



# HOKKAIDO UNIVERSITY

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# **Bioenergy: Key tool for Sustainable Society (Korean Experiences)**

**2013. 11. 5.**

**Jin-Suk Lee**

# Agenda

## **I. Introduction**

## **II. Bioenergy Experiences in Korea**

- Biogas**
- Biodiesel**
- Wood Pellets**

## **III. Other Issues**

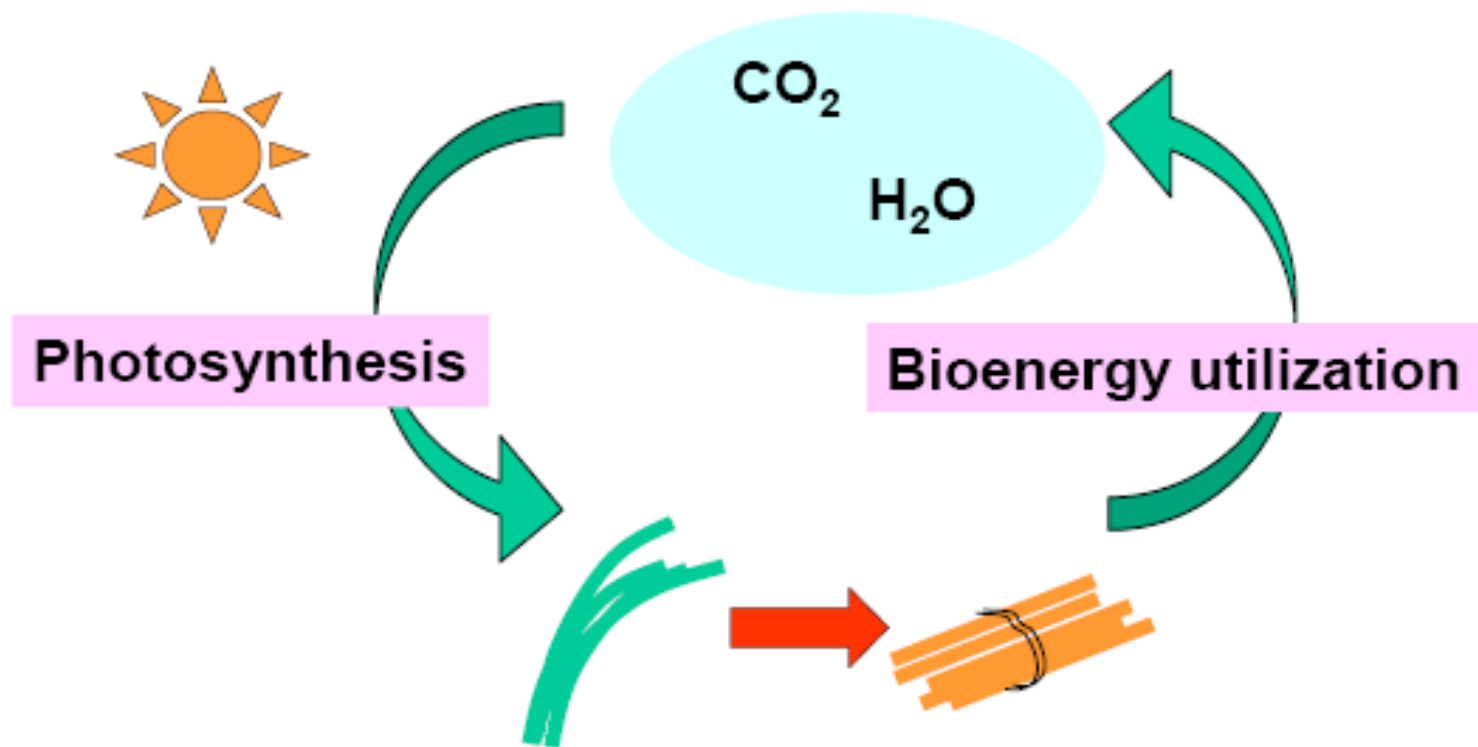
## **IV. Summary**

# I. Introduction

# Advantages of Bioenergy

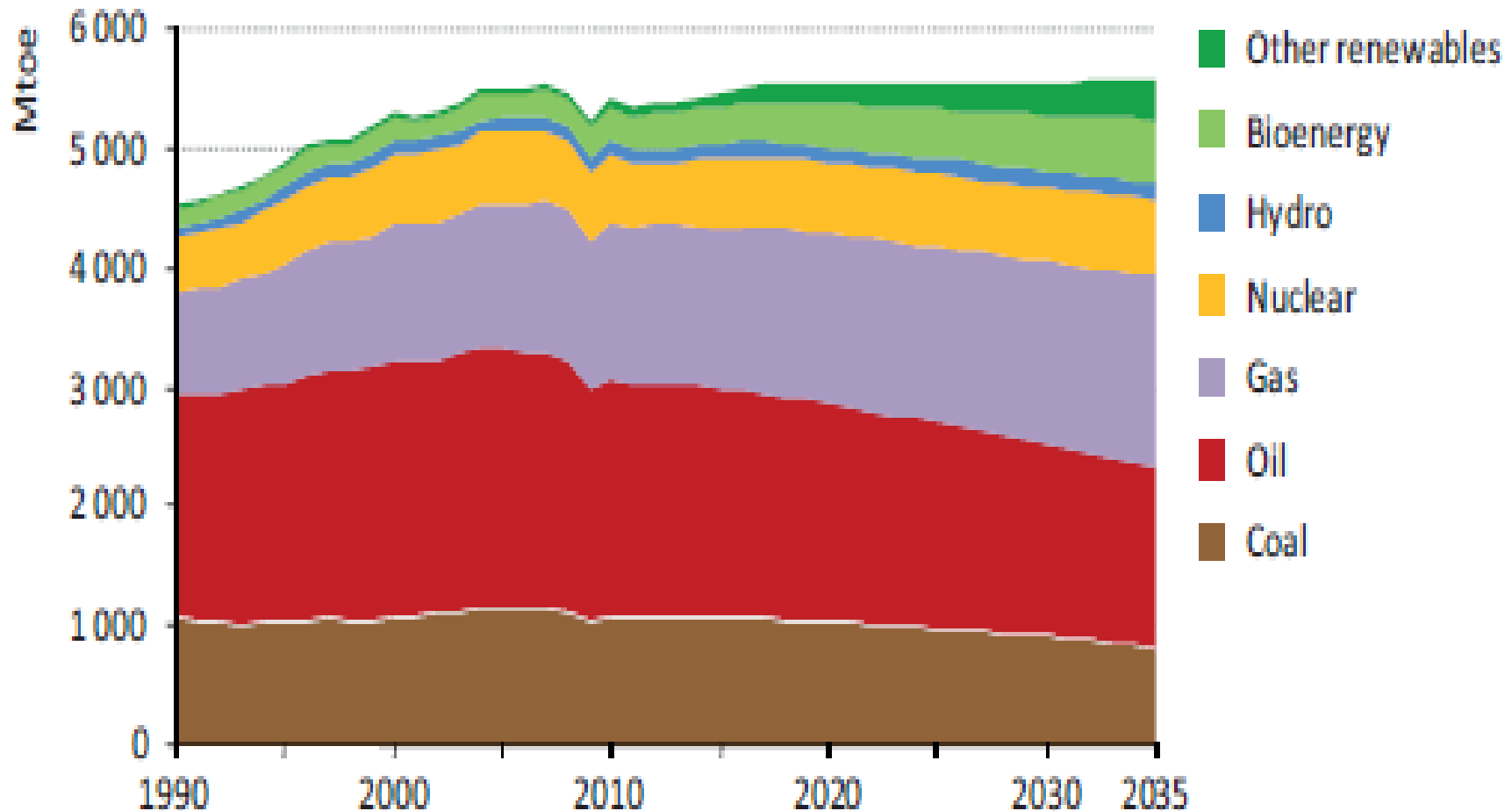
(Y. Matsumura, 2008)

- Sustainable Energy
- CO<sub>2</sub> neutral



# OECD Primary Energy Demand

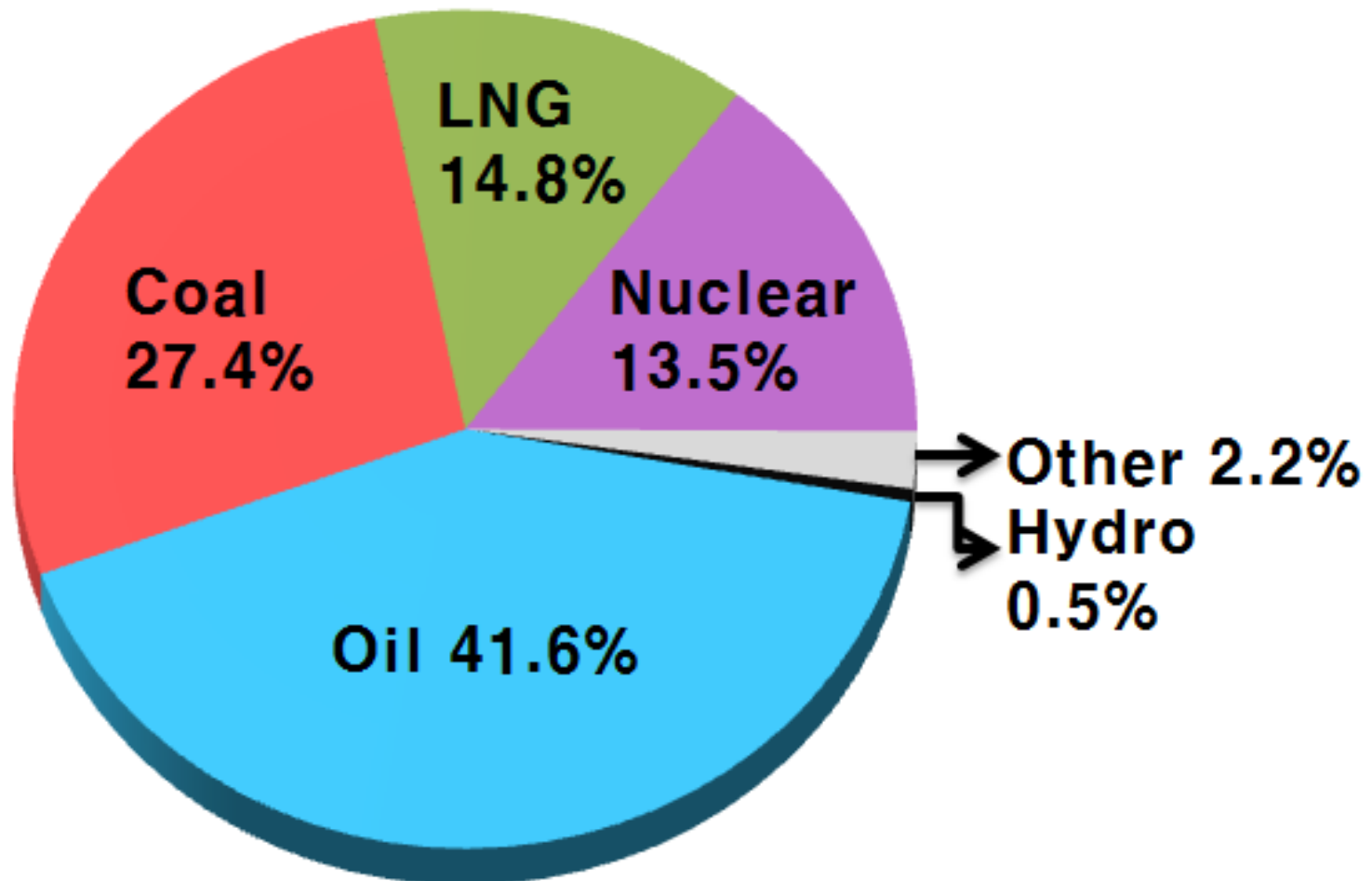
(IEA, WEO 2012)



# **II. Bioenergy Experiences in Korea**

# Energy Situation in Korea

(MKE, 2008)



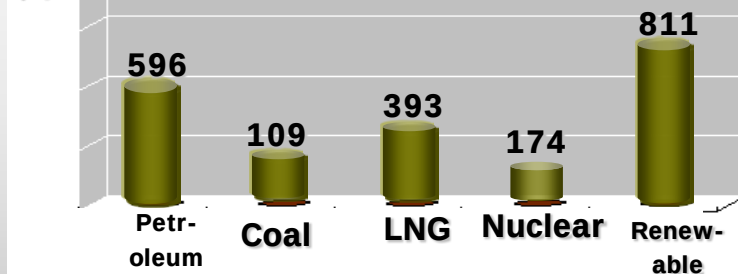


# Optimum Energy Mix

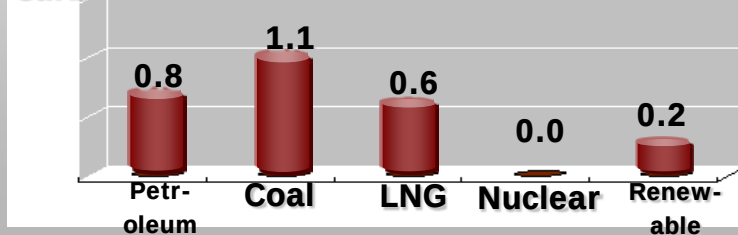
Consideration factors: Economy and Environment

## Economic & Environmental

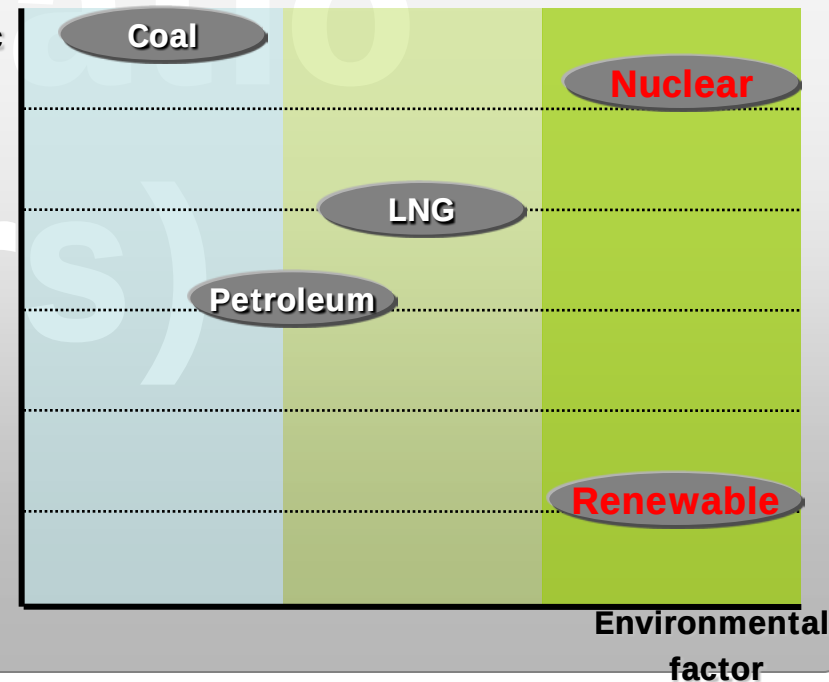
\$ / TOE



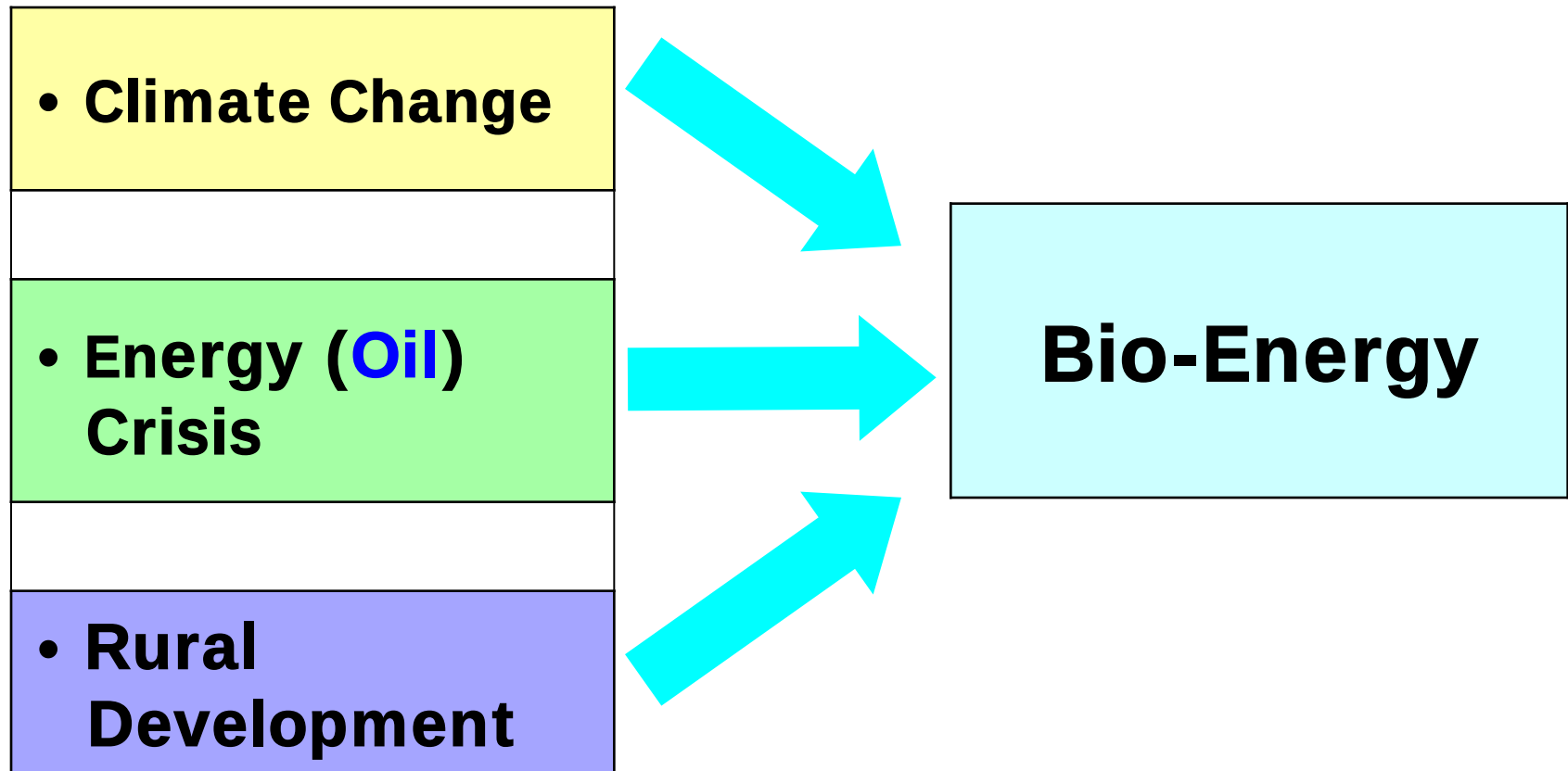
Carbon Ton / TOE



Economic factor

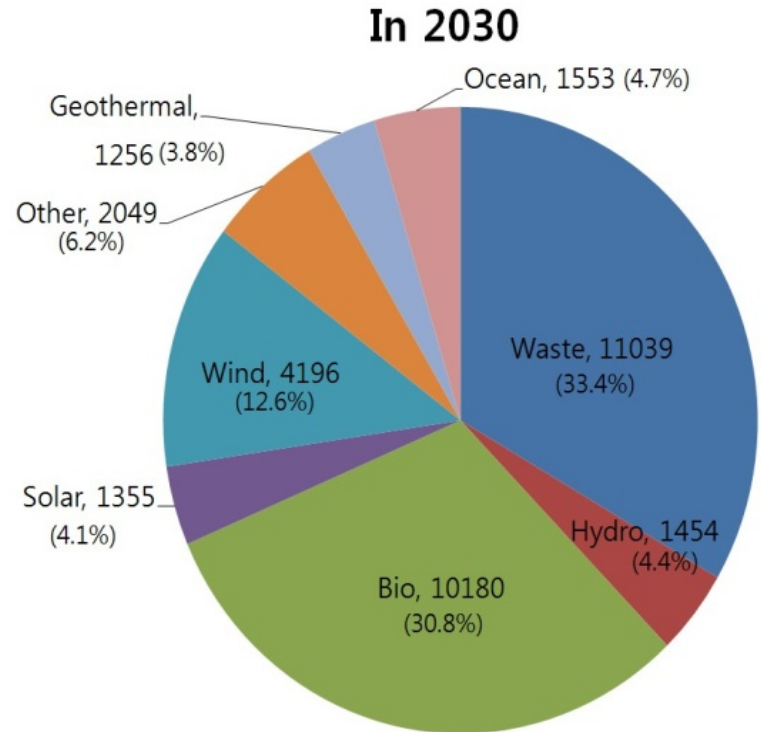
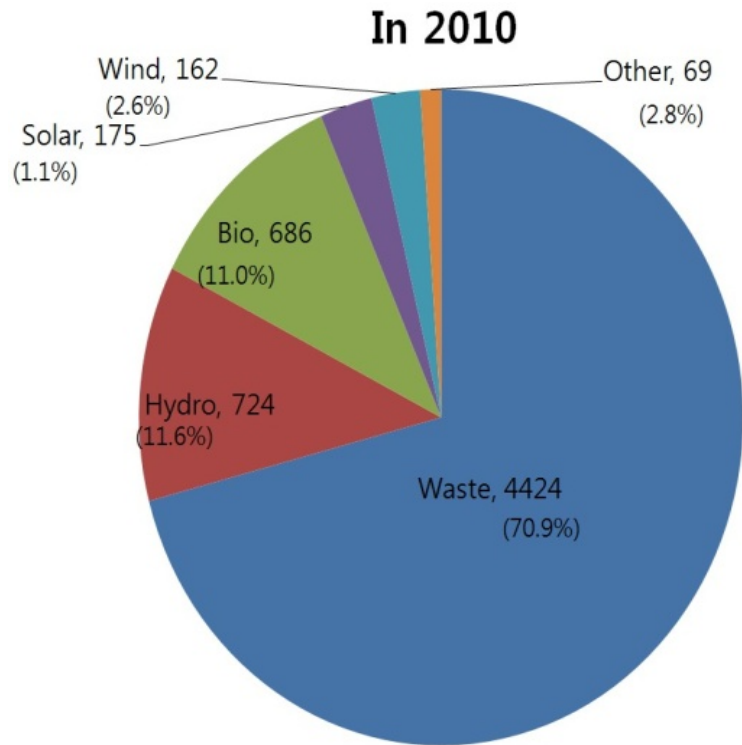


# Key Barriers for Realization of Sustainable Society in Korea



# Targets for Renewable Energy

## (National Energy Roadmap, 2008)



**x 5.1**

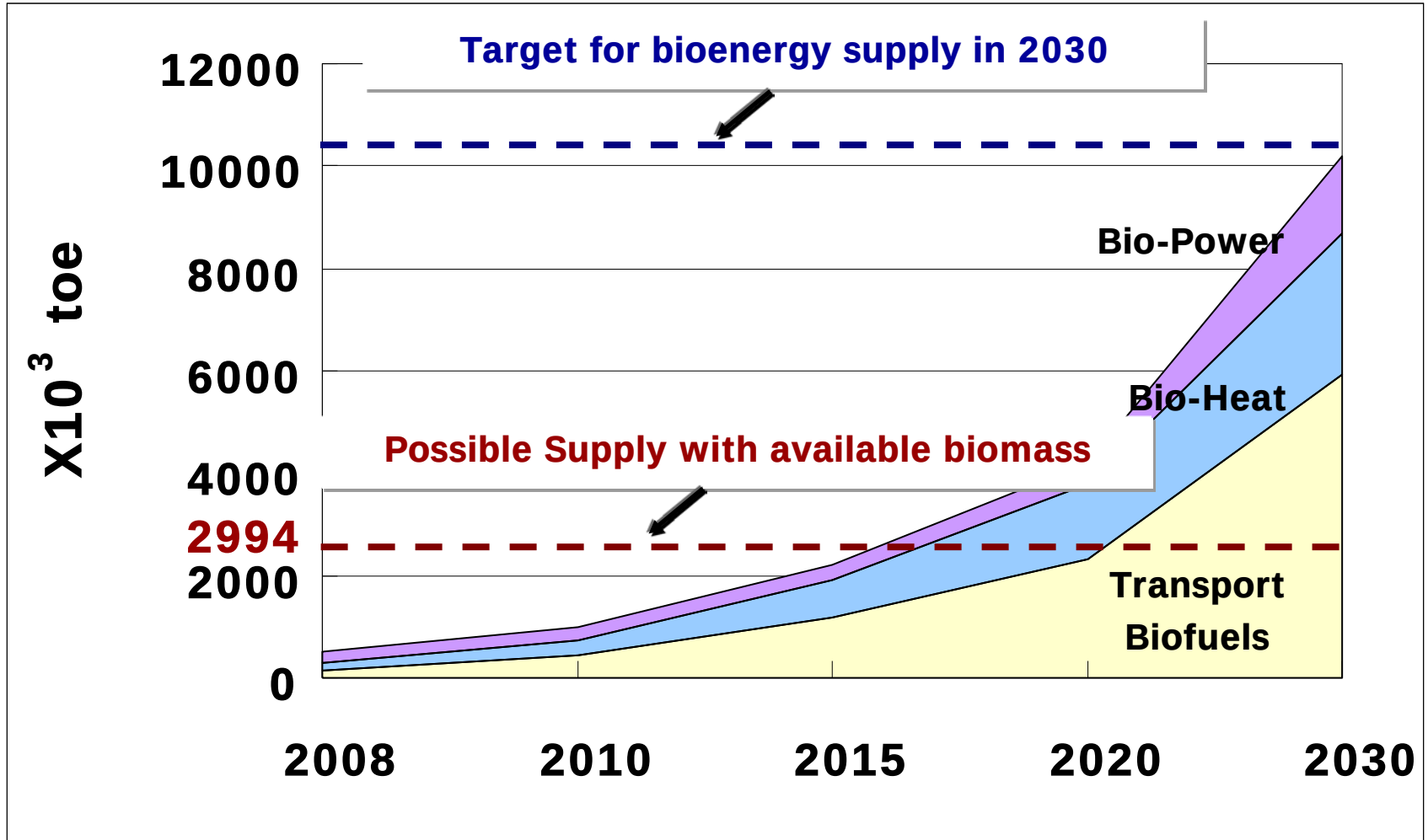
**Renewable energy :  $6.24 \times 10^6$  TOE -----→  $31.63 \times 10^6$  TOE**

**x 14.8**

**Bioenergy :  $0.68 \times 10^6$  TOE -----→  $10.16 \times 10^6$  TOE**

# Targets for Bioenergy

(National Energy Roadmap, 2008)

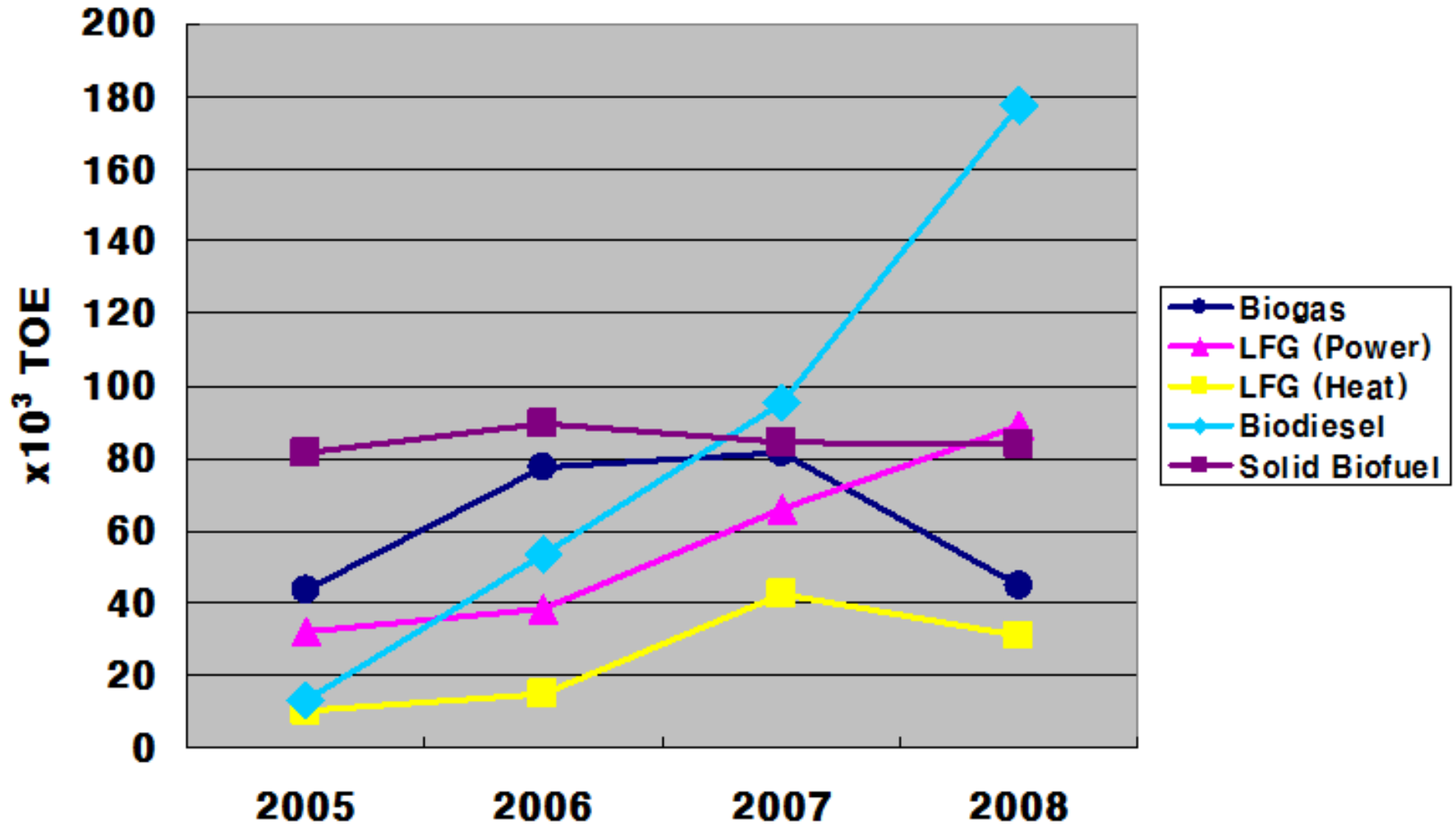


# Priority for Bioenergy in Korea

- Utilization of Organic Wastes (**Biogas, Waste fats**)
- **Transport Biofuels**
- Unutilized Resources (Agricultural and Forest Residues)

# Current Status of Bioenergy Supply

(KEMCO, 2009)



# Challenges for Bioenergy Supply

- **High cost** of bioenergy
- **Limited biomass resources** in Korea
- **Low stakeholder-group acceptance of transport biofuels**

# Feed-in tariffs for Biopower

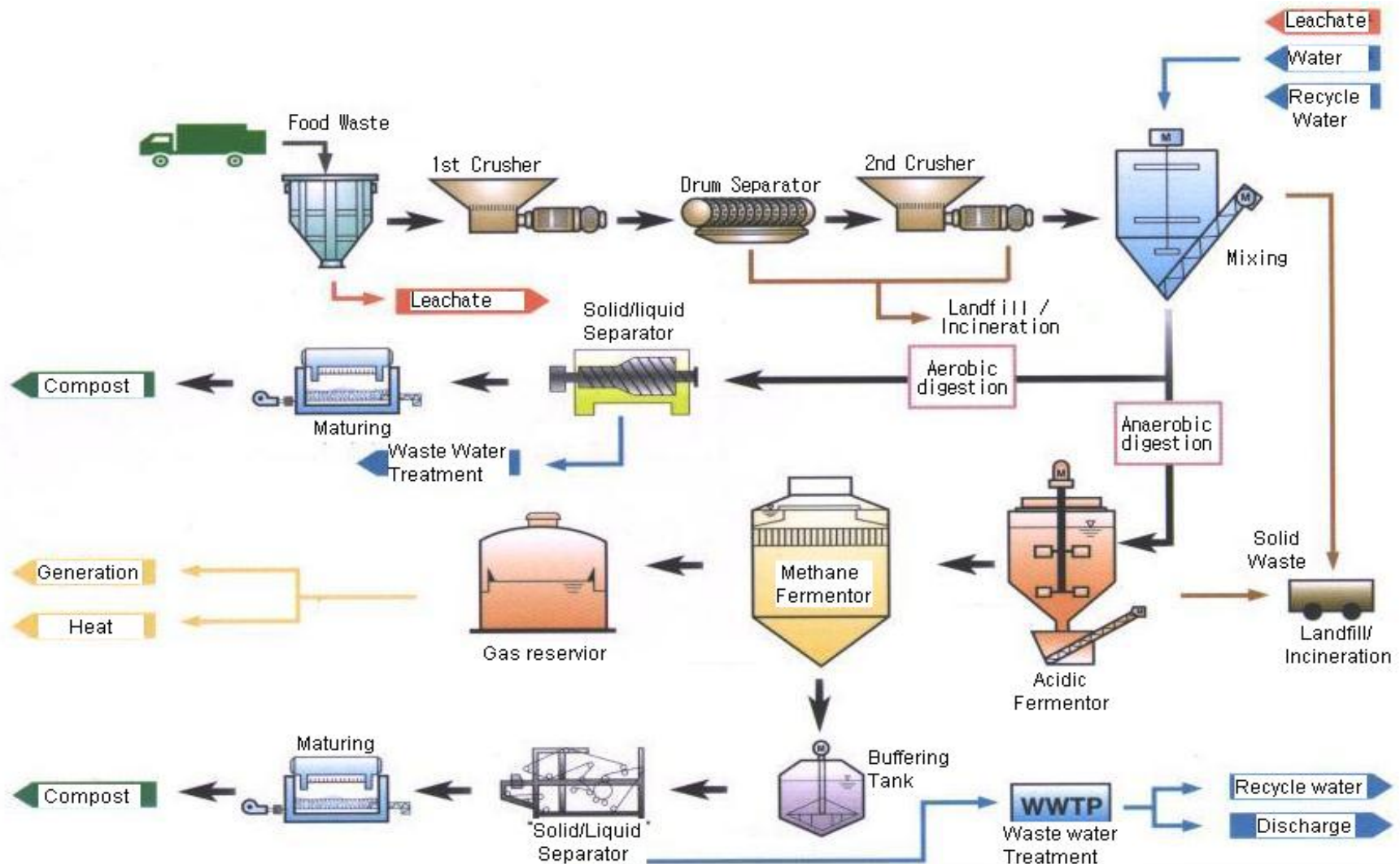
|          | Maximum Capacity | Capacity | Compensation rates, \$/kWh    |                 | Remarks                     |
|----------|------------------|----------|-------------------------------|-----------------|-----------------------------|
|          |                  |          | Minimum Baseline Compensation | Feed-in Tariffs | Fossil fuel lower than 30 % |
| LFG      | ≤ 50MW           | 20MW ≤   | 0.052                         | SMP+0.004       |                             |
|          |                  | ≤ 20MW   | 0.058                         | SMP+0.008       |                             |
| Biogas   |                  | 150kW ≤  | 0.056                         | SMP+ 0.008      |                             |
|          |                  | ≤ 150kW  | 0.066                         | SMP+0.011       |                             |
| Biopower |                  | Wood     | 0.053                         | SMP+0.004       |                             |



# Biogas from Food Wastes

- **Korean food waste takes about 30 % of total organic wastes (6.6million ton/year). The water content of food waste is about 90 % . Because of the characteristics, it is difficult to treat the waste by conventional technologies like land filling or incineration.**
- **KIER developed a two-phase anaerobic digestion process in which acidic fermentation and methane formation were done in separate reactors. The technology was found to be quite effective for the treatment of Korean food waste.**
- **After a series of test runs, the technology was commercialized. Two full scale commercial plants have been constructed to treat food waste and produce methane. The research for the electricity generation using methane was finished in 2008.**

# Two-phase Anaerobic Digestion



# Paju Biogas Plant (110 tons/day)



- 1996 : 30 (tons/day) food waste
- 2004 : 50/60 (tons/day) **food waste / manure**

- 4,800 m<sup>3</sup>/day
- 600kW E.G.



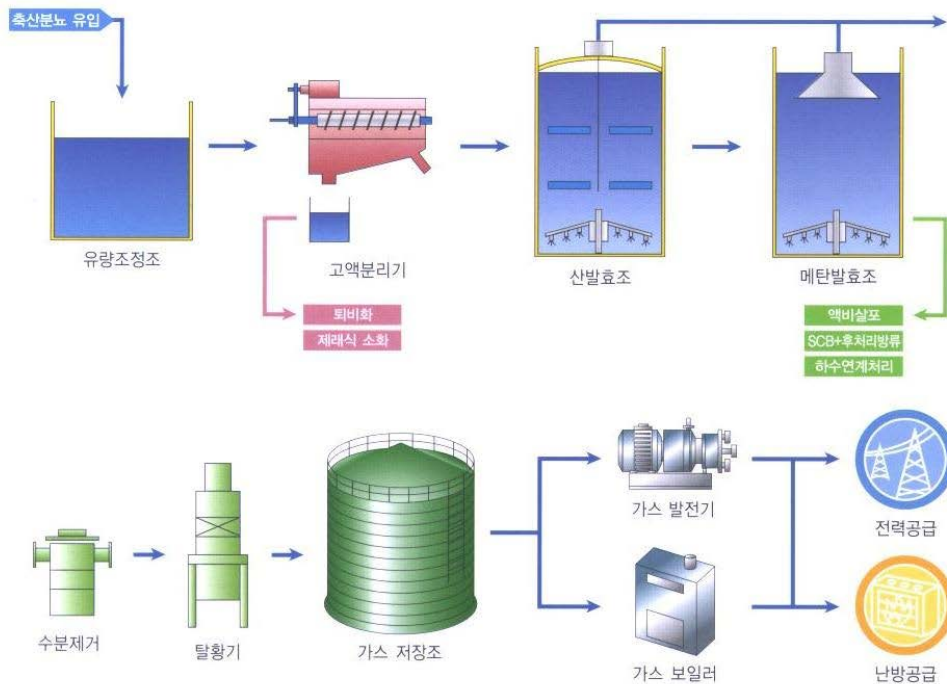
# LFG Power Generation in Busan



- Busan Sangkog Landfill
- Capacity : 6MW

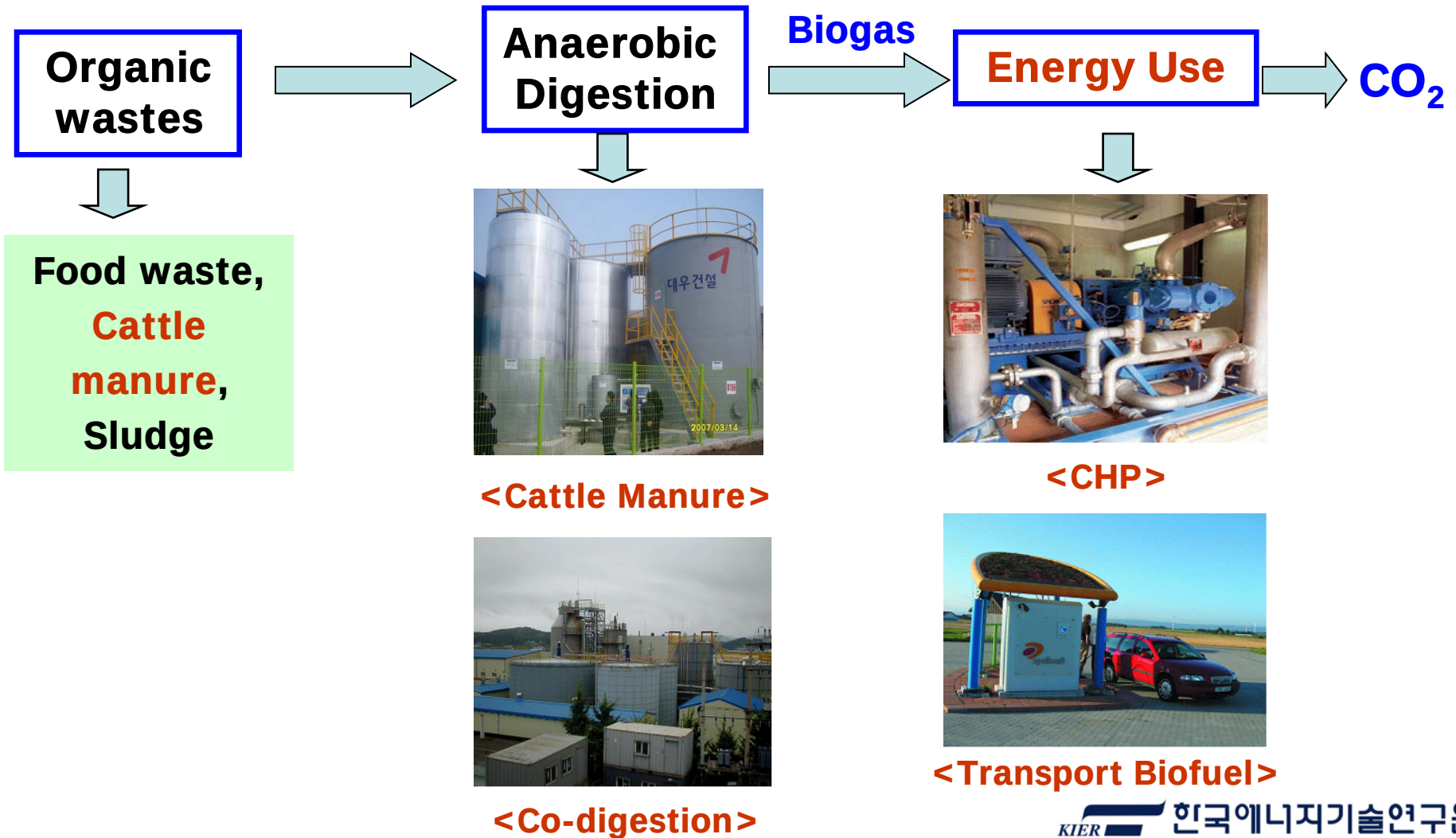


# Biogas from Waste Manure (Demo)



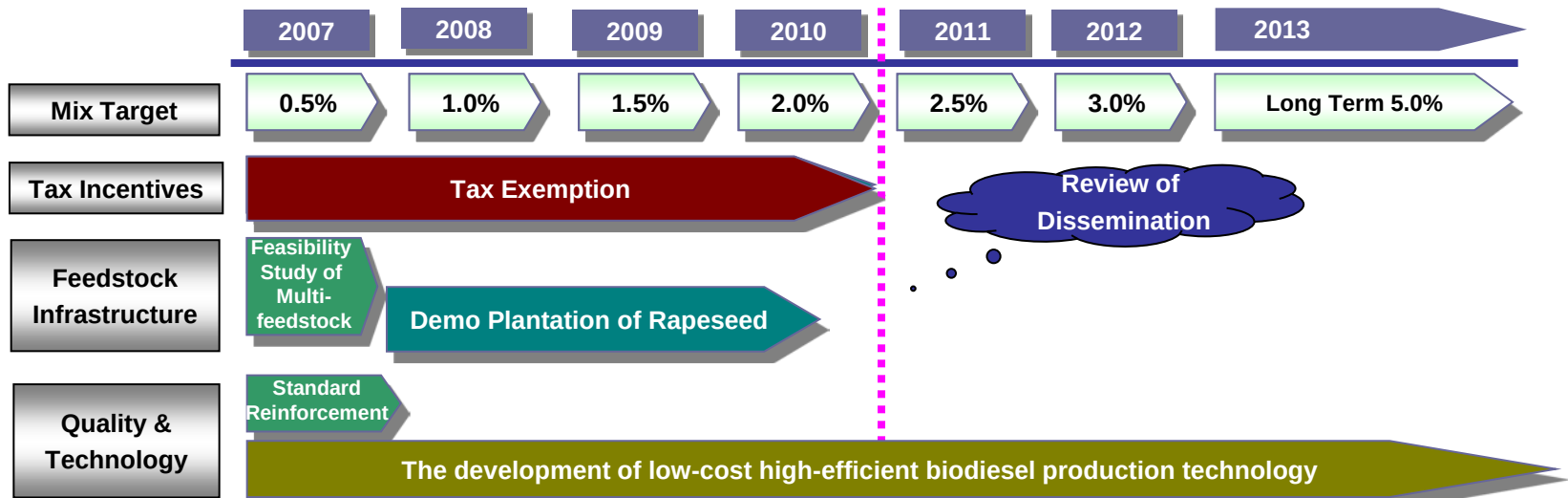
- Location : Mojun, Kyunggido, Korea
- Swine manure : 20 tons/day
- Process : 2 stage UASB treatment after solid removal
- Biogas : 250m<sup>3</sup>/day max. (30kW micro-gas engine)
- Fund : \$1 mil.

# Transport Biofuels from Waste



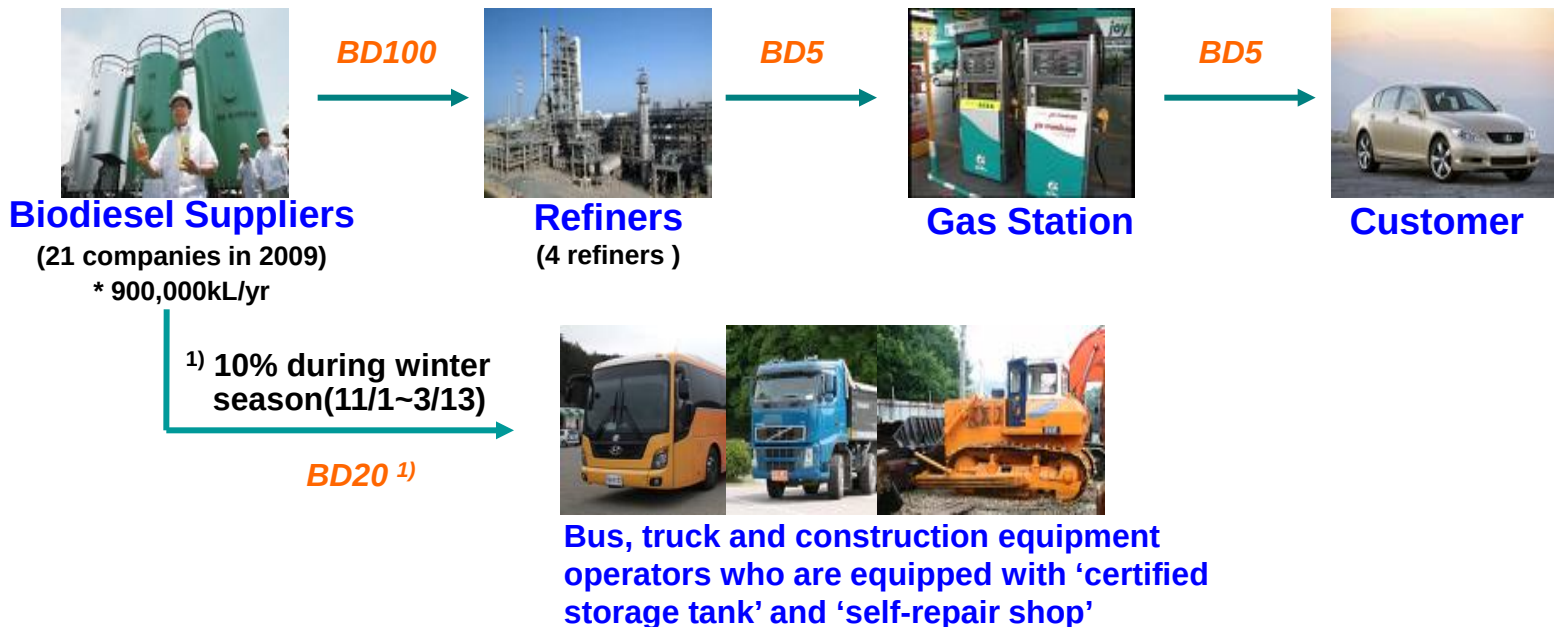
# Tax Exemption on Biodiesel

- Began in 2002 as demonstration project.
- Biodiesel is used 1.5% in 2009, and 3.0% in 2012 of total diesel consumption.
  - 0.5% increases in each year
- BD5 is commercialized in Korea in 2006, marked as the first country in Asia.
- BD20 is limited on the vehicles enabling to repair in their own facilities due to the technological problems.



# Biodiesel Distribution in Korea

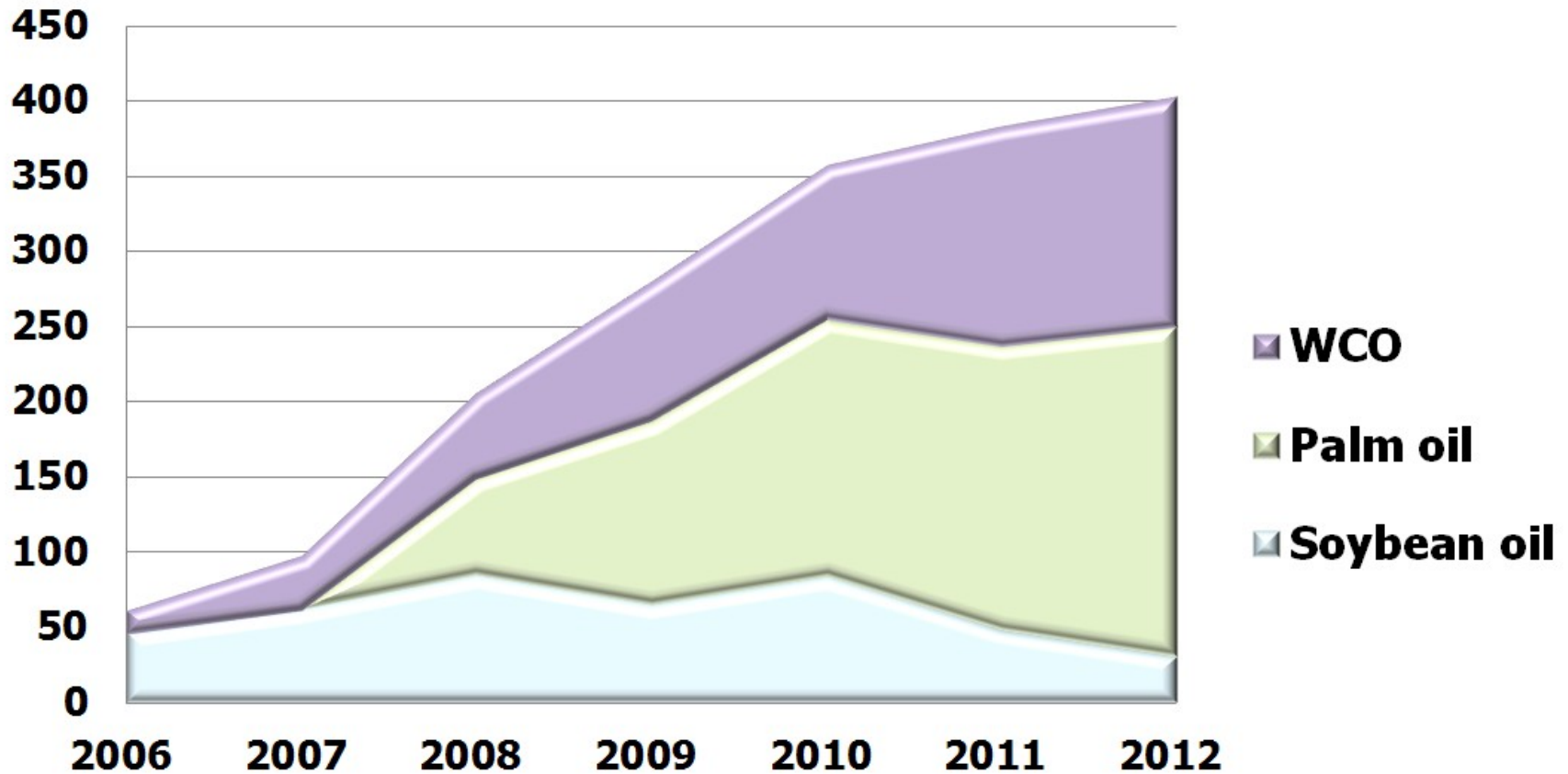
- **BD5** is subject to diesel fuel specification, and supplied only by refiners.
- Bus and truck company can use **BD20** with their own accord.





# Feedstocks for Biodiesel in Korea

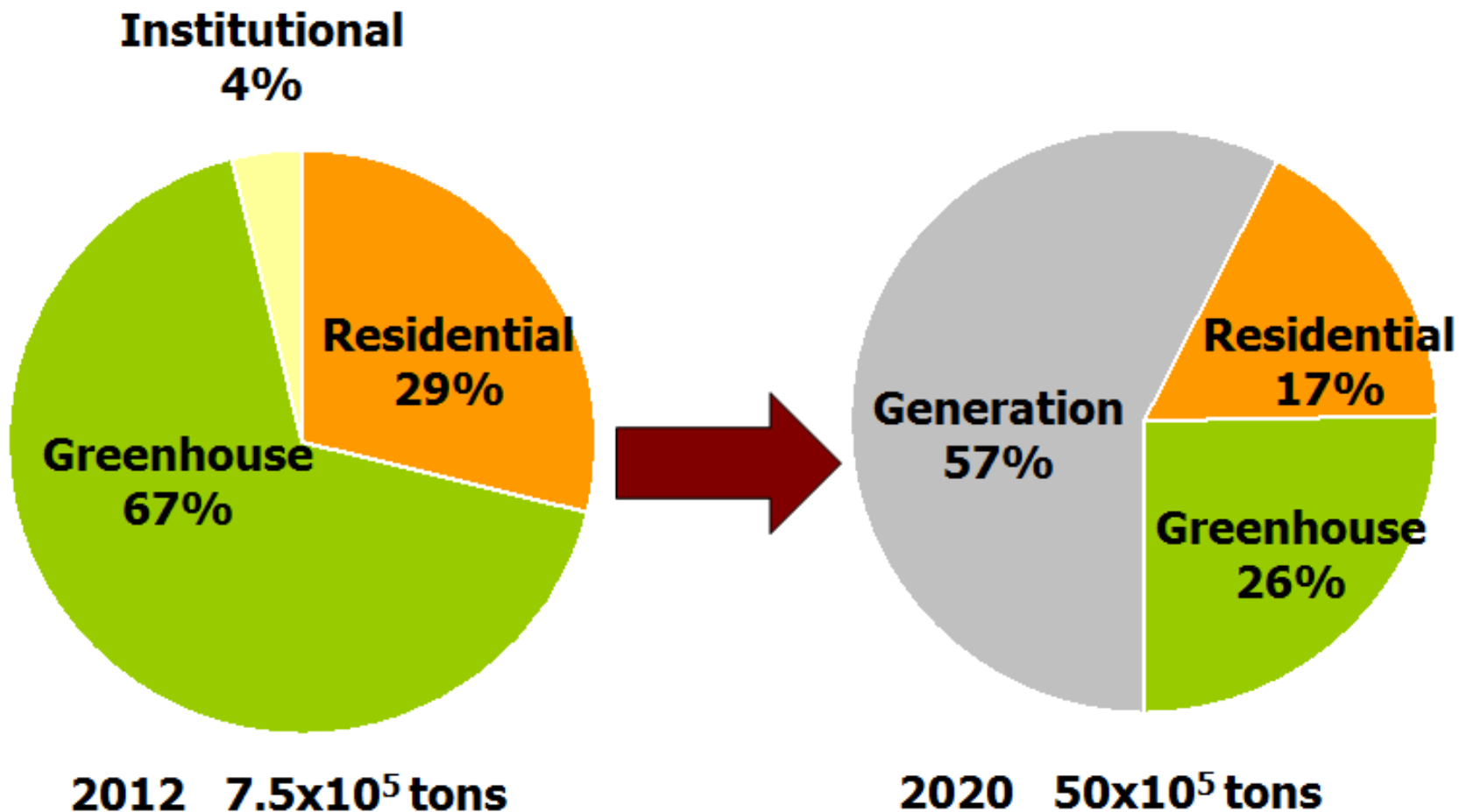
(Korea Bioenergy Association, 2013)



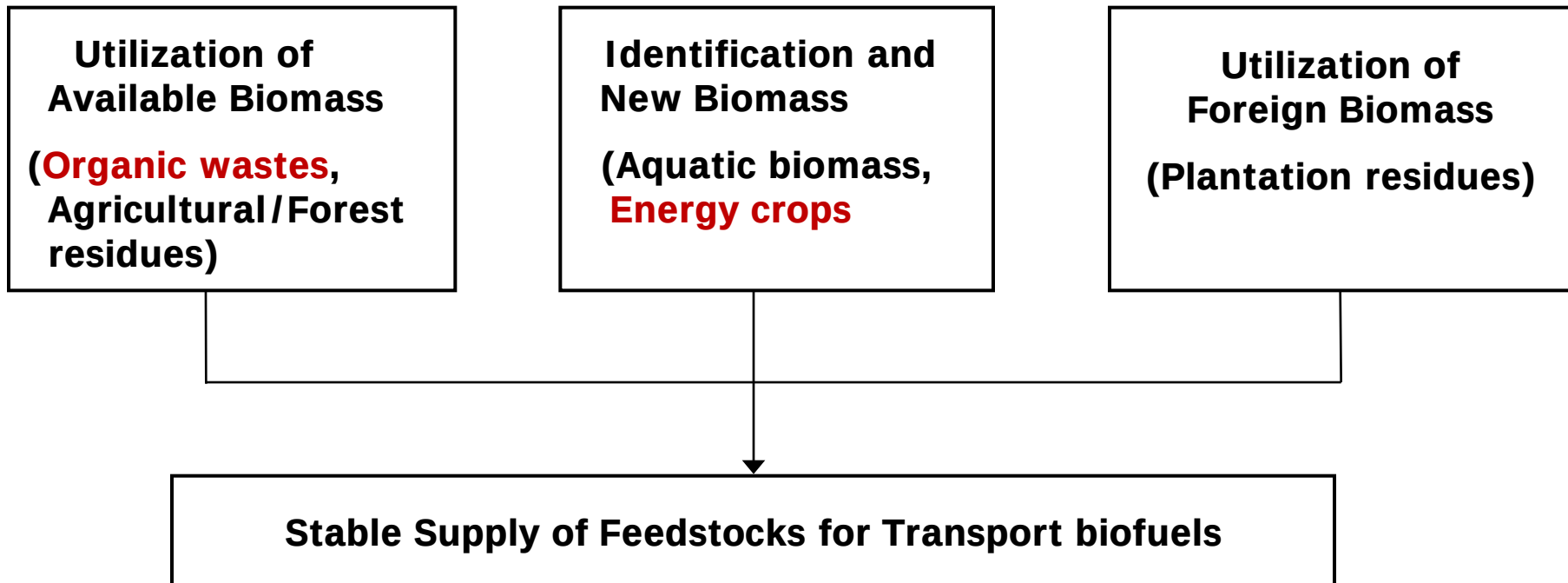
# Solid Biomass Utilization in Korea



# Demand for wood pellets in Korea

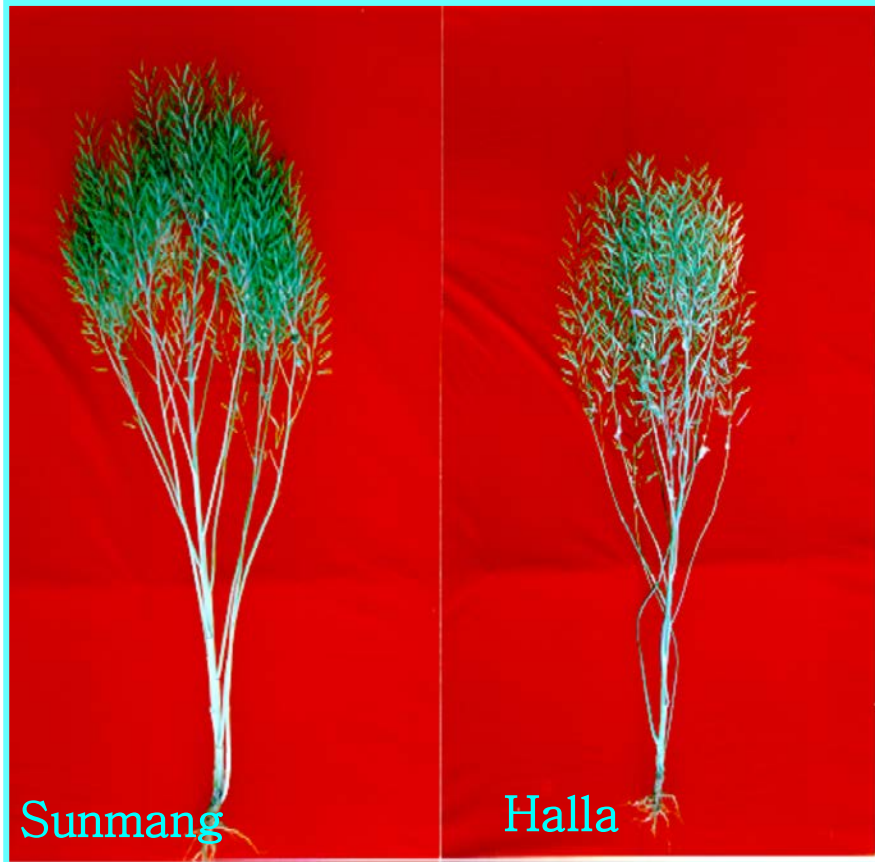


# Strategy for Securing Stable Supply of Feedstocks



# Demonstration Cultivation of Rapessed

(RDA Bioenergy Center, 2008)





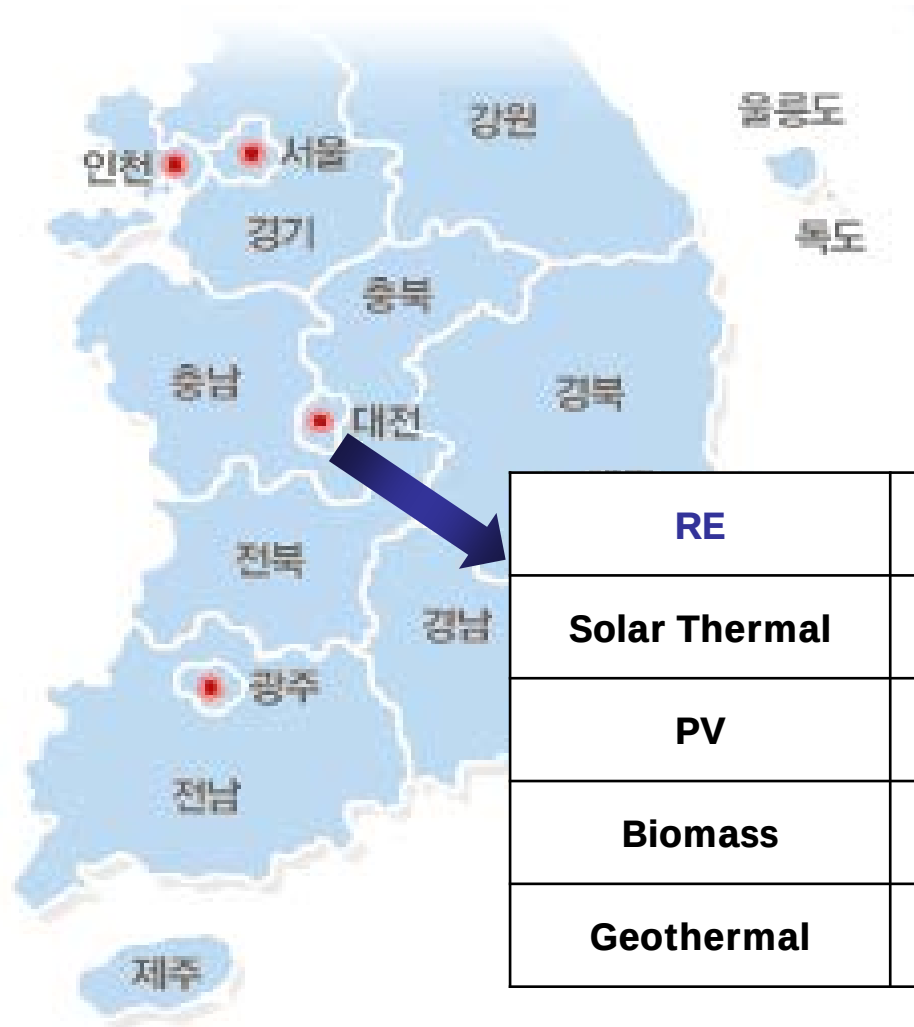
# III. Other Issues

# Issues for RE Implementation

- **Map of RE sources**
- **Financial deficit**

# Map of Renewable Energy Resources

(New & Renewable Energy Data Center, <http://www.kredc.net/>)

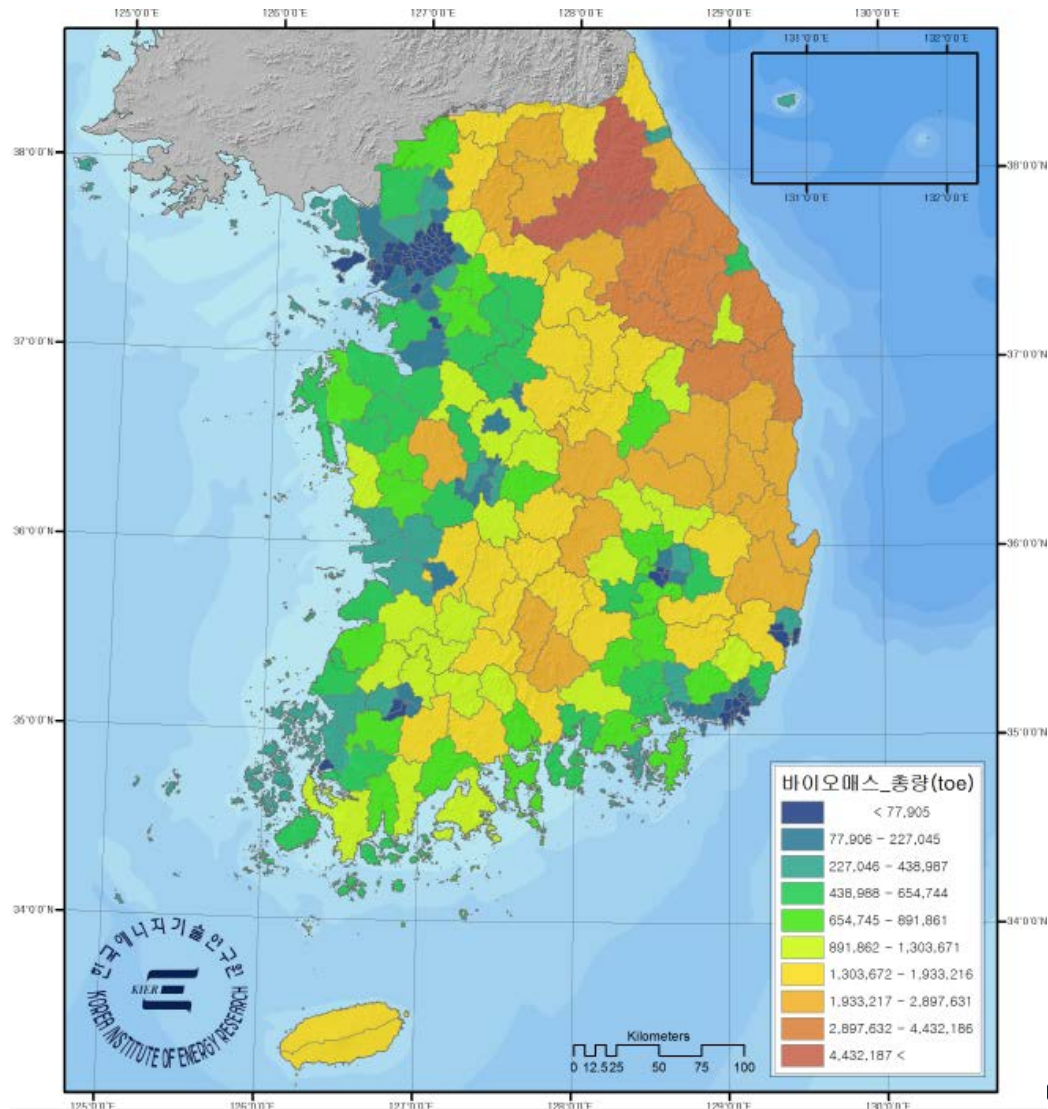


| RE            | Potential, x 10 <sup>6</sup> |
|---------------|------------------------------|
| Solar Thermal | 22,054 Gcal/yr               |
| PV            | 2560 GW/yr                   |
| Biomass       | 12.6 Gcal/yr                 |
| Geothermal    | 11.4 kTOE                    |



# Map of Biomass Resources

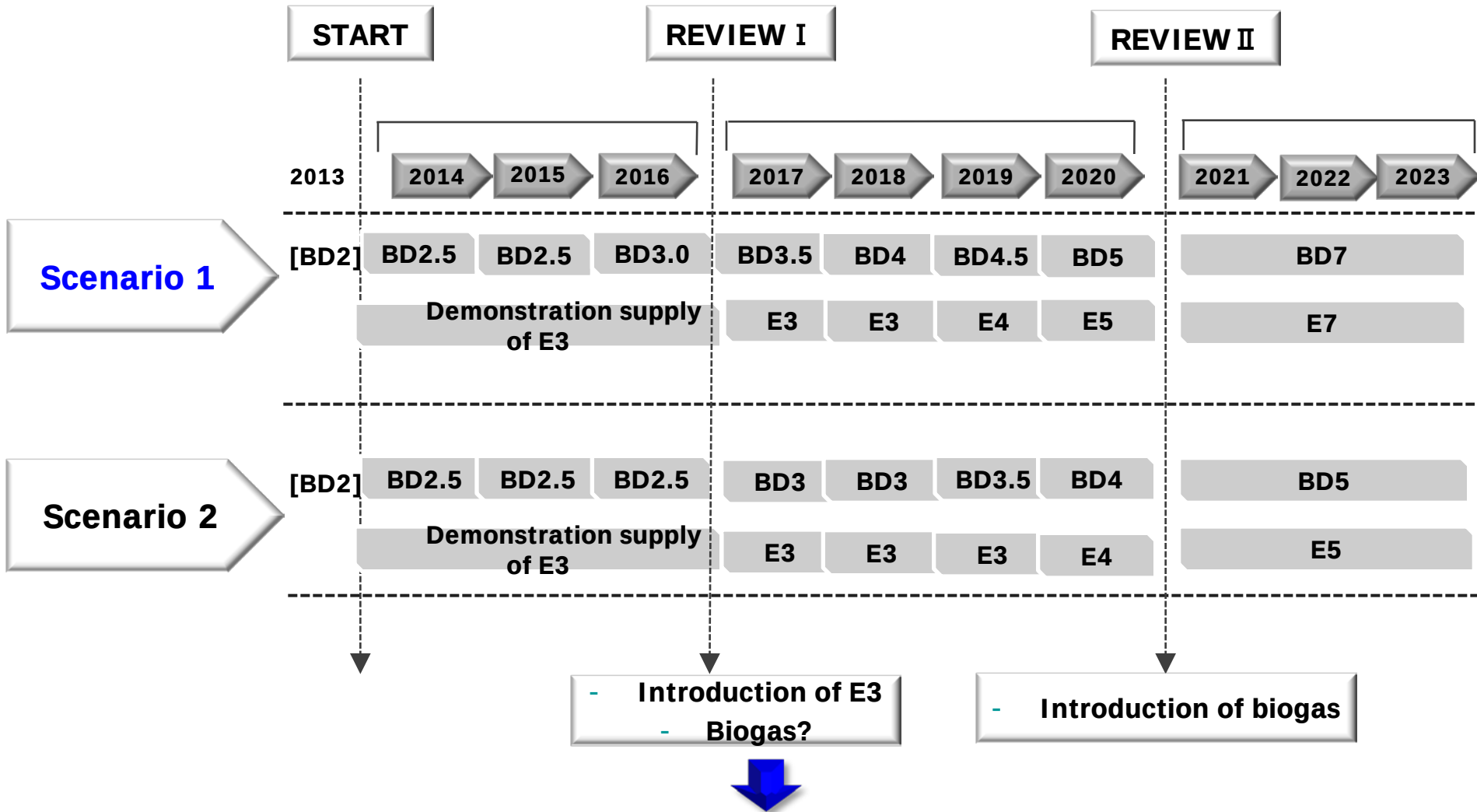
(New & Renewable Energy Data Center, <http://www.kredc.net/>)



# RPS

- **Effective in Korea from 2012**
- **Accelerates the implementation of renewable energy**
- **Impose quota for each renewable energy**
- **Total installed capacity – 1,914 MW**

# RFS in Korea



**Scenario 1 is effective from September, 2015!**

## IV. Summary

- Korean supporting policy for renewable energy implementation is changed from “Subsidy” to “Mandatory” (RPS (2012), RFS (2015) and RHO (2016))
- Bioenergy will play a key role for realizing the sustainable society in Korea
- Securing stable supply of the feedstocks will be the most challenging issue
- Organic wastes and energy crops may be the promising candidates as the feedstocks for bioenergy production

*Thank you for your kind attention!*

**For questions, [bmjslee@kier.re.kr](mailto:bmjslee@kier.re.kr)!**