Biomass Power as Major Power Source

~Create Huge Pellet Demand in Japan~

May 15th 2018

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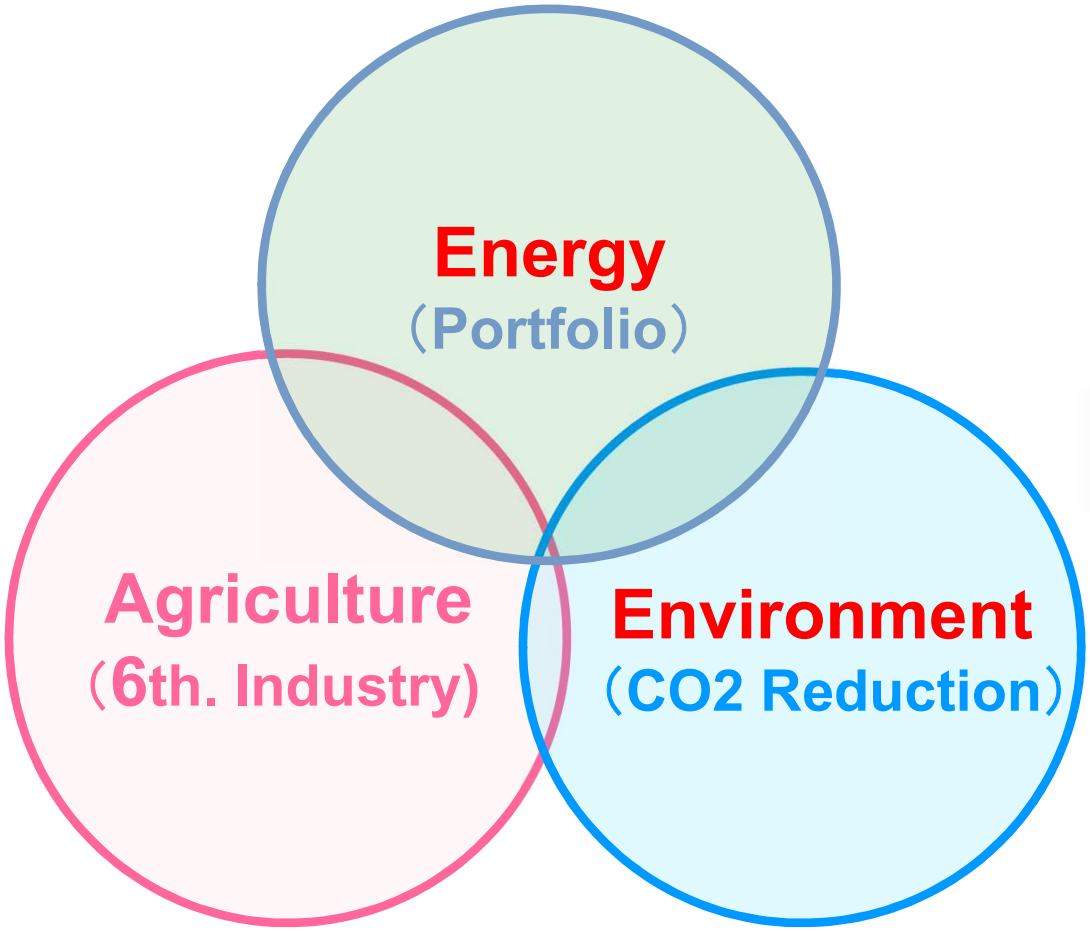
President , NEED

Deputy Chairman , BPA

Driving force to create Biomass Energy Industry



Industrialization

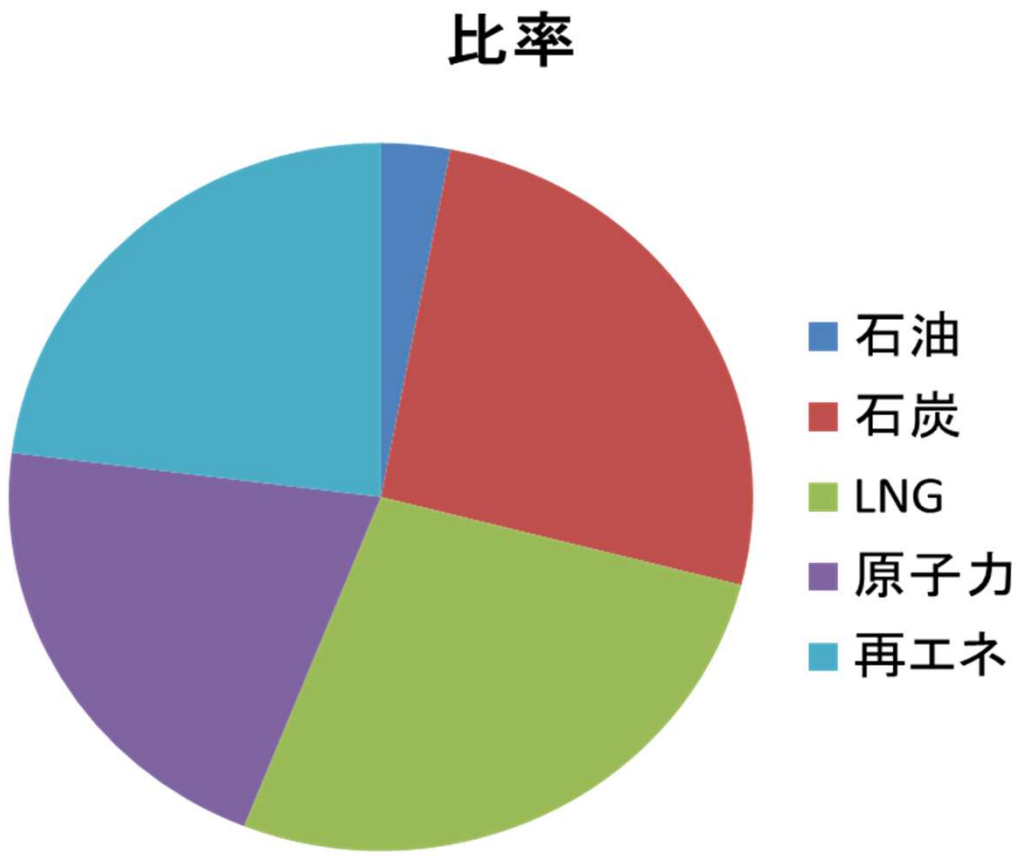
Employment

- **P**olitical Action
- **S**trategic Promotion

Energy Mix. of Power Generation in 2030

・ Oil	:	31.5 Bill. kWh	3%
・ Coal	:	281 Bill. kWh	26%
・ LNG	:	284.5 Bill.kWh	27%
・ Nuclear	:	231.7～216.8 Bill.kWh	22～20%
・ Renewable	:	236.6～251.5 Bill.kWh	22～24%
Total	:	1,065 Bill.kWh *	100%

（*As assumption that electricity consumption shall be 980.8 Bill. kWh after 17% energy saving from current）



Breakdown of Renewable Energy (Ratio**)

・PV	: 74.9Bill.kWh	7.0%	(30%)
・ Wind	: 18.2Bill.kWh	1.7%	(7%)
・ Geothermal	: 10.2～11.3Bill.kWh	1.0～1.1%	(5%)
・ Small Hydro	: 93.9～98.1Bill.kWh	8.8～9.2%	(39%)
・ Biomass	: 39.4～49 Bill. kWh	3.7～4.6%	(19%)

（** Upside case ）

GHG Reduction Target in 2030
⇒▲ 26% from 2013

FIT (Feed in Tariff) for Biomass Power Generation

FIT was introduced on **July 1, 2012** by METI.

		Unutilized Wood (1)	General Wood (2)	Waste Materials Sewage sludge	Recycled Wood
Cost	Power Plant Cost	¥ 410,000/kW	¥ 410,000/kW	¥ 310,000/kW	¥ 350,000/kW
	Annual O& M Cost	¥ 27,000/kW	¥ 27,000/kW	¥ 22,000/kW	¥ 27,000/kW
Expected IRR (before tax)		**8%**	**4%**	**4%**	**4%**
Original FIT Rate (¥ /kWh)		**32**	**24**	**17**	**13**
Revision		**40 (3)**	21(4) ⇒ **Bid (5)**	No change	No change
Duration		**20 years**			

(1) Forest residues
(2) Wood Chips , Pellets etc. **including imported one** (even PKS, Palm Oil)
(3) Applicable for **less than 2MW** Projects since April 1, 2016
(4) After Oct. 1, 2017 for more than 20MW
(5) **After April 1, 2018** for **more than 10MW** (**180MW** in 2018 **including co-firing with coal**)

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Evaluation Criteria for Power Sources

1. **Efficiency** → Density, **EPR**
2. **Convenience** → Storage, **Transport**
3. **Stable Supply** → Availability, **Stability**
4. **Safety** → **Safety**, Countermeasure
5. **Economy** → **LCC**, **Ripple Effect**
6. **Environment** → **LCA** (GHG),Waste Disposal
7. **Social Impact** → **New Industry** , **Employ**

\+ **Maturity of Technology** and **Reservation**

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Comparison Analysis of Power Sources

Type	Energy Sources	Efficiency	Convenience	Stable Supply	Safety	Economy	Environment	Social Impact	Maturity of Technology	Availability
Thermal	Coal	◎	○	◎	○	◎	×	×	◎	○
	Oil	◎	◎	◎	○	△	×	×	◎	△
	LNG	◎	△	◎	△	△	○	○	◎	○
Nuclear	Nuclear	◎	△	○	×	○	△	△	△	△
Renewable	Hydro	○	○	○	○	○	○	○	○	△
	Geo Thermal	△	○	△	○	△	○	○	○	△
	Wind	△	×	×	△	○	○	○	○	△
	PV	△	×	×	○	×	○	○	○	△
	CSP	△	○	○	○	×	○	○	△	△
	Biomass (dedicated)	○	○	○	○	△	○	◎	○	○
	Biomass (Co-Fired)	○	○	○	○	○	○	◎	○	○

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Advantage of Biomass Power over VRE

1. Biomass PS is stable Base-Road power source and Controllable like thermal PS
   ⇒・Considered as Coal-Fired PS Substitution.
   ・Usable as Back-Up power for VRE (PV/ Wind)

2. High Capacity Factor
   (Biomass 80% , PV13% , Wind 20%)

3. Power Source (Bio Fuel) can be transportable
   ⇒ Bio Fuel can be produced at different locations.

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Significance of Biomass Power Generation

Revitalization of local economy	➢ **Creation** of new **job** and revitalization of the **regional economy** especially for forestry and transportation industry
Stable power supply	➢ Stable **base-load power source** same as coal-fired power and nuclear power
Improvement of Energy Security	➢ By utilizing **both domestic and imported raw materials** for Biomass Fuels (from diverse sources such as **North America**, **Asia**, Australia,etc.),**Energy Security** shall be evidently improved in comparison with the fossil fuel based power sources
Contribution to the Energy Mix. Target in 2030	➢ Biomass accounts for **4.6%** of the Energy Mix (Approx.20% of Renewable Energy) and it's role is expected to be more towards 2050
Co2 Emission Reduction	➢ Contribute to reduce GHG Emissions

Outline of BPA（Biomass Power Association）

Established : On **November 22nd 2016**（**81 Members** as of April,2018）

Activity :To promote Biomass Power Generation Projects for the purpose of **Creating Sound Biomass Industry** and Sustainable Global Environment.

6 times Workshops and **3 times Seminars** as BPA's annual event.

Members

Marubeni
RENOVA
石狩新港新エネルギー開発合同会社
大阪ガス
サミットエナジー株式会社 Summit energy
Green 株式会社グリーン発電大分
株式会社福井グリーンパワー
合同会社境港エネルギーパワー
NED New Energy Development Co., Ltd. シンエネルギー開発株式会社
日本紙パルプ商事株式会社
ORIX
倉紡綿株式会社
株式会社 JCサービス JC Service Co., Ltd.
Hitz 日立造船株式会社 Hitachi Zosen
MUFG 三菱UFJリース
RENEWABLE JAPAN
株式会社 グリーン・エネルギー研究所 Green Energy Laboratory Co.,ltd.
SB Energy
TESS テス・エンジニアリング
エクイスバイオエネルギー株式会社
フォレストエナジー
WOODONE
株式会社サラ
大林クリーンエナジー株式会社 OBAYASHI
ユナイテッド計画株式会社
ENE-VISION 株式会社 エネ・ビジョン
F-BIT Fbit communications

株式会社ダイセン
株式会社ドップウエスト
山九株式会社
旭日産業株式会社 Asahi Sangyo Kaisha, Ltd.
TAKAFUJI 株式会社タカコジ
森・濱田松本法律事務所 Mori Hamada & Matsumoto
E GATE
JFE 商事 株式会社 JFE
住友商事
愛知海運株式会社 75th
荏原環境プラント株式会社 EBARA
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YANAN
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株式会社 グリーンフォーリスト
新日本サービス株式会社 FUYO LEASE 芙蓉総合リース株式会社
JCOAL Japan Coal Energy Center
水ing
PANALPINA on 6 continents
株式会社 新都心エージェンシー
株式会社 建設環境研究所 Civil Engineering & Eco-Technology Consultants
有限会社 三神エンジニアリング
INABATA
ITOCHU
四国工営
S-TAIL ecp Inc. 株式会社エステール ecp
TEIJIN
ANDRITZ
eCONeCOL
アサヒ機装株式会社
東京産業株式会社 TOKYO SANGYO CO.,LTD.
間口商事株式会社
Baker McKenzie.
bcpg
DJK 第一実業株式会社
乾汽船
MOL 商船三井
住友重機械
MITSUBISHI ELECTRIC Changes for the Better 三菱電機
神鋼商事 SHINSHO CORPORATION
SOMPOリスクケアマネジメント
We Find the Way 日本通運 NIPPON EXPRESS
ワケン機械
XYLOWATT
日本国土開発 株式会社 KOKUDO
太平洋セメント
NTTファシリティーズエンジニアリング
Sun Earth
立ちどまらない保険。 三井住友海上 MS&AD INSURANCE GROUP

東邦大学

Akita Biomass Power Plant (Site visit on May/17)

Scheme

Unused Wood Chips
(Akita Prefecture)

PKS
(Indonesia/Malaysia)

Outline

Name	United Renewable Energy Co., Ltd (URE)
Address	Akita Prefecture, Akita Mukaihama 1-8-1
Date founded	October 10, 2013
Number of Employees	30 people (as of March 31, 2017)
Output	Gross Electricity: 20.5MW
Fuel	Domestic Unused Wood Chip: 70% Palm Kernel Shells (PKS) : 30%
PPA	•Power Producer and Supplier •Tohoku Electric Power Co.

Target of Biomass Power Generation (2030)

Categoly	2014 .11	2030 Target（Ratio）	Additional Facility
1. Utilized Wood	30MW	240MW （8 times）	+ 210MW
2. Recycled Wood	330MW	370MW （1.1 times）	+ 40MW
3.General Wood	100MW	2,740 ～4,000MW (27.4 - 40 times）	+ 2,640 – 3,900MW
Wood Biomass Total （Sum of 1～3 ）	460MW (3.2Bill.kWh)	3,350 - 4,610MW (7 - 10times) (22 - 31 Bill. kWh)	+ 2890 - 4150MW (+ 19 - 28Bill.kWh)
4. Biogas（Methane）	20MW	160MW （8 times）	+140MW
5. Waste	780MW	1,240MW （1.6 times）	+ 460MW
6. RPS	1,270MW	1,270MW	
Biomass Total （Sum of 1～6）	2,520MW (17.7Bill.kWh)	6,020 -7,280MW(2.4-2.9times） (39.4 – 49 Bill. kWh)	+3,490 – 4,750 MW (+21.7-31.3BillkWh)

BPA's Assumption of Practical FIT Certified Projects

(based on FIT Certification Status as of Sept., 2017)

1. Wood Biomass **Certified** : **12.7GW**

   (**11.7GW** of **G**eneral **W**ood including **4.51GW** of **Palm Oil**)

2. Wood Biomass **Operated**: **1.16GW (0.48GW of G.W.)**

3. Wood Biomass **2030 Target** : **4.61GW** (**4.0GW of G.W.**)

4. **BPA**'s **assumption** : **1.96～2.5GW**

   (To be operated **among 1**) (**20～30%** of dedicated **5.45GW**

   + **50%** of coal co-fired **1.74GW**)

5. **BPA**'s **assumption** : **2.43～2.97GW**

   (**Including 2** Operated) (**53～75% achievement rate**)

BPA's Assumption of Practical FIT Certified Projects

- Including operated one, total operational capacity can be reached to **only 2.4 ~3GW** that is **far below 4 GW** (Energy Mix Target in 2030) , considering key factors to realize the Projects such as **① Long-term stable Fuel Procurement ,② Project Financing ,③ EPC** etc.
- There must be a **certain number of projects** that were **given up** due to non-conclusion of **electricity connection contract by the end of Dec. ,2017** .
- So in order to achieve Energy Mix Target in 2030, it is **necessary to check the status of each certified Projects and confirm the Practical Projects.**

Practical General Wood based FIT Certified Projects

（based on FIT certification status as of the end of September 2017）

Project status	Capacity (MW)	
Practical Certified	(196 ~ 250)	
Biomass **Dedicated**	(109 ~ 163)	To be operated **20-30%** of certified one (as of the end of September 2017)
Coal **Co-fired**	(87)	To be operated **50%** of certified one (as of the end of September 2017)
Operated	48	Operated projects including transition from RPS (as of the end of March 2017)
Practical Projects Total	243 ~ 297	Only solid wood biomass

(Source) Natural Resources and Energy Agency Website (Renewable Energy), Documents for Calculation Procurement Price Calculation Committee, Publications from each company etc.

Issues to achieve Energy Mix Target 2030

In order to ensure achievement of 2030 Target , **BPA would like to propose the followings**.

【 Bidding system 】

- From this fiscal year, the General Wood based Projects **more than 10 MW** should be subject to bidding system(Up to Max. 200 MW,consist of **180MW G.W. including Co-Fired** one and 20MW Palm Oil basis).
- At the same time, due to strict treatment for certified projects, **certain FIT licenses must be expired**.
- We would like to ask for **flexible review and appropriate implementation** regarding Cap of **Bid volume**, the Ceiling Price and the other bidding conditions (including fair price comparison).

【 Output Control 】

- As for output control of biomass power, we'd like to propose to set up the **minimum output capacity**, based on the facility characteristics of the biomass power station after several years from actual operation.

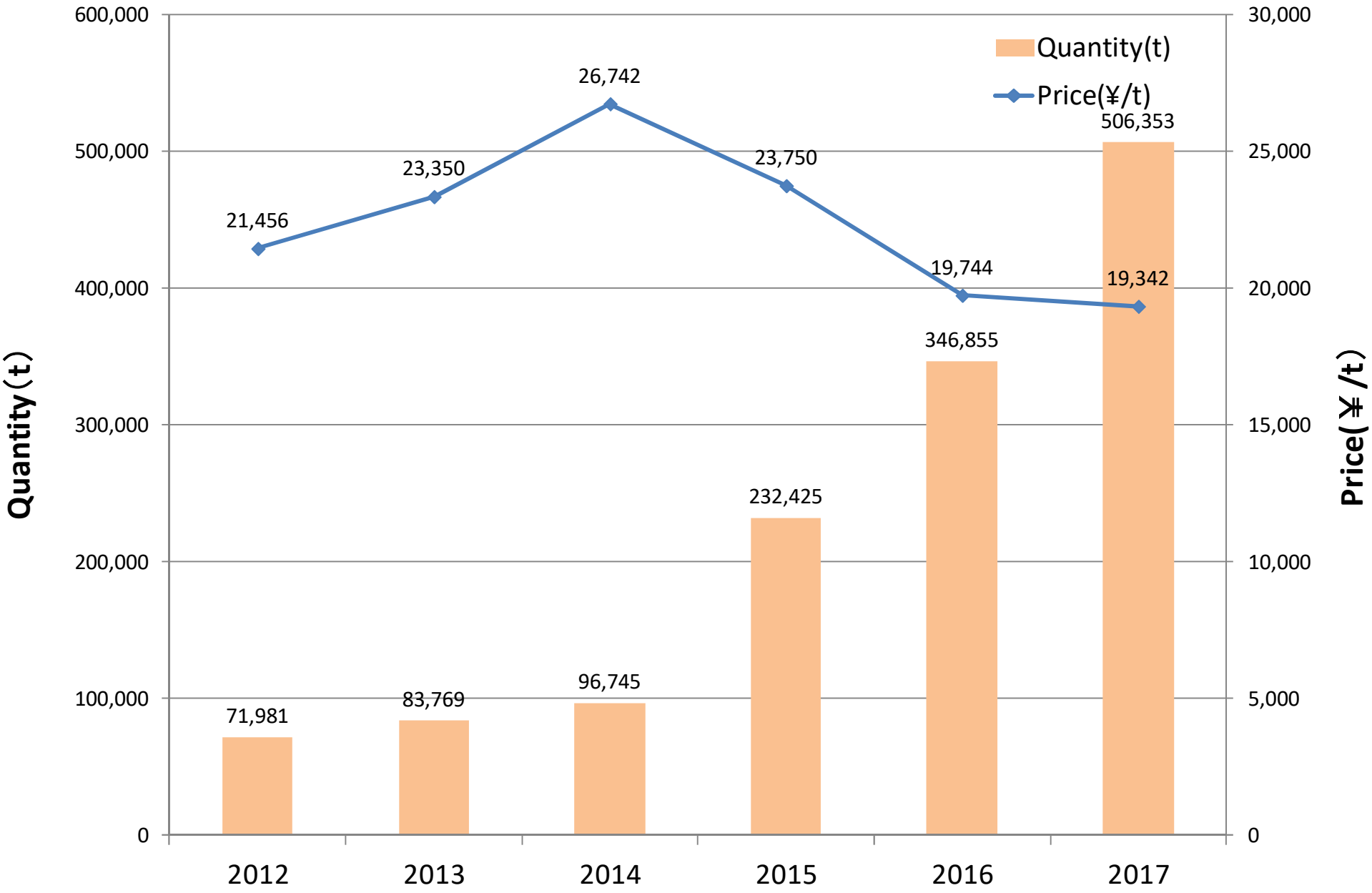
【 Billing Transmission Fee for Power Station 】

- Regarding the certified FIT projects (assuming that a part of the projects before the start of billing system is also included), the burden of the transmission fee was not assumed in the calculation of the power purchase price, and at the time of billing the fee, we would like ask METI to **devise adjustment measures to avoid substantial burden** at least during FIT purchase period (collection fee exemption or burden recovery)

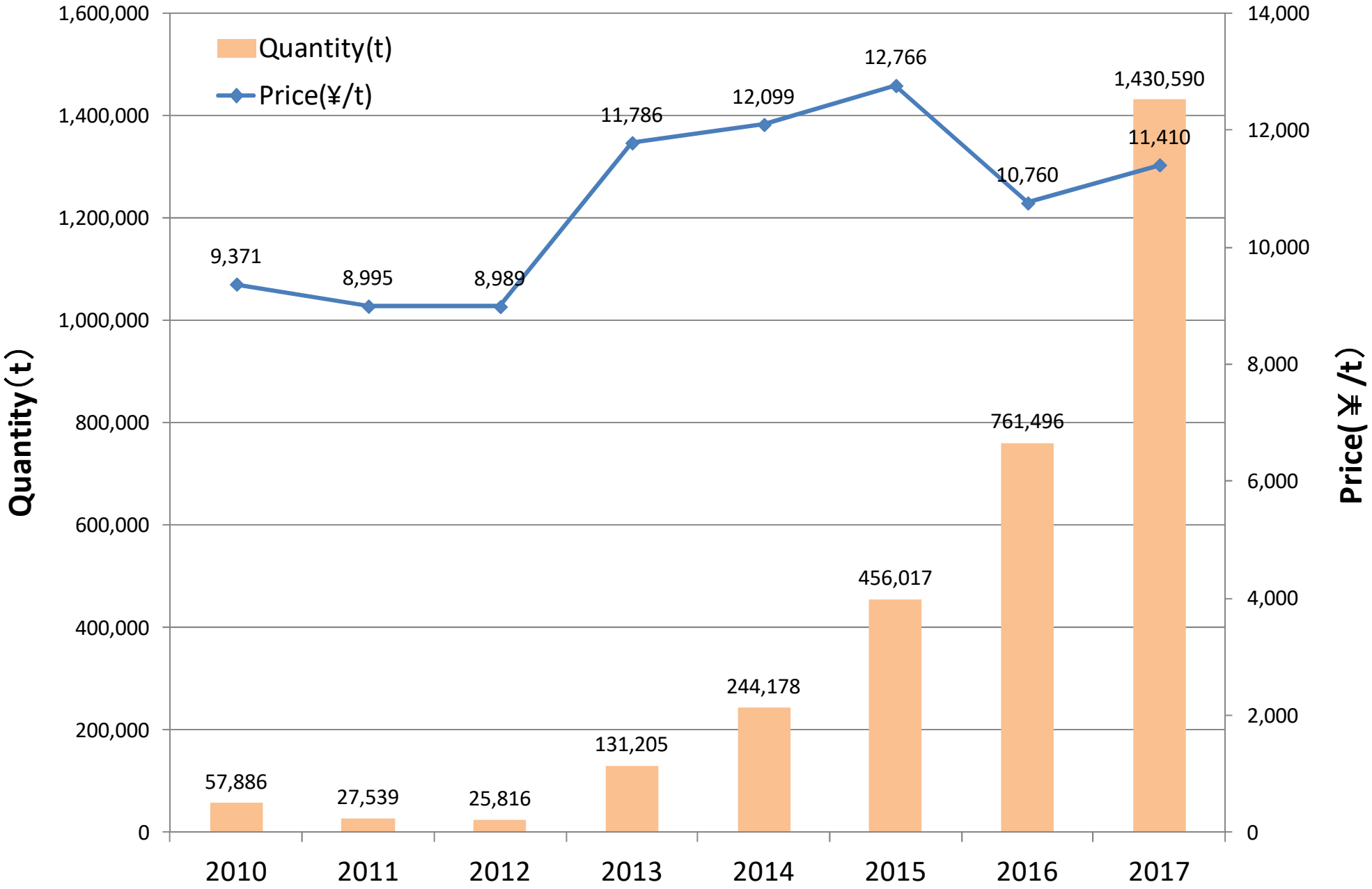
  ※In case of retroactive change in the system, the reliability of the system itself will be impaired and it may lead to restraining the introduction of renewable energy in the future
- For certified projects after the start of billing application, we also would like to ask for taking necessary measures such as applying the above measures and adjusting purchase price (maximum bid price)

(Source) Natural Resources and Energy Agency website (Renewable Energy), Documents for Calculation Procurement Price Calculation Committee, Publications from each company etc.

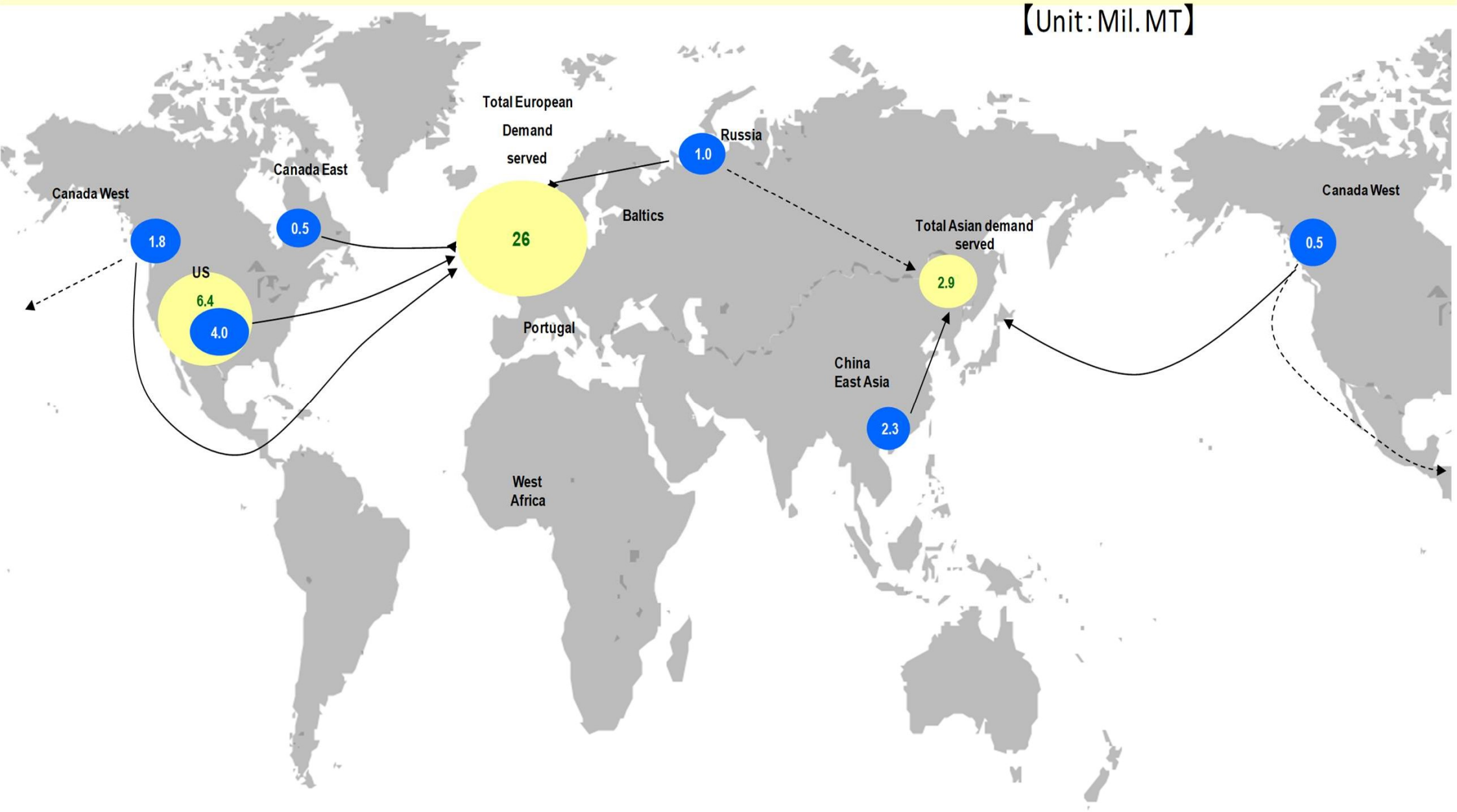
Quantity & Price of Imported Wood Pellet (Japan)



Quantity & Price of Imported PKS (Japan)



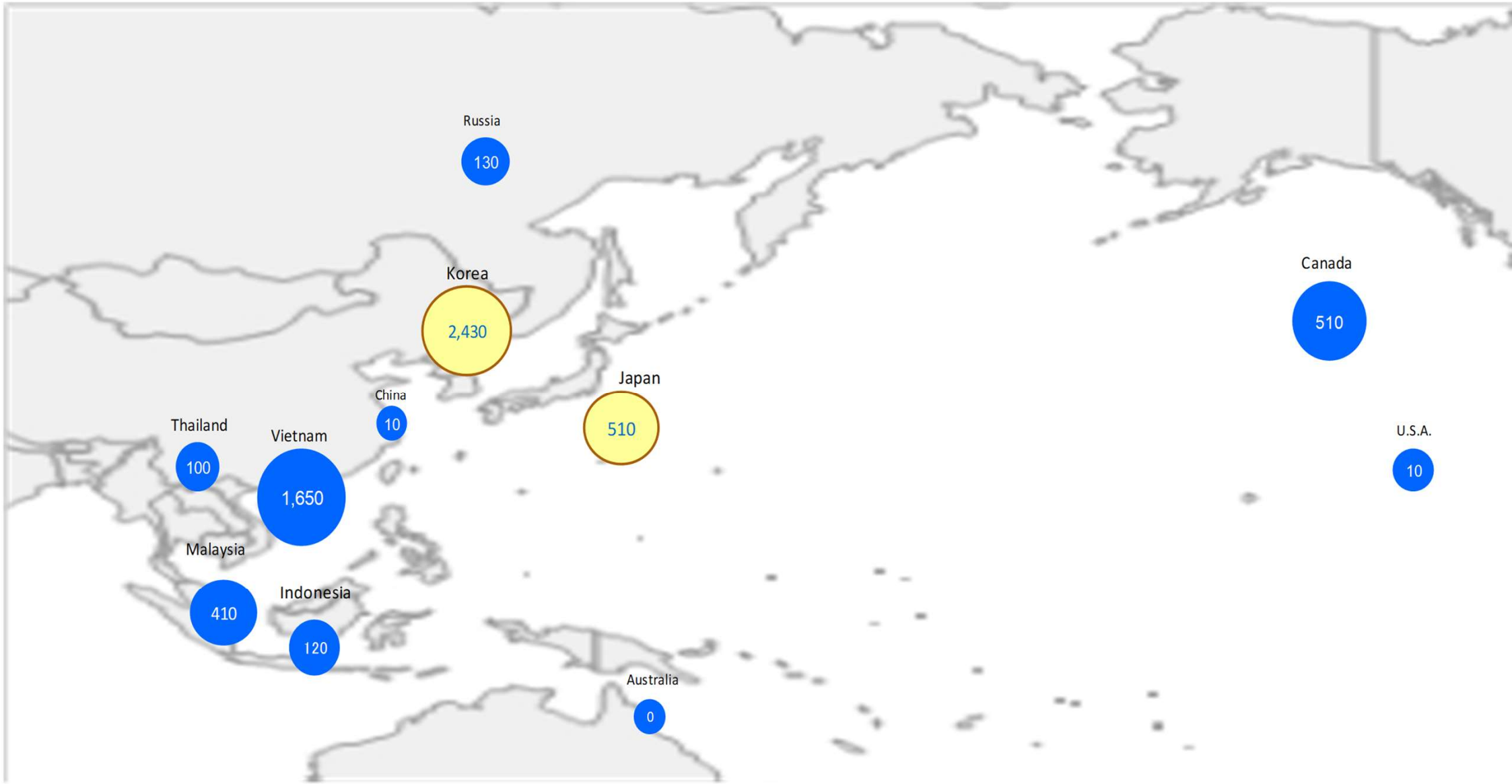
Global wood pellets trading volume (2017)



Source : KBLT

Pellets Trading in the Far East 【2017】

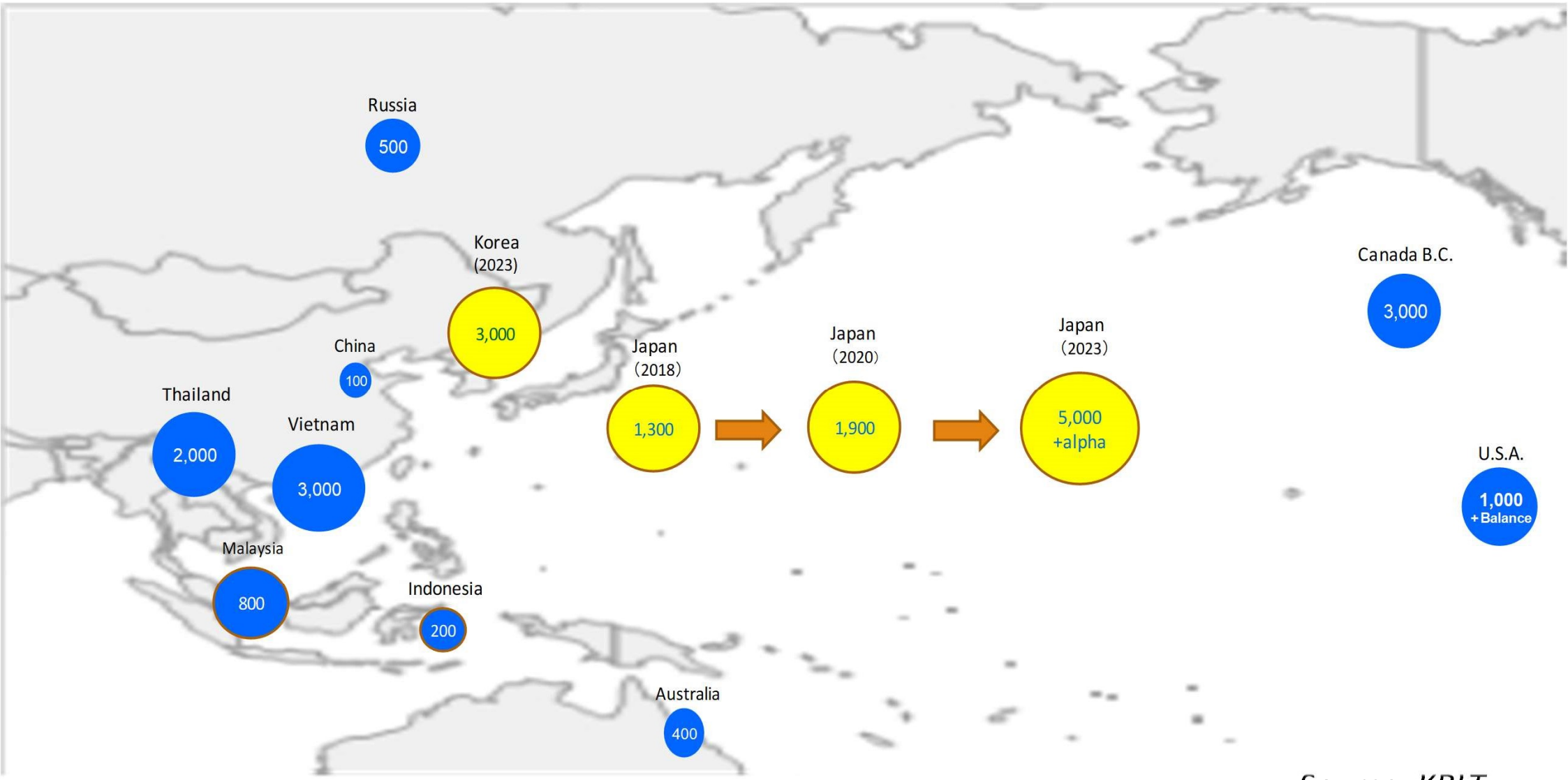
【Unit : thousand MT】



Source : KBLT

Pellets Import to the Far Eastern Market
【2023 Forecast】

【Unit : thousand MT】

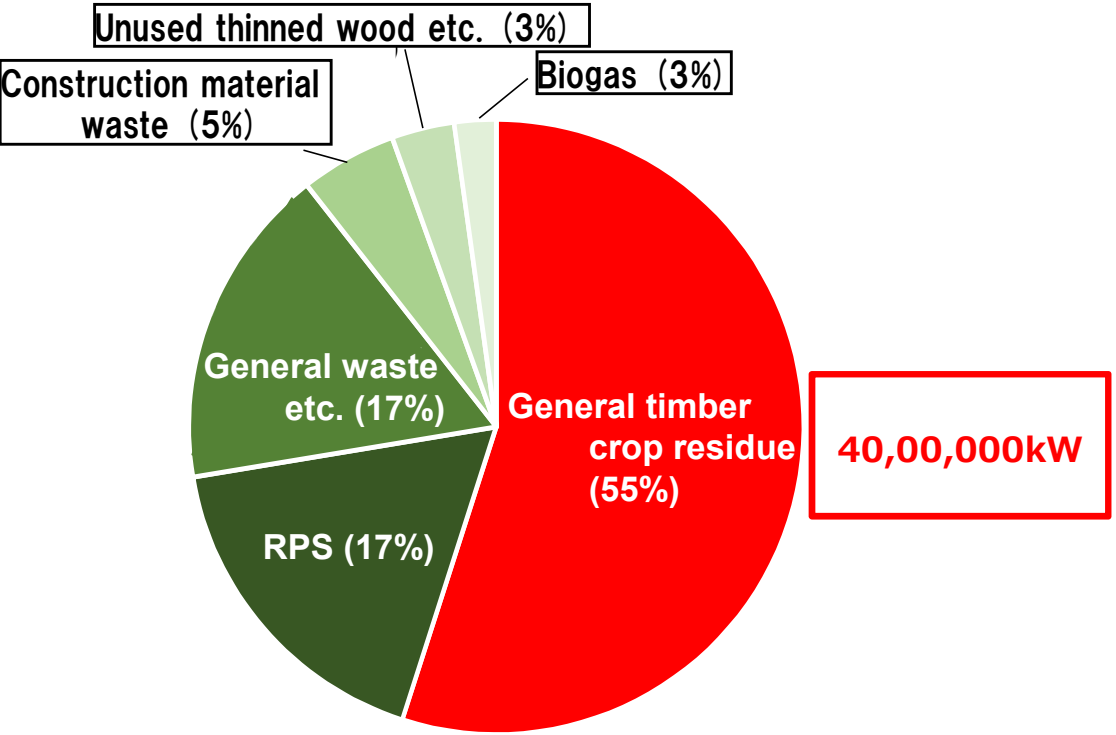


Source : KBLT

Co-Existence and Co-Prosperity of Domestic and Imported Wood Biomass and revitalization of Japanese Forestry

- In order to realize Energy Mix Target , **it is necessary to combine domestic and imported Wood Biomass effectively.**
- **The creation of fuel market for Biomass Power Generation Projects led by imported one will boost long-term investment towards strengthening supply capability of domestic wood biomass.**
- **Japanese Companies' overseas afforestation asset (over 450,000ha) can be utilized as raw materials for Pelletes.**
- **Strategic approach by Government is indispensable (as a measure to strengthen domestic forestry)** to establish the supply chain of domestic Wood Biomass for the purpose of **future shifting from import to domestic.**

Fuel capacity share of biomass in energy mix and general wood fuel demand



40,00,000kW

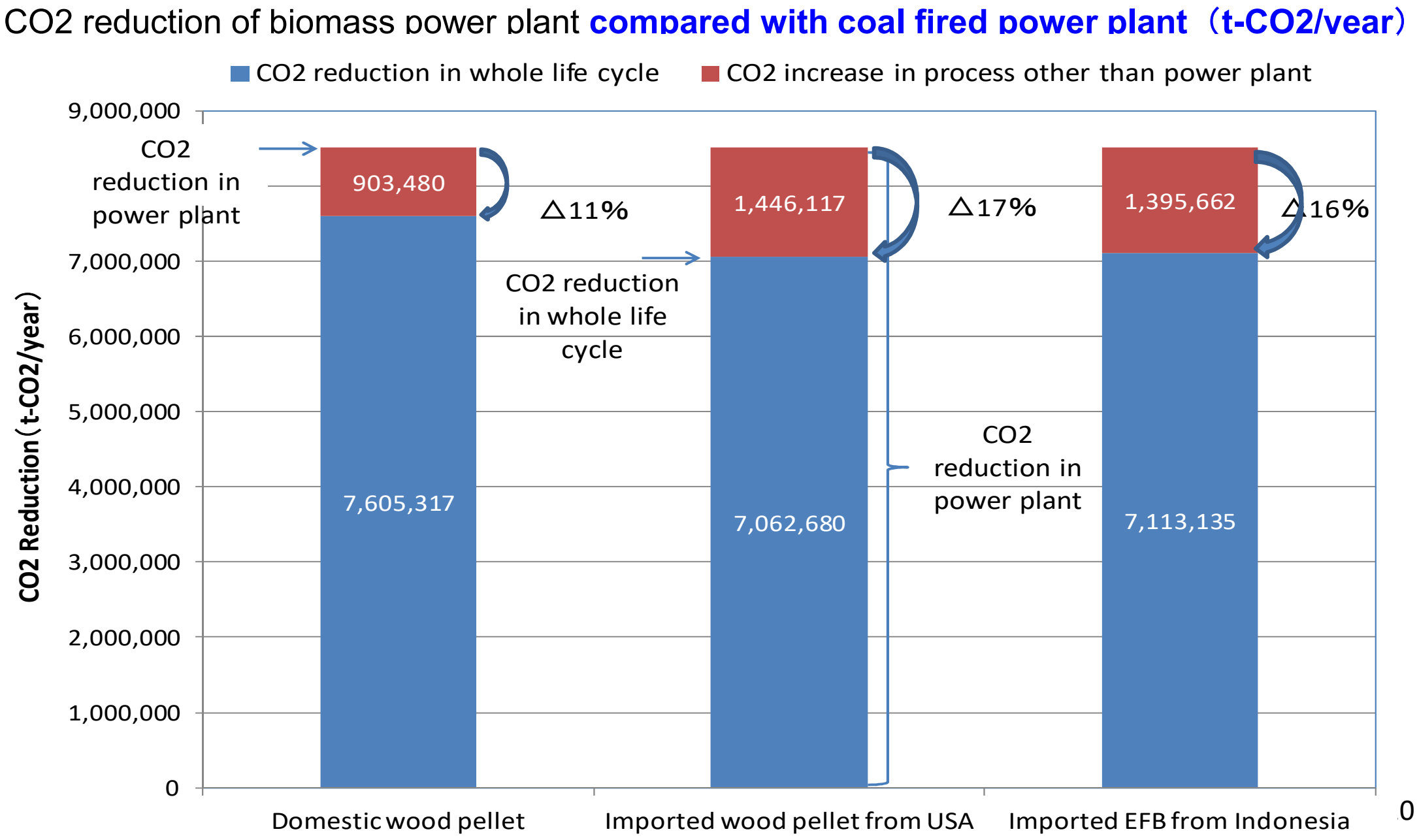
Estimated annual Max. Demand **~30 million ton** (Conversion to wood pellets)

Domestic Wood Biomass can be used to cover 10% of Max. Demand **~3 million ton** (Conversion to wood pellets)

(Reference) 3.9 million tons of wood chips (estimated) in terms of wood chip conversion for fuel that can be supplied by the forestry and forestry basic plan's (**Forestry Agency**) fuel material supply target of **800,000 ㎥ in FY 2025**

(Source) Ministry of Economy, Trade and Industry "Long-Term Energy Supply and Demand Outlook Data (2015)"
(Remarks) Assuming equilibrium water content equivalent (moisture content 15%), converted to wood chips with a moisture content of 35% (dry basis)

Comparison of LCA - CO2 Reduction for Import vs Domestic Wood Pellet



Biomass Power as Major Power Source (2030)

- We will try to reduce the Wood Biomass based Power Generation Cost towards year 2030 so that we can sell electricity **at the same price as Gas-fired Power Generation.**
- **After termination of FIT period** (i.e. 20years later), since the depreciation period of the plant shall be finished after 15years, we will aim to be a **competitive power source** by realizing the selling price even lower than Gas Thermal Power Generation
- As **VRE (PV and Wind power)** is expanding, **Biomass** will play a role as a **carbon free regulator.**

【 Key factors to lower the Cost 】

① Reduction of **Biomass Fuel Cost** (we would like to cooperate with relevant Ministries)

– Domestic Biomass Fuel produced at reasonable cost is limited **due to expensive collecting cost**.
Measures) ・**Utilize aged trees and replant fast growing trees**
・**Mechanization**
・**Improvement of road network**

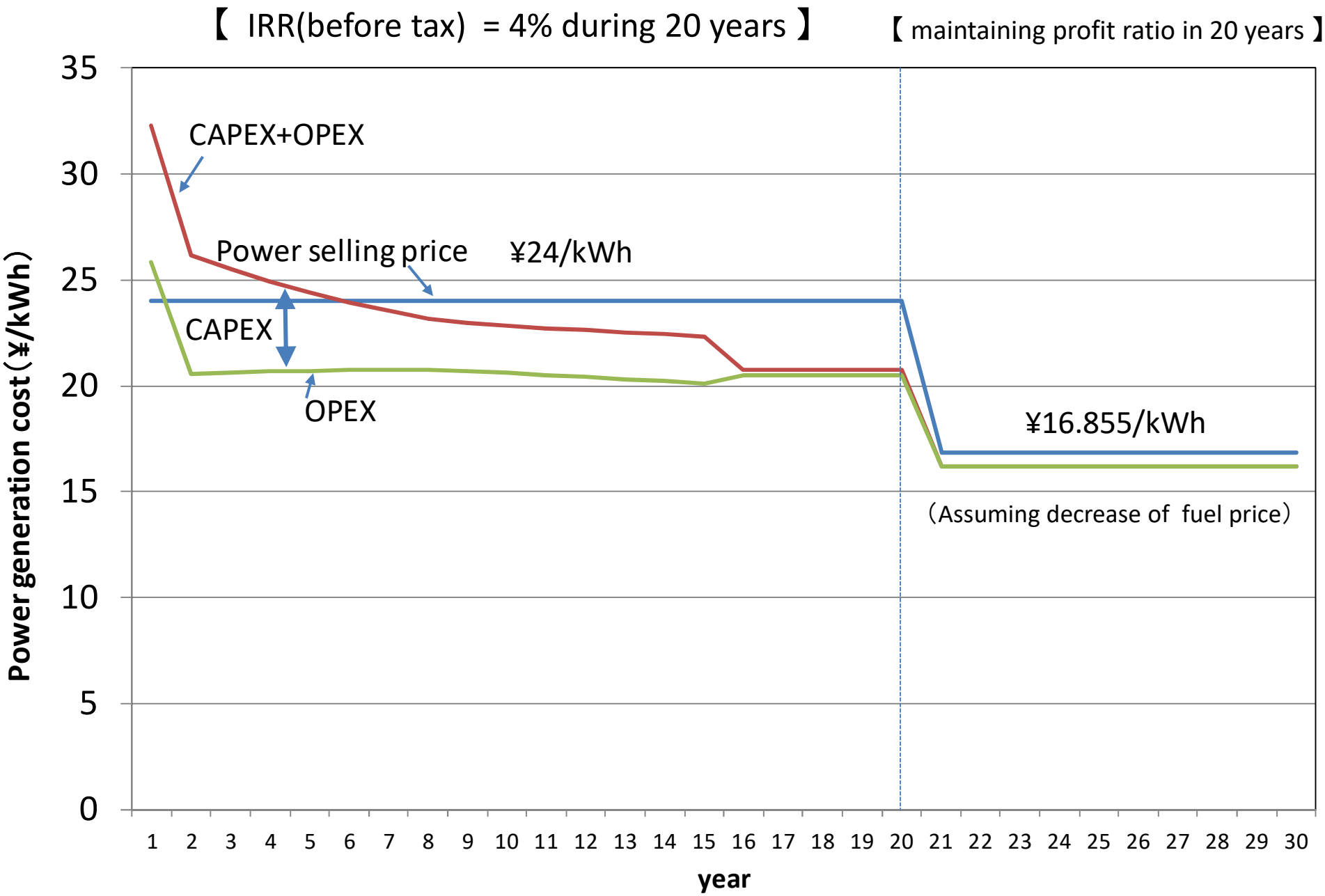
– Strategic investment to secure **raw material for imported Biomass Fuel** and support to develop **Biomass Power Generation Projects in overseas** **such as Asia in the future**.

② **Improvement of Power Generation Efficiency**
Scale-up , Reduction of **Internal Power Consumption**, Improvement of Operation Efficiency(optimum control by **IoT**)

③ **Reduction of Construction Cost**

– Current construction cost is very high due to coming Olympic impact.

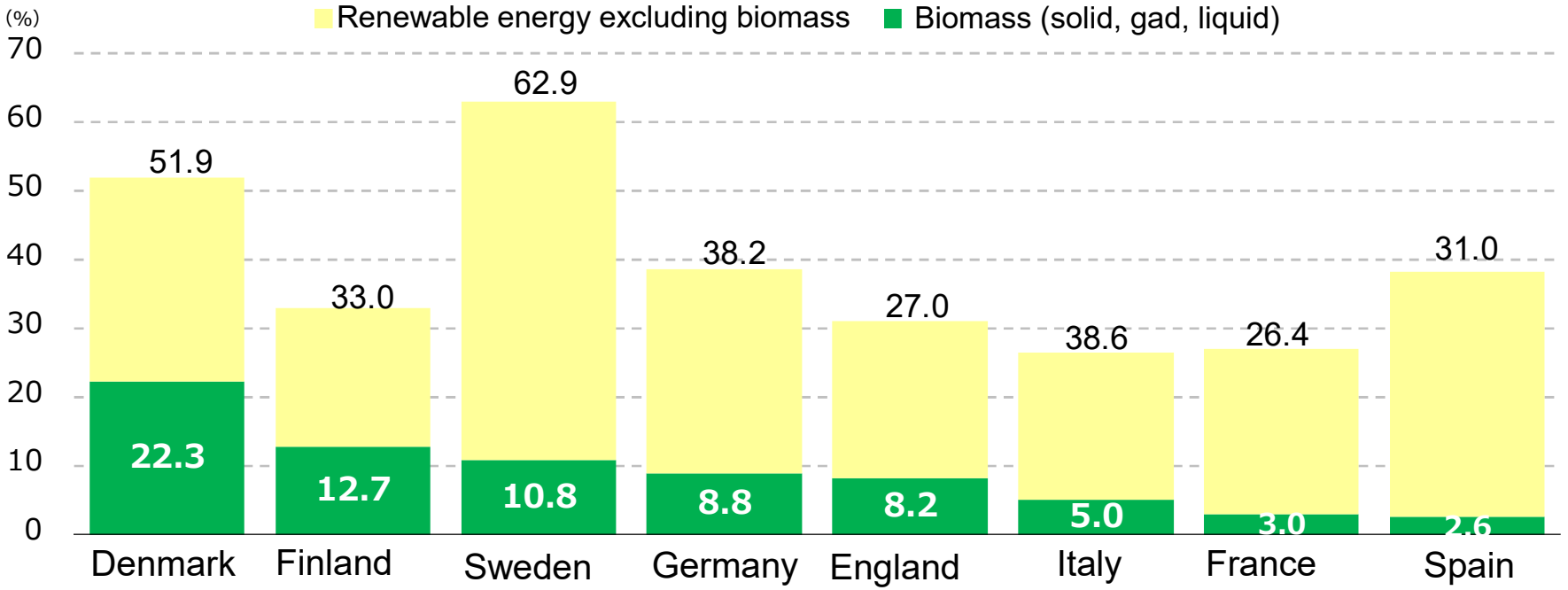
The Cost of Wood Biomass Power Generation



Biomass Power as Major Power Source (2050)

- Target: **15%** of total Power Generation **from Biomass** by **2050**
  - ① In order to reduce GHG emission by 80%,**Non-Fossil Power Source** should be over **90%.**
    Other Renewable Energy Target in 2050: **20% of PV , 20% of Wind, 10% of hydro , Geothermal 1%**
  - ② Major **European countries** set a target to cover **5 to 20%** of Total Electricity Generation in **2020** by Biomass Power Generation.
  - ③ In 2050,**BECCS** shall be realized utilizing existing Coal-fired PS (So-called “Stranded Asset”).

Revenue ratio target in 2020 in major European countries and internal number of biomass (estimate)



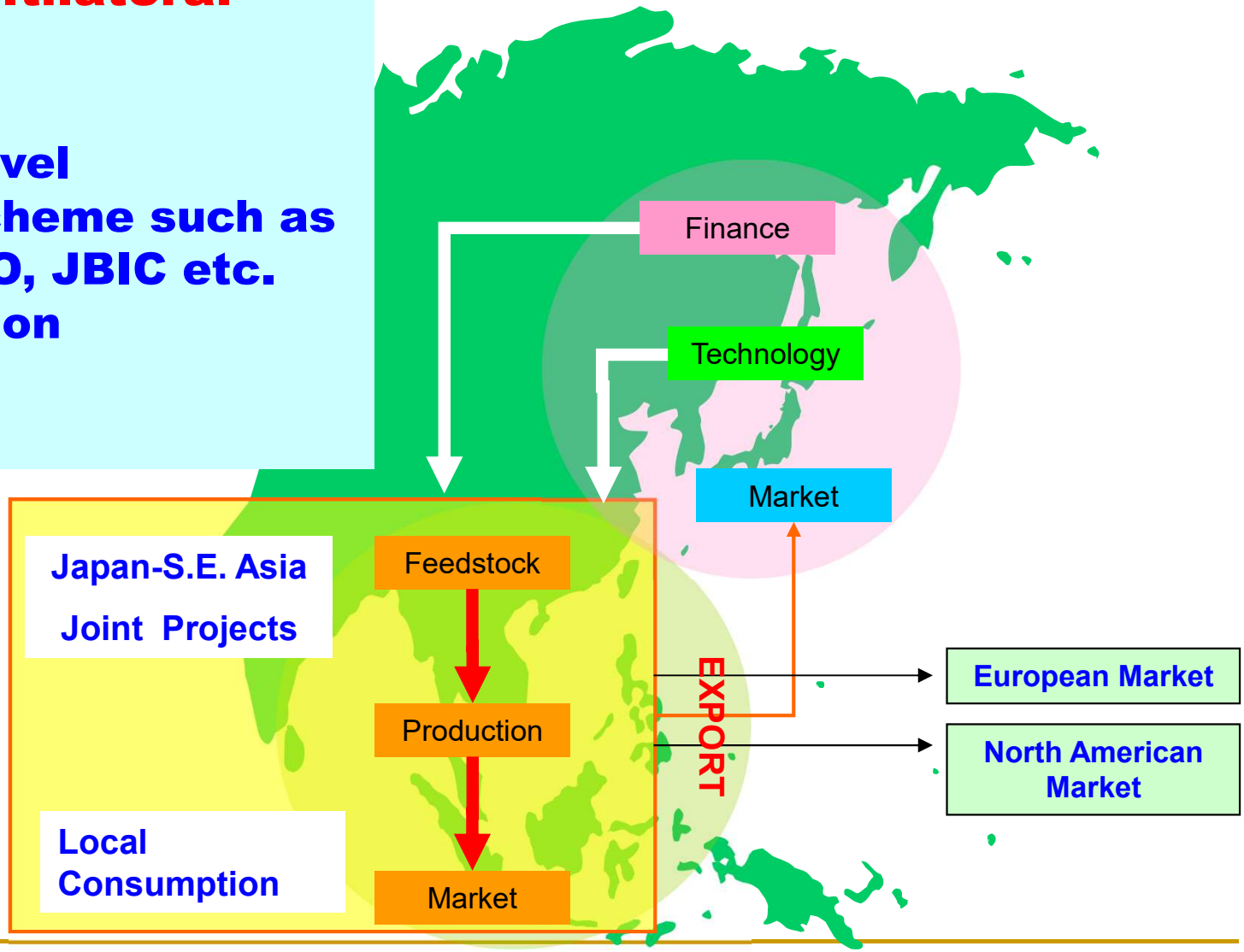
(Source) EU "National Renewable Energy Action Plans", JPEA "PV OUTLOOK ~ Dawn of Photovoltaic Power Generation 2050 ~ towards Realization of Decarbonised and Sustainable Society", JWPA "JWPA Wind Vision Report ~ Truly Trusted Aiming for a power supply ~ "

Creation of "Asia Biomass Community"

Enhance the Multilateral partnership

■**Governmental level**
・**Governmental scheme such as ODA , JCM, NEDO, JBIC etc.**
・**Biomass Plantation**

■**Private level**



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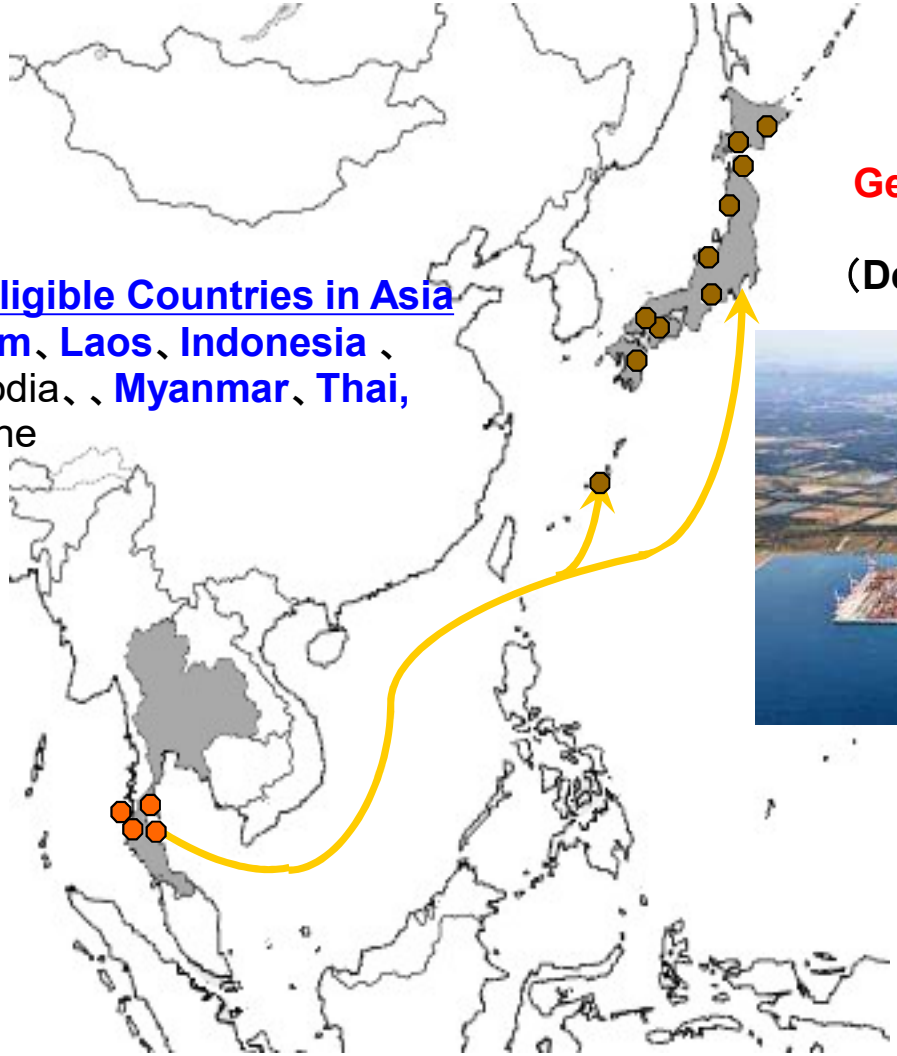
Phase-1 Production of Biomass Fuel in Asia and Biomass Power Generation in japan

Pellet Production in Asia under JCM scheme
（JV with Local Co.）

Wood Pellet

Torrefaction

JCM Eligible Countries in Asia
Vietnam、Laos、Indonesia 、
Cambodia、、**Myanmar、Thai,**
Phillipine



Biomass Power Generation in Japan under FIT
（Dedicated, Co-fired）

Phase-2 Biomass Power Generation and Production of Fuel in same location in Asia under JCM Scheme

Pellet Production in Asia under JCM scheme
(JV with Local Co.)

Wood Pellet

Torrefaction

Biomass Power Generation under JCM scheme
(JV with Local Co.)

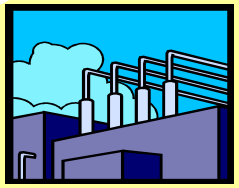
Establish Sustainable Biomass Industry

Biomass Plantation

・Next Generation Agriculture and Forestry "Contract Farming & Afforestation for Various usages"
・Biomass Plantation under ODA.

- Improvement of Yield
- Mechanization
- Infrastructure
- Logistics

Biomass Refinery



Biomass Industrial Complex

- Bio Ethanol (Cellulosic)
- Bio Pellet (⇒Torrefaction)
- Bio Jet Fuel (at existing Petrochemical Refinery)
- BDF (⇒High Quality)
- Biomass Power Generation
- Bio Chemical
- Feed, Fertilizer

Market

Stable & Matured Market

- Local Consumption
- Export to Japan
- Export to the other countries

- Long Term Offtake Agreement
- Reasonable Sales Price

Feedstock Management
(Stable Supply・Cascade Usage)

Industrialization
(Co-Production・Co-Location)

Establish Relationship with Buyers
(Utilities, Industries, Others)

Creation of Sustainable Supply Chain of Industrial Complex

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Thank you for listening !!

BPA (Biomass Power Association)

HP: http://www.bpa.or.jp/

NEED (Nippon Environmental Energy Development Co. ,Ltd.)

HP: http://need.co.jp