

The Current Status of Biogas Upgrading Business in South Korea

2013. 11. 14 / IEA Task No. 37 (Biogas)



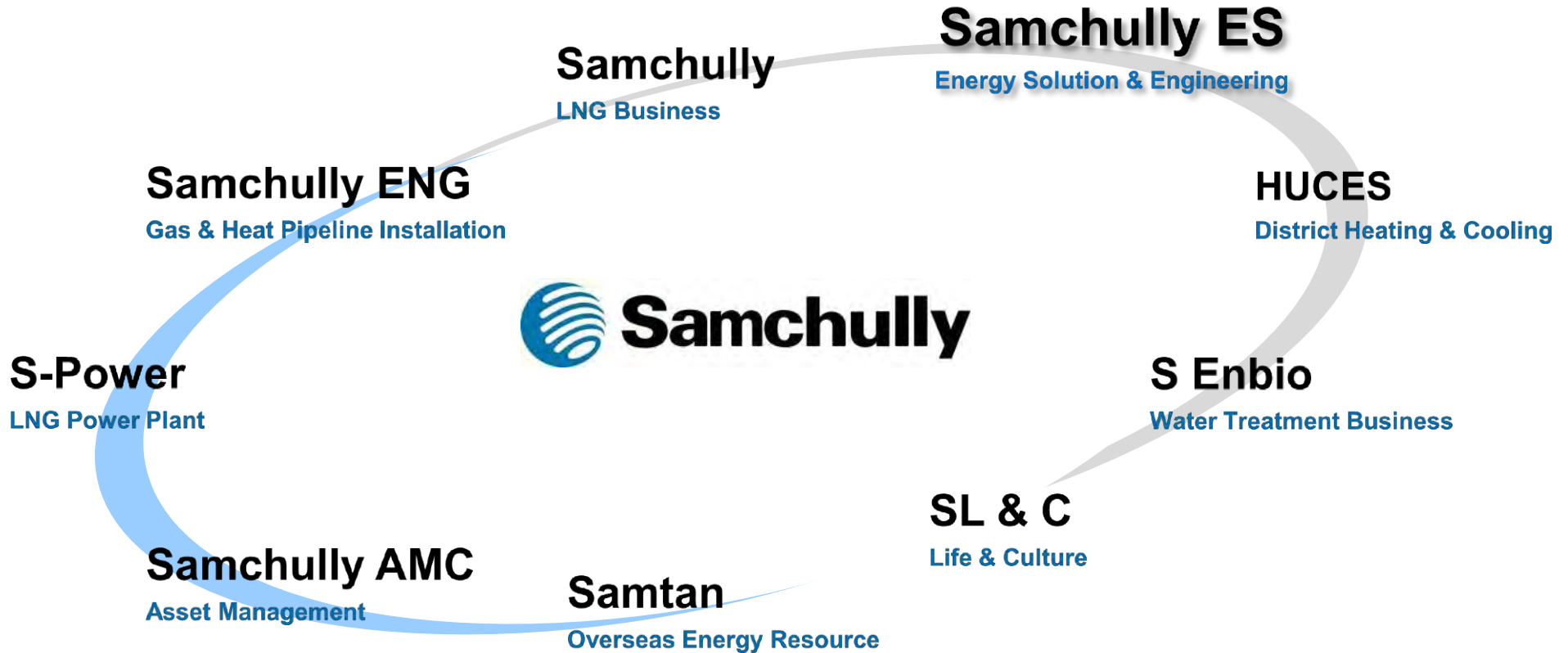
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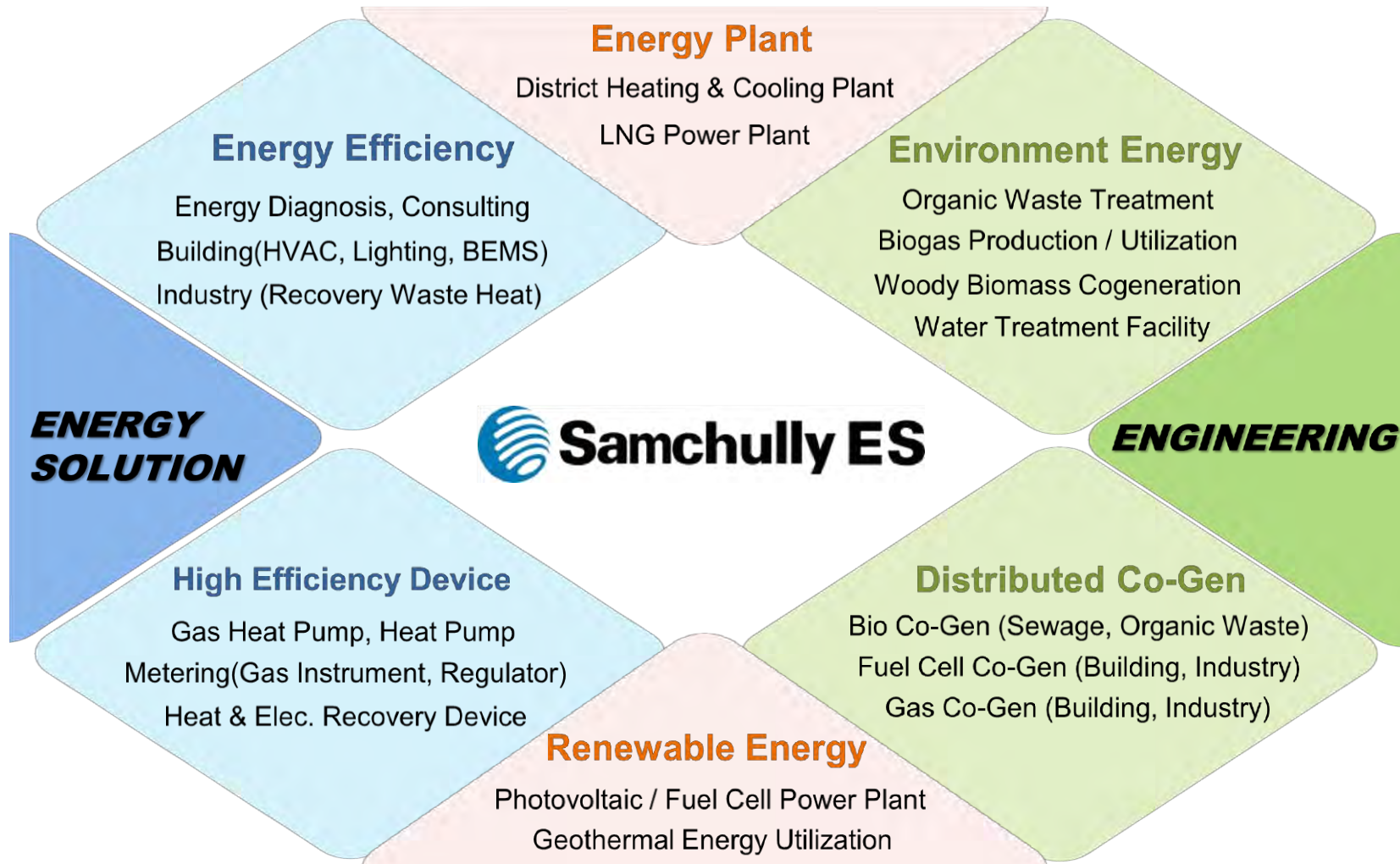


Company Introduction

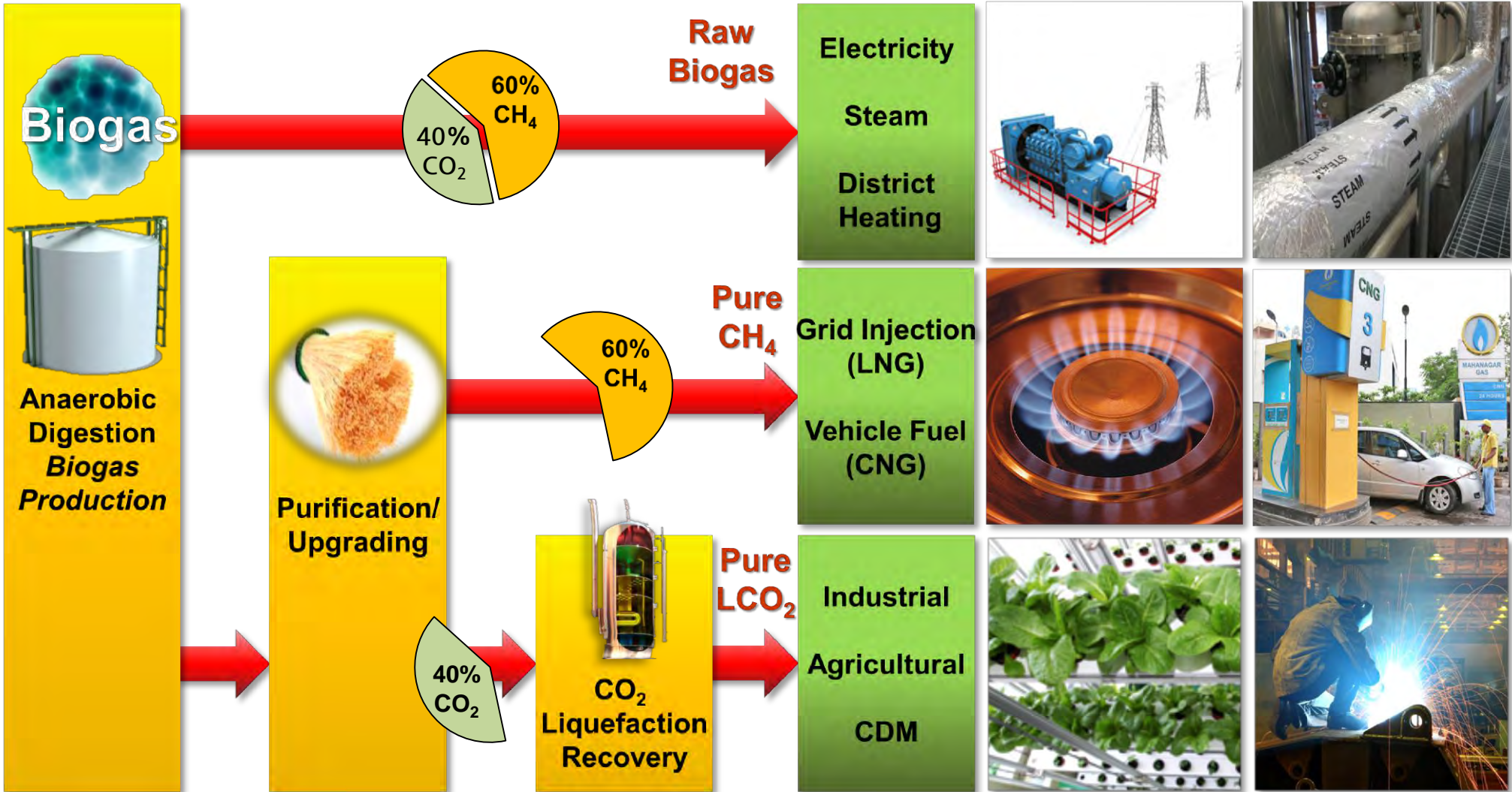
Samchully Group



Business Areas



Our Biogas Portfolio



Korean Legislative System (upon Biogas Upgrading Business)

Progress of Major Government Policy

Ministry	Major Policy
Ministry of Environment (with 4 other ministries and committee of green growth)	<ul style="list-style-type: none"> • Establishment of detailed action plan upon energy derived waste resources and biomass - Energy efficiency and consumption reduction, countermeasures on climate change, promoting renewable energy sources • Amendment of No. 33 attached table on Clean air conservation act (2011.03) - Establishment of quality standard on biogas in terms of vehicle fuel usage • Legislation of fundamental law regarding “Low carbon emission and green growth“ - Notification of guideline upon objective management toward green house gas and energy (2011.03)
Ministry of Land, Vehicle and Maritime affairs	<ul style="list-style-type: none"> • Establishment of countermeasure toward marine disposal of waste generated from land with a government-wide perspective (2006. 3) • Legislation of “Marine environment management “ Act (2011.8) - Prohibition of marine disposal toward sewage sludge and feedstock manure from 2013
Ministry of Trade, Industry and Energy	<ul style="list-style-type: none"> • Amendment of “City-gas enterprise” law (2009.10) - Admit biogas (biomethane) as one sort of natural gas • Notification of the quality standard upon city-gas including biogas (2012.2) - Can inject Purified biogas mixing with natural gas • Purchase obligation to purchase alternative natural gas toward city gas corporation (RFS ; Renewable Fuel Standard) (TBD, expected from 2017)

Legislative Foundation

City-gas Business Act

Article 2 (Definition) <Amendment in 2008.2.29, 2009.3.25, 2010.1.27>

- 1) City-gas is determined as an executive order and it includes natural gas (which could be liquefied and followings are same as well), petroleum gas and **biogas** supplied by grid of pipeline.
- 2) “City-gas business“ is a business of providing city-gas which could be supplied from whole-sale provider or own-producing to consumer through grid of pipeline.

“Biogas is defined as an alternative natural gas and it could be produced by city-gas providing company itself and could be supplied to consumer”

Special Announcement upon “Producing natural gas and city-gas”

- The standard of supply own-produced city-gas except natural gas to general city-gas provider
- Safety regulations is applied same as general standard of gas equipment for city-gas

Quality Standard of Alternative Natural gas

For Grid Injection (“City Gas”)

Criteria	Unit	Standard(Enacted at 2012.2)
Heating value	MJ/m ³	Variable with government notification of supply standard
Weber index	MJ/m ³	51.50 ~ 56.52 (12,300 ~ 13,500kcal/m ³)
Total sulfide	mg/m ³	<30
Odorant concentration	mg/m ³	4 ~ 30 (TBM+THT) 3 ~ 13 (MES+DMS+TBM+THT)
Carbon dioxide	mol %	<2.5
Oxygen	mol %	<0.03 (LPG+Air : <10)
Nitrogen	mol %	<1.0 (LPG+Air : <35)
Hydrocarbon Dew Point	°C	<-5.0, up to 70MPa
Water Dew Point	°C	<-12, up to 70MPa
Other gaseous materials	mol %	<1.0 (Hydrogen, Argon, CO etc.)
Ammonia	mg/m ³	N.D.
Total Halogen	mg/m ³	<10
Siloxane	mg/m ³	<10

For Vehicle Fuel (“CNG”)

Criteria	Unit	Standard
Methane	vol %	>95
H ₂ O Contents	mg/Nm ³	<32
Total Sulfide	ppm	<10
Inert gas	vol %	<5.0

**Legislative requirements
on upgraded biogas
has established**

**Biogas upgrading Business
is now available in S.Korea
based on legal foundation**

Renewable Fuel Mixing Obligation

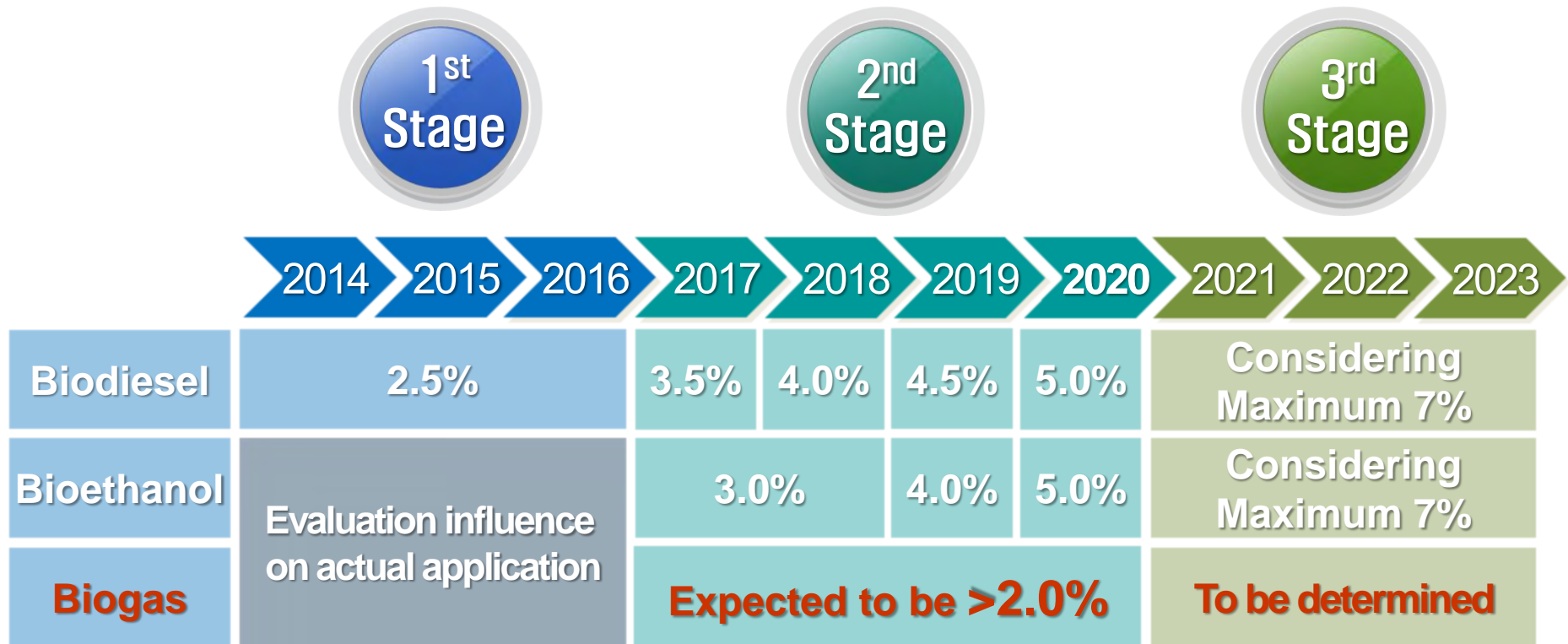
RFS System (Renewable Fuel Standard)

- **Obligation to mix fuel derived from renewable energy sources to conventional fuel**
: The system which obligates to mix renewable fuels including Biodiesel, Bioethanol, Biogas to vehicle fuel
- Partial amendment upon stimulating development, utilization and supply of renewable energy has prepared in 2013
- Mixing bioethanol to gasoline is supposed to be come into force from 2014
- In case of biomethane, it will be come into force from 2017

Adoption Perspective upon obligation of renewable fuels

Criteria	Renewable Fuels obligated to be mixed		
	Biodiesel	Bioethanol	Biomethane
Target Fuel	Diesel	Gasoline	Natural Gas
Obligated Mixing Ratio	2.0% (till 2013)	Expected to be below than 3.0%	T.B.D. Expected to be 2%
Begin from	2012. 1.1	2014. 1. (Expected)	2017. 1. (Expected)
Obligator	Domestic Oil Refining Company (SK, GS, Hyundai-oil, S-oil)		Expected to be City-gas provider

The Prospect of RFS System



According to carrying out RFS upon biogas sector, South Korea's biogas industry is expected to be grown faster

Reference : Korea Institute of Petroleum Management

Case Study

Case 1 : “Sudokwon” Landfill Site



Capacity	<ul style="list-style-type: none"> • 600Nm³-raw biogas/hr 	Upgrading Technology	<ul style="list-style-type: none"> • PSA • CH₄ Purity 97.2%, Recovery 95% above
Supply Biomethane	<ul style="list-style-type: none"> • Transfer by injecting to pipeline of 1.3km from plant to gas station (370 Nm³/hr) 	Calorific Value Adjustment	<ul style="list-style-type: none"> • Biomethane 23% mixed to LNG
Pre treatment	<ul style="list-style-type: none"> • Sulfa-treat, (H₂S concentration below than 1ppm) 	Storage Tank	<ul style="list-style-type: none"> • Storage Capacity : 180m³ (amount of 1 hr) • Design Pressure : 1 MPa.G

Case 2 : “Hongcheon” Organic Waste AD Plant



AD Capacity	<ul style="list-style-type: none"> • Manure 80t/d + Food Waste 20t/d 	Amount of Upgraded gas	<ul style="list-style-type: none"> • 1890 Nm³-biomethane/day
Upgrading Technology	<ul style="list-style-type: none"> • 3-stage Membrane 	Supply Biomethane	<ul style="list-style-type: none"> • Grid Injection • Supply BM to City-gas Provider
Site Area	<ul style="list-style-type: none"> • 3,575m² 	Type of Project	<ul style="list-style-type: none"> • Government Tender • Government budget for construction

Biogas Upgrading Cases in South Korea

Sudokwon Landfill Site

- 600Nm³-raw biogas/hr
- PSA
- Completion in 2011. 06
- Utilization : Vehicle fuel

Seonam SWTP

- 200Nm³-raw biogas/hr
- Water Scrubbing
- Completion in 2009. 12
- Utilization : Vehicle fuel

Gangreung SWTP

- 50Nm³-raw biogas/hr
- Water Scrubbing
- Completion in 2010. 07
- Utilization : Vehicle fuel

Wonju Organic Waste TP

- 600Nm³-raw biogas/hr
- Water Scrubbing
- Completion in 2014. 03
- Utilization : CNG(Fuel)

Daegu Organic Waste TP

- 1,400 Nm³-raw biogas/hr
- PSA
- Completion in 2013. 06
- Utilization : Vehicle fuel

Pyungchang Organic Waste TP

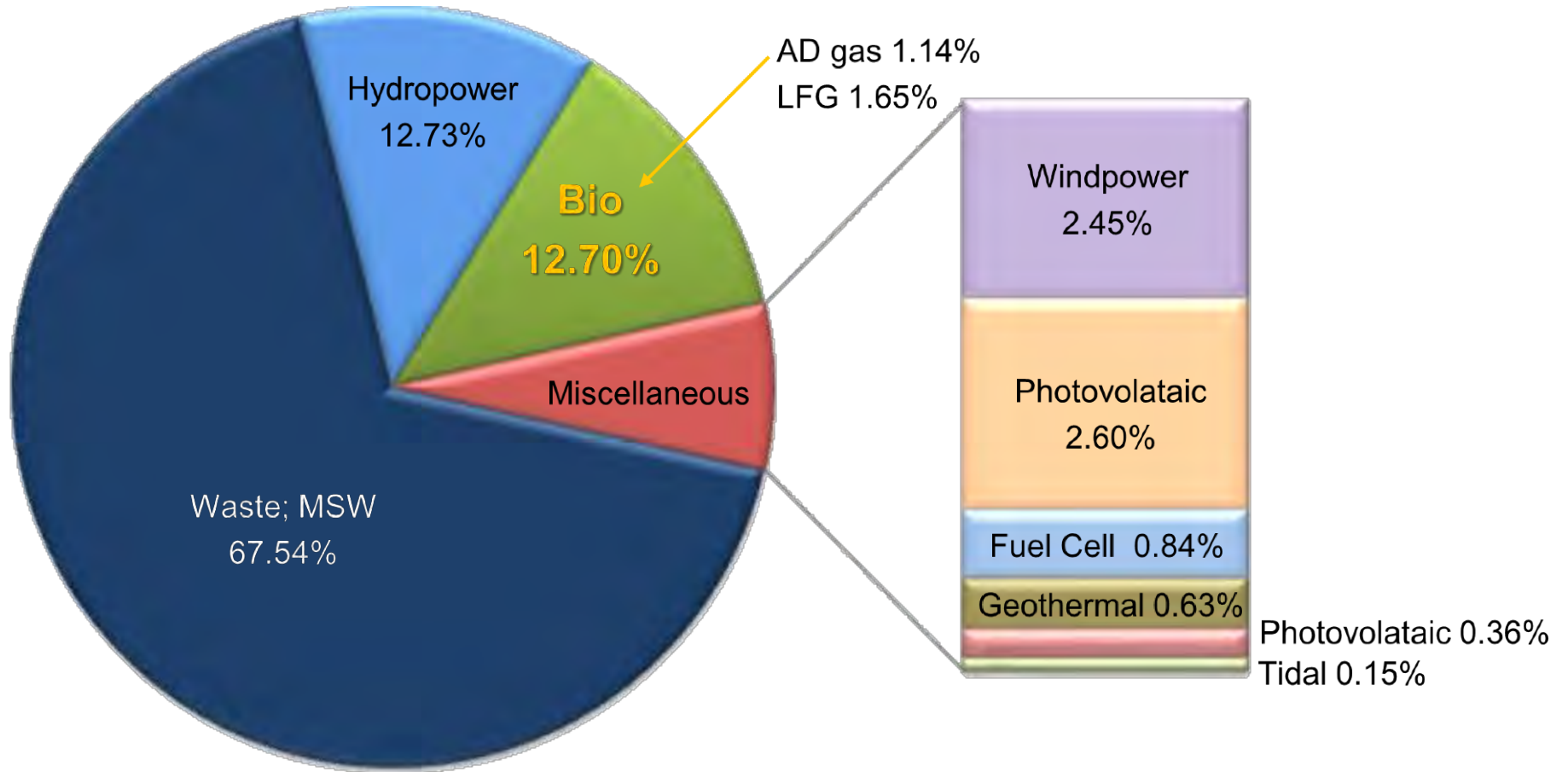
- 300Nm³-raw biogas/hr
- Water Scrubbing
- Completion in 2013.11
- Utilization : Grid injection

Biogas Upgrading Cases in South Korea

No	District	Feed Gas Capacity (Nm ³ /day)	Product Capacity (Nm ³ /day)	Upgrading Tech.	Utilization	Status
1	Incheon	14,400	8,640	PSA	Vehicle Fuel	Operating
2	Changwon	10,000	6,000	Water-scrubbing	Vehicle Fuel	Operating
3	Daegu	33,600	20,160	PSA	Vehicle Fuel	Operating
4	Seonam	4,800	2,880	Water-scrubbing	Vehicle Fuel	Operating
5	Gangreung	1,200	720	Water-scrubbing	Vehicle Fuel	Operating
6	Pyungchang	7,200	4,320	Water-scrubbing	Grid Injection	Constructing
7	Wonju	14,400	8,640	Water-scrubbing	Vehicle Fuel	Constructing
8	Busan	14,400	8,640	Water-scrubbing	Vehicle Fuel	Constructing
9	Uijeongbu	6,480	3,900	Membrane	Grid Injection	Planning
10	Guri	14,400	8,640	Membrane	Grid Injection	Planning
11	Cheongju	15,000	9,000	Membrane	Grid Injection	Planning
12	Jungrang	14,400	8,640	Membrane	Grid Injection	Planning
13	Hongcheon	3,000	1,900	Membrane	Grid Injection	Planning
14	Bucheon	27,000	16,200	Membrane	Grid Injection	Planning

Market Status and Prospect

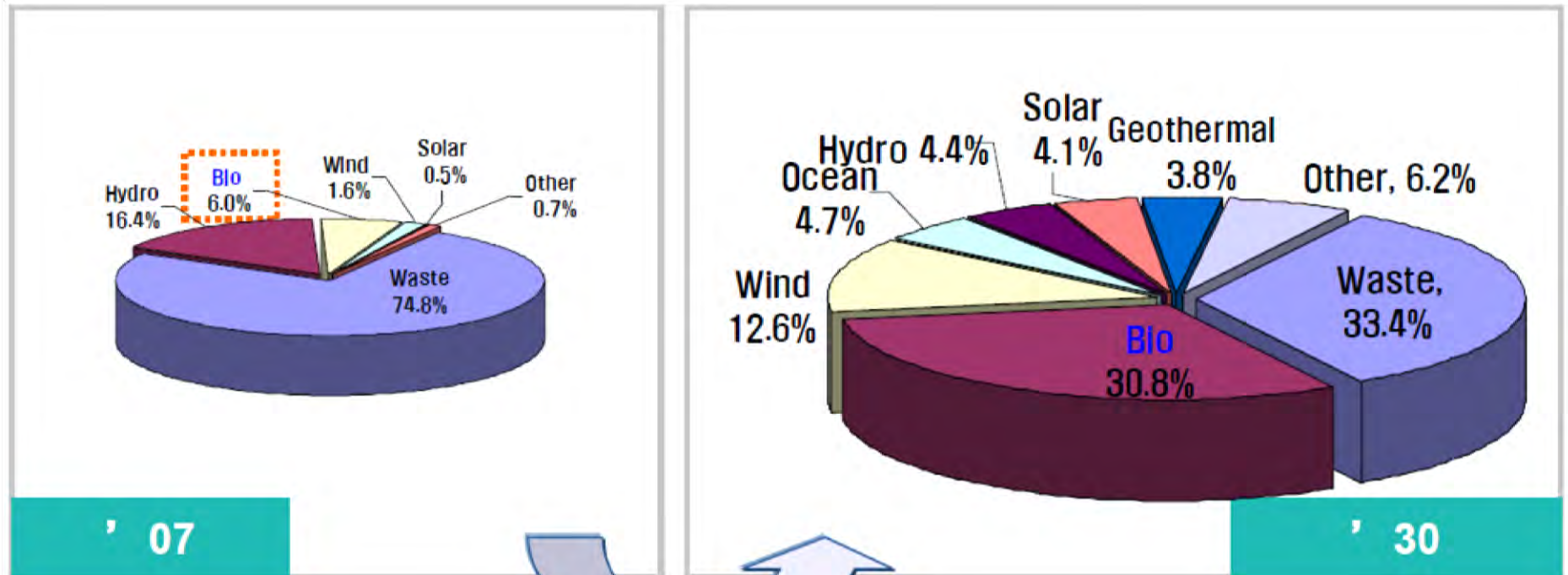
Supply Status of Renewable Energy (2011)



Reference : 2011 Supply Status of Renewable Energy, Renewable Energy Center

Future Share of Renewable Energy Sources

Objective of Renewable Energy Supply till 2030 : 11%



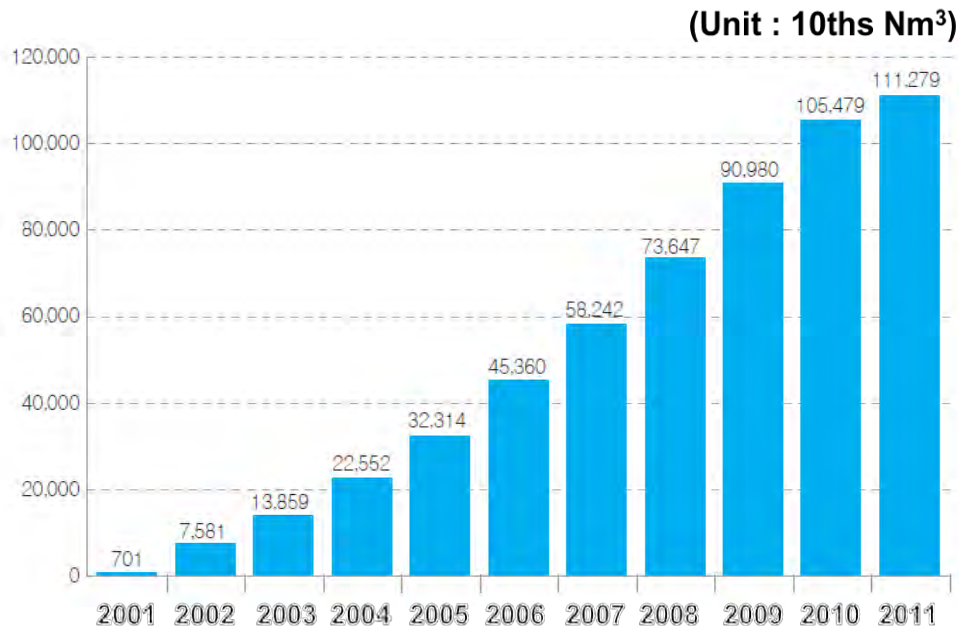
Bioenergy : 0.52×10^6 toe

Bioenergy : 10.18×10^6 toe

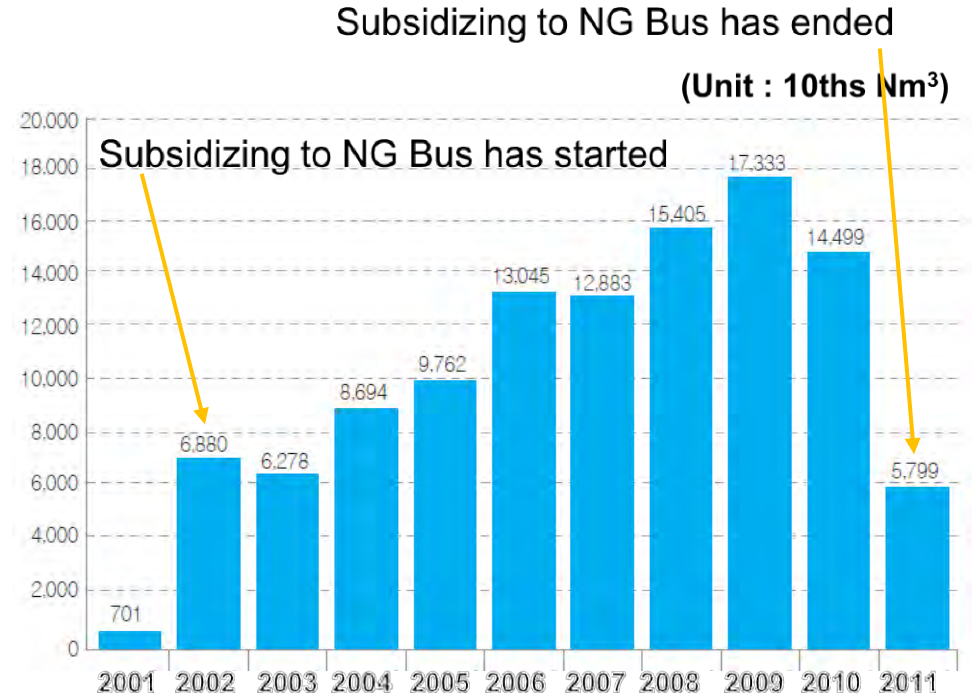
Renewable Energy from Bio Sources will be grown up to 30.8%

Share of Transport Energy among Primary Energy : 18% will be applied to RFS

Amount of CNG Consumption



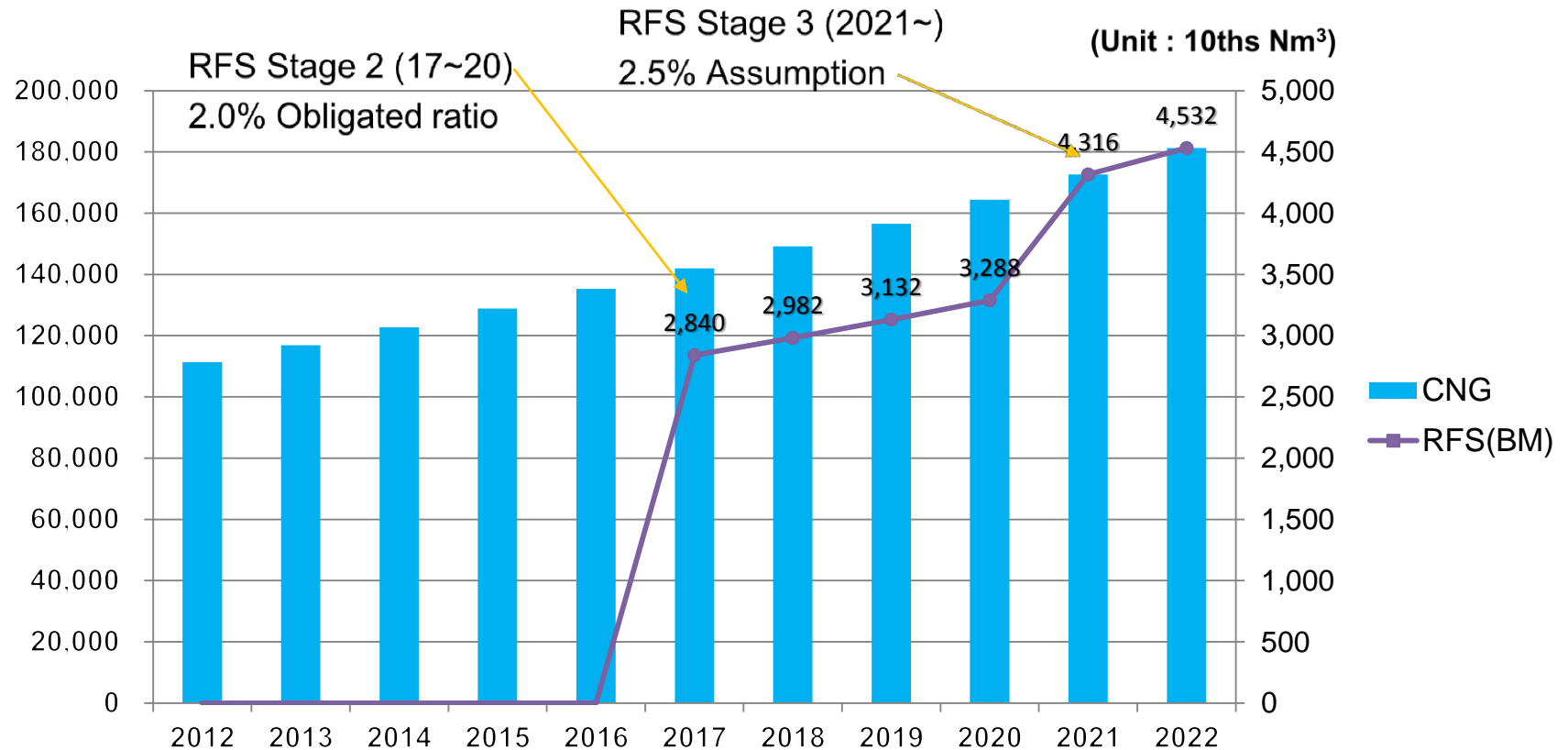
Annual CNG Consumption



Increasing Amount in comparison with year before

- To estimate Biogas Upgrading Demand upon RFS
→ Estimation CNG Consumption is needed to be calculated
- Amount of CNG consumption has exceeded 1 billion cubic meter in 2010
- Due to end of government subsidizing, CNG consumption is increasing slowly from 2011
- Increasing ratio of CNG consumption estimated as 5% of gradual ratio without further subsidizing policy

Prospect of Biogas Upgrading Demand on RFS

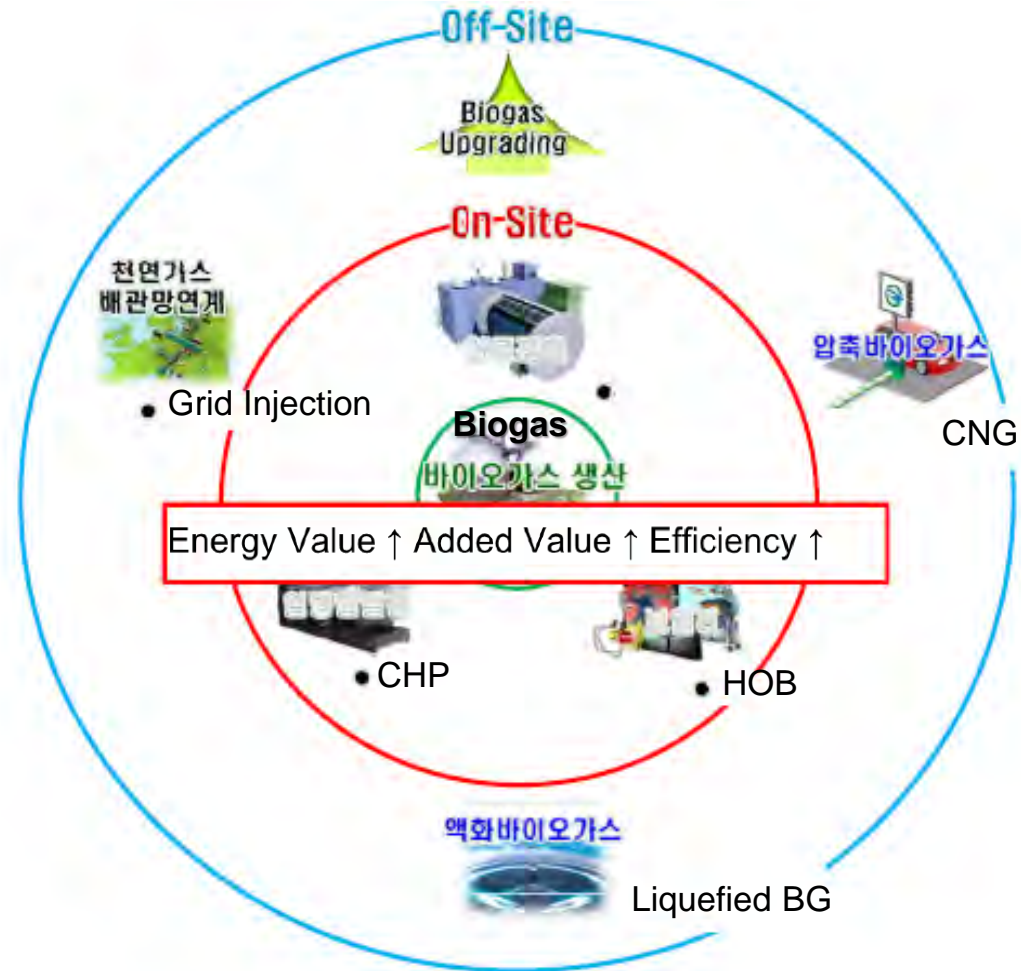


The Amount of Biogas Upgrading Demand on RFS

Till 2020 : 31,320,000 Nm³/year Biogas Upgrading Plant will be needed

From 2021 : 45,320,000 Nm³/year Biogas Upgrading Plant will be needed

Biogas Upgrading Market Prospect



End of presentation

Thank you for your attention