

January 20, 2021
Japan Paper Association

**Countermeasures against Global Warming aiming at
Net Zero GHG emission from Paper Industry
- Long-Term Vision 2050**

- Constructing a carbon-neutral industry -

Table of contents

- ◆ **Background to have formulated the long-term vision 2050 : p3**
- ◆ **Efforts of the paper industry to address climate change : p4**
- ◆ **Outline of the long-term climate response vision 2050 : pp.5-14**
- ◆ **Conclusions and Future course of action : pp15-16**

Background to have formulated the long-term vision 2050


May 2016: Cabinet Decision on the “Plan for Global Warming Countermeasures”  **Aims for 80% GHG emissions reduction by 2050**

October 2018: Keidanren (Japan Business Federation) calls on member companies and associations to consider formulating a “long-term vision” 

- Steel, chemical, cement, and other industrial associations have formulated their “long-term visions for GHG emissions reduction”
- **JPA has also started to consider its long-term vision at the Energy Committee since April 2019.**

July 3, 2020: METI Minister Kajiyama Declares to start examination of

- **Fade-out of inefficient coal-fired power generation toward 2030**
- Introduction of new regulatory measures and securing the supply capacity necessary for a stable supply

 Will consider creating specific measures to induce prompt withdrawal of inefficient coal-fired power plants

October 26, 2020: PM Suga **Declares carbon neutrality by 2050**

October 26, 2020: METI Minister Kajiyama Declares to discuss the path toward carbon neutrality by 2050 intensively at the Advisory Committee for Natural Resources and Energy and the Green Innovation Strategy Meeting, and to formulate **an action plan by year-end.**

November 9, 2020: Keidanren (Japan Business Federation) Announces **“New Growth Strategy,”** and declares to fulfill “Carbon Neutrality by 2050” through green growth initiatives. Five agenda items for “Green Growth Initiatives” are (1) to accelerate innovations toward a carbon-free society, (2) to prioritize assistance for competitive renewable energies, (3) to utilize nuclear power generation to achieve both carbon-free and economics, (4) to increase electrification, and (5) to form a coalition of Green Growth countries

December 25, 2020: Japanese Government Announces the **“Green Growth Strategy towards 2050 Carbon Neutrality”** as an action plan directed toward carbon neutrality. Lists specific time periods and targets for carbon-free power generation, hydrogen, fuel ammonia, batteries, carbon recycling, offshore wind power, and other major items essential for achieving the carbon neutrality, and mentions regulatory standards and other institutional streamlining, support measures for actual implementation, and international cooperation

Efforts of the paper industry to address climate change

- FY2008-2012: Reduced fossil energy intensity and CO₂ emission intensity under the “Voluntary Action Plan on the Environment”**
 Fossil energy intensity (target: 20% reduction from FY1990; actual: 24.8%)
 CO₂ emissions intensity (target: 16% reduction from FY1990; actual: 20.3%)
- Since FY2013: Formulated “Low Carbon Society Action Plan” with fossil energy-derived CO₂ reduction targets and have been working for them. Annual follow-up on the progress; going well toward the planned 2030 reduction (3.95 million ton reduction from FY2013)**

Table. History and plan of fossil energy-derived CO₂ emissions reduction in paper industry

	Emissions (10 ⁴ t/y)	Reductions (10 ⁴ t/y) Base year: FY2013	Reduction % against FY2013
FY2013 actual	1,880	—	—
FY2019 actual	1,658	222	11.8
FY2030 plan (Formulated in FY2019)	1,485	395	21.0

*As for GHG, about 2 million tons of CO₂ is emitted from waste, apart from the fossil energy-derived (FY2013).

Outline of the long-term vision 2050

Title: Countermeasures against Global Warming aiming at Net Zero GHG emission from Paper Industry

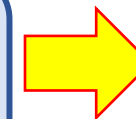
Subtitle: Constructing a carbon-neutral industry

Slogan: The paper industry supports the government's declaration of “net zero GHG emissions by 2050” and, in order to help maintain a sustainable global environment, will actively work on measures to reduce CO₂ emissions to construct a carbon-neutral industry by 2050.

Efforts toward a carbon-neutral industry

I. Zero CO₂ emissions from production activities by promoting energy efficiency and fuel conversion

1. Actively introduce the latest energy-efficient facilities and technologies
2. Increase the utilization ratio of renewable energies in in-house power plants
3. Promote the development of innovative technologies related to paper manufacturing
4. Actively adopt energy-related innovative technologies



Net zero CO₂ emissions from production activities

Reduce 21 million tons of CO₂ (base year: FY2013), including the fossil energy-derived and waste-derived GHG

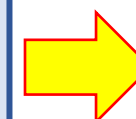
Efforts toward contributing to carbon-neutral society

II. Reduce CO₂ emissions from product life cycles by developing environment-friendly materials

1. Realize societal implementation of cellulose nanofiber
2. Promote use of paper materials replacing fossil-derived plastic packaging materials
3. Make conversion from fossil-derived products to bioplastic materials and biochemicals

III. Expand contribution in afforestation as a source of CO₂ absorption

1. Promote sustainable forest management
2. Promote forest tree breeding with high environmental adaptability and high growth



Additional CO₂ reduction besides production activities

I . Zero CO₂ emissions from production activities by promoting energy efficiency and fuel conversion

We aim for the achievement of net zero CO₂ emissions from production activities by 2050 through energy efficiency efforts, fuel conversion from fossil fuels, introduction of renewable energy facilities, and development and early introduction of innovative technologies mainly in the production of paper and paperboard. **(rough target: 21 million ton reduction from FY2013)**

1. Promote energy efficiency efforts by actively introducing the latest energy-efficient facilities and technologies

It is presumed that the continual energy efficiency efforts to this date enable us to expect around 20% CO₂ emissions reduction from production activities by 2050. **(rough target: 20% or 4.2 million ton reduction from FY2013)**

2. Increase the utilization ratio of renewable energies in in-house power plants

To convert energy source from fossil to renewable, it is necessary to secure stable wood and other biomass resources for the in-house thermal power generation facilities and to introduce hydro, solar, wind, and other non-thermal in-house power plants. **(rough target: 40% or 8.4 million ton reduction from FY2013)**

3. Take on the challenge of commercializing innovative technologies related to paper manufacturing

Regarding the large energy-consuming processes of kraft pulp chip digestion, black liquor enrichment, lime baking, and drying at paper machine, we will revisit previous R&D outcomes and explore new useful technologies for energy efficiency, energy conversion, and heat recovery and take on the challenge of their commercialization. **(rough target: 10% or 2.1 million ton reduction from FY2013)**

4. Actively adopt energy-related innovative technologies

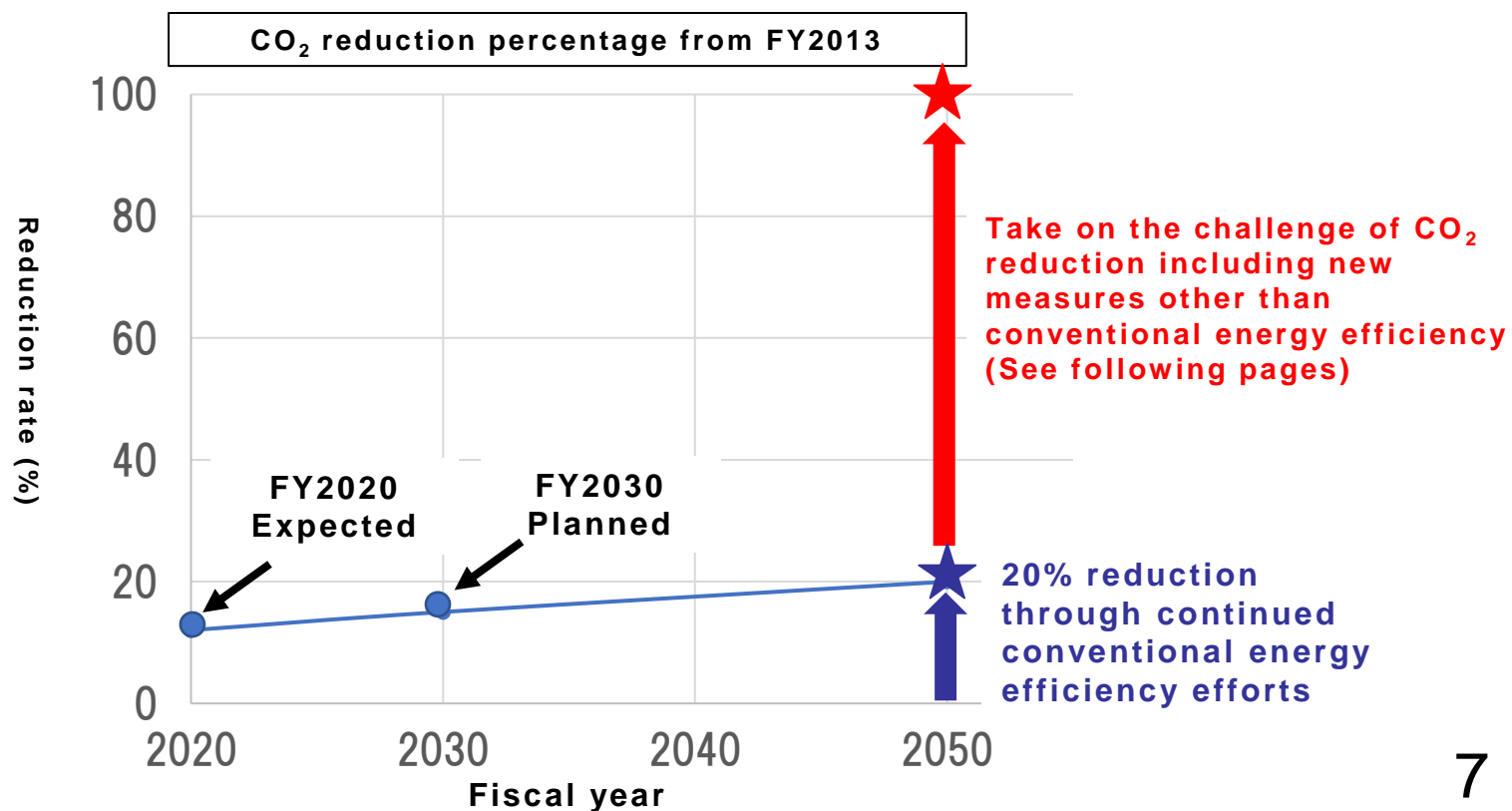
We will study possibilities of applying to the paper industry the energy-related innovations under validation in other industries, and also promote the use of carbon-neutral fuels and electricity. **(rough target: 30% or 6.3 million ton reduction from FY2013)**

I -1. Promote energy efficiency efforts by actively introducing the latest energy-efficient facilities and technologies

It is presumed that the continual energy efficiency efforts to this date enable us to expect around 20% CO₂ emissions reduction from production activities by 2050. (rough target: 20% or 4.2 million ton reduction from FY2013)

- 1) Introduce latest energy-efficient equipment and technologies (BAT: Best Available Technologies)
- 2) Review manufacturing processes (integration, shortening, etc.)
- 3) Intensify energy management (introduction of energy management systems, etc.)

- Even before 2030, no conventional coal boilers shall be introduced for expansion or renewal.

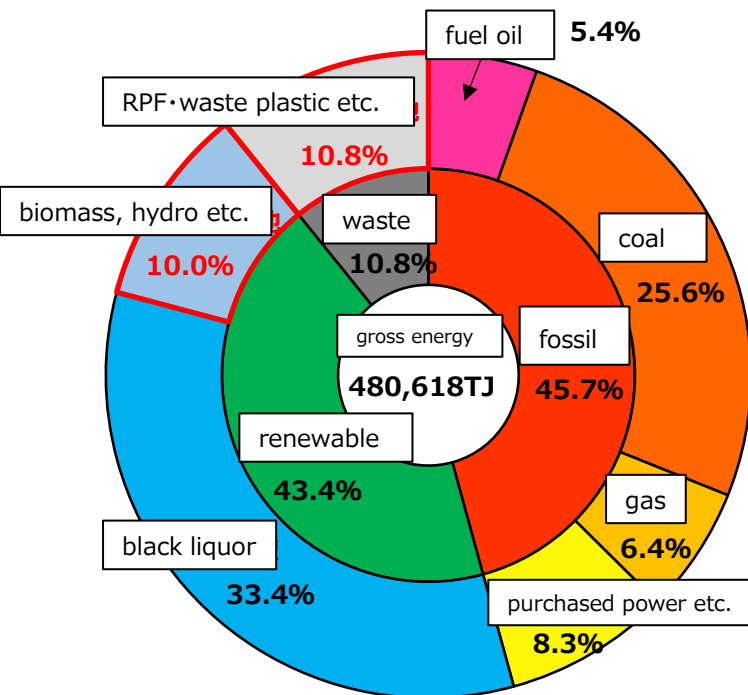


I -2. Increase the utilization ratio of renewable energies in in-house power plants

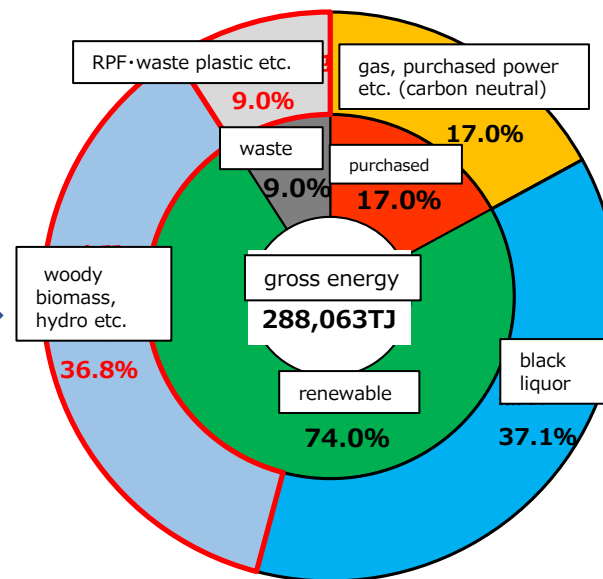
To convert from fossil energy to renewable at the in-house thermal power plants, it is essential to secure stable wood and other biomass resources and develop the technology to use them as fuel efficiently. Besides the thermal power plants, it is necessary to actively introduce hydro, solar, wind, and other renewable energy-based in-house power plants. (rough target: 40% or 8.4 million ton reduction from FY2013)

- 1) Secure stable supply of wood biomass for fuel from within Japan and abroad
- 2) Develop and introduce biomass fuel technology(white pellets and black pellets)
- 3) Introduce renewable energy-based power plants such as hydro, solar, wind, ocean, and geothermal

Energy Composition of Paper Industry in 2019



Energy Composition of Paper Industry in 2050 (Assumption)



<Assumptions for the 2050 graph>

- ① Total energy requirement is calculated from estimated production volume and energy intensity of paper and paperboard in 2050.
- ② Purchased gas and electricity are carbon neutral.
- ③ Waste energy is about half the amount in FY2019 and mostly carbon neutral.
- ④ Black liquor energy is down in proportion to the change in production from FY2019 to FY2050.

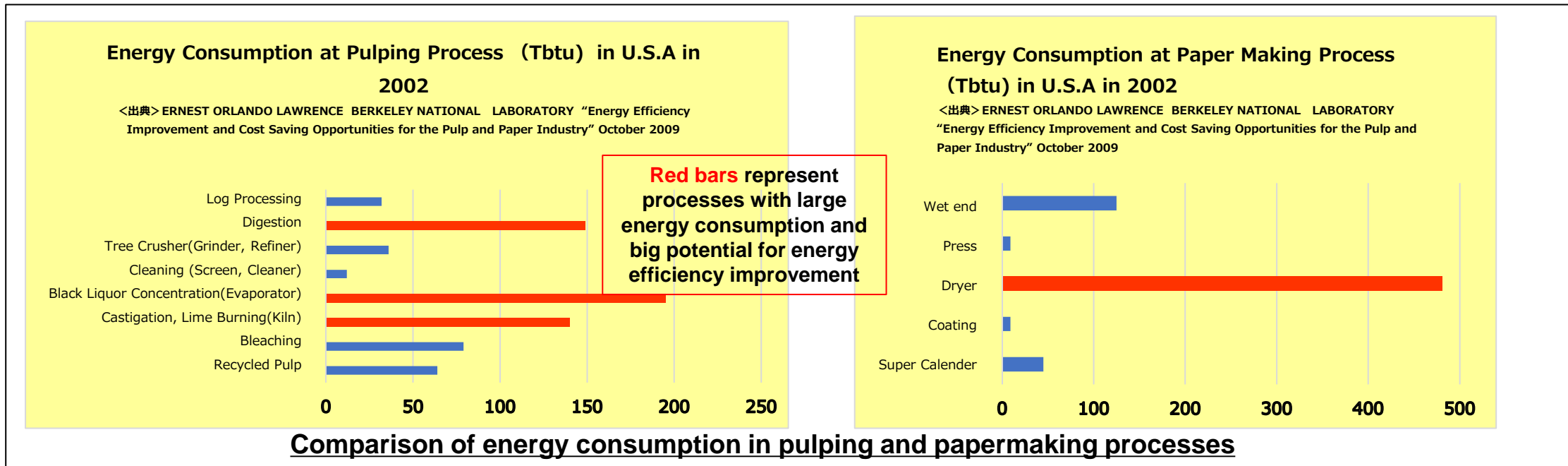
We will work to raise the use ratio of biomass fuel

**(i.e.)
Biomass, hydro, etc.:
From 10.0% (FY2019) to 36.8%(FY2050)**

I -3. Take on the challenge of commercializing innovative technologies related to paper manufacturing

Regarding the large energy-consuming processes of kraft pulp chip digestion, black liquor enrichment, lime baking, and drying at paper machine, we will revisit previous R&D outcomes and explore new useful innovative technologies for energy efficiency, energy conversion, and heat recovery and take on the challenge of their commercialization. (rough target: 10% or 2.1 million ton reduction from FY2013)

- 1) Electrify paper machine dryers and kilns (use carbon-neutral electricity instead of fossil energy)
- 2) Improve energy efficiency in the dryer by lowering water content entering the dryer (press process)
- 3) Develop high-efficiency pulping method
- 4) Develop energy-efficient black liquor enrichment equipment
- 5) Develop economical waste heat recovery technologies related to dryer hoods and paper machine wastewater etc..

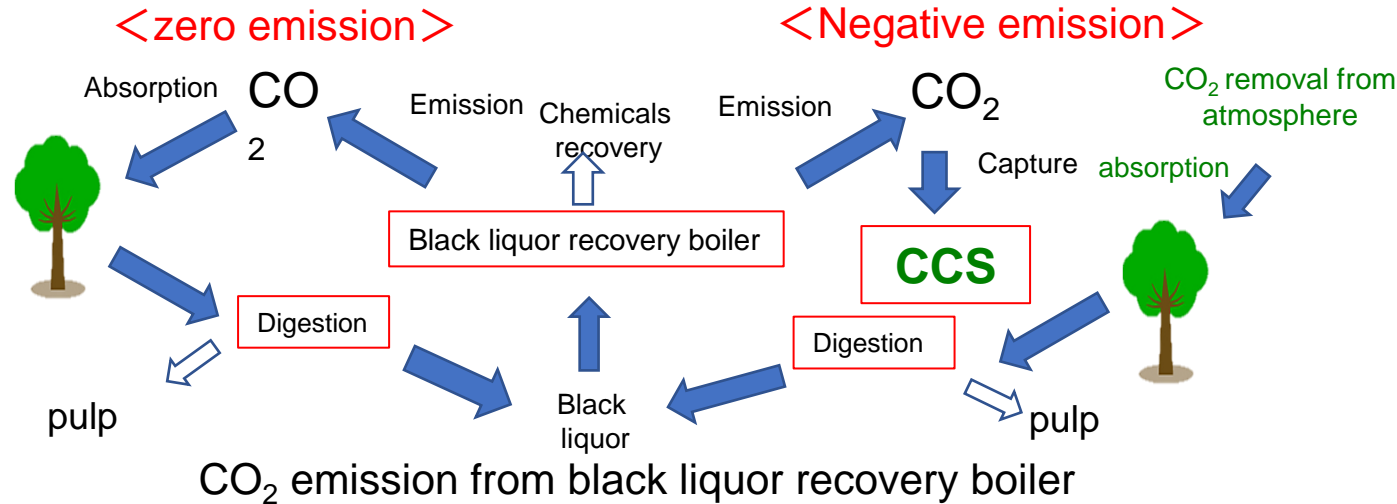


I -4. Actively adopt energy-related innovative technologies

We will study possibilities of applying to the paper industry the energy-related innovations now under validation in other industries, and also promote the use of carbon-neutral fuels and electricity. (rough target: 30% or 6.3 million ton reduction from FY2013)

1) Introduce CCS and CCUS technologies (carbon capture and storage; carbon capture, utilization, and storage)

- Capture of CO₂ from a boiler using black liquor, wood biomass, and other carbon-neutral fuels represents “negative emissions.”



< Negative emissions >
A generic term for technologies that not only reduce CO₂ emissions but also capture and remove the CO₂ historically emitted and accumulated in the atmosphere

2) Use energy of carbon-neutral gas and waste plastics

- Use carbon-neutral hydrogen and methane gas in thermal power plant
- Introduce fuel cell power generation (by electrochemical reaction of CO₂-free hydrogen and oxygen)
- Use carbon-neutral waste plastic products

3) Expand use of purchased carbon-neutral power

- Promote electrification of boilers and other heat sources using carbon-neutral electricity



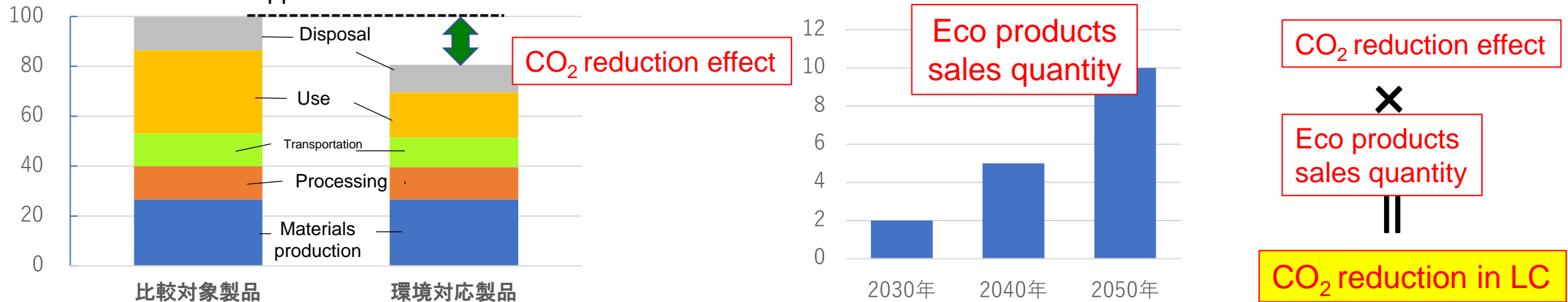
CCS Demonstration Project in Tomakomai
< Source > “The CCS Demonstration Project is underway in Tomakomai”
(Japan CCS Co., Ltd.)

II. Reduce CO₂ emissions from product life cycles by developing environment-friendly materials (1)

Contribute to creating a carbon-neutral society by reducing CO₂ from product life cycles (“LC”) using carbon-neutral, environment-friendly materials derived from wood biomass. (rough target: 4.2 million ton reduction, corresponding to 20% of paper industry emissions in FY2013)

1. Reduce CO₂ emissions in LC by societal implementation of cellulose nanofiber (“CNF”)

CNF is lightweight and has high strength properties and excellent thermal expansion, making it possible to develop a wide range of applications. Particularly, CNF composite materials, compounded with resins and rubber, are lightweight and have high strength properties. For example, they could reduce automobile weight and thus are expected to reduce CO₂ significantly in LC in terms of fuel economy improvement and others. Besides automotive products, CNF could also contribute to reducing CO₂ emissions in LC as building materials and home appliances.



(Reference)

- Fuel economy improvement by weight reduction of automotive components by CNF: 2.11 million tons (World market in 2035)
- Higher insulation housing materials by CNF: about 0.3 million tons (Japanese market in 2035)
- Higher insulation of electric home appliances by CNF: about 0.25 million tons (Japanese market in 2035, per appliance category)

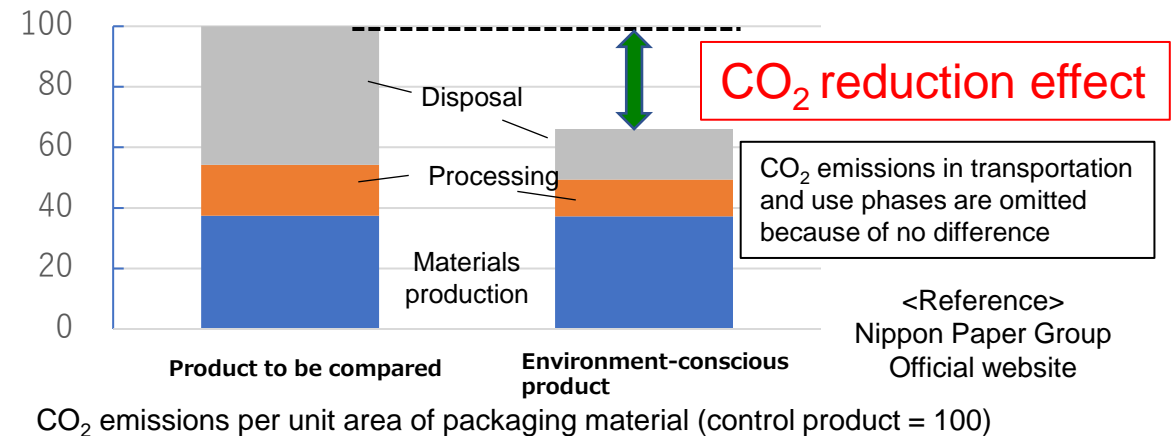
<source>

Japan Environmental Management Association for Industry
FY2018 MOE commissioned study: “Report on the Outcomes of Commissioned Work Concerning Assessment and Validation of CO₂ Emissions Reduction by the Utilization of CNF”

II . Reduce CO₂ emissions from product life cycles by developing environment-friendly materials (2)

2. Reduce CO₂ emissions through use of paper materials replacing fossil-derived plastic packaging materials

Develop use of paper-based packaging materials, replacing the conventional high-performance fossil-derived plastic materials having oxygen- or vapor-barrier properties to prevent degradation of the content. In comparison with fossil-derived products, CO₂ reduction effect is expected especially in after use.



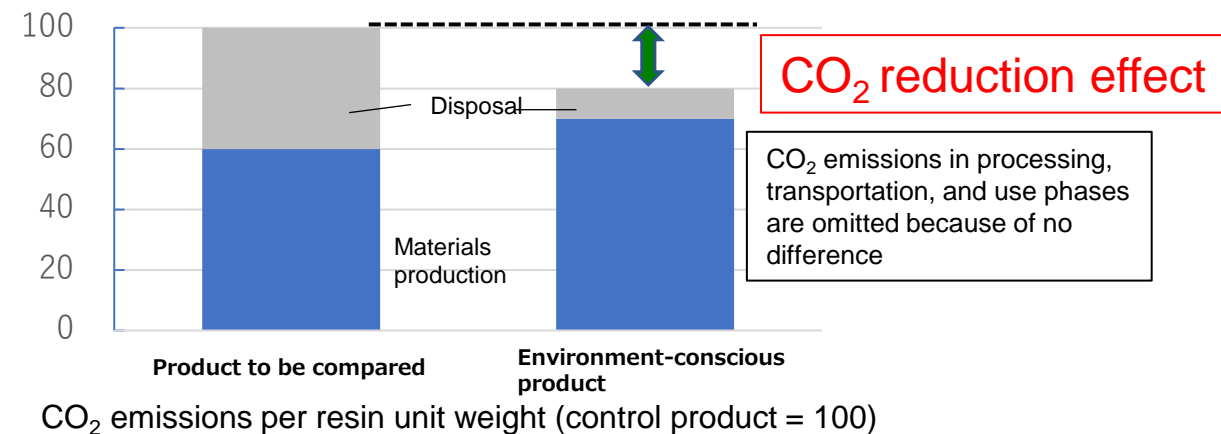
3. Reduce CO₂ emissions through conversion from fossil-derived products to bioplastics and biochemicals

Conversion from conventional fossil-derived chemicals to non-edible wood biomass-based bioplastics and biochemicals is expected to suppress CO₂ emission into the atmosphere. (Examples)

Cellulose: To produce fuel ethanol, polylactic acid, PE, and other general-purpose resins

Hemicellulose: To produce furfural for production of general-purpose resins (such as polyurethane and PET)

Lignin: To develop new applications such as additive, in addition to the conventional phenol resin applications for automobiles etc.

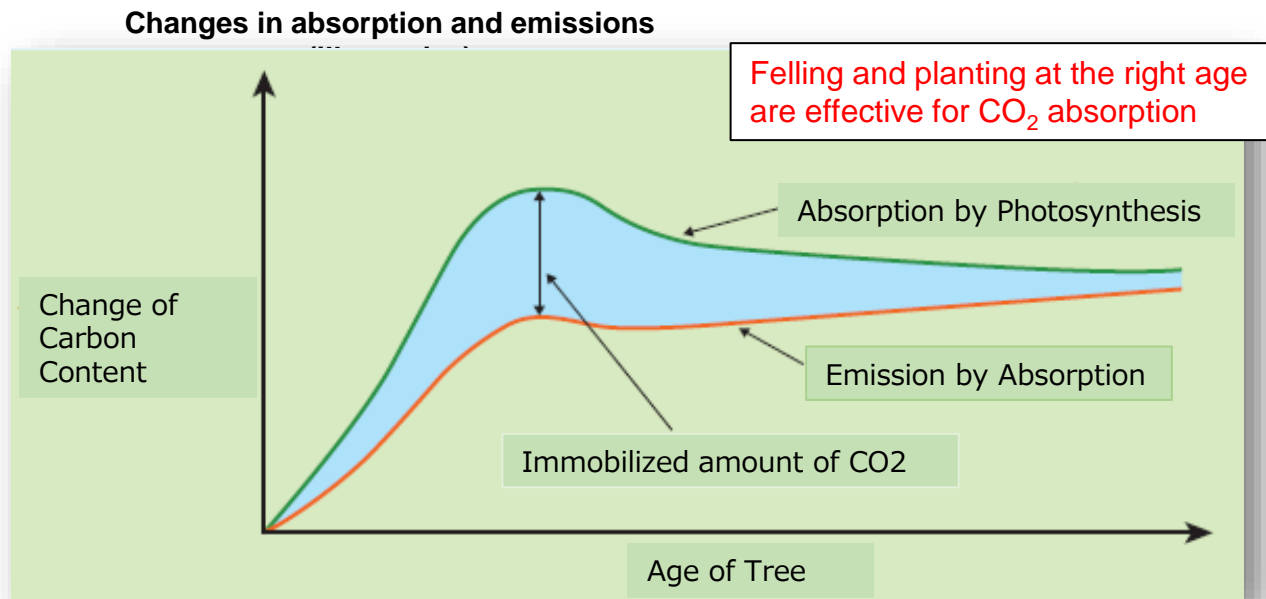


Ⅲ. Expand contribution in afforestation as a source of CO₂ absorption (1)

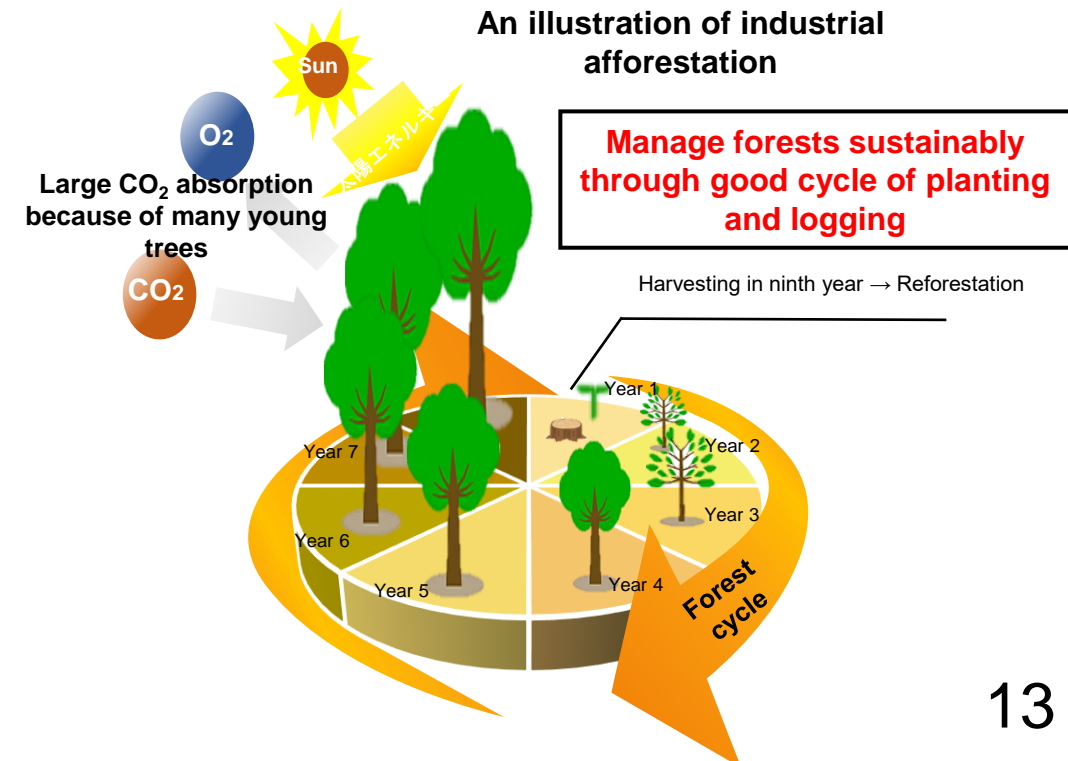
The paper industry is in a good position to ensure sustainable forest management and continual development of afforestation technology and thus contribute to CO₂ absorption and fixation by forests. We will actively promote such efforts also to secure stable supply of wood biomass.

1. Promote sustainable forest management

- Promote sustainable forest management, including conservation of biodiversity, through sound management of the owned forests and thus promote CO₂ absorption and fixation
- Duly assess the entire amount of CO₂ stored in owned forests, both planted and natural, and reflect the results in CO₂ absorption calculation



Source: Forest Research and Management Organization

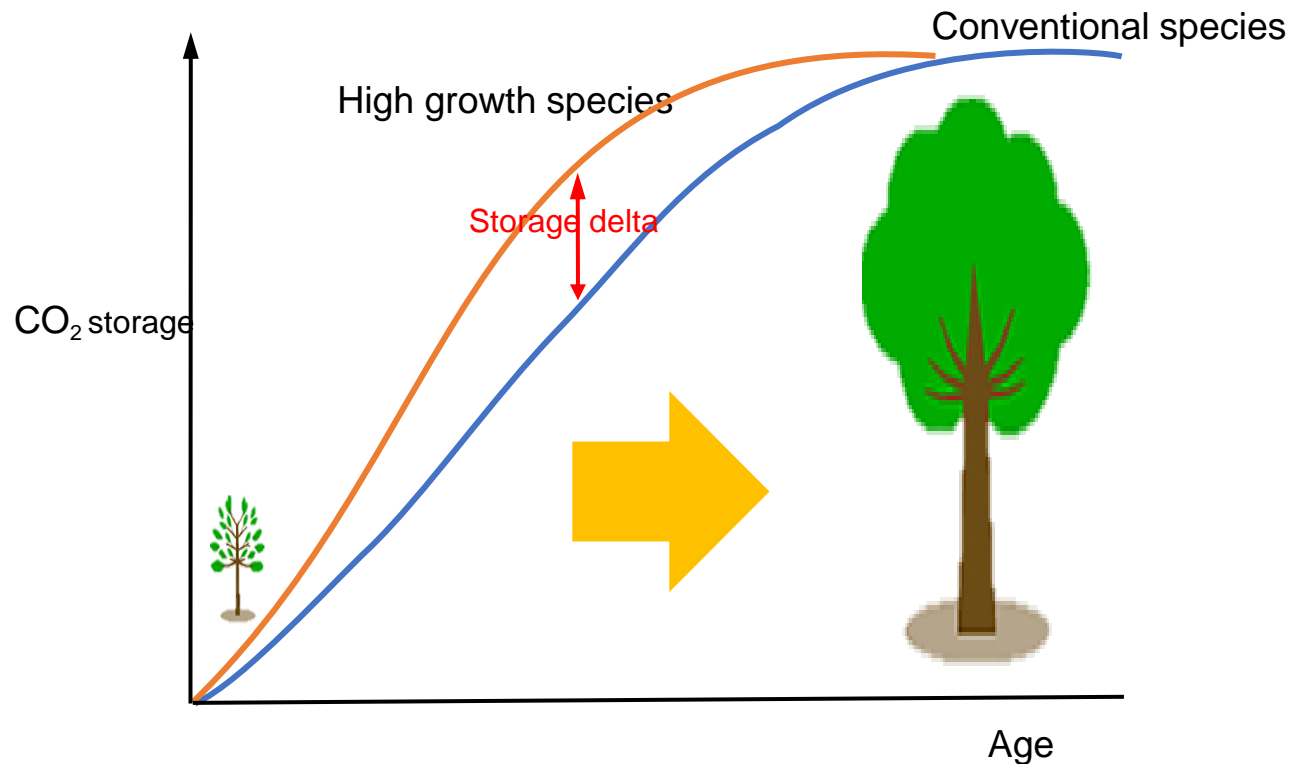


III. Expand contribution in afforestation as a source of CO₂ absorption (2)

2. Promote forest tree breeding with high environmental adaptability and high growth

- Develop and introduce superior tree species that are highly adaptable to the planting site and have a high growth rate to contribute to greater CO₂ absorption and fixation per forest area

Average annual growth and CO₂ storage of planted trees (illustrative)



Eucalyptus artificial breeding (from Nippon Paper Group official website)



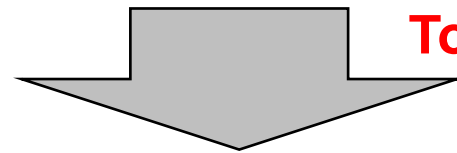
Soil survey (from Oji Holdings official website)



DNA analysis (from Nippon Paper Group official website)

Conclusions—Toward achieving the long-term vision

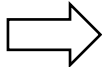
- JPA sets out its long-term vision toward **constructing a carbon-neutral industry by 2050** in the paper industry, to achieve **net zero GHG emissions by 2050** and thus maintain a sustainable global environment.
- For the realization of the Vision, **introduction of future innovative technologies is essential** besides the application and deployment of currently best available technologies. However, the **road map is not necessarily clear**, and the numbers mentioned are “**rough targets.**”
- **Apart from the technological development, there are many challenges** to be tackled such as the **cost burden** required to achieve this Vision and the **impact on the price competitiveness of the products** from a global perspective. It is also necessary to ensure information sharing with the general public about the paper industry’s environmental efforts.



Toward achieving our long-term Vision

- **This Vision will be presented to relevant JPA committees for the detailed discussions on more concrete technical matters and on any necessary modifications.**
- **We look forward to any support from the government and relevant organizations regarding introduction and promotion of various innovative technologies and renewable energies.**

Future course of action

- **January 20, 2021: Deliberate at the JPA Board meeting**  **Submit to Keidanren after approval. Announce on JPA website**
- **From February 2021: Energy Committee and Technical Committee jointly discuss details and concrete steps on Chapters I and II and draw up a road map for each study item including feasibility outlook (by March 2022). Forestry Committee with some others start discussions on Chapter III Afforestation.**

Study items	Methodologies
<p><u>I. Reduce CO₂ emissions by promoting energy efficiency and fuel conversion in production activities</u></p> <ol style="list-style-type: none"> 1. Actively introduce the best available energy-efficient facilities and technologies 2. Increase use of renewable and waste-derived energies 3. Take on the challenge for commercialization of innovative technologies related to paper manufacturing 4. Actively adopt energy-related innovative technologies 	<ol style="list-style-type: none"> 1. Grasp current status through follow-up surveys on global warming countermeasures and other means 2. Survey on biomass fuel (study possibility of forming a consortium) 3. Research on overseas technology, and develop strategy for development contracting and commercialization 4. Survey on CCS and CCUS (study possibility of forming a consortium)
<p><u>II. Reduce CO₂ emissions from product life cycles by developing environment-friendly materials</u></p> <ol style="list-style-type: none"> 1. Realize societal implementation of cellulose nanofiber 2. Develop paper containers and others replacing plastics 3. Develop biochemicals to enable conversion from petroleum-based raw materials 	<p>Grasp the progress of commercialization at member companies and examine the possibility of cooperation with other industries</p>
<p><u>III. Expand contribution in afforestation as a source of CO₂ absorption</u></p> <ol style="list-style-type: none"> 1. Promote sustainable forest management 2. Promote forest tree breeding with high environmental adaptability and high growth 	<p>Follow-up the progress by Forestry Committee, Overseas Afforestation Committee, and other related committees</p>