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GOVERNMENT OF MONGOLIA
MINISTRY OF ENVIRONMENT AND TOURISM

GREEN ECONOMY POLICY ASSESSMENT: MONGOLIA

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GREEN ECONOMY POLICY ASSESSMENT: MONGOLIA

FOREWORD

Definite goals and objectives have been set in policy documents including the Mongolia Sustainable Development Vision - 2030 and Green Development Policy of Mongolia in order to generate economic growth based on appropriate macroeconomic policy implementations and green development concepts. The Government of Mongolia has paid attention to and implemented activities aimed at supporting green financing, taxation, loan and incentives system and introduced appropriate leverage system.

Within this scope, Mongolia became the first country to join the United Nation's the Partnership for Action on Green Economy Initiative in 2013 and with the support of its partner countries, Mongolia has been contributing to the process of transitioning towards green economy and ensuring sustainable economic growth rate.

The Government of Mongolia is taking a series of measures in regard to the development of green economy such as by improving macroeconomic research or T21 modeling. However, improving of public knowledge and understanding in this field is still needed.

On the basis of the above mentioned requirements, "Green Economy Policy Assessment: Mongolia" has been formulated concerning the policy and legal environment of four sectors including water management, energy, construction and solid waste management. It is important because it illustrates different scenarios that can be achieved when investment in green economy is made based on T21 modeling tool, which is jointly developed by the Ministry of Environment and Tourism, Ministry of Finance and the Millennium Institute.

On behalf of the Ministry of Environment and Tourism, I'm expressing my deep gratitude to the United Nations' Environment Programme, Partnership for Action on Green Economy Initiative and colleagues of the Economic Policy and Competitiveness Research Center who jointly worked on formulation of the research report "Green Economy Policy Assessment: Mongolia".

BATBAYAR.Ts

Vice Minister of Environment and Tourism

Chairperson of the Steering Committee of the

Partnership for Action on Green Economy in Mongolia

CONTENTS

ACRONYMS AND ABBREVIATIONS

AUES	Altai Uliastai Energy System
AUIN	Altai Uliastai Integrated Network
CES	Central Energy System
CETP	Central Effluent Treatment Plant
CHP	Combined Heat and Power
CNC	Controller National Center
CNDS	Comprehensive National Development Strategy
EDAL	Electricity Distribution Air Link
EDC	Energy Development Center
EDS	(Ulaanbaatar) Electricity Distribution System
EEI	Energy Economic Institute
ERC	Energy Regulatory Commission
GDPolicy	Green Development Policy
GDP	Gross Domestic Production
GDPU	General Development Plan of Ulaanbaatar City until 2020, documentary on Development Tendencies until 2030
GE	Green Economy
GoM	Government of Mongolia
HN	Heat network
HPP	Hydropower plant
IMGC	Institute of Mongolian Green Construction
INCR	Integrated Network of Central Region
INER	Integrated Network of Eastern Region
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
MET	Ministry of Environment and Tourism
MEGDT	Ministry of Environment, Green Devolopment and Tourism
MDG	Millennium Development Goals
MECS	Ministry of Education, Culture and Science
MoE	Ministry of Energy
MET	Ministry of Environment and Tourism
MCUD	Ministry of Construction and Urban Development
MSDV	Mongolia Sustainable Development Vision
MNT	Mongolian tugrug (national currency)
MUST	Mongolian University of Science and Technology
NAMWR	National Association of Mongolian Waste Recycling
NCRE	National Center of Renewable Energy
NSO	National Statistical Office
NSED	National System of Electricity Distribution
PRC	People's Republic of China
RE	Renewable energy
SGK	State Great Khural (Parliament of Mongolia)
SPS	Solar Power Station
UB	Ulaanbaatar
UN	United Nations
UNEP	United Nations Environment Programme
UNITAR	United Nations Institute for Training and Research
UNDP	United Nations Development Programme
WES	Western Energy System
WPS	Wind Power Station

LIST OF TABLES, FIGURES, SCHEMAS AND MAPS:

1. INTRODUCTION

1.1. GREEN ECONOMY

The United Nations Conference on Sustainable Development, held in 2012 in Rio de Janeiro, declared that "Sustainable development and poverty reduction is the key message of the green economy and the future we want." By reducing carbon dioxide and more effectively managing resources, transitioning to a "Green Economy" will mitigate environmental risks and ecological degradation, improve livelihoods and reduce inequality and lead to a more inclusive social participation.

In recent years, countries have increasingly prioritized sustainable development, and pointed out the importance of developing green economy when achieving this goal. Mongolia's desire to join this "Wave" has been demonstrated by the State Great Khural's adoption of the Green Development Policy (hereafter GDPolicy) in 2014.

Mongolia made some not worthy progress towards achieving the Millennium Development Goals (MDGs). The MDGs were embedded into national development policies and plans which were reviewed every two years. More than 500,000 Mongolians were lifted out of poverty and maternal and infant (under five) mortality was reduced. But some of the MDGs are not fully achieved. Today 21.6 % of the population lives below the poverty line and MDG targets for clean water and sanitation remain a challenge.

In 2015, the global community adopted the 2030 Agenda for Sustainable Development and developed the Sustainable Development Goals (SDGs). If Mongolia is to reach the targets set in the Green Development Policy, it will need to also reach the SDGs. Transitioning towards a green economy has become essential.

1.2. RESEARCH WORK

The Green Economy Policy Assessment report gives an overview of the current situation of four selected sectors: construction, solid waste management, energy and water management. The report also presents scenarios utilizing the Threshold 21 (T21) framework jointly developed by the Millennium Institute, Ministry of Finance and Ministry of Environment and Tourism to test national targets and the effects of investing in a green economy in Mongolia.

The report is divided into six sections. Section 2 presents the socio-economic situation and challenges in Mongolia, followed by Section 3 (Sector Priorities), which includes a comparison of UN and Mongolian definitions, and an overview of each sector. For each of the priority sectors MDG targets were reviewed considering goals presently achieved. Section 4 presents the features of the T21 framework, which was utilized for this study. The process of defining the scenarios, the underlying assumptions and the modeling and scenario results are covered in this section.

The modelling results consist of one Business as usual (BAU) case, in which no GE investments takes place, and five GE investment percentages 2%, 2.5%, 3%, 3.5% and 4% as scenarios for comparison. Similarly, for 2017, 2018 and 2019 the GE investment levels are simulated at 0.5%, 1% and 1.5% respectively.

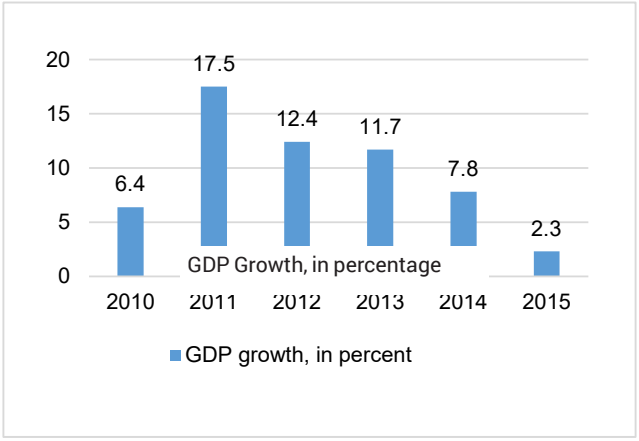
Study conclusions and policy recommendations are presented in Sections 5 and 6.

2. SOCIOECONOMIC SITUATION AND CHALLENGES IN MONGOLIA

2.1. MACROECONOMIC ENVIRONMENT

Mongolian economic growth was high during 2011-2013 but since 2014 the macroeconomic environment has worsened. Growth of gross domestic production (GDP) was at 2.3%, a decline of 5.5 percentage points against the previous year.

Figure 1: GDP Growth, by percentage



Source: National Statistical Office

As a share of GDP, the mining sector accounts for 17.6%, wholesale and retail trade 16.4%, agriculture 14%, processing industry 10.6%, and the selected construction sector 5.8%. Electricity, gas and ventilation supply account for 1.6%, and water supply, sewage, solid waste management and treatment amount to 0.4%.

The volume of foreign direct investment declined in 2012 by 17%, in 2013 by 47%, and by 64% in 2014 (a value of USD 405 million[1]), which resulted in a sharp devaluation of the MNT, and a negative impact on the Mongolian economy.

Economic difficulty in Mongolia has been driven primarily by:

1. ***A decline in investment in mining sector*** which resulted in the slowing of growth in many relevant sectors.

2. ***Slowing growth of the Chinese economy, Mongolia's main export market.*** Additionally the prices of copper and coal dropped in the international market, which in their turn resulted in a decline in investment and income for economic entities, and had a negative impact on fiscal tax revenue. The budget revenue deficit reached 808 billion MNT.

1 Mongolian Balance of Payment summarized table, February 2015, Bank of Mongolia

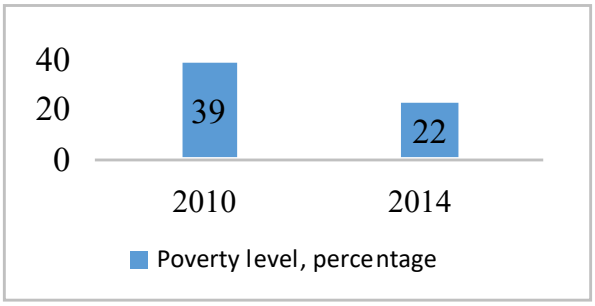
3. ***A long period of financial weakness and soft monetary policy.*** To address the issue, Bank of Mongolia started pursueing a tight monetary policy by increasing the policy interest rate in July 2014 by 1.5 points to 12%, and again in January 2015 by a further point to 13%. These measures are designed to stabilize the exchange rate, to keep inflation low and to facilitate financial and macroeconomic sustainability.

2.2. SOCIAL INDICATORS

As of 2014, the population of Mongolia had increased by 2.2% compared to that of 2013, reaching 2,995,949. At a national level, there are 1.2 million economically active people (the workforce) of which 573,400 or 47.6% are women. The unemployment level in 2014 was 7.7%, a decrease by 0.1 point in 2013.

One of the most important social indicators is the number of people unable to afford necessary food and non-food consumption (poor people), which has declined against 2010 - see Figure 2. In 2010, the poor constituted 38.8% of the total population (1.03 million), a proportion that declined to 21.6% of the total population (634,000) in 2014[2].

Figure 2: Poverty Level



Source: Household Social and Economy Survey 2014, NSO

The declining poverty level indicates the improvement of household livelihoods. As of the first quarter of 2015, average monthly income per household was 941,500 MNT, an increase by 56,500 MNT or 6.4% compared to that of 2014, while per household monthly average expenditure was 963,300 MNT, which indicated an increase of 81,800 MNT or 9.3%.[3] The Gini coefficient, which indicates income inequality across population, was 0.32 in 2014, a decline of 0.01 units, reflecting the decline in inequality since 2010. However per capita health service expenditure is only USD 187, which is 13 times lower than developed countries like Singapore[4].

2.3. MAJOR ENVIRONMENTAL CHALLENGES

With a long and cold winter, comparatively short summer and an extremely low percentage of precipitation, Mongolia has a unique climate. The temperature reaches -40^{0}C in winter and +40^{0}C in summer. From 1940 to 2008 the annual average temperature increased by 2.14^{0}C which is 3 times higher than the world's average of 0.74^{0}C[5]. While

2 Household Social and Economy Survey 2014, NSO
3 Household Social and Economy Survey 2014, NSO
4 Mongolia in World Competitiveness 2014, pg 137, EPCRC
5 Mongolian Green Economy Stocktaking Report, EPCRC, 2014

the concentration of carbon dioxide in the atmosphere is rapidly increasing, Mongolia's share of global carbon dioxide emissions was only 0.03% as of 2010[6]. It is important for countries to ensure their socioeconomic development without harming or degrading their environment or land, water, plants, forest and wild animals. In 2014, 45.5% of Mongolia's population, 1.362 million people, lived in the capital Ulaanbaatar. Increased consumption has created a number of problems that need to be addressed urgently:

1. **Air pollution:** As of 2013, there were 177,349 households living in ger districts, consuming 993,373 tons of coal in winter to fuel their stoves. Additionally, 384,944 vehicles were registered[7], of which 96,003 consumed gasoline, 276,350 diesels, 10,839 dual fuel and 5,227 consumed gas[7]. Air quality in 2013-2014 has improved when compared against that of 2012-2013 winter.

Table 1: Ulaanbaatar City Air Quality

	Sulphur Dioxide		Nitrogen Dioxide		Particulate Matter PM10		Particulate Matter PM 2.5	
Cold season: Oct-April	2012-2013	2013-2014	2012-2013	2013-2014	2012-2013	2013-2014	2012-2013	2013-2014
Concentration mkg/m^3	40	32	68	51	255	258	130	105
Tolerable air quality norms kg/m^3	20		40		100		50	

Source: Report of Environmental Perspective, 2013-2014, MEGDT

Particulates are the most harmful substances for human health. As shown in Table 1, the concentration of particulate matter PM10 has increased. Green facilities are needed to help decrease it.

2. **Water pollution:** As of 2011, at a national level, 607 out of 6,646 rivers and streams, 1,587 out of 10,557 springs, and 486 out of 3,613 lakes had dried up[8]. A 2013 water quality inspection estimated water pollution indexes and made water quality assessments covering six categories in rivers and lakes. Results showed that for 93% of rivers and lakes covered in the assessment, the water quality fell into either the "Very clean" or "Clean" categories, five percent into "little polluted" and three percent into the "Much polluted" category.

   Surface water quality inspections were conducted[8] across cities and dwellings to define water quality by 20-25 indicators. These cover 179 sites and 122 watch-posts covering 91 rivers and 16 lakes, and measure the water environment, its mineralization, oxygen level, dissolved oxygen, weighted substances, general hardness, and permanganate oxidizing nature amongst others [9].

   The main source of pollution of Tuul River is the sewage coming from the Ulaanbaatar central treatment facility. The water quality from Songino to Altanbulag Bridge is extremely poor and pollution is high.

3. **Soil contamination:** 73.5 % of Mongolia's total territory is allocated for agricultural

6 WHO Database -Mongolia
7 Report on Environmental Perspective, 2013-2014, MEGDT
8 The Statistical Yearbook of Mongolia, 2014, pg 186
9 Report on Environmental Perspective, 2013-2014, MEGDT

use, especially herding, 16.1 % for state special purpose, 9.2 % for forestry, 0.5 % for human settlements and 0.4 % for roads, networks and pipelines. Of this, 9.4 million hectares[10], or 6 % of total territory, is damaged. In 2014, tests were carried out for 12 heavy metals such as cadmium, lead, mercury, bromine, chromium, zinc, copper, cobalt, strontium, zircon and chlorine in soil samples taken from 48 sites covering four districts of Ulaanbaatar city and 85 sites over 21 aimags. Comparing the test results with permissible soil quality standard MNS 5850:2008, soil content of Ulaanbaatar city was found to have heavy metals at a standard level, but some sites had high levels of contamination[11].

2.4. LEGAL AND POLICY ENVIRONMENT FOR A GREEN ECONOMY

Currently there are over 40 laws and regulations in force, regarding the green economy and natural resources (water, forest, plants and air) and waste in Mongolia.

The GDPolicy was adopted on 13 June 2014 and has become the pillar policy on green development. The policy defines green development goals, objectives and their implementation policy and strategy divided in medium and long term targets up to 2030.

Green Development Policy

Goals: To evolve as a developed nation having built conditions for environmental sustainability to be inherited by future generations and with an opportunity of gaining benefits from it in the long run through participatory and inclusive economic growth based on a green development concept.

Table 2: GDPolicy Criteria, percentage

	Criteria\ Indicators	2020	2030
1.	Share of renewable energy in total installed capacity of energy production	20	30
2.	Share of reduction of building heat loss	20	40
3.	Waste recycling share	20	40
4.	Share of expenditure in green development in total GDP	2	3
5.	Share of expenditures for science and technology research in total GDP	2	3
6.	Share of green procurement in total government procurement	20	30
7.	Share of protected areas	25	30
8.	Increased investment in environmental protection and restoration	20	30
9.	Share of forest area in total territory	8.5	9
10.	Percentage of population with access to qualified drinking water	80	90
11.	Percentage of population with access to improved sanitation facilities	40	60
12.	Poverty level	24	15
13.	Percentage of green facilities in Ulaanbaatar city and other urban areas	15	30
14.	Share of agriculture and manufacturing in total GDP	28	30

The above GDPolicy criteria/ Indicators were tested for their possibility of accomplishment by using a T21 model.

10 Mongolian Statistical Yearbook- 2014, pg 185
11 Mongolian Statistical Yearbook- 2014, 185 page

3. SECTOR PRIORITIES

Four sectors have been prioritized within this report: construction, energy, solid waste management and water management. Table 3 shows different definitions according to international and Mongolian source.

Table 3: Definitions of Green Economy Sectors

№	Sector	International definition	Mongolian definition
1.	Renewable Energy	*Energy that is derived from natural processes (e.g. sunlight and wind) that are replenished at a higher rate than they are consumed. Solar, wind, geothermal, hydro, and biomass are common sources of renewable energy. Source: International Energy Agency http://www.iea.org/about/glossary/r/*	Renewable energy means the electricity and heating generated by naturally replenished resources such as solar, wind, water, geothermal and biomass. Source: *Article 4, Law on Renewable Energy*
2.	Green Building	A "Green" building is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life. Source: *World Green Building Council http://www.worldgbc.org/what-green-building*	Buildings and facilities that are constructed with materials that: Have no negative impact on human health; Have no negative impact on the environment; Have minimal heating loss; Contribute low levels of airborne waste; Are energy and resource efficient; and Potentially collect and utilize rain water and treat sewage. Source: *GDPolicy*
3.	Solid Waste	Solid waste is useless and sometimes hazardous material with low liquid content. Solid wastes include municipal garbage, industrial and commercial waste, sewage sludge, wastes resulting from agricultural and animal husbandry operations and other connected activities, demolition wastes and mining residues. Source: *Organisation for Economic Co-operation and Development, https://stats.oecd.org/glossary/detail.asp?ID=2508*	There is no definition of solid waste in Mongolia.
4.	Water Resource Management	Integrated Water Resources Management is a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment. Source: *Global Water Partnership https://www.gwp.org/en/GWP-CEE/about/why/what-is-iwrm/*	The "Water Management Plan" regulates activities to ensure the protection of water basins, the appropriate use of water and water replenishment. Source: *Law on Water, 3.1.16*

3.1. WATER RESOURCE MANAGEMENT

3.1.1. Total Water Resources in Mongolia

The total amount of surface water resource in Mongolia is 608 billion cubic meters, of which 70 % lies within 30 % of the total territory of Mongolia. This ultimately flow to either the Arctic Ocean, Pacific Ocean and/or some major Central Asian basins which include 17 rivers and lakes. Most of the rivers flow to neighboring countries[12].

Article 4.1 of the Law on Water of Mongolia states that "Water resources in the territory of Mongolia are strategic and valuable wealth".

Ground water resource terms

- ***Rechargeable groundwater resources*** is the quantity of water that could be added to groundwater annually from sources such as direct infiltration of rainfall or leakage from adjacent formations. "Rechargeable resources" and "natural resources" have the same meaning.
- ***Non-rechargeable groundwater resources*** is the ground water accumulation which cannot be recharged from infiltration of rainfall or leakage from adjacent formations. Non-rechargeable ground water could also be called pressed water.
- ***Potential groundwater resource*** to use means the quantity of water which can be exploited from rechargeable and non-rechargeable underground water resources.
- ***Groundwater utilization resource*** means underground water resources for use as defined by water exploration and assessment, calculated by detailed exploration work and examined and approved by an authority organization.

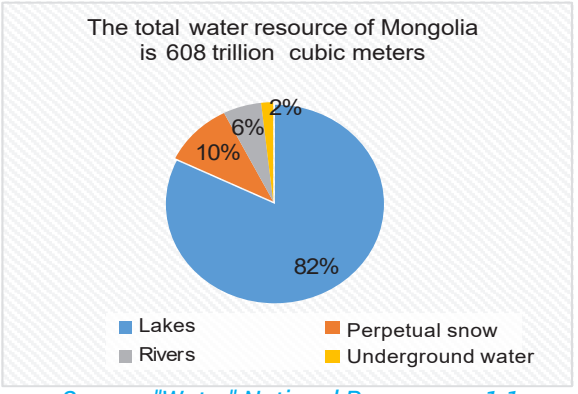
Source: https://www.eia.gov/tools/faqs/faq.php?id=82&t=11

Annual water consumption in Mongolia is 500 million cubic meters. Population Access to qualified drinking water differs among the population; daily consumption of water in apartments is 220 liters per person, while in the ger districts the average daily consumption is about 20-30 liters.

In the World Competitiveness Yearbook 2016, published by the International Institute for Management Development World Competitiveness Center, Mongolia ranked 59 out of 61 countries for its infrastructure indicators.[13] Mongolia is also ranked as one of the least competitive in terms of both "Water consumption intensity" and "Access to water". This reflects Mongolia's poor water infrastructure compared with other countries. As of 2010, about 76 % of the population was connected to a qualified drinking water source, while only 25 % of population is connected to both sewage and drinking water networks.

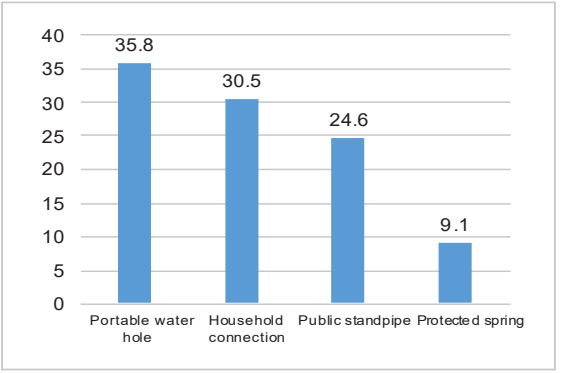
12 "Water" National Programme 1.1
13 World Competitiveness Yearbook 2016, published by the International Institute for Management Development (IMD) World Competitiveness Center

Figure 3: Water Resource of Mongolia



Source: "Water" National Programme 1.1

Figure 4: Percentage of Drinking Water



Source:"Water" National Programme 1.1

Why water saving must increase

Water consumption in Ulaanbaatar, a city of 1.4 million people, is increasing every year. According to the "Revision of Ulaanbaatar 2020 Master Plan and Development Approaches for 2030" document, water consumption demand in 2030 will be doubled compared with 2010 (Table 4).

Table 4: Ulaanbaatar City Water Consumption

Type of water consumption	Consumption of water in Tuul river basin*	GDPU **	GDPU ** / projection/	GDPU ** / projection/
	Year 2010, m^3/day	2010 m^3/day	2020 m^3/day	2030 m^3/day
Non-food sector consumption	132,123	168,600	261,000	321,700
Food production sector consumption	7.493	6,320	7,370	8,520
Population consumption	106,658	128,027	196,970	330,220
Total consumption	246,275	302,947	465,340	614,382
* Tuul River basin water resource management plan ** Revision of Ulaanbaatar 2020 Master Plan and Development Approaches for 2030				

Although 99% of Ulaanbaatar city's water is sourced from underground, Mongolia derives about 80 % of its water consumption from underground water. However, no tangible survey on underground water resources has been conducted since 1980. In 2015, a survey was conducted to determine Ulaanbaatar city water resources from centralized and non-centralized sources (see Table 5). Comparing water resources from 2015 to 1980, it was found that the main four resources declined by 27,860 m^3/day, while consumption of water by power plants increased by 10,095 m^3/day. The total quantity of resources declined by 58,472.6 m^3/day.

Table 5: Potential Underground Water Resources of Ulaanbaatar City

№	Source	Certified resource, m^3/day*	Total resource, m^3/day**	Quantity of extracted water by WMA m^3/day	Percentage compared with 2015 defined resource
1	Upper source	89,700	73,353.60	50,000-60,000	68.1%-81.7%
2	Central source	90,300	93,840.00	60,000-70,000	63.9%-74.5%
3	Meat plant source	8,800	8,018.62	10,000-12,000	124.7%-149.6%
4	Industrial source	30,300	16,027.20	18,000-21,000	112.3%-131%
5	Air field source	22,500	8,640.00		
6	Yarmag source	20,000	14,428.80		
7	Gachuurt source	25,200	3,924.00		
8	Power plant 2	59,500	4,795.20		
9	Power plant 3		33,868.80		
10	Power plant 4		30,931.20		
11	Other				
12	Total	346,300	287,827.4		
*Resources approved by Resolution #7 dated June, 20, 1980					
**resource determined in 2015					

Source: Report on the Re-assessment of Underground Water Resources of Centralized and Non-centralized Ulaanbaatar city Water Supply, 2015, volume 1.

As shown in the table above, Ulaanbaatar city water resources are facing some difficulty. Accordingly the Ulaanbaatar city Master Plan outlines that by 2030, 45% of total water demand will be met by grey water. In the Master Plan there are eight goals aimed at exploring new sources of water, to protect and to use surface water, and to ensure the reuse of water.

3.1.2. Legal Environment

The laws and legislations in Mongolia concerning water issues and usage are shown in the table below (see Table 6). Law on Water Pollution Fee aims to protect water from pollution, yet the law is not enforced because the procedure for the law's implementation is yet to be developed. Government Resolution #326 of 2013 sets out that the reuse of treated waste water shall be fully exempted from the water use fee and used water, sourced from rain and snow for livestock and land cultivation shall be 99% exempt from

the water resource use fee. Also, the Annex to Resolution #303 sets out those economic entities shall be exempted from income tax on the sale of equipment designed for the efficient use of natural resources, like equipment for waste water treatment.

Table 6: Overview of Some Laws Covering the Water Management

№	Law	Date adopted	Date amended	Goals and objectives
1	Law on Water	May 2012	17 August 2012	To regulate the protection of water resources and basins, as well as restoration. Significant changes were introduced in 2012, including the inclusion of a definition for water users and water consumers, and the regulation of their relations. "Water user" means individuals, entities and organizations using water, water basins and mineral springs for manufacturing and services for profit, while "Water consumer" means those using water for non-profit purposes - for drinking, domestic and household needs and for livestock, land and cultivation.
2	Law on Natural Resource Use Fee	17 May 2012	5 January 2015	To regulate the natural resource use fee, its allocation in the public budget, its financial statements, as well as the determination of an amount to be allocated for the purpose of environmental protection and rehabilitation from the income generated through the resource use fee.
3	Law on Prohibiting Mineral Exploration and Mining Operation at Headwater of Rivers, Protected Zones of Water Reservoirs and Forested Areas	16 July 2009	18 February 2015	To regulate the prohibition of mineral exploration and extraction near water sources protected areas, forests and also environmental rehabilitation in those areas.
4	Law on Water Pollution Fee	17 May 2012	-	To regulate the imposition of the water pollution fee on individuals, entities and organizations responsible for water pollution and the allocation of fees in the public budget. Law has yet to be enforced because the procedure to implement the law has not been approved.
5	Government Resolution on Fixing Water Resources Usage Fee	21 September 2013	-	The resolution has approved "Size of water resource use fee" and "Exemption of water resource use fee".
6	Approval of list: Government Resolution #303	23 August 2013		Sets out the procedure to create exemption on income tax for the sale of 41 products that are important in ensuring green development

Source: www.legalinfo.mn

3.1.3. Combining United Nations Goals with National Level Policy

The UN's Millennium Development Goals

The framework to ensure environmental sustainability contains two key goals relevant to the water sector. The following is the status of their implementation, as shown in the MDG report of 2013.

Target 15: Reduce the shrinking process of rivers and streams by protecting and rehabilitating their sources:

The target within the framework *"To ensure 80% protection and rehabilitation of water sources"* can be achieved with additional measures. *"To ensure 100% protected and rehabilitated water sources"* target was exceeded in 2012.

Table 7: Achievement of Millennium Development Goals Target 15

	2010	2011	2012	2013	2014	2015
Proportion of protected and rehabilitated water sources.	38,7	45,3	-	–	–	80
Number of protected and rehabilitated water sources.	631	812	1,100	–	–	1,000

Source: Achieving the MDG's, Fifth National Progress Report 2013

Target 16: Reduce the proportion of people without sustainable access to qualified drinking water and basic sanitation by 2015

Within the framework of Target 16, it was recommended that the *"Proportion of the population without access to qualified drinking water"* shall be reduced to 40% in 2015. This target was achieved at a national level, reaching 45% in 1990. This however dropped to 33% in 2000 and 27.4% in 2010, and the target could not be achieved in Khangai and the Western regions.

Table 8: Proportion of Population without Access to Qualified Drinking Water, by Region

Regions	2000	2005	2010
National level	33.8%	28.4%	27.4%
Western region	62.8%	47.8%	64.7%
Khangai region	57.5%	46.3%	48.2%
Central region	17.5%	35.3%	33.3%
Ulaanbaatar	7.5%	4.9%	3.3%

Source: NSO, www.1212.mn

Within Target 16 of the MDG, it was recommended that the *"Proportion of population without access to improved sanitation facilities will be reduced to 60% by 2015"*. This indicator at national level was 77.4% in 1990, 77% in 2000 and 76.8% in 2010 (Table 9). In

recent years the implementation of construction sector projects has intensified, and we consider the target could be achieved in the coming years.

Table 9: Percentage of Population without Access to Improved Sanitation Facilities

Regions	2000	2010
National	77.0%	76.7%
Western region	96.5%	95.5%
Khangai region	89.7%	91%
Central region	79%	79.7%
Ulaanbaatar	51.2%	62.1%

Source: NSO, www.1212.mn

Comprehensive National Development Strategy (CNDS)

Mongolia adopted its CNDS on 31 January 2008, to be implemented in two phases: 2007-2015 and 2015-2021. The following Table 10 shows water related issues in this long-term policy:

Table 10: Targets and Implementation of Water Related Issues in the CNDS

Strategic objectives	Implementation phases	Achievement in percentage
Strategic objective 5.2.1.4.4: To improve the water supply of land cultivation and pasture, and increase qualified drinking water for the rural population (Ministry of Food and Agriculture).	2007-2015	70
Strategic objective 6.3: To protect water resources against pollution and deficiency and to create conditions to supply the population with qualified water. To implement national "Water" National Programme (MEGDT).	2007-2021	70
Strategic objective 5.3.5.3 To ensure radical improvement in housing supply. To implement national "Housing" National Programme (MCUD).	2007-2021	90

Source: CNDS Implementation Report 2014

As projected in the CNDS, the "Water" National Programme was adopted on 20 May 2010. The programme will be implemented in two phases with the first phase (dynamic development) covering 2010-2015, and the second phase (sustainable development) covering 2016-2021.

Section 3.5 of the "Water" National Programme sets out several issues regarding the improvement of integrated management of water resources. On 30 November 2013 the "National Water resource integrated management plan" was approved in accordance with provision 3.5.2 that *"Mongolia shall develop an integrated water resource management system, determine potential water resources for use at high-demand rivers, and develop and implement a water management plan"*.

The implementation of the national Programme is facing difficulties due to financing problems. For example, Programme objective 3.4.1 "To carry out technical and technological renovation of sewage treatment facilities in aimag centers, cities and urban settlement and to improve its utilization and to meet standard demand" could not be achieved. There was also no substantial renovation at the Ulaanbaatar city central treatment facility during 2010-2015.

Table 11: Six Strategic Objectives of the "Water" National Programme

1.	To protect water resources, and to ensure all possibilities for its creation, keeping pure quality and natural replenishment;
2.	To establish water resources, and a quality monitoring and research network based on efficient, and advanced technology;
3.	To ensure storage of water resources for supplying the population with qualified drinking water meeting hygienic standards, improving industrial and agricultural water supply and ensuring sustainable development;
4.	To introduce advanced technology designed to ensure the appropriate use of water, to reuse treated waste water, and to take comprehensive measures to prevent flood danger, and to render all necessary support to these activities, and initiatives within the legal framework;
5.	To improve water resource and utilization management and to improve the legal environment, management, and organizational structure to regulate multi-sided relations and capacity building;
6.	6. To carry out promotional activities aimed at spreading scientific information, advanced technology blended with traditional ethics and morals on water resource protection and its appropriate utilization among young people and the entire population.

Green Development Policy

In 2013, information based on GDPolicy criteria was developed. Objectives for 2020 and 2030 will be achieved as shown in Table 12:

Table 12: Objectives Advanced Within GDPolicy Regarding the Water Sector

Criteria	2010 (percent)	2020 (percent)	2030 (percent)
Share of population with access to qualified drinking water.	76	80	90
Share of population with access to improved sanitation facilities.	26	40	60

Table 13: Issues to be Addressed Within GDPolicy Regarding Water Management Sector

3.2.1. Conserve nature, and balance in the ecosystem, by protecting at least 60% of water streams and spring water areas, and expanding protected areas by 25 to 30% by 2020 and 2030 respectively, and creating sustainable financing mechanisms;
3.2.9. Provide at least 60% of the population with access to qualified drinking water and 90% to improved sanitation facilities by increasing water supply, and sewerage capacity and productivity;
3.2.10. Limit the use of surface water for industrial purposes and promote the introduction of technologies for wastewater treatment that ensure waste water is treated to meet permissible standard levels for its reuse;
3.2.11. Promote research and development towards improving surface water restoration systems, as well as initiatives to store and use rain water, and projects creating river basins.
3.2.12. Reduce impacts from desertification, land degradation and drought by creating conditions to minimize human impacts on the environment through climate change and rapid economic growth;

Mongolia Sustainable Development Vision 2030

The present MSDV was adopted in 2016, taking into consideration the Millennium Development Goals, the adoption of the UN concept on sustainable development and the completion of first phase of the CNDS. With the MSDV's adoption, the CNDS expired.

The MSDV sets out the following two objectives within framework 4.3.1: *to improve integrated water resource management (IWRM) and to ensure sufficient access of population and industry.*

Target 1: Objectives advanced in *"Protecting water resources and preventing water shortages"* are shown below in Table 14. Additionally the target to construct at least two water reservoirs to accumulate surface water by 2016-2020 does not specify how many of them will be built in the following phases.

Table 14: MSDV Goal 4.3.1, Target 1

	2016-2020	2021-2025	2026-2030
Percentage of water resources and upper streams of rivers in protected area.	50	55	60
Percentage of areas with developed hydro geological, mid-scale mapping.	15	23	30

Target 2: *"To increase the accessibility of qualified drinking water and improved sanitation facilities".* Two objectives regarding Target 2 are shown in the following table.

Table 15: MSDV Goal 4.3.1, Target 2

	2016-2020	2021-2025	2026-2030
Share of population with access to qualified drinking water.	80	85	90
Share of population covered by improved sanitation facilities.	40	50	60

3.1.4. To Increase Economic Use of Water

Reasons to increase the economic use of water

- As shown in Table 5, although water consumption is going to double by 2030 compared with 2010, the current potential water resource has decreased by 58,4 м3/day compared with 1980.
- Mongolia is ranked 102 out of 166 countries regarding rechargeable water resources.[14]
- 70% of surface water resources are located in 30% of Mongolia's territory. And most rivers flow out to neighboring countries
- If the water demand of Ulaanbaatar city non-food industry was met by reusing treated water, the present demand for water consumption would be halved.

14 http://www.photius.com/rankings/2015/geography/total_renewable_water_resources_2015_0.html

- As of 2014, the ratio of pressed sold water by water authority is 85.3%.[15]
- Households living in apartments without meters consume 220 liters of water daily, while those with meters consume 160 liters daily. Out of 153 entities reviewed in 2014, only 69 had meters installed, and groundwater consumption of those households was 21 times more than surface water consumption.[16]
- There is a need to make a decision on the renovation of the central treatment facility and to stop sending waste water, polluted above the waste water standard by industrial enterprises, and to tighten the control over it. According to the Water Supply and Sewarage Authority 2014 Annual Report, the treatment level of waste water in Central wastewater treatment plant is 71%. Compared with the standard of waste water sent to treatment centers (or MNS4943:2011) the pollution level was higher than standard, which directly impacts on the treatment level.

The current legal environment offers entities that reuse water a 100% exemption from the water use fee. Further, eco-friendly equipment (covered in the list of Government Resolution #303 Annex) is exempt from tax. That list includes equipment for waste water treatment, which is a step to encourage the reuse of water. Some entities are reusing the water; however the use of grey water is not sufficient. There is therefore a need to introduce grey water for consumption by entities. The priority is to increase the number of water treatment facilities which will treat waste water up to the required standard. The price for sewage and clean water could subsequently be increased, which would facilitate economic leverage.

Use of surface water

Consumption of slow rechargeable groundwater has a negative impact on water resources and the ecosystem. Therefore, it is better to use surface water which is easily rechargeable and has comparatively more potential for use.

According to Government Resolution #326 of 2013, use of rain and snow accumulation water for livestock and land cultivation shall be 99% exempt from the water resource use fee. This is a form of encouraging the use of surface water.

In recent years, the quantity of water consumed in the Gobi region has increased. It will not be possible to meet the demand with groundwater. In addition, the groundwater used by big mining companies is more than 60 million years old, and the recharging process takes much longer. A solution to the water supply issue through improving water supply infrastructure and introducing an appropriate proportion of groundwater to surface water use is necessary. To find a solution to this problem, for many years projects such as “Orkhon-Gobi”, “Kherlen-Gobi and “Tuul-Songino” water resource complexes have been discussed.

If Mongolia could implement these projects, it would promote land cultivation and industry in the Gobi region. The Gobi region is rich in natural wealth, and compared with the Khangai region the warm season comes earlier and the cold season later, which is more suitable for land cultivation and livestock. The use of surface water is the main instrument for decreasing the consumption of groundwater.

15 http://www.usug.ub.gov.mn/index.php/about-us/tailan/113-2014
16 Report on Environmental Perspective, 2013-2014, MEGDT

Outcomes of the implementation of the above projects:

- Eco-balance of rivers will become sustainable.
- A solution will be found for water supply to cities situated in the Gobi region.
- Water supply for big projects, such as Oyu Tolgoi and Tavan Tolgoi will be improved.
- Improvement in watering will facilitate dynamic development of land cultivation and livestock.
- Hydro power plant will be built and renewable energies supply will increase

Conclusions

Ulaanbaatar city might face water shortage. Whilst water consumption is going to double by 2030 compared with 2010, the current potential water resource has been decreasing by 54,400 м3/day compared with 1980 (see Table 5).

Waste water treatment facilities have become the cause of river pollution. There is a need to address problems of aimag center and soum center treatment facilities. In particular, Tuul river pollution is very high from Songino to Altanbulag.

Economic entities which could use grey water are using underground water. There is a need to treat food industry waste water up to a standard level and use it in non-food industries, such as construction material industries and power plants. If this is achieved, Ulaanbaatar's water consumption could be halved.

Reduction of water pollution caused by waste and garbage. Leaving garbage in flood ditches and canals results in the pollution of river water once taken by rain or melted snow to rivers. Uncollected garbage along the banks of Tuul River is becoming another source of water pollution.

To enforce law implementation. For example, 1.1 of Article 24 of the Law on Water says that water user individuals and entities must "Have treatment facilities to treat their used waste water up to the standard" and 1.2 sets out the requirement to have technology to reuse of waste water and efficient use of water. However waste water flowing to the central treatment facility contains hazardous chemical substances and heavy metals, which have negative impacts on the quality of treated water

To approve and put into force a procedure ***for the implementation of the Law on Water Pollution Fee.*** The Law on Water Pollution Fee was adopted in 2012, yet the law is yet to be enforced due to the absence of procedure for its implementation.

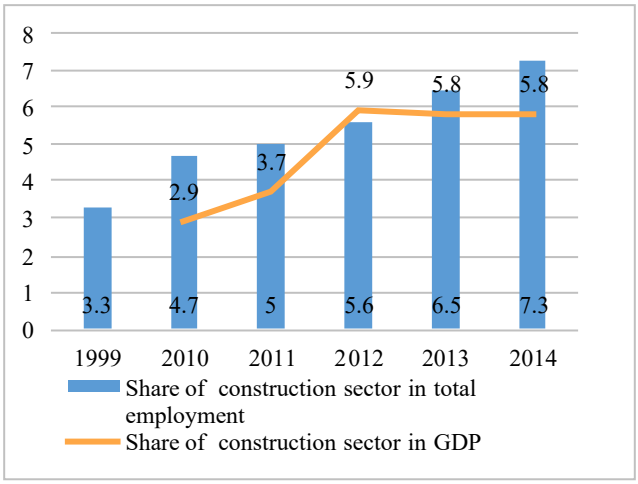
To introduce leverage for the use of grey water. The present water usage fee is not sufficient for economic entities and individuals to be interested in reuse and to economize water.

There is insufficient inclusion of targets for using grey water in national level policies. Targets for the promotion of grey water have been included in sectorial policies, yet targets and criteria for the increased use of grey water were not included in the national policy as objectives.

3.2. THE CONSTRUCTION SECTOR

3.2.1. GENERAL INFORMATION ABOUT THE CONSTRUCTION SECTOR

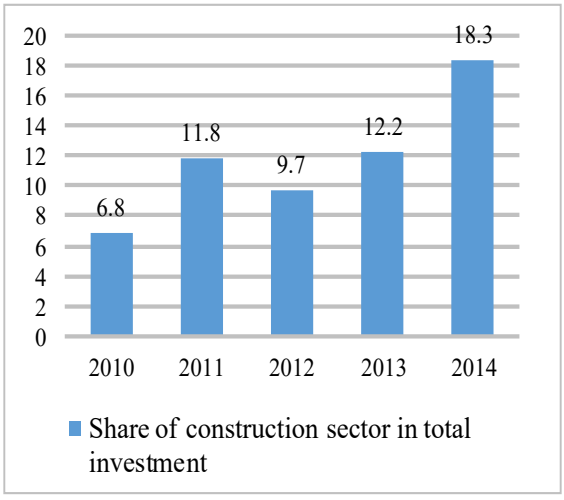
Figure 5: Share of Construction Sector in GDP and in Total Employment



Source: National Statistical Office

Today the construction sector has become one of the main economic sectors. By the end of 2014, the share of the construction sector in GDP was 5.8% and 7.3% of all employees (81,100 people) worked in the construction sector.

Figure 6: Share of Construction Sector in total Investment



Source: National Statistical Office

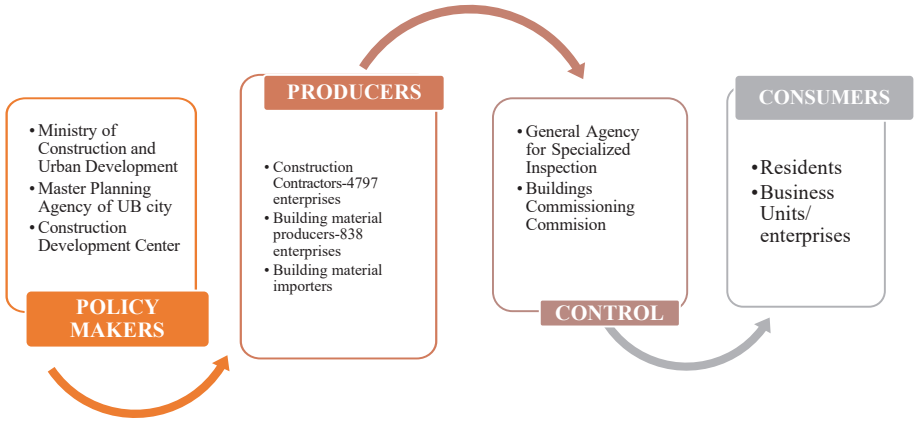
Although the role of the construction sector in the economy is increasing, 80% of construction materials are imported from China. There is a need to manufacture construction materials domestically to reduce currency outflow and to improve domestic production capacity. Investment in the construction sector has increased since 2012 and its share in overall investment is also increasing.

3.2.2. STRUCTURE OF THE CONSTRUCTION SECTOR

As of quarter one 2015, 60,515[17] organizations are conducting activities, of which 7.9% or 4,795 are engaged in the construction sector. The sector is divided into four groups:

- Policy developer or the relevant Ministry;
- Construction companies or developers;
- Construction supervising and
- Customers or citizens; entities.

Schema 1: Main Stakeholders of Construction Sector



Source: Self research by the research team, EPCRC

17 http://1212.mn/statHtml/statHtml.do

3.2.3. LEGAL ENVIRONMENT

There are about 20 pieces of legislation and about 1,000 normative documents in force in the construction sector today. Key legislations are shown in the following table:

Table 16: Overview of Key Legislations in the Construction Sector

№	Law	Date adopted	Latest amendment date	Goals and Objectives
1.	Law on Construction	5 February 2008	2 July 2015	The objective of this law is to regulate relations concerning the development of construction design, manufacturing of construction materials, executing construction works and technical supervising. Revised version of the Law on Construction: 11.1.7. To implement GDPolicy and green construction requirements: introduction of advanced technology, efficient planning of electricity, steam and water sources. Inclusion of these points in construction work principles and the legal support for green construction.
2.	Law on Urban Development	29 May 2008	26 November 2015	The objective of this law is to regulate relations of the state, economic entities, institutions and citizens, within the framework of the urban development policy of Mongolia, concerning issues such as population localization, settlement, and the creation of an appropriate development structure of comparatively independent development regions, and development of cities and dwellings according to the city development plan.
3.	Law on Housing	22 April 1997	23 January 2015	The objective of this law is to regulate relations concerning issues such as the definition of the mandate of state organizations, planning of housing, financing of activities for the development of housing, changing the purpose of public areas and operational issues of houses.

Source: www.legalinfo.mn

3.2.4. Sectorial Policy Documents, Projects and Programmes

The following table shows global and Mongolian policy goals related to construction sector.

Table 17: Construction Related Goals in Mongolian Long Term Policy

	Policy/ Goals	Date adopted	Target	Implementation process
1.	MDGs	UN-2001	**Target-17:** By 2015, improve housing conditions and increase the share of households living in apartments to 30%.	30.5% in urban area and 14% in rural area in 2010.[18]
2.	MDGs-based Comprehensive National Development Strategy (2008-2021)	Mongolian Government 2008	**Target 5.3.5:** To intensify urban development, on the basis of urban development, construction and development policy, and appropriate population localization and settlement. To upgrade construction and construction material production to the level of medium developed countries. To develop and implement the "Cities" National Programme. Strategic objective 3: To improve housing supply. To implement "Housing" National Programme: by 2021, to ensure housing to the majority of households, to introduce new technologies to the construction materials industry, to improve the production quality and introduce many types of products.	1. Innovative project to manufacture insulating material from Mongolian sheep wool. 2. To produce "WINTEX" insulation material using sheep and camel wool waste. 3. To improve technologies for manufacturing sheep wool insulating construction material up to ISO level. Norms, rules and standards were approved: 30 in 2000; 45 in 2009; 11 in 2010. 4. General regulation on mortgages was developed and approved in 2013 in collaboration with the Bank of Mongolia.
3.	Green Development Policy (2014-2030)	MET 2014	**Target 3.1.2:** To reduce building heat loss by 20% in 2020 and 30% in 2030 through the introduction of green solutions, energy efficient advanced technologies and standards such as a construction evaluation system, energy audit and implementation of incentive mechanisms.	Works such as the introduction of a green construction evaluation system, development of design for small green buildings in schools and kindergartens are in progress.
4.	Sustainable Development Goals (2015-2030)	UN-2015	**Target 11.1** By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.	

18 UN's Millennium Development Goals, National 5th report, Government, 2013

5.	Mongolia Sustainable Development Vision 2030 (2016-2030)	Mongolian Government 2016	**Target 6:** To develop an urban green development standard; to create infrastructure in line with the green development model; to introduce a redevelopment plan in Ulaanbaatar and in other cities; to reduce building heat loss by 20% (2016-2020); to ensure adaption of a standard and to reduce building heat loss by 25% (2021-2025); create a healthy, secure, comfortable environment according to international standards; and reduce building heat loss by 40% (2026-2030).	
6.	Coordination of policies		Works are in progress to manufacture construction materials with technologies friendly to human health and the environment. Construction material industries making buildings with less heat loss, based on domestic resources are in operation. At the same time, a policy to cover the majority of the population with housing is continuing. Judging the above, policy coordination is relatively good.	

1. State Policy on Housing

Objective: The state policy of Mongolia on housing focuses on the determination of roles and responsibilities for the housing sector in the market economy. It aims to increase housing infrastructure, to improve availability of housing and to allow for comfortable accommodations, that meet health and security requirements to be built.[19]

2. Midterm Targeted Programme "New Developments"

The Programme plans to build 100,000 homes with engineering and other social infrastructure facilities (schools, kindergartens, hospitals, vocational training centers, etc.). Of these 100,000 homes, 75,000 households are planned in Ulaanbaatar, and the remaining 25,000 are in rural areas. As of the reporting period, the Programme implementation is at about 65%[20].

3. Midterm Programme to stabilize the price of major goods and products – sub-programme to support the construction sector and stabilize the housing prices

This Programme was approved in 9 January 2013 on the basis of a mutual agreement between the Government of Mongolia and the Bank of Mongolia. The purpose of the Programme is to maintain stable housing and rental prices through ensuring the correlation of housing demand and supply, and by increasing the access to healthy, secure housing.

19 Housing Policy of the Government of Mongolia
20 Ministry of Construction and Urban Development, http://www.mcud.gov.mn/pages/251#sthash.cKjFJ2iG.dpuf

Within the framework of the sub-programme, in order to ensure sustainable domestic supply of major construction materials, loans were provided by commercial banks totaling 166.7 billion MNT for 68 companies, and 125.4 billion MNT to 55 companies for the purpose of importing necessary materials (cement, steel); with a total of 292.1 billion MNT financing.

4. Housing 8% interest rate loan

On the basis of Government Resolution #135, dated 13 April 2013 on housing of population, the government issued resolution #200 of 2013 which approved the procedure "Housing 8% interest rate loan". This is a procedure to provide a concessional loan at an annual rate of 8 (±1) percent for 20 years to citizens who sent their application to buy new flat of not more than 80 m2, or to buy flat in an old building where they have paid 10-30% of the total housing price. The loan is provided through commercial banks.

Since the implementation of the Programme, as of November 2015, the number of lenders reached 76,583 with loans totaling 3.4 trillion MNT.

The share of housing loans in GDP was 3.3% in 2006, which increased to 13.5% in 2015.

3.2.5. Transition of Construction Sector to Green Building Practices

As of the end of 2014, the share of construction sector in GDP was 5.8%. The sector constituted 7.3% of the total work force and the expectation is that this number will further increase. It is therefore important to ensure the green development of this sector, or to develop it in such a manner which will meet the requirements of modern city planning, incorporate green facilities and utilize natural resources effectively to create a comfortable environment for people to live.

There are several requirements to transition the construction sector into green construction. US construction firm McGraw-Hill suggested that green buildings could reduce energy consumption by 30-50%, carbon dioxide emissions by 35%, solid waste by 70% and water consumption by 40%.[21]

According to a study "Building Design and Construction: Forging Resource Efficiency and Sustainable Development" carried out by United Nations Environment Programme (UNEP) in 2012, 40% of global energy usage, 38% of global greenhouse gas emission, 12% of global portable water use and 40% of solid waste streams in developed countries account for buildings. However the construction sector has the greatest potential for resource and emission reductions at the least cost. It is possible to cut energy usage by 30-50%, greenhouse emissions by 35%, water usage by 40% and waste outputs by 70% according to a global analysis of the buildings sector (McGraw-Hill Construction, 2008).

21 UNEP "Building Design and Construction, Resource Efficiency and Sustainable Development " research

Table 18: Green Building Requirements at a National Level

№		Present consumption
1.	Solid waste from construction sector[22]	93,500 tons in 2014, which constitutes four percent of total solid waste.
2.	Building heat loss[23]	Additional insulation of already existing buildings will facilitate the reduction of coal consumption by 30%, and CO2 by 30%.
3.	Energy consumption	30% of total energy and 70% of electricity is consumed by the construction sector.
4.	Water consumption	The daily average water consumption of households is 20 times greater than consumption in the ger district.

These are the requirements for transitioning the construction sector to green buildings in Mongolia.

What is a green building?

Advantages of green buildings:

1. Efficient use of energy.
2. Less negative impact on the environment.
    - Less consumption of natural resources.
    - Less waste of construction materials.
3. Improvement of quality of life.
    - Less hazardous materials.
    - Good air quality.
    - Good external and internal environment.

International experience of green buildings

It is important for the state to create a legal and policy environment for the development of a sustainable model of investment, innovation, technology and construction business in order to implement the green building concept, to reduce greenhouse gas and to develop a sustainable construction sector. The private sector is more actively engaged in construction sector activities such as in the development of building designs, construction of buildings, manufacturing of construction materials and infrastructure management.

Many countries are using the following green building rating system:

22 UNEP "Building Design and Construction, Resource Efficiency and Sustainable Development " research Environment Database www.eic.mn

23 Inspections can reduce air pollution building heat loss , Mongolian Academy of Sciences, 2014

Table 19: Coverage of Green Building Rating System

Energy	x	x	x	x
Material		x	x	x
Inside air quality		x	x	x
Water			x	x
Management			x	x
Construction waste			x	x
Infrastructure - communication			x	x
Location ecology			x	x
Pollution			x	x
Innovation			x	x

Source: Building Energy Efficiency Project, "Green Building Rating System" report by B. Munkhbayar, MUST

Introduction of the LEED, or "Leadership in Energy and Environmental Design" green building rating system, which is used in the USA could be considered.

LEED rating system[24]

The priority planning of energy and environment, or LEED system is a rating system first introduced in 1998, that when compared with other like systems covers all issues related to construction.

Methodology of the rating system

LEED is a means to change the planning, construction, repair and use of houses and construction facilities. The system can be used for different purposes, including construction planning and assembly, interior design and installation, building exploitation and services, and for households. In essence it can be used in any type of building, and uses criteria and indicators, such as construction processes, materials, water economization, inside air quality, innovation and green infrastructure.

LEED uses a score system; acquiring a score of 40-49 which provides an ordinary certificate and 50-59, 60-79 and above 80 allow for silver, gold and platinum certificates respectively. A score below 40 shall be considered as not meeting the minimum requirements of green building.

Obtaining the certificate provides the possibility to enjoy a tax exemption of a certain percent, and to get concessional credit.

24 Mongolian Green Building Council

LEED certificates

Progress in the area of building heat loss reduction

Within the framework of the development and implementation of norms and regulations for the introduction of energy efficiency consumption in the construction sector and the construction of energy efficient buildings and facilities, the "Building Energy Efficiency Project" MON\09\301\ project was implemented during 2011-2014 by the Ministry of Construction and Urban Development in cooperation with the UNDP[25].

Within the framework of this project:

- New construction norms, regulations and standards were developed in order to ensure more effective energy consumption in old buildings with poor insulation, as well as in all new buildings and facilities.
- Measures were implemented to introduce the new system, technology and financing mechanisms for saving energy in houses and public building facilities that are to be built and for the construction of energy efficient buildings and facilities.
- Measures were undertaken to put additional insulation into buildings with greater heat loss
- When adopting international standards as a national standard, new standards were developed and approved in relation to ISO building heat protection and standards in the area of energy consumption and insulation materials, heating and cooling systems.
- To make heat protection norms clear, “Green House” labels were issued to energy efficient buildings.

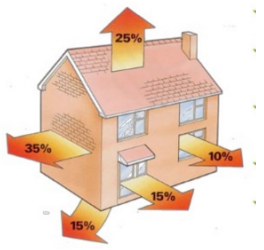
Classification of building heat loss

The parts of buildings with most heat loss are wall and roof.

25 Ministry of Construction and Urban Development

Table 20: Classification of Building Heat Loss

Heat loss parts	Share in total heat loss
Wall	35%
Roof	25%
Window	10%
Door	15%
Floor	15%



Source: Environment Protection Fund, Vegan Green NGO "Human Ecology Track Report" 2013

Table 21: Activities Conducted in Mongolia in the Field of Green Building

	Activities	Organization
1.	School and kindergarten green buildings	MEGDT jointly with the global green development organization prepares design of the "green kindergarten building", and "Green school building".
2.	Caritas Czech Republic's project "Supporting a Greener and More Energy Efficient Construction Industy in Mongolia"	"Green building practice" was officially included in the curriculum of the School of Civil Engineering and Architecture of MUST in September 2015 as a subject. Working jointly with the Ministry of Labour on the inclusion of "Green building practice" subject in the curriculum of vocational training centers of 21 aimags. 176 teachers of 11 Technical Vocational Education and Training Institutions were trained in teaching the methodology of "Green building practice". Project introduced to 500 engineers, and technical staff from about 50 enterprises. "Construction Development Center" NGO jointly with Green Construction Institute introduced the project to 210 engineers and staff. Auto lab light block with dry and wet ashes of power plant. Glue used for dry and ash based ingredients of construction work of power plant. Hollow block made with dry and wet ashes of power plant. New standard for construction materials with ash based ingredient is approved.
3.	Green Building Rating System	MEGDT, MCUD, Mongolia Green Building Council,
4.	Market survey to determine the possibility and demand for the introduction of a green development concept, environmental management package standard ISO 14000 to private sector.	MMCG - Mongolian Marketing Consulting Group

Conclusions

1. **Policy coordination is comparatively good, yet the implementation is unsatisfactory.**

   In the construction sector, goals and objectives reflected in national level policies are interrelated. For example, goals like "To ensure accessibility of population to housing without heat loss", "To reduce heat loss in old residential buildings" and "To produce domestic construction material with less heat loss" were included in policies. Sufficient policies have been developed, but their implementation is unsatisfactory.

2. **Lack of tax concessions or a credit incentives system.**

   Introduction of "Passive building" and a "Green building rating system" will create conditions for providing incentives and tax concessions to construction companies. Therefore if buildings are energy efficient, saving water and using grey water, companies that built those buildings will get recognition, and enjoy certain tax relief on their next construction.

3. **Shortage of green construction specialists.**

   Teaching "Green building practice" to construction engineers and at construction schools is an important step towards the preparation of national specialists. Empowering students with information on green construction will likely find its reflection in the future buildings.

4. **There is a need to increase the domestic production of construction materials with less heat loss.**

   GDPolicy and the long term sustainable development concept of Mongolia sets out targets to reduce building heat loss by 20% by 2020 and by 30% by 2030. In this direction, MAK (Mongolyn Alt Corporation) put into operation an aerated concrete plant, with capacity to supply 30% of domestic demand. Further, construction materials with less heat loss are being manufactured using sheep and camel wool. There is a need to increase the number of such factories.

5. **Green construction issues were included in the Law on Construction.**

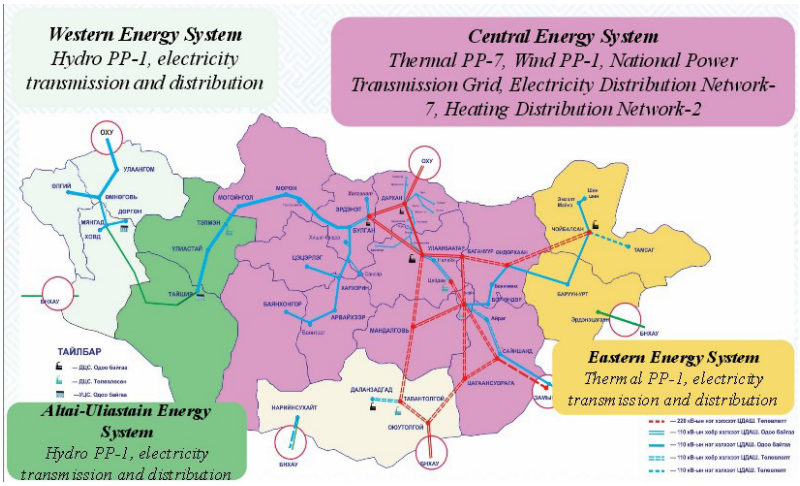
   Article 11.1.7 of the revised Law on Construction has a provision stating: "To implement GDPolicy and green construction requirements in construction activities: introduction of advanced technology, and effective planning to use of electricity, steam and water sources." There is a need to clarify in detail the meaning of "Effective planning".

3.3. ENERGY SECTOR

3.3.1. Present Situation of the Energy Sector of Mongolia

As of 2015, 314 soums out of 329 were connected to central energy systems with transmission lines, and the remaining 15 soums had access to renewable energy sources and imported electricity from Russia and China. Electricity supply is divided into four basic networks (AUES, EES, WES, CES), depending on the remoteness and infrastructure development. As of the end of 2014, the length of electricity transmission and distribution lines was 42,591 km and these employed 10,340 people in substations.

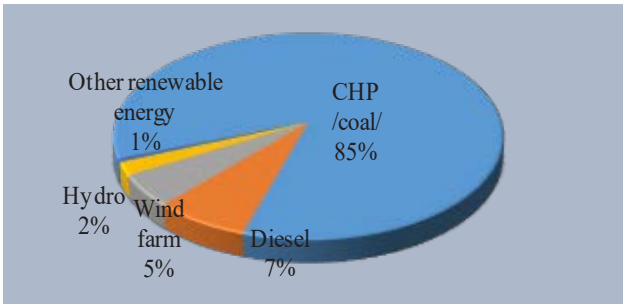
Image 1: Integrated Energy Network of Mongolia



Source: Current Situation and Future Planning of Mongolian Energy Sector, Gansukh Mygmar, MoE

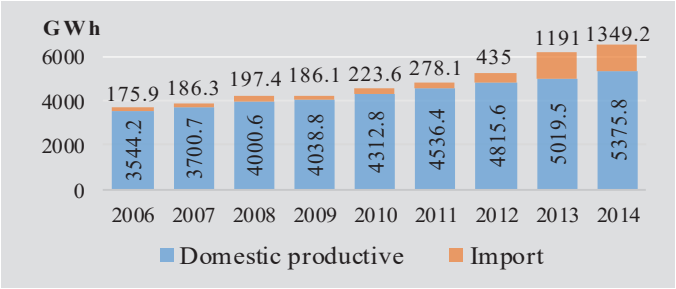
Article 3.2.1.5 of the "State Policy on Energy" says that regional energy systems will be connected with high capacity electrical transmission lines, and a further ***integrated energy system will be established.***

Figure 7: Installed Capacity of Electricity Production, by Sources[26]



Energy supply of Mongolia in 2014 was 6,725 million kWh, of which 80% or 5,375 million kWh was produced domestically and 20% or 1,349 million kWh was imported. Of these 28% of total imports or 396.98 million kWh was from Russia and 72% or 999.26 million kWh from China. Mongolia exported 30.3 million kWh to Russia[27].

Figure 8: Energy Production, Import and Total Supply



Average annual growth of electricity consumption at a national level is nine percent, and per capita electricity supply is 2,241 kWh. In cities and urban settlements, thermo energy production was 10,032,000 Gcal, and average growth of consumption was 3.6%.[28]

Production of energy is increasing, yet the consumption of energy is increasing more rapidly than production facilitated by the growth of imported energy. The installed capacity for electricity production at the national level is 1,082 MW. CHPS produce 85% of the total and these CHPS are located in cities and urban settlements.

26 Source: Annual Report of Energy Regulatory Commission, 2014
27 Ministry of Energy, 2015
28 Energy Regulatory Commission, 2015

Table 22: Coverage of Energy Network and Consumption

№	Integrated energy network	Aimag covered	Additional stations	Annual consump-tion	Peak hour load
1	Western Energy System	Uvs, Khovd, Bayan-Ulgii	Connected to Russian Krasnoyarsk energy system. 12 MW Durgen hydro power stations.	104 million kWh	31 MW
2	Central Energy System	14 aimags Khangai, Central and Southern regions	936 MW capacity UB CHP II, III, IV, Darkhan CHP, Erdenet CHP, Dalanzadgad, Ukhaa Hudag CHP, Salkhit wind power station, connected with Russian Buriat energy system with 220 kW high voltage transmission line.	4 billion MWh	960 MW
3	Easten Energy System	Dornod, Sukhbaatar	36 MW Dornod power station.	139 million kWh	31 MW
4	AUIN	Zavkhan, Gobi-Altai	11 MW Taishir power station, Uliastai and Esunbulag diesel station.	47.2 million MWh	15 MW

3.3.2. Legal Environment

While new energy sources are needed in order to meet increasing demand for energy consumption, it is necessary to estimate energy consumption with proper justification and to ensure effective and efficient consumption. Key legislation in force in the energy sector:

Table 23: Overview of the Laws in Energy Sector

No.	Legal document	Adopted date	Last amendment date	Goals and Objectives
1.	Law on Energy	1 February 2007	19 June 2006	To regulate relations concerning the production of energy using resources, control coordination of transmission, supply activities, construction of energy facilities and energy.
2.	Law on Energy Conservation	26 November 2015	26 November 2015	To regulate relations concerning energy saving and effective use.
3.	Law on Renewable Energy	7 January 2011	19 June 2015	To regulate relations concerning the production of energy by renewable sources and supply.
4.	Adoption of List: Government Resolution #303	23 August 2008		Resolution reflected income tax exemption for entities which traded 41 types of techniques and equipment of green development importance. List includes renewable energy equipment.

Source: www.legalinfo.mn

3.3.3. Inclusion in National and Sectorial Policies

Comprehensive National Development Strategy

Mongolia adopted the MDGs-based CNDS on 31 January 2008, which was implemented in two phases: 2007-2015 and 2015-2021. The following are the energy sector goals included in the long term policy:

Table 24: CNDS Long Term Policy Goals

Strategic objectives	Implementation phase	Implementation /in examined assessment/
Strategic objective 5.3.2.1. To establish "Integrated energy system" of Mongolia, to upgrade the energy sector efficiency level and to create favorable development. Energy sector will have the capacity to export energy: (Responsible: Ministry of Energy.)	2007-2015	70
Strategic objective 5.3.2.2. To improve electricity supply of soums, urban settlements for herders (Responsible: Ministry of Energy).	2007-2021	90
Strategic objective 5.3.3.1. To start gasification of coal and supply fuel to small-scale power stations (Responsible: Ministry of Mining).	2007-2015	30
Strategic objective 5.3.3.2. To set up coking-chemical and coal, energy and chemical industry complex (Responsible: Ministry of Mining).	2007-2015	10

Green Development Policy

The statistics of 2013 were used as baseline data to evaluate the GDPolicy and to define the criteria. Below are the objectives for 2020 and 2030:

3.1.1. Reduce greenhouse gas emissions in the energy sector, through increased energy efficiency by 20 percent in 2030, and by ensuring that the share of renewable energy used in total energy production is at 20 percent by 2020, and at 30 percent by 2030. This will be achieved by renewing energy production and other industrial technologies, by reducing excessive consumption and losses, and by the optimization of pricing policies.

3.1.2. Reduce building heat losses by 20 percent by 2020, and by 40 percent by 2030, through the introduction of green solutions such as energy efficient and advanced technologies and standards, green building rating systems and energy audits, and the implementation of incentive and leverage mechanisms.

Criteria	2020 (by %)	2030 (by %)
Share of renewable energy in installed capacity of energy	20	30

Mongolia Sustainable Development Vision 2030

The present long term development policy was adopted in 2016 following the expiration of CNDS. This contains two objectives regarding the energy sector.

- **Objective 1:** Ensure stable, reliable and full supply of energy domestically and export energy
- **Objective 2:** Increase the sare of renewable energy in the consumption of total energy and seef for new energy sources

	2016-2020	2021-2025	2026-2030
Objective 1. Percentage of energy to be supplied by domestic production	85	90	Will be 100% produced locally
Objective 2. Share of renewable energy in total energy production	20	25	30

Policy within the sector: In recent years, dynamic social and economic growth, the intensification of market relations, legal reforms in the investment environment and increasing interest from domestic and foreign investors in the energy sector have justified the improvement of the legal and policy framework in the energy sector. Changes and reforms carried out in 2015 include:

- State Policy on Energy - 19 June, 2015
- Amendment of "Law on Energy" – 19 June, 2015
- Law on Renewable Energy amendment – 19 June, 2015
- Law on Energy Conservation – 26 November, 2015

State Energy Policy (2015-2030)

The "State Policy on Energy" reviewed the present situation of energy sector, its challenges and opportunities, and defined six strategic objectives and 26 targets covering three priority areas. It is to be implemented in two phases, over 2015-2023 and 2024-2030. In article 3.2.6 of the policy, strategic objective 6 calls for an increase in renewable energy, and the reduction of the negative impact of traditional energy on the environment, and greenhouse gas emissions. The article asks:

- To define renewable resources of Mongolia, including solar, wind, water, geothermal and biomass, to create a database, to develop institutions to carry out surveys and research new machinery and technologies
- To increase the share of renewable energy in installed energy capacity to 20% by 2020 and 30% by 2030;
- To create a favorable legal and taxation environment in order to increase investment, and to introduce a financing mechanism to support renewable energy development;
- To use solar, wind, biomass, liquid and gas fuel, geothermal, fuel elements and other new sources to meet energy consumption of households, entities, remote dwellings and individuals.

- To reduce the negative impact of energy production, transmission and distribution activities on the environment;
- To improve monitoring on environmental impacts.

Chapter of the "Law on Energy Conservation" defines regulations of the relations within the law, and chapter two defines SGK, the mandate of national government, local government and other state organizations within the authority of state organizations in energy saving. Chapter three ("Rights and responsibilities of consumers") and chapter four specifically take up issues related to professional services for energy saving, and the final chapter deals with sanctions for violations of the law. Once the law is implemented, it will significantly improve energy effectiveness.

CLEAN DEVELOPMENT MECHANISM

One of the three mechanisms to facilitate the implementation of Kyoto Protocol is the Clean Development Mechanism. This mechanism does not impose concrete obligations on the reduction of greenhouse gas emissions in accordance with the Protocol (not in annex one of the Protocol). It is a mechanism to provide certified reduction of emissions units to projects on the basis of the measurement and certification of the greenhouse gas emission reduction. This regards projects implemented in developing countries, with units permitted to be used within the Protocol in countries with an obligation to reduce their greenhouse gas emissions, creating an environment for unit trading. The three requirements for countries to implement a clean development mechanism are:

a) They must have ratified the United Nations Conciliation Commission for Palestine (UNCCP)

b) Be party to the Kyoto Protocol, but not be a country of annex one

c) To have appointed an institution with authority to issue a Clean Development Mechanism (CDM) certificate.

Mongolia became party to the UNCCP in 1993, ratified the Kyoto Protocol in 1999 and is not party to annex one of the protocols. The National Bureau, affiliated with the Minister of Environment and Tourism in 2004 was charged with issuing CDM, creating the legal environment to implement CDM in Mongolia.

3.3.4. Renewable Energy

Global climate change, desertification and warming are having an impact on the economy, national security and daily life of the population. At an international level, the enforcement of a carbon tax (or tax on CO_2 emissions) has become a strategic advantage for Mongolia, which is rich in renewable energy sources. An amendment was introduced to the Law on Energy which enforced a tariff; the financing of the Egiin Gol HPP was resolved - positive changes are underway in the renewable energy sector.

Electricity produced from renewable energy sources is comparatively expensive; its 1 kWh price is higher than the electricity produced by power plants or that imported, and with the current currency exchange rate the price difference is widening. The price difference has not been substituted with any type of energy tariff however a "RE support tariff" of 4 MNT per 1 kWh has recently been introduced. Many countries have introduced a support tariff or green tariff structure within their renewable energy development policy.

Table 25: Price of Renewable Energy

	Wind	Solar	Water
In USD (article 11.1 of the Law on Renewable Energy)	0.08-0.095 USD	0.15-0.18 USD	0.045-0.06 USD
Converted to MNT (2016.12.28, Bank of Mongolia closing exchange rate 1USD=2,489.53MNT)	199.16-236.505 MNT	373.43-448.115 MNT	112.029-149.37 MNT

Four projects in Mongolia were registered through the clean development mechanism; one of them is the Salkhit WPS project. Two of the four projects are the Durgen and Taishir HPP, which sold their reduced greenhouse gas units to Japan[29].

Mongolia advanced a goal to supply electricity to soum centers far from the central energy system using solar and wind combined stations. Presently 11 hydropower stations, five solar and wind combined stations and eight solar power stations are in operation. One wind power station is being used for the supply of electricity to soums and bag centers.[30]

Figure 9: Production of Renewable Energy in Mongolia (MWh)

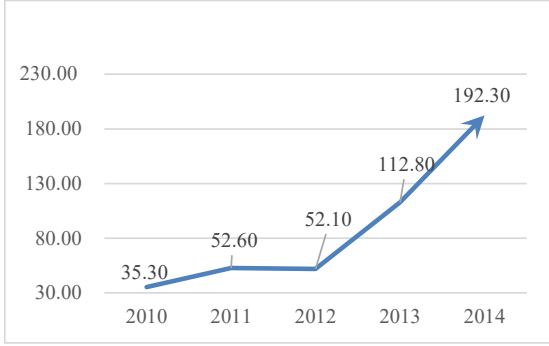
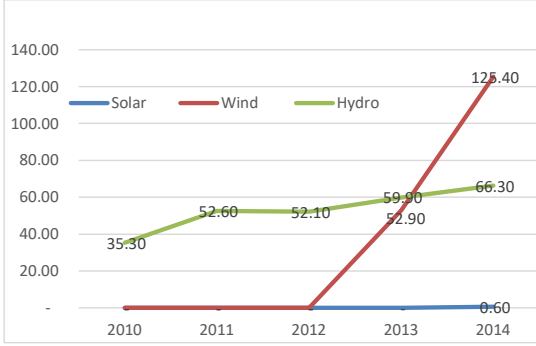


Figure 10: Production of Renewable Energy in Mongolia by type (million kWh)



The installed capacity of renewable energy production of Mongolia is 81.7 MW, of which hydropower accounts for 28 MW and solar and wind account for 53.7 MW.

29 http://www.newcom.mn/mn/media/news/222
30 Mongolian Government – Mid-term development strategy

Greenhouse gas is directly and indirectly linked with climate change, global warming, the ozone layer hole, air pollution and other environmental issues. In Mongolia, 65.4% of greenhouse gas is produced by the energy sector[31], and production of 1 kWh of electricity produces 520 grams of carbonic acid gas emission. Mongolia's power plants have been operating for 30-55 years and their chimneys have no filters; this has direct and harmful impact on the population, plants, animals, soil and water on the area around Ulaanbaatar. Furthermore, electricity usage, heat loss and coal consumption are all high in power plants.

Loans proposed for the purchase of electric heating devices

The Government of Mongolia issued Resolution N 214 on December 28, 2016 providing ger district residents with free electricity at night to fight the air pollution in Ulaanbaatar. The free night time electricity will be provided until April 1, 2017.

The Government is now proposing to provide citizens in the ger district with loans for the purchase of electric heating units, to be financed from the Green Credit Fund, as reported by Prime Minister J.Erdenebat to the National Security Council on January 10, 2017.

Currently 75 per cent of all household in ger districts or 110,800 have electrometers, which calculate consumption over different time periods. Payment for night time consumption has begun to be zeroed. The remaining 36,400 households need these electrometers.

During 2011 – 2014, about 130 – 140 billion MNT was spent on reducing air pollution.

Combining these activities with a programme that provides solar panels for households in the ger district would reduce emissions further. This would allow households use heating devices at affordable prices during the day without burning coal. Mongolia has a daytime energy shortage and is importing energy, yet at night time it is in overcapacity. Only through an efficient use of energy air pollution can be hastily reduced. However amendments to the Law on Renewable Energy are needed first.

Sources of Renewable Energy

Wind power stations - WPS

The Salkhit WPS is located 70 km from Ulaanbaatar, in Sergelen soum, Tuv aimag, and connected to the central energy system with a capacity of 49.6 MW. Salkhit WPS represents the first private sector initiated project which is an example of successful partnership between government and the private sector. Developers of the wind power station are Newcom LLC, General Electric LLC (USA), ERDB and Clean Energy LLC, which is financed by the Netherlands Development Finance Company. This wind power station has two 1.6 MW transmission lines, 28 km long, and each sub-station has a 1.6 KW capacity. 31 wind generators provide a total capacity of 49.6 KW and were constructed with a total investment of MNT 170 billion. The Salkhit project is the first wind power station project registered as part of the "Clean Development Mechanism". The plant

31 http://www.newcom.mn/mn/media/news/222

allows to reduce CO2 emissions by 180 thousand tons approximately every year, which is 6 times more than Durgen and Taishir hydropower plants.[32]

The second project developed by Clean Energy Asia LLC is the Tsogttsetsii wind park. Clean Energy Asia LLC together with its shareholders Newcom LLC and SB Energy Corporation signed a financing agreement with JICA and EBRD to construct a 50 MW wind park in Umnugobi, Tsogttsetsii sum. The launch of the operations is expected in December 2017.

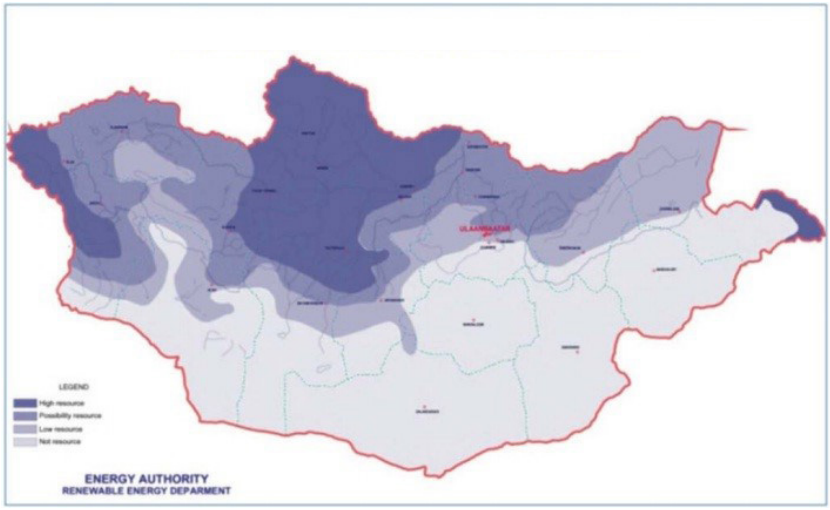
Projects to be implemented: ***Oyu Tolgoi wind power station project*** (with capacity of 50 MW), ***Choir wind power station project*** (50 MW capacity), ***Sainshand Wind Park*** (52 MW capacity) and several other projects are underway. There are also several moderate capacity wind turbines operating in rural areas. Herder families have installed approximately 4,000 wind micro systems to date.[33]

Another possible way to reduce emissions and counter the daytime power shortage would be for construction companies or corporations to build solar panels on the roofs of their buildings and sell the energy produced to the central grid.

Hydropower Plants - HPP

Mongolia has comparatively rich water resources for producing energy, but these are not fully utilized. According to the 1994 estimation of the Mongolian Water Policy Institution, it would be possible to produce 56.2 million kWh of electricity annually if 6,400 KW plants were installed on all rivers with 1 m^3/sec flow.

Image 2: Hydro Energy Resource of Mongolia



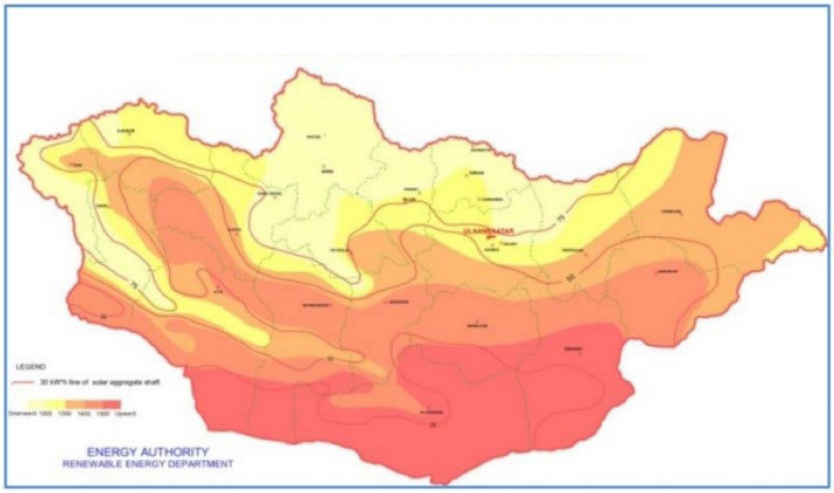
32 http://www.newcom.mn/mn/media/news/222
33 The Mongolian Government's draft investment for increasing renewable energy usage

As of today, hydropower stations produce 75 million KWh annually, which is equal to one percent of existing resources. Western Region Rivers constitute about 70% of Mongolian hydro energy resources. It would also be possible to erect hydropower stations at Onon and Kherlen Rivers in the Eastern region. At present there are 13 hydro power stations in Mongolia of which nine are operating. Three have large capacities and 10 have small capacities. Total capacity is 28 MW. Bigger HPPs are connected with the local electricity transmission network, while the smaller HPPs are connected with separate networks in remote soums. Two big HPPs (Taishir and Durgen) operate around the year, and the smaller ones operate only during the warm season. Several small capacity HPPs stopped operation due to equipment failure.

Solar Power Station - SPS

Mongolia has on average 270-300 sunny days annually and average sunlight hours of 2,250-3,300 per year, which indicates the possibility of SPSs in Mongolia.

Image 3: Solar Energy Resource of Mongolia



Sunlight period in central and northern parts of Mongolia is over 2600 hours annually; per km^2 solar energy per day is 4.5 KWH\m^2.

The "100,000 Solar Light Renewable Energy National Programme" provided100,000herder households in 15 soums with electricity through renewable energy. Within this Programme, remote soums, far from the centralized energy system, gained access to electricity. The Programme was a positive one, however there were risks to the environment as herders discarded used batteries in natural spaces.

Wind Station

At the global level, the capacity of wind power stations is over 360 GWh. China has become a leading country regarding the exploitation of WPS, contributing significantly to WPS development and has during the past five years managed to reduce wind turbine costs by about 30%, which has had a major impact on the increasing number of WPS in development.

Conclusions

Significant positive changes have occurred in the legal environment of the energy sector. The goal to improve the legal environment of energy sector saw an amendment introduced to the Law on Energy in 2015, which introduced regulations to ensure the coordination of infrastructure and customers, in connection with the use of coal layer methane and gas with high methane content. This created a legal condition for the use of natural gas. Further, the Law on Energy Conservation and the State Policy on Energy document adopted an amendment regarding renewable energy. The policy document defined three priorities: reliable supply, effectiveness and environment. Within each of these pillars, objectives have been set to be implemented in two phases, including an establishment of foundations for the development of RE by creating resources capacity in 2015-2023 and exporting of energy and ensuring sustainable development of RE in 2024-2030.

Energy sector loss declined. In order to implement SGK resolution #2 of 2015 "Some measures concerning the fuel and energy sectors", the Economic standing committee of SGK, the Ministry of Energy and the Energy Regulatory Commision jointly stated that 2015 be a year of increasing efficiency and decreasing cost and expenditure. As a result, the central energy system and Dornod region energy system worked without loss and reduced the size of accumulated credits and debits.

Implementation of small and medium programmes and projects represent more than 90%, while the implementation of bigger projects and programmes are about 5%. Reviewing the implementation of policies such as the "Energy Integrated System Programme", "National Programme on Renewable Energy" and "100 000 Solar Ger Programme", found that the implementation of projects of small and medium investment was over 90%, however implementation of projects and programmes requiring big investment were less than five percent. Projects defined in these Programmes as mega projects, like regional transmission lines, hydropower stations and power plants have not been implemented because of capital, financial and sectorial legal limitations.

The share of renewable energy in overall installed energy capacity is 7.5%. As of the end of 2014, installed green energy capacity was 81.7 MW, meaning that renewable energy produced about four percent of all consumed energy at the national level.

3.4. SOLID WASTE MANAGEMENT

3.4.1. Overview of Solid Waste in Ulaanbaatar City

Over the last four years, the amount of solid waste in Mongolia has increased by an average of 500,000 tons annually. There is a need to develop an independent and comprehensive solid waste policy, considering the increasing size of solid waste.

Table 26: Size of Solid Waste of Mongolia

Period	Number of garbage sites	Size of garbage sites, in hectares	Size of domestic solid waste, in hectares	Industrial solid waste, in tons	Total removed solid waste garbage at national level, in tons
2010	391	4,308.26	722,838.07	117,732.77	840,570.84
2011	402	11,768.37	990,592.03	207,420.10	1,198,012.13
2012	426	3,831.07	1,616,452.19	307,486.70	1,922,088.49
2013	371	3,831.46	1,977,739.02	348,085.63	2,325,824.66
2014	389	4,867.80	2,083,898.34	347,070.46	2,430,968.80

Source: Environmental Statistics Database, MEGDT, 2016

There are three centralized garbage sites in Ulaanbaatar: Tsagaan Davaa, Morin Davaa and Naran Slope/Ulaan Chuluut.

About 400,000 tons of waste garbage is deposited at the Naran Slope site annually, of which 20% is made of plastic items. That figure includes only waste and garbage transported to dump sites, not to recycling facilities.

At a local level, in 2014, about 55% of total solid waste was generated in 21 aimags, of which the greater part came from Orkhon and Dornogobi aimags. Khentii and Bayan-Ulgi aimags produced the least waste[34].

Recycling of solid waste at the national level was 356 tons in 2008 and about 2,000 tons in 2014 a six-fold increase. The amount of recycling in Umnugobi, Orkhon and Selenge aimags contributed greatly to the proportion of recycling nationwide. At aimag and local levels, recycling is carried out intensively, making it one of the important environmentally friendly activities, directed towards the promotion of a green economy.

Table 27: Recycling of Paper and Paper Products

Period	Paper, paper products waste at national level - tons	Recycling at national level - percentage	UB city paper, paper product waste - tons	UB city recycling - percentage
2013	168,849	0.013	157,995	0
2014	91,340	0.023	77,000	0
2015	118,906	0.006	114,273	0

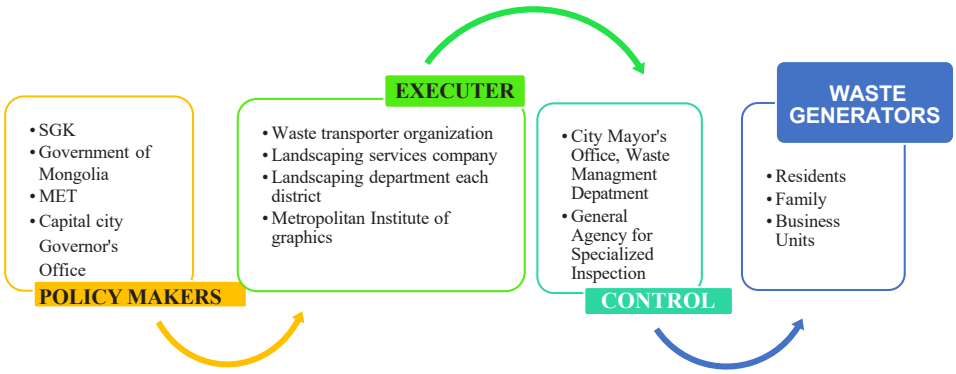
Source: Environnemental Statistic Database, MEGDT, 2016

34 Ministry of Environment and Green Development of Mongolia, www.eic.mn , 2016

The above table shows that at the national level, a very small portion of paper and paper products were recycled. In addition, paper and paper product waste in Ulaanbaatar was 157,995 tons in 2013 and 77,000 tons in 2014, which is higher than in aimags and local places.

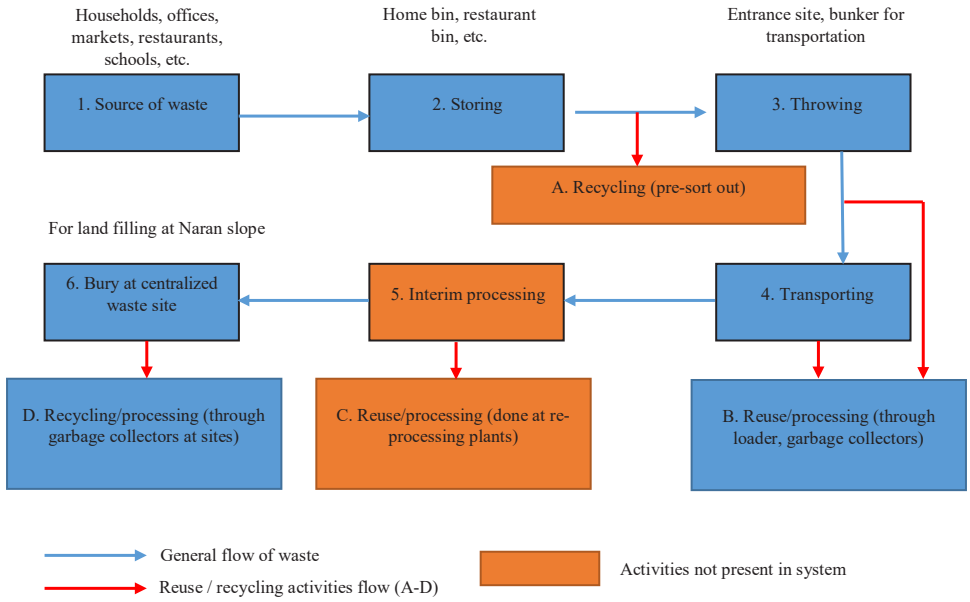
3.4.2. Structure of Solid Waste Management

Schema 2: Stakeholders of Ulaanbaatar City Solid Waste Sector



Source: Self research by the research team, EPCRC

Schema 3: Flow of Ulaanbaatar City Solid Waste Management



Source: Capacity Building Project in UB City Solid Waste Management

Not only in the capital city but also at a national level, the pre-sorting and interim processing stages shown above have not been implemented satisfactorily. Waste is transported to waste sites without sorting and is buried in landfills, which has a negative impact on soil quality, and causes environmental degradation.

3.4.3. Legal Environment

There are about 20 pieces of legislation in force, and four of them are shown below:

Table 28: Objectives of Key Legislations Related to Waste Management

№	Law	Adoption date	Latest amendment date	Goal, objective
1	Law on Waste	21 June 2012		To regulate relations concerning the eradication of hazards, their impact on human health and the environment, as well as reducing, sorting, collecting, transporting, storing, recycling, reusing, destroying, exporting and importing and imposing prohibition on transborder transportation in order to prevent negative impacts.
2	Law on Air	21 June 2012	13 November 2015	To regulate relations protecting air against pollution, prevention and reduction of substances, and monitoring.
3	Law on Hygiene		4 February 2016	To regulate relations concerning the creation of favorable health and secure conditions, prevention of negative impacts, their reduction and elimination.
4	Law on Environmental Protection	5 June 1995	8 July 2015	To ensure rights to live healthily and in a secure environment, to coordinate socioeconomic development with ecological balance, to protect the environment for the sake of present and future generations, and to appropriately use and rehabilitate natural wealth.

Source: www.legalinfo.mn

3.4.4. Policy Documents Projects and Programmes

Some national level policies and programmes which include issues of waste management are detailed below:

Table 29: National Level Policies Regarding Waste Management

№	Policy	Approved date	Objectives	Implementation
1.	Comprehensive National Development Strategy (2008-2021)	2008	Measure 4.5.4.10: access to qualified drinking water; improved hygiene; creation of healthy environment, including management of chemical, industrial and domestic waste	- Recommendations on "Nano structured hospital waste management and risk management" was developed. - "Procedure to sort, transport and destroy" waste from medical institutions. Revised Health Minister's resolution 158 on the provision concerning liquid chemical waste and other wastes. - "Contract was concluded to establish recycling center for hospital waste between Health Ministry and Ulaanbaatar city General Manager in September 2014 and valid for 20 years.
			Strategy objective 6.1. To limit and stop environmental pollution and degradation.	- Working group to develop "National Programme to Improve Waste Management" was established and approved by State Secretary order #A-258 of 2014 and Government Resolution #298 of 18 September 2014 - "Procedure to Create Waste Database, Information Service" was established and approved by Minister of MET, order #A-115 of 9 April 2014, and the procedure is registered in national integrated registration at 3451.
2.	Green Development Policy (2014-2030)	2014	Waste recycling proportion, percentage	2020 - 20% 2030 - 40%
3.	Sustainable Development Goals (2015-2030)	2015	Target 12.5: To ensure significant reduction in the amount of waste through preventing waste, recycling and reuse by 2030.	
4.	Mongolia Sustainable Development Vision 2030	2016	Target 2: To improve planning of city and dwelling green facilities, to improve waste management.	Phase 1 (2016-2020): to make the share of green facilities 15% of total city green facilities, to make recycling 20% of total waste. Phase 2 (2021-2025): to make the share of green facilities 25% of total city green facilities, to make recycling 30% of total waste. Phase 3 (2026-2030): to make the share of green facilities 30% of total city green facilities, to make recycling 40% of total waste.

1. Project to Build Green part of Comprehensive Solution: 2015

Ulaanbaatar city's "ECO Park" project is underway according to the action plan for 2013-2016. This project will integrate recycling plants operating in Ulaanbaatar city.

The draft contract to implement the project has been approved. Surveys were consolidated and 39 projects totaling MNT 236 billion from 32 economic entities have been registered.

2. National Programme to Improve Waste Management

The "National Programme to Improve Waste Management" was approved on 18 September 2014 by Government resolution.

The Programme implementation is divided in two phases: phase one covering 2014-2017 and phase two 2018-2022.

Programme mission:

2.1. To form appropriate management of solid waste and to create a clean, healthy environment through the promotion of an effective and efficient use of resources and technology to reduce waste; to ensure transportation of low negative impact on the environment; to increase hygiene awareness amongst the population; to introduce proper behaviors and living habits.

2.2. Activities that will be carried out to ensure the implementation of the Programme:

2.2.1. To introduce an improved legal environment management, to ensure its implementation and to create accountability, and incentive-based system;

2.2.2. To reduce waste volumes through increased manufacturing effectiveness, reduction of resource and raw material consumption and resultant savings, to promote advanced technology free of waste, and to create an appropriate waste management and supervising system;

2.2.3. To improve the management of hazardous waste, to create capacity for safe transportation and to prevent the accumulation of hazardous waste;

2.2.4. To create favorable conditions to live through the improvement of green consumption culture, to shape proper habits to sort out waste and appropriate hygiene;

2.2.5. To reduce the volume of waste buried through the production of value-added products by recycling, reusing, or turning waste into a source of energy.

3. Technical assistance project on capacity building of Ulaanbaatar city solid waste management

Within the "Improvement of Ulaanbaatar City Waste Management" project 2006-2010 (implemented by JICA and funded by the Government of Japan), a centralized waste burning site was established at Narangiin Enger in Songino Khairhan district which also put into operation new garbage trucks. Implementation of this project provided a new step forward in the waste management system.

Several useful activities were carried out as part of the project. Sorting transportation was organized in 7th Khoroo of Sukhbaatar district, waste management training and seminars were held for aimags of the Central region, and training was held for an electric system of waste transporting vehicles.

3.4.5. Improvement of Solid Waste Management

What is waste management?

"Waste" has been defined in the following ways:

- *Materials of no economic value, which are generated in the process of production (Shell WMG 1989).*
- *Substances or things removed or to be removed or to be thrown out in accordance to legislation provisions (Basel convention).*
- *Materials to be removed which are not for manufacturers nor be used in further production (UN).*
- *Goods which are not suitable to use or with no value or need (World Bank dictionary).*

As for "Waste Management" we first of all think of how to remove our waste. In fact, "Waste Management" is how to manufacture and service without loss, avoid wasting of time, and prevent against useless actions. It is both the reduction or waste, and the efficient use of resources.

It is necessary to define waste according to type, source, size and volume.

When determining the nature of waste, what kind of management approach should be applied to determine the level of hazards?

There are number of methods to determine the nature of waste: sectorial, national, transnational companies, national and international organizations, the UN and others.

Source: http://www.mongolchamber.mn/index.php/home-page/home/2012-08-27-08-29-56/1733-2013-01-23-161752

According to international survey findings, the bulk of solid waste is easily loosened, and the remaining small percent is paper, metal, glass, plastic, rubber, fur, ceramic, dust, stone, briquette fuel, ash, wood, grass and livestock waste.

As reflected in the Green Development Policy:

3.1.8. Promote the production applies resource efficient and low waste technologies in the mineral resources sector.

3.6.4. Reduce solid waste in landfills by 20% by 2020 and by 40% by 2030, by recycling, reusing wastes and producing value added products, and establishing proper waste-reduction management practices through the promotion of efficient technology, provision of practical knowledge on maintaining healthy environment and lifestyles.

Criteria	2020 (percent)	2030 (percent)
Percentage of waste recycling	20	40

Requirement to improve waste management

- As of 2014, 2.4 million tons of solid waste are being generated annually, of which over one million tons were from Ulaanbaatar.[35] In Ulaanbaatar, 246 tons of waste is thrown at undesignated places daily [36], which equals to 89,790 tons annually. This figure is increasing by 30% annually, and if this trend continues, it will stand in the way of Mongolia's green economy development.
- Ulaanbaatar Narangiin Enger garbage site receives an average of 400,000 tons of waste annually, of which 20% is plastic waste. The remaining 80% could be recycled.
- As of 2009, cities and dwellings occupy 24,174.5 hectares and 32%, or 7,735.9 hectares of land is occupied by ger districts. This area's solid, liquid waste as well as smoke has a high chance of causing ravine damage, soil surface erosion, pollution of rivers and also contamination of drinking water. Annual solid waste produced in Ulaanbaatar city is on average about 260,000-280,000 tons, of which 40,000-50,000 tons are removed and transported to garbage sites and the rest is accumulated in ravines, flood dams and river basins near ger districts, polluting soil and water, and increasing the risk of flood.[37]
- There are 76 hide processing plants, 314 auto repairing workshops (including tire repair, lubrication changing shops), 174 gasoline stations, 21 oil storage sites, 19 brick plants and 32 construction stone preparation sites in Ulaanbaatar city, which are generating extremely harmful wastes for soil.[38] These numbers change every year, and cause negative impacts on the environment. Careful actions aimed at preserving the environment should be taken.

35 Ministry of Environment, Green Development and Toursim of Mongolia, 2015
36 National Programme to Improve Waste Management', 1st Appendix
37 The General Development Plan of Ulaanbaatar city until 2020, Documentary on Development Tendencies until 2030, iv
38 Human Development Report, 2011, UN

Conclusions

1. **Legislation lacks definitions and terms for waste.**

   The revised Law on Waste of 2012 contains definitions of waste types and terms and also information on how to discard waste and manage land filling, but there is no definition of solid waste nor its classification or types. In general there is no common understanding of solid waste management.

2. **State support for the plants.**

   It is imperative for the state to render support for industries and plants engaged in the pre-removal sorting of waste, and interim processing of waste, which are important for improving management in different stages of the waste flow.

3. **Increasing recycling of paper waste.**

   Paper waste in 2015 in Mongolia amounted to 118,906 tons, of which 7.5 tons were recycled and the rest was dumped without any further usage or actions. Recycling paper could save trees, which is one of the basis for promoting green economy.

4. **The volume of waste is increasing on average by 30% annually.**

   In recent years the volume of solid waste in Mongolia has increased annually by 30%, reaching 2.4 million tons in 2014. This indicator could be considered in connection with development speed, increasing human consumption and the growth of national revenue. In other words, it shows the necessity to develop policies that take close consideration of environmental pollution issues, along with basic principles for protecting a healthy and clean environment.

4. FROM A BROWN ECONOMY TO A GREEN ECONOMY

After the global financial crisis in 2008, a report by UNEP in 2009 (Barbier, 2010) called for a Global Green New Deal to be made. At a visionary level (UNEP 2011), a green economy is seen as "An economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities".

At an operational level, a green economy is seen as one where growth is driven by investments that:

- reduce carbon emissions;
- enhance energy and resource efficiency; and
- prevent the loss of biodiversity and ecosystem services.

Mongolia's heavy reliance on coal makes it especially necessary to look at all the benefits of a transition to a greener economy. There are about 750,000 or about 25% of the population living in "Gers" burning about 5 tons of coal per winter per household, just in Ulaanbaatar city. This is the main factor explaining the thick layer of smoke around the city every winter. Additionally, traffic decreases air quality to hazardous levels during rush hours.

According to 2016 data from the International Energy Agency, Mongolia ranks fifth to bottom out of 140 countries regarding GDP Intensity stressing further the need to prioritize and emphasize green investment, particularly in the energy sector[39].

4.1. INTRODUCTION OF THE T21 MODEL USER VERSION

Threshold 21 (T21) is a dynamic simulation tool designed to support comprehensive, integrated long-term development planning released by the Millennium Institute. T21 integrates economic, social, and environmental factors in its analysis, thereby providing insight into the potential impacts of development policies across a wide range of sectors, and revealing how different strategies interact to achieve desired goals and objectives. T21 is the result of more than 20 years of extensive research and application carried out in consultation with the World Bank, UN agencies, developing country governments, and nongovernmental organizations.[40] Over 30 customized T21 models have been created to this date and are used by NGOs as well as governments all around the world.

The T21 model can be customized for country specifics. In the case of Mongolia, additions have been made to the base modules, to take into account the significant share of mineral revenue and profit of total exports and GDP as well as the prices of those minerals amongst other things.

All the fundamental explanatory variables, their interactions and relationships, effects and calculations are well documented within the software to guarantee transparency. The

39 "CO_2 Emissions from Fuel Combustion" IEA, 2016
40 "T21 Brief General" of the Millennium Institute

assumptions of the modules are clearly stated to maximize confidence in the model.

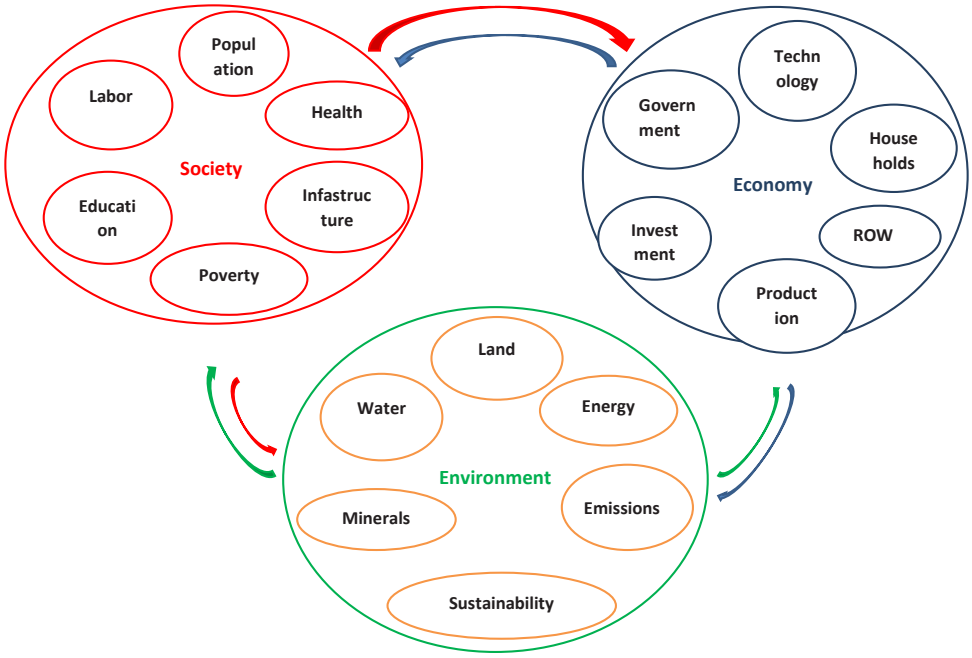
The latest version of the T21 Model for Mongolia starts with simulation in 2014 and simulates until the year 2030 to compare the results with the green economy policy targets. Historical trends from 1995 until 2013 were used to ensure the correct replication of characteristics of the behavior of sectors and modules in the model. The next chapter will show a brief description of the sectors, sub-sectors and modules.

The version of T21 used in this report was the User Version of the T21 model where the fundamental relations and equations between variables cannot be altered.

Structure of the T21 Model

The Model is segmented into three different sectors with sub-sectors as shown below:

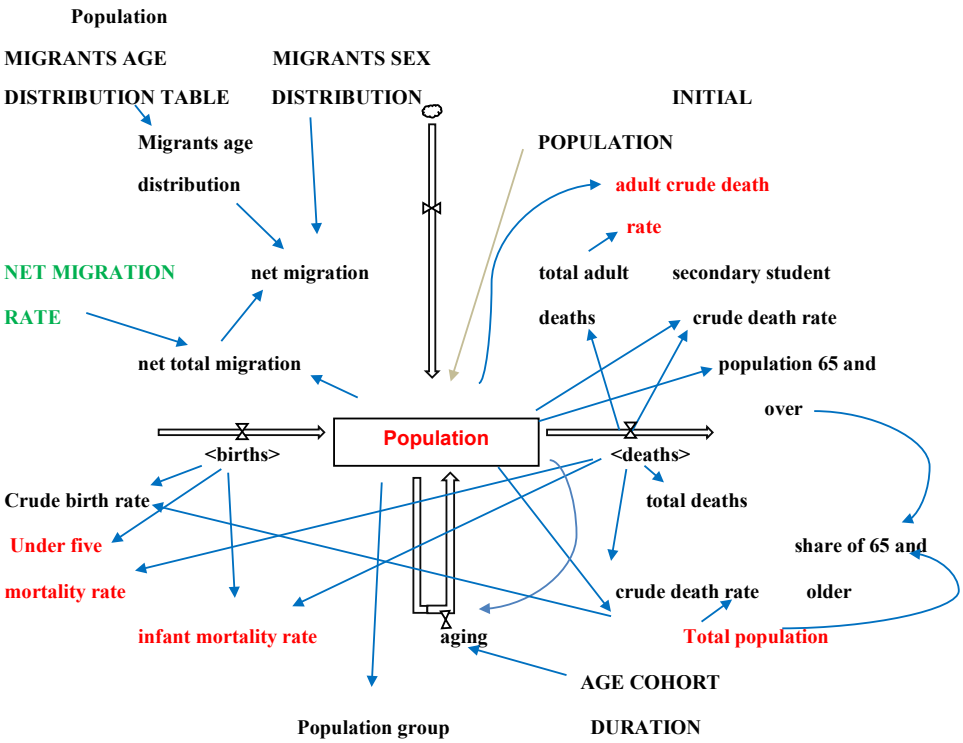
Figure 11: The Three Sectors of the T21 Base Model



In the case of Mongolia, the T21 model was customized using the help and input of the Ministry of Finance, Ministry of Environment, Green Development and Tourism and UNITAR as well as UNEP to reflect important business sectors and specific details as well as important fundamentals of the Mongolian economy such as the vast mineral resources, taxation on mining products, the two biggest mines and their production capacities, the unique "Ger housing", amongst other variables. A full list of additions to the T21 Model for Mongolia is to be found in Appendix I.

Sub-sectors are interconnected and influence other sub-sectors, as shown in this example:

Figure 12: Example of the Underlying Connections Between Sub-Sectors and Modules



4.2. SCENARIO DEFINITIONS

Scenarios made utilizing the T21 Threshold model were focused on analyzing the impacts of green economy investments in four of the selected sectors: construction, waste management, energy and water management. The modelling addresses the sources of financing only to the extent with the share of green economy investments from domestic sources were assumed to be 30%, with the remainder to be financed from foreign sources. The share of GE investment as a share of GDP is then allocated to different sectors in the green economy. There is no disaggregation at provincial or city levels.

This work is based on the comparative analysis of green targets and of sensitivity analysis.

The share of GE investment in the model for each sector are further allocated as follows:

- **Energy:** Of the 70% investments in renewable energy, it was assumed that 40% were invested in wind and solar and the remaining 20% were invested in hydro.
- **Water:** Of the 10% investment in water management, 40% is allocated for the recycling of water with the rest being allocated to each region for drinking and sanitation based on population shares. The share of investment in recycling in the capital Ulaanbaatar City is 60%.
- **Waste:** Solid waste share of GE investment was assumed in baseline to be 10%, half of which was to be made in Ulaanbaatar City.

- **Construction:** Housing renovation share of GE investment in baseline was assumed to be 10% as well, of which 70% was to be made in Ulaanbaatar City.

Table 30: Allocation of GE Investment

Sector	Share of GE investment
Energy	70%
Water management	10%
Waste management	10%
Construction	10%

The T21 Model for Mongolia included an explanatory variable for an improved stove Programme. However, it was proven to be inefficient and in all scenarios was not considered as an input variable. Like in the case of the relative small share of geothermal energy which was not considered in any case as well. The model also has a variable for the construction of a fifth thermal power plant (CHP5) that was not considered either.

The exploitable power and capacity factors of renewables is shown in the following table:

Table 31: Exploitation and Capacity Factors of Green Energy Sources

Energy Source	Exploitable Power in MW	Capacity Factors
Wind	800	0.25
Solar	400	0.14
Hydro	800	0.40

A sensitivity analysis was defined to explore the results of green investments (GE) as a share of GDP. The sensitivity analysis included 5 scenarios with a gradual increase in GE investments as share of GDP starting in the year 2017. In the years 2017, 2018 and 2019, we assumed the share of GE investments from GDP for all scenarios to be 0.5%, 1,0% and 1.5% respectively. In addition to the GE sensitivity analysis, simulations for three scenarios of minerals price developments were made, to reflect the dependence on mineral exports in the Mongolian economy. The three mineral price outlooks include one that is pessimistic, one with an optimistic price development and one in between. The entire simulation is based on the value of MNT in 2005.

The sensitivity analysis and its 5 scenarios reflect a gradual increase in green investment as share of GDP from 2% to 4% in 0.5% increments starting in the year 2020.

Mineral Price Variations & Estimations

Because of the significant impact of mineral prices on GDP and thus their impact on the share of GE investments, as mentioned before, we considered four different mineral prices for the following explanatory minerals variables that were custom built for the T21 Model of Mongolia:

- Gold
- Coal
- Iron Ore
- Copper

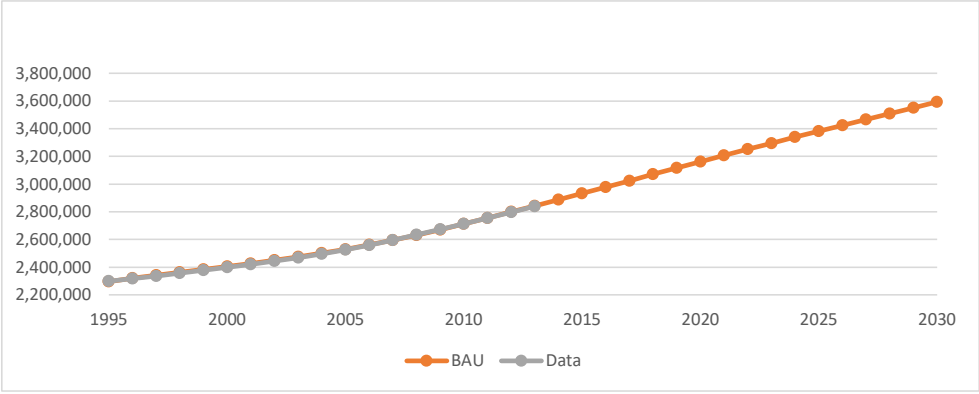
The results of the green economy investment scenarios were mostly not affected by the variation in mineral prices to the extent that one could see the difference in a graph, thus we only will show the average price scenario between the pessimistic and optimistic one.

To see complete mineral price estimates, please refer to Appendix 2.

4.3. HISTORICAL COMPARISON WITH BUSINESS AS USUAL SCENARIO

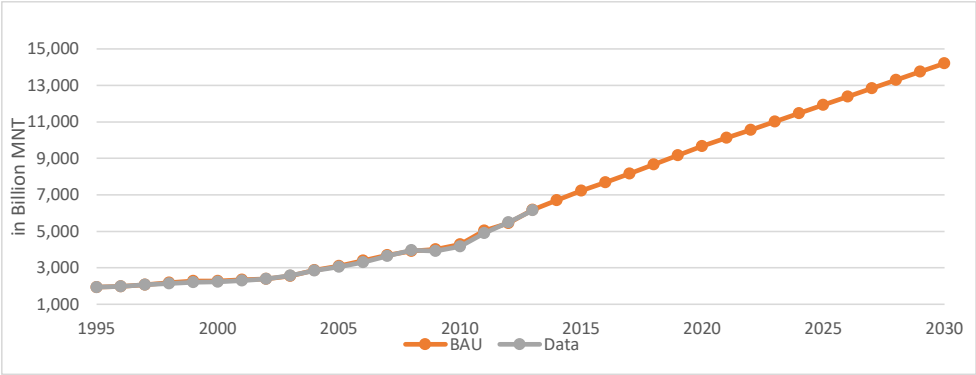
The Business as Usual scenario (BAU) refers to the scenario where no additional actions on green investment is taken and no additional green policies are introduced or implemented. The following graphs will illustrate how the BAU simulation accurately compares to historical data.

Figure 13: Comparing Total Population with Historical Data



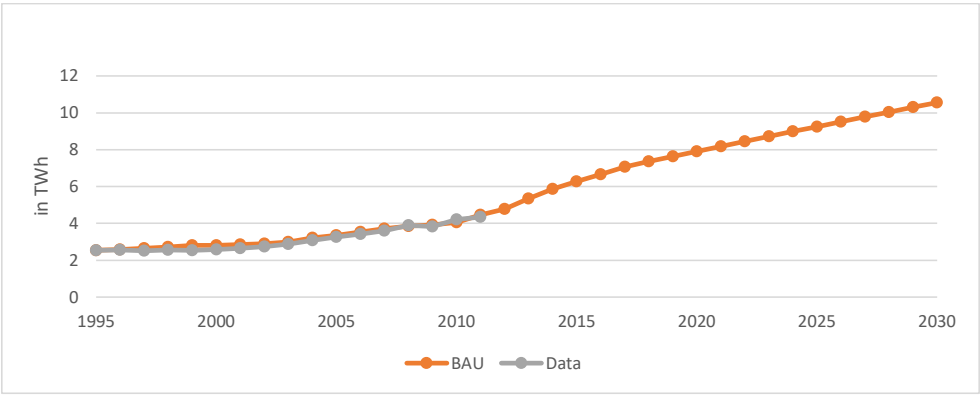
The population will grow to around 3.6 million people in 2030, of which 63% will live in the capital Ulaanbaatar city, putting further strain on the city's infrastructure. Only after 2020 will the population living in ger housing slowly decrease. The trend of people moving to Ulaanbaatar from rural areas will continue and, by 2030, people in Ulaanbaatar will create almost 600,000 tons of waste per year. The Ulaanbaatar water demand will increase to 113 million m^3 from now 95 million m^3. The residential area will triple from 9 million m^2 in 2014 to 28 million m^2 2030 helping to reduce people living in gers.

Figure 14: Comparing Real GDP with Historical Data



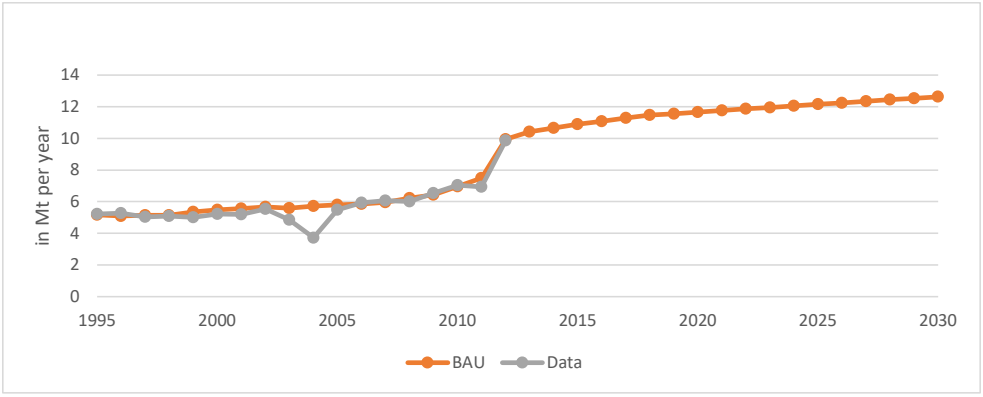
By 2030 the real GDP will increase to over MNT 14 trillion (adjusted for inflation). During the same period the poverty rate will decrease from 20.8% in 2014 to under 7% by 2030 and tertiary school enrollment will increase to 114,000.

Figure 15: Comparing Electricity Demand with Historical Data



The electricity demand correlates with the increase in population. By 2030, the demand will reach 10.5 TWh and resembles an 80% increase over 16 years whereas the electricity production is projected to increase only by 20% to 6.6 TWh representing a huge gap between consumption and generation of almost 4 TWh by 2030, which means the share of imported electricity will increase.

Figure 16: Comparing Coal Demand with Historical Data

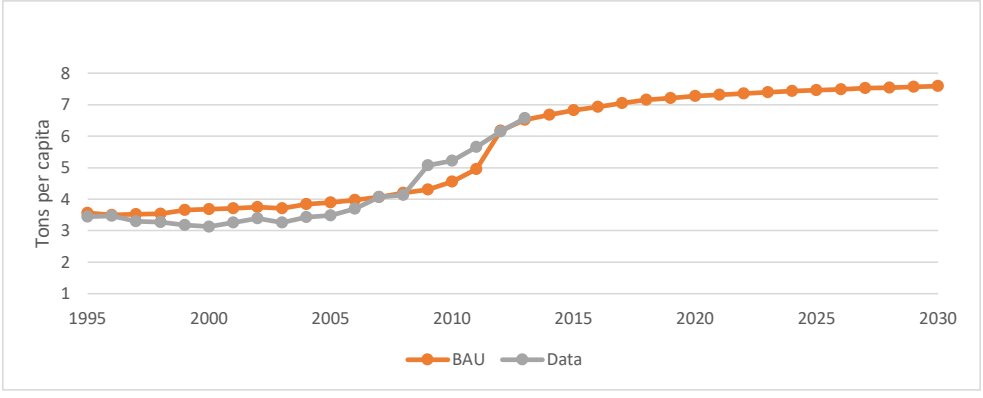


As of 2014, 10.6 million tons of coal was consumed every year with its demand expected to increase to almost 13 million tons by 2030, representing the bulk of Mongolia's greenhouse gas emissions. For every short ton (1 short ton = 907 kg) burned, more than twice that amount, 2.1 tons, of CO_2 is created[41].

The U.S. Department of Energy describes that fact as follows:

- "The amount of carbon dioxide (CO_2) that is produced from burning fuel weights more than the amount of the fuel itself because, during complete combustion, each carbon atom in the fuel combines with two oxygen atoms in the air to make CO_2. The addition of two oxygen atoms to each carbon atom forms CO_2, which has an atomic weight of 44 - roughly 3.6667 times the atomic weight of the carbon, which is 12". That chemical process results in more than twice the amount of CO_2 emissions as the next chart illustrates.

Figure 17: Comparing CO_2 Emissions with Historical Data



41 https://www.eia.gov/tools/faqs/faq.php?id=82&t=11

Increase in CO_2 emissions correlates closely to the demand for and burning of coal. As of 2014, almost 20 million tons of CO_2 were emitted per year and by 2030 that would increase to over 27 million tons of CO_2, representing an enormous strain on cities, especially Ulaanbaatar City which is confined between two mountain ranges, as well as the well-being of its inhabitants. This increase in CO_2 emissions will decrease air quality during winter times drastically, resulting in hazardous levels of particulate matter.

Particular matter, also called particulates are microscopic solid or liquid matter suspended in air. There are two main sub-types of particulates, PM2.5 and PM10 particulates. Their size allows them to penetrate deep into the lungs of animals and humans, resulting in adverse health effects.

Figure 18: Comparing CO_2 Emissions per Unit GDP with Historical Data

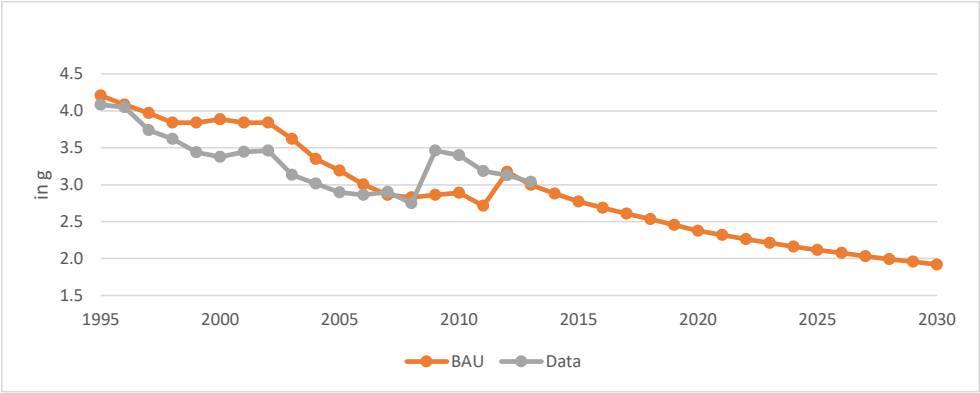
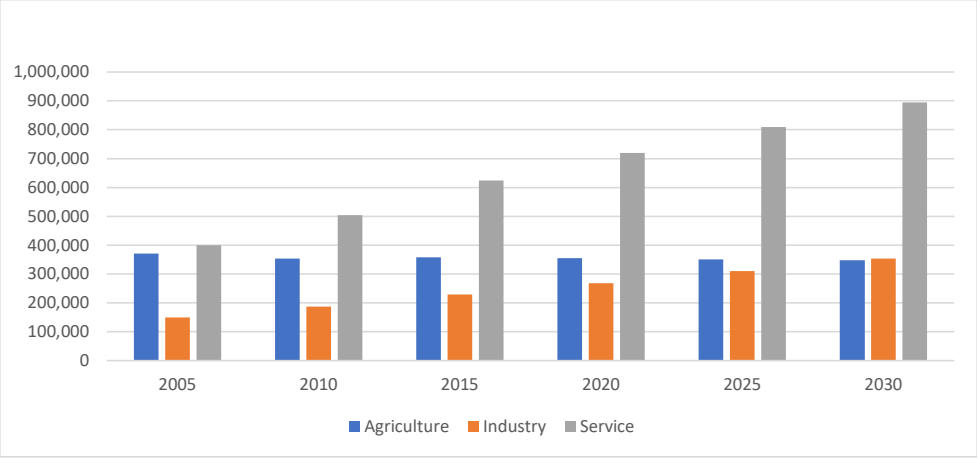


Figure 18 shows the real GDP intensity which measures how much CO2 emissions is created for one unit of GDP. For 1,000 MNT 2005 GDP units in 2014, 2.8 tons of CO2 were emitted, which means that 1.21 short tons of coal are used to create 1,000 MNT. This is one of highest rates in the world. According to the IEA, Mongolia ranks fifth out of 140 countries regarding GDP intensity in 2016[42].

42 IEA Website. The IEA uses nominal GDP numbers whereas the T21 model has an annual GDP deflator built in, thus the IEA GDP intensity stands at 1.59 kg / 1 USD'05 for Mongolia.

Figure 19: Employment Across Sectors Historically and BAU Case Simulated without a Change in Variables



This chart shows employment in the three economic sectors of Mongolia. Employment in agriculture barely changes over the course of 25 years. In 2030, 348,000 people will be employed in that sector, whereas in 2005, 371,000 people had jobs in the cultivation of crops and farmland.

While employment in agriculture barely changes, people employed in the industry sector will more than double during the period from 2005 to 2030. In 2005, 148,000 workers had jobs in the industry, while in 2030 that number will increase to 353,000.

The highest growth regarding jobs itself, however, is in the services sector. From 2005 to 2030 there is an expected increase of almost half a million jobs (124%) in the services sector. This shows that the model predicts that the industry sector will remain weak in the BAU case.

4.4. RESULTS OF THE GREEN ECONOMY SCENARIOS

This section will explore the results of the sensitivity analysis regarding GE investments in four sectors, water, construction, energy and waste, by showing and comparing graphs with a BAU case, in which no GE investments take place, and 5 GE investment scenarios for comparison; 2%, 2.5%, 3 %, 3.5% and 4%. For 2017, 2018 and 2019 the GE investments are 0.5%, 1% and 1.5% respectively.

4.4.1. Water Resource Management

This chapter explores water demand, mainly in the capital Ulaanbaatar city.

Figure 20 shows that with almost no agriculture in the capital, water demand strongly correlates with population growth. This demand will reach 102 million cubic meters by 2020 and 113 million cubic meters in 2030.

Figure 20: Annual Water Demand in Ulaanbaatar City

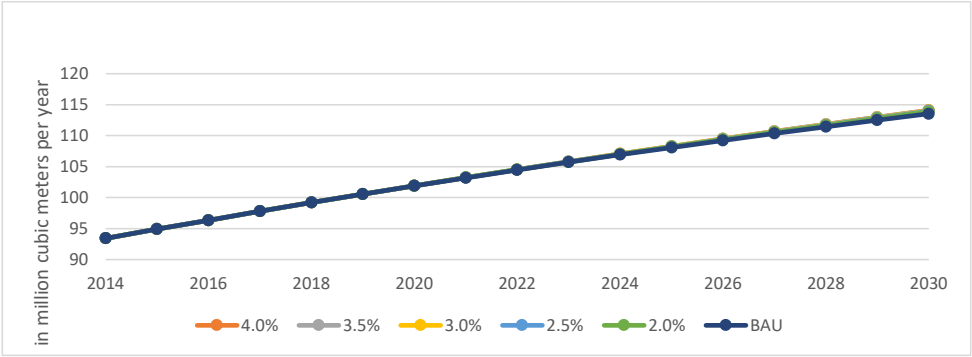


Figure 21 shows a gradual improvement in earlier years with more GE investments. In the 4% GE investment scenario, 98% will have access to clean water by 2026 whereas the 3.5% scenario only reaches 99% a year later and the 3% scenario two years later.

Figure 21: National Share of Access to Clean Water

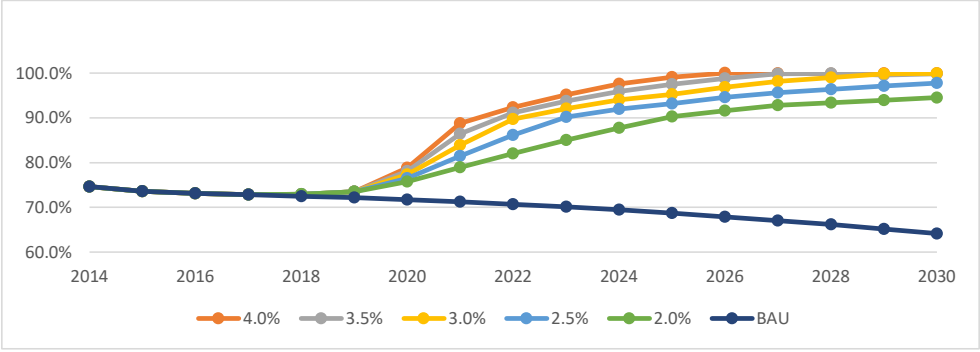
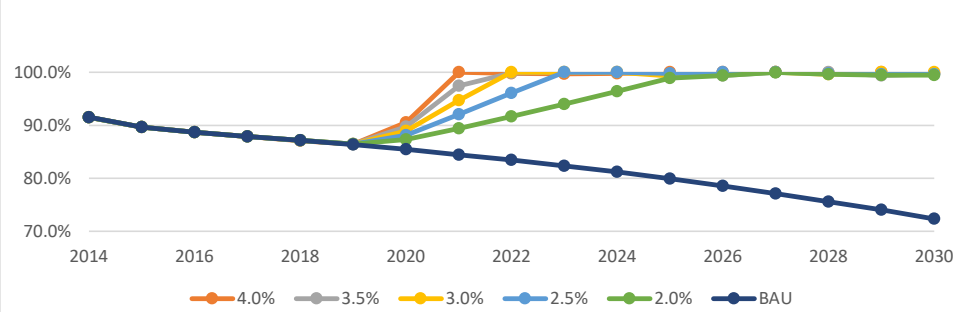


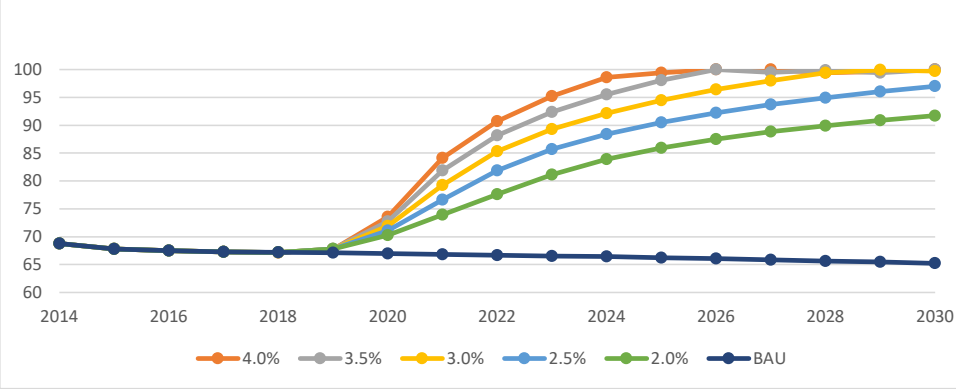
Figure 22 again shows the same tendency in the investment scenarios as before. The 4%, 3.5% and the 3% GE investment scenarios reach 100% share of access to clean water in the capital Ulaanbaatar city by 2022. The 2.5% GE investment scenario only reaches 100% one year later and the 2% scenario reaches 98.8% in 2025.

Figure 22: Share of Access to Clean Water in Ulaanbaatar City



Other cities lag behind the capital when it comes to the access to clean water, as the following Figure 23 shows. Only by 2026, the 4% and 3.5% GE investment scenarios reach 100% access to clean water for other cities in Mongolia.

Figure 23: Share of Access to Clean Water in Other Cities



In rural areas the share of access to clean water is only around 51% by 2017 when the usual pattern of the GE investment scenarios are illustrated. Even with little investments access rates, over 80% are achieved. The BAU case again shows, that with no investments at all, a decline of access, like in other cities and UB will continue. The scenarios show that aggressive investment (of at least 3%) is necessary to ensure access to clean water in achieving the goals for both Ulaanbaatar and other cities by 2030.

Figure 24 and Figure 25 show the level of access to clean water in the rural areas and the national share of access to sanitation respectively.

Figure 24: Share of Access to Clean Water in Rural Areas

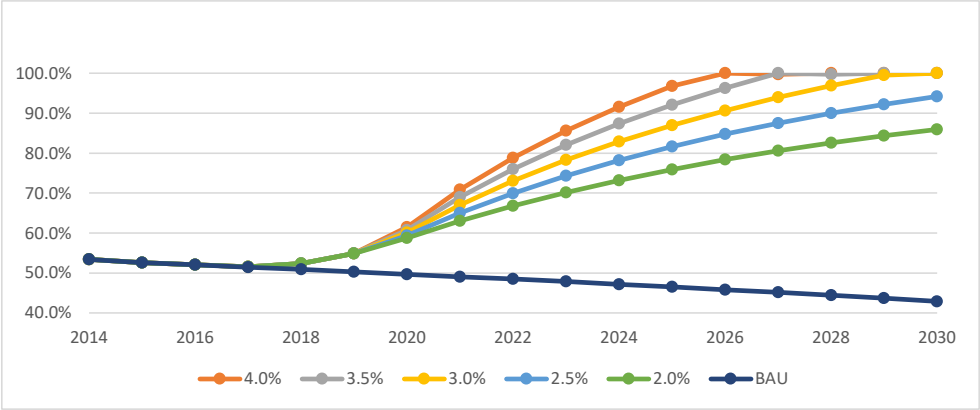


Figure 25: National Share of Access to Sanitation

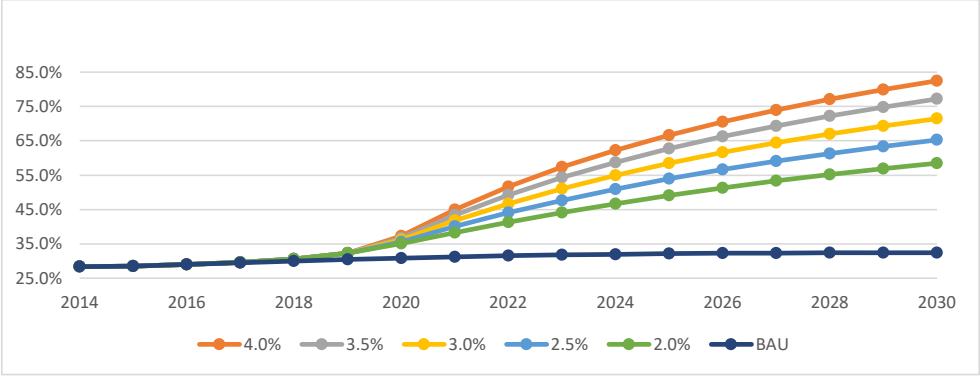


Figure 26 shows that in the capital, the access to sanitation is above national average. If nothing is done in that sector, the rate will barely change over the course of the next 13 years. The 4% and 3.5% scenarios show rates of access to sanitation of over 80%.

Figure 26: Share of Access to Sanitation in Ulaanbaatar City

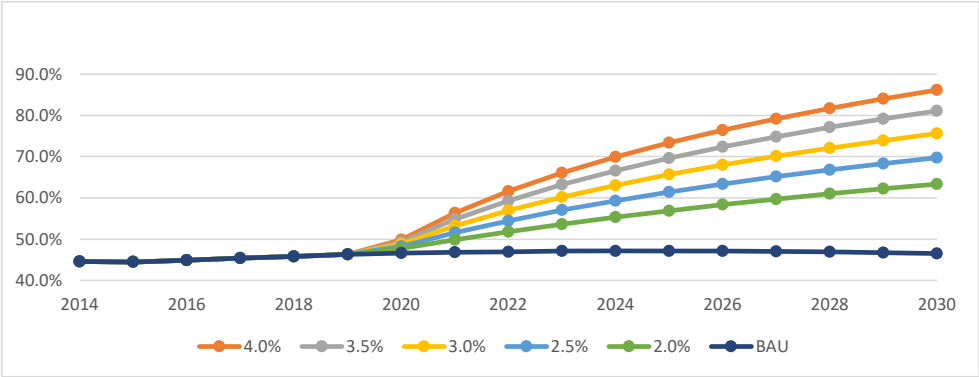
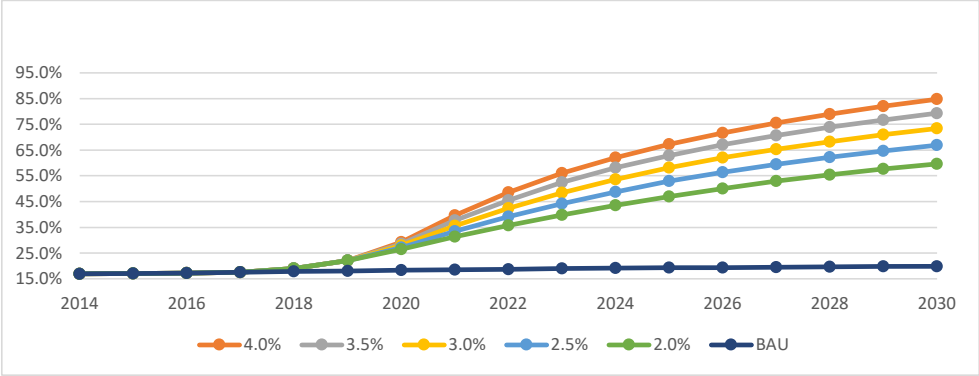


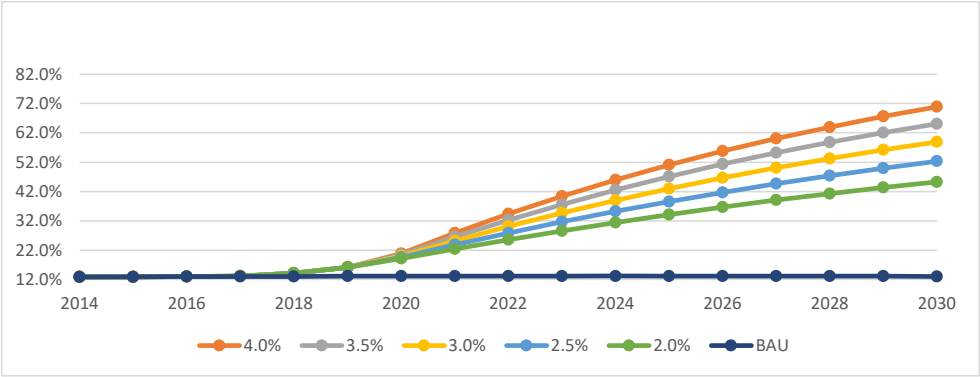
Figure 27 shows a very poor access to sanitation in other cities in Mongolia at only around 16%. A rate of 84% could be achieved with a 4% GE investment by the year 2030.

Figure 27: Share of Access to Sanitation in Other Cities



The lowest number of people that have access to sanitation are in rural areas as shown in the following Figure 28: Rural Share of Access to Sanitation. Only around 13% of the rural population have access to sanitation in the years from 2014 until 2020. With the beginning of GE investments as the share of GDP, people having access to sanitation increases. However, even with a 4% GE investment over a decade, the number of people with access only increases to just over 60%.

Figure 28: Access to Sanitation in Rural Areas



In the BAU case, the number of people with access to sanitation does not increase at all – staying at a steady rate of only 13%.

Green Economy investment in the water sector will help improving access to fresh water and sanitation for thousands of people. GE investments will also reverse the decline in people having access to clean water in the entire country. While GE investment in both sanitation and water is essential, investment in sanitation in the countryside will help closing the gap between urban and rural standards of living: rural access to sanitation is markedly less than access to clean water.

4.4.2. Construction Sector

The simulations regarding construction will focus on the capital of Mongolia, Ulaanbaatar City. Residential construction will continue to increase in all scenarios in UB. The simulations show that GE investments do not have significant impacts on that increase. By 2014, there were 893,000 square meters of residential area created and in the year 2020 that growth increases to 1.33 million square meters per year. All scenarios reach almost 2 million new square meters per year by 2030 showing a steady increase over that decade.

Figure 29 shows the share of highly efficient residential area in Ulaanbaatar city. With ongoing growth that area will increase significantly. However, in all GE investment scenarios, that area increases even more, showing a correlation between the increase in highly efficient residential area and an increase in GE investment. In 2014, there were only 429,000 square meters of highly efficient residential area. By the year 2020, that area is expected to increase to around 2.8 million square meters on all scenarios. The 4% GE investment scenario will create 17.5 million square meters of highly efficient residential area compared to only 13.4 million square meters in the BAU case. That is a difference of over 4 million additional square meters in highly efficient residential area, which will help to reducing heating costs and thus reduces CO_2 emissions.

Figure 29: Share of High Efficiency Areas in Ulaanbaatar City

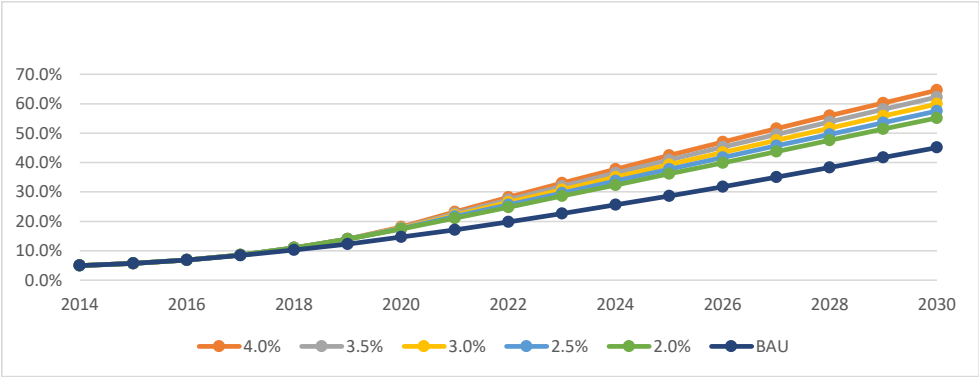
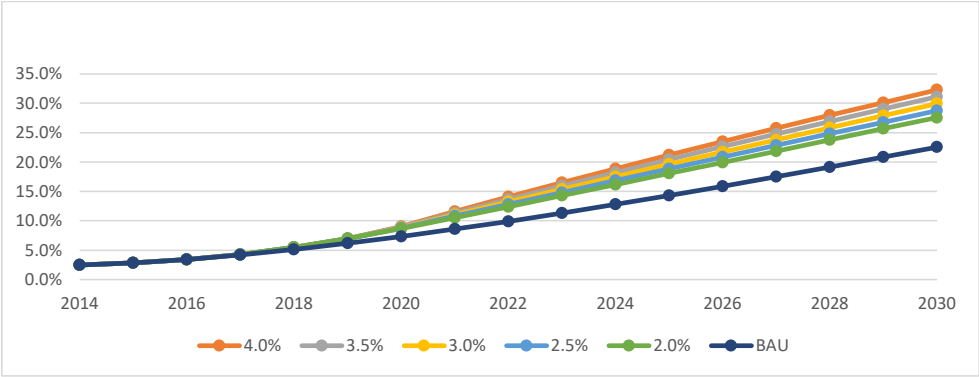


Figure 30 shows the reduction of heat loss from buildings. The BAU case will reach a reduction of heat loss of 22.5% by 2030, however even with small allocation of GE investments in the construction sector, the GE scenarios show a reduction of well over 27%, marking an additional reduction from 5% to almost 10% in the 4% GE investment scenario.

During the very cold winters in Mongolia, when temperatures reach -40 C, heating is the number one reason for carbon emissions. By reducing the low efficiency residential area and at the same time increasing the highly efficient area with better insulation, green investment will significantly help to reducing heating costs and thus help reduce CO_2 emissions over the course of a decade.

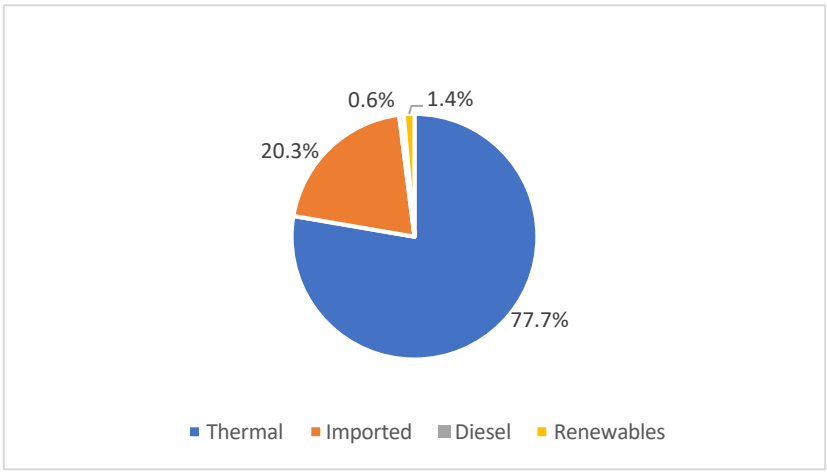
Figure 30: Heat Loss in Ulaanbaatar City Residential Areas



4.4.3. Energy Sector

The biggest share of GE investments is to be allocated to the energy sector, thus having a huge impact overall. The biggest part of the transition to a green economy is the production of electricity from renewable and sustainable sources like wind, water and solar. By investing in these areas, the reliance on coal will decrease, CO_2 emissions will be reduced significantly and dependence on imports will be limited.

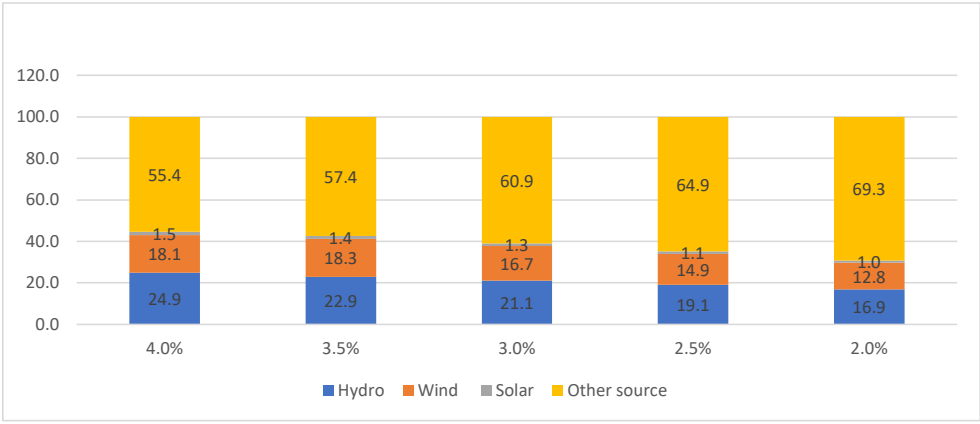
Figure 31: Mongolia's Energy Sources, 2015



Mongolia's electricity mix in 2015 is shown in Figure 31, which demonstrates a heavy reliance on coal used in thermal power plants. Since 2010, there has been a 15% increase in imported energy from Russia and China[43].

Mongolia will achieve its target of 30% renewable energy by 2030 if 2% of GDP is directed to green investment. If 4% of GDP goes towards green investment, renewable energy will amount to 44.6% of the energy mix by that time.

Figure 32: Mongolia's Energy Sources in 2030



43 Ministry of Energy of Mongolia, 2015

Figure 33: Total Energy Demand

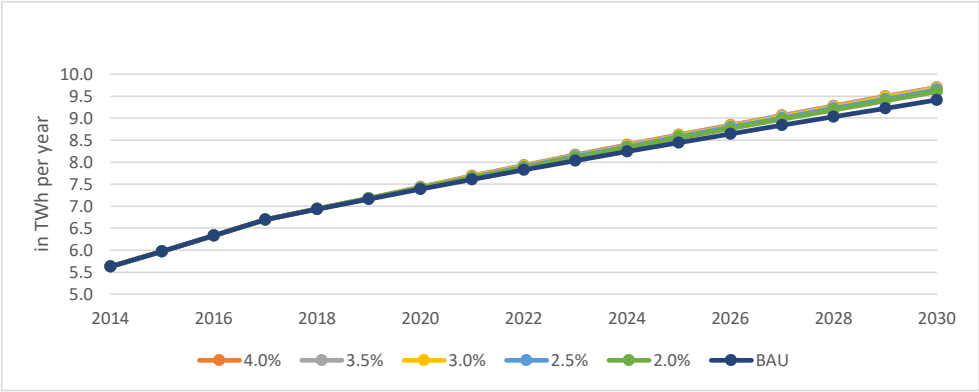


Figure 33 shows the electricity demand of 5.6 TWh in 2014, which increases to above 9.5 TWh per year in 2030 in every GE investment scenario, which is in line with population growth.

Figure 34: Total Renewable Energy Generation

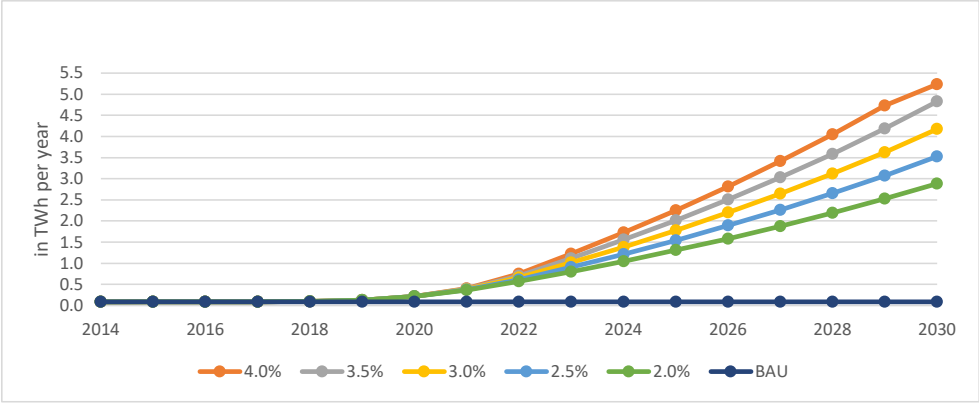


Figure 34 shows an increase in renewable power generation from 2017 to 2030. By 2030, the 4% GE investment scenario estimates that 5.2 TWh will be produced every year while the 2% GE investment scenario will only achieve a power generation of 2.8 TWh per year. The other two scenarios are as expected in between those. The BAU scenario assumes an unchanged renewable electricity generation of 1.4%.

Figure 35: Share of Energy From Renewables

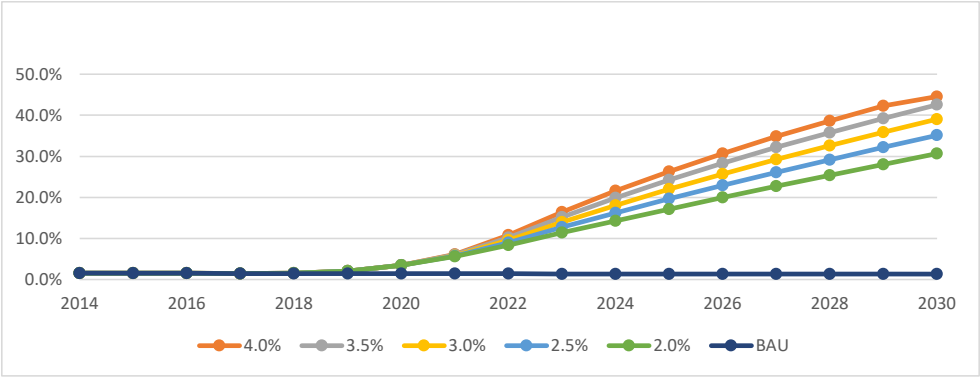


Figure 35 clearly shows that with a 4% GE investment the GDPolicy target of 30% by the year 2030 will be achieved at the end of 2026. All scenarios reach the MSDV target of 30% by the year 2030. That shows the relevance of a big allocation of GE investment in the energy sector.

Figure 36: Hydropower Energy Generation

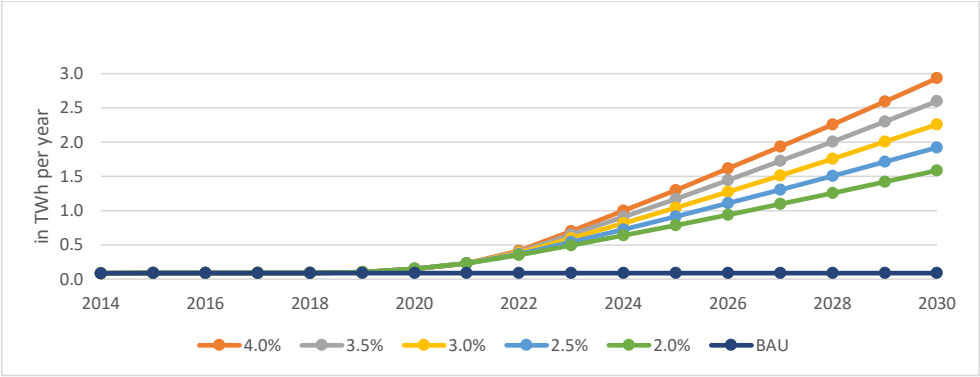
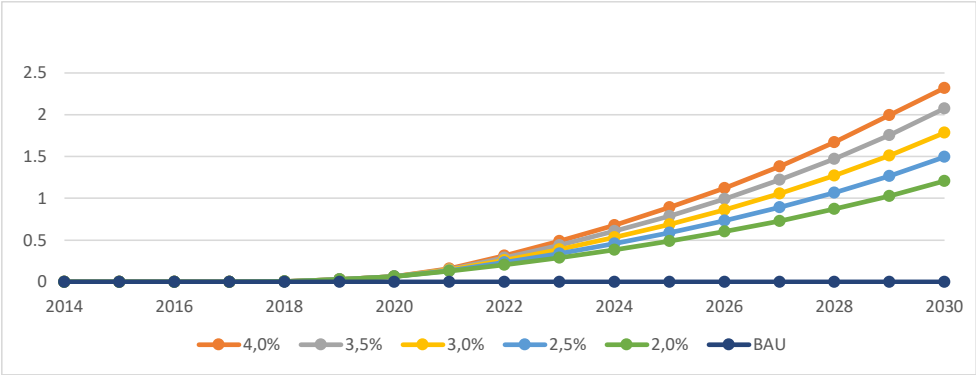


Figure 36 shows that hydropower production increases after 2017 and reaches over 1 TWh per year in 2024 with a 4% GE investment in energy despite the smaller allocation of GE investments into hydro-electric power of only 20% compared to 40% for solar as well as wind. By 2030 all scenarios reach over 1.5 TWh per year.

Establishing of new hydro-electric power production projects faces several obstacles, because of rivers flowing through other countries. Reaching agreements with countries downstream often results in prolonged negotiations and uncertain project implementations. However, there are 3 Hydro power plants in development in the northern and western parts of Mongolia (Egiin Gol HPP, Shuren HPP and Erdenburen HPP). Introduction of those hydropower plants may encourage further development of solar and wind farms. Hydro-electric power plants also have good efficiency factors of around 40%.

Figure 37: Wind Power Generation (in TWh per year)



Wind power generation increases in the same manner as hydro-electric power , as evidenced by Figure 37. However, because of a bigger allocation of GE investments, the energy produced from wind power reaches almost 1.6 TWh per year in the scenario with 4% GE investments and the other scenarios show the same behavior as in Figure 36. The amount of TWh produced per year in wind power for the years before 2017 do not include the fact that there was a wind farm built in 2013/14 that produces 125 MW of renewable energy.

Figure 38: Solar Power Energy Generation (in TWh per year)

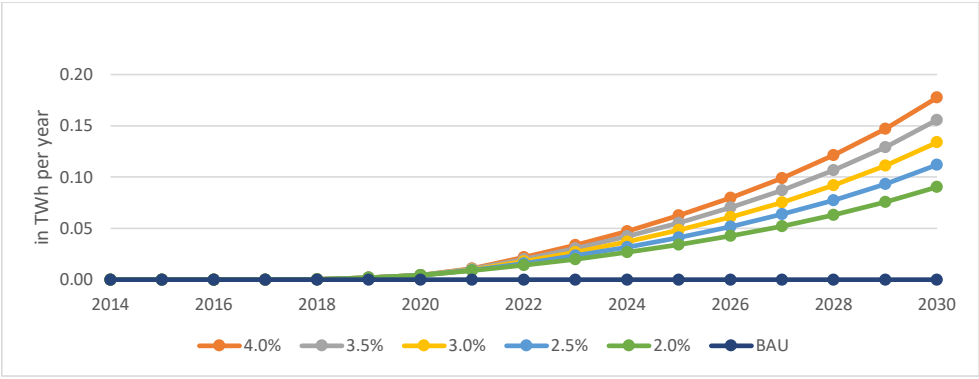
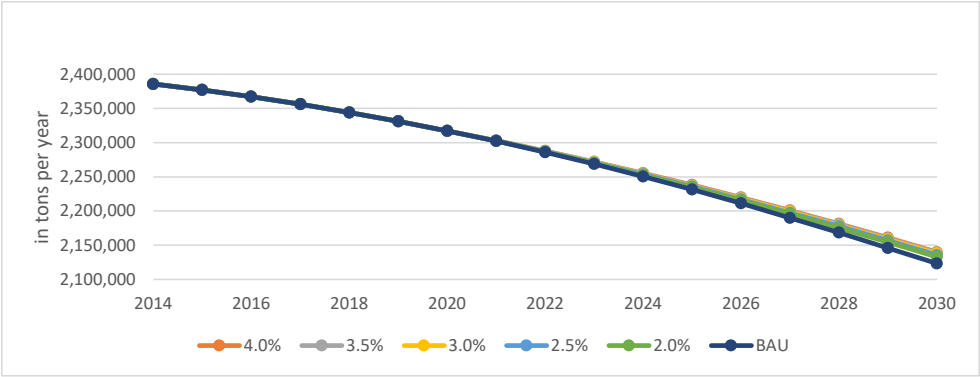


Figure 38 shows the same behavior as the previous Figures in which solar power increases greatly after 2020. The total energy produced in the 4% and 3.5% GE investment scenario reach over 0.15 TWh per year.

Figure 39: Ger District Coal Demand



The coal demand from ger housing decreases almost the same in all scenarios due to the fact that it is assumed that people will move into residential buildings, hence people living in ger housing will steadily decrease over the next decade.

The energy demand will keep increasing and without the implementation of more renewable energy sources, there will be an even bigger increase in imported energy as well as an increase in consumption of fossil fuels in thermal power plants, especially coal. With the additional construction of coal power plants, the environmental problems and CO2 emissions will increase further and cause ever more severe problems.

Green economy investments will result in less coal usage, more renewable energy sources and will also make the Mongolian energy market less dependent on imports and ensure a sustainable energy production.

4.4.4. Solid Waste Management

T21 modelling for the solid waste sector was only done in the capital Ulaanbaatar city, like the construction sector, as it creates by far the biggest share of waste in Mongolia. Figure 40 shows an increase for all scenarios from 403 tons per year in 2014, to 460 tons per year in 2020 and well over 520 tons per year in 2030 for the green scenarios.

Figure 40: Ulaanbaatar City Waste Generation

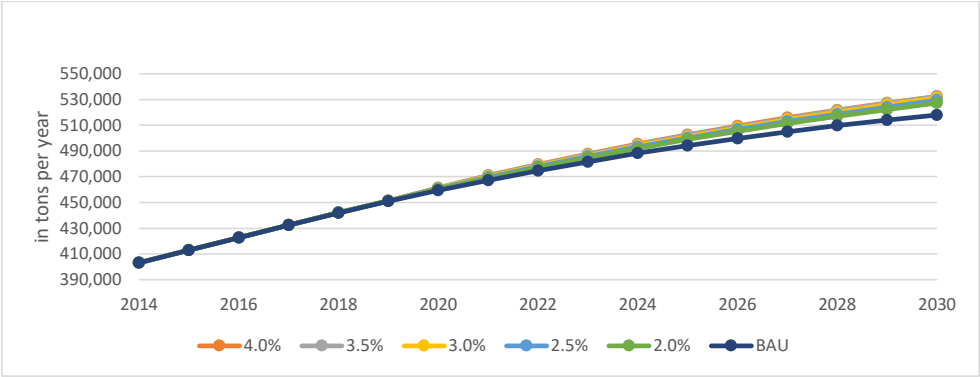
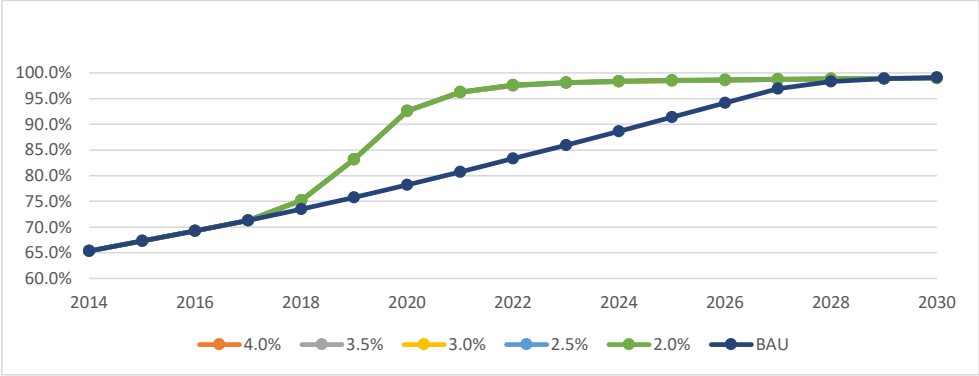


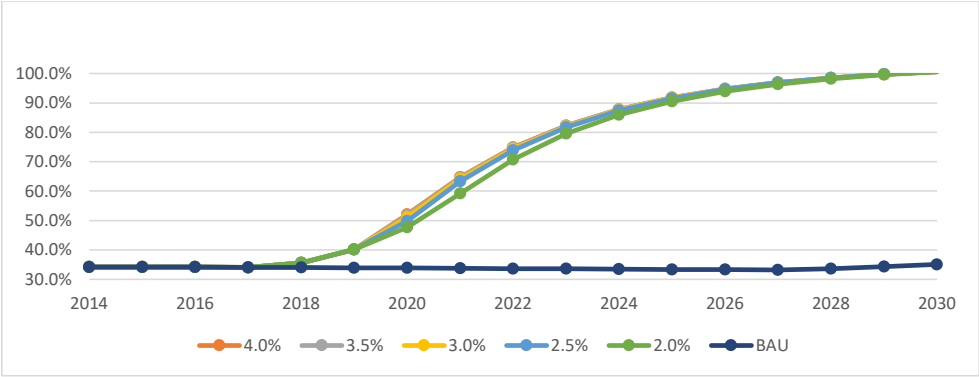
Figure 41 shows that with the help of GE investments the solid waste collection rate in Ulaanbaatar city will reach 96% by the year 2021, whereas in the BAU case, it will take another 7 years until 2028 to reach the same collection rate.

Figure 41: UB Solid Waste Collection Rate



While the collection rate benefits relatively quickly from GE investments the solid waste separation rate in the capital shows that 1% GE investment has only little impact in the short term. Only the other three higher GE investment scenarios show a considerable increase in the separation rate within one year to around 90%.

Figure 42: UB Solid Waste Separation Rate



The same behavior of the investment scenarios seen in Figure 42 can be found in the following Figure 43 solid waste recycling rate. The 1% scenario's impact is much smaller compared to the other three green scenarios.

Figure 43: Solid Waste Recycling Rate in Ulaanbaatar City

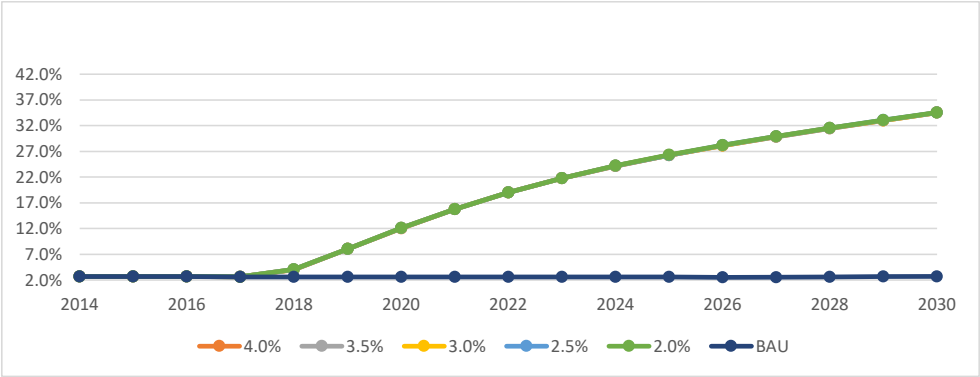
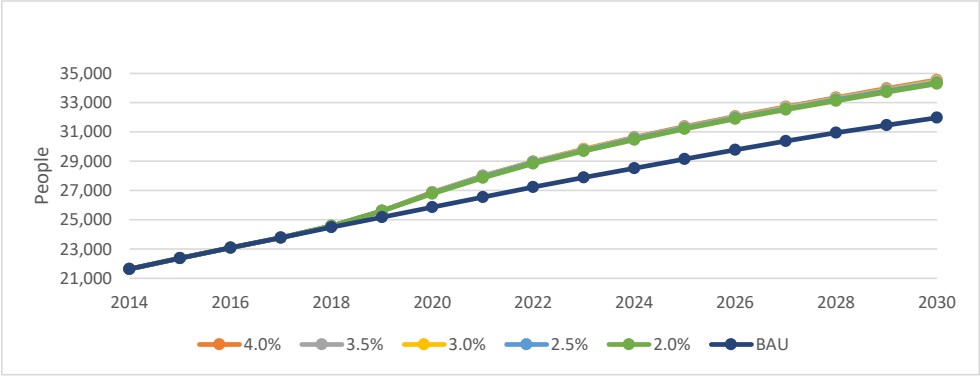


Figure 44: Total Employment in the Ulaanbaatar City Solid Waste Management Sector



Green investments in the waste sector will help improve the collection, separation and recycling of solid waste in Ulaanbaatar city significantly. The BAU case only reaches a 100% collection rate by 2029 and there is no separation or recycling happening at all. Waste separation and recycling are important parts of sustainability. Only in the green investment scenarios can these goals be achieved.

4.5. SUMMARY OF MAIN INDICATORS FOR 2014, 2020 AND 2030

The following tables show for each main indicators 15 scenario outcomes regarding mineral prices and GE investment size as share of GDP. Some variables show bigger dependences on mineral prices whereas others show no change.

Table 32: Summary of Main Indicators for 2014, 2020 and 2030

Main Indicators	Unit	2014
		BAU
Environmental Sector		
CO2 emissions	Million ton/year	18.6
Emission intensity	Ton/GWh	3,377
UB water demand	Million ton/year	93.4
Oil demand	TJ	62,263
Electricity demand	GWh	5,628
Economic Sector		
Real GDP	Billion MNT 2005	6,043
Real GDP per capita	MNT 2005	2,096,740
Agricultural production	Billion MNT 2005	938
Industry production w/o OT TT	Billion MNT 2005	1,096
OT & TT production	Billion MNT 2005	243
Services production	Billion MNT 2005	2,880
Social sector		
Total population	Millions	2.88
Employment in Agriculture	Thousands people	359
Employment in Industry	Thousands people	222
Employment in Services	Thousands people	602
Unemployment rate	%	8.2%
Poverty rate	%	20.4%
UB ger housing	Thousands	192

Main Indicators	Unit	MP	2020					
			BAU	2.0%	2.5%	3.0%	3.5%	4.0%
Environmental Sector								
CO2 emissions	Million ton/ year	low	21.3	21.2	21.3	21.3	21.3	21.3
		avg	21.4	21.3	21.4	21.4	21.4	21.4
		high	21.5	21.5	21.5	21.5	21.5	21.5
Emission intensity	Ton/ GWh	low	3,435	3,358	3,361	3,363	3,365	3,367
		avg	3,452	3,374	3,376	3,379	3,381	3,382
		high	3,468	3,390	3,392	3,394	3,397	3,399
UB water demand	Million ton/ year	low	101.9	101.9	101.9	101.9	101.9	101.9
		avg	101.9	101.9	101.9	101.9	101.9	101.9
		high	101.9	101.9	101.9	101.9	101.9	101.9

Oil demand	TJ	low	81,910	82,615	82,802	82,988	83,174	83,360
		avg	83,266	83,992	84,181	84,371	84,559	84,648
		high	84,626	85,373	85,566	85,758	85,950	86,142
Electricity demand	GWh	low	7,363	7,387	7,393	7,400	7,406	7,413
		avg	7,389	7,414	7,420	7,427	7,433	7,436
		high	7,415	7,440	7,447	7,453	7,460	7,466
Economic Sector								
Real GDP	Billion MNT 2005	low	7,874	7,932	7,947	7,963	7,978	7,993
		avg	7,985	8,045	8,060	8,076	8,091	8,098
		high	8,097	8,158	8,173	8,189	8,205	8,220
Real GDP per capita	MNT 2005	low	2,499,358	2,517,696	2,522,531	2,527,375	2,532,195	2,537,017
		avg	2,534,523	2,553,354	2,558,267	2,563,164	2,568,049	2,570,351
		high	2,569,704	2,589,030	2,594,009	2,598,970	2,603,920	2,608,876
Agriculture production	Billion MNT 2005	low	1,101	1,101	1,101	1,101	1,101	1,101
		avg	1,101	1,101	1,101	1,101	1,101	1,101
		high	1,101	1,101	1,101	1,101	1,101	1,101
Industry production w/o OT TT	Billion MNT 2005	low	1,207	1,207	1,207	1,208	1,208	1,208
		avg	1,261	1,261	1,261	1,262	1,262	1,262
		high	1,315	1,315	1,315	1,316	1,316	1,317
OT & TT production	Billion MNT 2005	low	519	519	519	519	519	519
		avg	568	568	568	568	568	568
		high	617	617	617	617	617	617
Services production	Billion MNT 2005	low	4,050	4,046	4,049	4,052	4,055	4,058
		avg	4,044	4,041	4,044	4,047	4,050	4,047
		high	4,038	4,035	4,038	4,041	4,044	4,047
Others	Billion MNT 2005	low	997	1059	1071	1083	1095	1107
		avg	1011	1074	1086	1098	1110	1120
			1026	1090	1102	1114	1127	1138
Social sector								
Total population	Millions	low	3.15	3.15	3.15	3.15	3.15	3.15
		avg	3.15	3.15	3.15	3.15	3.15	3.15
		high	3.15	3.15	3.15	3.15	3.15	3.15
Employment in agriculture	Thou-sands people	low	354	354	354	354	354	354
		avg	354	354	354	354	354	354
		high	354	354	354	354	354	354
Employment in industry	Thou-sands people	low	248	247	247	247	247	247
		avg	248	248	248	248	248	248
		high	249	249	249	249	249	249
Employment in services	Thou-sands people	low	690	699	701	703	705	707
		avg	689	698	700	702	704	705
		high	687	697	699	701	703	704
Unemployment rate	%	low	8.5%	7.9%	7.7%	7.6%	7.5%	7.3%
		avg	8.5%	7.9%	7.8%	7.6%	7.5%	7.4%
		high	8.6%	7.9%	7.8%	7.7%	7.5%	7.4%
Poverty rate	%	low	14.5%	13.9%	13.8%	13.7%	13.5%	13.4%
		avg	14.8%	14.2%	14.1%	14.0%	13.8%	13.6%
		high	15.1%	14.5%	14.4%	14.2%	14.1%	14.0%

UB ger housing	Thou-sands	low	194	194	194	194	194	194
		avg	194	194	194	194	194	194
			194	194	194	194	194	194

Main Indicators	Unit	MP	2030					
			BAU	2.0%	2.5%	3.0%	3.5%	4.0%
Environmental Sector								
CO2 emissions	Million ton/year	low	23.7	22.3	22.0	21.7	21.3	21.1
		avg	23.9	22.5	22.2	21.9	21.5	21.2
		high	24.1	22.7	22.4	22.0	21.6	21.4
Emission intensity	Ton/ GWh	low	3,590	2,389	2,206	2,043	1,893	1,806
		avg	3,620	2,394	2,209	2,043	1,892	1,803
		high	3,650	2,400	2,212	2,044	1,891	1,811
UB water demand	Million ton/year	low	113.5	113.8	113.9	114.0	114.0	114.1
		avg	113.5	113.9	114.0	114.0	114.1	114.1
		high	113.6	113.9	114.0	114.1	114.1	114.1
Oil demand	TJ	low	100,060	105,304	106,473	107,552	108,099	108,501
		avg	102,690	108,023	109,239	110,297	110,808	110,805
		high	105,334	110,793	112,017	113,015	113,593	113,895
Electricity demand	GWh	low	9,368	9,554	9,595	9,633	9,652	9,666
		avg	9,416	9,603	9,646	9,682	9,700	9,701
			9,464	9,654	9,696	9,731	9,750	9,761
Economic Sector								
Real GDP	Billion MNT 2005	low	10,094	10,568	10,674	10,770	10,820	10,856
		avg	10,332	10,813	10,922	11,017	11,063	11,062
		high	10,571	11,061	11,171	11,260	11,312	11,338
Real GDP per capita	MNT 2005	low	2,831,508	2,951,526	2,977,091	3,001,012	3,012,649	3,021,342
		avg	2,897,432	3,018,579	3,045,168	3,068,458	3,079,169	3,077,935
		high	2,963,441	3,086,667	3,113,298	3,134,975	3,147,369	3,153,554
Agriculture production	Billion MNT 2005	low	1,373	1,372	1,371	1,371	1,370	1,370
		avg	1,372	1,370	1,370	1,370	1,369	1,369
		high	1,371	1,369	1,369	1,369	1,368	1,368
Industry production w/o OT TT	Billion MNT 2005	low	1,364	1,391	1,396	1,401	1,404	1,406
		avg	1,509	1,537	1,542	1,547	1,550	1,548
		high	1,653	1,682	1,688	1,692	1,695	1,697
OT & TT production	Billion MNT 2005	low	456	456	456	456	456	456
		avg	570	570	570	570	570	570
		high	684	684	684	684	684	684
Services production	Billion MNT 2005	low	5,983	6,245	6,300	6,347	6,369	6,379
		avg	5,942	6,205	6,262	6,307	6,328	6,311
		high	5,902	6,169	6,225	6,266	6,289	6,297
Others	Billion MNT 2005	low	918	1104	1151	1195	1221	2478
		avg	939	1131	1178	1223	1246	1264
			961	1157	1205	1249	1276	1292
Social sector								
Total population	Millions	low	3.56	3.58	3.59	3.59	3.59	3.59
		avg	3.57	3.58	3.59	3.59	3.59	3.59
		high	3.57	3.58	3.59	3.59	3.59	3.60

Employment in agriculture	Thousands people	low	348	348	348	348	348	348
		avg	348	348	348	348	348	348
		high	348	348	348	348	348	348
Employment in industry	Thousands people	low	284	284	284	284	283	283
		avg	288	288	288	288	288	287
		high	293	292	292	292	292	292
Employment in services	Thousands people	low	810	834	840	846	848	851
		avg	801	826	832	838	840	841
		high	793	818	824	830	833	834
Unemployment rate	%	low	13.4%	12.3%	12.1%	11.8%	11.7%	11.6%
		avg	13.6%	12.6%	12.3%	12.1%	12.0%	12.0%
		high	13.9%	12.8%	12.6%	12.3%	12.2%	12.2%
Poverty rate	%	low	11.9%	10.3%	10.0%	9.7%	9.6%	9.5%
		avg	12.4%	10.7%	10.4%	10.1%	10.0%	10.0%
		high	12.9%	11.1%	10.8%	10.5%	10.4%	10.3%
UB ger housing	Thousands	low	174	175	175	175	175	176
		avg	174	175	175	175	176	176
			174	175	175	176	176	176

The sensitivity analysis shows that, with GE investment, the real GDP will reach MNT 10,568 billion in the year 2030 with a pessimistic mineral outlook and smallest GE investment of 2% and up to MNT 11,338 billion with optimistic mineral prices and the biggest GE investment of 4%. Because of the significant impact of mineral prices on the real GDP, due to the high contribution of the mining sector (OT & TT production), the pessimistic, average and optimistic mineral prices scenarios show a great increase in real GDP in mining thanks to OT & TT. That correlation was expected.

The high mineral prices also have more significant impact on the oil demand of Mongolia in the year 2030. The simulations show a difference in demand of 8.5 TJ from the scenario with low mineral prices and low GE investment to the high mineral prices scenario with a big 4% GE investment. The energy demand shows the same behavior. The CO2 emissions are expected to decline with the size of the GE investment as share of GDP by 2030. An important measurement for economies is the emission intensity which varies significantly across the GE investment scenarios, ranging from 3,650 tons per GWh in the optimistic prices BAU case to just half of that in the low mineral prices and 4% GE investment scenario with 1,806 tons per GWh in 2030. This shows the considerable impact resulting from the allocation of 70% of the GE share in the energy sector.

By 2030, the unemployment rate will be the lowest with a high GE investment scenario, which is a major argument for a GE investment strategy. The exact same results are forecasted with the poverty rate, which is lowest when GE investment reach 4%. The total population in all 15 different GE investment scenarios changes by 0.7%. The simulations show that the employment in agriculture does not change at all in all cases. The slight decline continues across all scenarios. By the year 2030, the number of traditional ger houses, which are the main cause of Ulaanbaatar's air pollution during winter, as the residents heat and cook with coal, will decline from its peak in 2018, at 196,000 to 176,000 in 2030.

4.6. SUMMARY OF GREEN INDICATORS FOR 2014, 2020 AND 2030

The following tables show for each green economy indicator 15 scenario outcomes regarding mineral prices and GE investment size as a share of GDP. Some variables show bigger dependences on mineral prices whereas others show no change.

Table 33: Summary of Green Economy Indicators for 2014, 2020 and 2030

Green Indicators	Unit	2014
		BAU
Water		
National share of access to clean water	%	74.6%
UB share of access to clean water	%	91.5%
Other cities share of access to clean water	%	68.8%
Rural share of access to clean water	%	53.4%
National share of access to sanitation	%	28.4%
UB share of access to sanitation	%	44.6%
Other cities share of access to sanitation	%	16.9%
Rural share of access to sanitation	%	12.9%
UB annual water recycled	Million m^3	25.7
UB water recycling capacity	Million m^3	28.5
Construction		
UB residential reduction of heat loss	%	2.5%
UB residential high efficiency share	%	4.9%
Energy		
Real GDP Intensity	MNT 2005 / $kgCO_2$	324
Share of coal	%	98.6%
Share of solar	%	0.0%
Share of wind	%	0.8%
Share of hydro	%	0.6%
Share of renewables	%	1.4%
Ger coal demand	Thousand tons/year	2,386
Solid Waste		
UB waste generation	Thousand tons/year	403
UB total solid waste employment	People	21,637
UB solid waste collection rate	%	65.3%
UB solid waste separation rate	%	34.2%
UB solid waste recycling rate	%	2.7%

Green Indicators	Unit	MP	2020					
			BAU	2.0%	2.5%	3.0%	3.5%	4.0%
Water								
National share of access to clean water	%	low	71.7%	75.6%	76.4%	77.2%	77.9%	78.7%
		avg	71.7%	75.7%	76.5%	77.3%	78.1%	78.8%
		high	71.7%	75.9%	76.6%	77.4%	78.2%	79.0%
UB share of access to clean water	%	low	85.5%	87.2%	88.0%	88.8%	89.6%	90.4%
		avg	85.5%	87.3%	88.1%	88.9%	89.8%	90.5%
		high	85.5%	87.4%	88.2%	89.1%	89.9%	90.7%
Other cities share of access to clean water	%	low	67.0%	70.2%	71.0%	71.8%	72.6%	73.4%
		avg	67.0%	70.3%	71.1%	71.9%	72.8%	73.6%
		high	67.0%	70.4%	71.3%	72.1%	72.9%	73.7%
Rural share of access to clean water	%	low	49.7%	58.6%	59.3%	60.0%	60.6%	61.3%
		avg	49.7%	58.7%	59.4%	60.1%	60.8%	61.4%
		high	49.7%	58.8%	59.5%	60.2%	60.9%	61.6%
National share of access to sanitation	%	low	30.9%	35.0%	35.5%	36.1%	36.6%	37.2%
		avg	30.9%	35.0%	35.6%	36.2%	36.7%	37.3%
		high	30.9%	35.1%	35.7%	36.3%	36.8%	37.4%
UB share of access to sanitation	%	low	46.6%	47.7%	48.2%	48.7%	49.3%	49.8%
		avg	46.6%	47.7%	48.3%	48.8%	49.4%	49.9%
		high	46.6%	47.8%	48.3%	48.9%	49.5%	50.0%
Other cities share of access to sanitation	%	low	18.3%	26.3%	27.0%	27.7%	28.4%	29.1%
		avg	18.3%	26.5%	27.2%	27.9%	28.6%	29.3%
		high	18.3%	26.6%	27.3%	28.0%	28.7%	29.4%
Rural share of access to sanitation	%	low	13.1%	19.0%	19.4%	19.8%	20.3%	20.7%
		avg	13.1%	19.1%	19.5%	19.9%	20.4%	20.8%
		high	13.1%	19.1%	19.6%	20.0%	20.5%	20.9%
UB annual water recycled	Million m3	low	19.2	19.8	19.8	19.9	19.9	20.0
		avg	19.2	19.8	19.9	19.9	19.9	20.0
		high	19.2	19.8	19.9	19.9	20.0	20.0
UB water recycling capacity	Million m3	low	21.4	22.0	22.0	22.1	22.1	22.2
		avg	21.4	22.0	22.1	22.1	22.2	22.2
			21.4	22.0	22.1	22.1	22.2	22.2
Construction								
UB residential reduction of heat loss	%	low	7.3%	8.7%	8.8%	8.8%	8.9%	9.0%
		avg	7.3%	8.7%	8.8%	8.8%	8.9%	9.0%
		high	7.3%	8.7%	8.8%	8.9%	9.0%	9.0%
UB residential high efficiency share	%	low	14.6%	17.3%	17.5%	17.7%	17.8%	18.0%
		avg	14.6%	17.4%	17.5%	17.7%	17.9%	18.0%
		high	14.6%	17.4%	17.6%	17.7%	17.9%	18.1%
Energy								
Real GDP Intensity	MNT 2005 / kgCO2	low	370	373	374	374	375	375
		avg	373	377	377	378	378	378
			377	380	381	381	382	382
Share of coal	%	low	97.8%	96.6%	96.6%	96.6%	96.6%	96.6%
		avg	97.8%	96.5%	96.5%	96.5%	96.5%	96.5%
		high	97.8%	96.5%	96.5%	96.5%	96.5%	96.5%

Share of solar	%	low	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%
		avg	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%
		high	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%
Share of wind	%	low	0.8%	1.0%	1.0%	1.0%	1.0%	1.0%
		avg	0.8%	1.0%	1.0%	1.0%	1.0%	1.0%
		high	0.8%	1.1%	1.1%	1.1%	1.1%	1.1%
Share of hydro	%	low	1.4%	2.3%	2.3%	2.3%	2.3%	2.3%
		avg	1.4%	2.3%	2.3%	2.3%	2.3%	2.3%
		high	1.4%	2.3%	2.3%	2.3%	2.3%	2.3%
Share of renewables	%	low	2.2%	3.4%	3.4%	3.4%	3.4%	3.4%
		avg	2.2%	3.5%	3.5%	3.5%	3.5%	3.5%
		high	2.2%	3.5%	3.5%	3.5%	3.5%	3.5%
Ger coal demand	Thou-sand ton/ year	low	2,317	2,317	2,317	2,317	2,317	2,317
		avg	2,317	2,317	2,317	2,317	2,317	2,317
		high	2,317	2,317	2,317	2,317	2,317	2,317
Solid Waste								
UB waste generation	Thou-sand ton/ year	low	458	459	460	460	460	460
		avg	459	460	461	461	461	461
		high	461	462	462	462	463	463
UB total solid waste employment	People	low	25,863	26,757	26,805	26,839	26,857	26,868
		avg	25,873	26,773	26,823	26,854	26,872	26,882
		high	25,883	26,789	26,839	26,870	26,886	26,897
UB solid waste collection rate	%	low	78.1%	92.5%	92.6%	92.6%	92.6%	92.6%
		avg	78.2%	92.6%	92.6%	92.6%	92.6%	92.6%
		high	78.3%	92.6%	92.7%	92.6%	92.6%	92.6%
UB solid waste separation rate	%	low	33.9%	47.6%	49.6%	51.0%	51.7%	52.1%
		avg	33.8%	47.8%	49.8%	51.1%	51.8%	52.2%
		high	33.8%	47.9%	50.0%	51.3%	51.9%	52.2%
UB solid waste recycling rate	%	low	2.6%	12.1%	12.0%	12.0%	12.0%	12.0%
		avg	2.6%	12.1%	12.1%	12.1%	12.1%	12.1%
		high	2.6%	12.1%	12.1%	12.1%	12.1%	12.1%

			2030					
Green Indicators	Unit	MP	BAU	2.0%	2.5%	3.0%	3.5%	4.0%
Water								
National share of access to clean water	%	low	64.2%	94.6%	97.5%	100.0%	100.0%	99.9%
		avg	64.1%	94.5%	97.8%	99.9%	99.8%	99.9%
		high	64.1%	94.9%	98.0%	99.8%	100.0%	100.0%
UB share of access to clean water	%	low	72.4%	99.6%	99.6%	100.0%	100.0%	100.0%
		avg	72.3%	99.4%	99.6%	99.6%	99.7%	99.8%
		high	72.3%	99.6%	99.6%	99.8%	100.0%	100.0%
Other cities share of access to clean water	%	low	65.3%	91.3%	96.5%	99.9%	100.0%	100.0%
		avg	65.2%	91.7%	97.0%	99.7%	100.0%	100.0%
		high	65.2%	92.2%	97.5%	99.5%	100.0%	100.0%
Rural share of access to clean water	%	low	42.9%	85.3%	93.4%	100.0%	100.0%	99.6%
		avg	42.9%	85.9%	94.2%	100.0%	100.0%	100.0%
		high	42.9%	86.6%	94.9%	100.0%	100.0%	99.5%

National share of access to sanitation	%	low	32.4%	57.9%	64.6%	70.8%	76.5%	81.8%
		avg	32.4%	58.5%	65.3%	71.5%	77.2%	82.5%
		high	32.4%	59.0%	65.9%	72.1%	77.9%	83.4%
UB share of access to sanitation	%	low	46.5%	62.8%	69.2%	75.0%	80.4%	85.5%
		avg	46.5%	63.4%	69.8%	75.6%	81.1%	86.2%
		high	46.5%	63.9%	70.3%	76.3%	81.8%	87.0%
Other cities share of access to sanitation	%	low	19.9%	59.0%	66.2%	72.7%	78.6%	84.1%
		avg	19.8%	59.6%	66.9%	73.4%	79.3%	84.8%
		high	19.8%	60.2%	67.6%	74.1%	80.1%	85.7%
Rural share of access to sanitation	%	low	13.0%	44.7%	51.7%	58.2%	64.3%	70.1%
		avg	13.0%	45.3%	52.3%	58.9%	65.1%	70.9%
		high	13.0%	45.8%	53.0%	59.6%	65.9%	71.8%
UB annual water recycled	Million m3	low	12.1	16.0	17.0	18.1	19.2	20.3
		avg	12.1	16.1	17.1	18.2	19.3	20.4
		high	12.1	16.1	17.2	18.4	19.5	20.6
UB water recycling capacity	Million m3	low	13.5	17.8	18.9	20.1	21.3	22.5
		avg	13.5	17.8	19.0	20.3	21.5	22.7
			13.5	17.9	19.2	20.4	21.6	22.9
Construction								
UB residential reduction of heat loss	%	low	22.5%	27.5%	28.6%	29.8%	31.0%	32.1%
		avg	22.5%	27.6%	28.8%	29.9%	31.1%	32.3%
		high	22.5%	27.7%	28.9%	30.1%	31.3%	32.5%
UB residential high efficiency share	%	low	45.1%	55.0%	57.3%	59.6%	61.9%	64.2%
		avg	45.1%	55.2%	57.5%	59.9%	62.2%	64.6%
		high	45.1%	55.3%	57.7%	60.1%	62.6%	65.0%
Energy								
Real GDP Intensity	MNT 2005 / kgCO2	low	426	473	485	497	508	515
		avg	432	480	492	504	515	522
			439	488	500	512	523	530
Share of coal	%	low	97.9%	69.7%	65.3%	61.4%	57.9%	55.8%
		avg	97.9%	69.3%	64.9%	60.9%	57.4%	55.4%
		high	97.9%	69.0%	64.5%	60.5%	57.0%	55.2%
Share of solar	%	low	0.0%	0.9%	1.1%	1.2%	1.4%	1.5%
		avg	0.0%	1.0%	1.1%	1.3%	1.4%	1.5%
		high	0.0%	1.0%	1.1%	1.3%	1.4%	1.5%
Share of wind	%	low	0.8%	12.7%	14.7%	16.5%	18.1%	17.9%
		avg	0.8%	12.8%	14.9%	16.7%	18.3%	18.1%
		high	0.8%	13.0%	15.1%	16.9%	18.5%	18.0%
Share of hydro	%	low	1.3%	16.7%	18.9%	20.9%	22.7%	24.7%
		avg	1.3%	16.9%	19.1%	21.1%	22.9%	24.9%
		high	1.3%	17.1%	19.3%	21.3%	23.1%	25.3%
Share of renewables	%	low	2.1%	30.3%	34.7%	38.6%	42.1%	44.2%
		avg	2.1%	30.7%	35.1%	39.1%	42.6%	44.6%
		high	2.1%	31.0%	35.5%	39.5%	43.0%	44.8%
Ger coal demand	Thou-sand ton/ year	low	2,123	2,132	2,135	2,137	2,138	2,139
		avg	2,123	2,133	2,136	2,138	2,139	2,140
		high	2,124	2,134	2,136	2,139	2,140	2,141
Solid Waste								

UB waste generation	Thou-sand ton/ year	low	516	525	527	529	530	531
		avg	518	527	529	531	532	532
		high	520	530	532	534	535	535
UB total solid waste employment	People	low	31,941	34,254	34,342	34,417	34,479	34,532
		avg	31,974	34,292	34,380	34,456	34,517	34,562
		high	32,006	34,330	34,418	34,493	34,554	34,606
UB solid waste collection rate	%	low	99.1%	99.0%	99.0%	98.9%	99.0%	99.0%
		avg	99.1%	99.0%	99.0%	98.9%	99.0%	99.0%
		high	99.1%	99.0%	98.9%	98.9%	98.9%	99.0%
UB solid waste separation rate	%	low	34.8%	100.0%	100.0%	100.0%	100.0%	100.0%
		avg	35.1%	100.0%	100.0%	100.0%	100.0%	100.0%
		high	35.3%	100.0%	100.0%	100.0%	100.0%	100.0%
UB solid waste recycling rate	%	low	2.7%	34.6%	34.6%	34.5%	34.5%	34.5%
		avg	2.7%	34.6%	34.5%	34.5%	34.5%	34.5%
		high	2.7%	34.6%	34.5%	34.5%	34.5%	34.5%

Broadly, these four sectors do not show any significant correlation between low, average or high mineral prices.

Regarding construction, all GE investment scenarios fail to reach the targets set in the GDPolicy. This Policy sets the target of a reduction in building heat loss of 40% by the year 2030. The GE investment scenarios reach percentages from 27.5% with subdued prices and 2% investment to 32.5% with high prices and a 4% investment, falling short on average by 10% of the Policy goal.

Real GDP intensity, an important measure of how many units of GDP an economy creates per kg CO2 emission, increases slightly from only 324 MNT / kgCO2 in the starting year (2014) of the simulation to 530 MNT per kg CO2 emission with the highest GE investment scenario and high mineral prices. The mineral price variation will have an impact on GDP intensity within a GE scenario of around 3%. During the course of the simulation, the GDP intensity improves by 63.5% in the best case. Worldwide, however, Mongolia will likely keep ranking at the bottom of the IEA's GDP intensity ranking . The share of energy from coal, diesel and imports will steadily decrease with the amount of GE investments. Energy produced from wind farms and hydro-electric energy generation dominates the renewable energy mix, ranging from 12.7 to 18.0 TWh for hydro and 16.7 to 25.3 TWh for hydro and wind respectively. The variation of mineral prices only has an impact of 0.4% difference in the 2% GE investment scenario to 0.6% in the 4% GE investment scenario. This emphasizes that the renewable energy creation isn't significantly affected by a slowdown or pickup in mining production. The share of renewables will reach around 30% by 2030 in the lowest GE investment scenario and a significant 44.6% in the highest GE investment scenario.

By 2030, almost all waste in Ulaanbaatar city will be collected and sorted. However, only 34% will be recycled across all 15 scenarios, showing a similar independent behavior from mining prices during the simulation, a trend similar to what we forecast for water.

4.7. RESULTS COMPARED TO GREEN DEVELOPMENT POLICY TARGETS

This section explores how the simulation compares to the goals set by the Mongolian Government. Targets or criteria are set out for the years 2020 and 2030. The following Table 34: GDPolicy Goals and Criteria illustrates these targets. Within the scope of this work and the T21 modelling, not all criteria were compared.

Table 34: Green Development Policy Goals and Criteria

#	Criteria \ Indicators	2020	2030
1	Share of renewable energy in total installed capacity of energy production	20%	30%
2	Share of reduction of building heat loss	20%	40%
3	Waste recycling share	20%	40%
4	Share of expenditure in green development in total GDP	2%	3%
5	Share of expenditures for science and technology research in total GDP	2%	3%
6	Share of green procurement in total government procurement	20%	30%
7	Share of protected areas	25%	30%
8	Increased investment in environmental protection and restoration	20%	30%
9	Share of forest area in total territory	9%	9%
10	Percentage of population with access to qualified drinking water	80%	90%
11	Percentage of population with access to improved sanitation facilities	40%	60%
12	Poverty level	24%	15%
13	Percentage of green facilities in Ulaanbaatar city and other urban areas	15%	30%
14	Share of agriculture and manufacturing in total GDP	28%	30%

Numbers in red indicate failure to reach a GDPolicy target and numbers in green indicate achievement of the policy target.

Table 35: Green Development Policy Targets and Scenario Comparison

#	2020	BAU	2.0%	2.5%	3.0%	3.5%	4.0%
1	20	2.2%	3.5%	3.5%	3.5%	3.5%	3.5%
2	20	7.3%	8.7%	8.8%	8.8%	8.9%	9.0%
3	20	2.6%	12.1%	12.1%	12.1%	12.1%	12.1%
4	2	NA	NA	NA	NA	NA	NA
5	2	NA	NA	NA	NA	NA	NA
6	20	NA	NA	NA	NA	NA	NA
7	25	NA	NA	NA	NA	NA	NA
8	20	NA	NA	NA	NA	NA	NA
9	8.5	NA	NA	NA	NA	NA	NA
10	80	71.7%	75.7%	76.5%	77.3%	78.1%	78.8%
11	40	30.9%	35.0%	35.6%	36.2%	36.7%	37.3%
12	24	14.8%	14.2%	14.1%	14.0%	13.8%	13.6%
13	15	NA	NA	NA	NA	NA	NA
14	28	29.6%	29.4%	29.3%	29.3%	29.2%	29.2%

Table 36: Green Development Policy Targets and Scenario Comparison

#	2030	BAU	2.0%	2.5%	3.0%	3.5%	4.0%
1	30	2.1%	30.7%	35.1%	39.1%	42.6%	44.6%
2	40	22.5%	27.6%	28.8%	29.9%	31.1%	32.3%
3	40	2.7%	34.6%	34.5%	34.5%	34.5%	34.5%
4	3	NA	NA	NA	NA	NA	NA
5	3	NA	NA	NA	NA	NA	NA
6	30	NA	NA	NA	NA	NA	NA
7	30	NA	NA	NA	NA	NA	NA
8	30	NA	NA	NA	NA	NA	NA
9	9	NA	NA	NA	NA	NA	NA
10	90	64.1%	94.5%	97.8%	99.9%	99.8%	99.9%
11	60	32.4%	58.5%	65.3%	71.5%	77.2%	82.5%
12	15	12.4%	10.7%	10.4%	10.1%	10.0%	10.0%
13	30	NA	NA	NA	NA	NA	NA
14	30	27.9%	26.9%	26.7%	26.5%	26.4%	26.4%

Table 35 shows that, because of a late investment in green development policies compared to the start of the simulation, most of the criteria will not be achieved by year 2020. Only the targets of reducing poverty below 24% and having a share of agriculture and industry to 28% of the total GDP are achieved in all scenarios. Both of these targets are achieved even in the BAU case with no additional GE investment. There is simply not enough time for the other criteria to be reached by the year 2020.

Looking at Table 36 and the targets to be achieved by 2030, we see different and better results. Criteria 1 "Energy from Renewables" will be reached even with a smaller 2% GE investment starting in the year 2020. With the biggest GE investment scenario the share of renewables reaches a remarkable 44.6% hinting that if a relatively big amount of GE investment is made, the allocation to the energy sector should be less than 70%.

The share of reduction in building heat loss as well as waste recycling cannot be reached in all of the 5 GE investment scenarios by 2030, also hinting a slightly different allocation of GE investment capital.

Targets 10, 11 and 12 are achieved in all scenarios except target 11 in the 2% GE investment scenario that narrowly misses the necessary 60% by 1.5 percentage points by the year 2030. Access to qualified drinking water (10) and sanitation (11) as well as the poverty level (12) are positively well beyond the target rate. Access to qualified drinking water reaches levels of 94.5% in the lowest GE investment scenario with 2% as share of GDP up to almost complete access for every resident in the best case. Access to sanitation reaches levels from 58.5% to 71.5% in the 3% GE investment scenario and a satisfactory 82.5% in the 4% GE investment scenario. These are all acceptable rates considering that half of the residents in Ulaanbaatar live in traditional ger housing.

The poverty level, target 12 is in all green investment scenarios at around 10%, which is below the target rate by almost 5%. The BAU Case anticipates a 2% higher rate of the poverty level, emphasizing the positive effect of GE investments for the Mongolian economy.

5. CONCLUSIONS

The T21 modelling for the Mongolian economy was aimed at exploring the impacts of investment in green economy as well as to investigate the impact of the significant share of GDP of the mining sector by comparing the prices of the four most important minerals (gold, copper, iron ore and coal). The investment in green economy sensitivity analysis comprises 5 investment scenarios from the year 2020 to the year 2030, starting at 2% investment per year as share of GDP up to 4%, in 0.5% increments. They were compared to a scenario were no actions regarding green policies were taken, referred to as the (BAU) case, to emphasize their impact in achieving medium and long- term sustainable development policy targets set by the Mongolian Government. This GE investment sensitivity analysis was also done for three different mineral price scenarios – as shown in the summary tables sections – to explore their impact with regard to changing mineral prices.

The different GE investment scenarios clearly show benefits in every sector. They have positive impacts throughout the different mineral price scenarios on the main indicators of an economy as well as on the green indicators that represent a transition to a green economy.

Regarding the allocation of the four different sectors of the GE investments, it shows that the energy sector is by far the main recipient, receiving a 70% share. This number significantly exceeds the GDPolicy targets set by the Mongolian Government for 2030 in the scenarios that invest more than 2% in GE. This relative overinvestment in energy in the aforementioned scenarios can be allocated to the construction sector and waste management to achieve an even better reduction in building heat loss and further improving the waste recycling rate. Reaching all targets simultaneously could not be achieved as criteria 14 “Share of Agriculture and Manufacturing” remained weak in simulations (not included in this report). This is due to the underlying fundamentals and composition of Mongolia’s economy as well as natural circumstances, namely a dry continental climate and harsh winters. Generally, the GE investment scenarios show significant improvements, even in cases where the targets were not achieved, compared to the BAU scenarios. As usual, investments need time for many of their effects to become tangible. Besides, even in cases in which targets were not achieved, the GE investment scenarios show that they could represent significant improvement in comparison to the BAU scenario.

By implementing green development policies and translating those into real world benefits, the decline of access to water at the national scale can be reversed, access to sanitation can be significantly improved and the CO_2 footprint can be reduced by using a lot less fossil fuels, especially coal. Along with these indicators, the general wellbeing of people will improve compared to the BAU, again emphasizing the need to act towards a sustainable future, especially in the case of Mongolia with its vast resources of fossil fuels.

If Mongolia can implement its Green Development Strategy, not only national objectives but also the internationally agreed targets from the UN’s Sustainable Development Goals will be met, as shown in the table 37 below.

Table 37: Strategic objectives of the GDPolicy vs. SDG's

Strategic objectives of GDPolicy	Sustainable Development Goals
Objective 1	SDG 3: Good Health SDG 9: Industry, Innovation and Infrastructure SDG 12: Responsible Consumption SDG 15: Life on Land
Objective 2	SDG 6: Clean Water and Sanitation SDG 13: Climate Action SDG 14: Life Below Water
Objective 3	SDG 1: No Poverty SDG 7: Affordable and Clean Energy SDG 9: Industry, Innovation and Infrastructure SDG 17: Partnerships for the Goals
Objective 4	SDG 4: Quality Education SDG 5: Gender Equality SDG 8: Decent Work and Economic Growth SDG 10: Reduced Inequalities
Objective 5	SDG 11: Sustainable Cities and Communities SDG 12: Responsible Consumption and Production SDG 17: Partnerships for the Goals
Objective 6	SDG 6: Clean Water and Sanitation SDG 13: Climate Action

6. POLICY PROPOSALS AND RECOMMENDATIONS

It can be seen from the result of the research that transitioning to a green economy faster and more efficiently, general actions such as fostering cooperation among sectors, monitoring implementations of projects and programmes and increasing funding for sectors should be carried out.

In addition, the current situations of each sectors, next necessary steps and their competent institutions, and suggested solutions are shown in the Table 38.

Mongolian economy is precariously dependent on mining industry and volatile due to a global commodity prices. However investment in green economy can bring a long-term and sustainable growth.

Table 38: Policy Proposals & Recommendations

	Activities	Current situation	Solution	Responsible organization
	General recommendations			
1	Improve inter-sectorial cooperation.	Poor policy coordination between sectors. GDPolicy performance planning working group was established, but ceased working.	To solve problems of interrelated sectors will save time and money rather than solving these separately.	MET
2	Monitor and review Project and Programme implemen-tations.	Lack of information on concerned projects and implementation processes.	Project implementation status to be reported annually and electronically.	Relevant ministries
3	Ensure Financing	Foreign direct investment decreased due to declining revenue from mining sector.	Develop a long term finance Programme from budget and also with the help of FDI	Ministry of Finance
	Water sector			
4	Reduce the difference between pumped and sold water.	As of 2014, pumped and sold water ratio is 85.3%.	Increase the financing of pipes and network maintenance, and get financial assistance from donor institutions.	Water Supply and Sewarage Authority, Housing and Public Utilities Authority
5	Put meters in households and entities consuming water from centralized and non-centralized water sources.	Some old apartments and entities do not have water meters.	- Impose penalty on households and entities without water meters or increase the water usage fee several times in order to create economic leverage. -State should provide financial assistance for the installation of water meters.	MCUD, Water Supply and Sewarage Authority

6	Include grey water consumption in national long term policies.	- Grey water consumption is reflected in sectorial policy but not in national level policies. - Insufficient consumption of grey water.	- Include target percentage for grey water consumption in national policies.	MET
	Construction sector			
7	Define and implement concrete standards and norms in accordance with the green construction definition.	-No green construction standards. -Buildings are not built according to any standards.	-Introduce economic leverage, such as tax incentives or loans. -Introduce an evaluation system for grading green constructions.	MCUD, Agency for Standard and Metrology
8	Conduct green construction training for construction engineers	No training halls or trainers.	Conduct training through the Mongolian Association of Civil Engineers.	Mongolia Green Building Council, Mongolian Association of Civil Engineers, CARITAS Czech International Organization
	Conduct green construction training for construction engineers			
9	To prepare skilled professional groups	Because of the shortage of professional groups, there are ineffective expenditures and improper handling of equipments.	To conduct renewable energy training and practice in foreign countries, possibly with PRC. Aim to adopt the best practices possible, while training specialists at a lower cost.	Ministry of Energy, MECS
10	Settle energy credit and debit issues.	State-owned energy companies are operating at loss.	Estimate the energy sector's real expenditures, liberalize prices and acknowledge the public on the important issues	ME, State Property Committee
11	Create opportunities for households and entities to produce small-scale renewable energy	Absence of economic and legal environment to promote small renewable energy sources. For example, there is no opportunity to sell the excess renewable energy produced by households to the central energy grid	-Introduce a service control system to receive excess household energy, into an integrated system. -Provide state support to households self-supplying energy using renewable sources, such as through concessional loans or tax incentives.	MoE, ToC Initiative

	Solid waste			
12	The Law on Waste	Law on Waste contains definition of domestic waste but no definition of solid waste and sorting out and grouping of waste.	In a PPD process, develop proper definitions and classification of different categories of waste such as domestic, industrial, service and solid waste.	MET MMongolia, National Association of Solid Waste Recycling, Office of the UB City Governor
13	Conduct waste sorting training and promotion activities in communities.	It becomes impossible to recycle waste because it is transported without being sorted. Waste which could be recycled are landfilled and has a negative impact on the environment.	Raise public awareness through media about waste classification, recycling and production. Information could, for example, spread through TV ads.	MET, Office of the UB City Governor, Mass media
14	Start pre-sorting process at organizational level	Because of the shortage of easily accessible garbage bins for sorting waste, waste which could be recycled are mixed with other waste, having a negative impact on the environment and human health.	Waste segregation into two types of waste bins designated for recyclable and non-recyclable waste. These are to be gradually introduced to households. Sorted waste should be transported separately.	MET , Office of the UB City Governor, Mongolian Trade Union Federation
15	Establish a waste removal and recycling plant, in parallel	Number of recycling plants is low, and those are insufficient to sort out waste.	Provide support through concessions and incentives to individuals who want to establish recycling plants.	
16	Conduct waste management by granting incentives through product purchase.	People throw glass and plastic bottles together with unrecyclable wastes.	Through supermarkets and big shops, introduce a system to collect recyclable glass and plastic bottles. Offer incentives in return for people who bring them and send them to recycling industries.	

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8. APPENDIX

APPENDIX 1

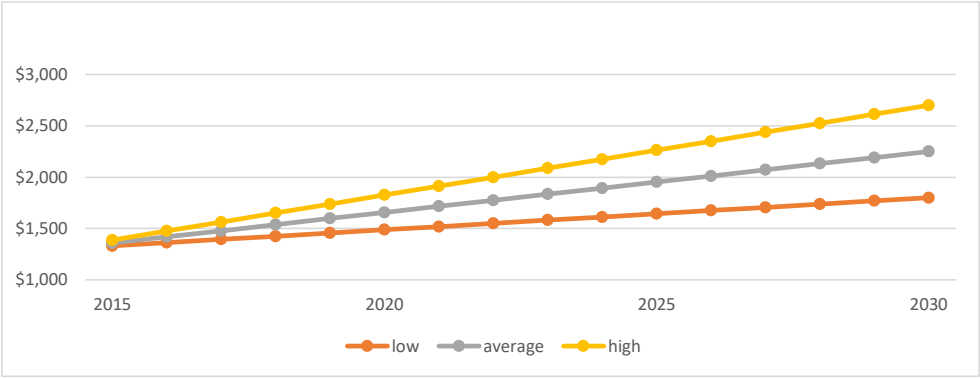
Full list of specific variables added to the T21 Model by their developers & contributors at the Ministry of Finance:

- Non OT TT mining tax rate
- Non mining industry tax rate
- Gold price
- Iron price
- Coking coal price
- Copper price
- Copper concentrate as share of copper price
- Use of stability fund (not used)
- Gold production
- Iron ore production
- Coal production
- Share of coking coal in coal production
- Erdenes TT starting year
- Erdenes TT coking coal production
- Erdenes TT non coking coal production
- Erdenes TT government share
- OT copper 100% production
- OT gold production in kg
- OT government share
- Share of OT TT revenue that is deposited in stability fund (not used)
- Year of next Dzud
- Magnitude of Dzuds compared to 2010
- Frequency of Dzuds
- Fifth CHP phase 1 starting year
- Fifth CHP phase 2 starting year
- Improved Stove Programme
- Share of GE for Ulaanbaatar waste, water and renovation investment
- Improved stove sales
- CHP 2 - 4 annual water usage
- Fifth CHP per MW water usage
- UB required subsidy for access to clean water per person
- Solid waste generation from ger households using traditional stoves
- Solid waste generation from ger households using improved stoves
- Construction costs per square meter
- Ulaanbaatar building areas in square meters per person in residential area
- Ulaanbaatar ratio of commercial to residential area
- Required subsidy per square meter of renovation
- Ulaanbaatar high efficiency share of new residential buildings
- Average annual heating coal required for low and high efficiency buildings
- Net rural migration to Ulaanbaatar
- Net rural migration to other cities
- Shares of people living in ger households in Ulaanbaatar, other cities and rural

APPENDIX 2

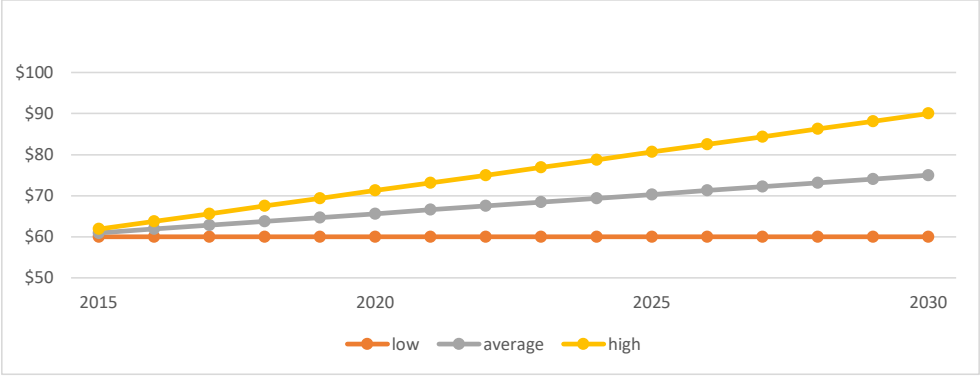
The estimation of the prices up to the year 2030 of these four minerals are partly based on qualitative estimations done by Bloomberg, EIA, BMI and ISCG.

Figure 45: Gold Price Estimate



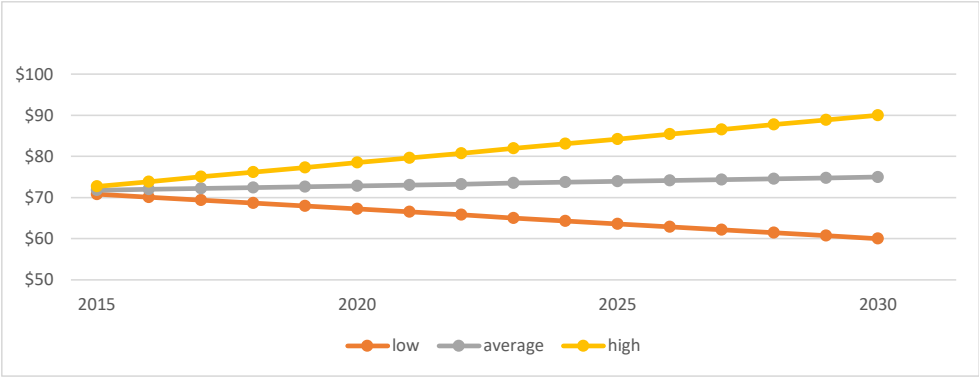
Source: BMI Research BMI Gold Report

Figure 46: Coal Price Estimate



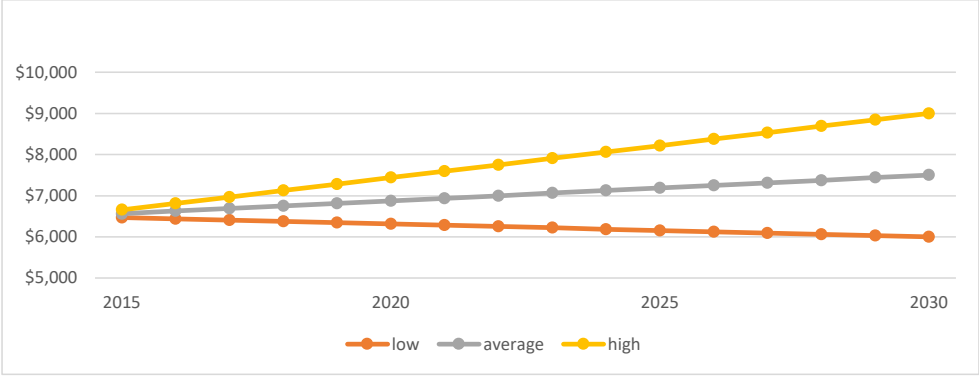
Source: EIA International Energy Outlook 2016

Figure 47: Iron Ore Price Estimate



Source: Bloomberg Iron ore 2016 midyear outlook

Figure 48: Copper Price Estimate



Source: International Copper Study Group ICSG Website

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