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ANNUAL ENVIRONMENTAL ACCOUNTS 2017

National Statistics Bureau
Royal Government of Bhutan
Thimphu : Bhutan

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FOREWORD

September, 2017

The National Statistics Bureau (NSB) is pleased to publish the Annual Environmental Accounts (AEA), 2017. The AEA presents green economic indicators, other environmental accounts such as electricity, fossil fuel (diesel, petrol, liquid petroleum gas or LPG and kerosene), fuelwood and briquette. It also includes asset accounts (timber, sand, stone aggregates and stone chips) and mineral accounts covering from 2010 to 2016. This is the first publication of a separate Annual Environment Accounts by the Economic and Environment Statistics Division of the National Statistics Bureau. Prior to this publication, the division published Electricity and Fossil Fuel Accounts as a chapter in the Annual National Account Report.

The AEA is compiled and presented based on the guidance and the framework of the System of Environmental – Economic Accounts (SEEA). We hope that the information in the report will be helpful in policy formulation, evaluation and monitoring of economic development plans and programs.

The National Statistics Bureau would like to sincerely thank and acknowledge all agencies, both government and private sector, for the continued support and cooperation in the publication of this report. We would appreciate any feedback or comments in improving this report for the larger benefit of data users.

Chhime Tshering
Director
National Statistics Bureau

ABBREVIATIONS & ACRONYMS

AEA: Annual Environmental Accounts....1, 2, 3, 1, 2

BPCL: Bhutan Power Corporation Ltd.....12

DGM: Department of Geology & Mines.....39

DGPC: Druk Green Power Corporation.....12

GDP: Gross Domestic Product.....12

GNH: Gross National Happiness.....1

LPG: Liquid Petrolium Gas.....2, 22, 29, 30

MoEA: Ministry of Economic Affairs.....39

NSB: National Statistics Bureau.....2, 3, 4, 39, 52

SEEA: System of Environmental- Economic Accounting.....2, 12, 35

SNA: System of National Accounts.....35

UNEP: United Nations Environment Protection.....3

UNSD: United Nations Statistics Division.....3

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CHAPTER ONE: INTRODUCTION

1.1. Objective

The Annual Environmental Accounts (AEA) is intended to provide environmental related information in key economic sectors in Bhutan so that planners, policy makers, researchers and other data users can use the information for better decision and policy-making purposes.

The report aims to provide foundations and development towards improved decision makings related to sustainable development and green economy. Improvement in the management of our environmental assets are critical in making sustainable use of our scarce resources and allowing the capacity of the environment to continue providing inputs to the economy and society. It is for this reason that the state of environment and resource use needs to be monitored and reported on an annual basis to inform decision makers for long-term policy formulation relating to environmental assets.

Further, there are national requirements that provide the rationale for the development of such accounts. Bhutan has high regards for its nature and environment. *The Constitution of the Kingdom of Bhutan*[1] requires conserving the country's natural resources and to prevent degradation of the ecosystem, and maintain at least 60% of forest cover in the country for all times.

Environmental conservation is one of the pillars of GNH and it is integrated in every policy and developmental plans of the country. Some of our legal and policy documents such as, *The Forest and Nature Conservation Act (1995)*[2]*, National Forest Policy (2010)*[3]*,The National Environment Protection Act (2007)and The Five-Year Development Plans*[4] emphasize sustainable utilization and management of natural resources.

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[1] *Article 5 of the Constitution of the Kingdom of Bhutan*
[2] *Aims to strengthen and promote scientific management of forest resources and community forests.*
[3] *Adopts sustainable forest management practices*
[4] *Bhutan's Eleventh Five-Year Development Plan (2013-2018) emphasizes to enhance sustainable land and biodiversity resource management.*

It is for these reasons that the development of environmental related accounts is crucial, as it will provide fundamental tools for improved decision making. The development and compilation of such environmental economic accounts has become a core mandate of the Environmental Accounts Section of the National Statistics Bureau. It shall be done in a phased manner and based on priority. NSB will compile various environmental accounts and a full set of environmental economic accounts shall be published in the future as data and capacity issues are addressed.

1.2. Method and Scope

The AEA adopts the System of Environmental –Economic Accounting (SEEA) Central Framework in preparing and developing environmental economic accounts.

The focus of the analyses is more on the physical quantities and values of environmental assets and explains the changes in these assets over a period of time. The physical and monetary (value) changes record additions to the stock of environmental assets due to new discoveries and reductions in the stock through extraction and natural loss.

The main focus of this report is on accounting electricity and fossil fuel (diesel, petrol, LPG gas, briquette& kerosene). Further, other accounts include asset accounts for major mineral production by type such as coal, dolomite, limestone, gypsum, marble, quartzite, stone and iron ore. In addition, fuelwood consumption account is also developed in our efforts to develop a full set of energy account in future.

As a part of additional asset accounts, timber resource account, aggregate stone, briquette, sand and stone chips supplied by the Natural Resource Development Co-operation are also compiled. The measurement scope of environmental assets is not limited to these accounts, but as and when the data are available, NSB shall extend its effort to other natural resources accounts to help policy and planning.

CHAPTER TWO: GREEN ECONOMY INDICATORS

2.1. *Objective*

Green Economy[5] or green growth has been brought to the forefront of today's agenda globally by many international experts. There is a growing demand for green economy indicators both from policy and decision makers. Green growth economy indicators are pathway to sustainable development (WorldBank, 2012). Thus, NSB compiled core indicators[6] that are relevant and that will inform and enhance our ability to manage our natural resources sustainably with minimal environmental impacts, increase resource efficiency and reduce waste.

2.2. *Method and Scope*

The Green Economy Indicators are compiled based on the framework of United Nations Statistics Division (UNSD), which closely follows the OECD green growth structure. It consists of 44 core set of indicators (CS) and 53 indicators that are non-core (NCS). However, NSB developed these indicators with necessary adaptions to Bhutan. These indicators are compiled based on the scoping workshop organized by NSB. The initial workshop was conducted to carry out an assessment on the availability of environmental information based on the Framework for the Development of Environmental Statistics (FDES) of UNSD. Gradually, after much consideration in regard to relevancy, requirement, usefulness and availability of information, which are critical in the process of planning and decision-makings in the country, indicators were eventually compiled.

Gathering these indicators based on the above-mentioned framework was difficult. There were challenges especially in some areas due to lack of information. Despite our emphasis and focus on monitoring the state of our environment, there is paucity in terms of statistics related to environment.

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[5] *UNEP 2011 defined green economy as one that results in "improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities".*
[6] *Core Green Economy Indicators are presented in Table 1-6*

The NSB, however, intends to strengthen and widen its scope with improved and better indicators with the availability of environmental information. We need to recognize the fact that environmental related statistics and information are limited at the moment and those available are scattered across sectors and are not organized for statistical purposes which calls for better coordination and management of environmental statistics. The current initiative of NSB therefore provides opportunity to gather such important information and put them in '*one stop statistical information', which* are indispensable for evidence based decision-making in the government.

2.3. *Demographic Patterns and Trends*

The demographic indicators are presented in *Table 1* below. Three different notations were used to indicate the changes in trend for different indicators. The '(+)' notation indicates an upward trend while '(-)' indicates downward and '(=)' indicates that there was no change. The no change would also mean that one time data was available during the accounting period and that there has been no update thereafter.

Table 1 Demographic indicators

Indicators	Source	Unit	2013	2014	2015	2016	Trend
Demographic patterns and trends							
Total population, both sexes combined	PHCB/SYB/ Dzongkhag Population Projection of NSB	Nos	733,004	745,153	757,042	768,577	(+)
Population growth rate		%	1.3	1.3	1.3	1.3	(=)
Percentage of urban population		%	37.22	38.05	38.89	n.a	(+)
Growth rate of urban population		%	1.3	1.3	1.3	1.3	(=)
Population (age 65 and above), total, both sexes		Nos	53,274*	56,820*	60,711*	64,452*	(+)
Population density, inhabitant per km2		per km2	19.09	19.41	19.72	20.02	(+)
Life expectancy at birth, both sexes combined		Years	68.93	68.93	70.94	70.94	(+)

*Note: * Based on population projection figures of NSB. The crude death rate has been adjusted.*

2.4. *Economic Growth, Structure of Economy and Productivity*

Economic growth, structure of economy and productivity indicators are presented in *Table 2*.Indicators on poverty, income and other social issues are also incorporated.

Table 2 Economic Growth, Structure of Economy and Productivity Indicator

Indicators	Web or table reference	Unit	2013	2014	2015	2016	Trend
Economic growth, structure of economy and productivity							
Real GDP, index	NAS Report, NSB	%	2.06	5.46	6.5	7.99	(+)
[base year as determined by the reporting country]		in Mil USD	897.02	904.98	923.60	953.08	(+)
GDP per capita		USD	2,463.8	2,610.45	2,719.11	2,879.07	(+)
Net Disposable Income [or Net National Income]		Mil Nu	97,873.98	108,821.87	115,713.39	133,150.25	(+)
Share of agriculture in GDP		%	16.1	16.77	16.67	16.52	(-)
Share of industry/manufacturing in GDP		%	8.33	8.12	7.99	7.46	(-)
Share of services in GDP		%	41.55	42.68	41.99	42.02	(+)
Proportion of cellular subscribers to total population	Annual Report of MoIC	%	74.3	84.3	89.3	90.9	(+)
Proportion of internet users of total population		%	34.3	46.9	60.2	73.6	(+)
Labour							
Labour force participation	DoE, MoLHR	%	65.3	62.6	63.1	n.a	
Proportion of employment by relevant economic activities		Pry	189,245	192,369	199,640	n.a	
		Second	36,805	36,749	33,263	n.a	
		Tertiary	109,820	110,451	111,390	n.a	
		∑ (in Nos)	335,870	339,569	344,293	n.a	
Unemployment rate		%	2.9	2.6	2.5	n.a	
Labour productivity [GDP per person employed]		in Mil USD	5,354.96	5,768.49	5,978.54	n.a	
Green jobs	No official publication but data is available for Govt.	Nos	n.a	n.a	n.a	n.a	
Poverty, income distribution and other social issues							
Income inequality: GINI coefficient	Poverty Analysis Report, NSB		0.36	0.36	0.36	0.36	(=)
Percentage of population living in poverty and extreme poverty [measured by National/Regional poverty lines]		%	12	12	12	12	(=)
Proportion of population below $1.25 (PPP) per day		%	2.4	2.4	2.4	2.4	(=)
Educational attainment: at least completed lower secondary (ISCED 2 or higher), population 25+	Annual Education Statistics, MoE	%	74.2	74.2	74.2	74.2	(=)

years (%)							
Total net enrolment ratio in primary education [both sexes]		%	96	95	95.2	95	(-)
Total public expenditure on education as a percentage of GDP	NAS Report, NSB	%	n.a	4.87	3.86	2.19	(+)
Total expenditure on health per capita (PPP)	NAS Report, NSB	Nu	n.a	n.a	2,576.50	3,713.76	(+)
Inflation and commodity prices							
Consumer price index		%	8.77	8.3	4.58	3.22	(-)
Export prices of three major commodity groups [as determined by the reporting country]	Trade Statistics & DGPC	Nu	1. Electricity = 2.12	1. Electricity = 2.12	2.12	2.12	(+)
			2. > 55% Silicon = 69.92			61.6	(-)
			3. Other cross section= 31.9			22.68	(-)
International trade and tourism							
Relative importance of trade: (exports + imports)/GDP	NAS Report, NSB	Mil Nu	1.03	0.94	0.93	0.83	(-)
International tourist arrivals in % to population	Annual Report, TCB	%	6.04	9.14	6.45	7.10	(+)
International tourism, receipts	Annual Report, TCB	in Mil USD	63.5	73.2	71.04	73.74	(+)

2.5. *Environmental and Resource Productivity*

The indicators on environmental and resource productivity are presented in *Table 3*. Carbon emissions, information on energy, which includes both renewable and non-renewable are important indicators for energy resources.

Table 3 Environmental and Resource Productivity Indicator

Indicators	Web or table reference	Unit	2013	2014	2015	2016	Trend
The environmental and Resource Productivity							
Carbon emissions							
Carbon dioxide emissions (CO2), thousand metric tons of CO2	UNFCC Report	Metric tons	1,559,560	1,559,560	1,559,560	1,559,560	(=)
Carbon dioxide emissions (CO2), metric tons of CO2 per capita		Tons/Capita	2.13	2.09	2.06	2.03	(=)

Carbon dioxide emissions (CO2), kg CO2 per $1 GDP (PPP)		Metric tons/GDP	1.74	1.72	1.69	n.a	
Energy							
Energy productivity [US$ per ktoe]	NAS Report, NSB	Mill GWh	7,549.84	7,164.09	7,396.28	7,584.87	(+)
Energy (electricity only) consumption per capita [total or final]	electricity per capita consumption	Mil GWh	0.010	0.01	0.01	0.01	(=)
Energy intensity by sector [manufacturing, transport, households, services]	NAS Report, NSB	Mil GWh	Household-251.71	Household-283.4	Household-317.96	Household-571.37	(+)
			Manf-1,549.88	Manf-1,747.91	Manf-1,733.88	Manf-858.31	(-)
			Trans,Storage& Comu-7.62	Trans,Storage& Comu-13.56	Trans,Storage& Comu-13.62	Trans,Storage& Comu-38.23	(+)
Renewable energy supply	for hydro electricity production, only (BPC)	in Mil Gwh	7,662.1	7,351.46	7,554.74	7,695.51	(+)
Renewable electricity [% total electricity generation]	NAS Report, NSB	%	98.535	97.451	97.903	98.562	(+)
Fuelwood, production [thousand cubic metres]	Annual Report of NRDCL & MoAF	1000 m^3	76.48	103.38	104.48	119.78	(+)

2.6. *The Natural Asset Base*

The natural asset base indicators include information on renewable and non-renewal resources. Information on biodiversity and ecosystem are also included.*Table 4* presents natural asset base indicators.

Table 4 Natural Asset Base Indicator

Indicators	Web or table reference	Unit	2013	2014	2015	2016	Trend
The natural asset base							
Renewable resources							
Forest area	Forestry Facts & Figure, MoAF	Sq Km	27,053	27,053	27,053	27,053	(=)
Proportion of land area covered by forest [percentage]		%	70.5	70.5	70.5	70.5	(=)
Natural forest as % of total forest area		n.a	n.a	n.a	n.a	n.a	
Planted forest as % of total forest area		ha	48.85	58.85	697.33	620.51	(-)
Deforestation [Ha and % of forest area per year]			n.a	n.a	n.a	n.a	
Fish catch, total [marine and freshwater]	DoL	Kgs	54,661	119,086	149,109	187,361	(+)
Non-renewable resources							

Mineral resources: stocks or reserves of selected minerals, including fossil fuels and critical raw materials, as determined by the reporting country		Type					
Extraction rates of selected minerals, including fossil fuels and critical raw materials, as determined by the reporting country	DGM	Dolomite (MT)	1,740,015.95	2,040,690.96	2,662,309.68	2,367,659	(-)
		Limestone (MT)	1,006,234.63	1,122,825.09	850,431.17	1,257,101	(+)
		Gypsum (MT)	351,420.64	414,147.54	389,364.8	317,597	(+)
		Coal (MT)	77,743.58	121,890.58	85,164.45	117,783	(+)
		Marble (Sq Ft)	60,708.49	61,921.1	97,647.84	75,031	(-)
		Quartzite (MT)	90,909.28	83,907.14	79,818.5	92,770	(+)
		Talc (MT)	9,584.24	12,601.37	5,807.27	2,261	(-)
		Stone (MT)	38,542.28	1,474,394.94	2,203,065.41	341,4215	(+)
		Granite (MT)	6,463.81	4,362.21	3,889.05	n.a	
		Phyllite (MT)	13,818.4	40,076.71	40,417.25	41,800	(+)
		Calc Tufa (MT)	n.a	n.a	n.a	n.a	
		Iron Ore (MT)	20,505.81	18,997.37	43,201.96	28,065	(-)
		Clay (MT)	15,165.66	10,208.95	n.a	n.a	
Proportion of agricultural area to total land area	RNR statistics	%	2.93	2.93	2.93	2.93	(=)
Area equipped for irrigation as % of agricultural area	RNR statistics	%	94.2	94.2	94.2	94.2	(=)
Arable land, % total land area	RNR statistics	%	2.93	2.93	2.93	2.93	(=)
Pasture, % total land area		%	n.a	n.a	n.a	n.a	
Land area affected by degradation, by type of degradation, as % of total land area		%	0.54	0.54	0.54	0.54	(=)
Proportion of organic agricultural area in total agricultural area		%	n.a	n.a	n.a	n.a	
Pesticides used on crop areas [kg / ha]		kg/hec	205.23	218.35	4,876.14	n.a	
Chemical fertilizers used, kilogram per hectare of crop land		kg/hec	26.05	26.75	31.15	32.31	(+)
Natural fertilizer use, kilogram per hectare of crop land			n.a	n.a	n.a	n.a	
Biodiversity and ecosystems							
Number of known flora and fauna species by status category	NBC	Nos	5,603 Vascular plants	5,603 Vascular plants	5,603 Vascular plants	5,604 Vascular plants	(+)
			400 Lichens	400 Lichens	400 Lichens	401 Lichens	(+)
			200 Mammals	200 Mammals	200 Mammals	201 Mammals	(+)
			700 Birds appx	700 Birds appx	700 Birds appx	701 Birds	(+)

						appx	
Number of endemic flora and fauna species by class (mammals, reptiles, etc.)	National Paper on Biodiversity Persistence and Climate Change, 2011 of NBC	Nos	105 endemic plants	105 endemic plants	105 endemic plants	106 endemic plants	(+)
			27 Globally Threatened mammals	27 Globally Threatened mammals	27 Globally Threatened mammals	28 Globally Threatened mammals	(+)
			18-Critically endangered & vulnerable birds	18-Critically endangered & vulnerable birds	18-Critically endangered & vulnerable birds	18-Critically endangered & vulnerable birds	(=)
% of threatened flora and fauna species by class (mammals, reptiles, etc.)		%	n.a	n.a	n.a	n.a	
Proportion of terrestrial protected areas to total surface area, %	MoAF	%	51.32	51.32	51.32	51.32	(=)
Footprints							
Ecological footprint	GNHC	Hec/capita	n.a	1.8	1.8	1.8	(=)

2.7. *The Environmental Dimension of Quality of Life*

Table 5 presents indicators on environmental dimension of quality of life. Information on environmental health and risks, environmental services and amenities are crucial.

Table 5 The Environmental Dimension of Quality of Life Indicator

Indicators	Web or table reference	Unit	2013	2014	2015	2016	Trend
The environmental dimension of quality of life							
Environmental health and risks							
Concentration of particulate matter (PM10) in urban air [main cities]	UNFCC Report	Microgram/m3	53.14	37.87	45.51	43.88	(+)
Environmental services and amenities							
Proportion of total population using an improved drinking water source	BLSS Report/SYB, NSB	%	98.1	98.1	98.1	98.1	(=)
Proportion of urban population using an improved drinking water source	BLSS Report	%	99.30	99.30	99.30	99.30	(=)
Proportion of rural population using an improved drinking water source	BLSS Report	%	97.50	97.50	97.50	97.50	(=)
Proportion of total population using an improved sanitation facility	BLSS Report	%	81.00	81.00	81.00	81.00	(=)

Proportion of urban population using an improved sanitation facility	BLSS Report	%	95.50	95.50	95.50	95.50	(=)
Proportion of rural population using an improved sanitation facility	BLSS Report	%	73.50	73.50	73.50	73.50	(=)
Municipal waste collected [total]	Annual Info Bulletin, MoWHS	Tons	17246.25	17246.25	20429.05	25367.5	(+)
Municipal waste collected [per capita]	Annual Info Bulletin, MoWHS	Tons per capita	0.063	0.061	0.14	0.13	(-)

2.8. *Policy Responses and Economic Opportunities*

The policy responses and economic opportunities indicators are organized in *Table 6*. It includes information on regulations, management and international financial flows.

Table 6 Policy Responses and Economic Opportunities Indicator

Indicators	Web or table reference	Unit	2013	2014	2015	2016	Trend
Policy responses and economic opportunities							
Regulations and management							
Annual government environment protection expenditure [as % of government expenditure and/ or as % of GDP]	Public Expenditure Review Report	% of GDP	2.9	2.9	2.9	2.9	(=)
Participation in multilateral environmental agreements [list and number of MEAs]	NEC	Nos	15	15	15	15	(=)
Number of regulated pollutants by media [water, air, soil, etc.]	Environmental Standards - 2010 (NEC)	Water = 5	Water = 5	Water = 5	Water = 5	Water = 5	(=)
		Industrial effluent = 32	Industrial effluent = 32	Industrial effluent = 32	Industrial effluent = 32	Industrial effluent = 32	(=)
		Sewerage effluent = 3	Sewerage effluent = 3	Sewerage effluent = 3	Sewerage effluent = 3	Sewerage effluent = 3	(=)
		Ambient air = 5	Ambient air = 5	Ambient air = 5	Ambient air = 5	Ambient air = 5	(=)
		Industrial emission = 4	Industrial emission = 4	Industrial emission = 4	Industrial emission = 4	Industrial emission = 4	(=)
		Workplace emission = 5	Workplace emission = 5	Workplace emission = 5	Workplace emission = 5	Workplace emission = 5	(=)
		Vehicle emission = 2	Vehiclemission = 2	Vehicle emission = 2	Vehicle emission = 2	Vehicle emission = 2	(=)
		Noise level = 3	Noise level = 3	Noise level = 3	Noise level = 3	Noise level = 3	(=)

Green taxes (number and/or annual revenue)	AFS, MoF	Mil Nu	35.937	1.68	545.87	1,007.121	(+)
International financial flows							
Official Development Assistance, total	AFS, MoF	Mil Nu	9,562.636	14,236.353	9,955.02	14,890	(+)

CHAPTER THREE: ELECTRICITY ACCOUNT

3.1. *Introduction*

Electricity sector is the leading contributor to growth of the economy and accounts for a major share of the total GDP of Bhutan. The share of electricity sector to the overall GDP has been increasing and accounts for 13.38 percent of the total GDP in 2016.

Hydropower is the major source of energy resources in Bhutan. Apart from hydropower and solar, most energy resources are non-renewable. Hence, it is important to understand the stock, the rate at which these kinds of energy resources[7] are being exploited. Although hydropower is the main source of energy in Bhutan, for the transport sector, we depend on fossil fuel, which is not clean energy.

Electricity accounts in Bhutan is compiled based on the information furnished by BPCL and DGPC. The estimates cover from 2000to 2016. It is accounted both in terms of physical quantities and in monetary values.

Electricity accounts are compiled based on the framework of energy flow accounts wherein supply within the economy is production/extraction and imports. The use within the economy is the intermediate consumption in industries, final private household consumption, change in inventories, exports and cable losses. The supply should equal to use. The Supply Use Table (SUT) framework is used to establish and understand the use of hydro-electricity resource by industries, broken down based on national accounts industry classification (ISIC). The supply in the economy includes total domestic production and import of electricity, if any, during the accounting period. The use is the total exports, domestic consumption and transmission loss. Monetary values recorded are all in current prices.

3.2. *Method and Scope*

The total supply as explained above is accounted as: S=DP+M; where, S=Total Supply, DP=Domestic Production and M=Import. Information on the production

[7] *SEEA defines Energy and Mineral resources as known deposits of oil resources, natural gas resources, coal & peat resources, non-metallic minerals and metallic minerals.*

side(supply) are sourced from the annual reports of DGPC.

The total use is computed as: U=DU+X; where U=Total Use, DU=Domestic Use (input in industries & household consumption), X=Export. The consumption data[8] are sourced from BPCL and accordingly mapped into different sectors of economy.

3.3. *Electricity: Supply& Consumption*

The supply of electricity increased to 8,072.40GWh in 2016 from 7,909.04 GWh in 2015, which is an increase of 2 percent. *Table 7* presents the physical account of electricity. The estimates are revised based on the latest available statistics in Power Data Book of BPCL. The average growth of electricity supply was around 10 percent from 2001 to 2016. Import accounted for slightly more than 1 percent of the total supply in 2016, down by almost 31 percentage as compared to 2015.

Table 7 Physical Account of Electricity (2000-2016)

(GWh)

	SUPPLY			USE			
Year	**Production**	**Imports**	**Total**	**Exports**	**Transmission Loss**	**Domestic Use**	**Total**
2000	1,921.70	34.39	**1,956.08**	1,460.48	35.30	460.30	**1,956.08**
2001	1,967.75	6.90	**1,974.65**	1,392.62	39.14	542.89	**1,974.65**
2002	2,173.08	24.30	**2,197.38**	1,476.37	68.06	652.94	**2,197.38**
2003	2,377.43	18.72	**2,396.15**	1,695.80	93.05	607.30	**2,396.15**
2004	2,423.27	22.80	**2,446.07**	1,707.19	122.72	616.17	**2,446.07**
2005	2,519.56	18.43	**2,537.99**	1,713.61	130.18	694.20	**2,537.99**
2006	3,354.67	34.69	**3,389.36**	2,526.15	117.20	746.01	**3,389.36**
2007	6,421.95	22.22	**6,444.17**	5,372.57	121.05	950.55	**6,444.17**
2008	7,158.17	9.38	**7,167.55**	5,922.38	150.59	1,094.58	**7,167.55**
2009	6,922.94	64.16	**6,987.10**	5,404.82	165.47	1,416.81	**6,987.10**
2010	7,327.73	131.56	**7,459.29**	5,579.49	166.99	1,712.81	**7,459.29**
2011	7,067.55	40.32	**7,107.87**	5,273.10	93.98	1,740.79	**7,107.87**
2012	6,826.48	59.36	**6,885.84**	4,895.67	84.17	1,738.98	**6,718.82**
2013	7,549.84	112.26	**7,662.10**	5,557.63	43.06	2,061.41	**7,662.10**
2014	7,163.79	191.83	**7,355.62**	5,044.33	90.90	2,220.39	**7,355.62**
2015	7,745.89	163.15	**7,909.04**	5,541.76	146.99	2,220.29	**7,909.04**
2016	7,959.29	113.11	**8,072.40**	5,779.32	115.80	2,177.28	**8,072.40**

[8] *BPCL shares raw consumption of electricity data to NSB and accordingly consumption by different sectors of economy are estimated.*

In monetary terms, the supply of electricity has increased from Nu. 14,277.05 million in 2015 to Nu. 14,846.55 million in 2016, an increase of almost 2 percent. The monetary account of electricity is presented in *Table 8*.

Table 8 Monetary Account of Electricity (2000-2016)

(Mill. Nu.)

	SUPPLY			USE			
Year	Production	Imports	Total	Exports	Losses through transmission & distribution	Industries and households	Total
2000	2,307.26	51.58	**2,358.85**	2,190.72	38.22	129.90	**2,358.85**
2001	2,237.78	6.90	**2,244.68**	2,097.85	48.53	98.31	**2,244.68**
2002	2,530.55	24.30	**2,554.85**	2,289.82	85.75	179.28	**2,554.85**
2003	2,867.94	18.72	**2,886.66**	2,603.33	121.62	161.71	**2,886.66**
2004	3,005.05	30.73	**3,035.78**	2,711.75	149.47	174.56	**3,035.78**
2005	3,956.64	32.77	**3,989.41**	3,479.20	209.14	301.07	**3,989.41**
2006	5,552.83	63.13	**5,615.95**	4,976.18	247.25	392.52	**5,615.95**
2007	10,962.37	37.73	**11,000.10**	10,034.33	91.71	874.06	**11,000.10**
2008	12,593.17	14.26	**12,607.43**	11,032.60	103.94	1,470.89	**12,607.43**
2009	10,889.85	111.03	**11,000.88**	10,071.00	111.57	818.31	**11,000.88**
2010	11,811.46	233.87	**12,045.33**	10,411.46	139.73	1,494.14	**12,045.33**
2011	10,948.33	67.18	**11,015.51**	9,839.21	162.12	1,014.18	**11,015.51**
2012	11,140.80	110.30	**11,251.10**	9,714.53	148.23	1,388.34	**11,251.10**
2013	13,051.66	214.93	**13,266.59**	11,013.99	149.96	2,102.64	**13,266.59**
2014	13,905.77	371.28	**14,277.05**	10,698.31	-	3,578.74	**14,277.05**
2015	14,258.09	341.51	**14,599.60**	10,991.32	-	3,608.28	**14,599.60**
2016	14,624.05	222.50	**14,846.55**	11,421.89	0.80	3,423.86	**14,846.55**

Consumption of electricity by industries dropped by almost 17 percent in 2016 as compared to2015 in physical term. *Table 9* presents gross electricity consumption by household and industry both in physical and monetary values. At an aggregated level, industry accounted for almost 73 percent of the total consumption while electricity consumption by household accounted for the remaining 27 percent.

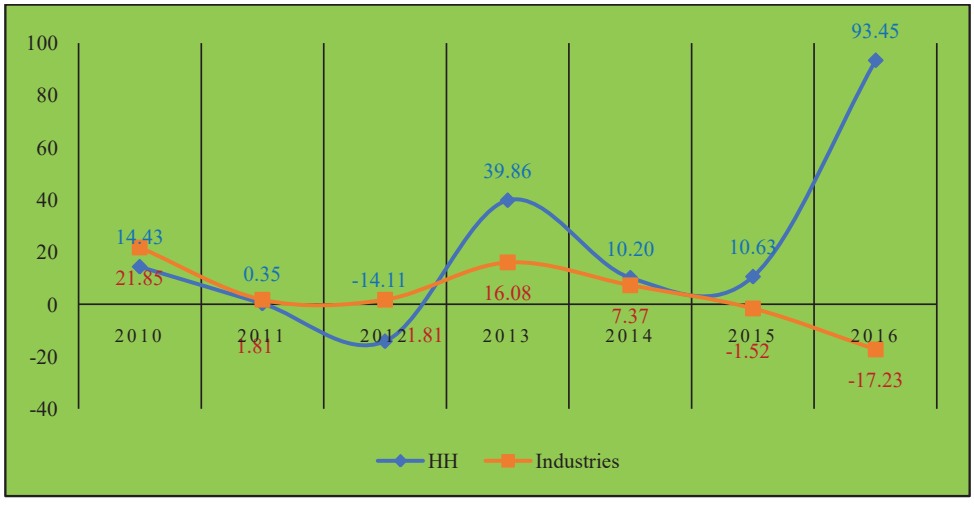
Table 9 Gross Electricity Consumption by Household & Industry (2000-2016)

Year	(GWh)			(Mill. Nu.)		
	Household	Industry	Total	Household	Industry	Total
2,000	64.01	396.30	**460.30**	14.54	115.36	**129.90**
2,001	72.09	470.81	**542.89**	10.50	87.81	**98.31**
2,002	91.28	561.67	**652.94**	20.16	159.11	**179.28**
2,003	88.40	518.89	**607.30**	18.96	142.75	**161.71**

2,004	87.59	528.57	**616.17**	19.98	154.58	**174.56**
2,005	93.23	600.97	**694.20**	32.48	268.58	**301.07**
2,006	90.37	655.64	**746.01**	38.12	354.40	**392.52**
2,007	110.97	839.58	**950.55**	81.86	792.20	**874.06**
2,008	126.41	968.16	**1,094.58**	136.27	1,334.62	**1,470.89**
2,009	182.47	1,234.34	**1,416.81**	84.64	733.67	**818.31**
2,010	208.80	1,504.01	**1,712.81**	146.20	1,347.94	**1,494.14**
2,011	209.53	1,531.26	**1,740.79**	97.89	916.29	**1,014.18**
2,012	179.96	1,559.03	**1,738.98**	136.23	1,252.11	**1,388.34**
2,013	251.69	1,809.72	**2,061.41**	206.31	1,896.32	**2,102.64**
2,014	277.37	1,943.02	**2,220.39**	414.54	3,164.20	**3,578.74**
2,015	306.86	1,913.43	**2,220.29**	433.97	3,174.31	**3,608.28**
2,016	593.61	1,583.67	**2,177.28**	933.48	2,490.38	**3,423.86**

*Figure 1*shows the consumption growth pattern of electricity by household and industries. Consumption of electricity by household steadily increased in 2016 while consumption by industries dropped.

Figure 1 Consumption Growth of Electricity by Household & Industries



In terms of share, manufacturing sector leads the consumption of electricity with almost 56 percent followed by the Community Social & Personal Services with 17 percent, Electricity and Water Services with 16 percent and Hotel & Restaurant and Transport, Storage and Communication Sectors with 3 percent respectively. The gross electricity consumption by different economic sectors in physical values is shown in *Table 10*.

Table 10 Gross Electricity Consumption by Economic Sectors (2000-2016)

(GWh)

Year	Total Industry	Agriculture, Livestock & Forestry	Mining & Quarrying	Manufacturing	Electricity & Water	Construction	Trade	Hotel & Restaurant	Transport, Storage & Communication	Finance, Insurance & Real Estate	Community, Social & Personal Service	Private, Social & Recreational Services
2000	**396.30**	0.24	1.06	335.44	12.89	2.84	7.29	0.58	1.71	0.55	33.66	0.03
2001	**470.81**	0.27	1.26	401.93	13.44	4.05	8.91	0.77	2.04	0.62	37.48	0.03
2002	**561.67**	0.36	1.82	471.99	17.88	5.70	12.48	0.93	2.74	0.72	47.03	0.04
2003	**518.89**	0.32	1.96	432.21	19.21	5.16	11.97	0.89	2.50	0.76	43.86	0.04
2004	**528.57**	0.33	1.39	444.06	16.46	5.51	13.32	1.04	2.92	0.83	42.68	0.04
2005	**600.97**	0.35	1.75	500.88	19.54	6.01	16.24	1.31	3.47	1.08	50.30	0.05
2006	**655.64**	0.34	2.54	548.71	26.10	5.29	16.38	1.69	3.32	1.16	50.05	0.05
2007	**839.58**	0.36	2.54	704.26	48.58	5.87	17.40	2.04	3.58	1.36	53.55	0.06
2008	**968.16**	0.39	3.62	813.39	56.44	5.49	19.04	3.20	4.35	1.53	60.62	0.07
2009	**1,234.34**	0.50	4.64	1,025.91	66.65	7.58	23.95	3.49	5.61	1.92	94.00	0.08
2010	**1,504.01**	0.54	5.29	1,267.70	70.60	10.25	30.02	3.87	6.38	2.10	107.19	0.09
2011	**1,531.26**	0.56	5.79	1,288.26	60.10	12.62	33.87	5.51	7.14	2.43	114.88	0.09
2012	**1,559.03**	0.51	3.52	1,345.23	45.32	14.13	34.39	5.61	6.47	2.07	101.71	0.08
2013	**1,809.72**	0.62	5.75	1,549.77	61.01	15.75	42.44	7.42	7.62	2.52	116.71	0.10
2014	**1,943.02**	1.54	4.50	1,710.72	71.09	26.95	22.41	18.72	13.27	2.91	70.08	0.81
2015	**1,913.43**	0.73	7.56	1,673.33	72.93	4.38	9.63	21.12	13.14	0.51	109.88	0.22
2016	**1,583.67**	2.44	10.26	891.71	251.57	20.67	28.55	54.64	39.72	15.95	267.44	0.71

Table 11 below shows the gross electricity consumption by different economic sectors within the industry in value term from 2000 to 2016. Consumption of electricity by different sectors of economy in value terms increased except for manufacturing and quarrying sector.

Table 11 Gross Electricity Consumption by Industry by Economic Sectors (2000-2016)

(Mill. Nu.)

Year	Total Industry	Agriculture, Livestock & Forestry	Mining & Quarrying	Manufacturing	Electricity & Water	Construction	Trade	Hotel & Restaurant	Transport, Storage & Communication	Finance, Insurance & Real Estate	Community, Social & Personal Service	Private, Social & Recreational Services
2000	**115.36**	0.07	0.39	95.92	3.87	0.95	2.19	0.16	0.55	0.16	11.09	0.01
2001	**87.81**	0.05	0.29	73.69	2.59	0.87	1.71	0.14	0.42	0.11	7.92	0.01
2002	**159.11**	0.11	0.64	131.26	5.22	1.86	3.64	0.25	0.86	0.20	15.07	0.01
2003	**142.75**	0.09	0.67	116.66	5.44	1.64	3.39	0.24	0.76	0.21	13.64	0.01
2004	**154.58**	0.10	0.51	127.53	4.96	1.86	4.01	0.29	0.94	0.24	14.13	0.01
2005	**268.58**	0.16	0.97	219.69	8.99	3.10	7.47	0.56	1.71	0.47	25.42	0.02
2006	**354.40**	0.19	1.71	291.38	14.54	3.30	9.12	0.88	1.98	0.62	30.63	0.03
2007	**792.20**	0.36	2.99	653.96	47.33	6.41	16.94	1.86	3.73	1.27	57.30	0.06
2008	**1,334.62**	0.58	6.24	1,103.70	80.36	8.76	27.10	4.27	6.64	2.09	94.80	0.09
2009	**733.67**	0.32	3.45	599.08	40.84	5.20	14.67	2.00	3.68	1.13	63.26	0.05

2010	**1,347.94**	0.51	5.92	1,117.37	65.29	10.62	27.75	3.35	6.32	1.86	108.87	0.08
2011	**916.29**	0.35	4.33	757.65	37.09	8.73	20.89	3.18	4.72	1.43	77.86	0.05
2012	**1,252.11**	0.45	4.98	1,055.89	43.61	12.62	30.32	4.96	5.83	1.73	91.64	0.07
2013	**1,896.32**	0.69	7.54	1,599.14	66.05	19.11	45.93	7.52	8.84	2.62	138.78	0.11
2014	**3,164.20**	3.02	11.26	2,687.10	122.27	58.23	41.79	44.52	29.49	6.31	158.50	1.72
2015	**3,174.31**	1.42	16.69	2,670.50	125.18	9.23	20.90	44.34	29.60	1.00	255.01	0.43
2016	**2,490.38**	3.84	16.14	1,402.26	395.61	32.51	44.90	85.92	62.45	25.08	420.57	1.12

The supplementary breakdown information on the supply and use of electricity, both in physical and monetary values, are presented in *Table 12-13*.

Table 12 Total Supply & Use of Electricity by Sectors (2000-2016)

(GWh.)

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
(I) TOTAL SUPPLY	**2,537.99**	**3,389.36**	**6,444.17**	**7,167.55**	**6,987.10**	**7,459.29**	**7,107.87**	**6,885.84**	**7,662.10**	**7,355.62**	**7,909.04**	**8,072.40**
Production	2,519.56	3,354.67	6,421.95	7,158.17	6,922.94	7,327.73	7,067.55	6,826.48	7,549.84	7,163.79	7,745.89	7,959.29
Imports	18.43	34.69	22.22	9.38	64.16	131.56	40.32	59.36	112.26	191.83	163.15	113.11
(II) TOTAL USE	**2,537.99**	**3,389.36**	**6,444.17**	**7,167.55**	**6,987.10**	**7,459.29**	**7,107.87**	**6,718.82**	**7,662.10**	**7,355.62**	**7,909.04**	**8,072.40**
1. Agriculture, Livestock & Forestry	0.35	0.34	0.36	0.39	0.50	0.54	0.56	0.51	0.62	1.54	0.73	2.44
2. Mining & Quarrying	1.75	2.54	2.54	3.62	4.64	5.29	5.79	3.52	5.75	4.50	7.56	10.26
3. Manufacturing	500.88	548.71	704.26	813.39	1,025.91	1,267.70	1,288.26	1,345.23	1,549.77	1,710.72	1,673.33	891.71
4. Electricity & Water	19.54	26.10	48.58	56.44	66.65	70.60	60.10	45.32	61.01	71.09	72.93	251.57
5. Construction	6.01	5.29	5.87	5.49	7.58	10.25	12.62	14.13	15.75	26.95	4.38	20.67
6. Wholesale & Retail Trade	16.24	16.38	17.40	19.04	23.95	30.02	33.87	34.39	42.44	22.41	9.63	28.55
7. Hotels & Restaurants	1.31	1.69	2.04	3.20	3.49	3.87	5.51	5.61	7.42	18.72	21.12	54.64
8. Transport, Storage & Communication	3.47	3.32	3.58	4.35	5.61	6.38	7.14	6.47	7.62	13.27	13.14	39.72
9. Finance, Insurance, Real Estate & Business Services	1.08	1.16	1.36	1.53	1.92	2.10	2.43	2.07	2.52	2.91	0.51	15.95
10. Community, Social & Personal Services	50.30	50.05	53.55	60.62	94.00	107.19	114.88	101.71	116.71	70.08	109.88	267.44
11. Private Social & Recreational Services	0.05	0.05	0.06	0.07	0.08	0.09	0.09	0.08	0.10	0.81	0.22	0.71
Household	93.23	90.37	110.97	126.41	182.47	208.80	209.53	179.96	251.69	277.37	306.86	593.61
Export	1,713.61	2,526.15	5,372.57	5,922.38	5,404.82	5,579.49	5,273.10	4,895.67	5,557.63	5,044.33	5,541.76	5,779.32
Cable Losses	130.18	117.20	121.05	150.59	165.47	166.99	93.98	84.17	43.06	90.90	146.99	115.80

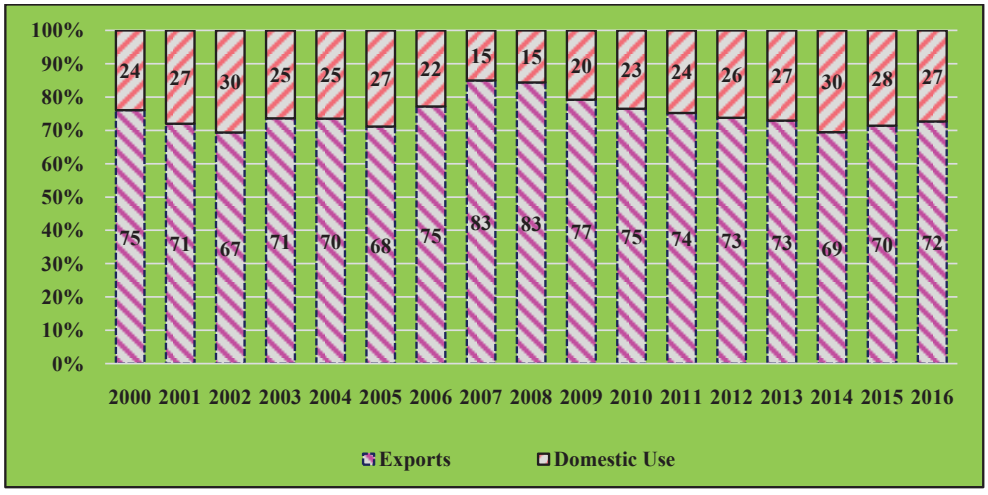
Table 13 Total Supply & Use of Electricity by Sectors (2005-2016)

(Mil. Nu)

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
(I) TOTAL SUPPLY	**3,989.41**	**5,615.95**	**11,000.10**	**12,607.43**	**11,000.88**	**12,045.33**	**11,015.51**	**11,251.10**	**13,266.59**	**14,277.05**	**14,599.60**	**14,846.55**
Production	3,956.64	5,552.83	10,962.37	12,593.17	10,889.85	11,811.46	10,948.33	11,140.80	13,051.66	13,905.77	14,258.09	14,624.05
Imports	32.77	63.13	37.73	14.26	111.03	233.87	67.18	110.30	214.93	371.28	341.51	222.50
(II) TOTAL USE	**3,989.41**	**5,615.95**	**11,000.10**	**12,607.43**	**11,000.88**	**12,045.33**	**11,015.51**	**11,251.10**	**13,266.59**	**14,277.05**	**14,599.60**	**14,846.55**
1. Agriculture, Livestock & Forestry	0.16	0.19	0.36	0.58	0.32	0.51	0.35	0.45	0.69	3.02	1.42	3.84
2. Mining & Quarrying	0.97	1.71	2.99	6.24	3.45	5.92	4.33	4.98	7.54	11.26	16.69	16.14
3. Manufacturing	219.69	291.38	653.96	1,103.70	599.08	1,117.37	757.65	1,055.89	1,599.14	2,687.10	2,670.50	1,402.26
4. Electricity & Water	8.99	14.54	47.33	80.36	40.84	65.29	37.09	43.61	66.05	122.27	125.18	395.61
5. Construction	3.10	3.30	6.41	8.76	5.20	10.62	8.73	12.62	19.11	58.23	9.23	32.51
6. Wholesale & Retail Trade	7.47	9.12	16.94	27.10	14.67	27.75	20.89	30.32	45.93	41.79	20.90	44.90
7. Hotels & Restaurants	0.56	0.88	1.86	4.27	2.00	3.35	3.18	4.96	7.52	44.52	44.34	85.92
8. Transport, Storage & Communication	1.71	1.98	3.73	6.64	3.68	6.32	4.72	5.83	8.84	29.49	29.60	62.45
9. Finance, Insurance, Real Estate & Business Services	0.47	0.62	1.27	2.09	1.13	1.86	1.43	1.73	2.62	6.31	1.00	25.08
10. Community, Social & Personal Services	25.42	30.63	57.30	94.80	63.26	108.87	77.86	91.64	138.78	158.50	255.01	420.57
11. Private Social & Recreational Services	0.02	0.03	0.06	0.09	0.05	0.08	0.05	0.07	0.11	1.72	0.43	1.12
Household	32.48	38.12	81.86	136.27	84.64	146.20	97.89	136.23	206.31	414.54	433.97	933.48
Export	3,479.20	4,976.18	10,034.33	11,032.60	10,071.00	10,411.46	9,839.21	9,714.53	11,013.99	10,698.31	10,991.32	11,421.89
Cable Losses	209.14	247.25	91.71	103.94	111.57	139.73	162.12	148.23	149.96	-	-	0.80

In terms of percentage share, the overall domestic use decreased from 28 percent in 2015 to 27 percent in 2016. Export share increased by 2 percent from 70 percent in 2015 to 72 percent in 2016 as reflected in *figure 2* below.

Figure 2 Share of Exports and Domestic Use (In Percent)



3.4. *Electricity Trade and Transmission Loss*

Bhutan imports electricity during the lean season. Between 2000 and 2016, increase in export of electricity occurred on an average of 10 percent. The growth in import has been declining. In 2016, export of electricity grew by slightly more than 4 percent while import fell by slightly more than 30 percent as shown in *figure 3* below.

Figure 3 Export & Import Growth of Electricity

In terms of the transmission loss[9], it has remained almost constant. The transmission loss, which was calculated as the percentage of total generation is not so significant as shown in *figure 4*. For example, the loss in 2016 was only 1 percent of the total production as compared to 2 percent in the previous year.

Figure 4 Transmission Losses (% of total production)

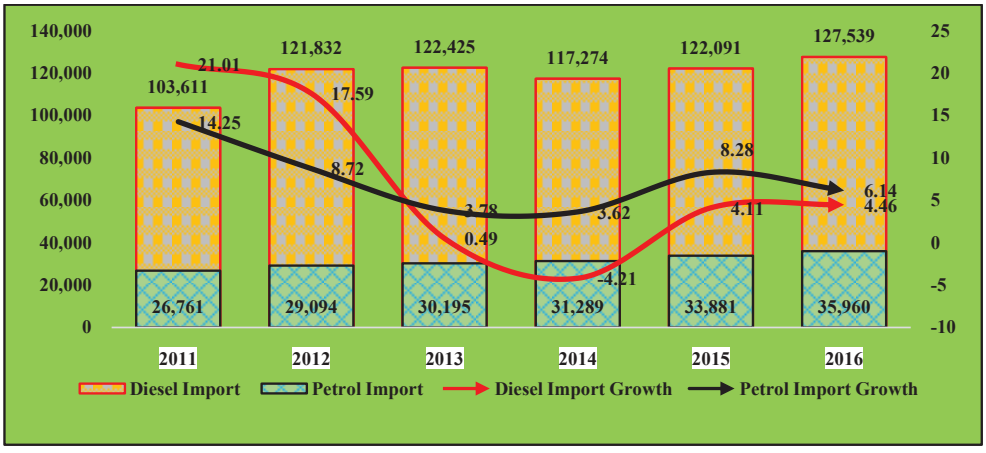
[9]*The transmission losses are the energy losses through cables.*

CHAPTER FOUR:FUEL ACCOUNT

4.1. *Fossil Fuel: Supply &Consumption of Diesel & Petrol*

Bhutan does not produce any fossil fuel. Fossil fuels such as diesel, petrol & LPG gas is imported from India. India is our major trading partner. Import of diesel grew by 4.46 percent in 2016 as compared to 4.11 percent in 2015. Petrol import grew by 6.14 percent in 2016 as compared to 8.28 percent in 2015, a decrease of almost 2 percent. *Figure 5*shows fuel imports in kiloliter and growth trends from 2011 to 2016.

Figure 5 Total kiloliters of Fuel Imports and Growth Trends



The total supply of fuel increased from 155,972 KL in 2015 to 163,499 KL in 2016, which translated to a total supply increase of 5 percent. Use of petrol grew by 6 percent in 2016 while that of diesel increased by 5 percent approximately. *Table 14* shows the supply and use of fossil fuel in KL from 2010 to 2016.

Table 14 Supply & Use of Fossil Fuel (Diesel & Petrol) (2010-2016)

(in KL)

Supply	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Domestic Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Import							
1. Diesel	85,620.00	103,610.90	121,832.00	122,424.80	117,273.80	122,091.40	127,539.00
2. Petrol	23,422.50	26,761.10	29,094.00	30,195.20	31,289.20	33,880.60	35,960.00
Total Supply	**109,042.50**	**130,372.00**	**150,926.00**	**152,620.00**	**148,563.00**	**155,972.00**	**163,499.00**
Use							

Major sectors	2010	2011	2012	2013	2014	2015	2016
1. Agriculture, Livestock & Forestry	**7,555.83**	**10,016.58**	**11,269.47**	**11,676.31**	**12,810.17**	**16,838.55**	**19,541.30**
Diesel	7,554.64	10,015.39	11,268.28	11,675.12	12,808.97	16,827.71	19,526.48
Petrol	1.19	1.19	1.19	1.20	1.19	10.85	14.82
2. Industry	**18,479.83**	**23,188.34**	**24,450.98**	**24,934.18**	**25,751.13**	**26,626.96**	**31,898.70**
Diesel	18,365.15	23,040.77	24,305.61	24,771.61	25,588.21	26,409.68	31,662.22
Petrol	114.68	147.57	145.37	162.57	162.92	217.28	236.48
3. Services	**47,855.76**	**56,805.04**	**58,346.78**	**60,852.59**	**61,058.08**	**62,132.52**	**62,619.11**
Diesel	47,070.86	56,048.19	57,652.61	60,079.95	60,285.98	61,149.61	61,761.89
Petrol	784.89	756.85	694.16	772.64	772.10	982.92	857.23
3. HH consumption	**21,957.49**	**24,472.51**	**26,218.26**	**26,304.71**	**27,345.30**	**30,527.70**	**34,503.53**
Diesel	3,003.06	3,525.11	4,000.95	4,033.25	4,166.79	4,719.66	6,674.08
Petrol	18,954.43	20,947.41	22,217.31	22,271.46	23,178.51	25,808.04	27,829.45
4. Re-Export	**13,193.60**	**15,889.53**	**30,640.51**	**28,852.20**	**21,598.32**	**19,846.27**	**14,936.35**
1. Diesel	9,626.30	10,981.45	24,604.55	21,864.87	14,423.84	12,984.75	7,914.33
2. Petrol	3,567.30	4,908.08	6,035.96	6,987.33	7,174.48	6,861.52	7,022.02
Total use of Diesel	85,620.00	103,610.90	121,832.00	122,424.80	117,273.80	122,091.40	127,539.00
Total use of Petrol	23,422.50	26,761.10	29,094.00	30,195.20	31,289.20	33,880.60	35,960.00
Total use	**109,042.50**	**130,372.00**	**150,926.00**	**152,620.00**	**148,563.00**	**155,972.00**	**163,499.00**

In terms of consumption, service sector accounts for 38.30 percent, the highest, followed by household at 21.10 percent. Industrial sector accounts for 19.51 percent, agriculture for 11.95 percent and consumption by foreign vehicles for 9.14 percent in 2016.

Further, in terms of percentage share, diesel import accounts for 78 percent in 2016 while petrol accounts for 22 percent. Consumption by services accounts for 38 percent, household consumption at 21 percent, industry at 20 percent and agriculture, livestock and forestry at 12 percent in 2016. *Table 15* presents the percentage share of fossil fuel.

Table 15Percentage Share of the Supply & Use of Fossil Fuel (Diesel & Petrol) (2010-2016)

(Percentage)

Supply	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Domestic Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Import							
1. Diesel	78.52	79.47	80.72	80.22	78.94	78.28	78.01
2. Petrol	21.48	20.53	19.28	19.78	21.06	21.72	21.99
Total Supply	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Use							
Major Sectors	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
1. Agriculture, Livestock & Forestry	**6.93**	**7.68**	**7.47**	**7.65**	**8.62**	**10.80**	**11.95**
Diesel	8.82	9.67	9.25	9.54	10.92	13.78	15.31
Petrol	0.01	0.00	0.00	0.00	0.00	0.03	0.04
2. Industry	**16.95**	**17.79**	**16.20**	**16.34**	**17.33**	**17.07**	**19.51**
Diesel	21.45	22.24	19.95	20.23	21.82	21.63	24.83
Petrol	0.49	0.55	0.50	0.54	0.52	0.64	0.66
3. Services	**43.89**	**43.57**	**38.66**	**39.87**	**41.10**	**39.84**	**38.30**
Diesel	54.98	54.09	47.32	49.07	51.41	50.09	48.43
Petrol	3.35	2.83	2.39	2.56	2.47	2.90	2.38
3. HH consumption	**20.14**	**18.77**	**17.37**	**17.24**	**18.41**	**19.57**	**21.10**
Diesel	3.51	3.40	3.28	3.29	3.55	3.87	5.23
Petrol	80.92	78.28	76.36	73.76	74.08	76.17	77.39
Re-Export	**12.10**	**12.19**	**20.30**	**18.90**	**14.54**	**12.72**	**9.14**
1. Diesel	11.24	10.60	20.20	17.86	12.30	10.64	6.21
2. Petrol	15.23	18.34	20.75	23.14	22.93	20.25	19.53
Total use of Diesel	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total use of Petrol	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total use	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Consumption of fuel in monetary values is presented in *Table 16*. The differences in the values are adjusted. The import, which is at basic price is adjusted to purchasers' price. The supply of fuel grew from Nu. 8,977.02 million in 2016 from Nu. 7,963.89 million in 2015, a growth of approximately 13 percent.

Table 16 Supply & Use of Fossil Fuel (Diesel & Petrol) (2010-2016)

(Nu. in million)

Supply	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Imports	**4201.76**	**4927.00**	**6228.71**	**7218.10**	**7731.32**	**6730.68**	**7307.19**
1. Diesel at basic price	3250.61	3562.81	4601.90	5471.94	5911.38	5024.82	5549.46
2. Petrol at basic price	951.15	1364.19	1626.82	1746.16	1819.94	1705.86	1757.73
Total Margin	**636.70**	**690.87**	**749.12**	**841.32**	**1035.00**	**1233.21**	**1669.84**
Trade and Transport margin (Diesel)	480.09	526.19	571.09	637.05	760.59	966.20	1113.18
Trade and Transport margin (Petrol)	156.62	164.67	178.03	204.26	274.40	267.01	556.66
Supply at market price (Diesel)	3730.70	4089.00	5172.99	6108.99	6671.97	5991.02	6662.64
Supply at market price (Petrol)	1107.77	1528.86	1804.85	1950.42	2094.34	1972.87	2314.39
Total Supply at market Price	**4838.46**	**5617.87**	**6977.83**	**8059.42**	**8766.32**	**7963.89**	**8977.02**
Use							
Major sectors	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
1. Agriculture, Livestock & Forestry	**278.46**	**395.33**	**478.53**	**582.67**	**728.81**	**826.37**	**1021.02**
Diesel	278.41	395.26	478.45	582.59	728.73	825.74	1020.06
Petrol	0.06	0.07	0.07	0.08	0.08	0.63	0.95
2. Industry	**682.23**	**917.73**	**1041.03**	**1246.60**	**1466.68**	**1308.58**	**1669.25**
Diesel	676.80	909.30	1032.02	1236.10	1455.77	1295.92	1654.03
Petrol	5.42	8.43	9.02	10.50	10.91	12.65	15.22
3. Services	**1776.06**	**2260.06**	**2495.54**	**3064.24**	**3532.77**	**3099.31**	**3340.12**
Diesel	1738.93	2216.83	2452.47	3014.33	3481.09	3042.08	3284.95
Petrol	37.12	43.24	43.06	49.91	51.68	57.24	55.17
3. HH consumption	**1007.12**	**1335.84**	**1548.13**	**1639.86**	**1788.51**	**1734.40**	**2139.76**
Diesel	110.67	139.12	169.88	201.26	237.06	231.59	348.65
Petrol	896.45	1196.73	1378.25	1438.60	1551.45	1502.80	1791.10
Re-Export	1094.60	708.90	1414.61	1526.05	1249.54	995.24	806.88
1. Diesel	925.88	428.50	1040.17	1074.71	769.32	595.70	354.94
2. Petrol	168.72	280.40	374.44	451.34	480.22	399.55	451.94
Total use of Diesel	3730.70	4089.00	5172.99	6108.99	6671.97	5991.02	6662.64
Total use of Petrol	1107.77	1528.86	1804.85	1950.42	2094.34	1972.87	2314.39
Total use	**4838.46**	**5617.87**	**6977.83**	**8059.42**	**8766.32**	**7963.89**	**8977.02**

4.2. *Import of vehicles over the years by Industries and Households*

The number of vehicles imported over the years has gradually increased. In 2016 alone, 9,419[10]units of vehicles were imported. Import of light vehicles was the highest at 6,188 units followed by heavy vehicles at 990 units, two wheelers at 734 units, taxi at 628 units, earth moving equipment at 399 units and power tiller at 229 units.

In terms of ownership, household sector owns the highest with 62.42 percent followed by service sector with 24.63 percent, agriculture, livestock &forestry sector accounts for19.57 percent.

4.3. *Import and re-export[11] of Fossil Fuel*

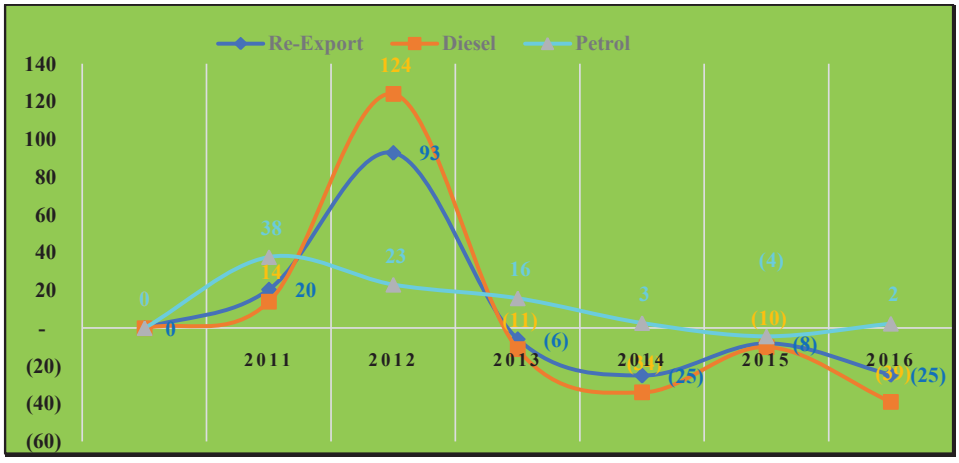
From the total import of petrol and diesel, some portion is consumed by Indian vehicles plying on Bhutanese roads transporting goods into and out of Bhutan. It also includes fuel consumed by Indian tourist vehicles and refueling by Indian vehicles in the border towns of Samdrup Jongkhar, Gelephu, Phuentsholing and Samtse.

Bhutan imported around 127.54 million liters of diesel in 2016as compared to 122.10 million liters in 2015, an increase of around 4 percent. The import of petrol in 2016 increased to 359.60 million liters from 338.81 million liters in 2015, an increase of 6 percent.

The re-export of fuel decreased from 19.85 million liters in 2015 to 14.94 million liters in 2016, a decrease by 25 percent. The decrease was mainly because of decrease in the re-export of diesel, almost 39.05 percent in 2016 as shown in *figure6* below.

[10]*The import figure was sourced from Road Safety and Transport Authority, Ministry of Information and Communication.*
[11] *Re-export is a term used for refueling by vehicles that are not registered in Bhutan*

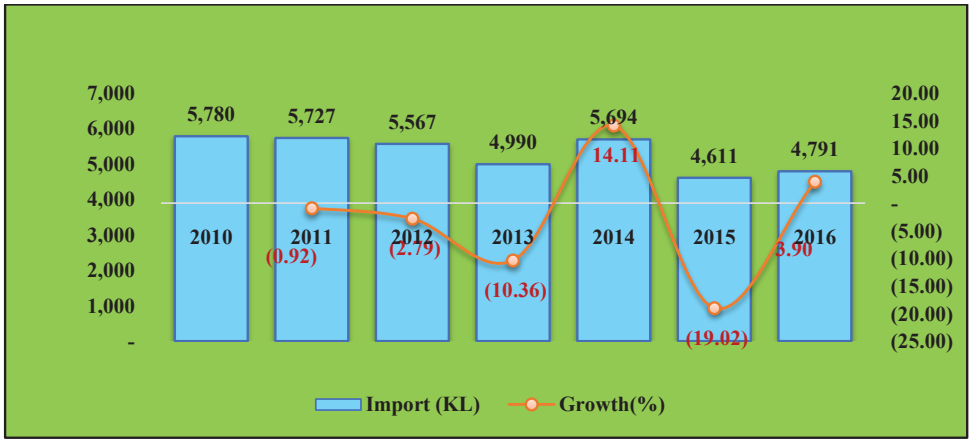
Figure 6 The growth of re-export (2011-2016)



4.4. *Kerosene: Supply& Consumption*

Kerosene is imported from India. Import[12] of kerosene increased from 4,611 KL in 2015 to 4,791 KL in 2016. Import growth was about 4 percent. *Figure 7*shows the total import of Kerosene in KL and the growth trends from 2010 to 2016.

Figure 7 Total KL of kerosene Imports & Growth Trends



Kerosene is mostly consumed by households[13]. Considering the national average household size of 4.5 and the projected population of 768,577 in 2016, a

[12] *The figures on the import of kerosene were provided by POL, Dept. of Trade, Ministry of Economic Affairs*
[13] *In the absence of reliable data on consumption, NSB aggregated the consumption into household consumption and industries consumption based on the import share of kerosene (Quota) and kerosene (industrial) as provided by Dept. of Trade, MoEA*

household consumes an average of 27.84 liter a year. The supply and use of kerosene in KL is presented in *Table 17*.

Table 17 Supply & Use of Kerosene (in KL) (2010-2016)

(in KL)

Supply	2010	2011	2012	2013	2014	2015	2016
Domestic Production	-	-	-	-	-	-	-
Import	5,780.00	5,727.00	5,567.00	4,990.00	5,694.00	4,611.00	4,791.00
Total Supply	**5,780.00**	**5,727.00**	**5,567.00**	**4,990.00**	**5,694.00**	**4,611.00**	**4,791.00**
Use							
Household	5,540.00	5,607.00	5,547.00	4,978.00	5,673.00	4,599.00	4,755.00
Industries	240.00	120.00	20.00	12.00	21.00	12.00	36.00
Total Use	**5,780.00**	**5,727.00**	**5,567.00**	**4,990.00**	**5,694.00**	**4,611.00**	**4,791.00**

The increase in the supply of kerosene was 4 percent as compared to 2015, directly proportional to the import growth. The overall growth in the supply and use of kerosene is presented in *Table 18* below.

Table 18Growth in Supply & Use of Kerosene (In percent) (2010-2016)

(In Percent)

Supply	2010	2011	2012	2013	2014	2015	2016
Domestic Production	-	-	-	-	-	-	-
Import	-	(0.92)	(2.79)	(10.36)	14.11	(19.02)	3.90
Total Supply	**-**	**(0.92)**	**(2.79)**	**(10.36)**	**14.11**	**(19.02)**	**3.90**
Use							
Household	-	1.21	(1.07)	(10.26)	13.96	(18.93)	3.39
Industries	-	(50.00)	(83.33)	(40.00)	75.00	(42.86)	200.00
Total Use	**-**	**(0.92)**	**(2.79)**	**(10.36)**	**14.11**	**(19.02)**	**3.90**

In monetary terms, Nu. 66.06 million worth of kerosene was imported in 2016 as compared to Nu. 60.69 million in 2015. The import value, which is in basic price, is readjusted to purchasers' price. In total, the supply of kerosene grew from Nu.72.46 million in 2015 to Nu. 77.67 million in 2016 as shown in *Table 19*.

Table 19 Supply & Use of Kerosene (In Mil. Nu.) (2010-2016)

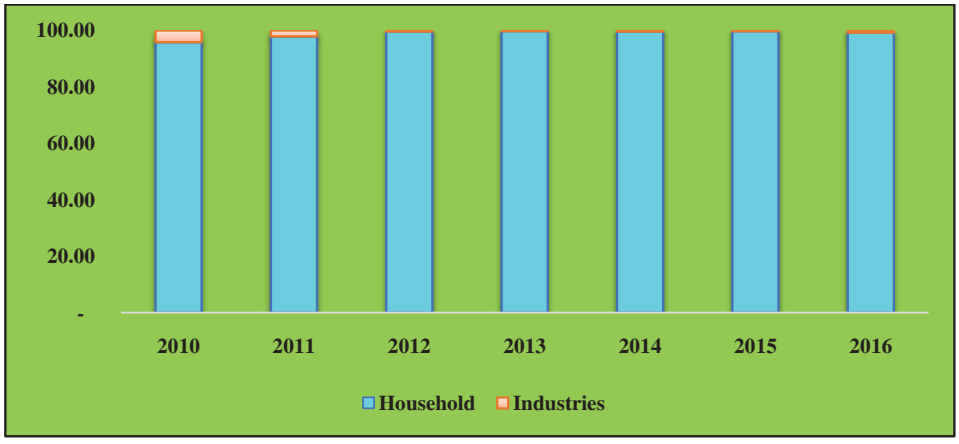
(in Mil. Nu.)

Supply	2010	2011	2012	2013	2014	2015	2016
Domestic Production	-	-	-	-	-	-	-
Import (at basic price)	60.61	72.68	72.71	65.56	75.83	60.69	66.06
Exports	-	-	-	-	-	-	-
Changes in inventories	-	-	-	-	-	-	-
Losses	-	-	-	-	-	-	-
Trade and Transport margin (TTM)	37.65	36.13	33.06	30.98	11.18	11.77	11.61

Total Supply (at market price)	**98.26**	**108.81**	**105.77**	**96.54**	**87.01**	**72.46**	**77.67**
Use							
Household	94.18	106.53	105.39	96.30	86.69	72.27	77.09
Industries	4.08	2.28	0.38	0.23	0.32	0.19	0.58
Total use (3+4)	**98.26**	**108.81**	**105.77**	**96.54**	**87.01**	**72.46**	**77.67**

In terms of share, household consumes almost 99 percent of the total import. The industries' use of kerosene is insignificant as shown in *figure 8*.

Figure 8 Consumption Share of Kerosene from 2010-2016 (in percent)



4.5. *LPG: Supply& Consumption*

Like fossil fuel, Bhutan relies on import of LPG from India. The use of electric cooking stoves is not common in Bhutan unlike in other countries. Thus, Bhutanese household use LPG for cooking and heating purposes. The import[14] of LPG increased from 7,302.60 MT in 2015 to 7,593.23 MT in 2016 as reflected in *Table 20*.

Table 20 Supply & Use of LPG (In MT)

(In MT)

Supply	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Domestic Production	-	-	-	-	-	-	-
Import	6,834.16	7,410.87	7,470.22	6,777.98	7,029.93	7,302.60	7,593.23
Total Supply	**6,834.16**	**7,410.87**	**7,470.22**	**6,777.98**	**7,029.93**	**7,302.60**	**7,593.23**

[14] *The figures on the import of LPG gas were provided by POL, Dept. of Trade, Ministry of Economic Affairs*

The import growth was about 4 percent as compared to 2015.*Table 21* shows the growth in supply and use of LPG from year 2010-2016.

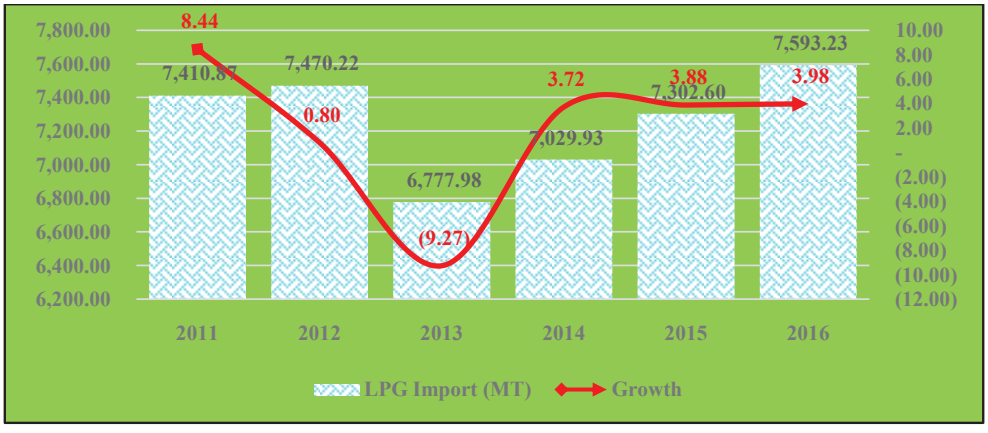
Table 21 Growth in Supply & Use of LPG (In Percent) (2010-2016)

(In Percent)

Supply	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Domestic Production	-	-	-	-	-	-	-
Import	-	8.44	0.80	(9.27)	3.72	3.88	3.98
Total Supply	**-**	**8.44**	**0.80**	**(9.27)**	**3.72**	**3.88**	**3.98**

*Figure 9*shows the total import of LPG in MT and the growth trends from 2011 to 2016.

Figure 9 Total Metric Tons of LPG Imports and Growth Trends

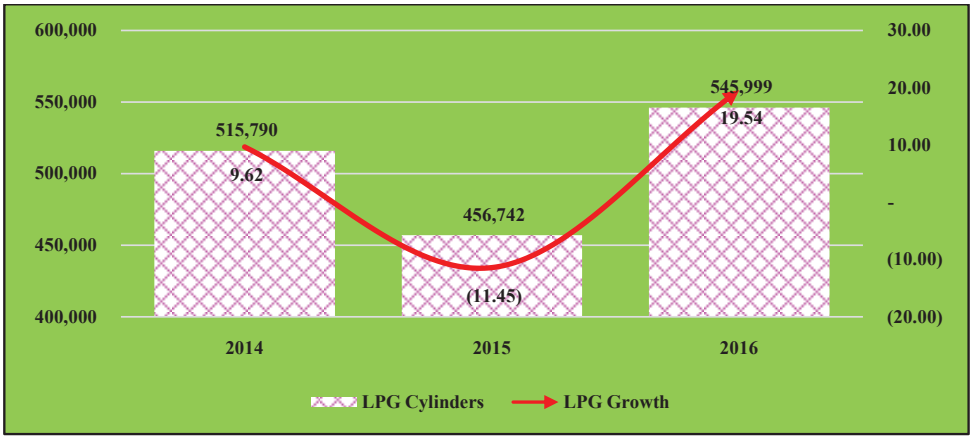


The consumption[15] of LPG on the other hand has grown by approximately 20 percent in 2016 as compared to 2015 as shown in *figure 10*. In order to estimate the number of cylinders, the import value, which is in MT, was converted to number of cylinders by considering the net weight of the cylinder, which is 14.2 kg per cylinder. In 2016, 545,999 LPG cylinders were consumed as compared to 456,742 cylinders in 2015. Thus, considering the national average household size[16]of 4.5 and projected population of 768,577 in 2016[17], a household consumes, an averageof,3 cylinders a

[15] *Figures on the annual consumption of LPG was sourced from POL, Dept. of Trade, Ministry of Economic Affairs.*
[16] *The average household size is 4.5 as per the Bhutan Living Standard Survey, 2012 of NSB.*
[17] *The projected population of Bhutan is 768,577 as per the Population Projection Figure of NSB.*

year. Due to absence of disaggregated data, consumption of LPG by urban and rural location could not be presented.

Figure 10 Consumption of LPG & Growth Trends



4.6. *Fuelwood: Supply& Consumption*

Fuelwood is a critical source of energy for rural households. Natural Resource Development Corporation Ltd. and Department of Forest and Park Services, Ministry of Agriculture and Forests supply fuelwood to both rural and urban population in Bhutan. *Table 22* shows the total supply and consumption of fuelwood.

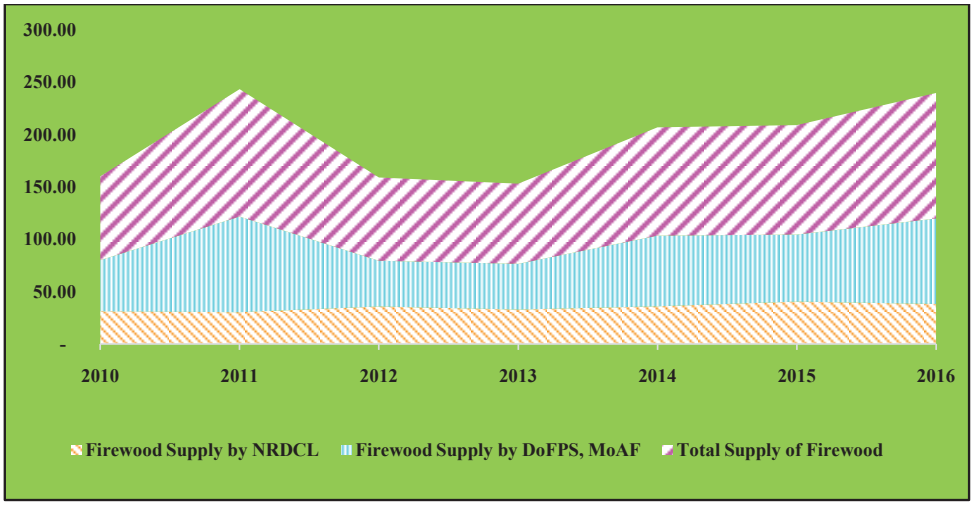
Table 22 Supply and Consumption of Fuelwood (000' M3)

(000'M^3)

SUPPLY	Year						
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
1. Supply by NRDCL	31.18	30.36	35.82	32.87	35.99	40.49	38.18
2. Supply by DoFPS, MoAF	48.86	91.27	43.65	43.65	67.42	63.99	81.61
Total Supply (1+2)	**80.04**	**121.63**	**79.47**	**76.52**	**103.40**	**104.48**	**119.80**
USE							
3. NRDCL Disposal (3.1+3.2)	31.18	30.36	35.82	32.87	35.99	40.49	38.18
3.1 Household	4.27	4.16	4.91	4.50	4.93	5.55	5.23
3.2 Industries	26.90	26.20	30.92	28.36	31.06	34.94	32.95
4. DoFPS, MoAF Disposal (4.1+4.2)	48.86	91.27	43.65	43.65	67.42	63.99	81.61
4.1 Household (4.1.1+4.1.2)	40.89	58.98	20.91	20.91	34.51	34.78	44.36
4.2 Industries	7.97	32.29	22.74	22.74	32.91	29.21	37.25
Total Household	**45.16**	**63.14**	**25.82**	**25.41**	**39.44**	**40.33**	**49.59**
Total Industries	**34.87**	**58.49**	**53.66**	**51.10**	**63.97**	**64.15**	**70.20**
Total Use	**80.04**	**121.63**	**79.47**	**76.52**	**103.40**	**104.48**	**119.80**

Supply[18] of fuelwood has grown by almost 15 percent in 2016 as compared to 2010. *Figure 11* shows the total supply of fuelwood by NRDCL and DoFPS, MoAF. Fuelwood supply to household are mostly from DoFPS, MoAF while NRDCL supplies to industries.

Figure 11 Total Supply of Fuelwood (000' M^3) (2010-2016)



In terms of the overall share, fuelwood supply by NRDCL is about 32 percent while supply by DoFPS, MoAF is 68 percent. The share of fuelwood supply for different years is presented in *Table 23*.

Table 23 Share of Supply and Consumption of Fuelwood (Percent)

(Percentage)

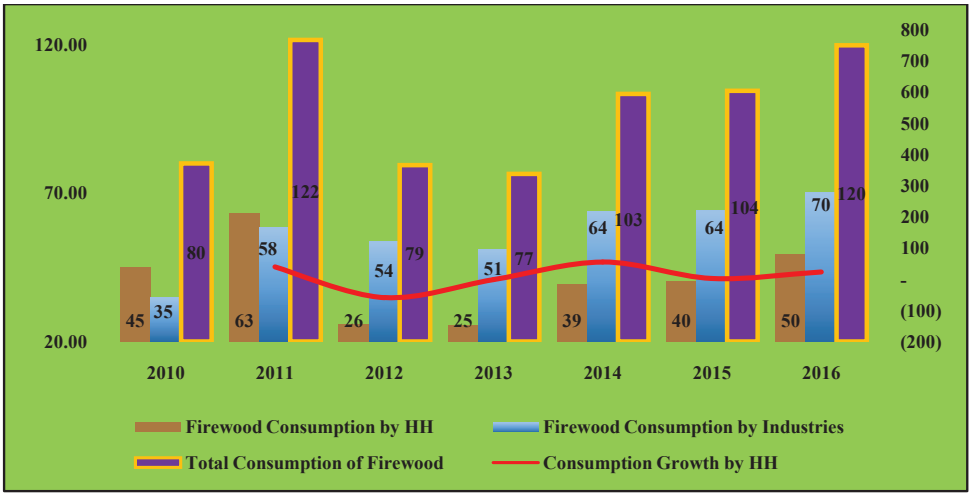
SUPPLY	Year						
	2010	2011	2012	2013	2014	2015	2016
1. Supply by NRDCL	38.95	24.96	45.08	42.95	34.80	38.76	31.87
2. Supply by DoFPS, MoAF	61.05	75.04	54.92	57.05	65.20	61.24	68.13
Total Supply (1+2)	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
USE							
3. NRDCL Disposal (3.1+3.2)	38.95	24.96	45.08	42.95	34.80	38.76	31.87
3.1 Household	13.70	13.70	13.70	13.70	13.70	13.70	13.70
3.2 Industries	86.30	86.30	86.30	86.30	86.30	86.30	86.30
4. DoFPS, MoAF Disposal (4.1+4.2)	61.05	75.04	54.92	57.05	65.20	61.24	68.13

[18] *The data on the supply of fuelwood are the total supply by NRDCL & DoFPS, MoAF*

4.1 Household	51.09	48.49	26.31	27.33	33.37	33.29	37.03
4.2 Industries	9.96	26.55	28.61	29.72	31.83	27.95	31.10
Total Household	56.43	51.91	32.49	33.21	38.14	38.60	41.40
Total Industries	43.57	48.09	67.51	66.79	61.86	61.40	58.60
Total Use (3+4)	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

The consumption[19] of fuelwood were broken into household and industries use based on the data of fuelwood distribution records with NRDCL and MoAF. Of the total consumption, household accounts for almost, on an average, 40 percent. Fuelwood consumption by institutions is lumped with industrial use. The consumption differential of fuelwood within industries could not be estimated, as specific purposes were not clear. However, the consumption of fuelwood both in the case of household and industries has increased in 2016 as compared to 2015 as shown in *figure 12*.

Figure 12 Consumption of Firewood by HH & Industries (000'M3) (2010-2016)



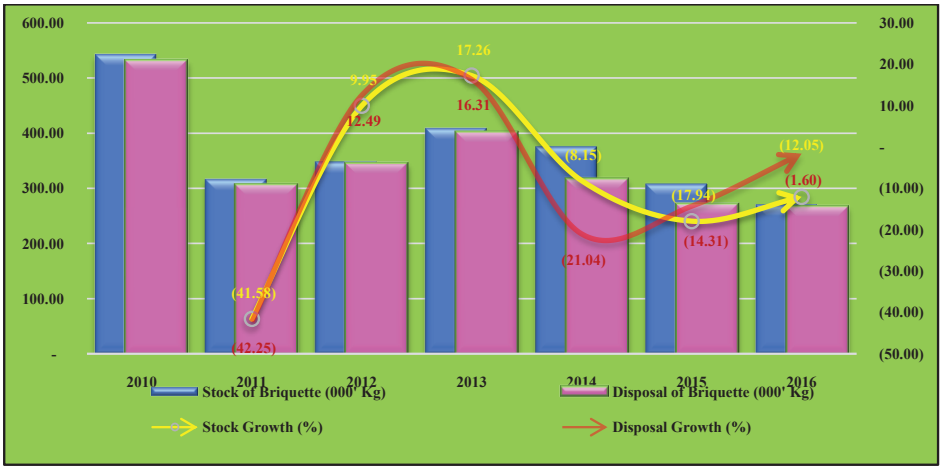
4.7. *Briquette: Supply& Consumption*

The demand for briquette is also provisioned through NRDCL. Although there may be some private sawmills that produce briquette, the figure is insignificant. The stock growth of briquette decreased by almost 12 percent in 2016 as compared to

[19] *The data on consumption of fuelwood are estimated based on the record of fuelwood issued to different individuals by NRDCL & MoAF.*

2015.The disposal growth of briquette on the other hand, has also decreased by almost 2 percent as reflected in *figure 13*.

Figure 13 Production, Disposal and Growth Trends of Briquette (2010-2016)



The physical stock and changes in the stock of briquette is presented in *Table 24.*Here the stock refers to those available in store for disposal.

Table 24 Physical Asset Account for Briquette (000' KG) (2010-2016)

(000' KG)

	Year						
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total Stock (1+2)	541.19	316.16	347.61	407.61	374.39	307.24	270.21
1. Opening Stock	147.86	11.28	10.14	3.27	6.93	58.24	36.33
2. Additions to stock (via production)	393.33	304.88	337.47	404.34	367.46	249.00	233.88
Total Reductions in stock (3)	529.92	306.02	344.25	400.41	316.15	270.91	266.58
3. Disposal	529.92	306.02	344.25	400.41	316.15	270.91	266.58
Closing stock (1+2-3)	11.27	10.14	3.36	7.20	58.24	36.33	3.63

CHAPTER FIVE: ASSET ACCOUNT

5.1. *Introduction*

SNA[20] 2008defines an asset *"as a store of value representing a benefit or series of benefits accruing to the economic owner by holding or using the entity over a period of time*". NSB compiled asset account for natural resources such as timber, sand, stone and stone chips supplied and disposed by NRDCL[21]. In addition, NSB included mineral resources[22]. The valuation of accounts includes valuation of stocks of the resources and the changes in stocks over the accounting periods.

The System of Environmental-Economic Accounting (SEEA) Central Framework provides that the flows of extraction, depletion and discoveries are central to asset account, which provides valuable information regarding the sustainability of individual resources.

5.2. *Timber: Supply& Consumption*

Timber is used particularly for construction purposes, renovation of Dzongs & Lhakhangs, rural constructions, etc. Timber stock[23] decreased by almost 11 percent in 2016 as compared to 2015. Stock here refers to timber already extracted by NRDCL. The potential standing timbers are not accounted and therefore, the estimated account here should not be assumed as the complete timber account for whole economy. The physical asset account for timber handled by NRDCL is shown in *Table 25*.

Table 25 Physical Asset Account for Timber

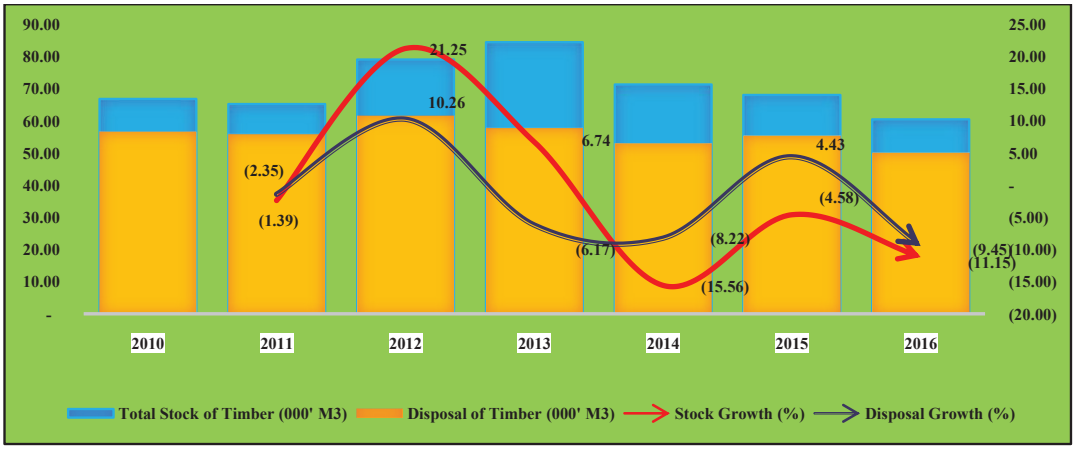
(000' M^3)

	Year						
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total Stock (1+2)	**66.82**	**65.25**	**79.11**	**84.45**	**71.30**	**68.04**	**60.45**
1. Opening Stock	15.03	10.20	9.42	17.55	25.86	18.30	12.67
2. Additions to stock (via production)	51.78	55.05	69.69	66.90	45.44	49.74	47.77
Total Reductions in stock (3)	**56.62**	**55.83**	**61.56**	**57.76**	**53.01**	**55.36**	**50.13**
3. Disposal	56.62	55.83	61.56	57.76	53.01	55.36	50.13
Closing stock (1+2-3)	10.20	9.42	17.56	26.69	18.30	12.68	10.32

[20] *The System of National Accounts is the framework of accounts which measures the level of economic development and the rate at which the economy of the country grows over time.*
[21] *Most of the information are sourced from Annual Reports of Natural Resource Development Corporation Ltd.*
[22] *Mineral Resources comprised known deposits of natural resources, coal, non-metallic minerals and metallic minerals.*
[23] *The total stock of timber includes both the opening stock and the production during the accounting period*

Disposal of timber by NRDCL on the other hand has decreased by almost 10 percent in 2016 as reflected in *figure 14*. Consumption of timber by different sectors of the economy could not be estimated, as NSB couldn't get any appropriate information. Timber supplied here excludes those supplied by DoFPS, MoAF.

Figure 14 Production, Disposal & Growth Trends of Timber (2010-2016)



5.3. *Sand: Supply& Consumption*

The domestic demand for sand is also met by NRDCL. These resources are made available by NRDCL at affordable price for public consumption. There is an increasing demand for sand particularly by urban households for building purposes. The total stock of sand has increased by almost 16 percent in 2016 as compared to 2015 as presented in *Table 26*.

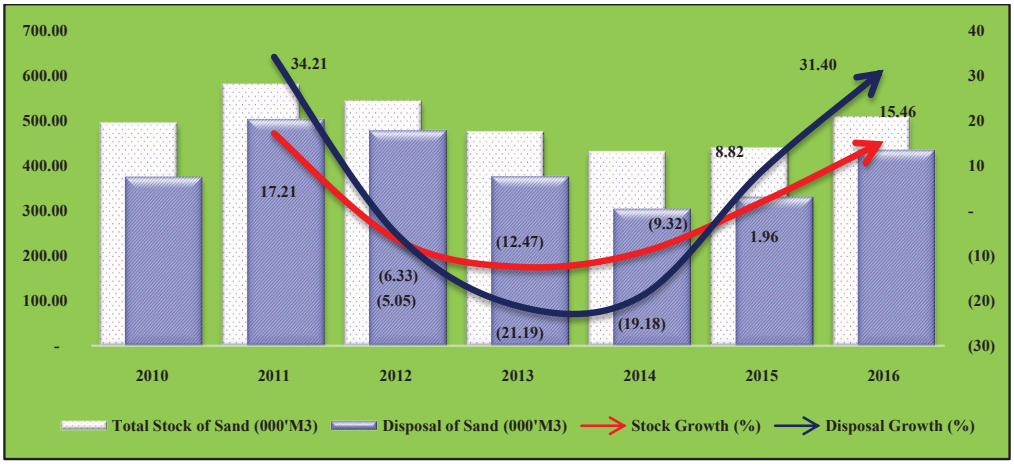
Table 26 Physical Asset Account for Sand (000' M3) (2010-2016)

(000'M3)

	Year						
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total Stock (1+2)	495.22	580.46	543.73	475.91	431.55	440.02	508.03
1. Opening Stock	34.26	121.46	63.25	65.35	85.42	121.57	97.92
2. Additions to stock (via production)	460.95	459.00	480.48	410.56	346.13	318.44	410.11
Total Reductions in stock (3)	373.75	501.60	476.28	375.36	303.38	330.13	433.80
3. Disposal	373.75	501.60	476.28	375.36	303.38	330.13	433.80
Closing stock (1+2-3)	121.46	78.86	67.45	100.55	128.17	109.88	74.23

Disposal of sand has grown dramatically by 31 percent as reflected in *figure 15*. This reflects that the demand for sand is increasing with increasing urbanization.

Figure 15 Production, Disposal and Growth Trends of Sand (2010-2016)



5.4. *Stone: Supply & Consumption*

Stones are an important material for construction. Domestic demand for stone in the economy is met through NRDCL and quarrying companies in the country. Department of Geology and Mines, MoEA shares information with NSB on stone extraction by different mining and quarrying companies. The opening stock for stone wasrecorded based on the stone reserve information from DGM. The total stock of stone has decreased by 3 percent in 2016 as compared to 2015 as shown in *Table 27*.

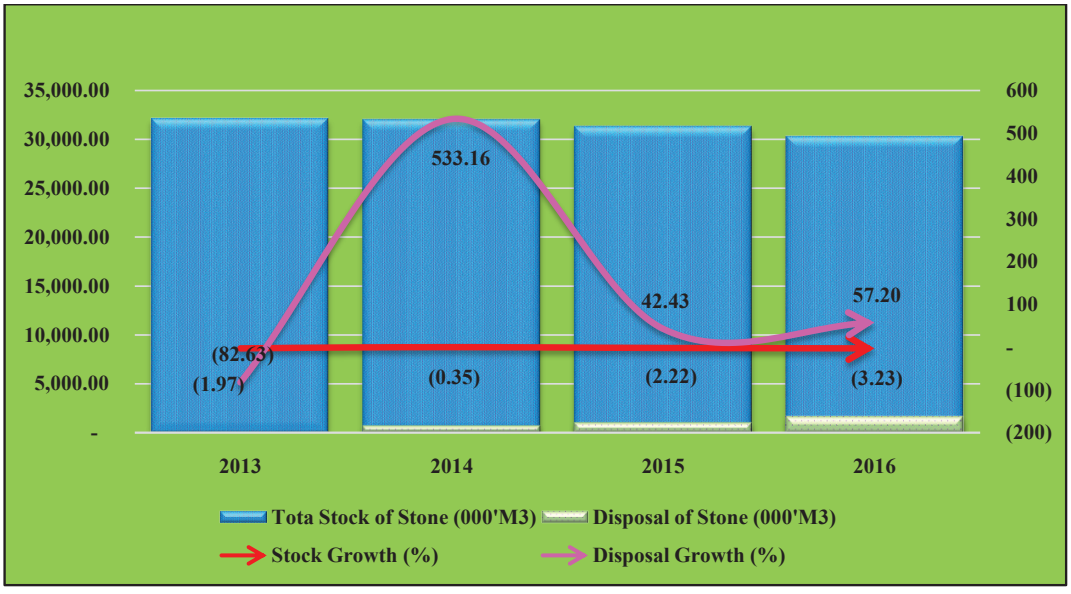
Table 27 Physical Asset Account for Stone (000'M3) (2012-2016)

(000'M3)

	Year				
	2012	**2013**	**2014**	**2015**	**2016**
Opening Stock	32,713.80	32,069.62	31,957.72	31,249.17	30,239.98
Total Reductions in stock	**644.18**	**111.91**	**708.55**	**1,009.19**	**1,586.46**
Disposal by NRDCL	18.38	95.11	91.15	85.19	154.26
Disposal by Quarrying companies as reported to DGM	625.80	16.80	617.40	924.00	1,432.20
Closing stock	**32,069.62**	**31,957.72**	**31,249.17**	**30,239.98**	**28,653.52**

In terms of disposal, the growth has increased by 57 percent as reflected in *figure 16*.

Figure 16 Production, Disposal and Growth Trends of Stone (2012-2016)



5.5. *Stone Chips: Supply& Consumption*

The production and supply of stone chips are also carried out by NRDCL and private quarrying companies. Stone chips are predominantly used for construction. Here, the data on stone chips only pertains to those carried out by NRDCL. The total stock of stone chips has increased by 19 percent in 2016 compared to2015. *Table 28* shows the physical asset account for stone chips.

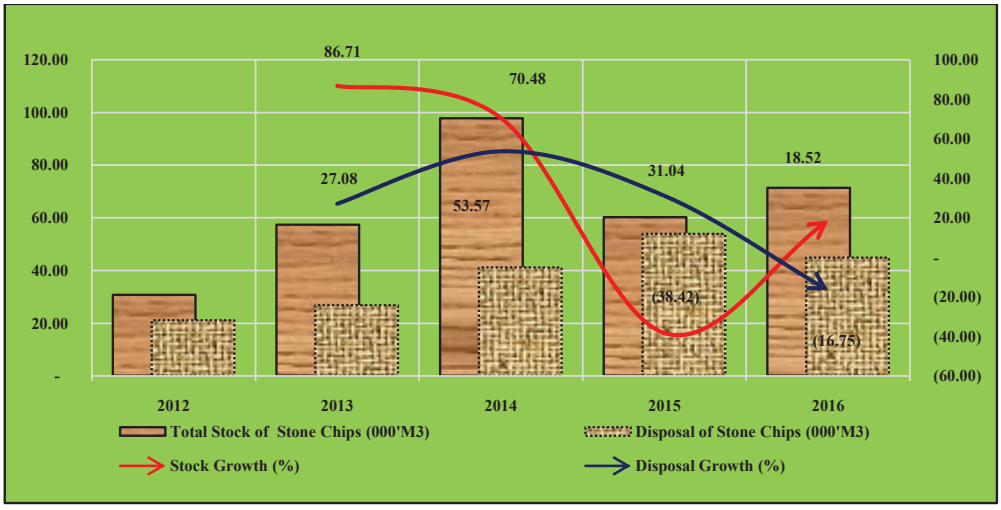
Table 28 Physical Asset Account for Stone Chips (000'M3) (2010-2016)

(000'M3)

	Year				
	2012	2013	2014	2015	2016
Total Stock (1+2)	30.70	57.32	97.71	60.17	71.31
1. Opening Stock	-	9.65	30.44	56.63	36.99
2. Additions to stock (via production)	30.70	47.67	67.27	3.54	34.32
Total Reductions in stock (3)	21.05	26.75	41.08	53.83	44.81
3. Disposal	21.05	26.75	41.08	53.83	44.81
Closing stock (1+2-3)	9.65	30.57	56.63	6.34	26.50

Disposal, on the other side has decreased by approximately 17 percent as reflected in *figure 17*.

Figure 17 Production, Disposal and Growth Trends of Stone Chips (2012-2016)



5.6. *Mineral Asset Account*

NSB compiled mineral accounts for only non-metallic mineral resources as information on metallic mineral resources in Bhutan are not available. The DGM, MoEA has the primary data to start the compilation of mineral asset account for non-metallic mineral resources. The key factors in the measurement of mineral asset accounting are understanding the mineral resources in the form of deposits or reserves and its extractions by different mining and quarrying companies. The deposits influence the likelihood and the cost of current and future extraction.

Mineral resources (non-metallic) in Bhutan are resources which are geologically known and extracted by mining and quarrying companies. The non-metallic resources include quarry recourses that are found in the country such as coal, dolomite, limestone, gypsum, quartzite, talc and iron ore.

The physical mineral asset accounts show the level of stock of individual mineral at a particular point in time and then records transactions that cause changes in the level of stock.

NSB considered reserves of minerals which are geologically known reserves and its level as the opening stock, while the extractions were recorded as depletion[24].

5.7. *Mineral Reserve*

The data on reserves[25] used in developing physical accounts are gathered so that we can understand the opening stock of individual mineral resources. Information on the percentage of individual metallic and non-metallic mineral reserves based on the categories of minerals are shown in *Figure 18* and *Figure 19*respectively.There are three categories of mineral resources: proved[26], probable[27] and possible[28].Metallic reserves particularly copper, iron ore and tungsten are probable reserve, while lead-zinc reserve constitutes 86 percent as proven reserve. *Table 29* summarizes the metallic mineral reserve in Bhutan by different categories.

Table 29 Metallic Mineral Reserve (Mil. MT)

(Million MT)

	Probable	Proven	Possible	Total
Non-Ferrous Metals				
Copper	2.04	-	-	2.04
Lead-Zinc	0.47	2.83	-	3.29
Ferrous Metals				
Iron Ore	2.69	-	-	2.69
Tungsten	3.87	-	-	3.87

Non-metallic reserve such as Talc (100 percent), Dolomite (99.68 percent) and coal (78.68 percent) are possible reserve. *Table 30* shows non-metallic mineral reserve.

Table 30 Non-Metallic Mineral Reserve (Mil. MT)

(Million MT)

Minerals	Probable	Proven	Possible	Total
Coal	0.22	-	0.82	**1.04**
Dolomite	-	46.57	14,495.90	**14,542.47**
Graphite Ore	35.91	5.56	7.28	**48.75**
Gypsum	0.03	113.84	20.35	**134.22**
Limestone	64.00	71.38	29.27	**164.65**
Quartzite	-	5.18	-	**5.18**
Talc	-	-	0.13	**0.13**

[24] *SEEA defines depletion as the decrease in the quantity of the stock of a natural resource over an accounting period due to the extraction of the natural resource by economic units.*
[25] *The information on reserve was sourced from the report "The Bhutan Himalaya By Ghargava and GIS 1995 inventory"*
[26] *Proved are economically mineable with high degree of certainty (high confidence level)*
[27] *Probable are economically mineable with lower level of confidence than proved reserves*
[28] *Possible are part of a mineral resource for which grade and mineral content are estimated with a low level of confidence*

Quartzite and gypsum are more of proven reserve with 100 and 85 percent respectively as

Figure 18Metallic Reserve (%)

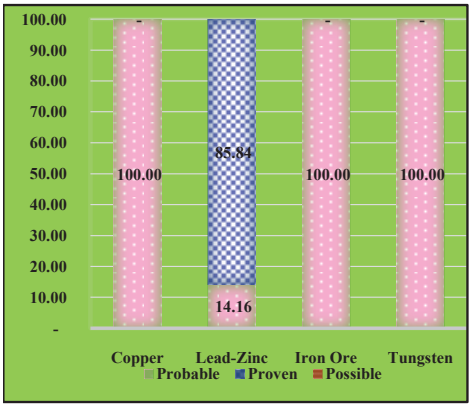
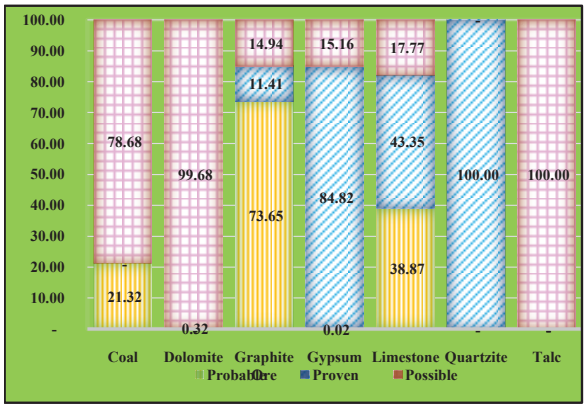


Figure 19 Non-Metallic Reserve (%)



reflected in *Figure 18-19*.

5.8. *Extraction of Minerals*

Mining and quarrying companies extract minerals from different areas in the country. Information on extraction[29] of minerals are compiled to ascertain whether or not mineral extractions or harvest per se, are carried out sustainably. *Table 31* shows the mineral extraction by mining and quarrying companies in Bhutan.

Table 31 Mineral Extractions (Mil. MT) (2010-2016)

(Mil. MT)

Minerals	2010	2011	2012	2013	2014	2015	2016
Coal	0.09	0.11	0.10	0.08	0.12	0.09	0.12
Dolomite	1.21	1.08	1.50	1.74	2.04	2.66	0.00
Lime stone	0.70	0.65	0.68	1.01	1.12	0.85	1.26
Gypsum	0.34	0.35	0.31	0.35	0.41	0.39	0.32
Quartzite	0.11	0.10	0.09	0.09	0.08	0.08	0.09
Stone	6.65	1.84	1.49	0.04	1.47	2.20	3.41
Talc	0.04	0.01	0.02	0.01	0.01	0.01	0.00
Iron Ore	-	-	0.00	0.02	0.02	0.04	0.03

Coal extraction averages 0.09 million MT annually. The extraction ranges from 0.09 million MT to 0.12 million MT as shown in *figure 20*. Extraction of dolomite on the other hand has occurred on an average of 0.95 million MT. The extraction of dolomite in 2016 was

[29] *The figures on extraction of minerals are sourced from DGM, MoEA.*

2.37 million MT as compared to 2.66 million MT in 2015 as reflected in *figure 21*. Limestone and gypsum extractions have been quite steady with an average of 0.65 million MT and 0.25 million MT respectively (*figure 22& 23)*.

Talc and quartzite extractions are declining. On an average, 0.03 million MT of Talc and 0.07 million MT of quartzite are being extracted as reflected in *figure 24& 25*. The only metal extracted in the country is iron ore. On an average, 0.01 million MT of iron ore are extracted annually as shown in *figure 26*.

Figure 20 Coal Extraction (Mil. MT) (2010-2016)

Figure 21 Dolomite Extraction (Mil. MT) (2010-2016)

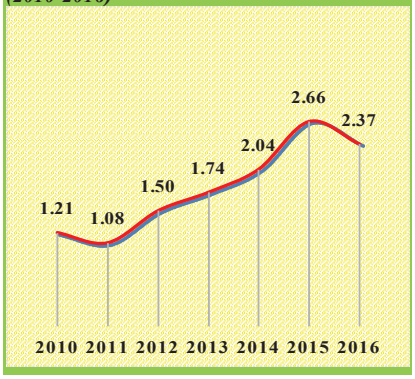


Figure 22 Limestone Extraction (Mil. MT) (2010-2016)

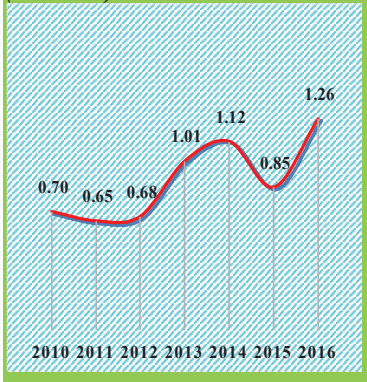


Figure 23 Gypsum Extraction (Mil. MT) (2010-2016)

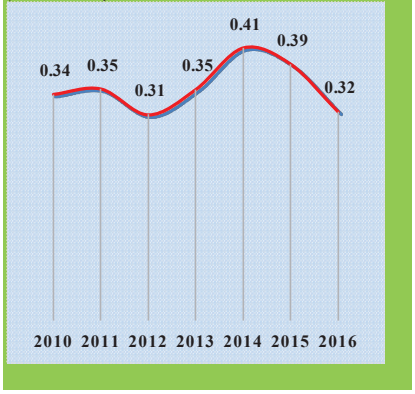


Figure 25 Talc Extraction (Mil. MT) (2010-2016)

Figure 24 Quartzite Extraction (Mil. MT) (2010-2016)

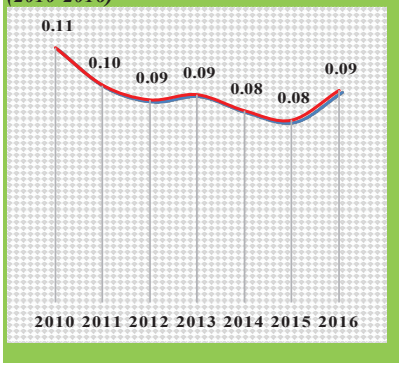


Figure 26 Iron Ore Extraction (Mil. MT) (2010-2016)

5.9. *Physical Asset Account for Minerals*

The physical asset account[30] records both the opening stock[31] levels and the closing stock[32] of minerals and the changes over a period of time. The changes over a period of time include both upward[33] and downward[34]. The total reserve of a particular mineral resource was considered as the opening stock in 2010, as it is done in many other countries. Extractions by

[30] *NSB compiled physical asset account for minerals based on the SEEA general structure of the physical asset account for environmental assets.*
[31] *The opening stock level is the level of the mineral resources at the beginning of the year and it should be equal to the closing stock of the previous year.*
[32] *The closing stock is the level of reserves at the end of the year and it should be equal to the opening stock of the subsequent year.*
[33] *Upward changes are any new discoveries of new stock through exploration and evolution.*
[34] *Downward changes are changes through extractions or any other decreases like catastrophic losses and reclassifications.*

different mining and quarrying companies are accounted and thus, subtracted from the total known reserves to ascertain the outstanding reserves[35] of individual mineral resources.

5.9.1. *Physical Asset Account for Coal*

The physical asset account for coal is presented in *Table 32*. The opening stock records the level of coal resources at the beginning of the year. Increases in stocks are through discoveries and other increases. Discoveries include gross addition to the level of resources and refers to the findings of resources previously unknown. These figures are not available at the moment. The decrease in stock are through extractions and other decreases. The closing stock is then estimated by subtracting the decrease in stock through extractions and other decreases from the actual opening stock. Coal resource as of 2016 is 0.34 million MT.

Table 32 Physical Asset Account for Coal (Mil. MT) (2010-2016)

(Million MT)

	2010	2011	2012	2013	2014	2015	2016
Opening stock (as of 1 January)	**1.04**	**0.95**	**0.85**	**0.75**	**0.67**	**0.55**	**0.46**
(+) Increases in stocks	-	-	-	-	-	-	-
Discoveries	-	-	-	-	-	-	-
Other increases	-	-	-	-	-	-	-
(-) Decreases in stocks	**0.09**	**0.11**	**0.10**	**0.08**	**0.12**	**0.09**	**0.12**
Extractions	0.09	0.11	0.10	0.08	0.12	0.09	0.12
Other decreases	-	-	-	-	-	-	-
Closing stock levels (as of 31 December)	**0.95**	**0.85**	**0.75**	**0.67**	**0.55**	**0.46**	**0.34**

5.9.2. *Physical Asset Account for Dolomite*

The physical asset account for dolomite is presented in *Table 33*. Similar estimation methodology is used and the dolomite resource as of 2016 is estimated at 14,532.23 million MT.

Table 33 Physical Asset Account for Dolomite (Mil. MT) (2010-2016)

(Million MT)

	2010	2011	2012	2013	2014	2015	2016
Opening stock (as of 1 January)	**14,542.47**	**14,541.26**	**14,540.17**	**14,538.67**	**14,536.93**	**14,534.89**	**14,532.23**
(+) Increases in stocks	-	-	-	-	-	-	-
Discoveries	-	-	-	-	-	-	-
Other increases	-	-	-	-	-	-	-
(-) Decreases in stocks	**1.21**	**1.08**	**1.50**	**1.74**	**2.04**	**2.66**	**0.002**
Extractions	1.21	1.08	1.50	1.74	2.04	2.66	0.002
Other decreases	-	-	-	-	-	-	-
Closing stock levels (as of 31 December)	**14,541.26**	**14,540.17**	**14,538.67**	**14,536.93**	**14,534.89**	**14,532.23**	**14,532.23**

[35] *Outstanding reserves may not necessarily mean reserves remaining in the country. There may be unknown reserves as well.*

5.9.3. *Physical Asset Account for Limestone*

Table 34 presents the physical asset account for limestone. The estimated limestone resources as of 2016 is 158.40 million MT.

Table 34 Asset Account for Limestone (Mil. MT) (2020-2016)

(Million MT)

	2010	2011	2012	2013	2014	2015	2016
Opening stock (as of 1 January)	**164.65**	**163.94**	**163.32**	**162.64**	**161.63**	**160.51**	**159.66**
(+) Increases in stocks	-	-	-	-	-	-	-
Discoveries	-	-	-	-	-	-	-
Other increases	-	-	-	-	-	-	-
(-) Decreases in stocks	**0.70**	**0.63**	**0.68**	**1.01**	**1.12**	**0.85**	**1.26**
Extractions	0.70	0.63	0.68	1.01	1.12	0.85	1.26
Other decreases	-	-	-	-	-	-	-
Closing stock levels (as of 31 December)	**163.94**	**163.32**	**162.64**	**161.63**	**160.51**	**159.66**	**158.40**

5.9.4. *Physical Asset Account for Gypsum*

The physical asset account for gypsum is presented in *Table 35*. The estimated gypsum resources as of 2016 is 133.05 million MT.

Table 35 Physical Asset Account for Gypsum (Mil. MT) (2010-2016)

(Million MT)

	2010	2011	2012	2013	2014	2015	2016
Opening stock (as of 1 January)	**134.22**	**133.87**	**133.52**	**134.53**	**134.17**	**133.76**	**133.37**
(+) Increases in stocks	-	-	1.32	-	-	-	-
Discoveries	-	-	1.32	-	-	-	-
Other increases	-	-	-	-	-	-	-
(-) Decreases in stocks	**0.34**	**0.35**	**0.31**	**0.35**	**0.41**	**0.39**	**0.32**
Extractions	0.34	0.35	0.31	0.35	0.41	0.39	0.32
Other decreases	-	-	-	-	-	-	-
Closing stock levels (as of 31 December)	**133.87**	**133.52**	**134.53**	**134.17**	**133.76**	**133.37**	**133.05**

5.9.5. *Physical Asset Account for Quartzite*

Table 36 shows the physical asset account for quartzite. The estimated quartzite resources as of 2016 is 4.54 million MT.

Table 36 Physical Asset Account for Quartzite (Mil. MT) (2010-2016)

(Million MT)

	2010	2011	2012	2013	2014	2015	2016
Opening stock (as of 1 January)	**5.18**	**5.07**	**4.98**	**4.89**	**4.80**	**4.71**	**4.63**
(+) Increases in stocks	-	-	-	-	-	-	-
Discoveries	-	-	-	-	-	-	-
Other increases	-	-	-	-	-	-	-
(-) Decreases in stocks	**0.11**	**0.09**	**0.09**	**0.09**	**0.08**	**0.08**	**0.09**
Extractions	0.11	0.09	0.09	0.09	0.08	0.08	0.09
Other decreases	-	-	-	-	-	-	-
Closing stock levels (as of 31 December)	**5.07**	**4.98**	**4.89**	**4.80**	**4.71**	**4.63**	**4.54**

5.9.6. *Physical Asset Account for Talc*

Table 37 provides physical asset account for talc. The estimated talc resources as of 2016 is 0.05 million MT.

Table 37Physical Asset Account for Talc (Mil. MT) (2010-2016)

(Million MT)

	2010	2011	2012	2013	2014	2015	2016
Opening stock (as of 1 January)	**0.13**	**0.09**	**0.08**	**0.08**	**0.07**	**0.05**	**0.05**
(+) Increases in stocks	-	-	-	-	-	-	-
Discoveries	-	-	-	-	-	-	-
Other increases	-	-	-	-	-	-	-
(-) Decreases in stocks	0.04	0.01	0.00	0.01	0.01	0.01	0.00
Extractions	0.04	0.01	0.002	0.01	0.01	0.01	0.002
Other decreases	-	-	-	-	-	-	-
Closing stock levels (as of 31 December)	**0.09**	**0.08**	**0.08**	**0.07**	**0.05**	**0.05**	**0.05**

5.9.7. *Physical Asset Account for Iron-Ore*

The physical asset account for iron-ore is presented in *Table 38*. The estimated iron-ore resources as of 2016 is 2.58 million MT.

Table 38 Physical Asset Account for Iron Ore (Mil. MT) (2010-2016)

(Million MT)

	2010	2011	2012	2013	2014	2015	2016
Opening stock (as of 1 January)	**2.69**	**2.69**	**2.69**	**2.69**	**2.67**	**2.65**	**2.61**
(+) Increases in stocks	-	-	-	-	-	-	-
Discoveries	-	-	-	-	-	-	-
Other increases	-	-	-	-	-	-	-
(-) Decreases in stocks	-	-	0.00	0.02	0.02	0.04	0.03
Extractions	-	-	0.00	0.02	0.02	0.04	0.03

Other decreases	-	-	-	-	-	-	-
Closing stock levels (as of 31 December)	**2.69**	**2.69**	**2.69**	**2.67**	**2.65**	**2.61**	**2.58**

In terms of overall percentage, coal reserve as of 2016 is almost 33 percent, talc 37 percent, dolomite 99.93 percent, gypsum 99.13 percent, limestone 96.21 percent, iron ore 95.75 percent and quartzite 87.69 percent. These are minerals that are still heavily available[36] in the ground. *Figure 27-33* presents the opening and closing stock of minerals.

Figure 28 Coal Reserve as of 2016 (Mil. MT)

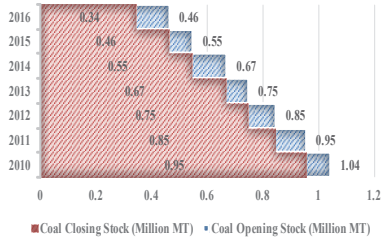


Figure 27 Dolomite Reserve as of 2016 (Mil. MT)

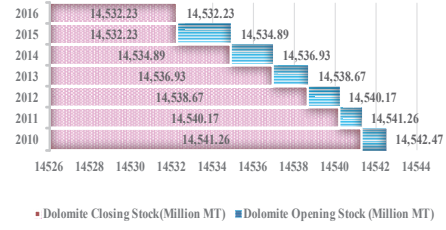


Figure 29 Gypsum Reserve as of 2016 (Mil. MT)

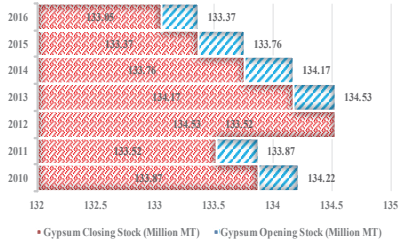


Figure 30 Limestone Reserve as of 2016 (Mil. MT)

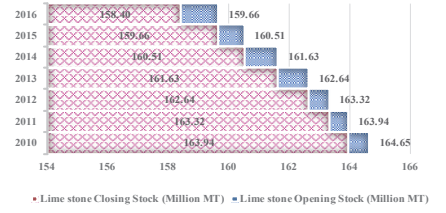


Figure 32 Quartzite Reserve as of 2016 (Mil. MT)

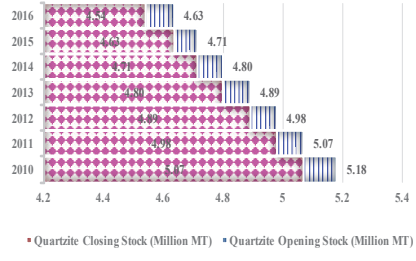
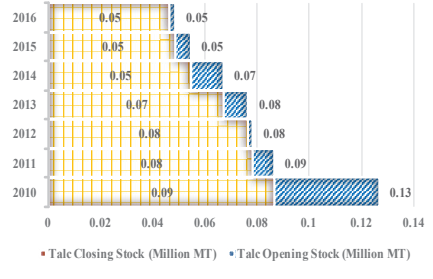
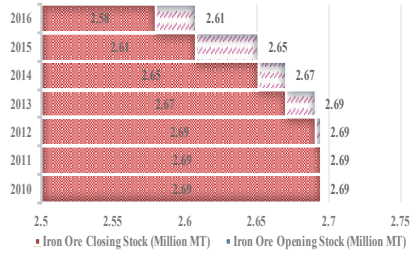


Figure 31 Talc Reserve as of 2016 (Mil. MT)



[36] *Based on the percentage of extractions from the total known reserves.*

Figure 33 Iron Ore Reserve as of 2016 (Mil. MT)



5.10. *Monetary Asset Account for Minerals*

The monetary asset account for mineral resources shows the value of an individual mineral at 2016 prices. The Net Present Value (NPV) approach is adopted to value the mineral resources. The formula for the calculation of NPV using an appropriate discount rate is:

$$V_t = \sum_{r=1}^{Nt} \frac{RR_{(t+r)}}{(1+r_t)^t}$$

where V_t is the value of the asset of time t; N is the asset life; RR is the resource rent; and r is a nominal discount rate.

In this calculation, NSB derived the harvest or actual quantity of extraction of individual mineral on the total volume of mineral resource left for future extraction dividing by the number of years[37] that the mining and quarrying companies are provided. The resource rent[38] for each mineral resource is calculated using national accounts data[39]. The NPV of future extraction are discounted back to current value term using appropriate discount rate[40].

In most countries around the world, in the absence of any appropriate discount rate, lending or interest rate is used as the basis to estimate the discount factor. For the current

[37] *This is the lease period provided to Mining and Quarrying companies*
[38] *The resource rent is calculated based on the residual value method of SEEA which excludes operating costs, specific taxes and subsidies, and consumption of fixed capital from the output.*
[39] *Companies books of accounts are used for estimating mineral resource rent.*
[40] *NPV method uses social discount rates to discount the value of future returns to explain in the current terms. The returns earned in the current period are worth more than returns earned in the future.*

initiative, NSB used Bank of Bhutan's fixed lending rate of 12 percent to Mining & Quarrying Companies as the discount rate.

5.11. *Monetary Asset Account for Coal*

The monetary asset account shows the value of mineral resources at 2016 prices. For coal, if constant extraction of coal[41]is maintained for future years, constant future resource rent[42]of coal (same as the resource rent in 2016) is also maintained for future years and the constant discount rate[43], the net present value (NPV) of coal extractions was estimated to Nu. 809.81 million. The detailed calculation for monetary asset account for coal is shown in *Table 39*. The total value of coal resources (at 2016 prices) is about Nu. 809.81million. In other words, this is the value of coal resources to be extracted in future under the above three assumptions.

Table 39 Monetary Asset Account for Coal (Mil. Nu.)

(Million Nu.)

Extraction Year	Quantity	resource rent per unit	Total resource rent from extraction	Discount rate, 12 per cent	Discount factor	Net present value (NPV) of extraction
2017	0.09	3,061.90	266.62	0.12	0.89	238.05
2018	0.09	3,061.90	266.62	0.12	0.80	212.55
2019	0.09	3,061.90	266.62	0.12	0.71	189.77
2020	0.09	3,061.90	266.62	0.12	0.64	169.44

5.12. *Monetary Asset Account for Dolomite*

Dolomite extractions are very less compared to available dolomite resources. The estimated monetary asset account for dolomite is presented in *Table 40*. If we consider extraction of dolomite for the next 15 years[44], the total value of dolomite resources (at 2016 prices) is estimated about Nu. 15,504,003.78 million.

[41] The 5-year moving average of extraction was considered. On an average 0.09 Mil. MT of coal are being extracted.
[42] The per unit resource rent in 2016 was 3,061.90
[43] The discount rate is 12%.
[44] If constant dolomite extraction of 968.82 million MT, constant resource rent of 97.17 and discount rate of 12% are considered.

Table 40 Monetary Asset Account for Dolomite (Mil. Nu.)

(Million Nu.)

Extraction Year	Quantity	resource rent per unit	Total resource rent from extraction	Discount rate, 12 per cent	Discount factor	Net present value (NPV) of extraction
2017	968.82	2,349.64	2,276,363.57	0.12	0.89	2,032,467.47
2018	968.82	2,349.64	2,276,363.57	0.12	0.80	1,814,703.10
2019	968.82	2,349.64	2,276,363.57	0.12	0.71	1,620,270.62
2020	968.82	2,349.64	2,276,363.57	0.12	0.64	1,446,670.20
2021	968.82	2,349.64	2,276,363.57	0.12	0.57	1,291,669.82
2022	968.82	2,349.64	2,276,363.57	0.12	0.51	1,153,276.63
2023	968.82	2,349.64	2,276,363.57	0.12	0.45	1,029,711.27
2024	968.82	2,349.64	2,276,363.57	0.12	0.40	919,385.07
2025	968.82	2,349.64	2,276,363.57	0.12	0.36	820,879.52
2026	968.82	2,349.64	2,276,363.57	0.12	0.32	732,928.15
2027	968.82	2,349.64	2,276,363.57	0.12	0.29	654,400.13
2028	968.82	2,349.64	2,276,363.57	0.12	0.26	584,285.83
2029	968.82	2,349.64	2,276,363.57	0.12	0.23	521,683.78
2030	968.82	2,349.64	2,276,363.57	0.12	0.20	465,789.09
2031	968.82	2,349.64	2,276,363.57	0.12	0.18	415,883.11

5.13. *Monetary Asset Account for Gypsum*

The monetary asset account for gypsum is presented in *Table 41*. If we consider extraction of gypsum for the next 15 years[45], the total value of gypsum resources (at 2016 prices) is estimated about Nu 28,303.75 million.

Table 41 Monetary Asset Account for Gypsum (Mil. Nu.)

(Million Nu.)

Extraction Year	Quantity	resource rent per unit	Total resource rent from extraction	Discount rate, 12 per cent	Discount factor	Net present value (NPV) of extraction
2017	8.87	468.50	4,155.68	0.12	0.89	3,710.43
2018	8.87	468.50	4,155.68	0.12	0.80	3,312.88
2019	8.87	468.50	4,155.68	0.12	0.71	2,957.93
2020	8.87	468.50	4,155.68	0.12	0.64	2,641.01
2021	8.87	468.50	4,155.68	0.12	0.57	2,358.04
2022	8.87	468.50	4,155.68	0.12	0.51	2,105.40
2023	8.87	468.50	4,155.68	0.12	0.45	1,879.82
2024	8.87	468.50	4,155.68	0.12	0.40	1,678.41

[45] *If constant gypsum extraction of 8.87 million MT, constant resource rent of 468.50 and discount rate of 12% are considered.*

2025	8.87	468.50	4,155.68	0.12	0.36	1,498.58
2026	8.87	468.50	4,155.68	0.12	0.32	1,338.02
2027	8.87	468.50	4,155.68	0.12	0.29	1,194.66
2028	8.87	468.50	4,155.68	0.12	0.26	1,066.66
2029	8.87	468.50	4,155.68	0.12	0.23	952.37
2030	8.87	468.50	4,155.68	0.12	0.20	850.33
2031	8.87	468.50	4,155.68	0.12	0.18	759.23

CHAPTER SIX: LOOKING AHEAD

Environmental-Economic Accounting has been recognized globally for its usefulness in terms of strategic and sustainable development planning. NSB has made a small beginning[46] based on the availability of information. However, NSB plans to build a comprehensive environmental-economic accounting compendium in future to provide information for national policy planning and also to help monitor and report on SDGs and other Green Economy Indicators.

NSB shall work towards developing priority accounts such as water, land, forest, timber resource account, carbon and selected ecosystem services. A detailed water account may not be practically possible because of information deficiency. However, pilot efforts to estimate water account in areas where hydropower activities are undertaken will be endeavored.

To address the need of information requirements, NSB shall work to strengthen partnerships and coordination with agencies both from the government and non-governmental organization. Training and capacity building[47] in environmental-economic accounting is another key area to be considered. This need shall be addressed within-house capacity building through HR development, training on environmental accounts compilation, analysis and valuation, and finally conducting knowledge dissemination workshops for data users.

[46] *NSB base on the Framework for Development of Environmental Statistics (FDES) of UNSD introduced a chapter on Environmental Statistics in Statistical Yearbook of 2014 and Electricity Accounts in Annual National Accounts Statistics 2014 through Environmental Accounts and Statistics project supported by DANIDA.*

[47] *The TA report on the assessment of Experimental Ecosystem Accounting done in 2014 also mentions that a lot of capacity buildings need to be done to compile environmental economic accounts.*

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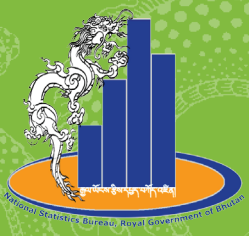

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