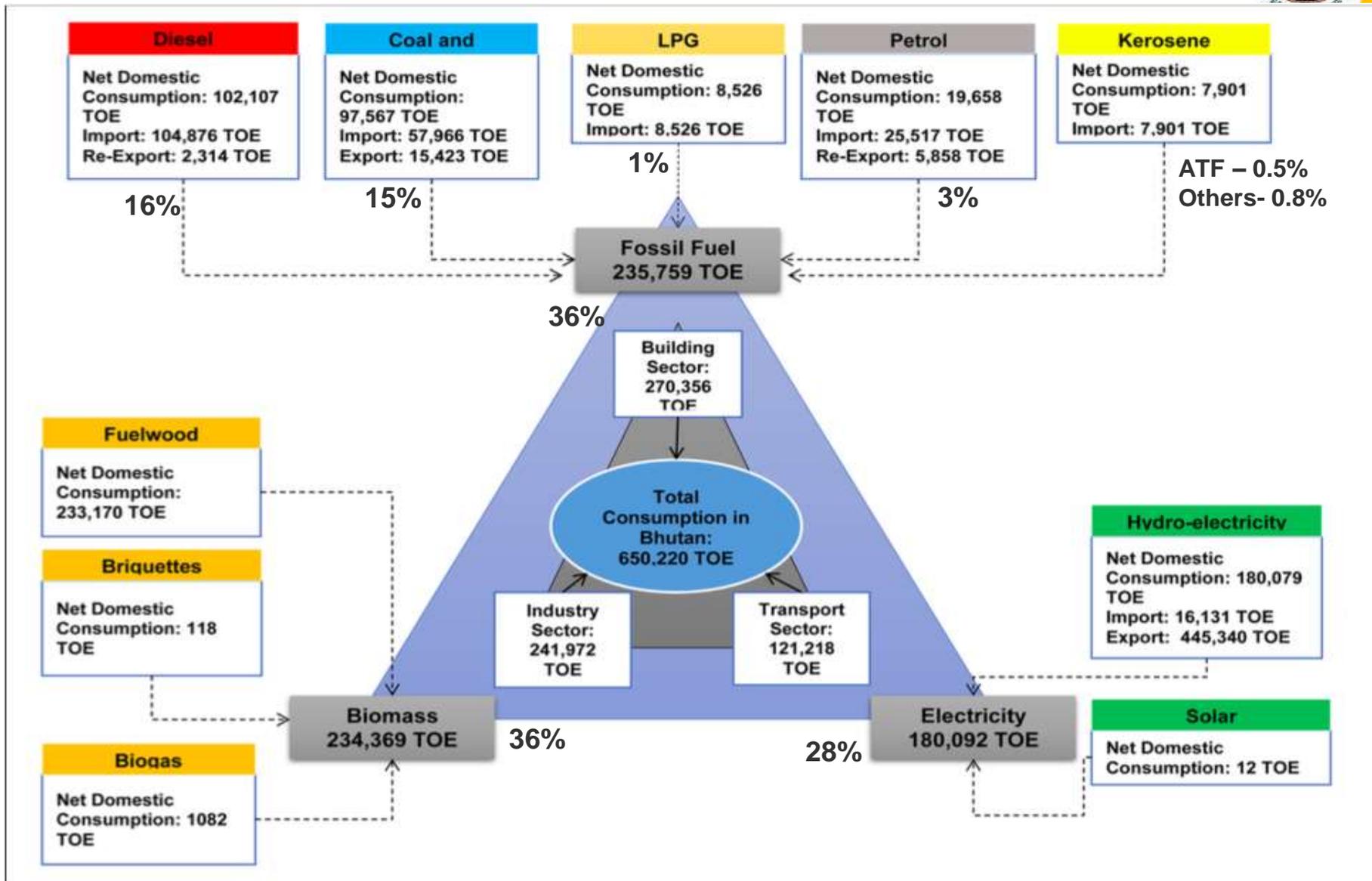
## Energy Supply 2017

Large HPP-	<b>1606 MW</b>	<b>7,709 GWh</b>
Mini/ Micro HPP -	<b>7.99 MW</b>	<b>12.1 GWh</b>
Wind Power –	<b>600 kW</b>	<b>1.1 GWh</b>
Others –		
	Coal, Petroleum fuel (import), Fuel wood	
Total Supply =	<b>937</b>	<b>ktoe</b>



# ENERGY DEMAND

# Energy Demand (2014)

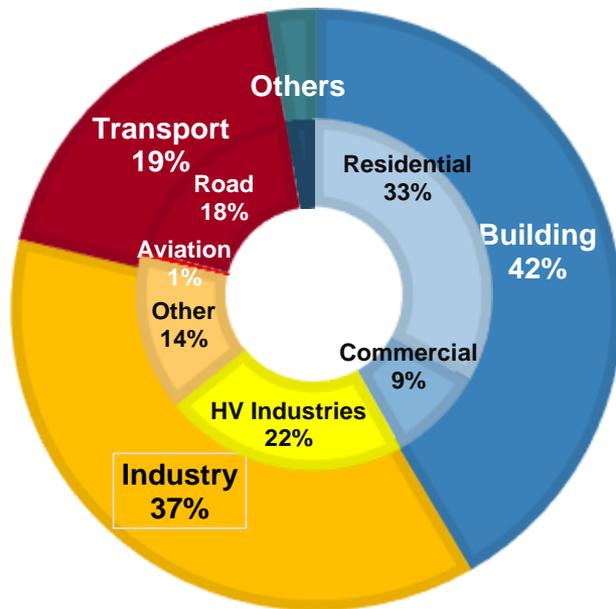


# Energy Consumption



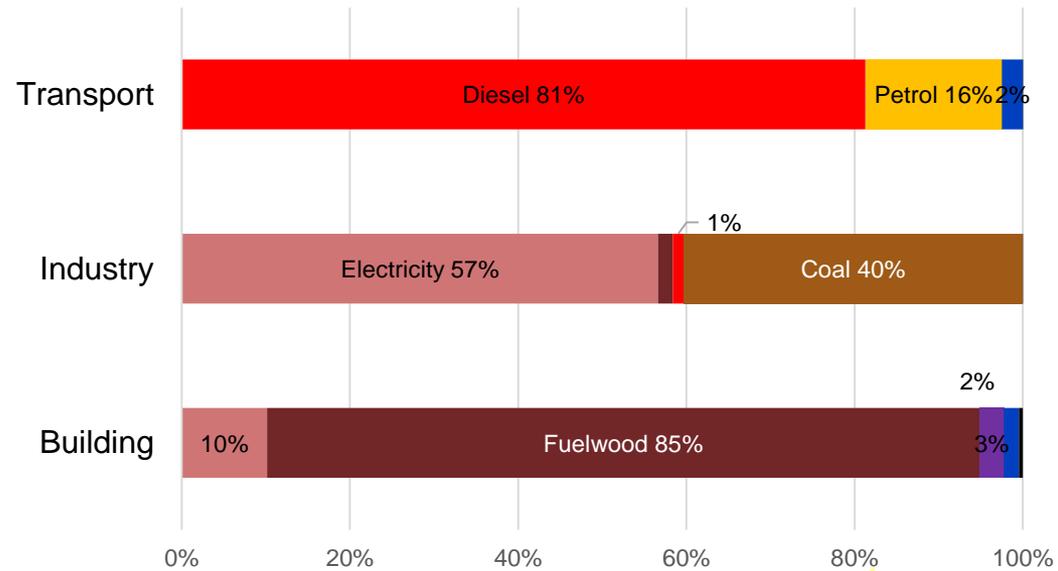
## RATIO OF ENERGY CONSUMPTION BY SECTORS (2014)

■ Building ■ Industry ■ Transport ■ Others

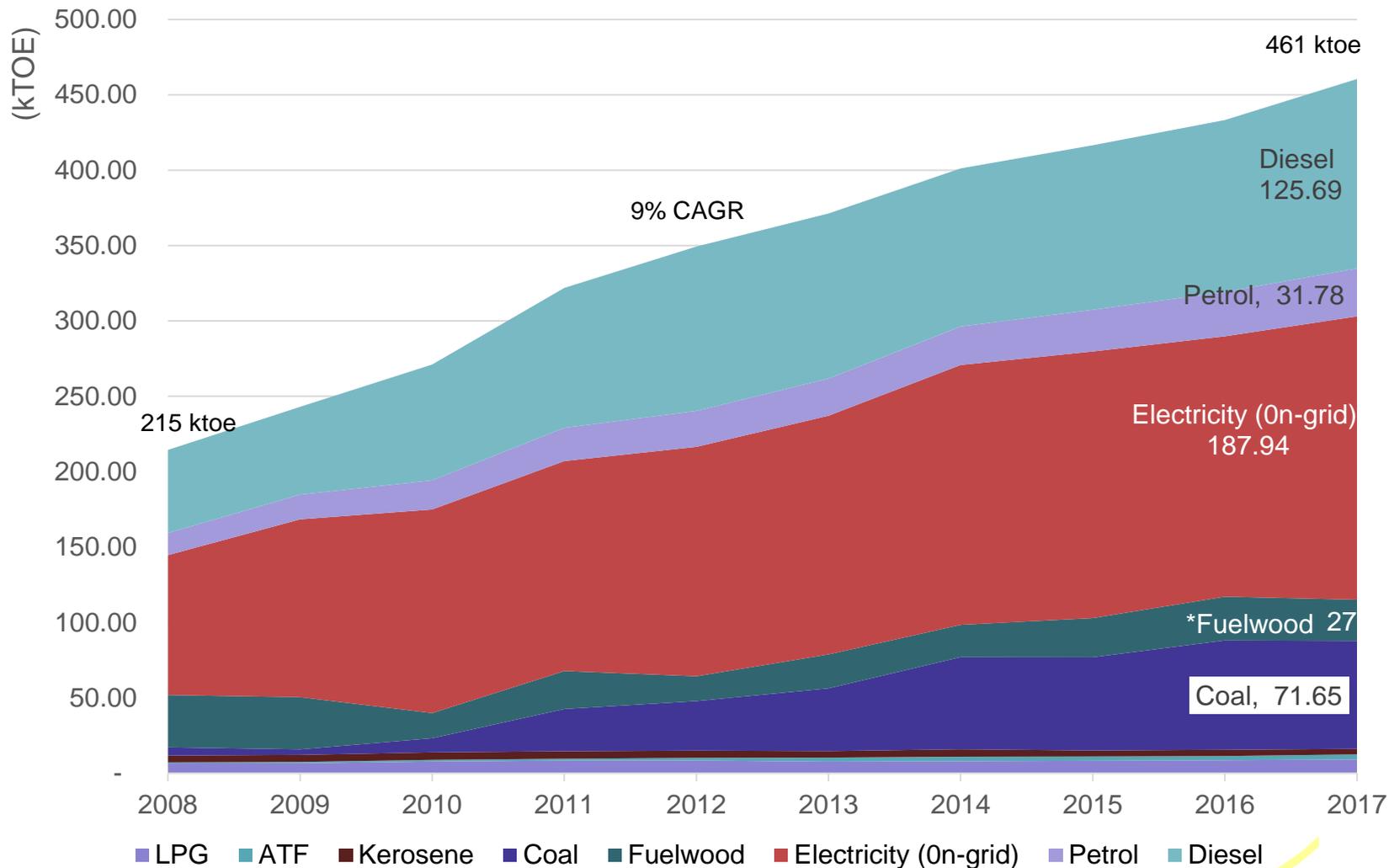


## RATIO OF ENERGY CONSUMPTION BY FUEL (2014)

■ Electricity ■ Fuelwood ■ Diesel ■ Petrol  
 ■ LPG ■ Kerosene ■ Coal ■ Others



# Energy Consumption Trend



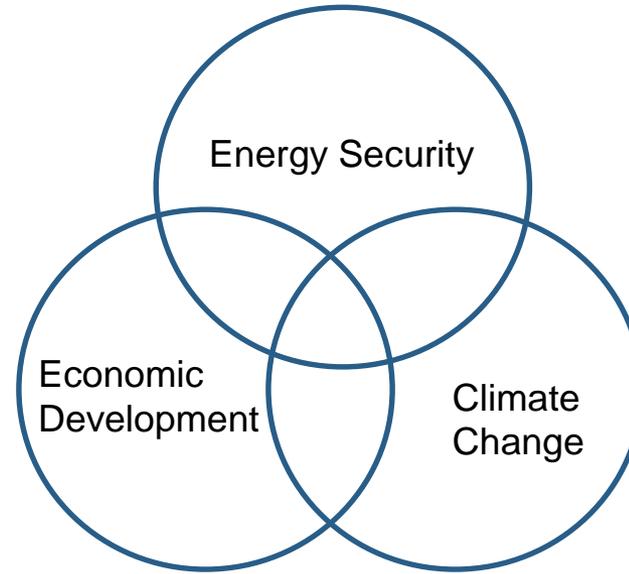
\*Fuelwood consumption - as per DoFPS

\* Coal consumption – as per draft GHG Inventory TNC

# Rationale and Strategies for Energy Demand Intervention



1. Diversify energy sources and enhance energy security
2. Increase revenue
3. Increase energy productivity
4. Reduce GHG emissions

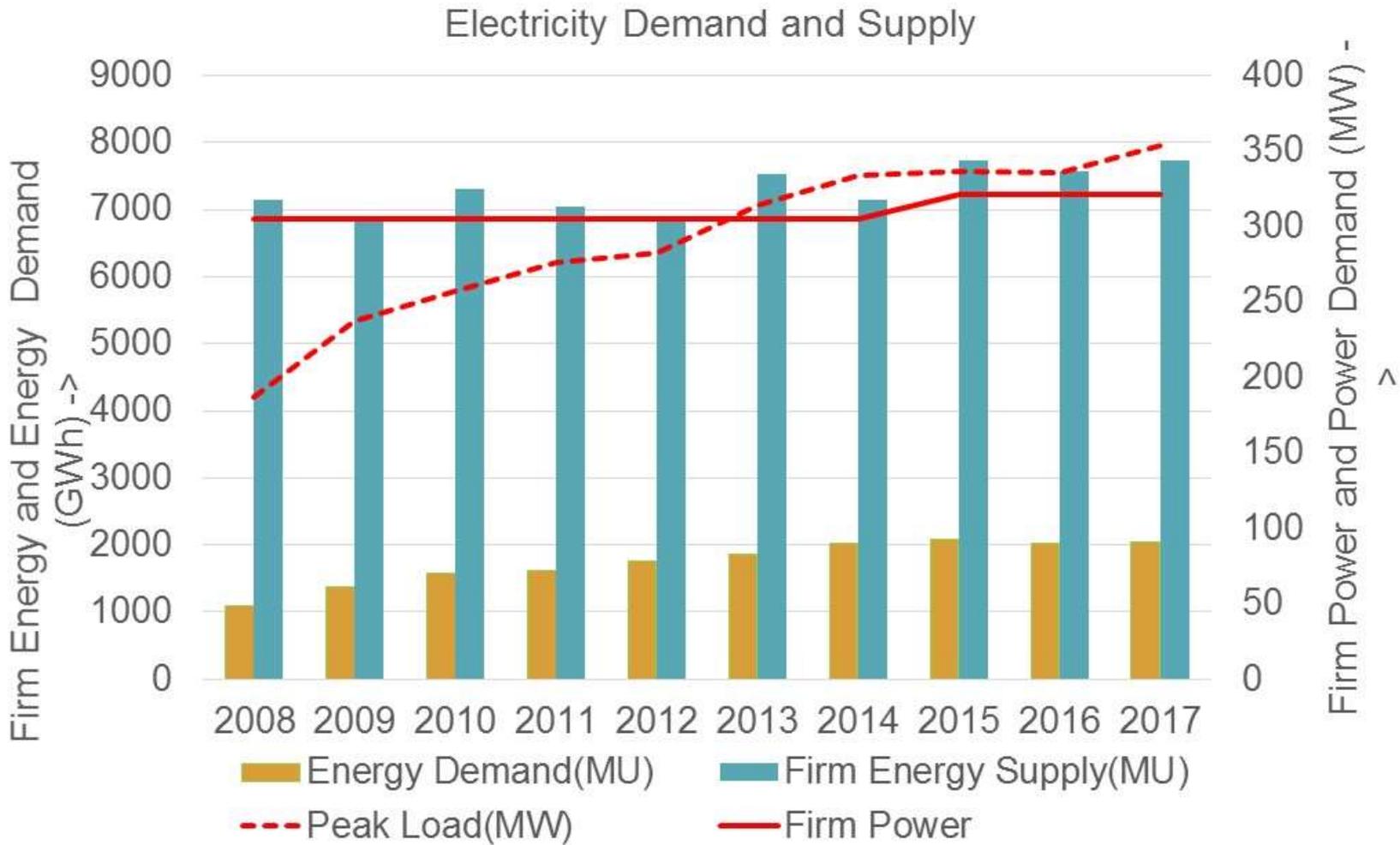


2017  
Revenue from Electricity Export = **12,397 Million Nu.**  
Import value of fossil fuel for Energy Use = **11,304 Million Nu.**

1. Improve energy efficiency
2. Reduce energy intensity
3. Switch to clean energy
4. Create awareness

Source: SYB 2018, BTS 2017

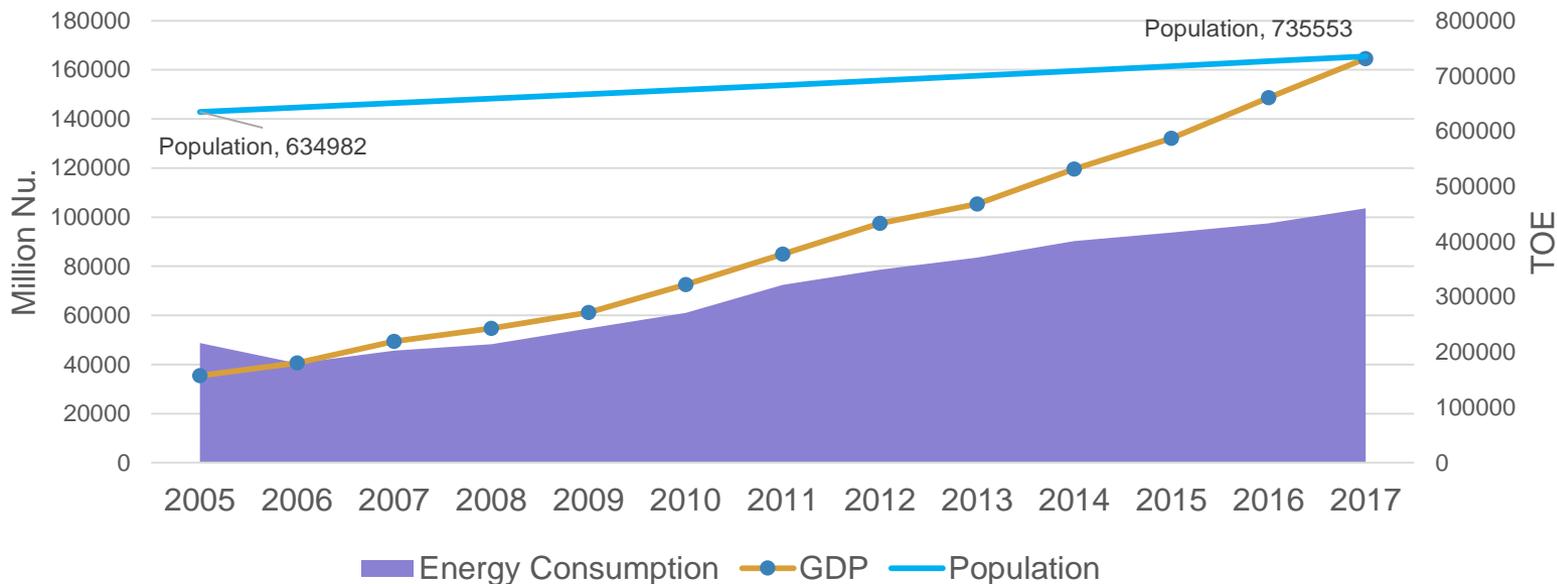
# Electricity



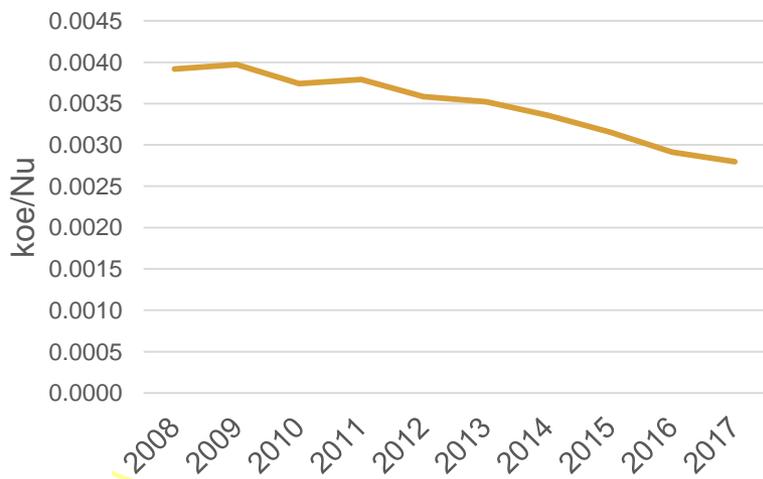
Source: DHPS Power Data Book 2017



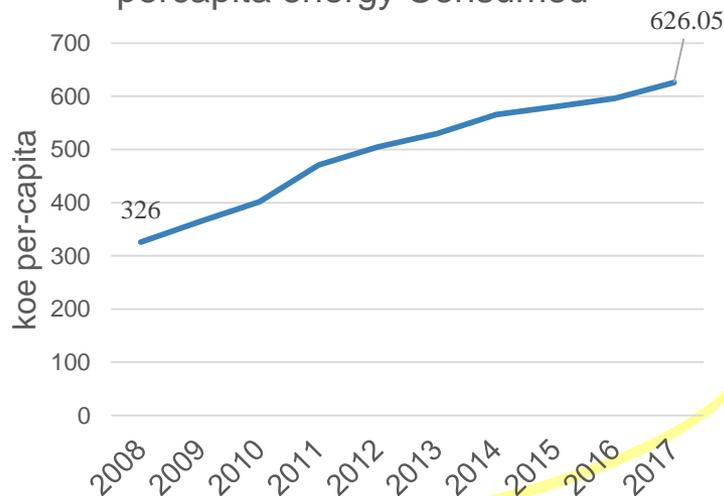
# Energy Demand and GDP



## Energy Intensity

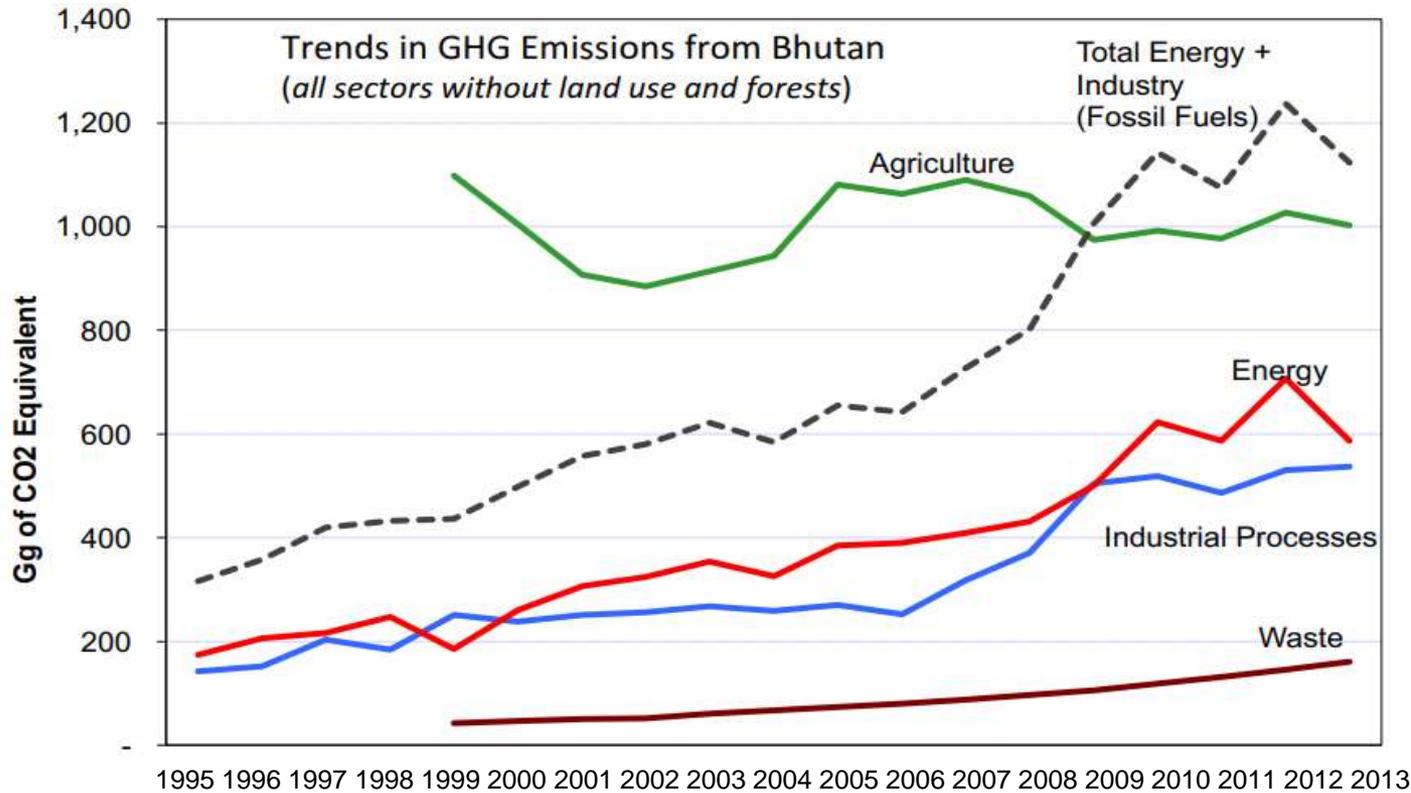


## percapita energy Consumed



Source: Annual Environmental Accounts 2018

# Energy Demand and GHG Emissions



Source: NEC

GHG emission cap - Sequestration capacity of Forests -> **6,310 Gg CO<sub>2</sub>e**

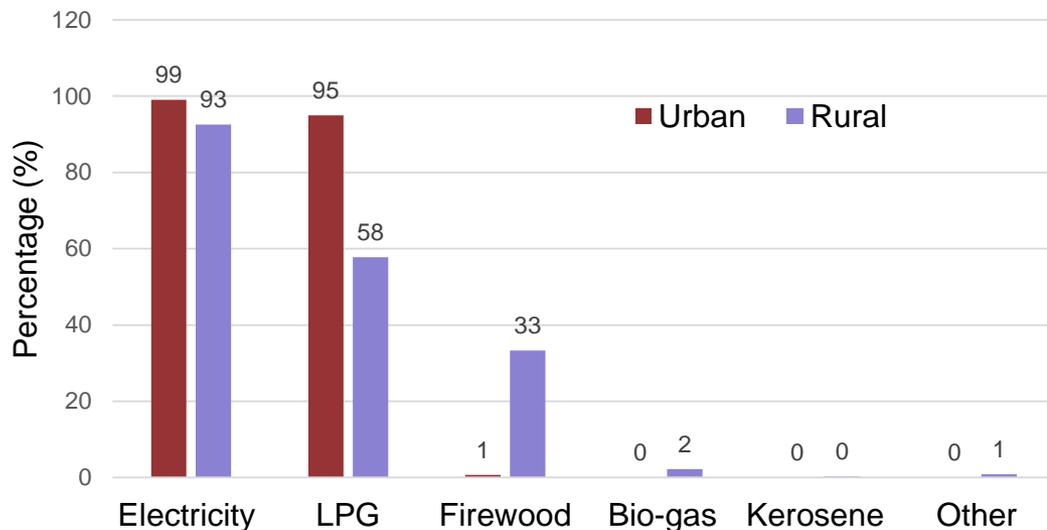


# Building & Appliances Sector

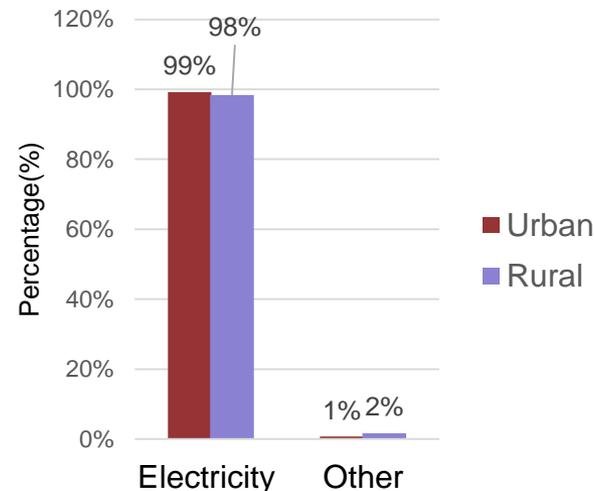


# Household Energy End-uses

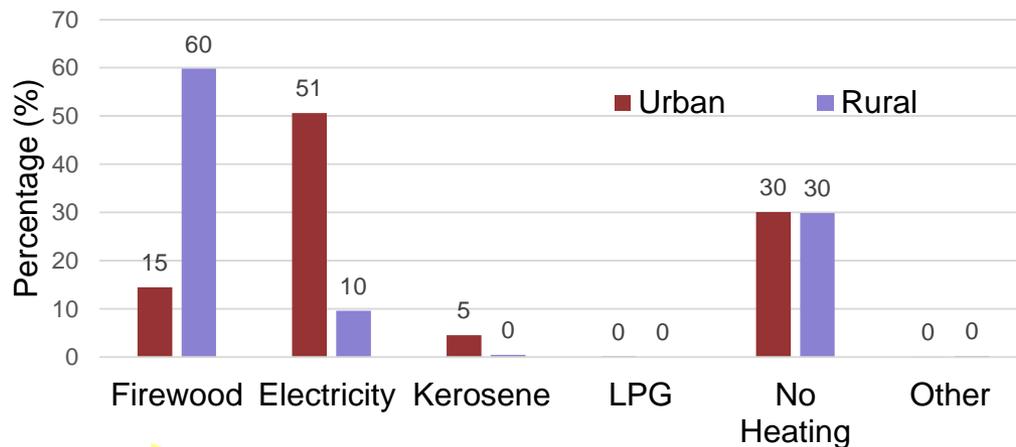
## Source of Energy for Cooking



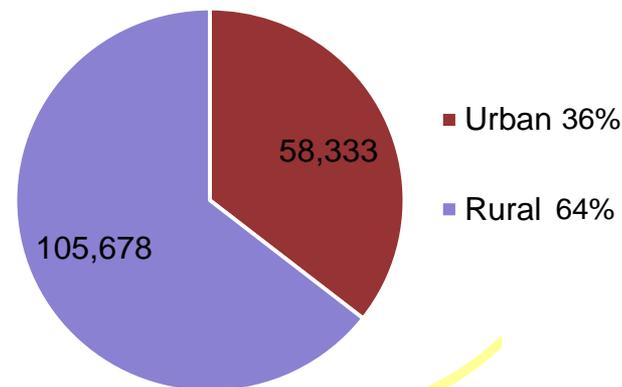
## Source of Energy for Lighting



## Source of Energy for Heating

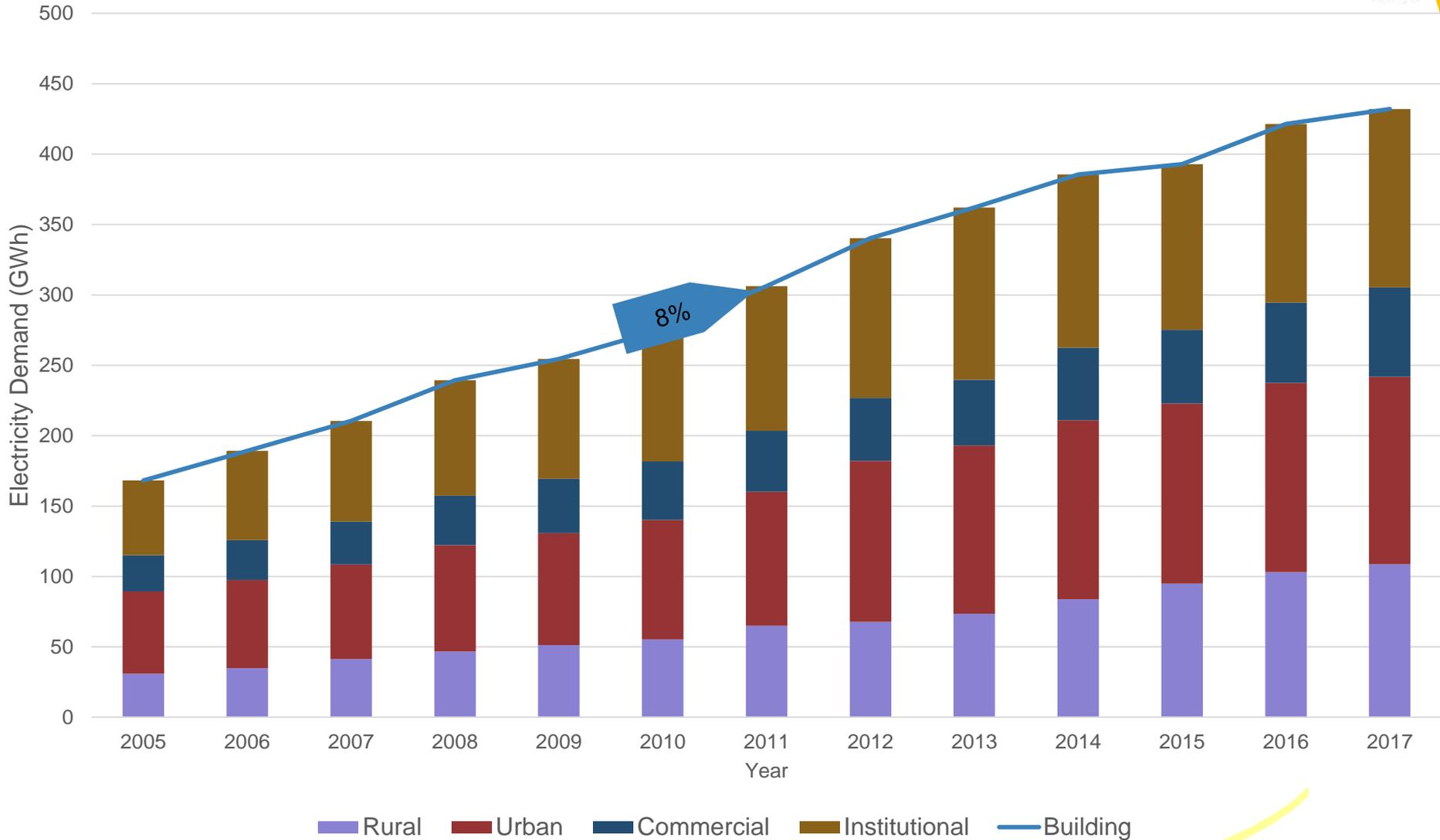


## Households



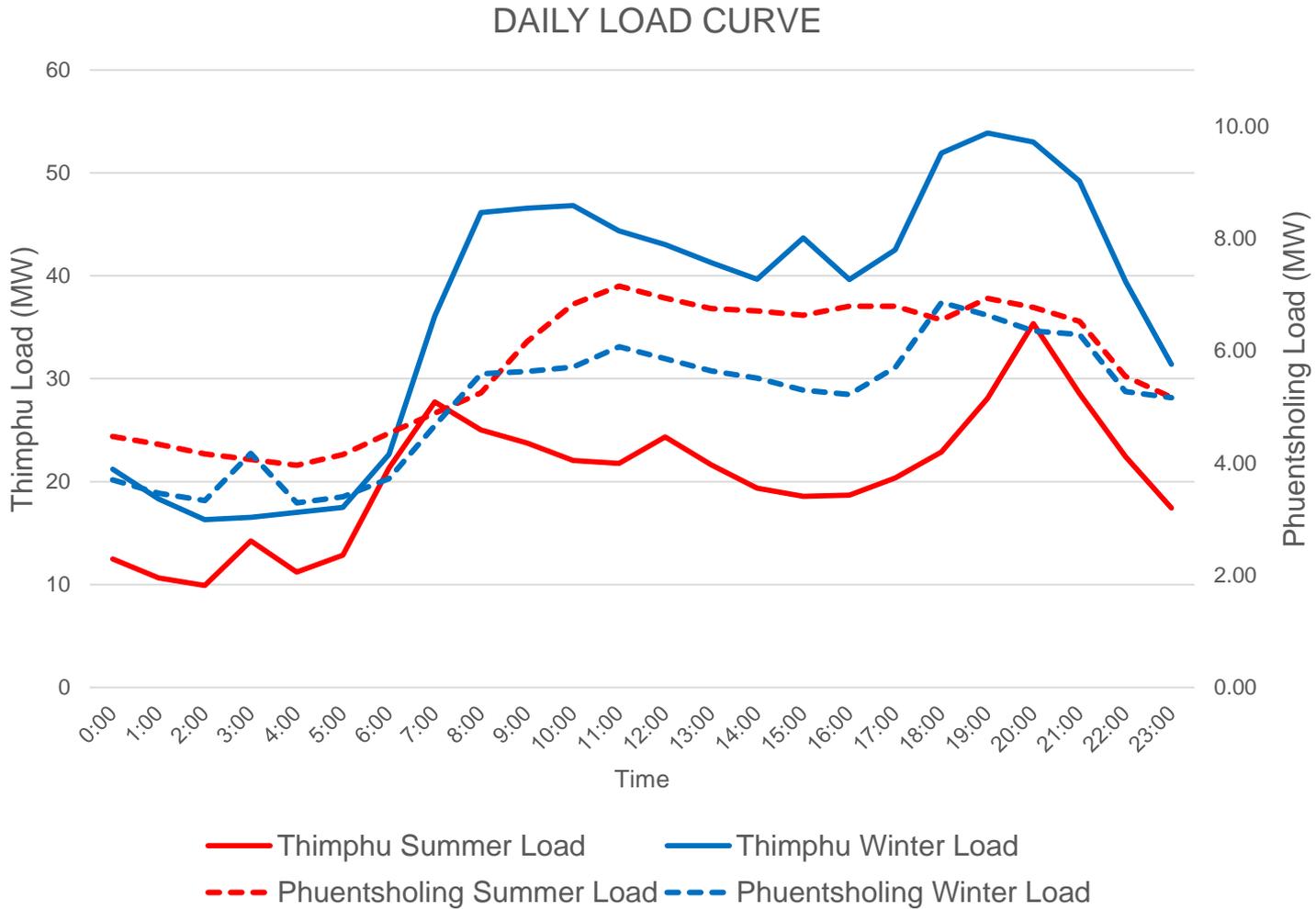


# Building Sector Electricity Demand



Source: BPC Power Data Book 2017

# Load Curve



Source: BPC Power Data Book 2017

# EE&C measures in Building & Appliances sector



- ✓ Building energy performance
  - Energy Efficiency Building codes
  - Energy Audit and reporting guidelines
- ✓ Energy efficient lighting (LED)
- ✓ Energy Efficient space heating (reversible heat pumps)
- ✓ Standards and Labeling of energy consuming appliances
  - Endorsement labels
  - Minimum Energy Performance Standards(MEPS)
- ✓ Clean cooking (promotion of electrical cook stoves)
- ✓ Peak shaving or load shifting (none in development)

# EE&C measures in Building & Appliances sector



- ✓ *Some recommendations from Energy Audit 2014 and S&L Scheme 2018*
  - Tax and duties exemption on LED lamps and reversible heat pumps.
  - Cash rebate scheme for 5-star refrigerators (direct cool and frost free)
  - Roll out of 600,000 LED lamps on cost sharing basis
  - Building insulation improvement by using 1 inch glass wool in 185 institutional/ commercial buildings
  - Use of 1 inch EPS insulation for roof in 75 institutional/ commercial buildings
  - Use of double-glazed windows in 300 buildings
  - Use of rat trap wall in 95 new buildings (residential/ institutional/ commercial)
  - Encourage public procurement of energy efficient appliances and equipment



# Energy Saving Potential in Building and Appliances sectors

## Energy Saving Potential - BAU to Low Intervention EE Scenario

Interventions Planned	Nos. targeted per year	Energy Saving Potential GWh	Projected Energy Saving Potential TOE
Building Insulation (1" glass wool)=	12	0.048	4.10
Building Insulation (1" EPS roof)=	5	0.080	6.87
Building Insulation (rat trap wall)=	6	0.052	4.49
Building Insulation (double glazed window)=	20	0.124	10.69
LED lamps (BAU to EE, 28% Market Share) =	200,000	3.720	319.86
Refrigerator (BAU to EE, 20% Market Share) =	2,251	0.246	21.13
Heating (BAU to EE, 20% Market Share) =	3,905	1.511	129.96
<b>Total Energy saving on Low EE Scenario =</b>		<b>5.8</b>	<b>497.11</b>

1.4 % of total LV Consumption

# Energy Saving Potential in Building and Appliances sectors



## Impact of EE Intervention – LED Lamps (200,000)

Description	Unit	Revenue Impact (1st Yr.)	Revenue Impact (Lifetime -10 Yrs.)
Foregone Sales Tax(-revenue)	Nu.	2,322,823	2,322,823
Foregone Import Duty (-revenue)	Nu.	11,607	11,607
Saved Subsidy (revenue)	Nu.	8,518,800	85,188,000
Balance (Total revenue	Nu.	6,184,370	82,853,570

## Impact of EE Intervention – Heating (Reversible Heat Pumps: 3,905)

Description	Unit	Revenue Impact (1st Yr.)	Revenue Impact (Lifetime -10 Yrs.)
Foregone Sales Tax(-revenue)	Nu.	16,282	16,282
Foregone Import Duty (-revenue)	Nu.	65,129	65,129
Saved Subsidy (revenue)	Nu.	4,980,690	49,809,447
Balance (Total revenue	Nu.	4,899,279	49,728,036

## Impact of EE Intervention – Refrigerators (2,215)

Description	Unit	Revenue Impact (1st Yr.)	Revenue Impact (Lifetime -10 Yrs)
Foregone Sales Tax(-revenue)	Nu.	1,274,246	1,274,246
Foregone Import Duty (-revenue)	Nu.	-	-
Saved Subsidy (revenue)	Nu.	561,872	5,618,721
Balance (Total revenue	Nu.	(712,374)	4,344,475



# Industry Sector

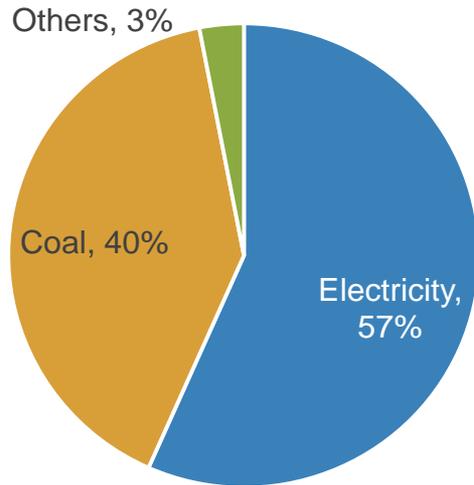
# Industry Sector



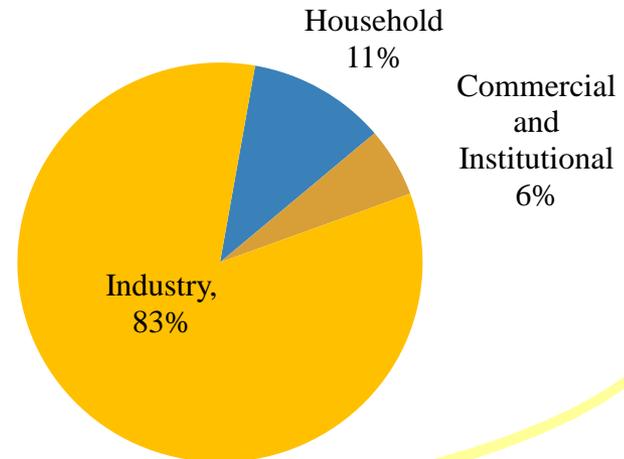
- Industry is the fastest growing sector in the country
- Most energy consumption by HV industries



## Industry Energy Consumption 2014



## Electricity Consumption by various Sector 2014



# EE&C measures in Industry sector



- ✓ Energy performance of energy-intensive industries
  - Energy Audit and reporting guidelines
- ✓ Training of energy managers in industries
- ✓ Awareness programs for industries

✓ *Some recommendations from Energy Audit 2014*

- Replacement of V-Belt with Flat-Belt Drives
- Improvement of power factor (in motors and utilities) through addition of capacitor banks
- Replacement/ downsize motors and use/ replace with Energy Efficient Motors
- Replacement of outdated pumps with right sized energy efficient pumps for blade cooling
- Replacement of inefficient lighting (FTL, HPMV, HPSVL) with efficient lighting system
- Installation of VFD to the high power cooling water circulation pumps and identified fans.
- Replacement of identified inefficient blowers, fans and compressors with energy efficient ones

## **Total Energy Saving**

**Potential = 2,392 TOE/ year**

**Electricity saving potential = 27 GWh per year**

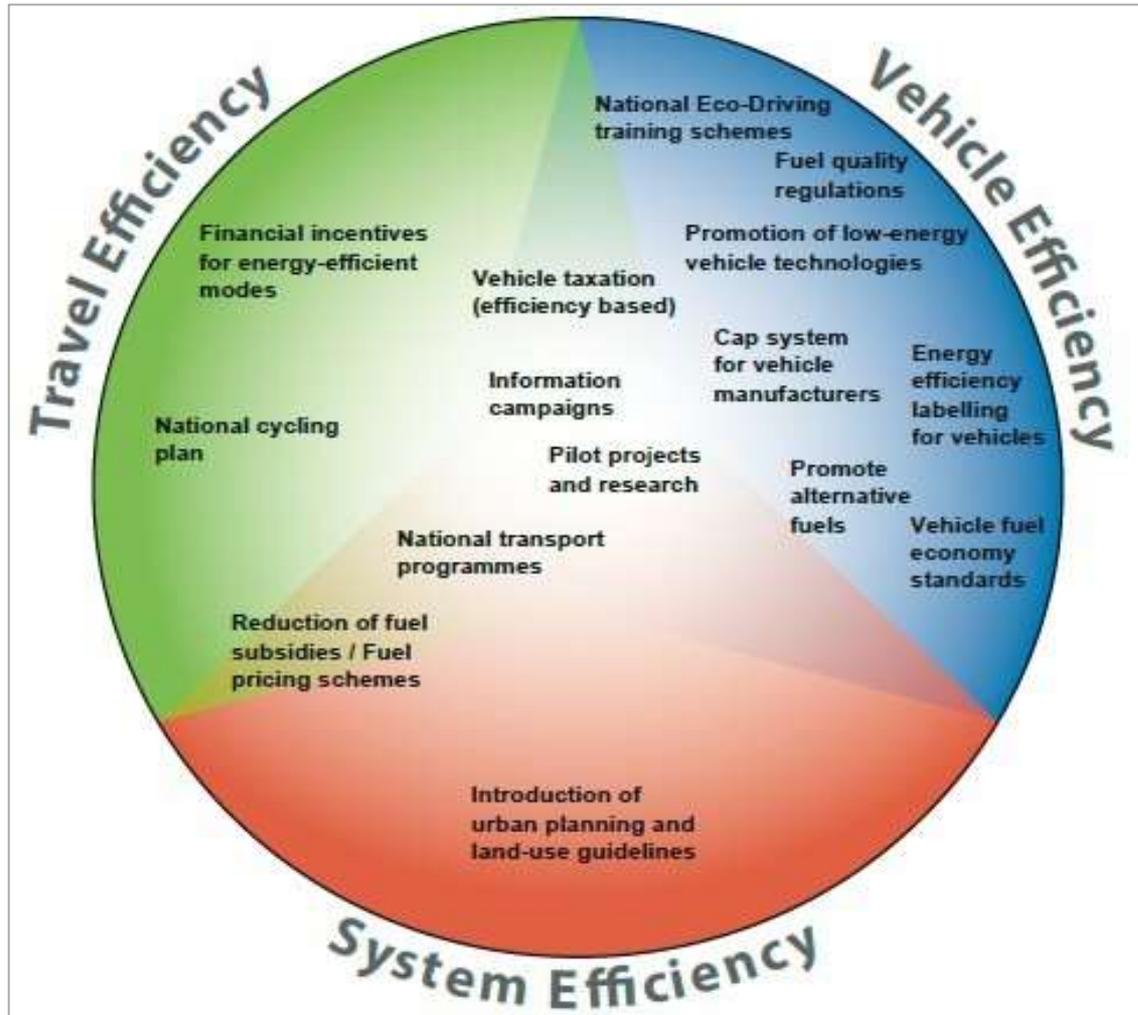


# Transport Sector

# Transport Sector



## EE navigators for National Governments



Source: Report on Climate Change, GIZ

# Transport Sector



- ✓ Transport sector is the leading contributor to current trade deficit (import of petroleum fuels)
- ✓ MoIC – introduce 300 EVs (Bhutan Sustainable Low-emission Urban Transport Systems) on cost sharing mechanism
- ✓ EE&C Policy targets for Energy Efficiency in Transport Sector:
  - Import of 23 electric buses instead of diesel buses (20 seater)
  - Import of 5,097 electric cars instead of petrol/ diesel cars
  - Import of 66 electric bikes instead of petrol bikes
  - Improvement in public transport system (26 buses replacing cars)

# Achievement



- ✓ 99.98% Rural Electrification achieved
- ✓ Draft Energy Efficiency & Conservation Policy
- ✓ Standards and Labeling scheme for energy efficient appliances
- ✓ 28,373 LED lamps distributed nationwide as pilot project
- ✓ 5,000 biogas plants installed in partnership with DoL.
- ✓ 12,390 Improved Cook Stoves rolled out on subsidy scheme.
- ✓ 1,610 Improved Heating stoves rolled out on subsidy.
- ✓ Solar Water Heating Systems – 8 Nos. piloted
- ✓ Energy audits for 39 industries and 1 HPP
- ✓ Yearly awareness programs conducted (painting competition, audiovisual programs, print media)
- ✓ Several bilateral and multilateral meetings/ workshops conducted to establish institutional arrangement and share knowledge & resources

# Challenges



- Need for legislative framework: Policy in draft, Act would be necessary in future.
- Funding Mechanism – No Revolving Fund for EE. Might draw from Renewable Energy Development Fund (REDF), local banks unaware of EE project appraisal.
- Tax incentives/ subsidies: Need to create sub-category (HS BTC) for “Energy Efficient Appliances” OR certification schemes to consider exemptions and waivers
- Energy Performance Standards not adopted
- Energy Management Systems: No dedicated energy managers or systems in place
- Lack of local capacity (Public and Private) – No Energy Managers, Energy auditors,
- Limited market for EE – No private players (ESCOs)
- Need for awareness on Energy Efficiency
- No defined roles for uptake of monitoring, reporting and evaluation

# Opportunities and Way Forward



- ✓ Policy and regulation

  - National Energy Efficiency and Conservation Policy (*Draft*)

  - Energy efficiency roadmap 2030 (*Final draft*)

  - Codes and Guidelines*

- ✓ Institutional arrangement

  - Coordination among key players

  - Lead agency - DRE ( proposed “Energy Efficiency Division”)

- ✓ Incentives

  - Tax and duties exemption for high energy efficiency

  - Cash rebates, low interest rates

  - Certification, awards

- ✓ Monitoring, evaluation and reporting mechanism

  - Energy management and reporting system for energy intensive buildings/ industries

  - Data collection and analysis

  - Compliance and surveillance

**Expected  
measures to  
realize EE&C  
targets**



# Thank you

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