UNEP-IETC Project – Waste Plastics Conversion
&
Linkages with Waste Agricultural Biomass Projects

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Outline

1. UNEP-IETC Project on Waste Plastics Conversion into Fuel
2. Properties of Waste Plastics
3. Conversion Technology
4. Possible Linkage with Biomass Conversion

1. UNEP-IETC Project on Waste Plastics Conversion into Fuel

- Local communities in developing countries have difficulties in waste treatment, especially, of *increasing amounts of plastics*.
- Various technologies have been developed to convert plastics into resources. But there is no guideline *how to select suitable technologies* for the wastes from various waste sources.
- This project provides *Technology compendium of plastics conversion* and *Selection guidelines of ESTs for plastics conversion into fuel*, and supports *Pilot plant demonstration*.

Purpose of Waste Plastics Conversion into Fuel

- Promote resource conservation by obtaining fuel from waste plastics
- Upgrade the properties of wastes as fuel for transportation, storage, feeding to a boiler, calorific value, smooth combustion and qualities of flue gas and ash
- Reduce green house gas by using waste plastics for the cleaner fuel production and supporting biomass utilization.

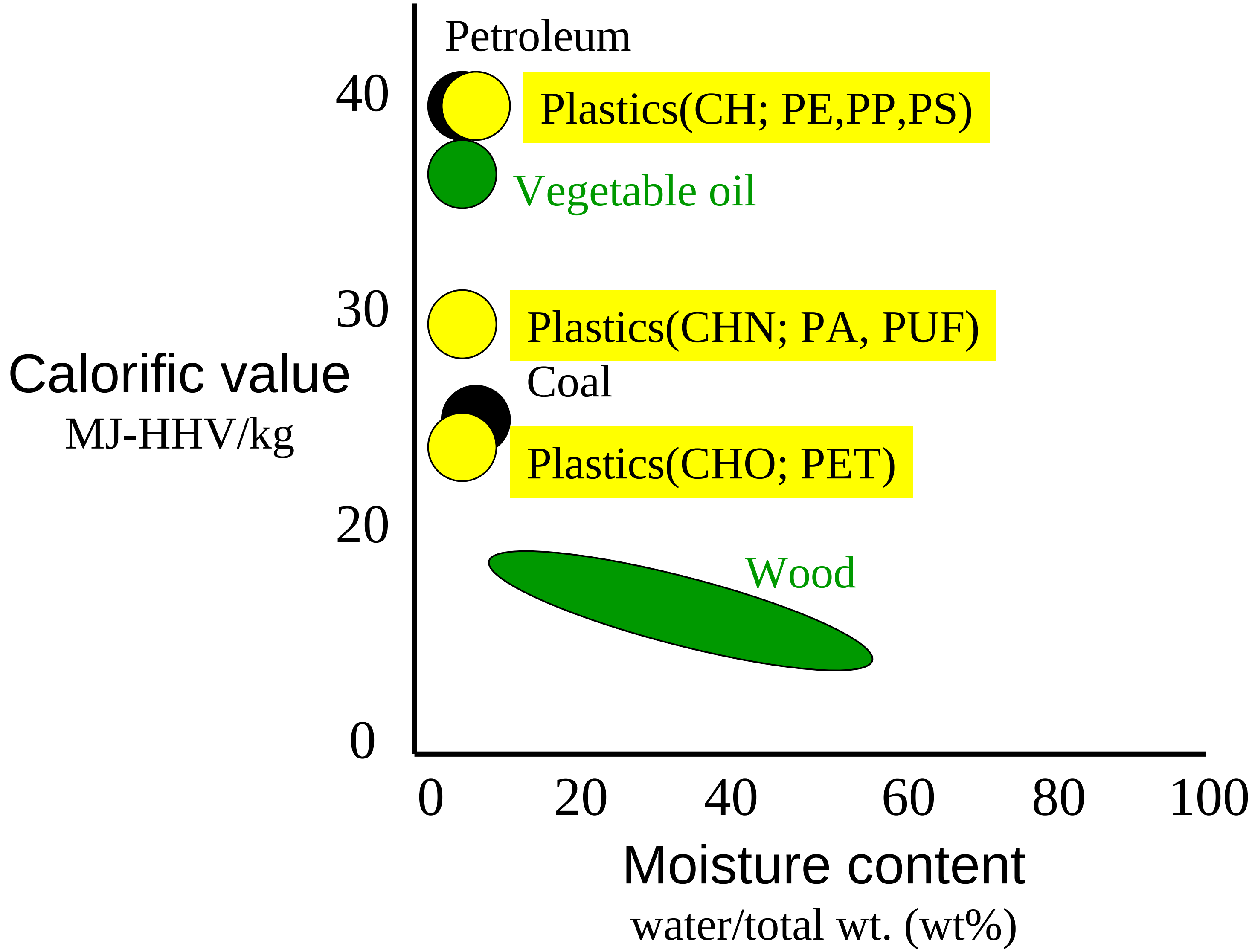
Sawdust of
4300 kcal/kg

Pelletization with Plastics
of 10,000 kcal/kg

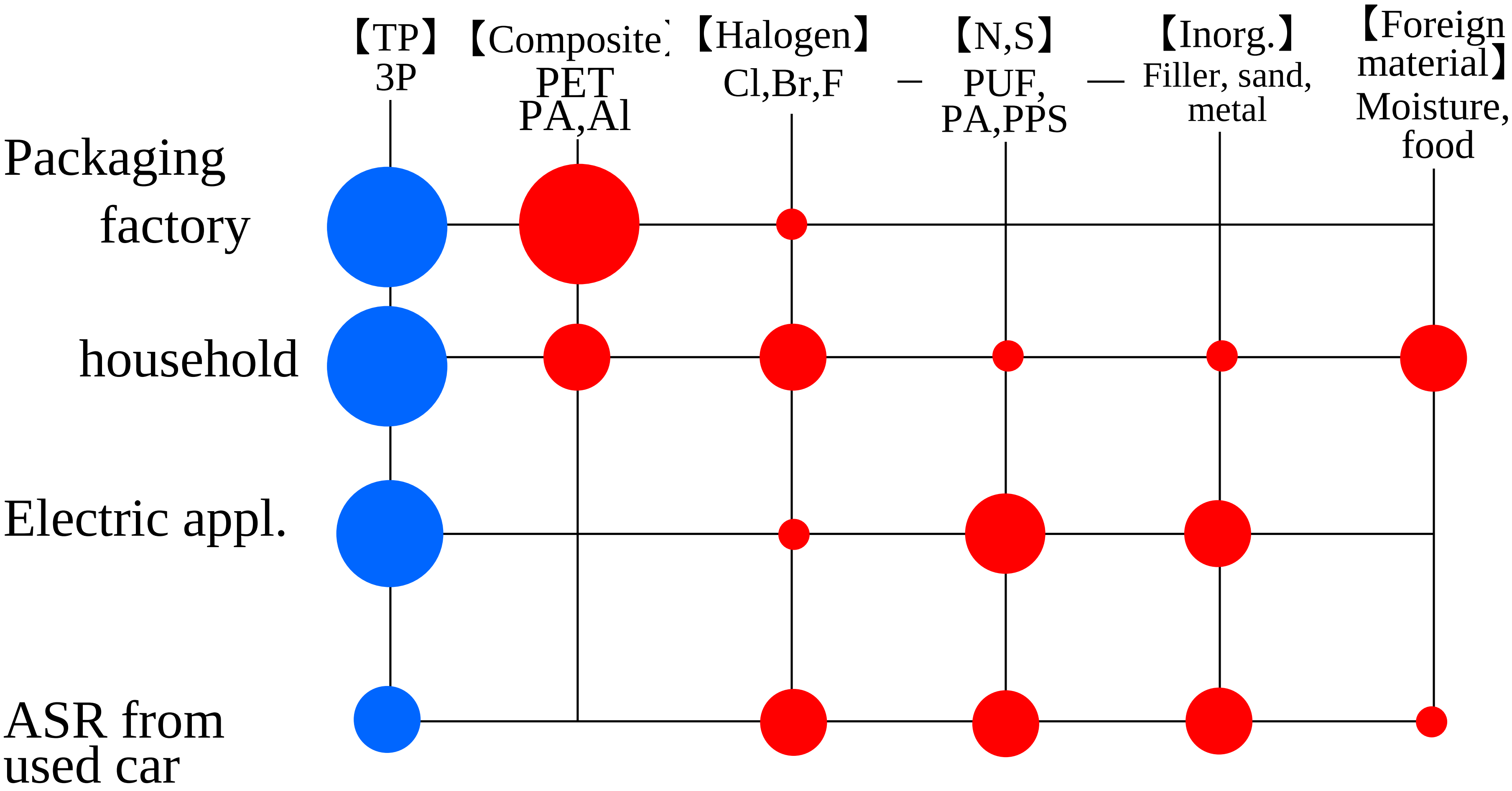
RPF of
7,000 kcal/kg

2. Properties of Waste Plastics

Comparison with other energy sources and biomass



Diversities in Composition Depending on Waste Sources



3. Conversion technologies available

Four methods for heat recovery

- Fuel production for local users
  - Solid fuel
  - Liquid fuel
  - Gaseous fuel
- Incineration with heat recovery on site
- *Each method has its scope and limitations in the types of waste plastics and user's applications.*

Scope of the four methods

Method*	**Feedstock****	**Production**	**Substitutes**
Solid fuel	Combustibles	Pelletization <200 ° C	Coal or wood
Liquid fuel	Mainly, three thermoplastics	Pyrolysis ca. 500 ° C	Petroleum
Gaseous fuel	PE and PP, or Combustibles	Gasification >700 ° C	LPG/LNG or Syngas
Incineration	Combustibles	Combustion >1000 ° C	(Non-storable) Heat recovery

*Flue gas quality and ash from fuel products should be examined.
**Plastics containing Cl, N, S and Al composite are to be avoided.

Solid fuel

- Two typical types:
  - RDF including putrefactive matters like kitchen wastes.
  - RPF consisting of paper, wood and thermoplastics
- Feedstock:
  - non-hazardous combustibles without emission of hazardous flu gas and ash upon combustion.
- Properties and application of fuel:
  - Calorific value 2000 – 4000 (RDF), 5000 – 7000 (RPF) kcal/kg and bulk density is about 0.4 ton/m^3
  - Special attention required for self-ignition and methane evolution in RDF storage
  - Due to flu gas quality, coal-combustion boiler is a typical application in Japan.

RPF

Sawdust or other combustibles
ca. 19 MJ/kg

Thermoplastics
ca. 40 MJ/kg

→

Pelletizer

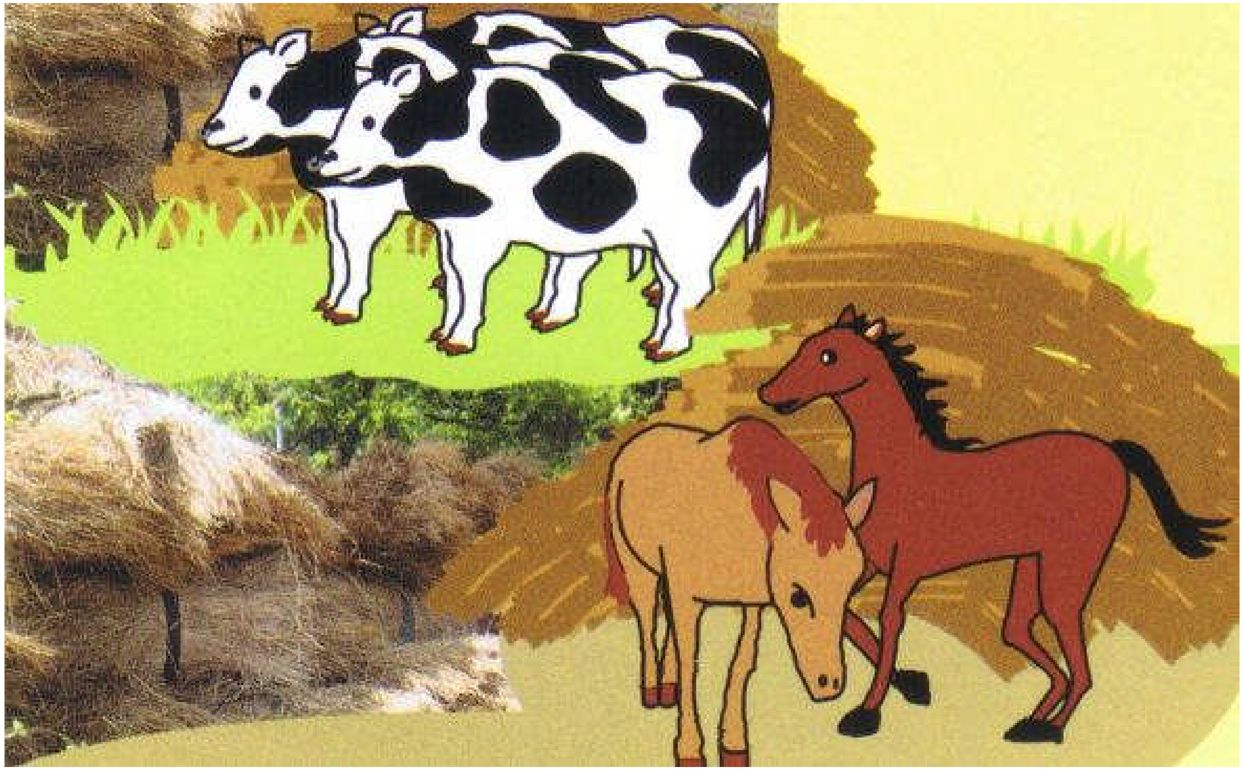
Solid fuel with the higher
calorific value 30 MJ/kg

Solid fuel

- Production: Crushing and pelletization. Drying process is required for wet wastes. Pelletization is carried out at ca.200° C.

Solid Fuel Preparation with Waste Plastics

- Solid fuel can be prepared from suitable waste plastics and agricultural wastes such as straw: Higher calorific value helps to dry straw to prepare solid fuel and will widen the way for users to apply it.



Liquid fuel

- Production: Pyrolysis followed by distillation. Crushing and separation required for some wastes.



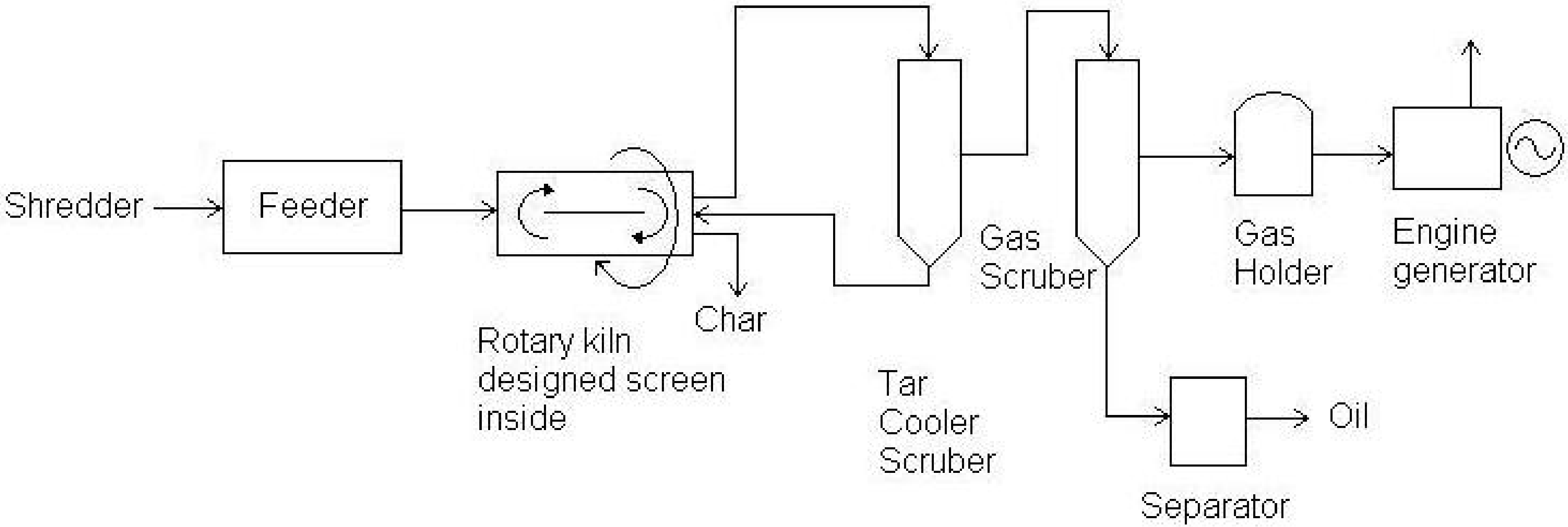


Liquid fuel

- Production of petroleum substitutes:
  - Substituted fuel to heavy oil, diesel oil and gasoline depending on distillation ranges
- Feedstock:
  - Thermoplastics, especially PE, PP and PS without contamination of PVC and PVDC.
- Properties and application of fuel:
  - Calorific value about 10000 kcal/kg, density is about 0.8-0.9 ton/m^3, similar to petroleum products.
  - Contamination of Cl-containing plastics is prohibited, and other materials yielding carbonous matter lowers product yields.
  - Expensive facility cost for the safety to highly flammable products.
  - Skillful operators are required.

Gaseous fuel

- Production: crushing and pyrolysis.
- Steam gen. – power gen., or gas turbine combustion– power gen.



Gaseous fuel

- Two typical types:
  - Syngas consisting of hydrogen and carbon monoxide.
  - Gaseous hydrocarbons under development.
- Feedstock:
  - Wide variety of combustible wastes.
- Properties and application of fuel:
  - Calorific value of Syngas would be between biogas and LNG/LPG.
  - A large gas holder is required if it is stored.
  - Careful operation to hydrogen explosion.
  - Skillful operators are required.

Remarks

- Waste plastics and the conversion products have high calorific values.
- Biomass contains much moisture and has low calorific values.
- Coprocessing of biomass with waste plastics can be a potential way to save energy for biomass processing or to improve biomass properties, resulting in the wider applications by the more users.

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