Potentials for rice straw ethanol production in the Mekong Delta, Vietnam

N.Q. Diep [*], *N. Nakagoshi*, *K. Sakanishi* , *S. Fujimoto*, *T. Minowa*

Presenter: Diep Quynh Nhu – VAST, VIETNAM

New Energy Foundation

National Institute of Advanced Industrial Science and Technology
AIST

E-mail : diepquynhnhu@gmail.com

Outline

- Introduction: why VN should pay attention to production of cellulosic ethanol?

- Review on potentials for rice straw ethanol production in the Mekong Delta, Vietnam

- Discussion on how to spur industrial production of cellulosic ethanol in Vietnam

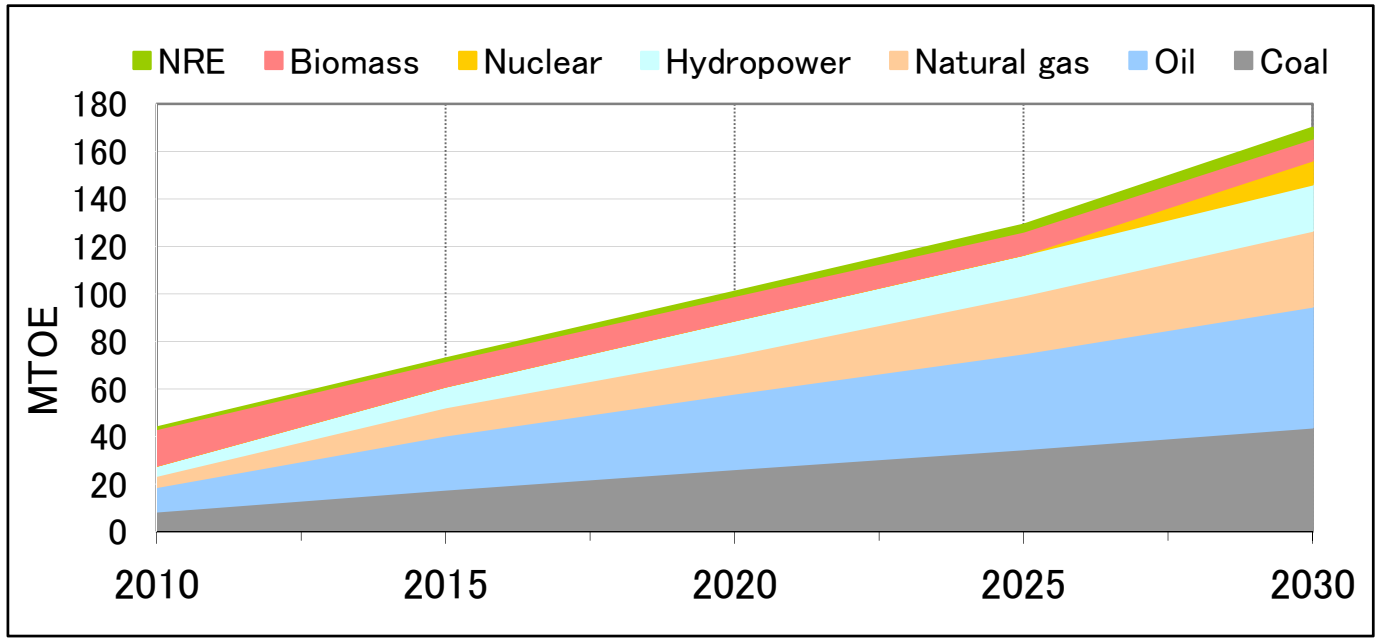
1. INTRODUCTION

- Vietnam has been a net energy importer since 2011, It is estimated that imports accounting for about 26% (basic plan) to 33% (high plan) of total energy consumption by 2020.

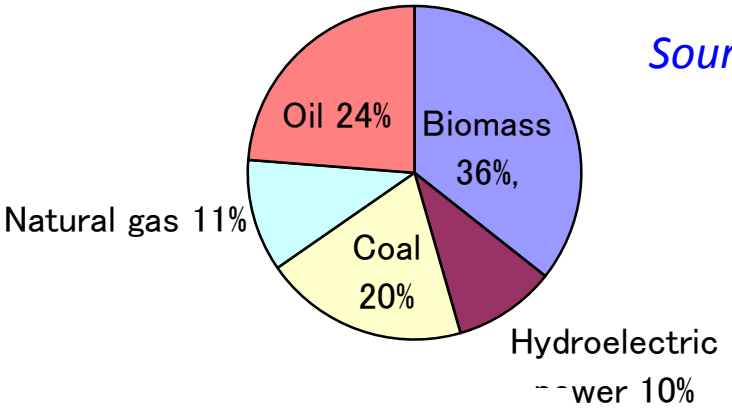
- In November 2007, the Vietnam government approved the scheme on development of bio-fuels up to 2015, with a vision to 2025, its target: 1.8 Mt of EtOH and vegetable oil by 2015. Presently, VN produces EtOH mainly from cassava but producers are in troubles to deal with low domestic market demand, high production costs

THE SCENARIO OF ENERGY CONSUMPTION UP TO 2030

Source: Vietnam Institute of Energy

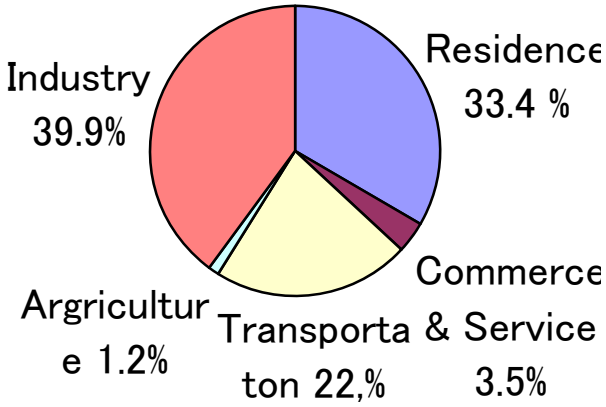


Total energy consumption in Vietnam by type, 2010

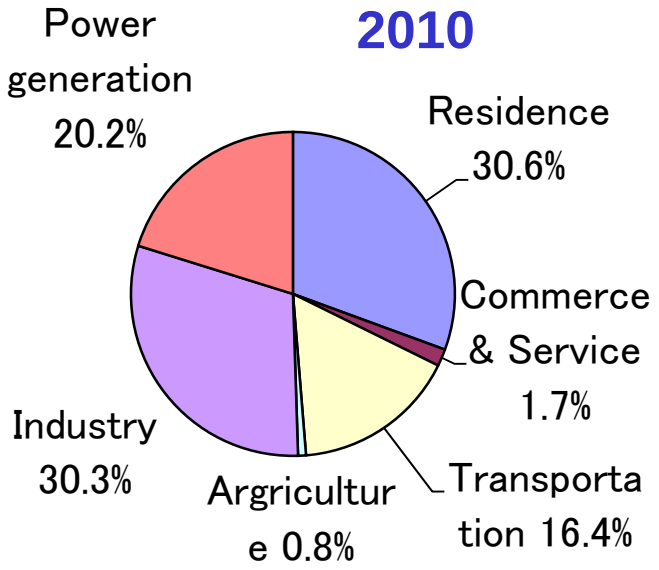


Source: Vietnam Institute of Energy

Share of energy consumption by sector, 2010



CO2 emission by sector, 2010



- Agriculture residue is the major form of traditional biomass energy, thus conversation of this type of biomass to other forms of renewable energy is important.

- **Mekong Delta** : **an intensive agricultural region.**

- *40,602 km*^{2}(12% of Vietnam's area), 64% of this area is used for agricultural-aquatic cultivation

- Population is *17 million*, 80% of this population is engaged in agriculture production.

-Rice residues account for nearly 80% of total agricultural waste. 90% of rice straw is openly burn on fields.

Rice straw -> EtOH

- Reduce gasoline import
- Reduce CO 2 emission
- Promote rural development

- Recently advanced technologies for cellulosic ethanol production introduced in US, Japan are almost ready for commercialized EtOH production

- In Vietnam, efforts in R&D cellulosic EtOH are being undertaken in some institutes and universities. However, to realize the potential for industrial ethanol production from rice straw, other concerns related to cost-competitive EtOH PCs should be addressed.

-*Biomass density, distribution.*

-Optimal plant size; Delivered cost of biomass

-Estimated EtOH production costs

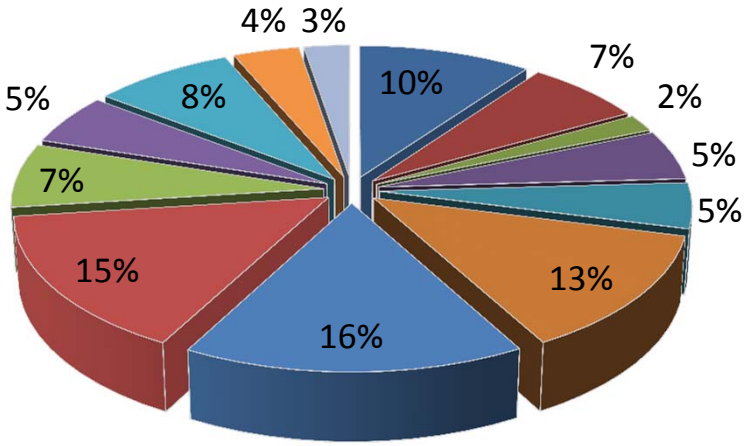
Based on research outcome of our recent studies, the following review will clearly show the great economic potential for industrial production of rice straw EtOH in the Mekong Delta, VN.

2. Review on the potentials for rice straw ethanol production

Table 1 Annually rice production and rice residues generation by region

Region	Total area (10^3 ha)	Rice-planted area (10^3 ha)	Rice production (10^3 ton)	Rice straw amount (dry 10^3 t year^{-1})
1(Red river delta)	2106.3	1155.4	6796.3	8665.3
2	9533.7	669.9	3047.1	3885.1
3	9588.6	1221.6	6252.0	7971.3
4	5464.1	213.6	994.3	1267.7
5	2360.5	306.7	1322.4	1686.1
6 (Mekong Delta)	4051.9	3872.9	20483.4	26116.3
Whole country	**33105.1**	**7440.1**	**38895.5**	**49591.8**

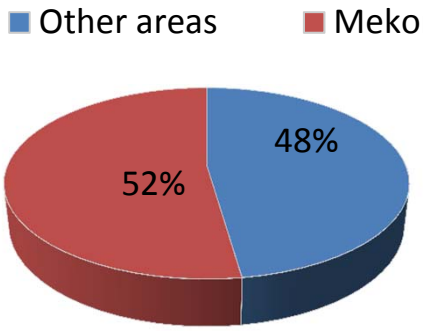
RICE



Total: 20.7 MT

Long An
Tien Giang
Ben Tre
Tra Vinh
Vinh Long
Dong Thap
An Giang
Kien Giang
Can Tho
Hau Giang
Soc Trang
Bac lieu
Ca Mau

Fig2. Annual rice production by provinces in Mekong delta



Total of VN: 38.7 MT

Fig1. Annual rice production in Vietnam

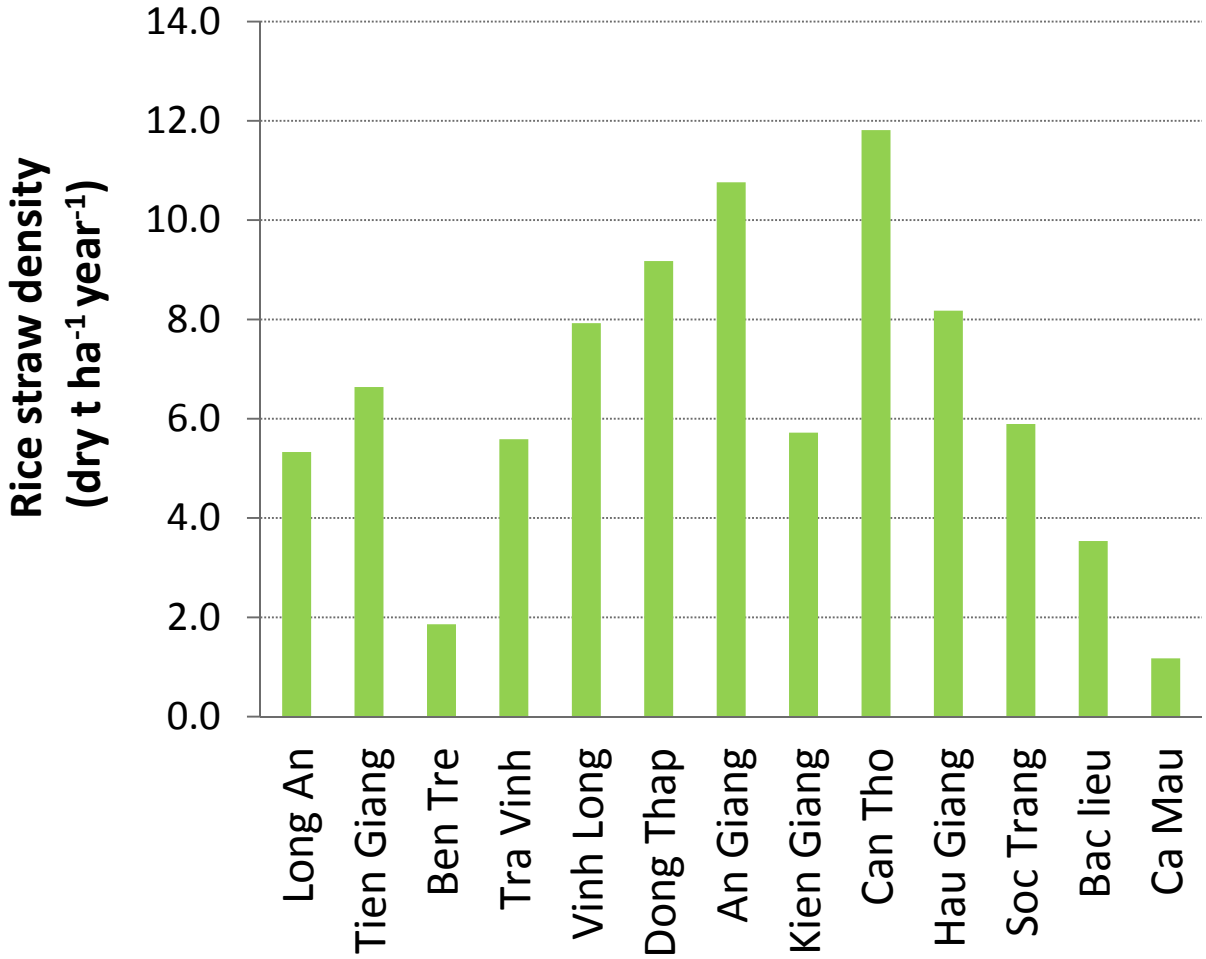


Fig3. Density of generated rice straw by sub-region

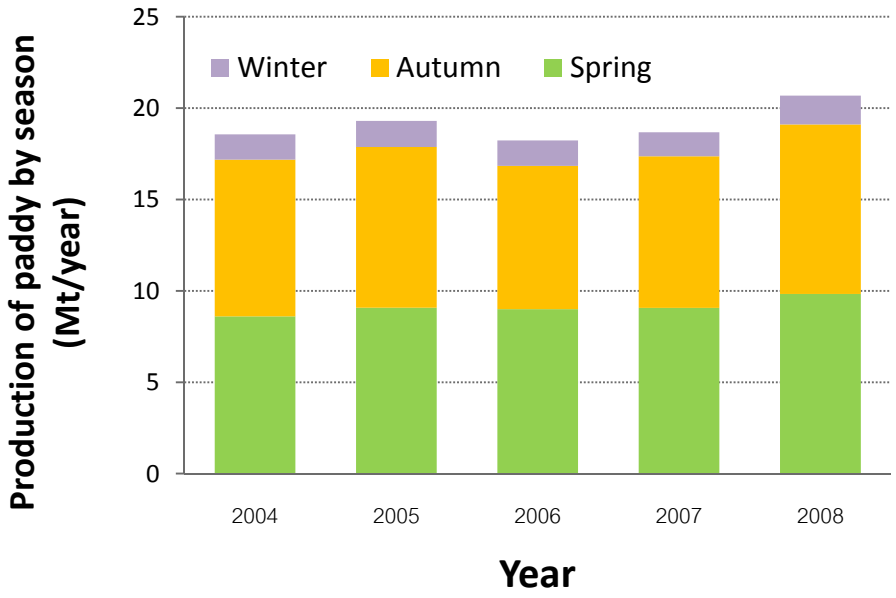


Fig4. Production of rice by season (Million tons)

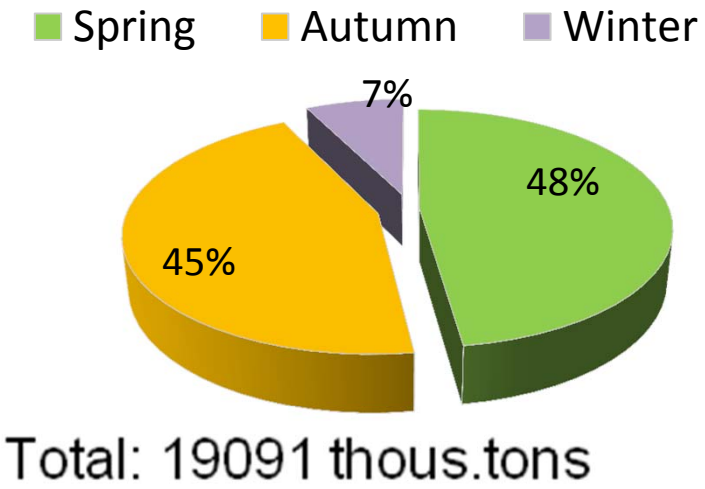


Fig 5. Annually rice production by season

3.2. Estimation of the delivered rice straw cost

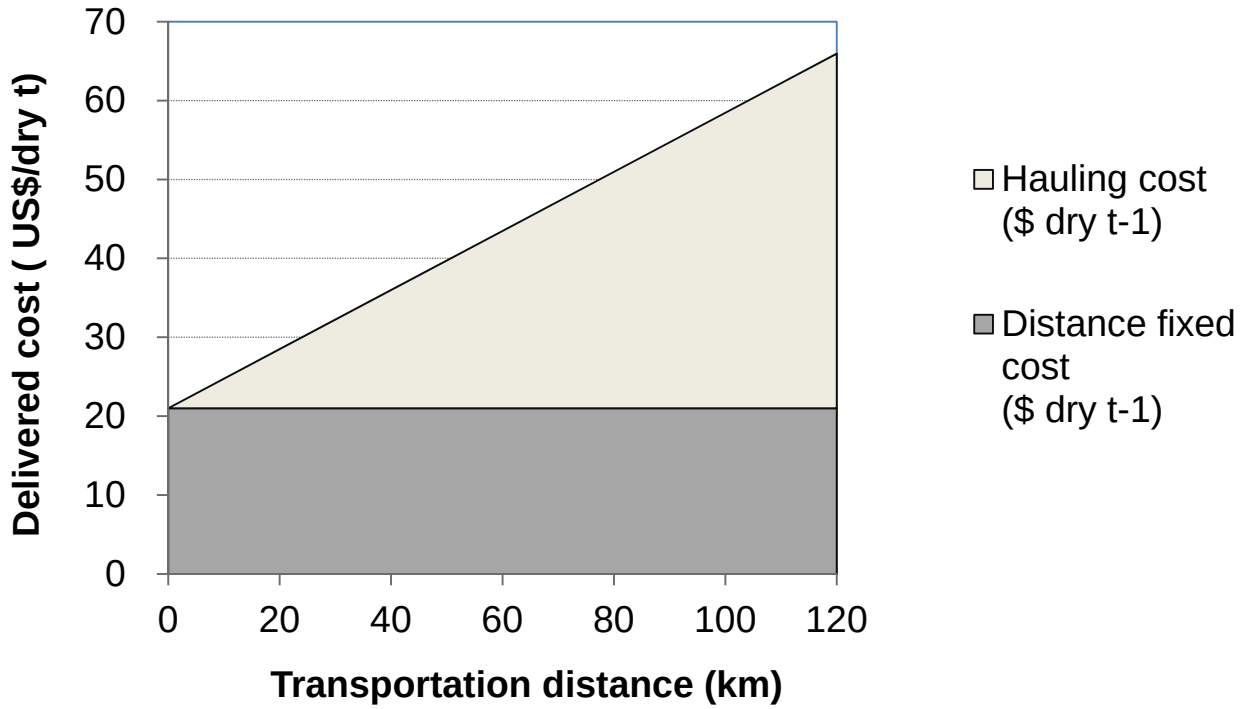
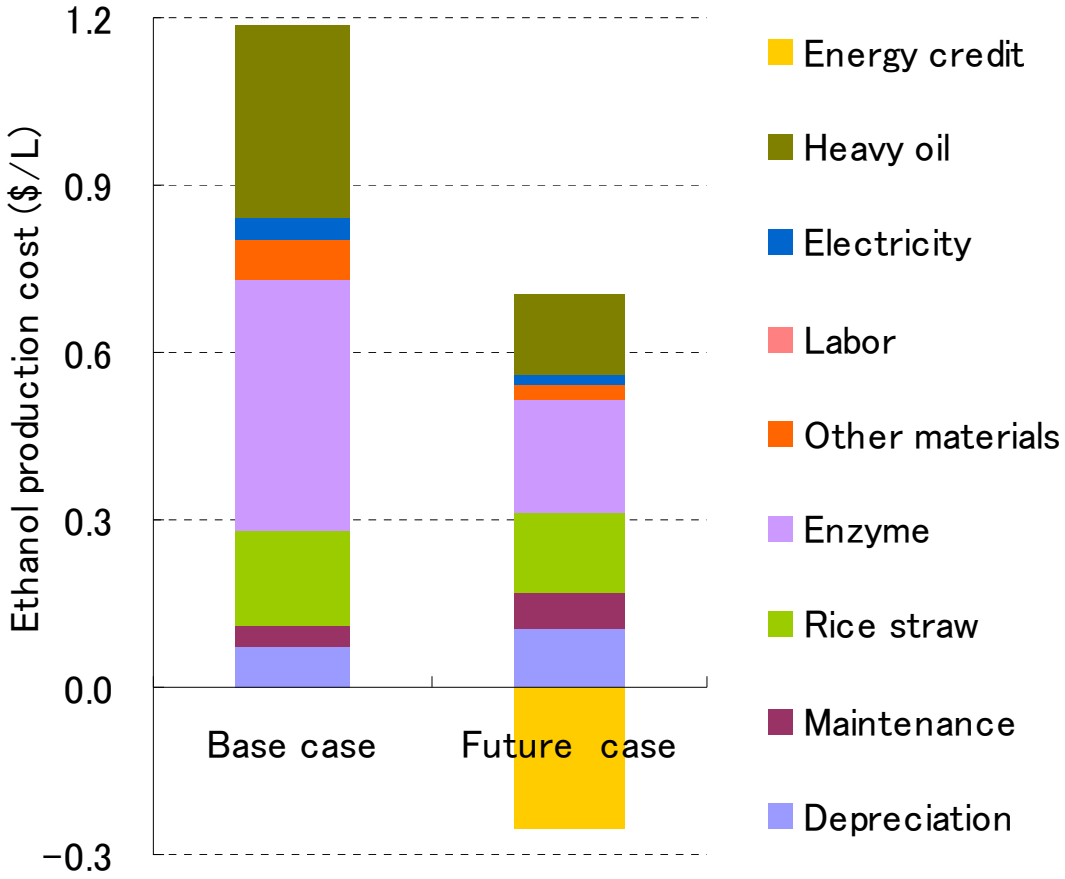


Fig 6. Analysis of delivered cost of rice straw

Table 2. Optimal plant size for different regions in Vietnam

Region	Optimal plant size (ML/year)	Ropt (km)	Number of *opt*Plant by region	Delivered cost of rice straw ($/ dry t)	Total of fixed cost + delivered rice straw cost ($/L EtOH)	Yearly ethanol production (ML/year)
Red river Delta (1)	112.5	45.5	1	37.6	0.244	112.5
Northern midlands and Mountain Areas (2)	52.5	98.8	2	57.5	0.368	105
North Central and Central Costal Areas (3)	7.5	26.2	6	30.3	0.492	45
Central Highlands (4)	15	70	2	46.7	0.448	30
South East (5)	45	69.1	1	46.4	0.335	45
Mekong Delta (6)	195	48	2	38.7	0.224	390
Whole country						**727.5**



✓**Plant's capacity**: 200ML/ year; 300 days/ year

✓**Delived rice straw cost**: 40US $/ton

✓**Base case**: applying recent technologies developed in AIST

✓**Future case**: applying innovative technologies intend to reduce Enzyme and energy cost in the future

Fig 7. Rice straw EtOH production costs in Mekong Delta, VN via techno-economic analysis.

Kawasaki
Powering your potential Kawasaki Heavy Industries, Ltd.

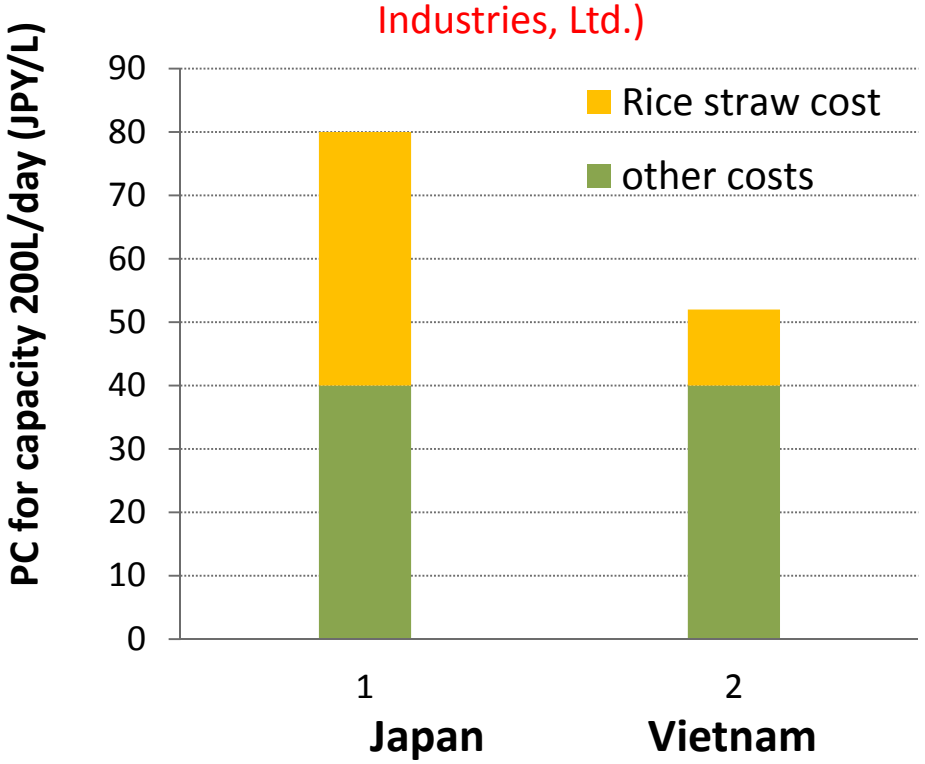
- **Capacity: 200L/day**

- **Ethanol: 99.5 vol.%**

- **Production cost**: **40 yen/L or 80 yen/L** with or without subsidy for rice straw cost from Japanese Government

Source: Reuters, May 30, 2013

Rice straw EtOH production costs in Mekong Delta, VN
(if applied technology from Kawasaki Heavy Industries, Ltd.)



- **If applied Kawasaki Heavy's new technology, EtOH PC in Vietnam will be <0.52 USD/L**

- **Cassava EtOH PC in Vietnam: 15,000 VND/L = 0. 74 USD/L (**by *Vietnam Oil and Gas Group*)

3. Discussion on how to promote industrial production of rice straw EtOH in Vietnam

❑Vietnam government must have **a strong policy to promote bioethanol consumption in Vietnam**, ensure a stable market for bio-ethanol. **Subsidies for capital investment should be drawn.**

❑Vietnam will face difficulties in investment funds and advanced technologies for develop cellulosic ethanol plants. Thus, **calls for investment from foreign entrepreneurs, transfer technologies or cooperation in production rice straw ethanol with Japan fuel companies** (e.g., Kawasaki; Mitsubishi Heavy Industries, Ltd.) are necessary.

❑ Increase the number of researchers , engineers sent to Research institutes, ethanol industrial companies in Japan **to learn experiences in developing technologies and operating EtOH plants. Technologies applied for production process must meet the requirement for GHG savings**.

References

1. Do TM, Sharmar D (2011) Vietnam's energy sector: A review of current energy policies and strategies. *Energy Policy,* 39:5770-5777.

2. Diep NQ, Fujimoto S, Minowa T, Sakanishi K, Nakagoshi N (2012). Estimation of the potential of rice straw for ethanol production and the optimum facility size for different regions in Vietnam. *Applied Energy*, 93:205-211.

3. Diep NQ, Fujimoto S, Yanagida T, Minowa T, Sakanishi K, Nakagoshi N, Tran XD (2012). Comparison of the Potential for Ethanol Production from Rice Straw in Vietnam and Japan via Techno-economic Evaluation. *International Energy Journal*, 13:113-122.

4. Diep NQ, Sakanishi K (2011). Potential for bio-ethanol production from agriculture residues in the Mekong Delta, Vietnam. *International Energy Journal*, 12:145-154.

5. Vietnam Institute of Energy (2012) The scenario of energy consumption in Vietnam up to 2030. Present at the annual meeting between VAST, Vietnam and AIST, Japan.

6. Vietnam News (2012) Ethanol producers cry, available from URL http://english.vietnamnet.vn/fms/business/51442/ethanol-producers-cry.html

Acknowledgment

I really appreciate the significant program supported by ***New Energy Foundation*** that help researchers from other ASIAN countries can approach advanced technologies and gain experiences in research and application from Japan.

Hopefully, more researchers, engineers will be invited to Japan to promote R&D and application of renewable energy in their home countries.


水産省補助「ソフトセルロース利活用技術確立事業」
バイオエタノール製造実証設備
Thank you very much for your kind attention!