Climate Change and Renewable Energy

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DOHWA

Contents

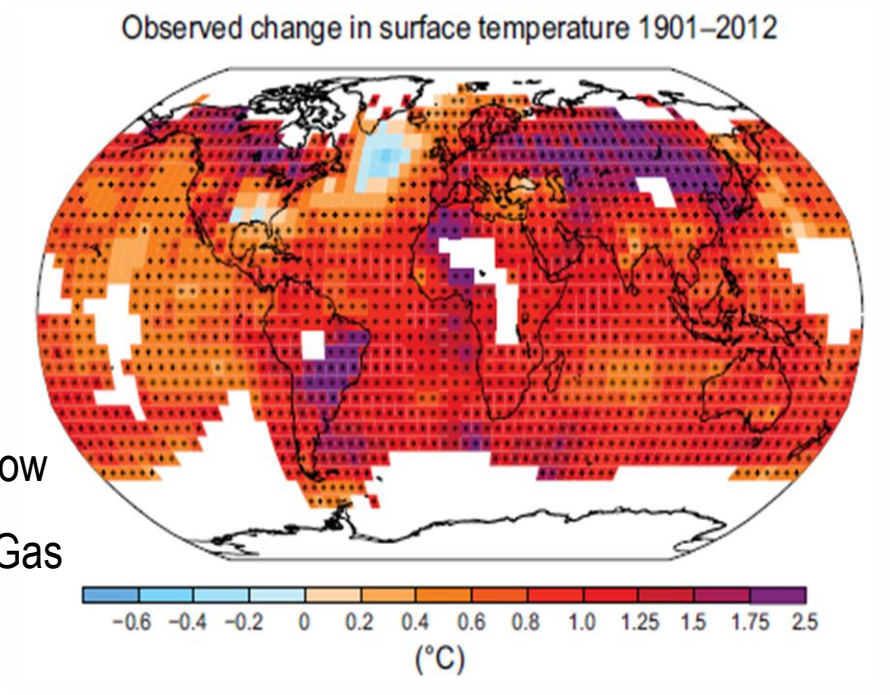
1. Climate change

1 Climate Change

1. Necessity of Climate Change Response

"Warming of the climate system is unequivocal," IPCC Assessment Report 5

- Most of the changes observed since the 1950s are unparalleled in history.
  - Sustained warming tendency of the atmosphere and oceans
  - Reduction of amount of the glacier and snow
  - Increase of Accumulation of Greenhouse Gas



Rising Trend of Average Temperature !!

1 Climate Change

2. Necessity of Green House Gas Reduction

"Human influence on the climate system is clear", IPCC AR5

1) The concentration of the CO_2 has increased since the Industrial Revolution.

- The concentration of the CO_2 has increased by 40% since the industrialization and increased by 20% since 1958, the beginning of the systematized measurement.

2) If the average temperature rises by 2 °C, expected (2050)

- Rising sea level by 90cm
- 30% species extinction
- 2 billion people suffer water shortage
- 30 million people have flood risk
- 30 million suffer famine
- Greenland glaciers and Andean annihilation

3) The Average Temperature expected to increase by 3.7 °C (2100)

The Average Temperature of Korea expected to increase by 2 °C (2050)

We need the active effort of the world for reduction of GHG

1 Climate Change

3. Recent Climate Change of Korea

- The average temperature has increased by 1.2°C for the past 30 years

Korean government set up the adaption measures for the climate change.

1 Climate Change

4. What is UNFCCC (United Nations Framework Convention on Climate Change)?

- The United Nations Framework Convention on Climate Change (UNFCCC) is a convention to regulate the anthropogenic emission of greenhouse gases.

- The Convention on Climate Change was adopted by the United Nations Conference on Environment and Development (UNCED) in Rio in June 1992 with the Convention on Biological Diversity and entered into force on 21 March 1994.

- 197 countries joined the Convention on Climate Change in 2017 and Korea joined the Convention for the 47th time in December 1993.

- The Convention on Climate Change covers the preparation of a national report on the implementation of policies and national statistics on the status of GHG emissions and removals in each country, **the establishment and implementation of domestic policies to reduce greenhouse gas emissions**, and the recommendation to discard GHG emissions.

- All Parties to this Convention should establish national strategies for reducing GHG emissions, prepare national reports on GHG emissions and removals, and submit them to the Conference of the Parties (COP).

1 Climate Change

5. Kyoto Protocol

- The Kyoto Protocol is an agreement on a specific implementation plan of the United Nations Framework Convention on Climate Change. It works from 2005 to 2020

- A total of 153 countries have ratified the Kyoto Protocol.

- Target countries for reducing GHG are 38 countries in Annex I, except Turkey and Belarus

- Since Korea is an Annex II country, there was no obligation to reduce.

- Annex I countries for reducing GHG (As compared to 1990)

  Canada (-6%), the United States (-7%), Iceland (+ 10%), Norway (+ 1%), Poland (-6%), EU (-8%), Russia (0 %), Japan (-6 %), Australia (+ 8 %), New Zealand (0%)

- The United States, which accounts for 24% of world emissions and 36% of developed country emissions, realized that reduction of GHG emissions were virtually impossible.
  And the they declared withdrawal.(2001)

1 Climate Change

6. Limitations of the Kyoto Protocol

- **Current Issue**

- **Only EU-led advanced countries**(15% of global GHG emissions) **are obliged** to reduce greenhouse gas emissions.
- **Developing countries** that emit a large amount of greenhouse gases, such as China and India, **are not obliged** to be reduced.
- **The United States**(24% of global GHG) : **Refused** to ratify the Kyoto Protocol.
- **Japan, Canada, New Zealand : Declaration to abandon obligation** to reduce GHG emissions in second commitment period

After 2020, an effective system to replace the Kyoto Protocol system is needed.

1 Climate Change

- **New Approach Requirements**

- **Major advanced nations** such as the United States strongly **oppose** the existing Kyoto Annex system.
- Need for Establishment of new climate change **response system** which makes **all countries participate.**

- ***New reduction target setting system***
  - *. Intended Nationally Determined Contributions(INDCs*) that must be submitted mandatory*
  - *. Bottom-up Approach : The characteristic of the INDCs, the system makes all countries participate.*

1 Climate Change

7. From COP 17 to COP 22

COP 17
2011 Durban

- Subsequence of Kyoto protocol
- Settlement for New climate system

"New climate system is a new system that applies to all parties, unlike the Kyoto Protocol, which is led by developed countries.

COP 19
2013 Warsaw

- After 2020, settlement to submit INDC in 2015

※ INDC : Intended Nationally Determined Contribution

COP 20
2014 Lima

- Materialization of guidelines for INDC

① Principle of contribution

② Submission information

③ Submission Procedure

COP 21
2015 Paris

- New climate system establish settlement :

- INDC submissions of all parties.
- Ratification agreement in 2016

Discussing details of the Paris Convention at COP22 (November 2016, Marrakesh)

- A carbon market that trades GHG emissions reductions internationally.
- Transparency system for GHG mitigation and climate change adaptation actions and support
- How to make Nationally Determinded Contribution(NDC) that must be submitted mandatory every five years

1 Climate Change

8. Kyoto Protocol(1997) and Paris Climate Convention(2015)

- To compare with two agreements,
  - The contents are similar to prevent global warming by reducing carbon emissions from factories, industrial facilities and automobiles.
  - The most important difference is that all of the 197 Parties that participated in the Paris Climate Convention had a greenhouse gas reduction obligation, unlike the 1997 Kyoto Protocol, in which only 37 developed countries had obligations to reduce greenhouse gas emissions.

	Kyoto Protocol(1997)	Paris Climate Convention(2015)
Target Country	37 major advanced countries	197 Parties that participated in the Convention
Effective Period	Regulate the method of respond to climate change until 2020	New climate change system after 2020
Object and Main Contents	▪ Define greenhouse gases which are the principal cause of the CC. ▪ Reduced greenhouse gas emissions by an average of 5.2% over 1990. ▪ GHG reduction targets are assigned differently.	▪ The average temperature rise is limited to less than 1.5°C before industrialization. ▪ From 2020, at least $ 100 billion every year to support climate change projects in developing countries ▪ From 2023, all parties report the carbon reduction status every 5 years.
Korea	No obligation to reduce.	Reduce emissions by 37% compared to 2030 emission estimates.

1 Climate Change

9. Main Contents of Paris Climate Convention(2015)

Temperature	Keep temperature rise much lower than 2°C, especially to limit temperature rise to below 1.5°C as compared to the Industrialization
Funds	Since 2020, Advanced countries will have to pay at least US $ 100 billion each year to fund the GCF
Reduction Goal	The goal is to reduce GHG emissions as soon as possible and to reduce the global GHG emissions to net-zero by 2050.
Burden sharing	Advanced countries should take the lead in reducing GHGs, also developing countries should make efforts to reduce GHGs and gradually implement the reduction standards.
Regal binding force	Regulated as voluntary efforts by the US, China, and Korea, etc.
Review	Co-verification with global stocktaking system. Reviewed every 5 years.
Damage	Efforts to help countries vulnerable to climate change

1 Climate Change

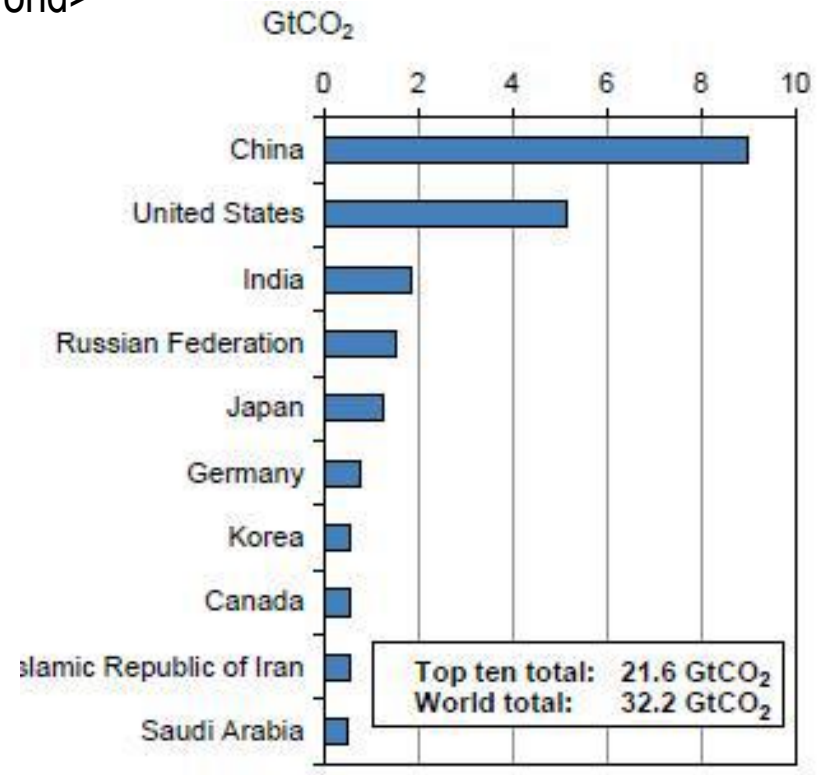
10. CO_2 Emissions in the world

- Looking at global CO2 emissions by country in 2013, China (28% of global emissions) and the United States (16% of global emissions) account for 44% of the world's carbon dioxide emissions and the top 10 countries account for 67%.

<CO_2 Emissions from Fuel Combustion in the World>

(Unit : million t CO_2)

		1990	2000	2010	2012	2013	INC/Dec Rate 90/13	INC/Dec Rate 12/13
World Total		20,623	23,322	29,838	31,491	32,190	56.1	2.2
Kyoto Protocol	Annex1	13,724	13,560	13,227	12,879	12,880	-62	-
	Non-Annex1	6,268	8,908	15,485	17,516	18,211	190.5	4.0
OECD	OECD	11,006	12,447	12,306	11,990	12,038	9.4	0.4
	Non-OECD	8,987	10,021	16,406	18,405	19,053	112.0	3.5
Top 7 mass emission countries	China	2,184	3,259	7,095	8,519	8,977	311.1	5.4
	US	4,802	5,643	5,356	5,032	5,120	6.6	1.7
	India	534	892	1,697	1,780	1,869	249.9	5.0
	Russia	2,163	1,474	1,529	1,551	1,543	-28.7	-0.4
	Japan	1,049	1,157	1,127	1,217	1,235	17.7	1.5
	Germany	940	812	759	745	760	-19.2	2.0
	Korea	232	432	561	575	572	147.0	-0.5



Source: IEA(2015), CO2 Emissions from Fuel Combustion

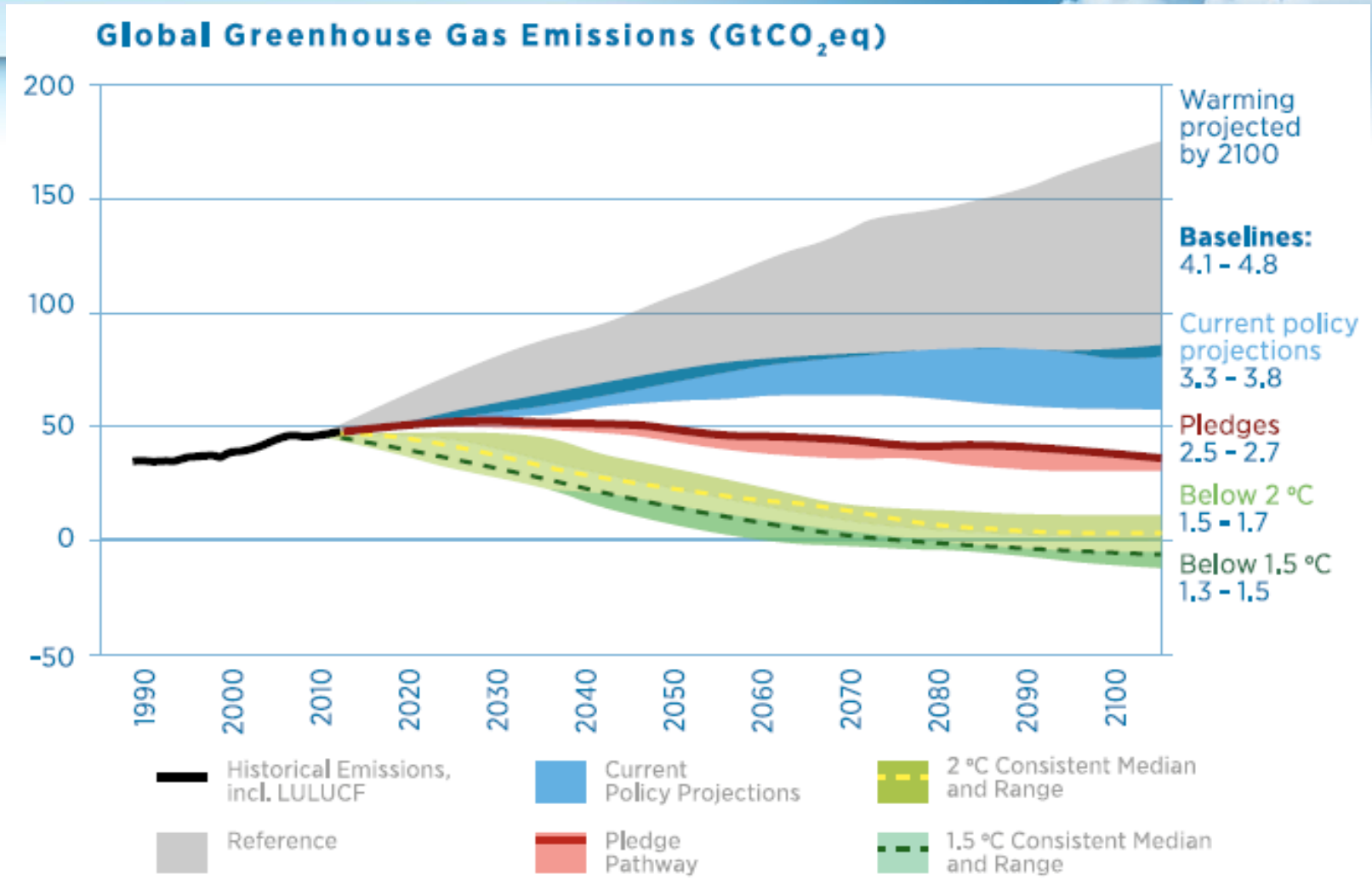
1 Climate Change

11. INDC form of Parties

- Submit the various forms of INDC considering national circumstances and characteristics
- 197 Parties submit the INDC (as of December 2016)
- More than 99% of the world's emissions and 99% of the world's population are covered by the Convention on Climate Change
- Present various basis forms of goals such as absolute amount, BAU(Business As Usual), and emission unit basis
- Contributing to the establishment of the basis for the Paris Agreement

Party	Form of Goal	Reduction Goal	Year of Goal	Basis Year
EU (28 Countries)	Absolute amount	40%	2030	1990 Emission
USA	Absolute amount	26~28%	2025	2005 Emission
China	Emission Unit	60~65%	2030	2005 Emission
Russia	Absolute amount	25~30%	2030	1990 Emission
Korea	BAU	37%	2030	2030 Predictive Emission
Japan	Absolute amount	26%	2030	2013 Emission
Mexico	BAU	25~40%	2030	2030 Predictive Emission

1 Climate Change



Effect of current pledges and polices on global temperature

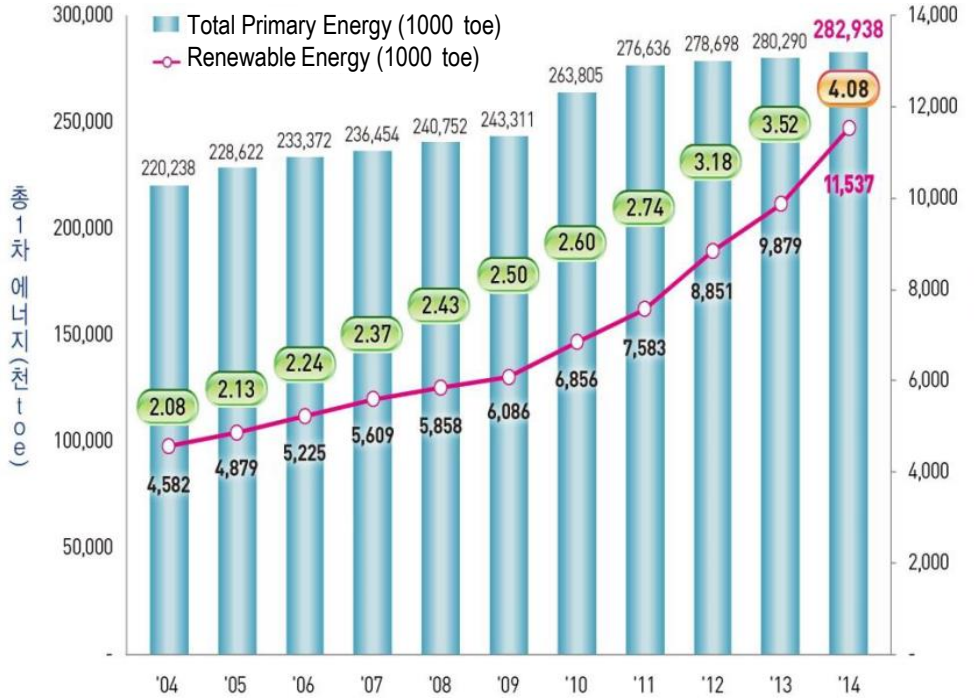
Source : Rethinking Energy, 2015, International Renewable Energy Agency

2. Trend of power market and renewable energy market

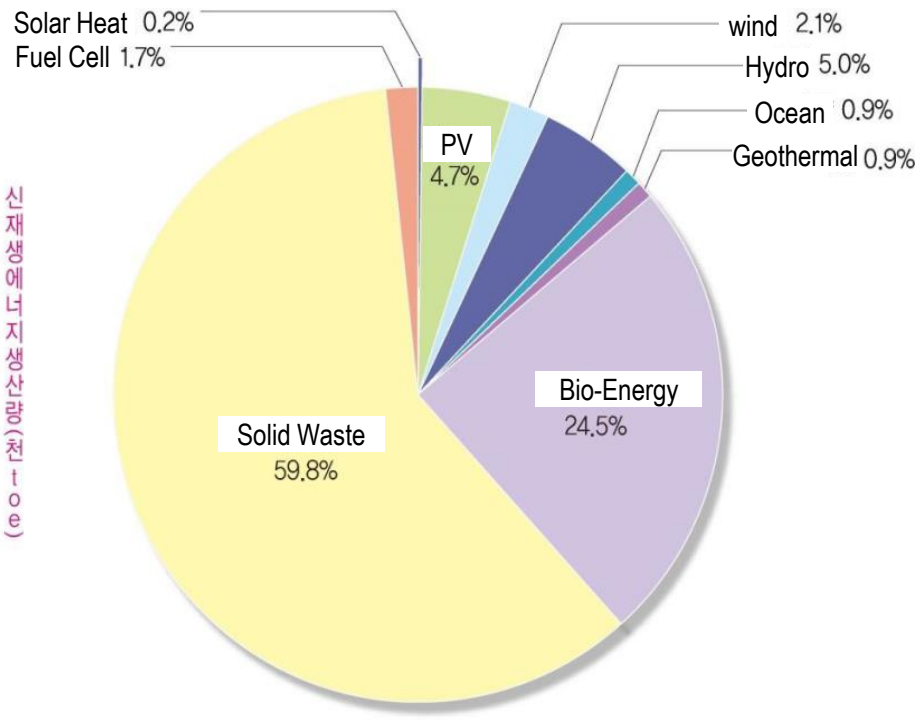
2 Trend of power market and renewable energy market

1. Korean Electric Market

- **Current status of renewable energy in Korea**
  - Domestic renewable energy supply has increased by average 11% per a year for the last 6 years
  - It is 4.08% as compare to primary energy and solid-waste and bio energy account for 84% in 2014



< Production and Proportion of Renewable energy >

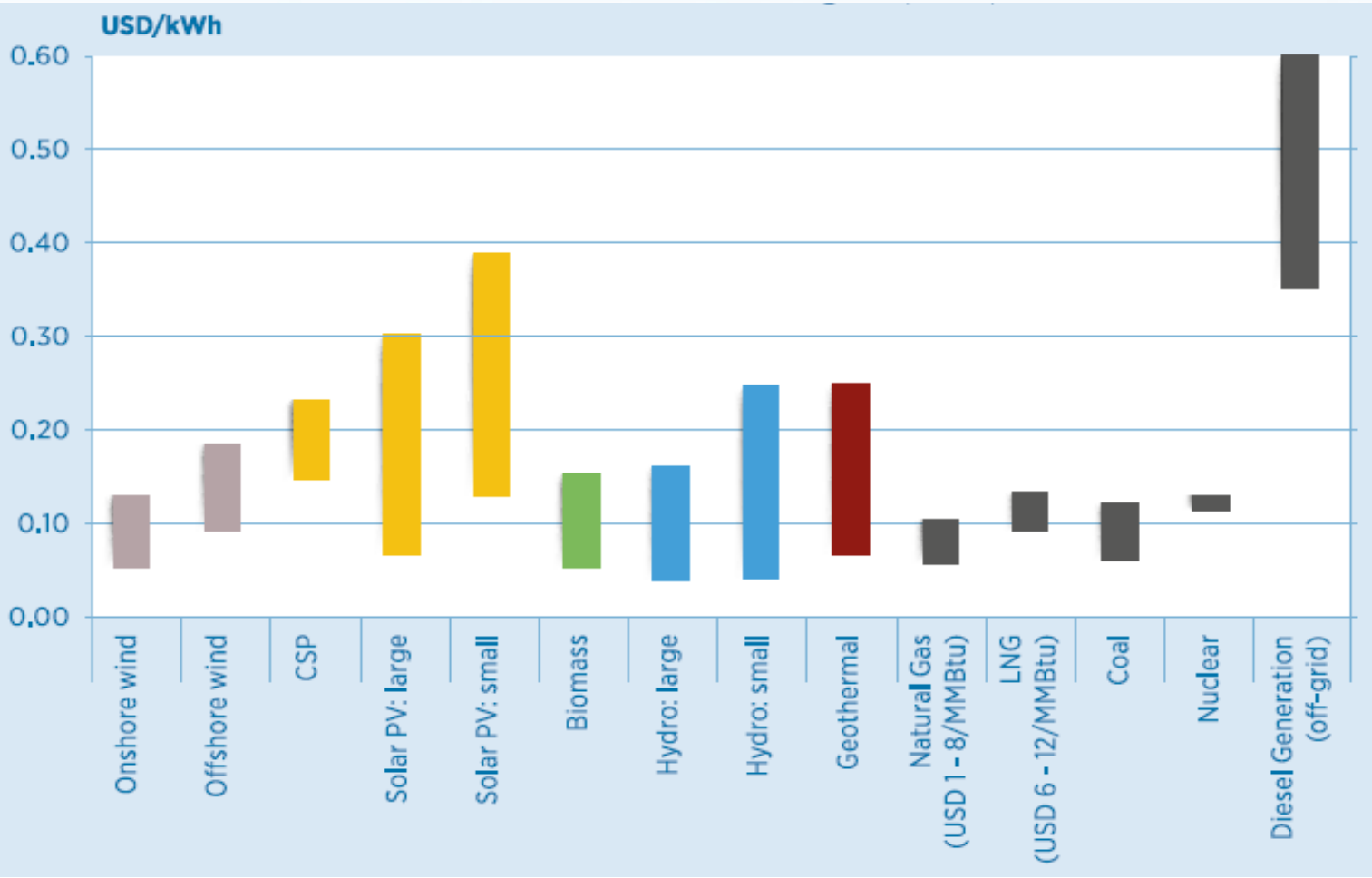


<Proportion of Supply by Renewable energy Source >

2 Trend of power market and renewable energy market

2. Power unit costs of energy source

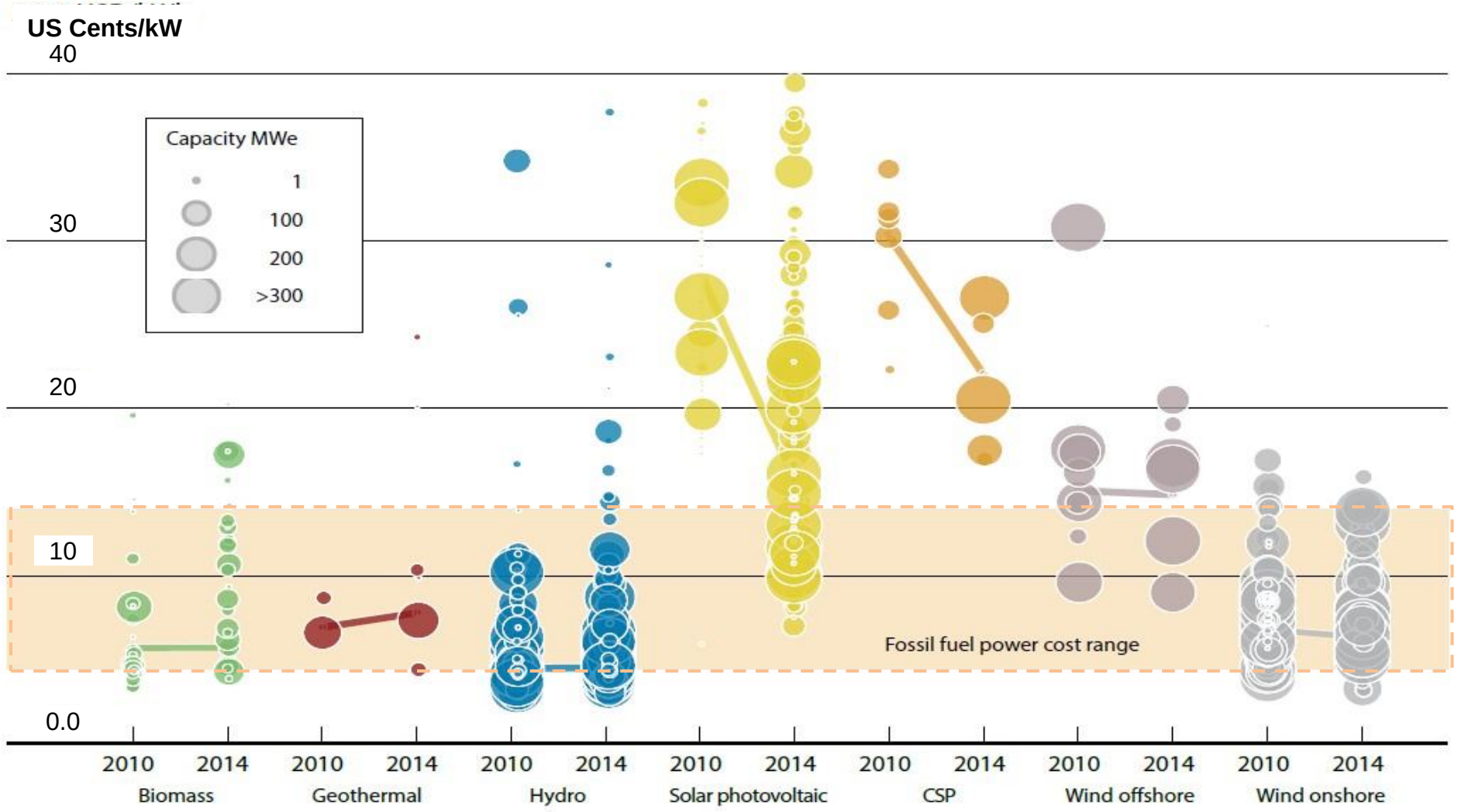
Costs for renewable energy technologies have fallen dramatically in recent years.



Source : Rethinking Energy, 2015, International Renewable Energy Agency

2 Trend of power market and renewable energy market

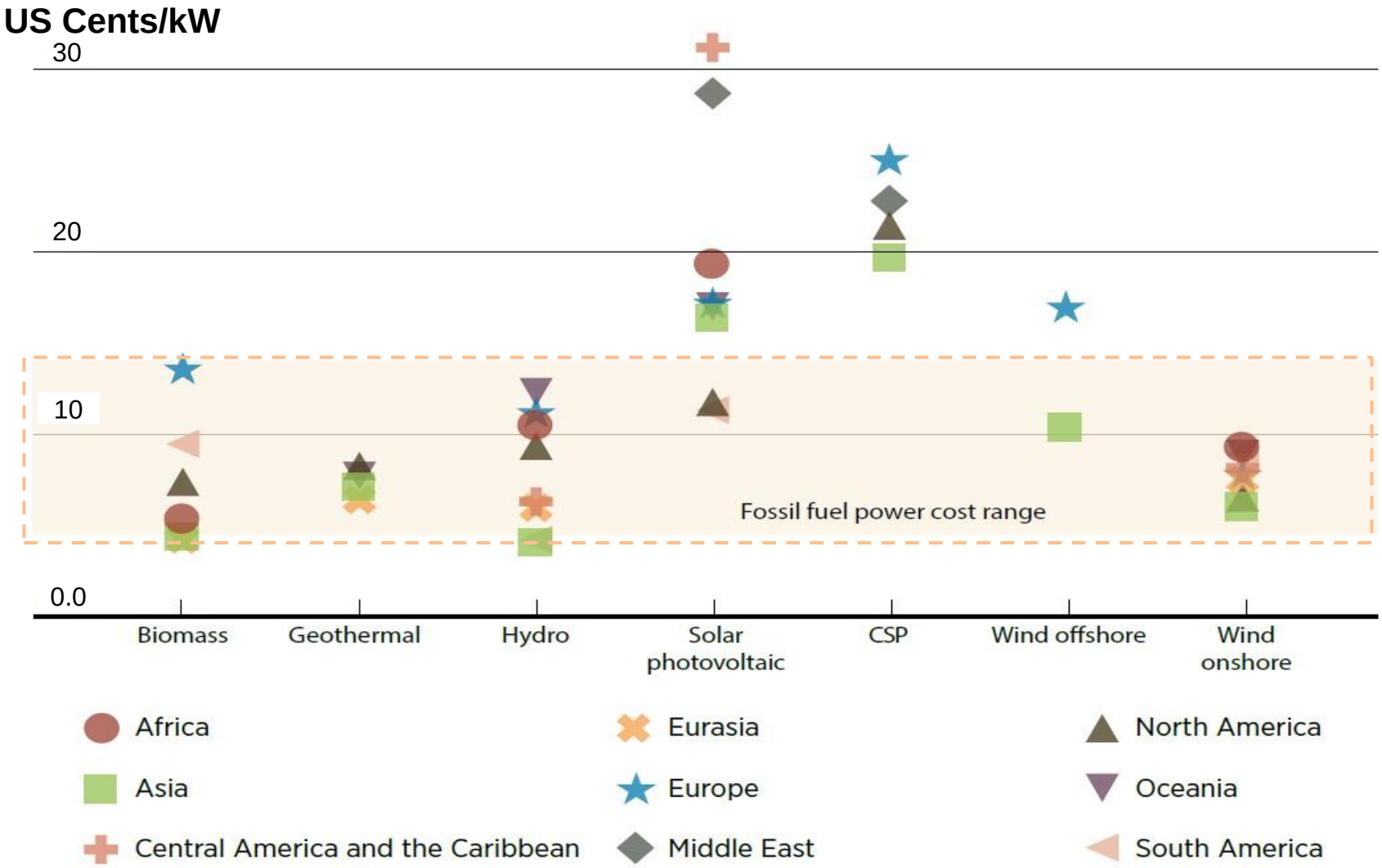
3. Global market of Renewable energy



Source : RENEWABLE POWER GENERATION COSTS IN 2014, International Renewable Energy Agency

2 Trend of power market and renewable energy market

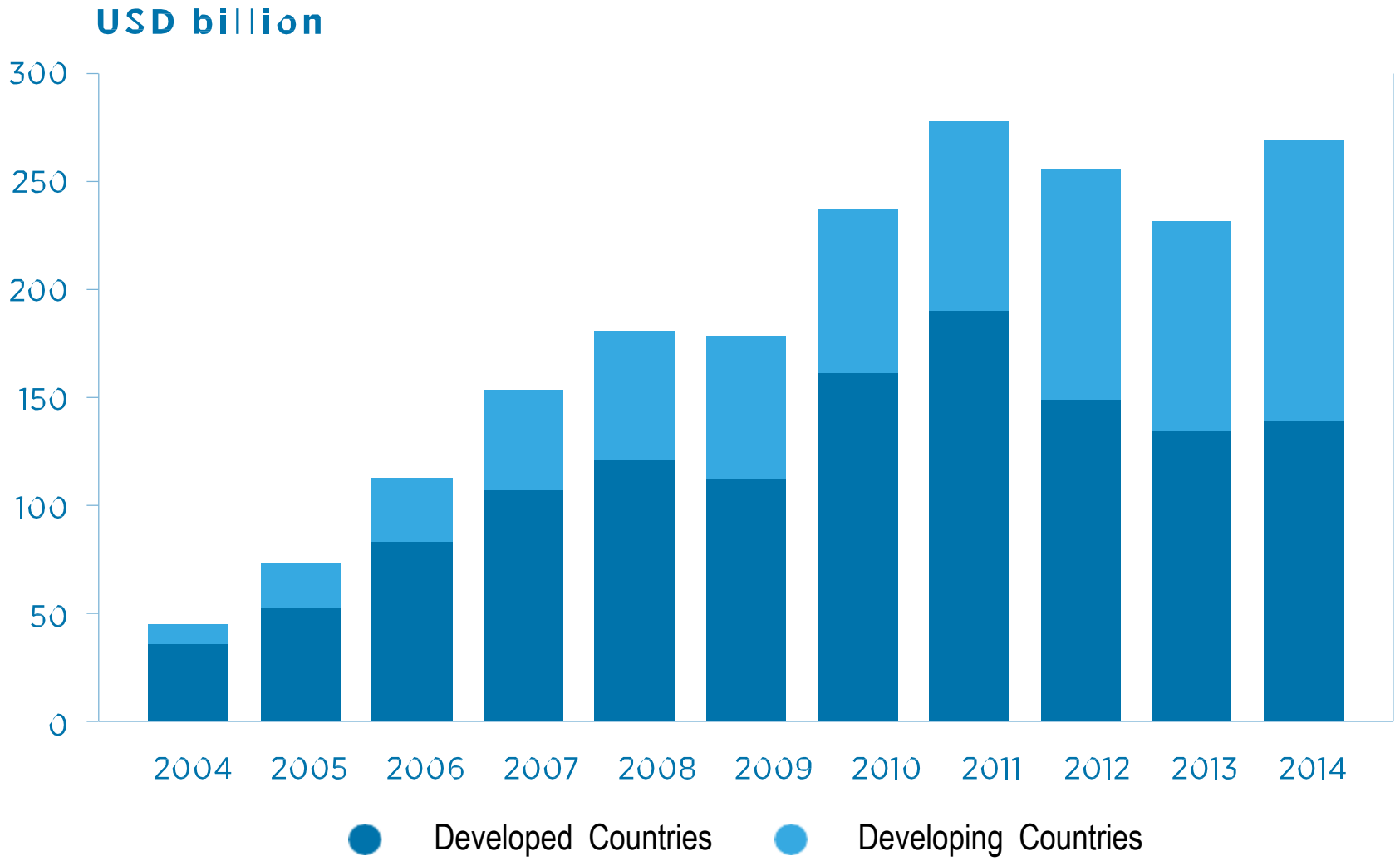
3. Global market of Renewable energy



Source : RENEWABLE POWER GENERATION COSTS IN 2014, International Renewable Energy Agency

2 Trend of power market and renewable energy market

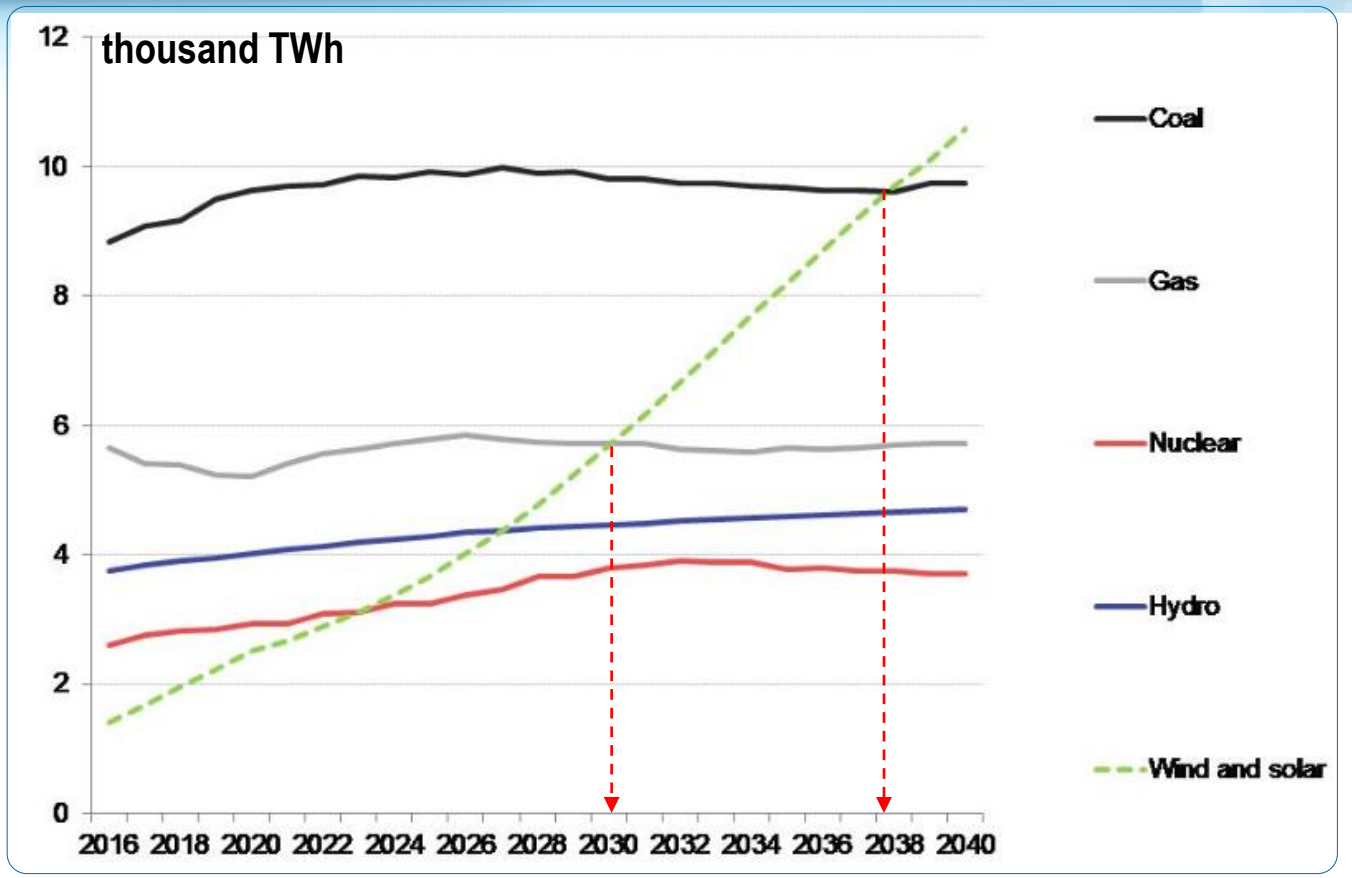
4. Global annual Investment in Renewable Energy (excluding large hydro)



Source : UNEP, BNEF and FS, 2015

2 Trend of power market and renewable energy market

5. Future electricity output by the major generating technologies



Source: Bloomberg New Energy Finance NEO 2016

Wind, solar, hydro and other renewable energy plants will generate 70% of Europe's power in 2040, up from 32% in 2015.

In the US, their share will jump from 14% in 2015 to 44% in 2040, as that from gas slips from 33% to 31%.

"Gas will be overtaken by renewables in 2030.
It will be 2040 before renewables overtake coal."

2 Trend of power market and renewable energy market

6. Power Supply Characteristics of Non-Urban Area

- Houses are scattered in each municipality in developing countries, making it difficult to bring grid from the existing thermal power plant

- Cost comparison :

  Cost of grid connection is higher than that of Independent Solar PV power installation.

  (2.7 PV cost = Grid connection cost)

"Small-scale renewable energy supply is efficient in non-urban area"

2 Trend of power market and renewable energy market

6. Power Supply Characteristics of Non-Urban Area

Applicability of Independent Power Grid

Classification	Type A (Large-scale power grid)	Type B (Small-Scale, Independent power grid)
Amount of Power used	Large	Small
Industrial structure	Mechanical equipment, Electric & Electronic Semiconductor, Automobile, Iron & Steel	Agriculture, Fisheries, Light Industry
Urbanization	Centralization	Decentralization
Unused Land	Small	Large
Power use & Grid length	Large & relatively short	Small & relatively long
Power consumption per capita	Large	Small
Power resources	Nuclear / Thermal / Hydro	Diesel (Heavy oil) / Gas
PV power generation time	Less than 3.5hrs	About 4.0hrs
Applied to	Hong Kong, Singapore, Korea, and big cities worldwide	Mongolia, Nicaragua, Guatemala, The Caribbean, and other island countries

3. Climate change and low-carbon business model

3 Climate change and low-carbon business model

1. Meaning of the new climate system

1) The new climate system is one in which all parties participate to the UNFCCC

- Paris Agreement Enacted on November 04th 2016
- As of November 23th 2016, 112 countries ratified (Korea ratified on November 3rd)

→ Increasing participation of developing countries in mitigation and adaptation for climate change

2) The new climate change system adopts a bottom-up approach in which the Parties determine their own contribution plans

- Suggest a contribution plan considering its economic and social conditions and capabilities
- Future controversy about equity and feasibility of contribution plans (reduction, financial support, etc.)

3) The new climate system requires a fundamental paradigm shift of energy policies.

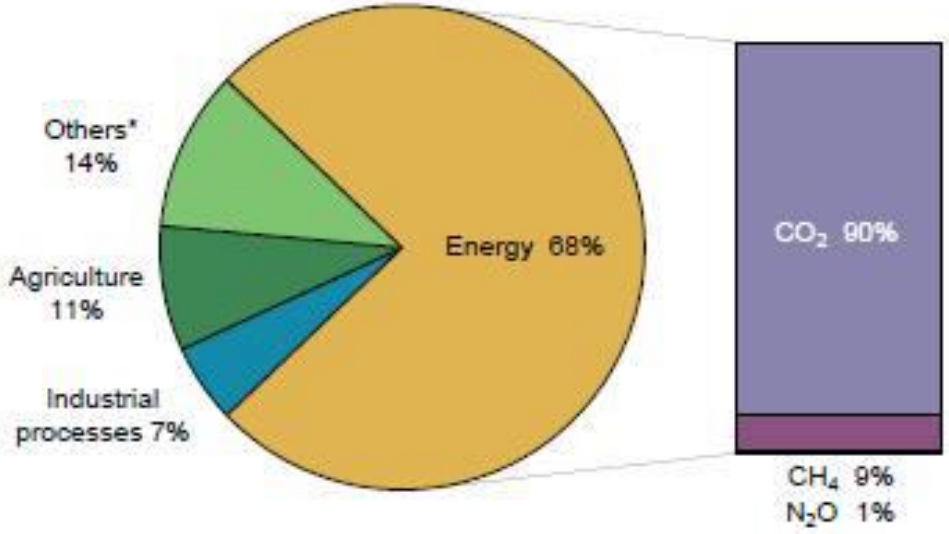
- The beginning of Post fossil energy age

→ ***The beginning of the era of high efficiency energy and renewable energy***

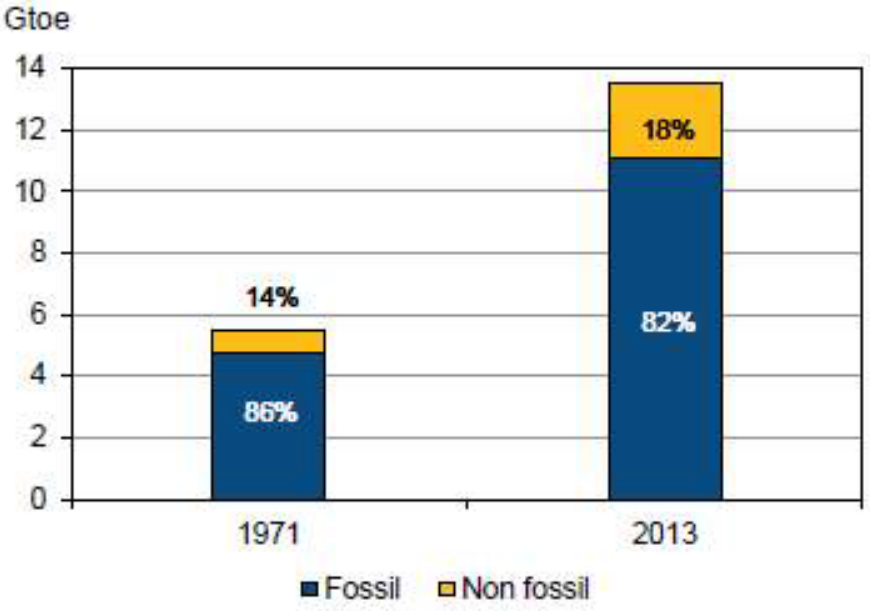
3 Climate change and low-carbon business model

2. CO_2 Emissions by Source of the world

- The increase in consumption of fossil fuels increase CO_2 concentration which is main cause of GHG emissions increase. (global CO_2 concentration increases 42% from 1990 (280ppm) to 2014 (397ppm)).
- In 2013, the energy sector (fuel combustion) accounted for 68% (the industrial sector : 7%, the agricultural sector : 11%, and the other : 14%) in the global greenhouse gas emissions (CO_2, CH_4 and N_2O).
- In 1971 and 2013, the world's total primary energy supply (TPES) increased by about 150%, with most of the increase in consumption was from fossil fuels.



<Proportion of global GHG emission sources (2013)>



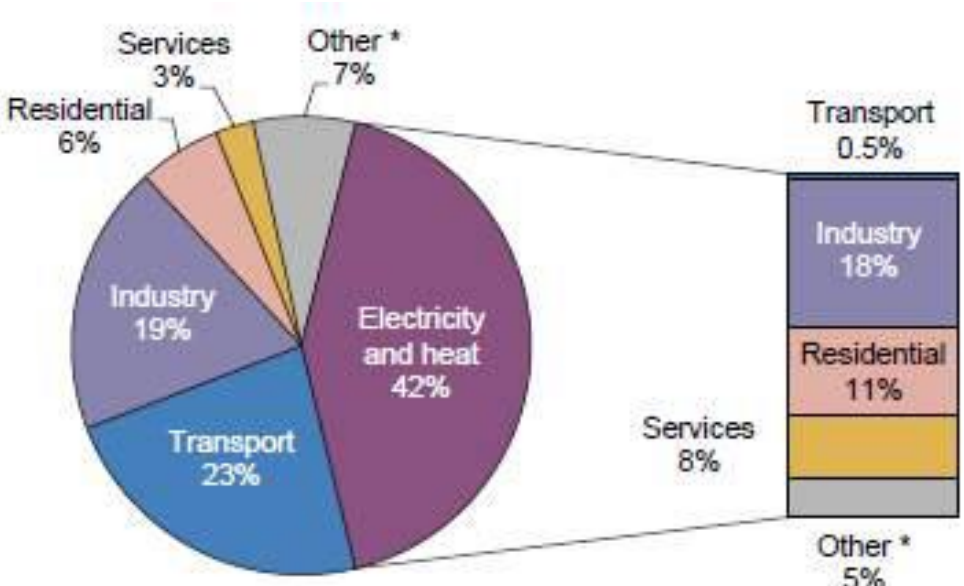
<Primary energy consumption trend of the world (1971, 2013)>

Source: IEA (2015), Key Trends in CO2 Emissions

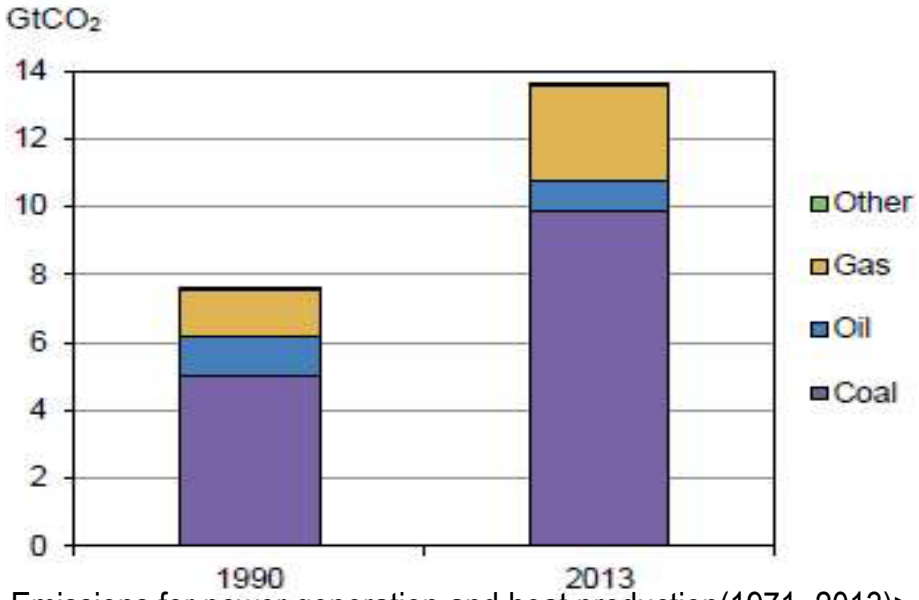
3 Climate change and low-carbon business model

3. CO_2 Emissions by Sector or the world

- Electricity production (power generation, heat production) is 42%, transportation sector is 23%, industry sector is 19%, household sector is 6%, service sector is 3%, and other sectors (agriculture / forestry, Energy production other than electricity generation and heat) accounted for 7%.
- From 1990 to 2013, the proportion of **Oil** in fuel used in power and heat production has decreased steadily, the proportion of **Gas** has slightly increased, and the proportion of **Coal** has increased significantly from 66% to 72%.
  - GHG emissions almost doubled due to the rapid increase in coal use from 1990 to 2013.



<Proportion of Global CO_2 Emissions by Sector (2013)>



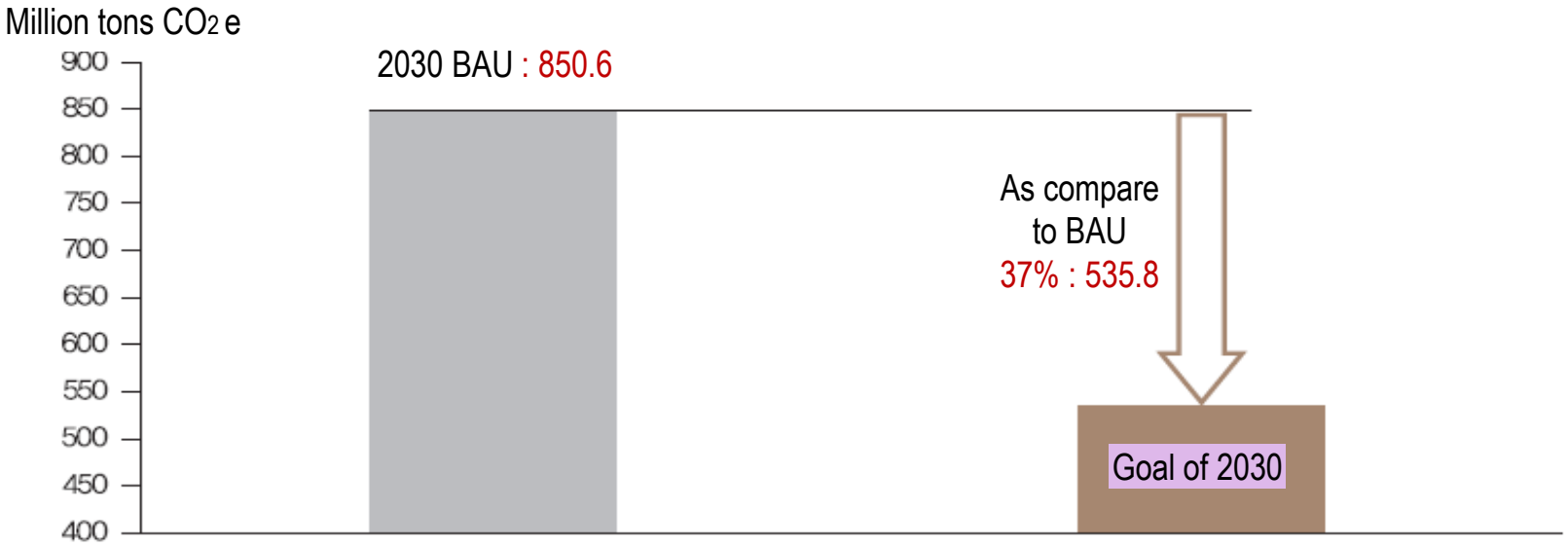
<CO_2 Emissions for power generation and heat production(1971, 2013)>

Source: IEA (2015), Key Trends in CO2 Emissions

3 Climate change and low-carbon business model

4. GHG Reduction goal of Korea

- Decrease by 37% compared to BAU (851 million tons) by 2030 and submit INDC (30th June 2015)
  - Domestic : 25.7%, remaining (11.3%) is reduced through IMM (International Market Mechanism of carbon)
- It considers international responsibilities and national circumstances
  - Implementation of GHG emission trading system in Korea
  - **Fostering new energy industry**
  - Induce voluntary reduction **by promoting renewable energy business**
  - The achievement of the reduction goal using the international market mechanism (IMM)

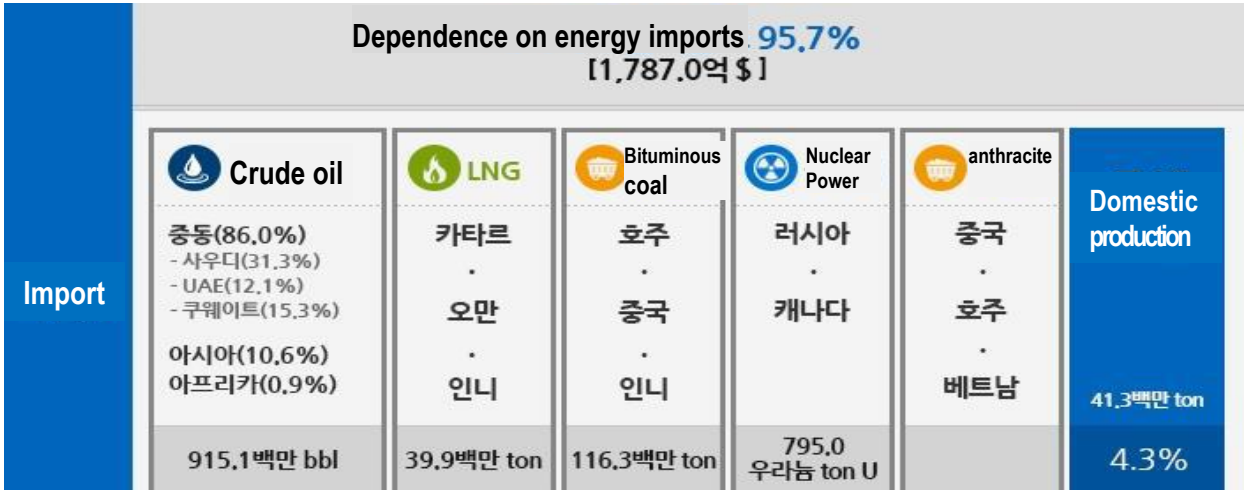


3 Climate change and low-carbon business model

5. Energy imports of Korea (2000 ~ 2013)

- Dependence on energy imports by 2013 is 95.7% (domestic production 4.3%)
  → **Need to foster renewable energy technologies** to reduce fossil fuel use and improve energy efficiency

Year	Total Energy (thousand TOE)	The rate of dependence on imports (%)	The rate of dependence on petrolieum (%)
2000	192,887	97.2	43.5
2005	228,622	96.6	34.4
2010	263,805	96.5	27.9
2013	280,290	**95.7**	25.2
'00-'13	2.9	-0.1	-4.1



3 Climate change and low-carbon business model

6. Low-carbon Business Model

1) Considering future growth of population and economy, GHG emissions of each country expected continue to increase

- Need to establish policies for prevention of GHG emissions

2) Need to institute a new model for economic development through the new climate change system

- Countries around the world are pushing ahead with investment for the future
- Each country needs time to develop low-carbon, high-efficiency energy technology actively and strengthen infrastructure investment capacity.

  → Greenhouse gas emission regulation, Energy efficiency technology development required.

3) Sharing Low-cobon business models with developing countries

- Entering into renewable energy business in developing countries by utilizing GCF and MDB institutions.

  → Possible to carry out GHG reduction project with industrial private capital

Activation of Renewable Energy Business

4. Overseas expansion plan of energy new business

4 Overseas expansion plan of energy new business

1. Outline of Overseas expansion business Plan

- **The projects promoted by overseas bidding are that the developer is hidden or the implementation cost rate is high**
  → (Measure) Need to **develop business directly** by utilizing network based on ODA to increase the rate of project award and project implementation profit.

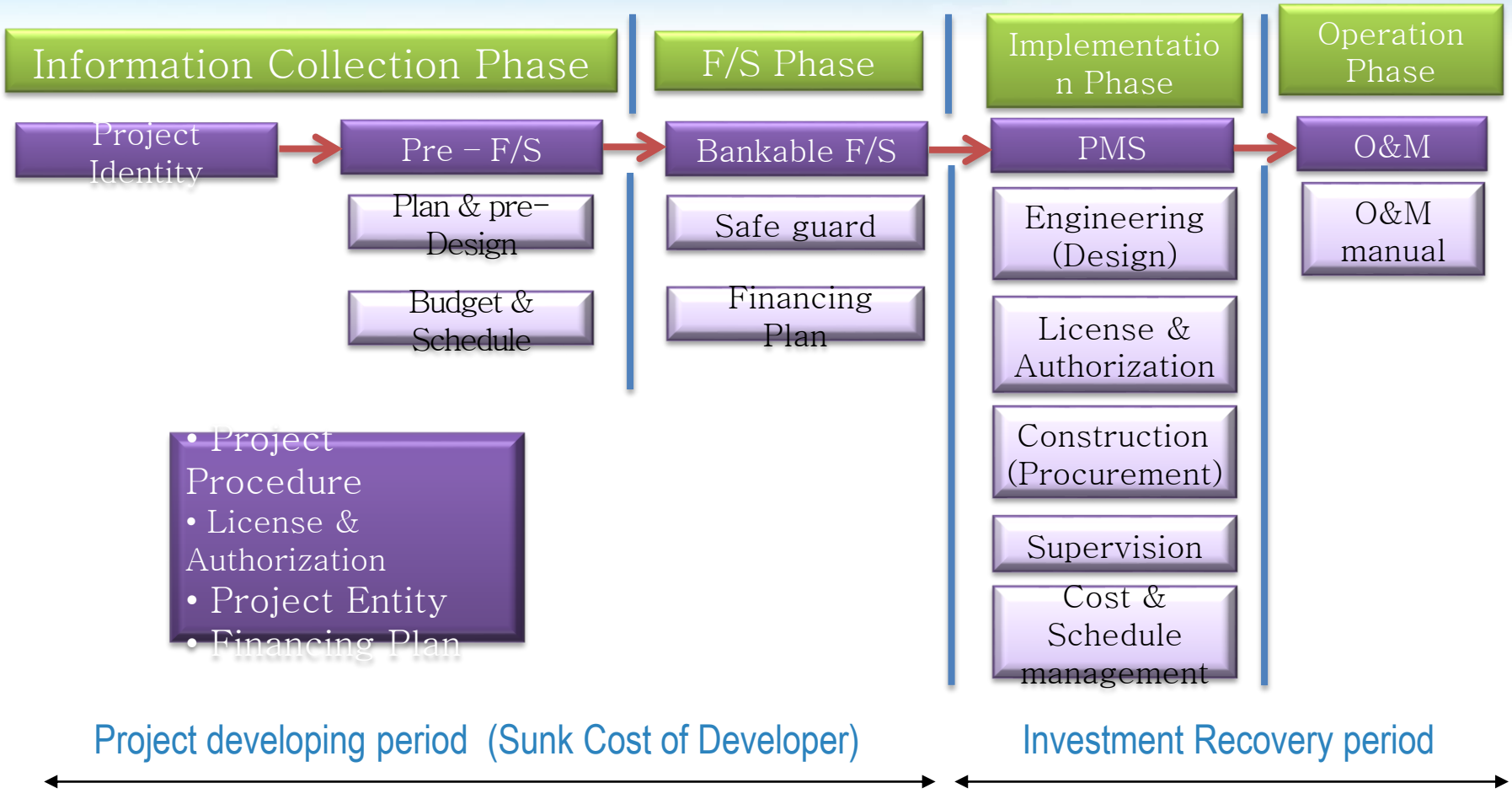
- **Many trap information by the private developer(high development cost, offering just basic information)**
  →(Measure) Need to analysis of land use, licensing, Fuel supply & price, PPA procedure, repatriation of profit, government guarantee, foreign investment protection, exchange hedge, TAX structure and etc. through **the direct consultation with client and stakeholder.**
  →(Measure) Need to analysis of Investment payback period, implementation cost rate, follow-up business etc. from **the point of view of a Lenders.**

- **Overseas business expansion plan of DOHWA**
  - Strength : Various kinds of domestic and foreign SOC project performance experience / Adapt quickly in fusion and complex business
  - Weakness : Lack of overseas Infra / Weak invest ability compared to major company / Lack of EPC and O&M organization and track record.

  → (Measure) **Consortium** with an **experienced local company** and establish the network based on ODA
  Screening business items that possible to perform
  Co-Work with **public enterprise (KEMCO, SLC etc)**
  Considering **financing method** with K-EXIM, KDB, MDB, GCF, K-Sure, New Industry Fund of Power , Asset management company etc.

4 Overseas expansion plan of energy new business

2. Business 4 Stage in Project



4 Overseas expansion plan of energy new business

Identification of Client

- Commercial Company or Investment(Development) Company
- Central Government
- Local Government
- Public Enterprise

Financing Plan

- Own Funds of Client
- Funds of Developer (with EPC + (O&M))
- MDB Loan, MDB Grant
- GCF Loan, GCF Grant
- Commercial Bank(Fund) or Co-financing (Fund + MDB etc.)

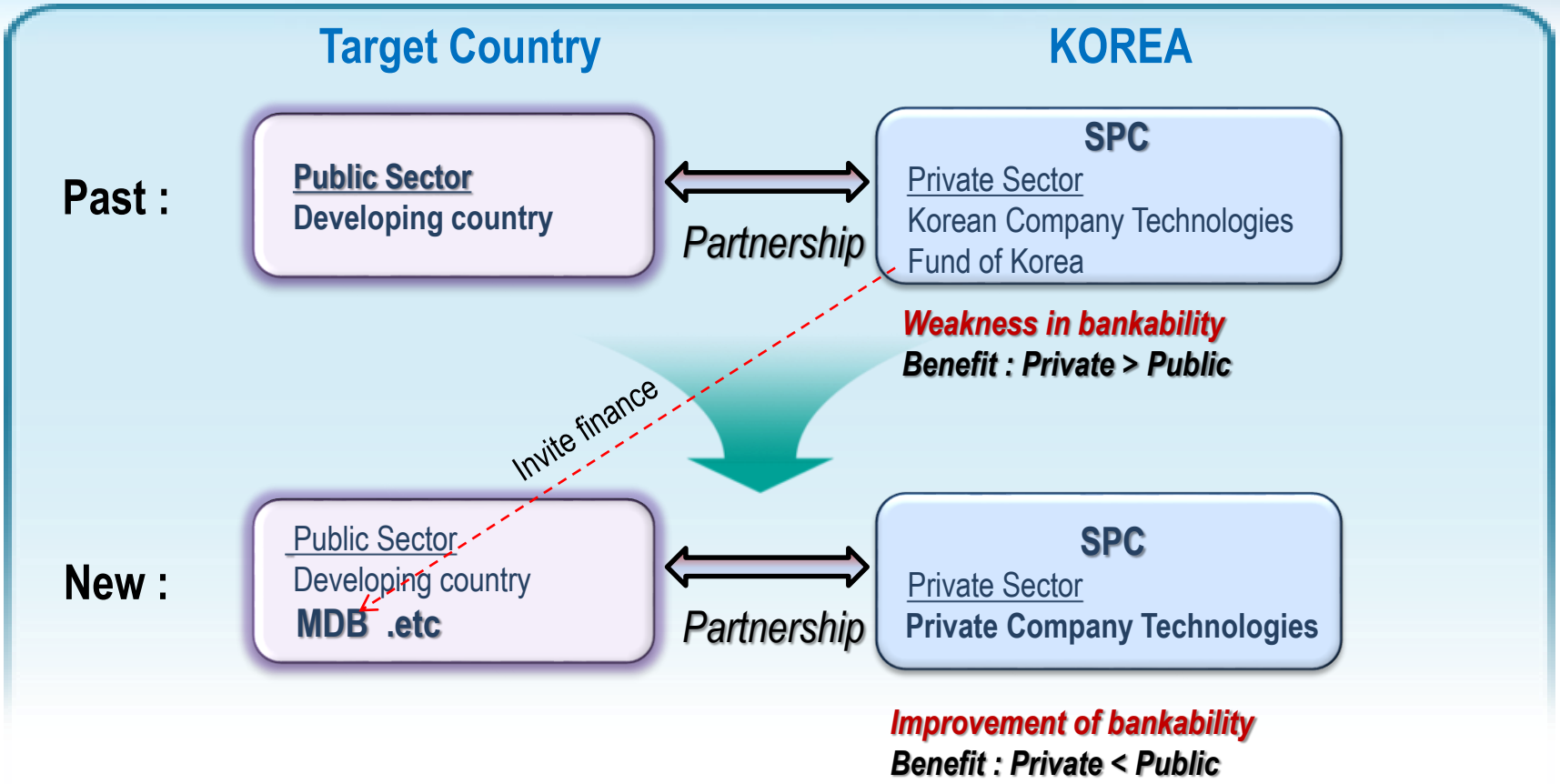
4 Overseas expansion plan of energy new business

2. Business Form

• **G 2 G**	Government + Government of a target country (Loan / Grant)
• **B 2 G** **PPP(Public Private Partnership)**	Private EPC Companies + Government of a target country (Loan Investment)
• **B 2 B**	Private EPC Companies + Companies of a target country (Loan Investment)
• **B(+G) 2 B(+G)**	Korean Companies (+SLC) + Companies(+Gov.) of a target country (Loan Investment)
• **B(+G) 2 G**	Korean Companies (+KEMCO) + Companies(+Gov.) of a target country (Loan Investment)
•**Tendering Procedures / Investment Projects** **(Loan / Grant / Loan Investment)**	

4 Overseas expansion plan of energy new business

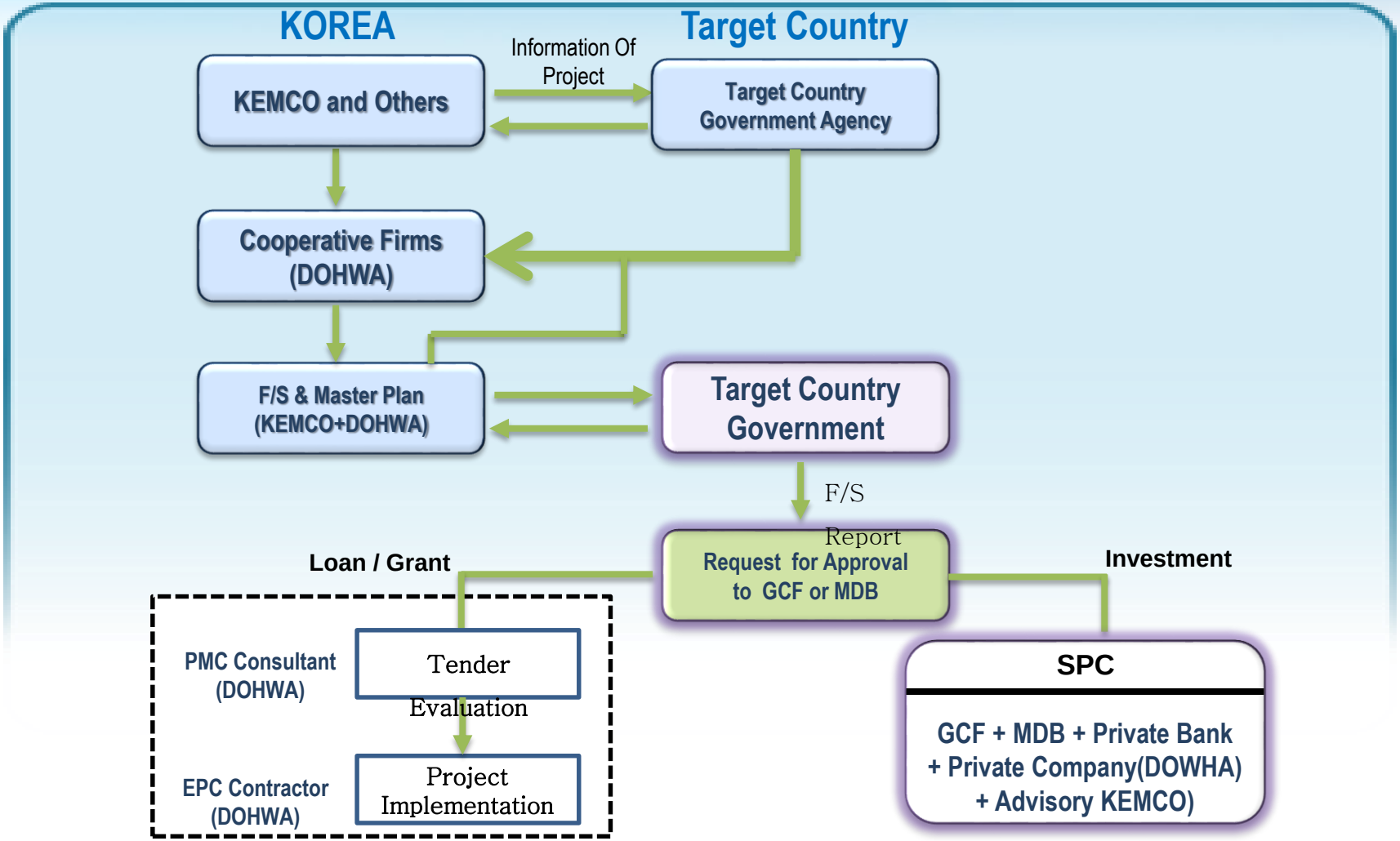
3. New Business Model (For example of PPP (B2G))



* Bankability = bankable

4 Overseas expansion plan of energy new business

4. New Business Paradigm

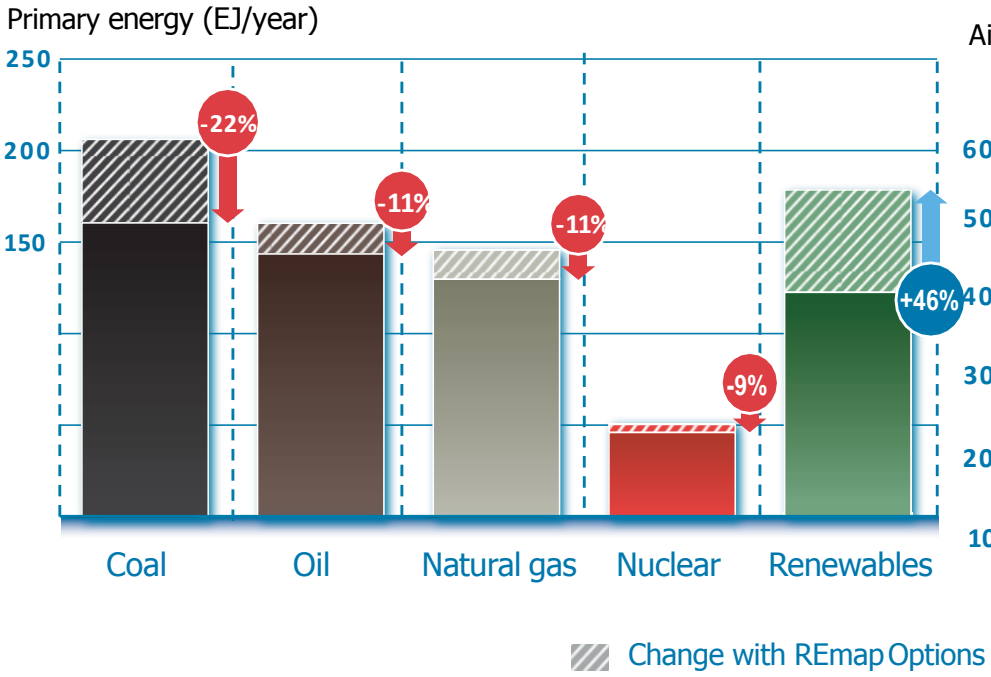


5. Key findings

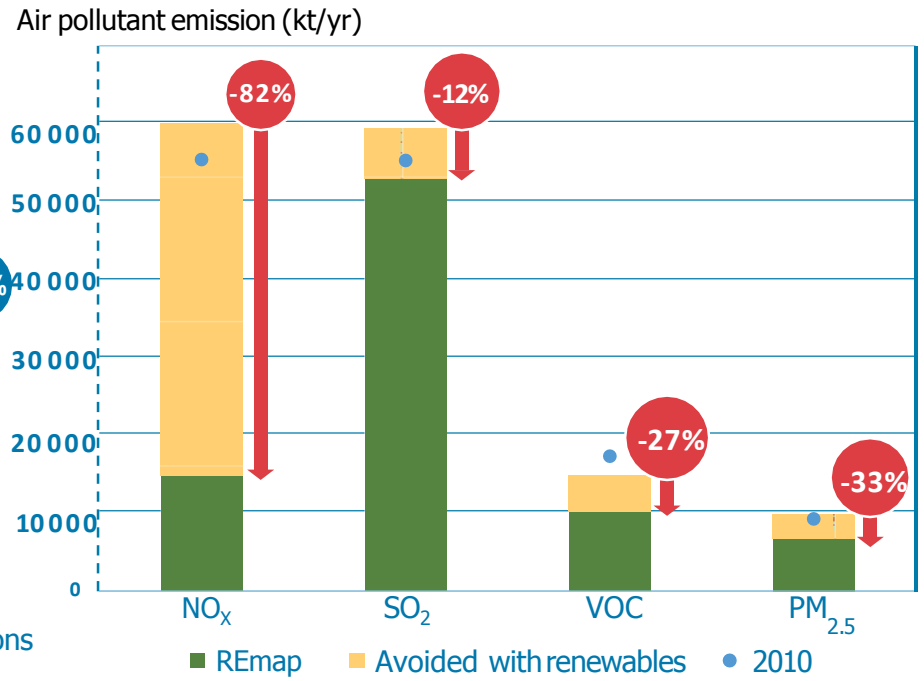
5 Key findings

- **Doubling the renewable share in the global energy mix can result in significant savings of fossil fuels.**

Coal, oil and natural gas supplies can be reduced by 22%, 11% and 11%, respectively, while renewable energy supply could increase by up to 46% over the coming 15 years.



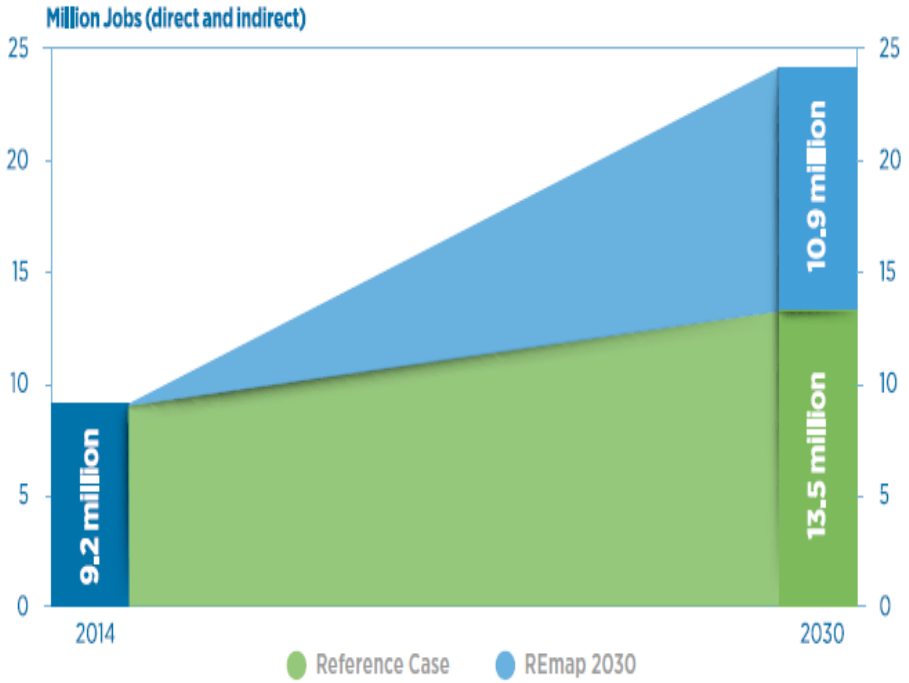
global change in primary energy use with remap options, 2030



Reductions in emissions of selected air pollutants with remap options, 2030

5 Key findings

- **Promoting renewables means providing secure and clean energy supply while supporting GDP growth, improving trade balances, creating local value and jobs.**



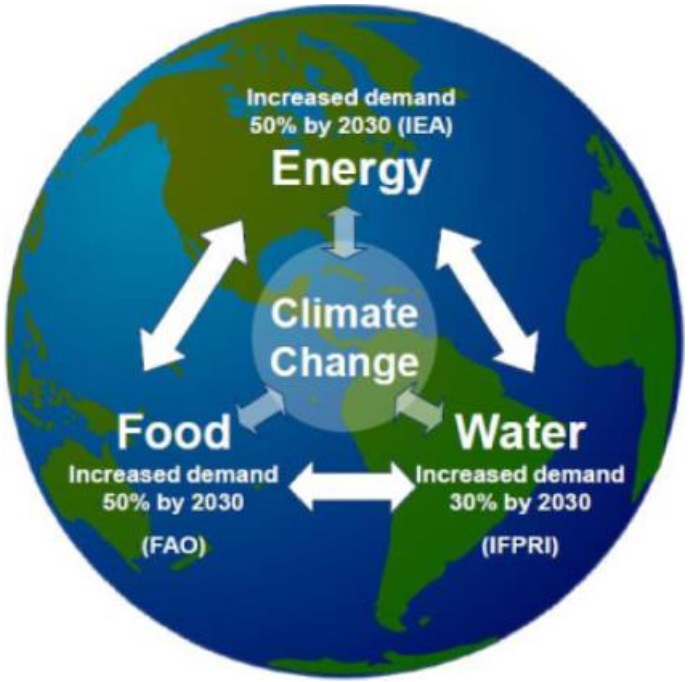
IRENA 2030 Employment Estimations

- Solar photovoltaic (PV) deployment, for example, creates twice the number of jobs per unit of electricity generation compared with coal or natural gas.
- Renewable energy could generate over 24 million jobs worldwide by 2030
- Solar PV modules, for instance, cost three-quarters less today than in 2009, while wind turbine prices have declined by almost a third over the same period.

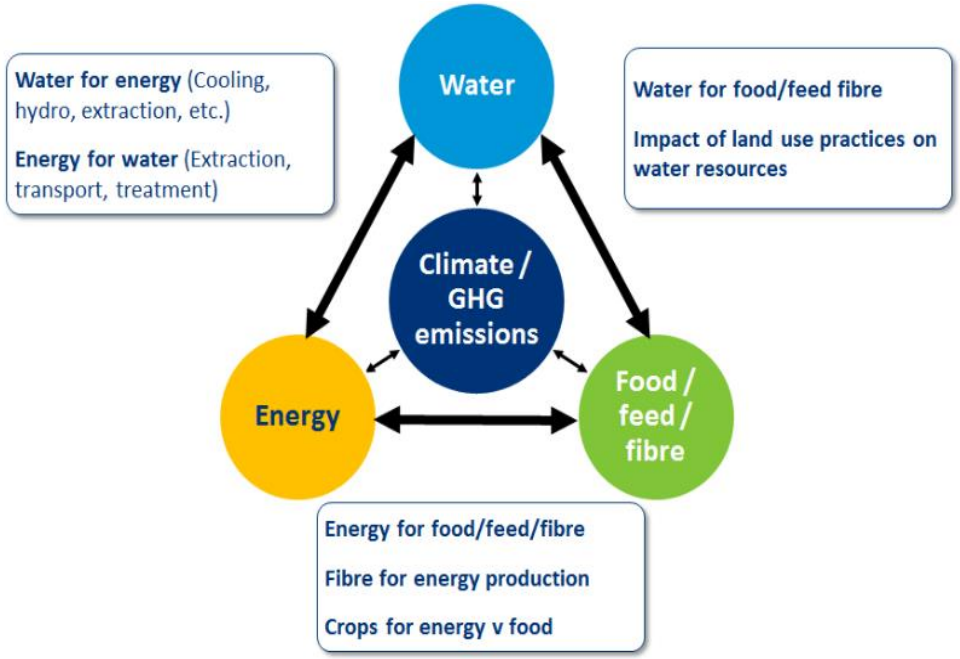
Source : Rethinking Energy, 2015, International Renewable Energy Agency

Energy, Water & Food … Nexus

- With the global population growing at a rate of approximately 80 million people a year, by 2030 it is estimated that the world will need 30% more water, 50% more energy and 50% more food.
- Growing populations, increasing demand for energy, food and water will create the "Perfect Storm" by 2030, and climate change will exacerbate matters in unpredictable ways. (UK government's chief scientific adviser Professor John Beddington)



The Climate-Water-energy-Food Nexus




Economy
Environment

Easter Parades on Fifth Avenue, New York, 13 years apart

1900: where's the first car?

1913: where's the last horse?

Images: L. National Archive, www.archives.gov/research/american-cities/images/american-cities-101.jpg; R, shorpy.com/node/204.
Inspiration: Tona Seba's keynote lecture at AltCar, Santa Monica CA, 28 Oct 2014, http://tonyseba.com/keynote-at-altcar-expo-100-electric-transportation-100-solar-by-2030/

Thank you