

Bhutan Carbon Neutral Scenario Tentative Result

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About Bhutan Carbon Neutral Scenario

- Bhutan is already carbon neutral country.
- The government of Bhutan declared that Bhutan remain carbon neutral in future in INDC.
- However, its possibility is unclear because Bhutan's economy is rapidly growing.
- This study can help to consider how to keep carbon neutral in Bhutan.



Framework

Region	Bhutan <ul style="list-style-type: none"> ■ Thimphu ■ Rest of Bhutan (ROB)
Base year	2012
Target year	2050
Types of scenarios	<ul style="list-style-type: none"> ■ BaU scenario ■ CM scenario

Target activities

- Energy use
 - Industry sector
 - Commercial sector
 - Residential sector
 - Transport sector
- Industrial processes
- AFOLU
 - Agriculture
 - Landuse

Scenarios

BaU (Business as Usual) Scenario

- Social and economic development based on future plan of the region
- Without implementation of LCS policy in future

CM (Countermeasure) Scenario

- Same assumption as BaU scenario about social and economic development
- With implementation of LCS policy



Data Preparation

- A variety of data and information of Bhutan were collected to estimate current status and future vision.
- We estimated regional data of Thimphu and ROB by downscaling of national statistics when regional data is not available.

	Source
Demography	<ul style="list-style-type: none"> ■ National Statistics Bureau (2009): Population Projections of Bhutan 2005-2030 ■ National Statistics Bureau (website): Dzongkhag Population Projection 2011-2015 ■ Gross National Happiness Commission, Bhutan (2013): Eleventh Five Year Plan ■ National Statistics Bureau and Asian Development Bank (2012): Bhutan Living Standards Survey 2012 Report ■ World Bank (2016): World Development Indicators
Economy	<ul style="list-style-type: none"> ■ National Statistics Bureau (2015): National Accounts Statistics 2015 ■ National Statistics Bureau (2013): Statistical Yearbook of Bhutan 2013 ■ Gross National Happiness Commission, Bhutan (2013): Eleventh Five Year Plan
Transport	<ul style="list-style-type: none"> ■ Ministry of Information and Communications: Current Status of National Transport Polices, Systems and Projects in Bhutan ■ National Statistics Bureau (2015): Statistical Yearbook of Bhutan 2015
Energy	<ul style="list-style-type: none"> ■ National Statistics Bureau (2015): National Accounts Statistics 2015 ■ Department of Renewable Energy and United Nations Development Programme (2012): Bhutan Energy Efficiency Baseline Study Final Report ■ Ea Energy Analyses and COWI (2012): Bhutan: A national strategy and action plan for low carbon development Final report ■ S. Jamtsho (2015): Energy Efficiency & Conservation Initiatives in Bhutan ■ Bhutan Statistical Services & Environmental Consultancy: Assessment of Fuel Consumption and Baseline Health Impact Study in Bhutan
Agriculture	<ul style="list-style-type: none"> ■ Ministry of Agriculture & Forests (2015): Bhutan RNR Statistics 2015
Landuse	<ul style="list-style-type: none"> ■ Ministry of Agriculture & Forests (2015): Bhutan RNR Statistics 2015



Collected Data

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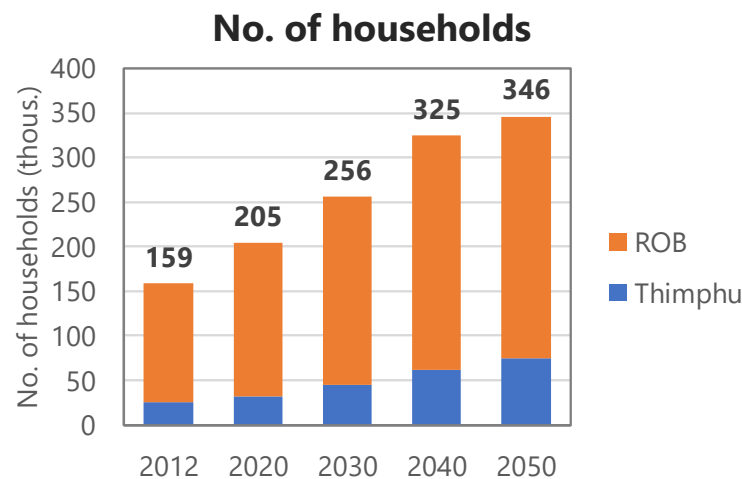
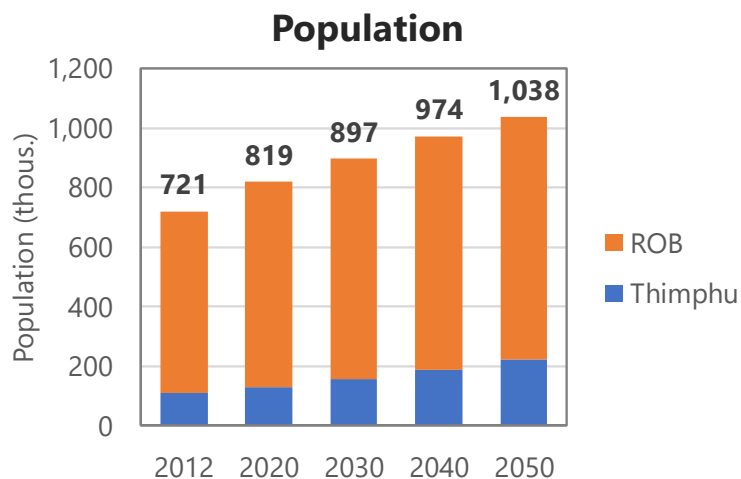
	Base year		Future	
	Bhutan	Thimphu	Bhutan	Thimphu
Demography	<ul style="list-style-type: none"> Population No. of households 	<ul style="list-style-type: none"> Population 	<ul style="list-style-type: none"> Population 	X
Economy	<ul style="list-style-type: none"> GDP No. of firms 	<ul style="list-style-type: none"> No. of firms 	<ul style="list-style-type: none"> GDP growth rate 	X
Transport	<ul style="list-style-type: none"> No. of vehicles Modal share by vehicle type No. of Drivers Licenses Issued 	X	X	X
Agriculture	<ul style="list-style-type: none"> Crop production Cultivated area 	<ul style="list-style-type: none"> Crop production Cultivated area 	X	X
Landuse	<ul style="list-style-type: none"> Land area 	<ul style="list-style-type: none"> Land area 	X	X
Energy	<ul style="list-style-type: none"> Energy consumption Power generation 	<ul style="list-style-type: none"> Electricity consumption 	X	X

X: cannot find



Population and Households

- Population of Bhutan will amount to 1 million in 2050.
- Population of Thimphu will become twice as large as that in 2014.

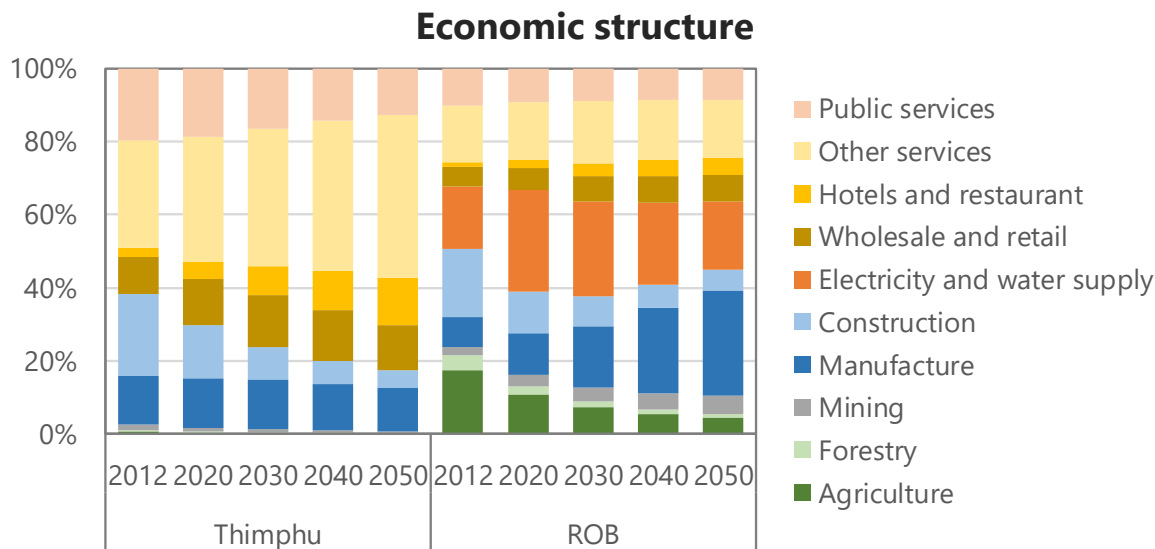
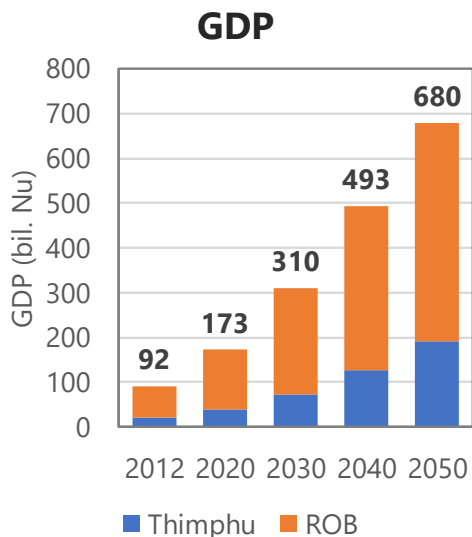


Reference and Assumption

2012		2050	
Source		Source	Assumption
<ul style="list-style-type: none"> ■ National Statistics Bureau, Bhutan (2009): Population Projections of Bhutan 2005-2030 ■ National Statistics Bureau, Bhutan (website): Dzongkhag Population Projection 2011-2015 ■ National Statistics Bureau, Bhutan and Asian Development Bank (2012): Bhutan Living Standards Survey 2012 Report 		<ul style="list-style-type: none"> ■ Gross National Happiness Commission, Bhutan (2013): Eleventh Five Year Plan 	<ul style="list-style-type: none"> ■ Population will increase. ■ Population growth rate of Thimphu continues to be higher than ROB. ■ Household size decreases.



- GDP will grow by 5.4%/year on average in Bhutan.
- Tertiary industry leads economic growth in Thimphu.

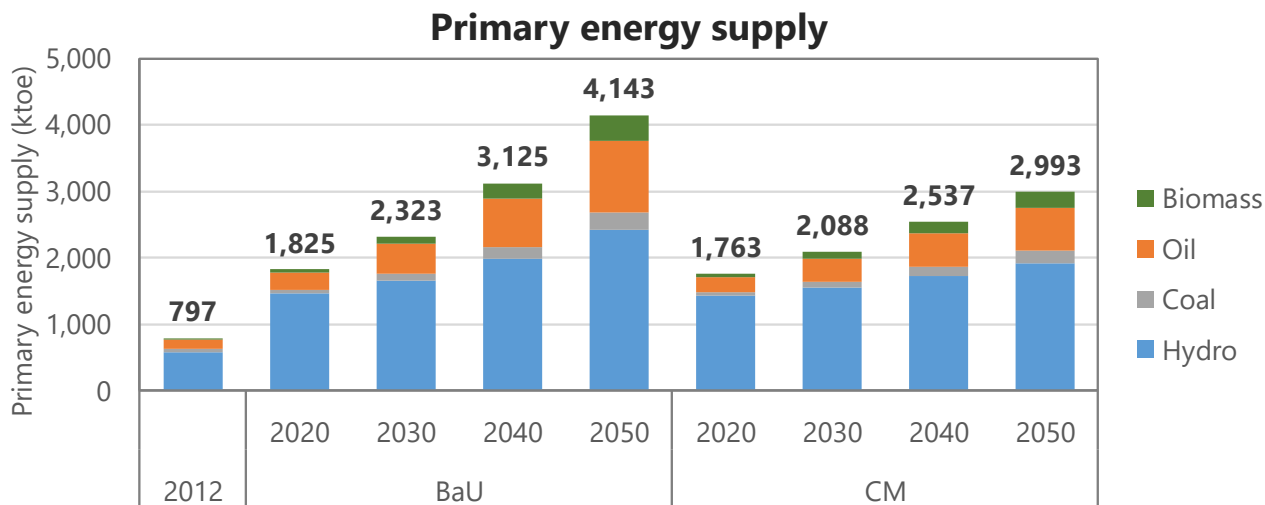


Reference and Assumption

2012		2050	
Source	Assumption	Source	Assumption
<ul style="list-style-type: none"> ■ National Statistics Bureau (2015): National Accounts Statistics 2015 ■ National Statistics Bureau (2013): Statistical Yearbook of Bhutan 2013 	<ul style="list-style-type: none"> ■ National GDP by industry was downscaled to Thimphu and ROB using proxy indices such as number of firm, land area, and population 	<ul style="list-style-type: none"> ■ Gross National Happiness Commission, Bhutan (2013): Eleventh Five Year Plan 	<ul style="list-style-type: none"> ■ Both Thimphu and ROB have economic growth. ■ It is slightly higher in Thimphu. ■ Current difference of economic structure between the regions is assumed to be larger in future.



- Primary energy demand will increase more than 5 times from 2012 level in 2050 BaU.
- The largest energy source is Hydropower in both scenarios in all years.
- Oil consumption of oil will increase mainly because of transport demand increase.



Reference and Assumption

2012		2050
Source	Assumption	Assumption
<ul style="list-style-type: none"> ■ National Statistics Bureau (2015): National Accounts Statistics 2015 ■ Department of Renewable Energy and United Nations Development Programme (2012): Bhutan Energy Efficiency Baseline Study Final Report ■ S. Jamtsho (2015): Energy Efficiency & Conservation Initiatives in Bhutan 	<ul style="list-style-type: none"> ■ Energy consumption except electricity was downscaled to the regions using proxy indices such as population and number of firm 	<p>BaU</p> <ul style="list-style-type: none"> ■ Same as the base year <p>CM</p> <ul style="list-style-type: none"> ■ Energy efficiency will be improved. ■ Share of electricity will increase in demand side fuel composition.

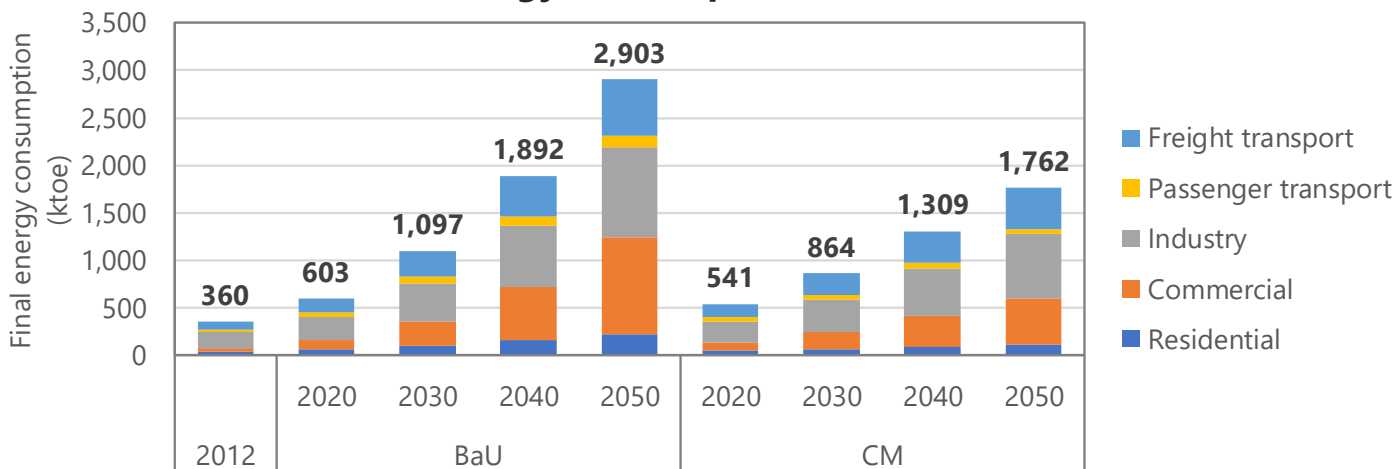


Energy

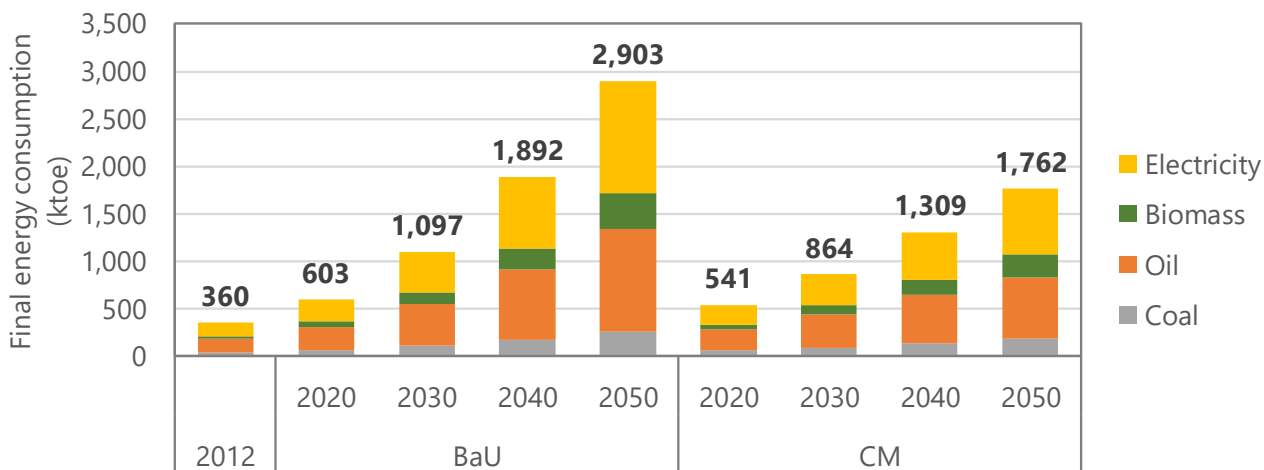
- Final energy demand will increase more than 8 times from 2012 level in 2050 BaU.
- Energy consumption in commercial sector will grow remarkably.
- A lot of energy demand in passenger transport sector will be reduced in CM scenario owing to improvement of fuel economy, diffusion of EV and modal shift to buses.

Final energy consumption

By sector



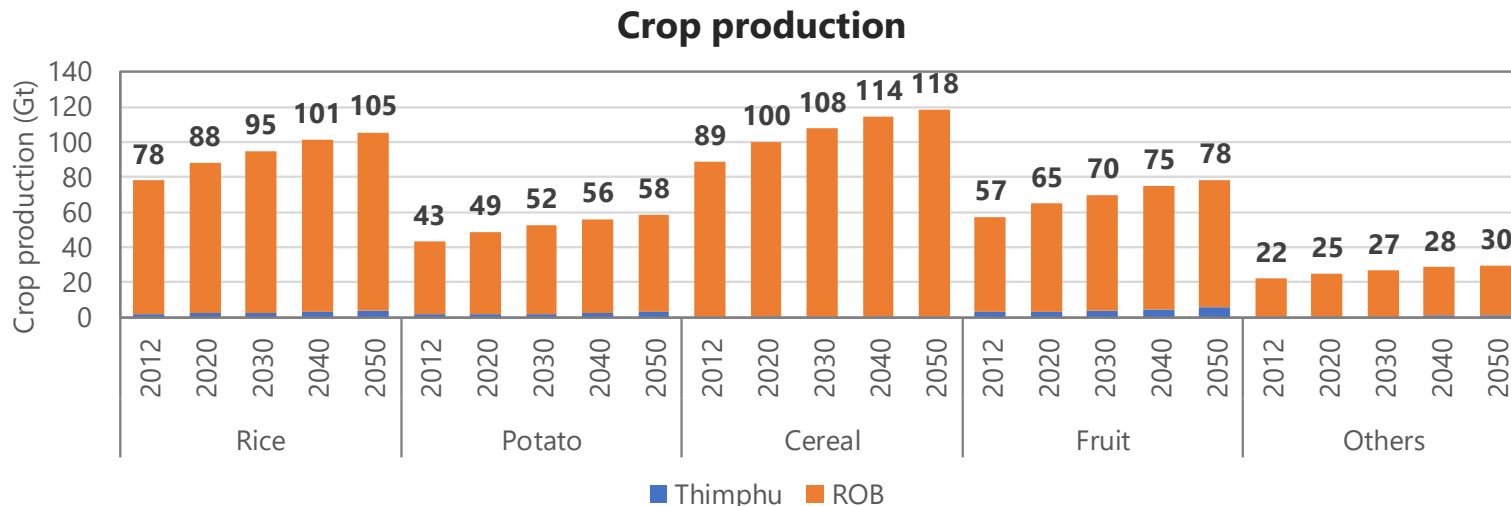
By fuel





Agriculture

- Crop production in Bhutan in 2050 will become twice as much as that in 2012.
- Most of crops are produced in ROB now and in future.
- Rice and fruit are main crops made in Thimphu.

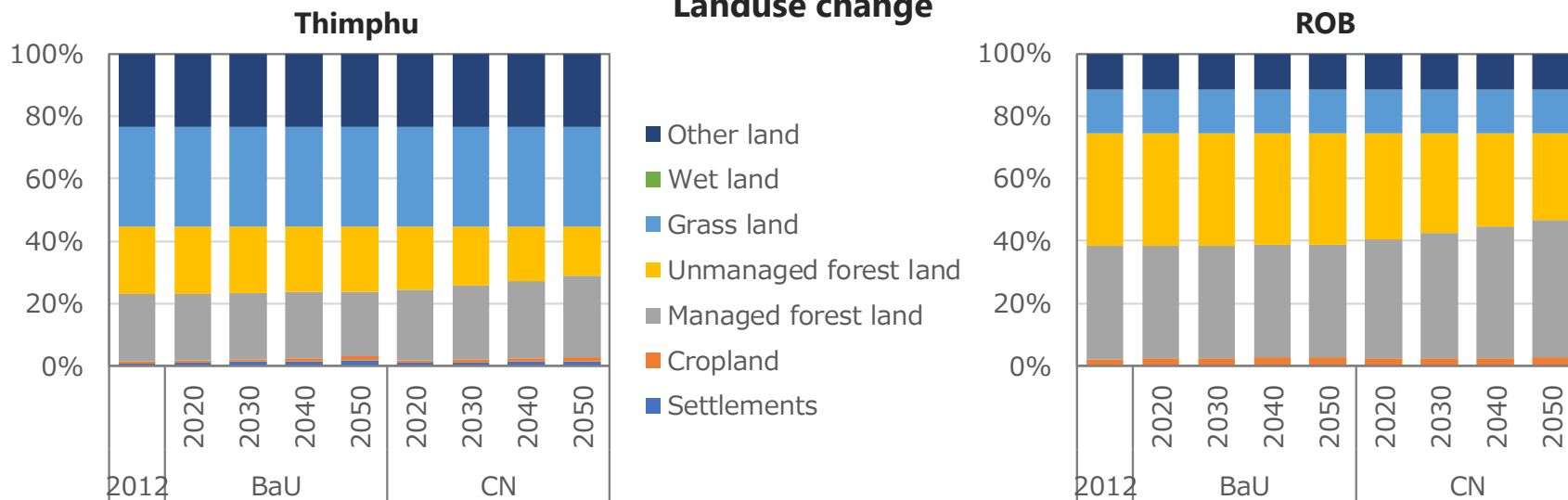


Reference and Assumption

2012	2050
Source	Assumption
<ul style="list-style-type: none"> ■ Ministry of Agriculture & Forests (2015): Bhutan RNR Statistics 2015 	<p>BaU and CM</p> <ul style="list-style-type: none"> ■ Crop production and cultivated area will increase in proportion to population <p>CM</p> <ul style="list-style-type: none"> ■ Yield will be improved.

- Landuse is different between Thimphu and ROB. Share of forest in Thimphu is much less than that in ROB.
- Settlements and cropland will expand with population growth. However, Increase of these area is controlled in CM scenario by urbanization and improvement of crop yield.

Landuse change



Reference and Assumption

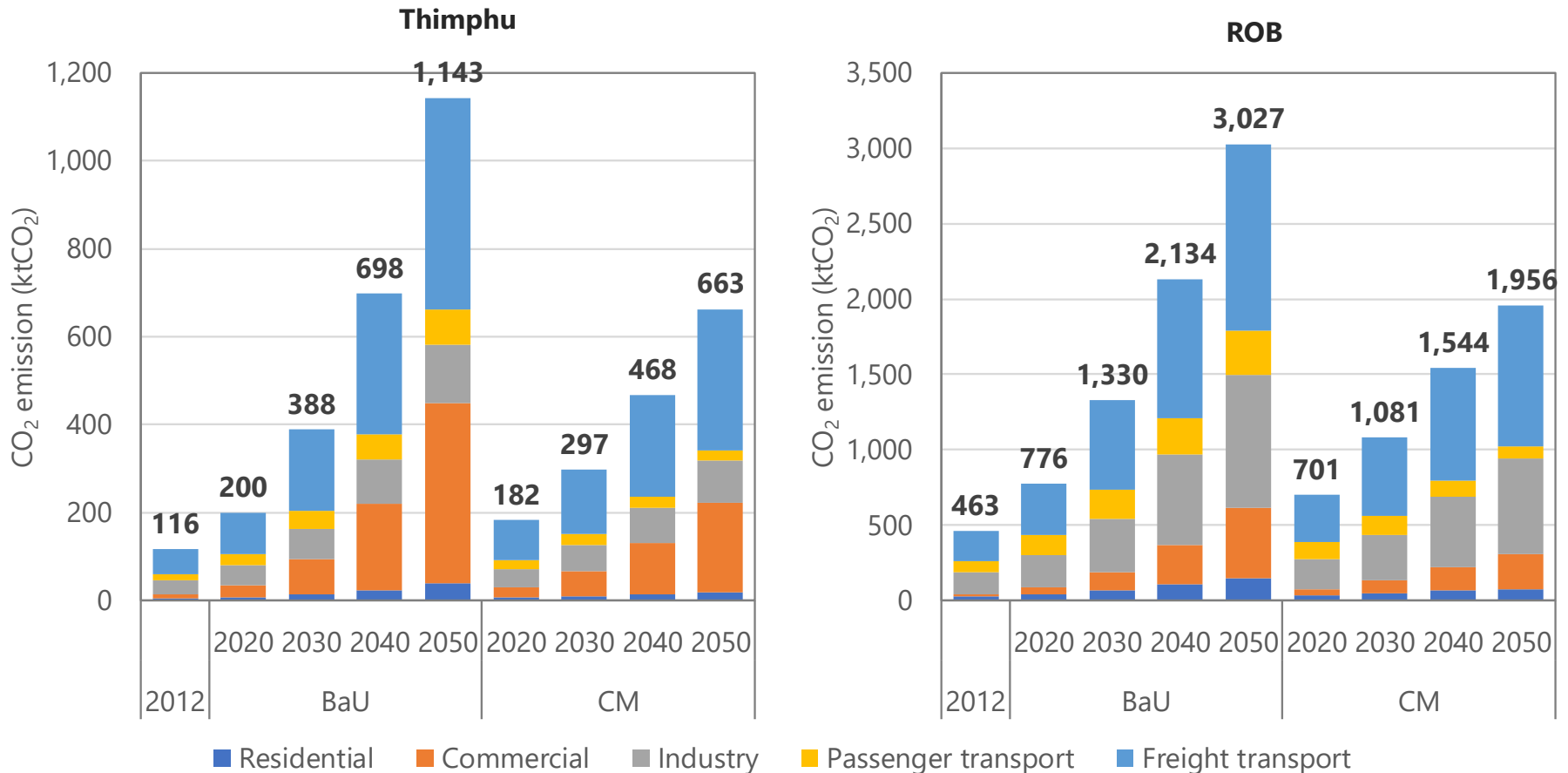
2012		2050
Source	Assumption	Assumption
<ul style="list-style-type: none"> ■ Ministry of Agriculture & Forests (2015): Bhutan RNR Statistics 2015 	<ul style="list-style-type: none"> ■ Half of forest land is managed. 	<p>BaU and CM</p> <ul style="list-style-type: none"> ■ Area of settlement will increase in proportion to population. <p>CM</p> <ul style="list-style-type: none"> ■ Population density becomes higher. ■ Managed forest land will increase.



CO₂ Emission from Energy Use

- Commercial sector and Freight transport sector will be main emitters in Thimphu.
- Industry sector and Freight transport sector will be main emitters in ROB.
- CO₂ emission in 2050 CM can be reduced by 42% in Thimphu and 35% in ROB compared with BaU.

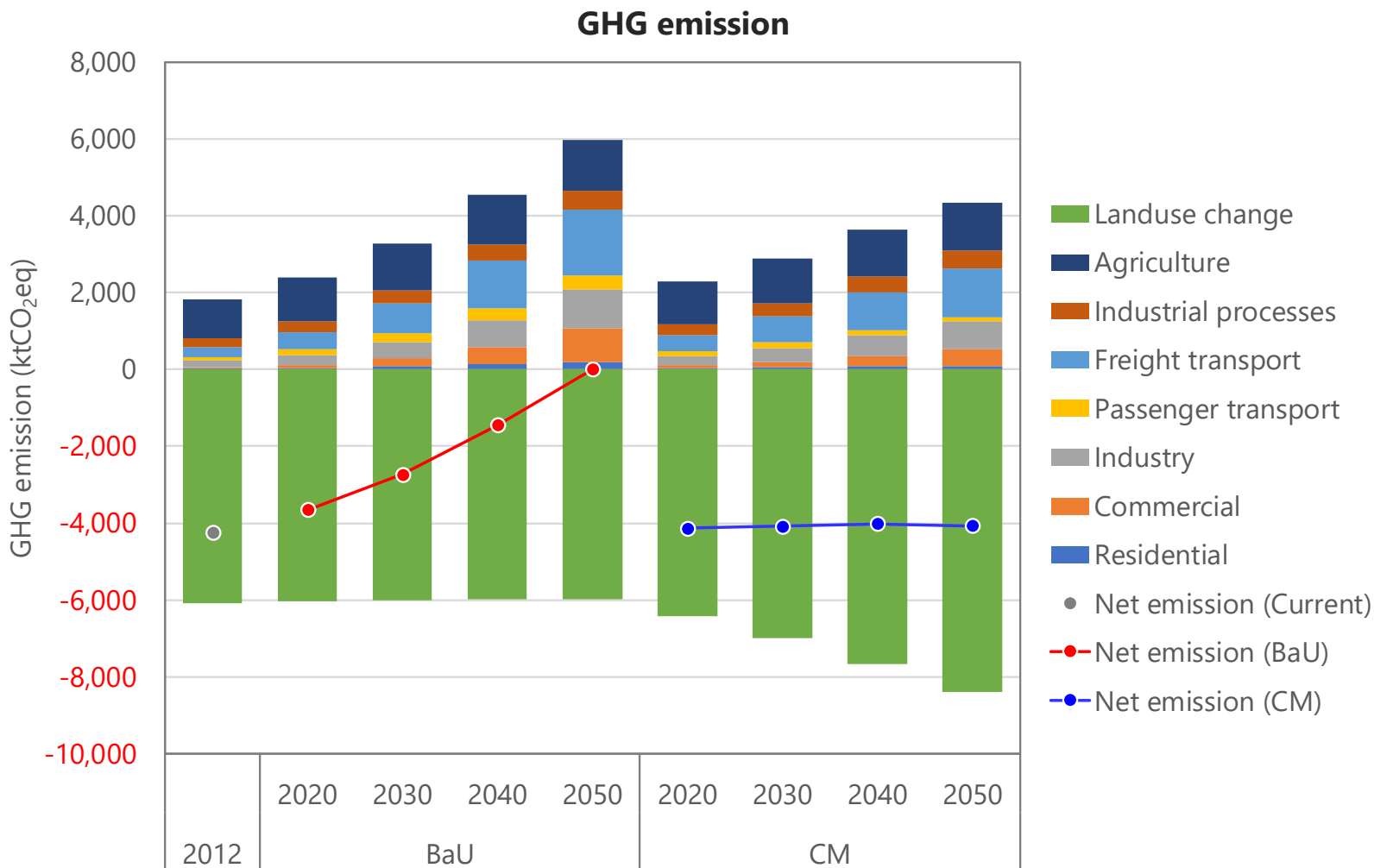
CO₂ emission





GHG Emission

- In the BaU scenario, GHG emissions will exceed carbon sequestration, changing into positive in 2050.
- GHG emission will also increase in CM scenario, but net emission can keep negative up to 2050, due to implementation of low-carbon measures and increase in carbon sink.

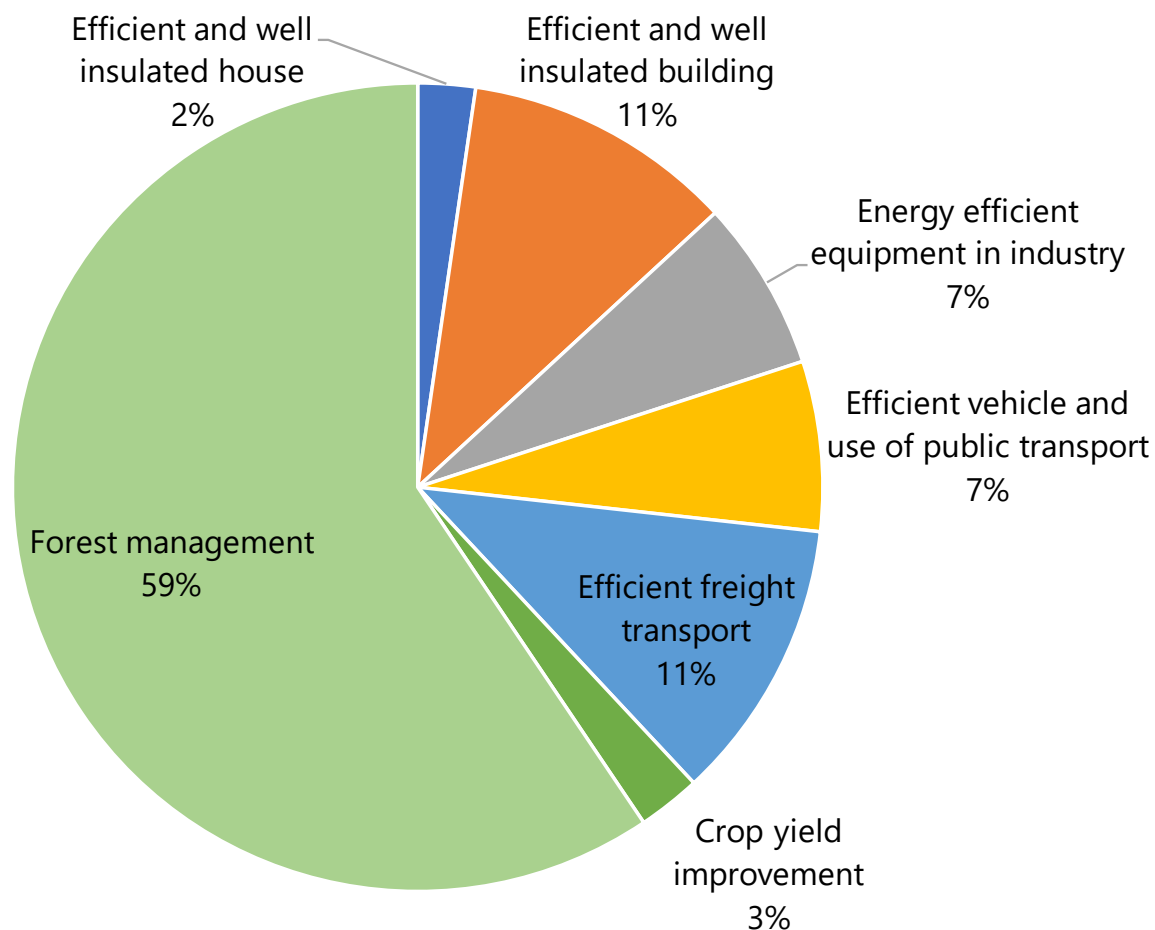




GHG Reduction

- The most contributed measure is forest management. Its carbon reduction is more than half of total reduction.
- Commercial sector and transport sector also have large potential to reduce emission.

Emission reduction contribution by measures in 2050 CM against 2050 BaU in Bhutan





- Two scenarios by 2050 were developed with current information and existing future plans.
- In Bhutan, GHG emission will exceed carbon sink in 2050 in BaU scenario.
- Hydropower will always be the main energy source, however, oil demand will increase remarkably in 2050 in BaU.
- In the CM scenario, Bhutan can remain carbon neutral.
- More than half of the emission reduction is by forest management.
- The projection is solely based on currently available data and plan. If the information is updated, the result will differ.