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The Implications of Packaging Plastic Recycling on Climate Change Mitigation and Fossil Resource Savings – A Case Study in Japan

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Content

Introduction

- The lack of adequate land for landfilling is a major problem in Japan
- Japan is pursuing a sound material recycle oriented society both to achieve sustainable development while reducing the amount of waste and saving the landfill space
- The highest fraction of recyclable represents plastic waste
- The domestic plastic waste is treated by using mechanical recycling (22%), liquefaction (4%), solid fuel (5%), waste power generation (36%), heat utilizing incineration (13%) incineration without power or heat (12%) and landfilling (10%)

General description of study locations

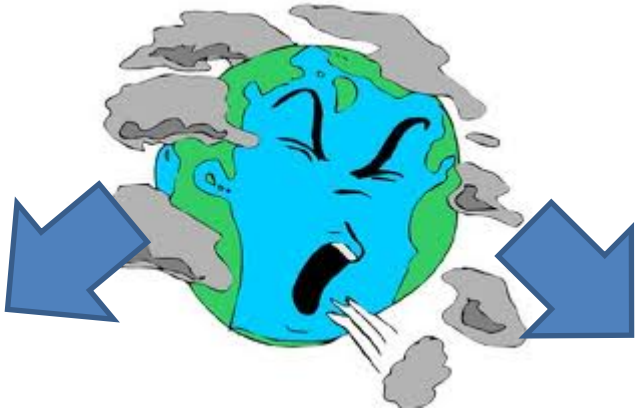
- Yokohama, the largest Japanese city by population (3.67 million people)
- Yokohama city generated 1,240,000 tonnes in year 2013 under the 3R dream plan
- The waste is treated using a combination of technologies, including recycling (27.3%), incineration (71.9%) and landfilling (0.8%).
- On average, 134 tonnes/day of source separated packaging plastic waste is collected in Yokohama
- The baled plastic is then transported to several facilities in different prefectures for recycling
- A significant fraction is transported and recycled in Shizuoka prefecture

Objectives of the study

- GHG emissions and their influence on climate change and the depletion of fossil fuels are considered to be critical global environmental challenges.

  e.g. Around 4% of world petroleum is used as feedstock for plastic production and another 3-4% is expended to provide energy for manufacturing

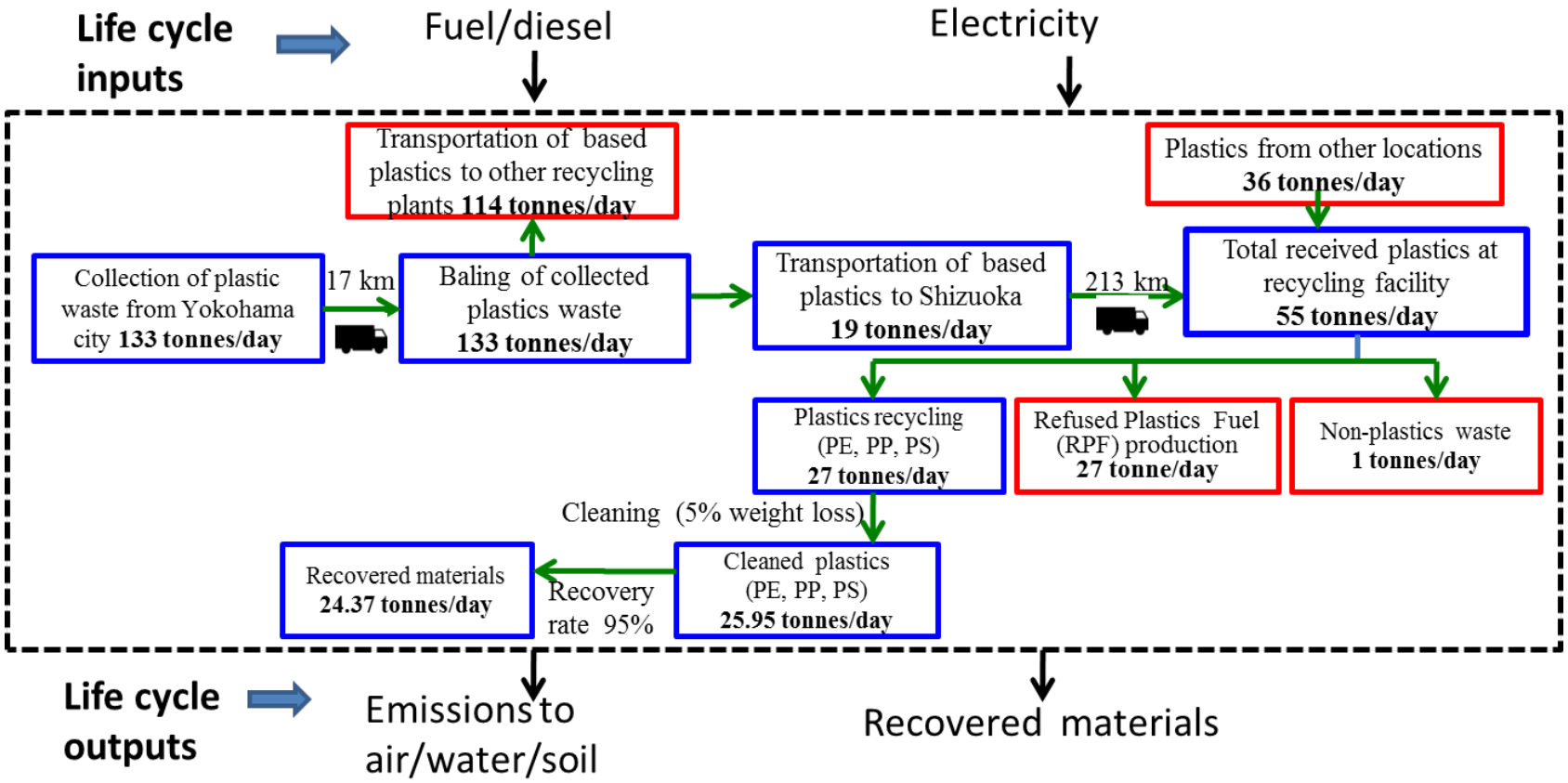
- Recycling activities contribute to the global environmental challenges of GHG emissions and the depletion of fossil resources
- However, material recovery from plastic recycling can offset the GHG emissions and resource depletion that would otherwise occur through the production of virgin resin.
- In this study, the effects of packaging plastic recycling on GHG mitigations and resource saving were assessed using the case of packaging plastics recycling in Shizuoka.



Methodology

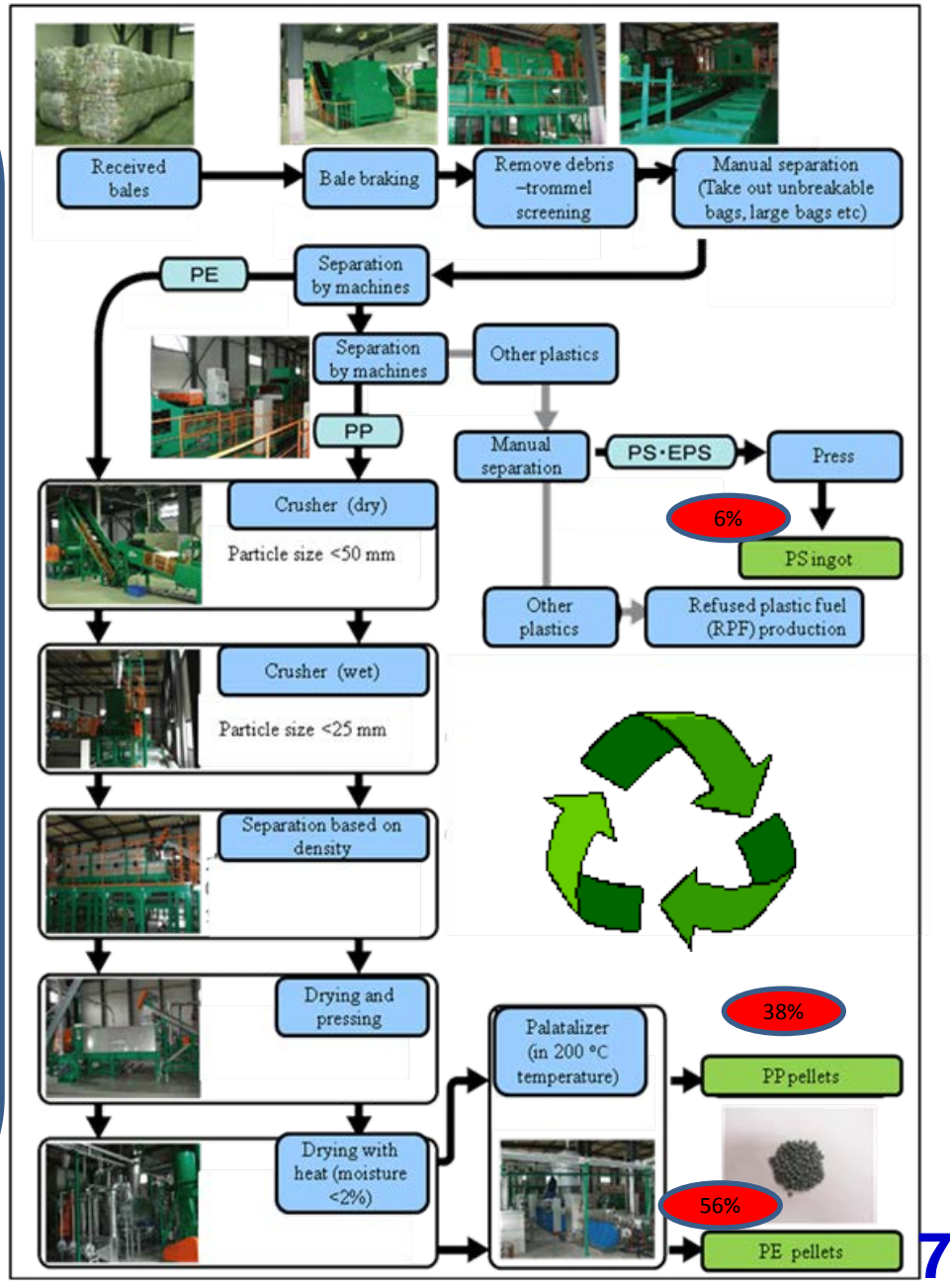
Framework for the assessment

- Life Cycle Assessment (LCA) framework was designed considering all the phases of the life-cycle
- System expansion was used to account for the effects of material recovery. Credits were provided to account for the avoided virgin production of materials which had been recovered as a result of recycling



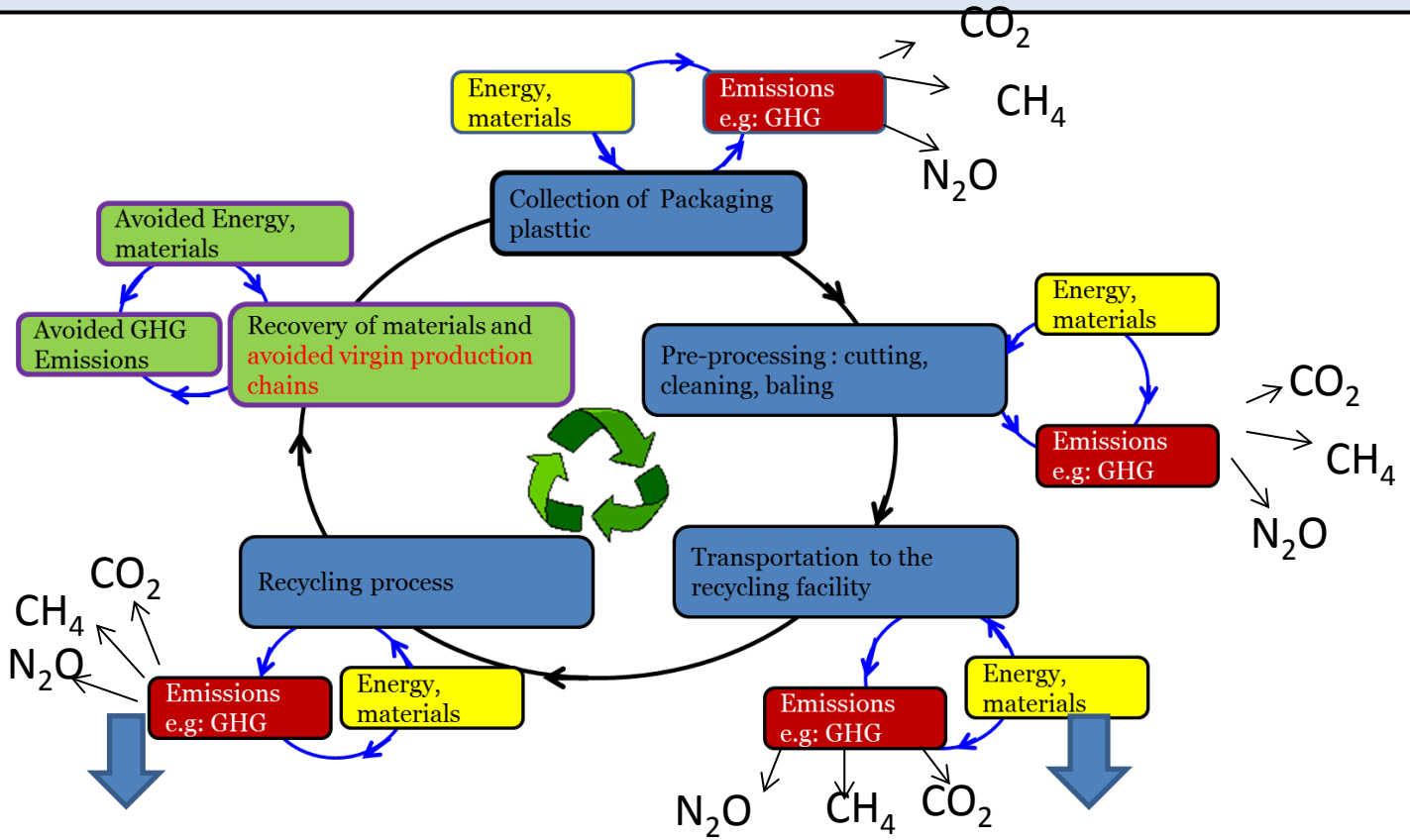
Framework for the Assessment

- The functional unit was defined as 1 tonne of packaging plastic waste recycled in a recycling plant in Shizuoka
- The recycled plastic in the Shizuoka plant falls into three major categories viz: polyethylene (PE), polypropylene (PP) and polystyrene (PS) at 56%, 38% and 6% respectively
- Plastic pellets are the final product from the PE and PP recycling processes whereas plastics ingots are produced from recycling PS
- Plant specific information was gathered on energy and material consumption Shizuoka plant. Additionally, literature data sources were used to find the required information related to waste collection, transportation, baling etc.



Indicators for the quantification of the impacts

Recycling activities are associated with a significant amount of fossil energy consumption and GHG emissions. In contrast, the materials recovered from recycling enable to gain environmental benefits from the avoided conventional production



Indicator : GHG emissions expressed in the unit of CO_2 equivalent

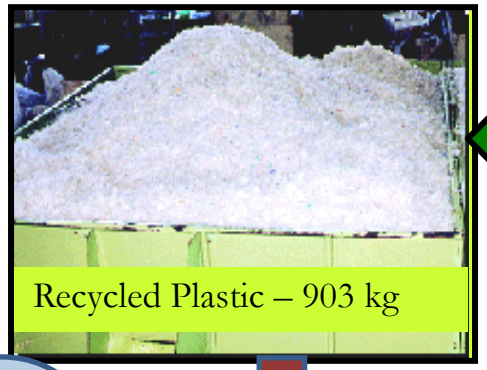
Indicator : Fossil fuel consumption expressed in the unit of crude oil equivalents (42 MJ/kg)

Results and Discussion

In order to calculate the overall GHG emissions and fossil fuel consumption from the packaging plastic recycling, overall fossil fuel and grid electricity consumption were accounted for, considering all the phases of their life cycle

Packaging Plastic recycling

Energy



Replace virgin Resin Production

-Waste collection and transportation (2.06L of diesel/tonne of plastic waste)
-Grid electricity consumption for baling (29.85 kWh/tonne of plastic waste)
-Long distance transportation (11.11 L of diesel/tonne of plastic waste)
-Grid electricity consumption for recycling process at Shizuoka (1,005.86 kWh/tonne of plastic waste)

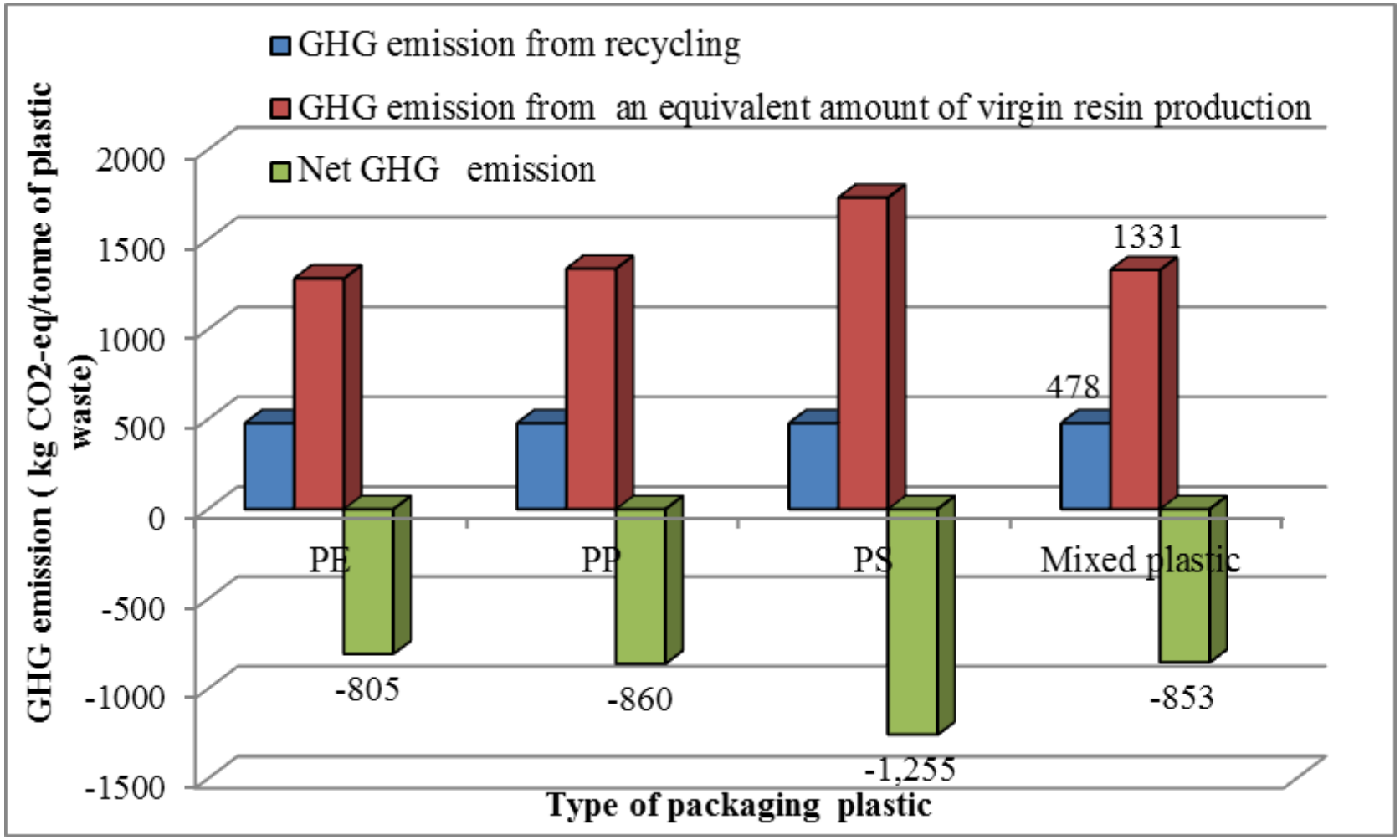
-Total GHG emissions?

-Total Fossil fuel consumption ?

-Total GHG avoidance ?

-Total fossil fuel savings ?

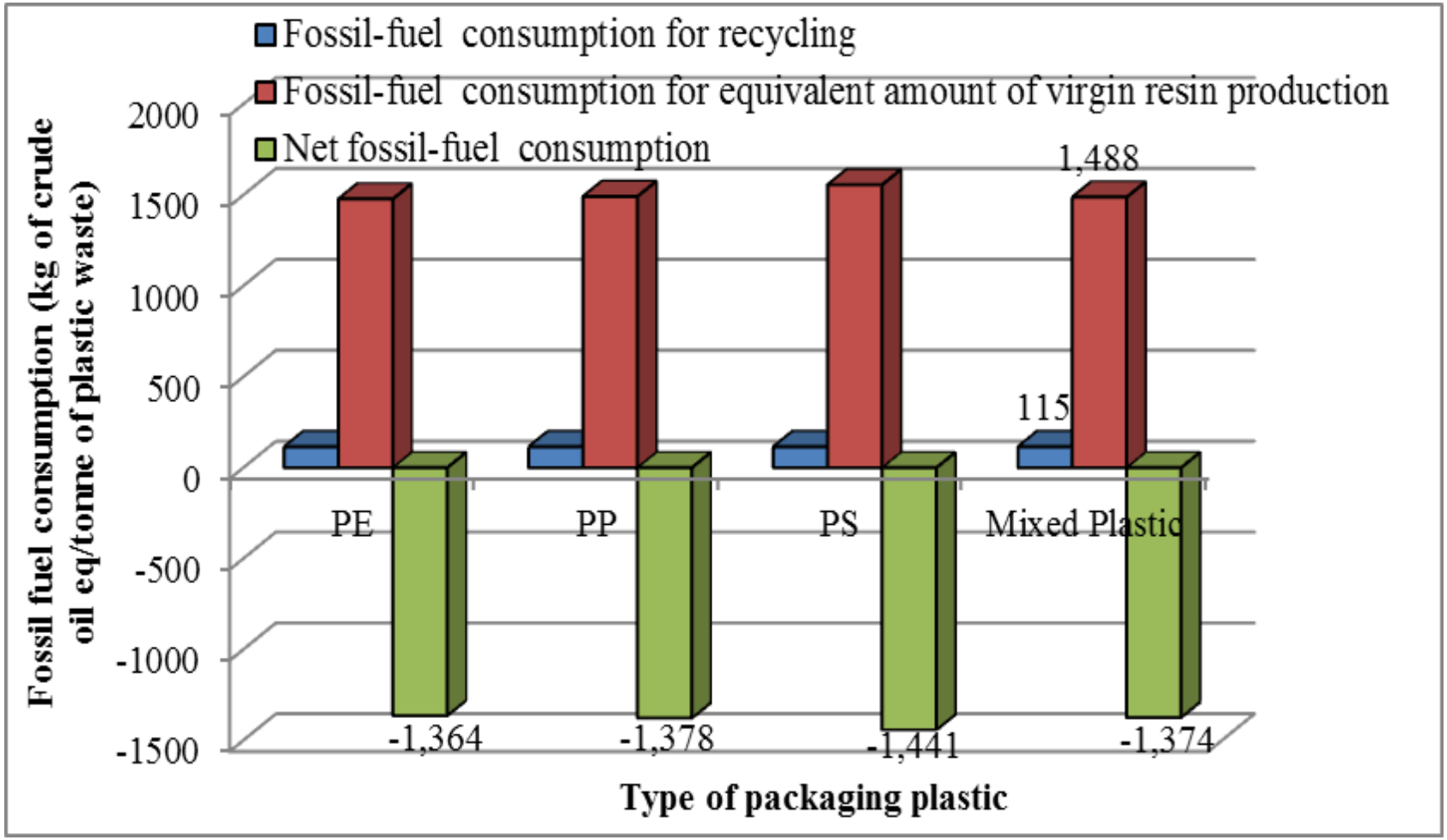
GHG emissions and GHG avoidance potential



-GHG avoidance potential is higher than GHG emissions from recycling

-Net GHG emissions from mixed packaging plastic recycling is -853 kg CO_2-eq/tonne of plastic

Fossil energy consumption and Fossil energy saving potential



-Fossil energy savings potential is always higher that fossil energy consumption for recycling activities

-Net fossil fuel consumption is -1,374 kg crude oil-eq per tonne of recycled packaging plastic

Conclusion

- The results of packaging plastic recycling process in Yokohama clearly show that it offers important prospects in terms of environmental benefits and thereby contribute to improve sustainability

- The results of this study can be used as a probing tool to convince all stakeholders involved in waste management of the benefits of packing plastics recycling and, as well as promoting and strengthening such recycling activities in Japan and elsewhere

- The results can contribute to convincing decision and policy makers involved in waste management about the need for strengthened support for such recycling to replace incineration and landfilling of this waste

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