



# Regarding the Vision of Reuse, Recycling and Appropriate Disposal in the End-of-Life Facilities for Renewable Energy

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## Summary

March 2015

Study Group on Reuse, Recycling and Appropriate Disposal  
in the End-of-Life Facilities for Renewable Energy

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# 0. Objective of the Study and the Contents

## <Objective of the Study>

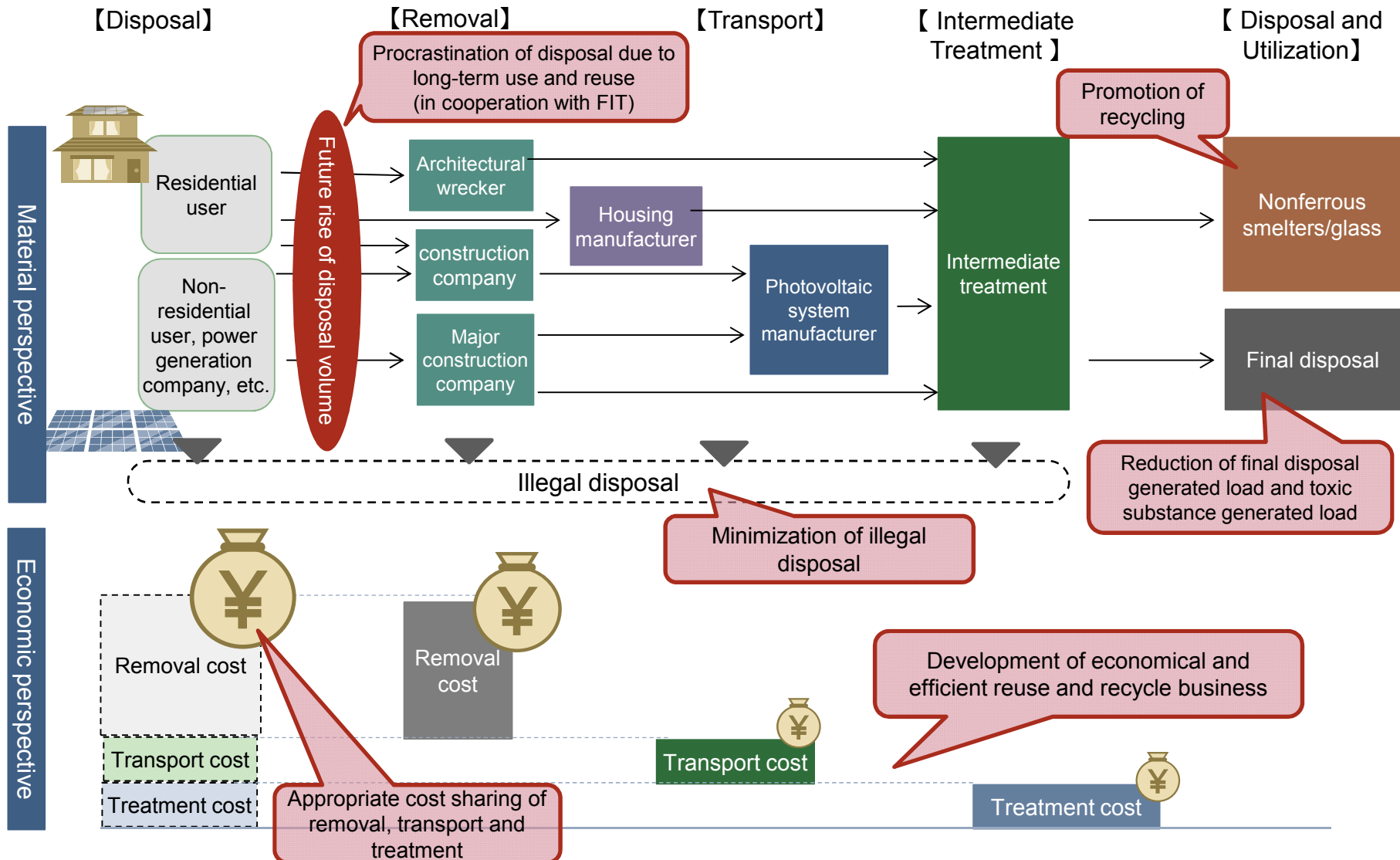
- Owing to the FIT scheme starting in July 2012, a substantial expansion of the use of renewable energy facilities is expected.
- The disposal of end-of-life facilities for photovoltaic systems and wind power generation which were introduced back in an early stage of the introduction have been identified, but currently a treatment system has not yet been established.
- Through the fiscal 2013 to 2014, a series of study commission group meetings, consisting of experts, etc. were convened and studied on tests of a series of operational procedures of disposal, transport, reuse and recycling, and appropriate treatment of end-of-life facilities for renewable energy, as well as studied on appropriate disposal methods and structures through model projects, etc.

## <Contents of the Study>

	Photovoltaic Systems	Solar Thermal Systems	Wind Power Generation Facilities
Research and current state analysis on removal, transport and treatment	<ul style="list-style-type: none"> <li>● Survey on the flow of end of life facilities</li> <li>● Survey on recycle technologies</li> <li>● Study on reuse and environmentally conscious design</li> <li>● Evaluation of resource value and harmful effects</li> <li>● Study on expected disposal volume and regional differences</li> <li>● Implementation of recycle model projects</li> <li>● Economic analysis on recycle system</li> <li>● Survey on national and international systems</li> </ul>	<ul style="list-style-type: none"> <li>● Survey on the flow of end of life facilities</li> <li>● Survey on the status of in-house/home storage of end of life products</li> <li>● Evaluation of resource value and harmful effects</li> </ul>	<ul style="list-style-type: none"> <li>● Material composition survey</li> <li>● Survey on the reuse market</li> <li>● Survey on actual recycle cases</li> <li>● Cos survey on disposal and recycle</li> </ul>
Future orientation based on the result of the current state analysis	<ul style="list-style-type: none"> <li>● Study on a menu of measures</li> <li>● Study on a roadmap</li> </ul>	<ul style="list-style-type: none"> <li>● Study on the issues and future orientation</li> </ul>	<ul style="list-style-type: none"> <li>● Study on the issues and future orientation</li> </ul>

# 1. Study on Removal, Transport and Treatment in Photovoltaic Systems (1/5)

- The ideal situation on Removal, Transport and Treatment in Photovoltaic Systems



# 1. Study on Removal, Transport and Treatment in Photovoltaic Systems (2/5)

## ■ Research and Current State Analysis on Removal, Transport and Treatment

Research Themes	Current State Analysis
Survey on the flow of the end of life facilities	<ul style="list-style-type: none"> <li>● Currently, a large volume of disposal has been detected from manufacturers resulting from initial product defect, etc. There are cases where these products are sold.</li> <li>● Photovoltaic systems used for residential application are dispersed in a small scale, so it is considered difficult to collect the products of a certain amount by construction company and architectural wrecker alone. Currently, the products are disposed via a conventional industrial waste stream with other wastes.</li> <li>● For non residential application, there are cases where the products are disposed after repair and exchange due to malfunction and natural disaster, etc.</li> </ul>
Survey on recycle technologies	<ul style="list-style-type: none"> <li>● Recycle technology assistance and model projects are in operation by NEDO and the Ministry of Environment.</li> <li>● Glass selection technology and application development are important to facilitate the recycling</li> </ul>
Study on reuse and environmentally conscious design	<ul style="list-style-type: none"> <li>● Domestically, there are almost no cases for reuse, whereas there are cases for reuse overseas.</li> <li>● Domestic module manufactures are in efforts to realize environmental conscious design, specifically prioritizes the longevity of the product. There are such actions as to reduce the content amount of designated chemical substances and improve the easiness for separation and dismantling modules.</li> </ul>
Evaluation of resource value and harmful effects	<ul style="list-style-type: none"> <li>● A resource value is determined by the amount of silver, but it largely differs by each product.</li> <li>● The elution test result showed lead was detected from some crystalline modules and a relatively high volume of selenium was detected from some chemical compound modules.</li> <li>● It was suggested that the test result may greatly vary depending on the sampling adjustment method administered, so a standardized analytical method was presented through this project.</li> </ul>
Study on expected disposal volume and regional differences	<ul style="list-style-type: none"> <li>● The expected disposal volume when the expected life-span being set at 25 years will be approx. 1,000 ton in 2020 and approx. 30,000 ton in 2030.</li> <li>● It was suggested that, if comparing the capacity of landfill site and the expected disposal volume per region, there are a certain level of regional differences (especially in Kanto and Kyushu region, the level of difference is high).</li> </ul>
Economic analysis on recycle system	<ul style="list-style-type: none"> <li>● The share of the removal cost is large. Both of the transport and treatment costs after removal outweigh the benefit: costs &gt; benefits. It is suggested that recycling is more cost-effective compared with landfill.</li> </ul>
Survey on national and international systems	<ul style="list-style-type: none"> <li>● The Waste Management and Public Cleansing Act mostly deals them as industrial wastes. Photovoltaic systems are not applicable to the designated construction materials of which separate dismantling and recycling are obligated by the Construction Recycling Law.</li> <li>● In Europe, based on the recast of WEEE directive, manufacturers are obligated to collect and recycle PV modules (it was so determined because recycling was considered as a cost effective option). And, prior to the directive recast, in Europe, PV CYCLE, which was mainly established by manufacturers, had established the voluntary recycling scheme.</li> </ul>

# 1. Study on Removal, Transport and Treatment in Photovoltaic Systems (3/5)

## ■ Future Orientation to be Aimed

1

Building a safety net for recycling

→ Related manufacturers play a certain role through environmental conscious design, etc.

2

Optimization of the flow, achieved by an appropriate cost sharing and securing the appropriateness of disposal and transport.

3

The government will study necessary schematic measures to facilitate a smooth implementation of voluntary collection, treatment and recycling

4

Promotion of technology development and environmentally conscious design to reduce the societal cost burden incurred in recycling

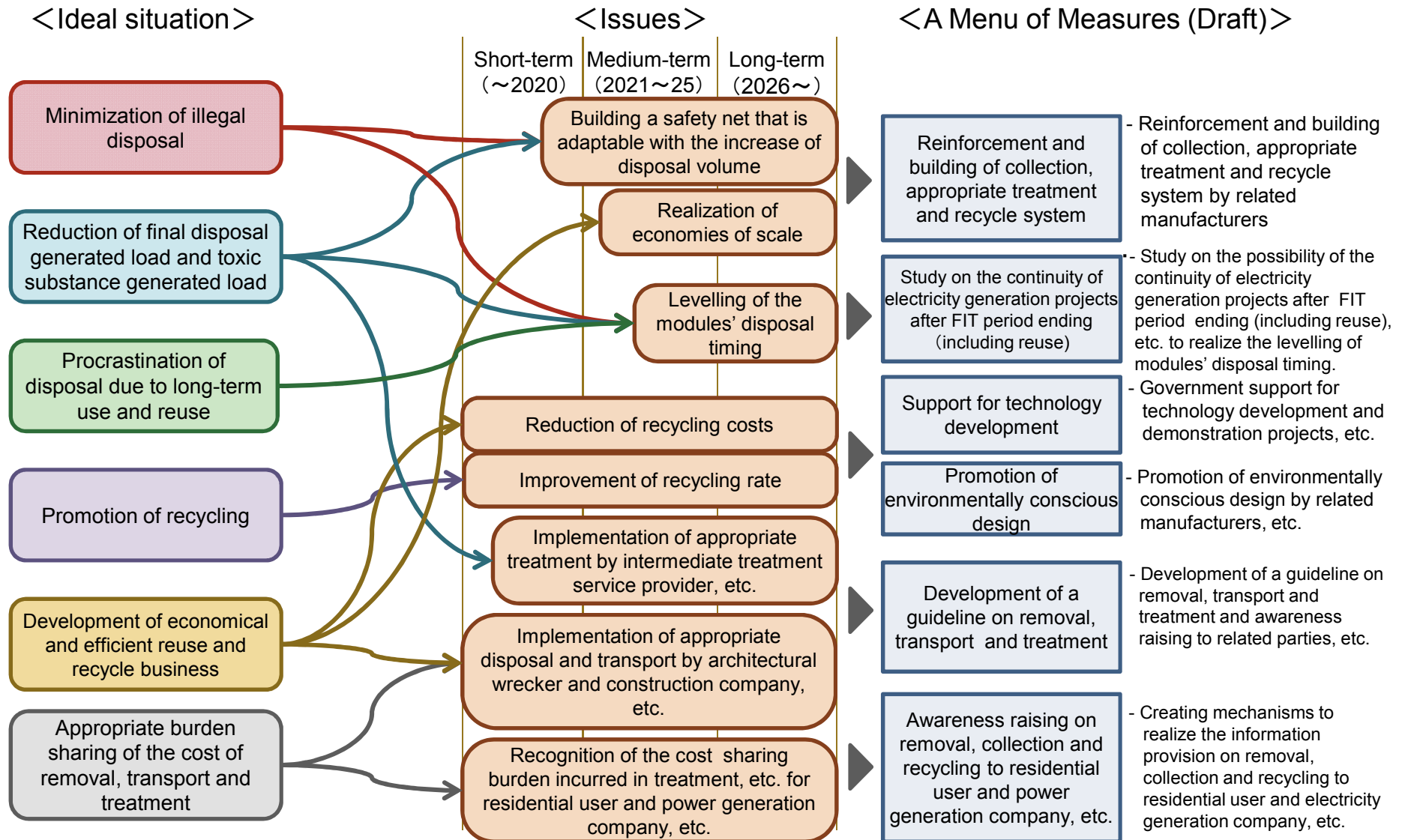
→ In harmonization with international actions such as EU WEEE directive, etc.

5

Study will be conducted on the possibility of the continuity of power generation projects (the product longevity and reuse, etc.) after the FIT period is complete.

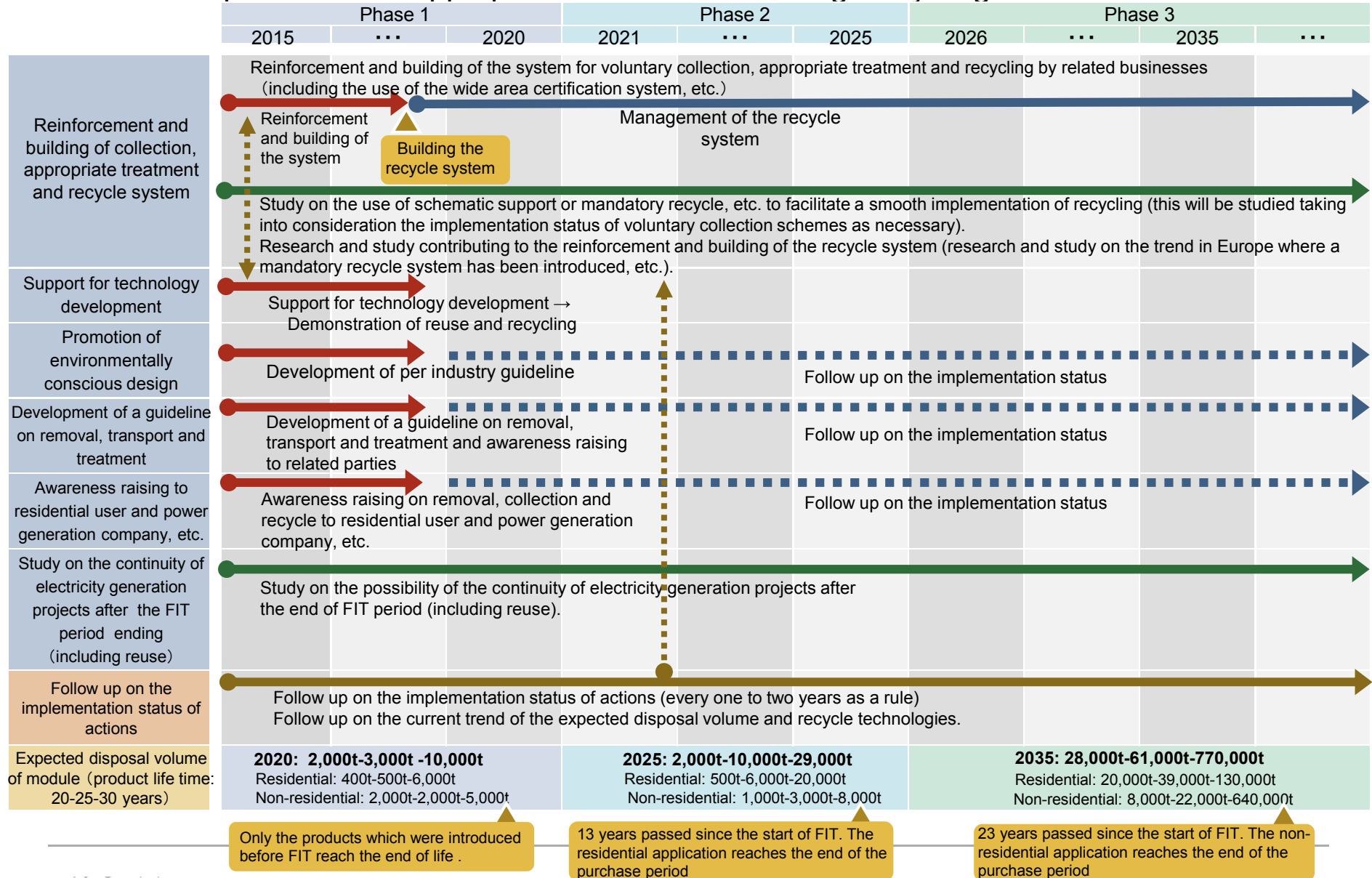
# 1. Study on Removal, Transport and Treatment in Photovoltaic Systems (4/5)

## ■ A Menu of Measures (Draft)



# 1. Study on Removal, Transport and Treatment in Photovoltaic Systems (5/5)

## ■ Roadmap to Promote Appropriate Treatment including Recycling





## 2. Study on Removal, Transport and Treatment in Solar Thermal Systems

### ■ Future Orientation based on the Current State Analysis

Perspective of this study		Facts obtained from this study	Issues and future orientation
Assurance of appropriate treatment	Prevention of illegal disposal	<ul style="list-style-type: none"> <li>● It is expected that the large part of the disposal results from industrial wastes. Under this situation, based on the Polluter Pays Principle, the responsibility for an appropriate treatment arises for businesses who dispose.</li> <li>● Although the volume may be small, it should be noted that there is a possibility that they will be disposed as a domestic waste.</li> </ul>	<ul style="list-style-type: none"> <li>● As a disposal activity is expected to for a long time, a monitoring will be continued.</li> <li>● Currently, there are no issues that have come up to the surface, but a study on solar thermal systems along with photovoltaic systems will be continued as necessary.</li> </ul>
	Proper management at the final disposal site	<ul style="list-style-type: none"> <li>● It is assumed that a special consideration may not be necessary if an appropriate disposal is secured based on the Waste Management and Public Cleansing Act.</li> </ul>	
	Characteristics of disposal	<ul style="list-style-type: none"> <li>● The rate of <b>in-house or home</b> storage is 14%. A certain amount of products are stored <b>in-house or at home</b>.</li> </ul>	
Promotion of recycling	Promotion of recycling	<ul style="list-style-type: none"> <li>● Metals of the pump, the counter, and the copper tube are recycled.</li> </ul>	<ul style="list-style-type: none"> <li>● There are no issues.</li> </ul>
PPP: Polluter-Pays-Principle and EPR: Extended Producer Responsibility	Responsibility for burden sharing of the costs and treatment	<ul style="list-style-type: none"> <li>● When it becomes an industrial waste, a fundamental responsibility for cost sharing and treatment is laid upon businesses disposing (construction company and architectural wrecker, etc.). In many cases, the costs will be passed through to users.</li> <li>● Users who are not willing to share the cost burden tend to store the product <b>in-house or at home</b>.</li> </ul>	<ul style="list-style-type: none"> <li>● As a disposal activity is expected to continue for a long time, a monitoring will be continued.</li> <li>● There are no issues that have come up to the surface, but a study will be continued in line with photovoltaic systems.</li> </ul>
	Action when there is no responsible manufacturer	<ul style="list-style-type: none"> <li>● Solar thermal system manufacturers who withdrew from the business are providing information for guidance about other manufacturers on websites, and the Solar System Development Association (SSDA) is providing information to introduce manufacturers upon request.</li> </ul>	



### 3. Study on Removal, Transport and Treatment in Wind Power Generation Facilities

#### ■ Future Orientation based on the Current State Analysis

Perspective of this study		Facts obtained from this study	Issues and future orientation
Promotion of reuse	Promotion of reuse	<ul style="list-style-type: none"> <li>Currently, the domestic market is small and a variety of models have been introduced, thus it is not that a certain amount of compatible parts are available in a certain region, so the reuse market has not been formulated.</li> <li>However, there are cases where reuse products have been used. There are the cases where some defective parts are repaired in a company, then reused for other windmills considering economic reasonability.</li> <li>There are preferences for reuse products (cost attractiveness, the advantage of a quicker purchasing). Although, there are views expressing fear factors about product quality and warranty.</li> </ul>	<ul style="list-style-type: none"> <li>A follow up for necessary assistance measures, etc. (information provision for manufactures and service providers, etc.) should be conducted taking into consideration the future trend of wind power generation market and expandability of the reuse market.</li> </ul>
	Promotion of recycling	<ul style="list-style-type: none"> <li>90% of a windmill (except for the foundation) is composed of metal. Recycling routes of these materials have been established.</li> <li>GFRP, which is used in blades, etc. is disposed in a certain amount, thus research and study on the recycle technology has been conducted overseas.</li> </ul>	<ul style="list-style-type: none"> <li>There are no issues that have come up to the surface, but a follow up on GFRP recycling should be conducted.</li> </ul>
Promotion of recycling	Rare metal (permanent-magnet-type generator) recycling	<ul style="list-style-type: none"> <li>Currently, a type of windmill using induction generator with a speed up gear is the main stream. The market share of permanent-magnet-type synchronous generator is small, but a certain amount of permanent-magnet is used.</li> <li>In the three disposal cases of permanent-magnet-type generators, it was identified that these were handed over to scrap metal companies, but no case was identified where these were recycled as magnet.</li> </ul>	<ul style="list-style-type: none"> <li>A follow up on the recyclability of rare metals should be conducted taking into consideration the future trend of technology development and the proliferation trend of permanent-magnet-type generators.</li> </ul>
Assurance of appropriate treatment	Prevention of illegal disposal	<ul style="list-style-type: none"> <li>Most disposal is expected to arise as an industrial waste. In this case, responsibility for appropriate treatment occurs based on the PPP: Polluter-Pays-Principle for businesses disposing the systems.</li> </ul>	<ul style="list-style-type: none"> <li>There are no issues that have come up to the surface, but a study may be conducted as necessary.</li> </ul>
	Proper management at the final disposal site	<ul style="list-style-type: none"> <li>If an appropriate treatment is assured based on the Waste Management and Public Cleansing Act, it is assumed that a special consideration may not be necessary.</li> </ul>	<ul style="list-style-type: none"> <li>There are no issues.</li> </ul>
	Disposal costs	<ul style="list-style-type: none"> <li>In the FIT: Feed-In Tariff scheme, 5% of the installation cost (15,000yen/kW) is assumed as the disposal cost.</li> <li>However, this study suggested that the disposal cost will substantially vary depending on the scale of electric generation, the location, the application (whether demonstration test use or commercial use) and the management entity (whether it is a local authority or a private company).</li> </ul>	<ul style="list-style-type: none"> <li>Regarding the disposal costs, there have been a small number of actual cases, thus, to accumulate more data of actual cases will be necessary toward the future.</li> <li>To assure appropriate treatment in the future, approximation of the adequate costs of disposal during a project planning stage is important. In line with the continued action of information provision for manufacturer and service provider, a follow up, taking into consideration the future trend of disposal and technology development, should be conducted to monitor whether the appropriate disposal has been realized.</li> </ul>

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## Reference Materials

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# 1. Study on Removal, Transport and Treatment in Photovoltaic Systems

## Current State Analysis: Flow on Reuse, Recycling and Appropriate Treatment in the End-of-Life Facilities for Photovoltaic Systems

- Currently, the following five routes are identified:
  - Photovoltaic systems manufacturer route
  - Architectural wrecker route
  - Major construction company and construction company route
  - construction company route
  - Reuse company route
- Of the above routes, currently, one which disposes the largest amount is assumed to be from the photovoltaic systems manufacturer route. Photovoltaic systems manufacturer usually stores the products until the amount reaches a certain degree, then hands them over to an intermediate treatment service and a scrap metal company.
- It should be noted that there may be possible change in the flow resulting from the future rise of resource price and disposal volume, etc.

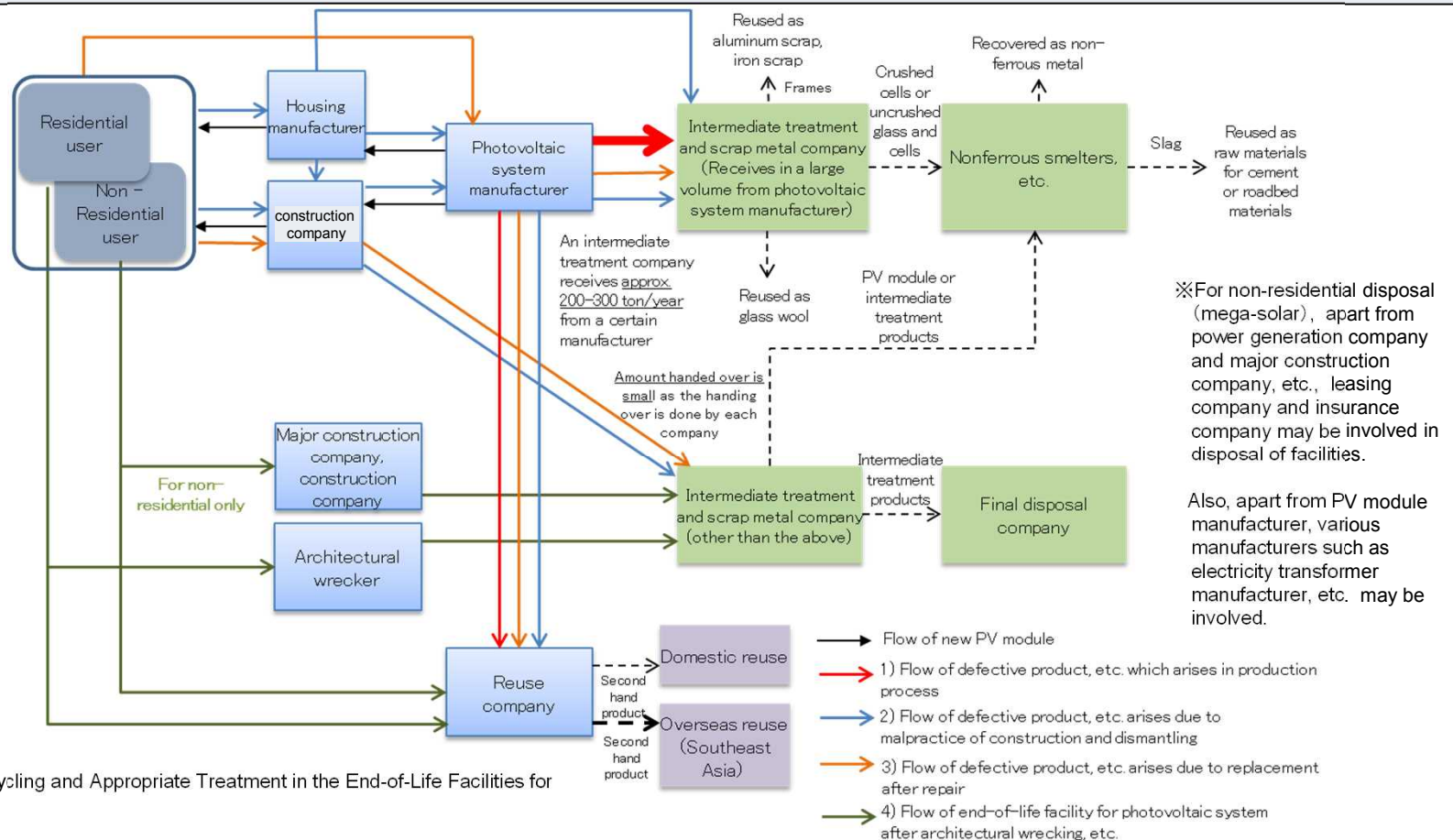


Chart: Flow on Reuse, Recycling and Appropriate Treatment in the End-of-Life Facilities for Photovoltaic Systems

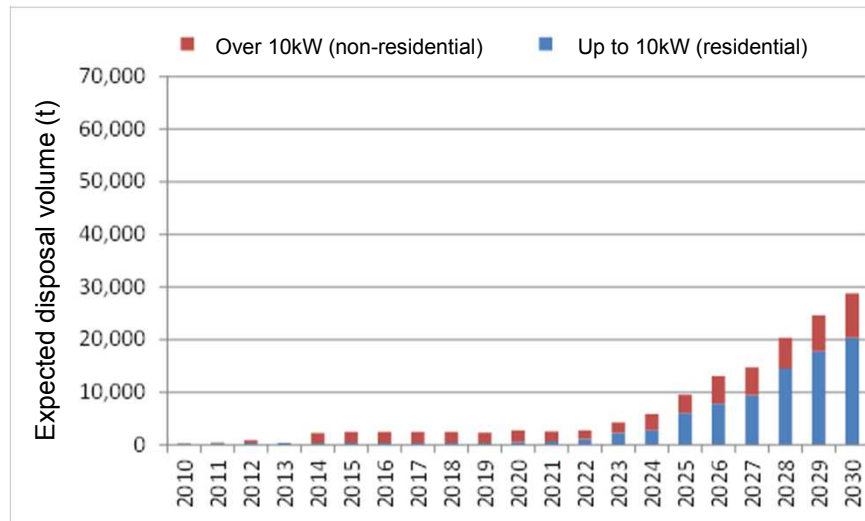
\* The line thickness indicates the magnitude of volume, large and small:

The solid line means the flow of PV module; the dotted line means the flow of reuse product or intermediate treatment products

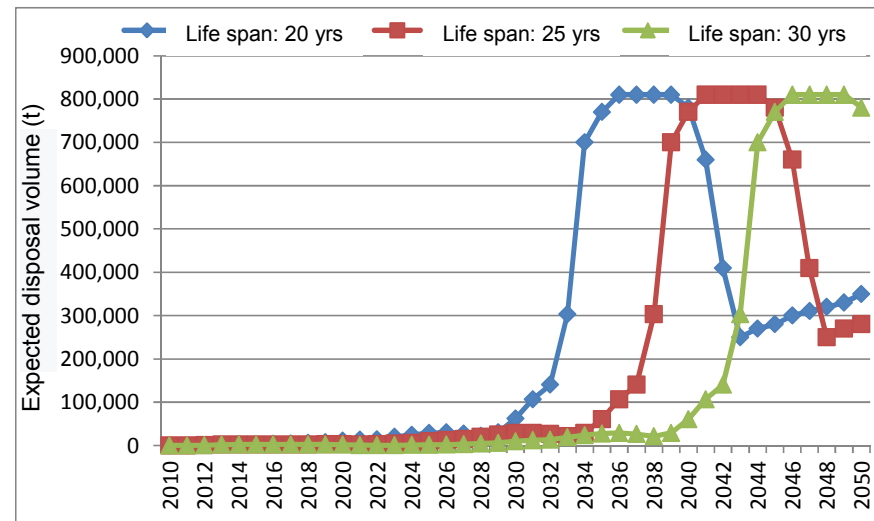
# 1. Study on Removal, Transport and Treatment in Photovoltaic Systems

## ■ Current State Analysis: Expected Disposal Volume of the End-of-Life Facilities for PV Module.

- Estimation of the future disposal volume of photovoltaic systems was made based on the data of photovoltaic systems previously introduced (nationally and regionally aggregated per prefecture per application (residential or non-residential)) and the forecast of the expected amount of photovoltaic systems to be introduced. For this estimation, the expected disposal volume is assumed to be the disposal which will arise due to the end of the system's life span (20, 25, 30 years) and the disposal which will arise due to replacement including repair (0.3% of annual domestic shipment volume).
- Estimation was made for residential and non-residential application, aggregated nationally and per prefecture. The national expected disposal volume (the life time: 25 years) will be approx. 1,000 ton in 2020 and approx. 30,000 ton in 2030. The timing of disposal may substantially differ depending on the system's life span.



Graph: Expected Disposal Volume of PV Module (life span of 25 years)



Graph: Expected disposal volume of PV module (life span of 20, 25, 30 years)