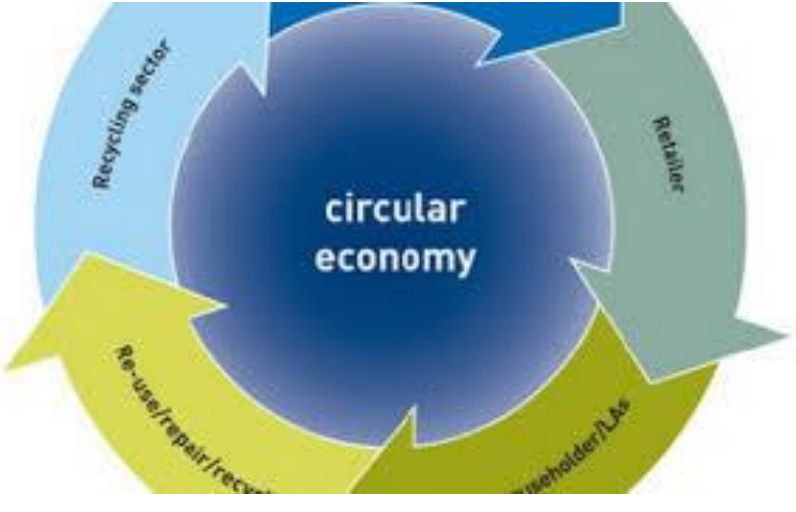
The Application of Refuse Derived Fuel (RDF) in Circular Economy for moving towards Net Zero Carbon City



By Prof. Ir Steve Wong
Managing Director
BUI Technologies Ltd.
BillionGroup Technologies Ltd.

INDEX

- BUI TECHNOLOGIES LTD. OVERVIEW
- REFUSE DERIVED FUEL (RDF)
- CIRCULAR ECONOMY
- BUSINESS MODELS FOR CIRCULAR ECONOMY

BUI OVERVIEW

BillionGroup Technologies Ltd.
兆豐科技設備有限公司

umwelttechnik & ingenieure GmbH

Leading **Energy & Environmental Consultant** during the last 2 decades, providing professional consultant services to the architecture, engineering, construction and industrial markets in Hong Kong, China and the Asian region.

Independent Consulting Engineering Company, located in Hannover, Germany.

Working fields are planning and clearing of **waste treatment and waste disposal plants, power generating plants, process engineering plants** and structural and civil engineering services.

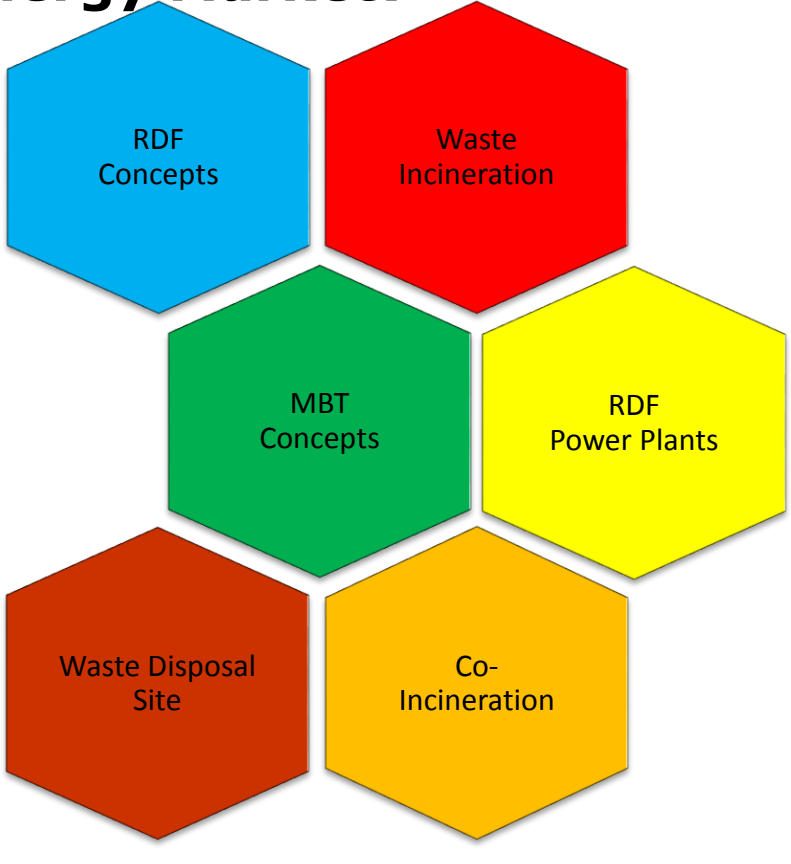
BUI Technologies Ltd.
Hong Kong

Consulting Services and Solutions Provider in the field of
Environmental and Energy Technologies

Are Experiences from Germany Transferable to the International Waste-to-Energy Market?

In principle, yes, but…

- Often several (partial) concepts at the same time
- Often combined locations of MBT and RDF power plant
- Increasingly concepts enable the high current revenues



One of the main Problems: Unknown/Discontinuous Waste Composition

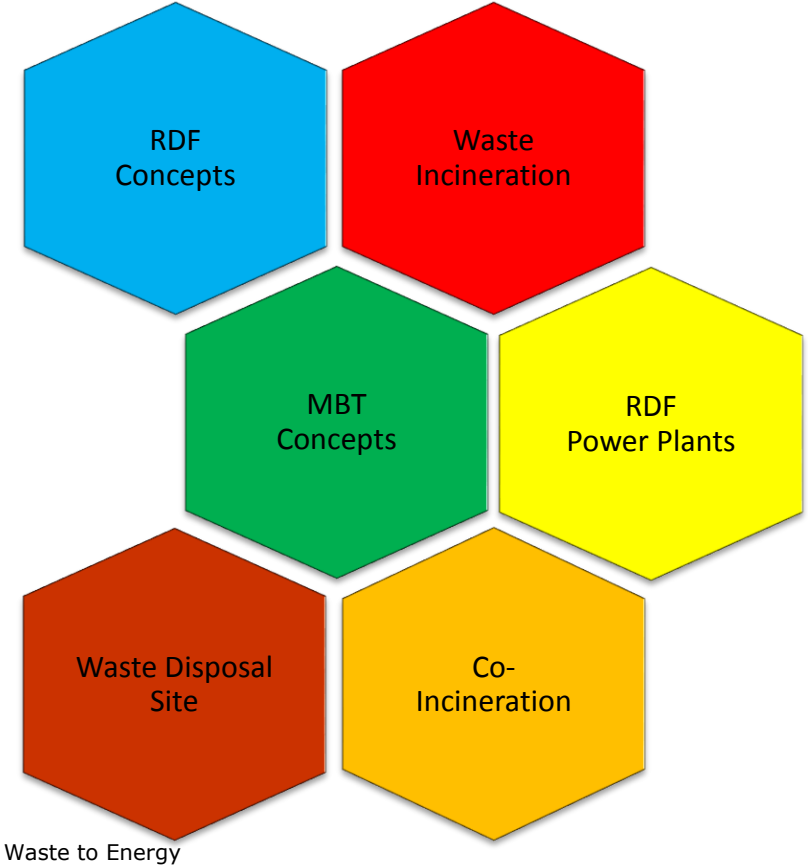




Are Experiences of Germany/Europe Transferable to the International Waste-to-Energy Market?

In principle, yes, but…

- Often several (partial) concepts at the same time
- Often combined locations of MBT and RDF power plant
- Increasingly concepts enable the high current revenues

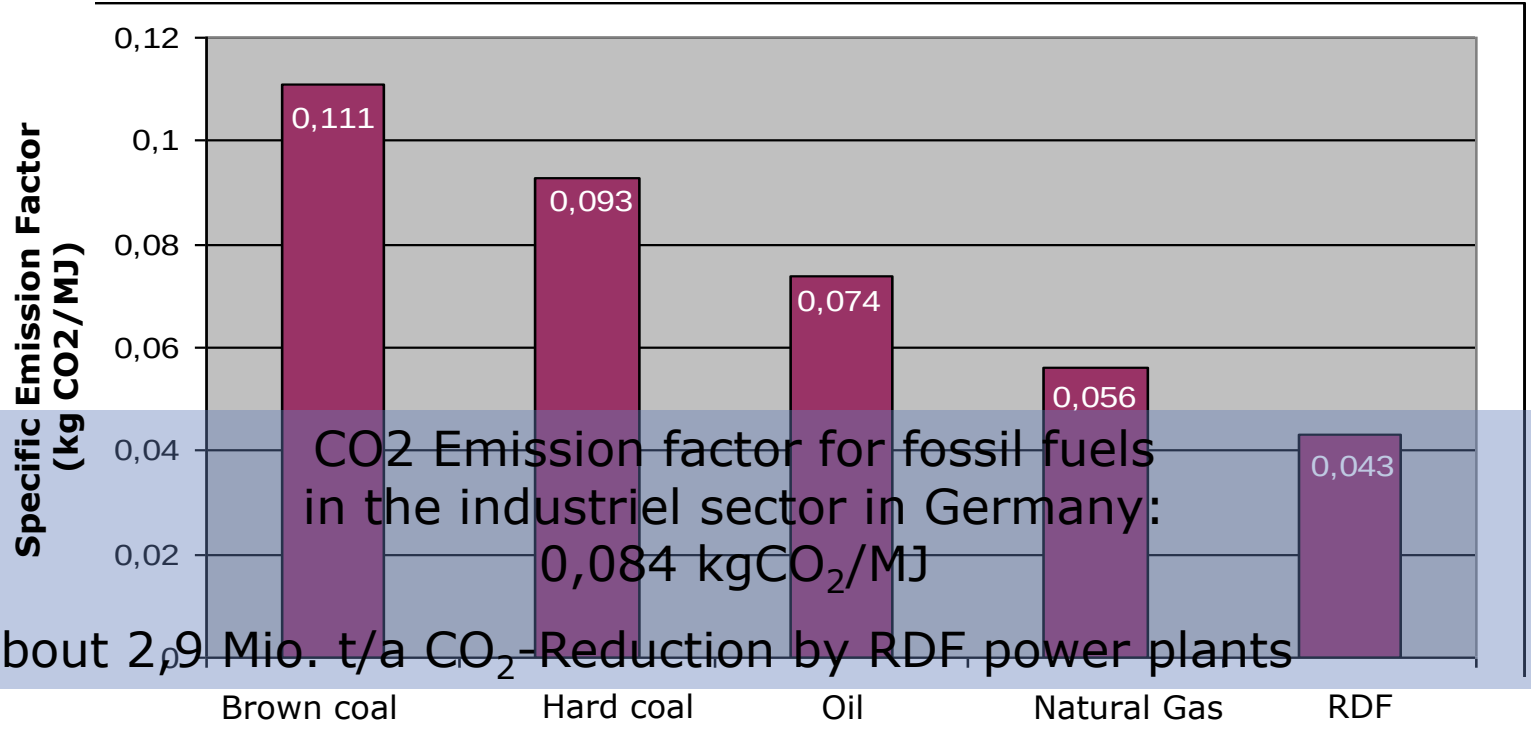


Definitions of RDF (Refused Derived Fuel)

Basic Idea:

- **Recovery** of the heating value of wastes in energy for combustion processes (not thermal treatment in WTE only!)
- Minimization of disposal quantities
- Substitution (+ saving!) of fossil fuels, minimization of greenhouse-effect

CO2 emission reduction through RDF compared with fossil fuel



CO2 Emission factor for fossil fuels in the industriel sector in Germany: 0,084 kgCO_2/MJ

⇒ About 2,9 Mio. t/a CO_2-Reduction by RDF power plants

Customers for RDF in Europe

RDF-Power-Plants:

- Combustion in optimized thermal recovery plants
- Production of process-steam, district-heating or cooling, electricity

Cement Industry:

- Substitution-rate 50% up to 100%

Production of asphalt (road construction)

- Heating-material for drying-drum during production of bitumen-surface-material)

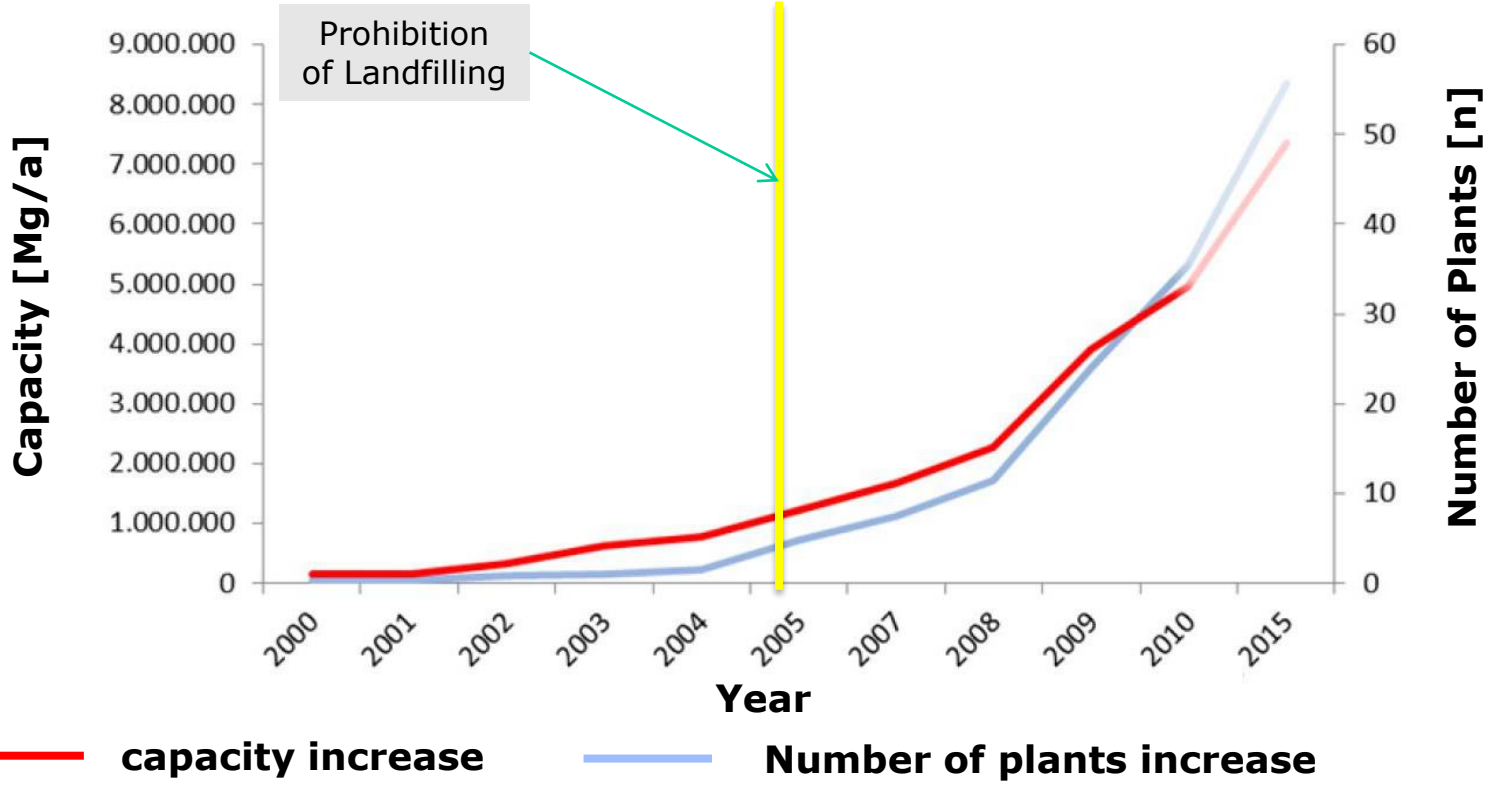
Production of steel:

- Reducing agent in reducing furnace
- Substitution of coke / heavy oil

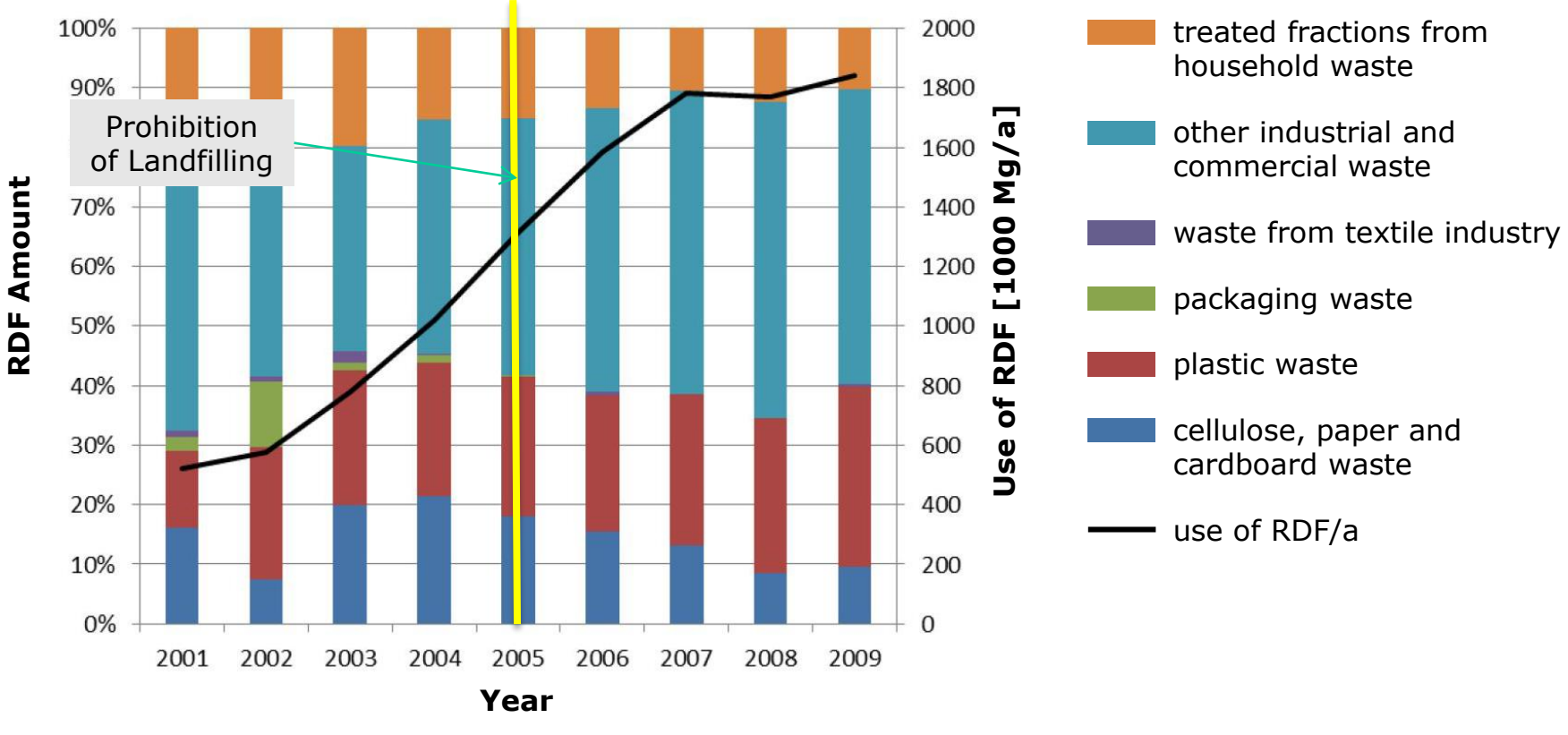
Coal-fired power plants

- Co-combustion with brown/hard coal
- Substitution of fossil fuels

Capacity Development of RDF-fired Power Plants in Germany



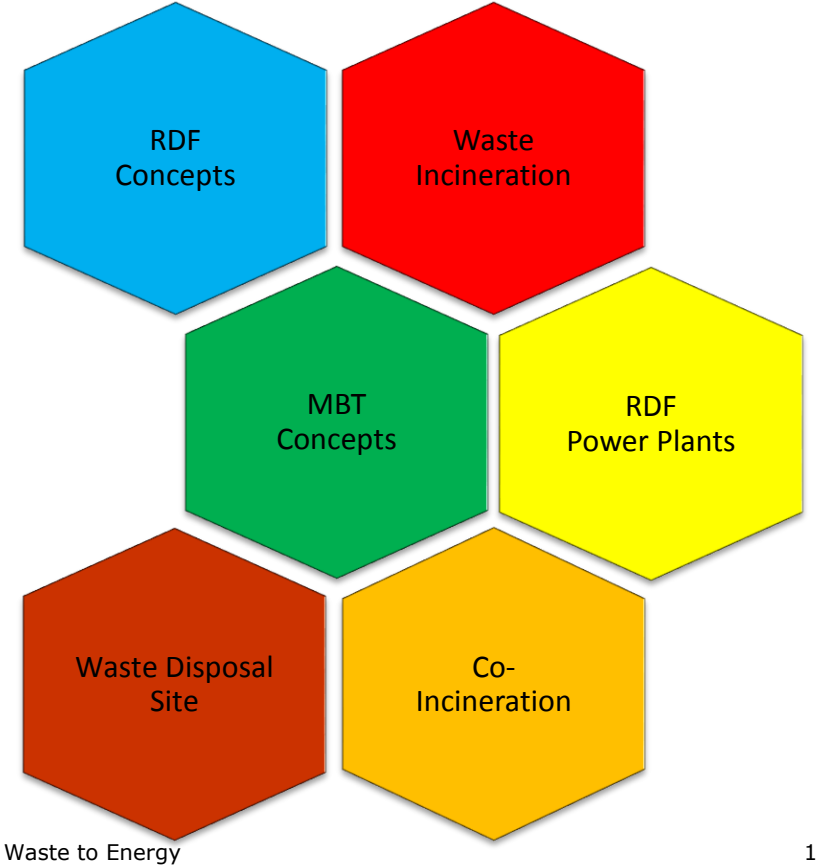
Development of RDF Amounts and Capacities in Cement Industry



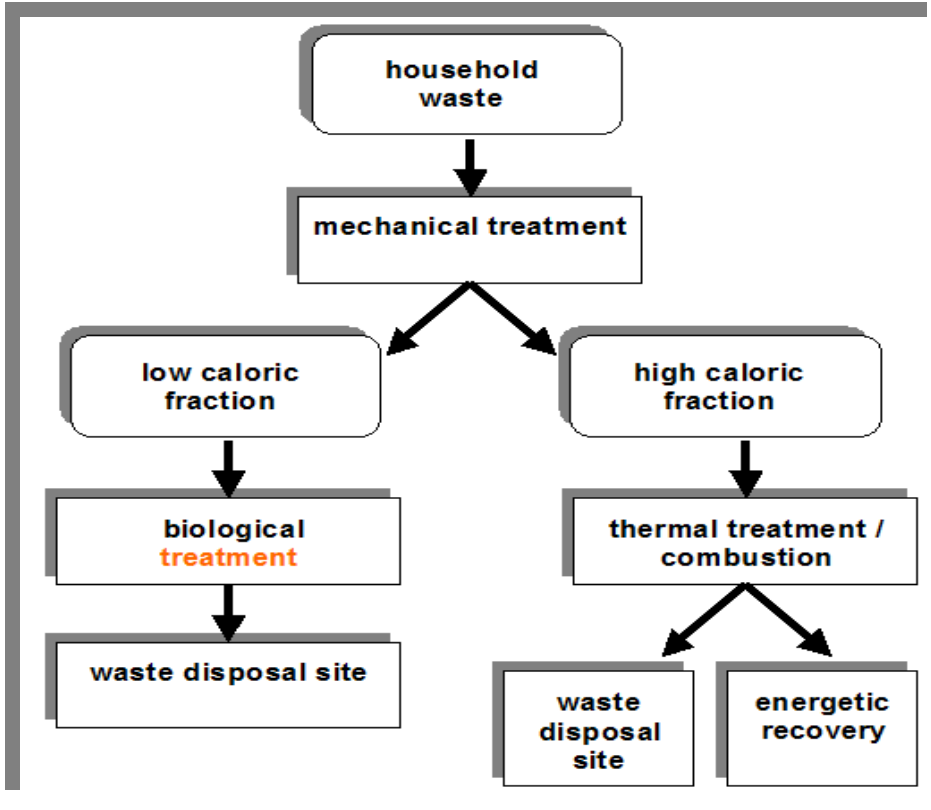
Are Experiences of Germany/Europe Transferable to the International Waste-to-Energy Market?

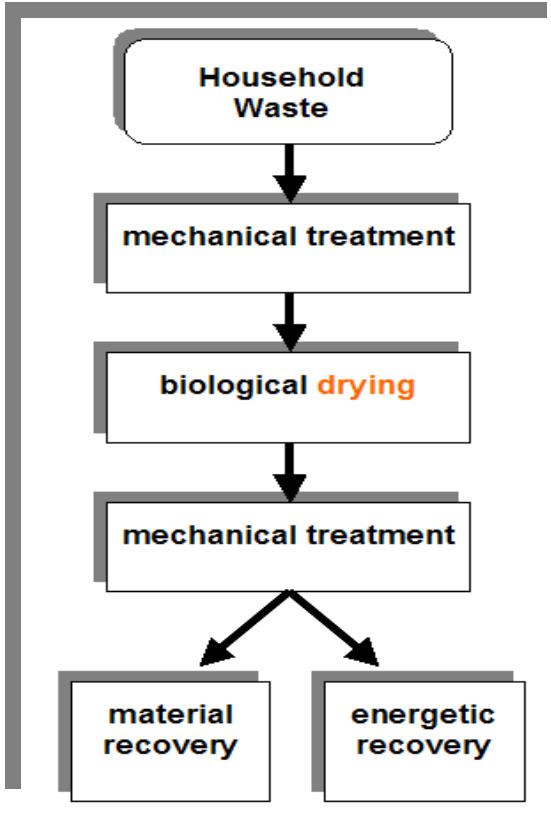
In principle, yes, but…

- Often several (partial) concepts at the same time
- Often combined locations of MBT and RDF power plant
- Increasingly concepts enable the high current revenues



Production of RDF





Combined MBT and Incineration Power Plant



Discontinuous

Calorific Value

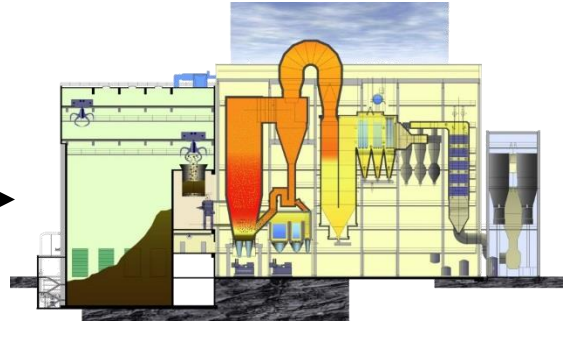






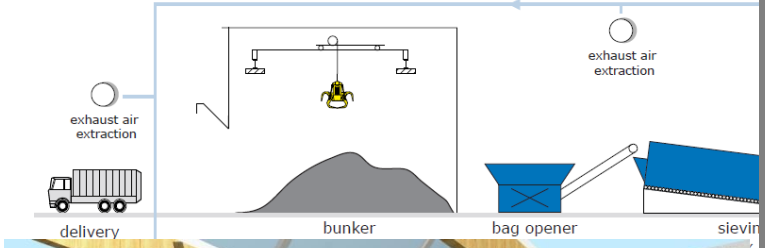
Constant

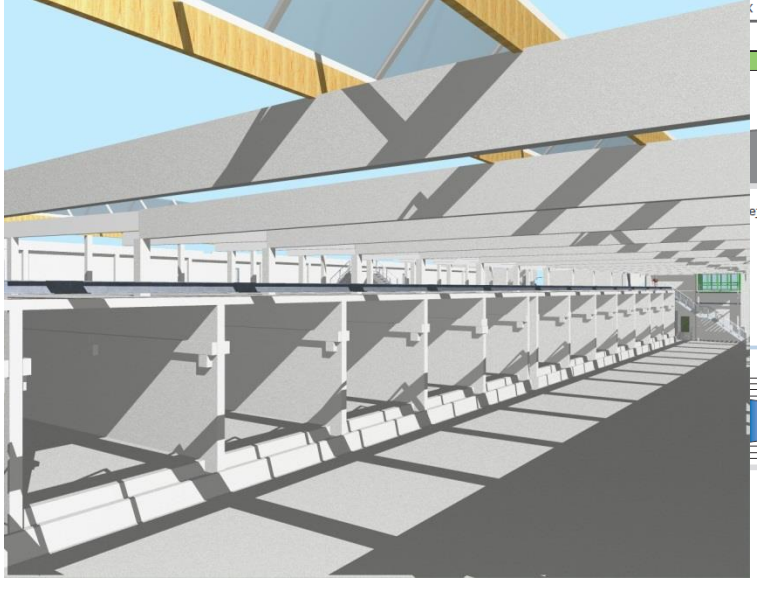
Calorific Value
+
Recycling



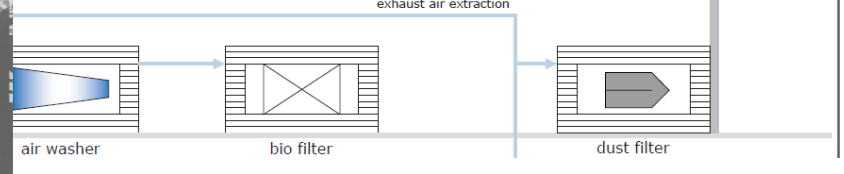
Step 1 biological drying

BUI Technologies Ltd.
Hong Kong





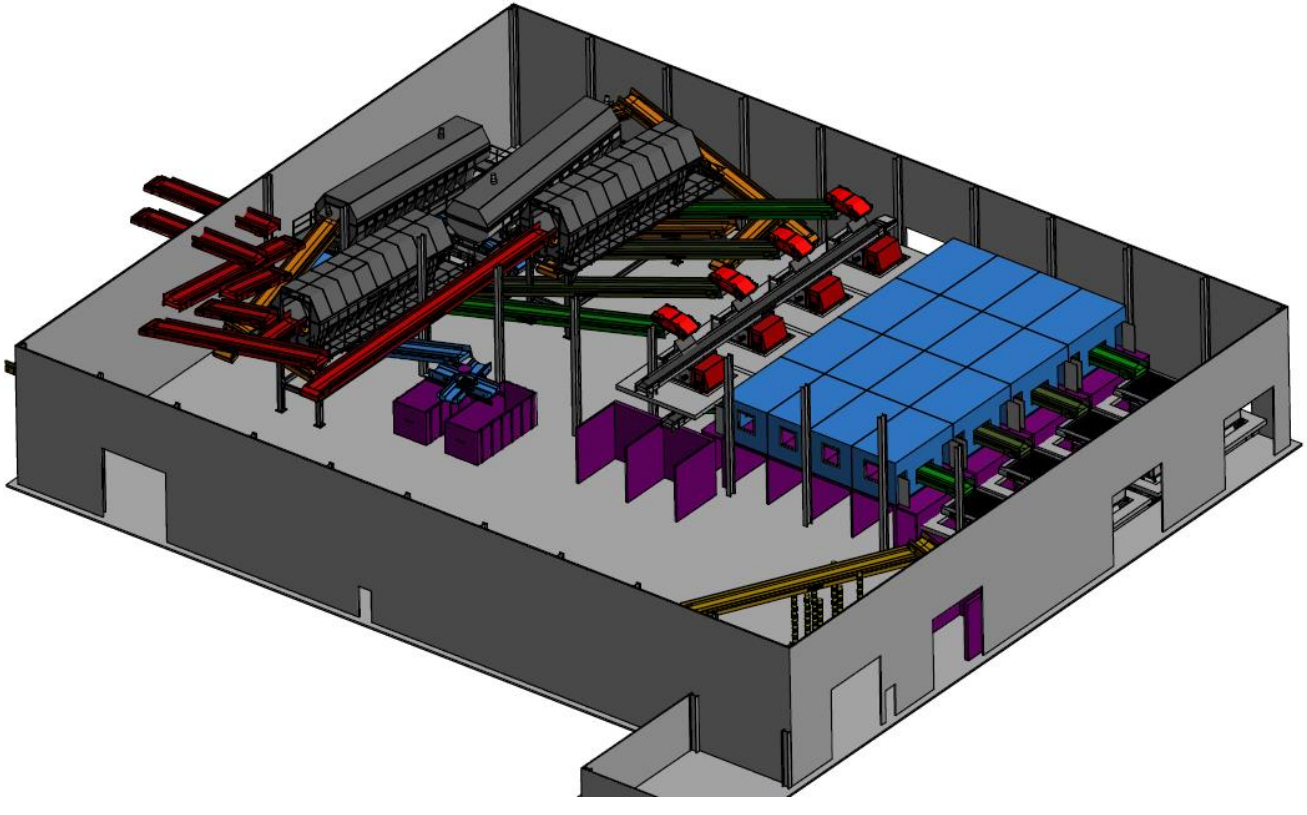


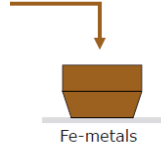


Step 2 mechanical Treatment / Recycling

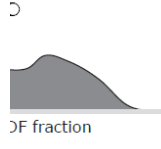
BUI Technologies Ltd.
Hong Kong

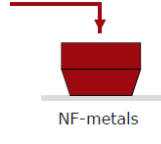




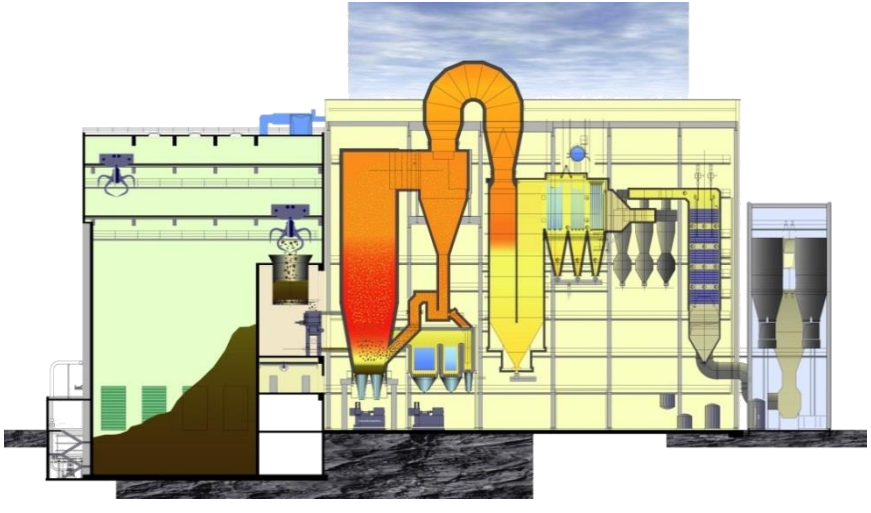








Step 3 RDF-fired Power Plant for the Generation of Steam and Electricity



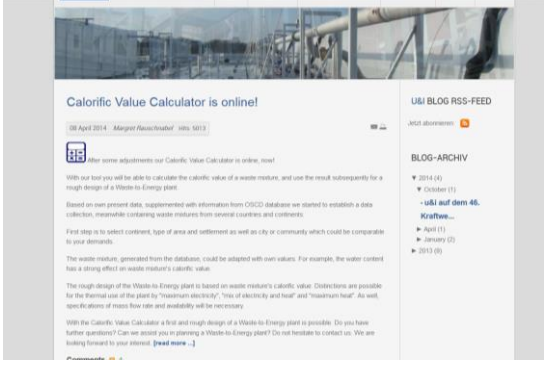


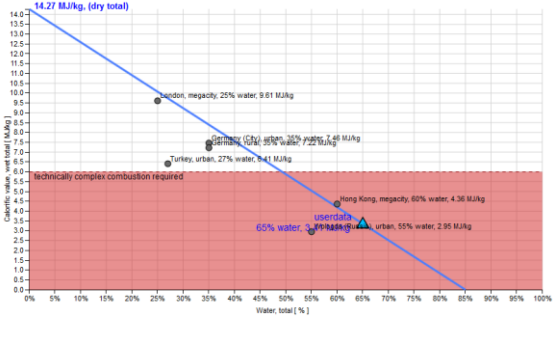
Our Tools for the first step

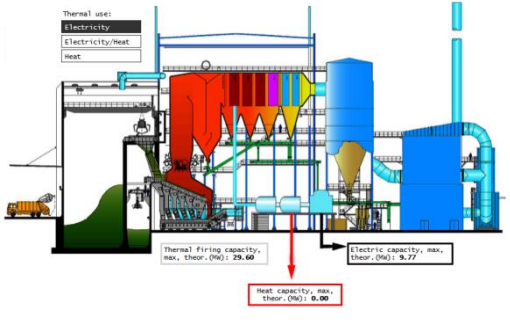
Online-Tools – Calorific Value Calculator

With our tool on http://www.uigmbh.de/cvc.html it is possible to calculate the calorific value of a waste mixture, and use the result subsequently for a rough design of a Waste-to-Energy plant.

- Based on own present data, supplemented with data from OSCD database we started to establish a data collection, meanwhile containing waste mixtures from several countries and continents.
- First step is to select continent, type of area and settlement as well as city or community which could be comparable to your demands OR to use preselected waste mixtures.
- The waste mixture, generated from the database, could be adapted with own values.
- With the Calorific Value Calculator a first and rough design of a Waste-to-Energy plant is possible.

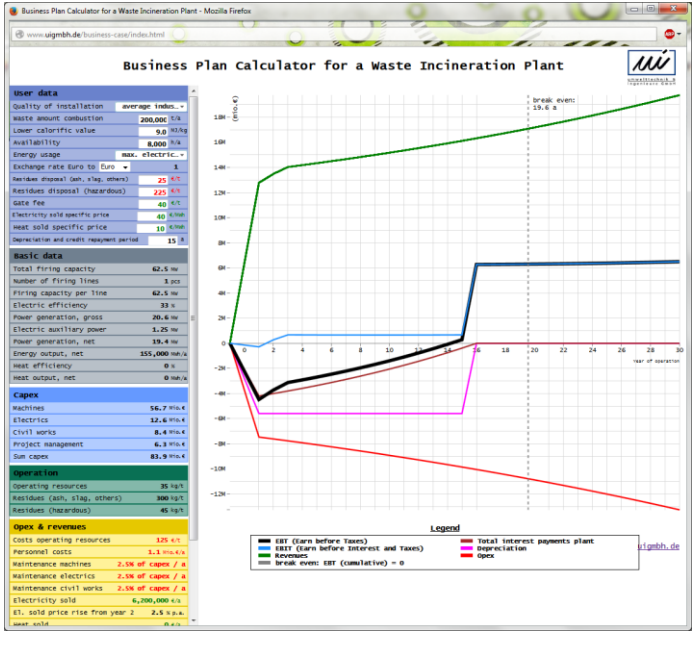






Online-Tools – Business Calculator

- By using the Business Case Calculator it is possible to generate a rough assessment of a business case for a waste-fired incineration or RDF fired Power Plant. With several parameters it is possible to estimate whether a plant will be refunded by the gate fee of the delivered waste or due to high energy rates by using a smaller gate fee.
- The values of the top table are individually adjustable resp. valuable. In the following tables calculated values and other fixed values are only being listed. All assumptions and dependencies used for calculation are based on our experiences.
- Results of the calculation with your data and basis values will be presented in a diagram. It shows course of revenues, OPEX (operational expenditure), depreciation, EBIT (earnings before interest and taxes), total interest payments plant und EBT (earnings before taxes).
- With the Business Case Calculator a rough estimate of the feasibility of a waste incineration plant plant is possible.



More of our References for RDF Power Plants

+

State of the art WTE

Industrial Combined Heat and Power Plant Korbach



Client: MVV Energie AG
Time Period: 2006 - 2011
Invest: approx. 28 m €

Summary/Description:
Installation of a RDF-industrial cogeneration plant in Hesse on the location of **Continental AG (Tyre factory).**

Technical Data:

- Mono-line grate combustion for RDF with a performance of 36 MW_{th} (75,000 t/a)
- Extraction condensation turbine Semi-dry flue-gas cleaning
- 2 * 20 MW_{th} gas-fired standby-boiler

Industrial Combined Heat and Power Plant Korbach





Industrial Combined Heat and Power Plant Korbach







Replacement Investment (ERIN) Combustion Line A at the Ruhleben Site





Replacement Investment (ERIN) Combustion Line A at the Ruhleben Site



Client: BSR Berliner Stadtreinigungsbetriebe
Period: 2010 - 2014

Summary/Description:

- BSR installed a new combustion line for municipal solid waste (MSW) to replace four existing combustion lines at MHKW Ruhleben. The new combustion line A at the site Ruhleben was installed while the existing plant was in operation. The integration in the existing plant took place at different locations during the gradual implementing. Thereby the secure disposal of MSW of the German Federal state of Berlin had to be ensured at any time.
- The commissioned main contractor was Fisia Babcock Environmental GmbH.

Technical Data:

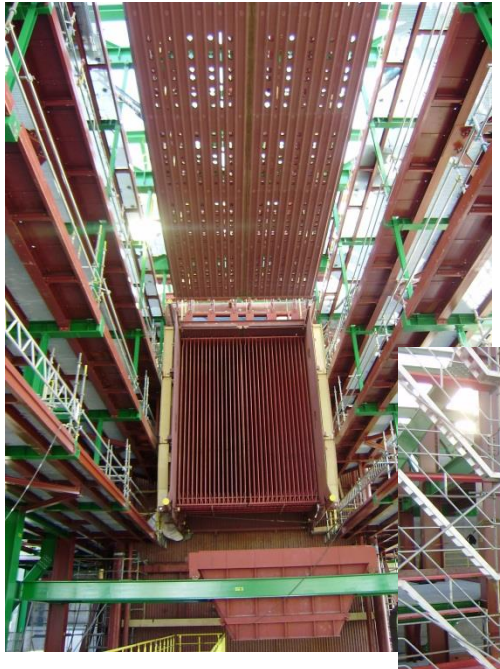
- Thermal output 90 MW
- Caloric value from 6,000 kJ/kg up to 14,000 kJ/kg (dimensioning 9,000 kJ/kg)
- Quasi-dry flue gas cleaning
- Parameters of live steam 68 bar and minimum 460 °C

Replacement Investment (ERIN) Combustion Line A at the Ruhleben Site

Services of u&i:

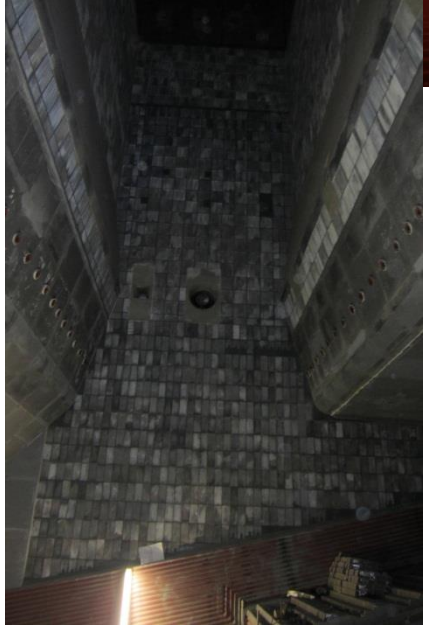
- Quality control in all ranges of performance of the main contractor incl. inspection controls at the producers/manufactures
- Construction supervision and preparation of construction process and progress documentation
- Assistance during the final inspection of the assembly, supervision of cold/hot commissioning and test runs including preparation of the final inspection of assembly at the side of the building owner, implementing and test runs
- Control of interfaces of e.g. interfaces with the existing plant, coordination of these services
- Record and monitoring of guarantee/liability for defects
- Coordination and support of the implementation activities in the fields of process engineering and electrical engineering and process control at the side of the building owner
- Progress control
- Invoice verification
- Verification of supplements and claim-management

Replacement Investment (ERIN) Combustion Line A at the Ruhleben Site









RDF Power Plant "ETN Heringen"

Client: E.ON Engineering GmbH/E.ON Energy from Waste Heringen GmbH
Period: 2007 to 2011
Investment: approx. 132 m €

General description:
Construction of a two-line incineration plant for RDF to supply an industrial area
with a second external superheating system to increase steam parameters

RDF Power Plant for Industrial Supply

BUI Technologies Ltd.
Hong Kong





Renewable Energy Projects

Biogas Park (anaerobic digestion) Grossenlueder

Client: Biothan GmbH
Period: 10/2010 - 02/2014

Description:

Biothan GmbH, a subsidiary of GWV Fulda, GWV Osthessen and the city of Fulda, has erected a high innovative plant for the production of bio natural gas at Finkenberg.

The facility includes two plants on one site.
First one is a wet fermentation for biogenic residues (organic wastes and slurry) and the second one is a dry fermentation plant for separate collected household waste.

The produced biogas will be upgraded and fed into the gas grid in natural gas quality.

Hereby valuable regenerative energy is produced from waste.

Biogas Park (anaerobic digestion)





Biogas Park (anaerobic digestion) Grossenlueder





Biogas Park (anaerobic digestion) Grossenlueder







Bio-Mechanical Treatment and Dry Fermentation Plant







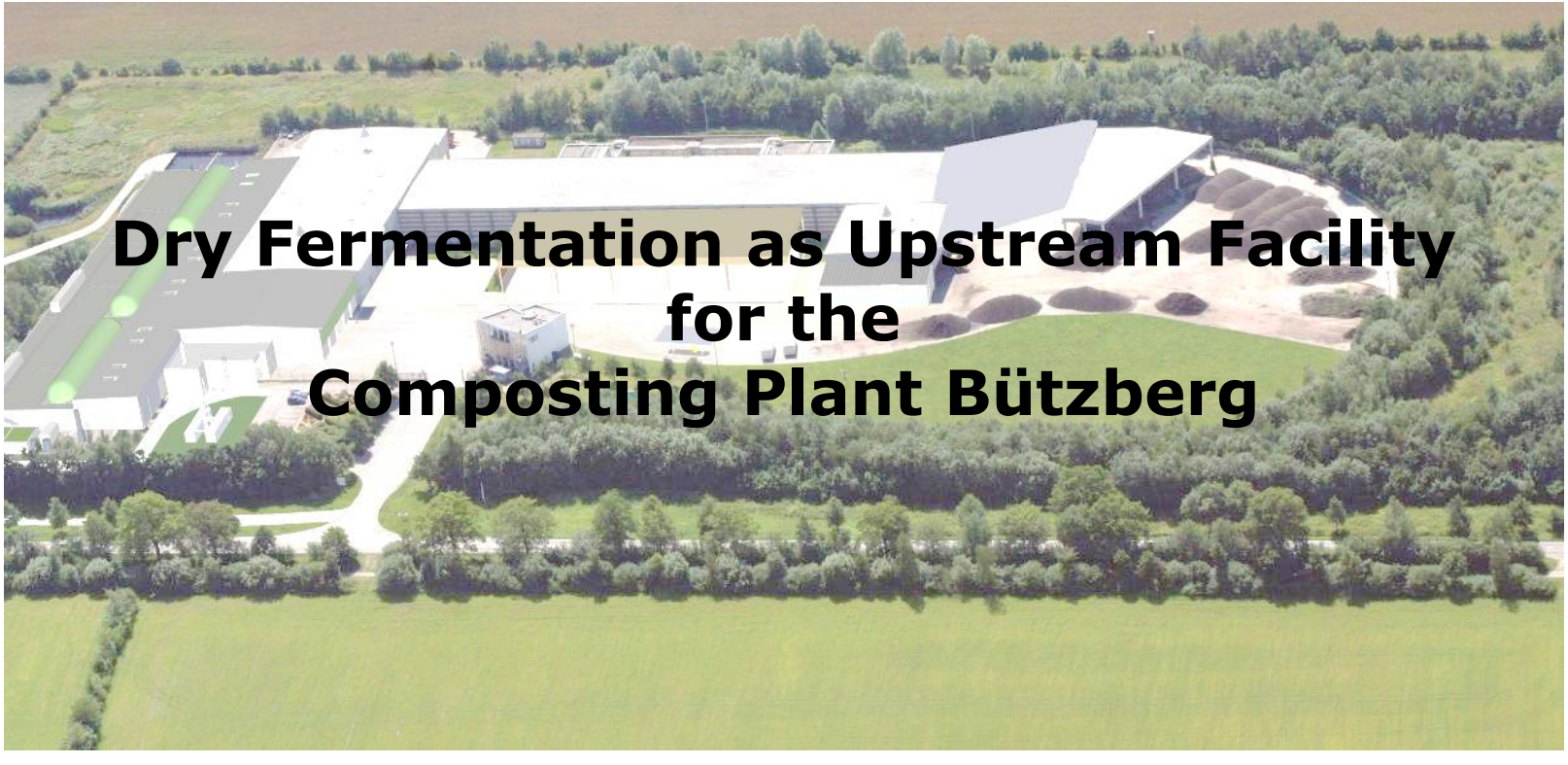
Bio-Mechanical Treatment and Dry Fermentation Plant

BUI Technologies Ltd.
Hong Kong









Dry Fermentation as Upstream Facility for the Composting Plant Bützberg

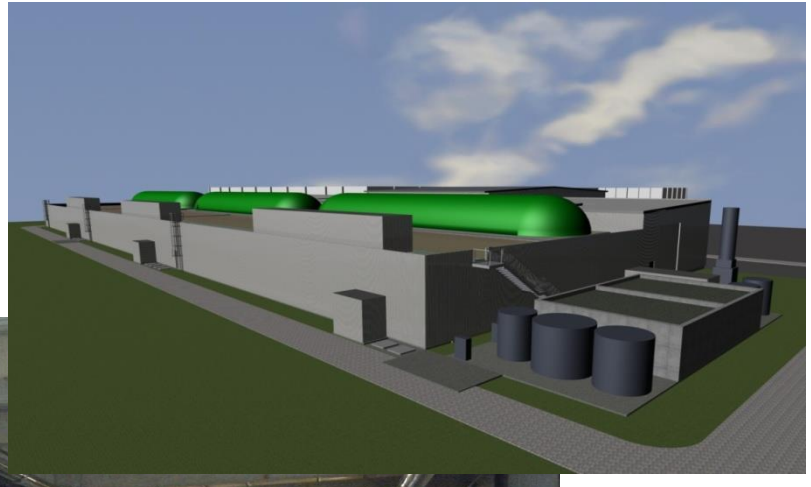
Dry Fermentation as Upstream Facility

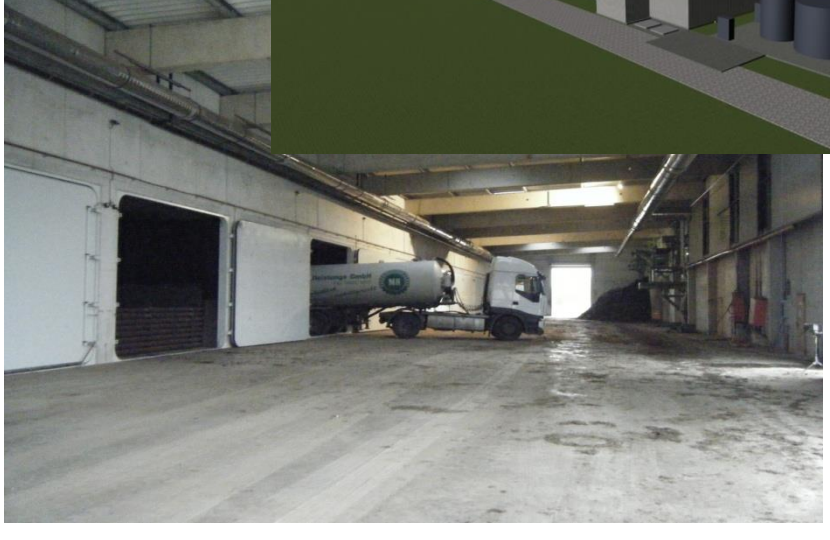
BUI Technologies Ltd.
Hong Kong





Dry Fermentation as Upstream Facility





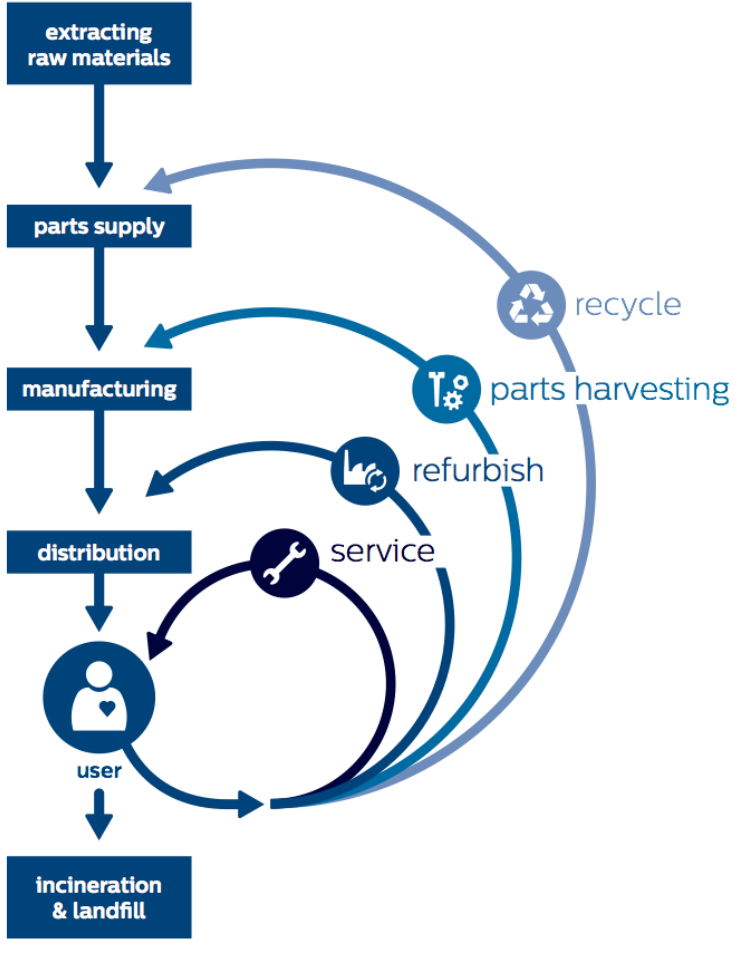


Dry Fermentation as Upstream Facility

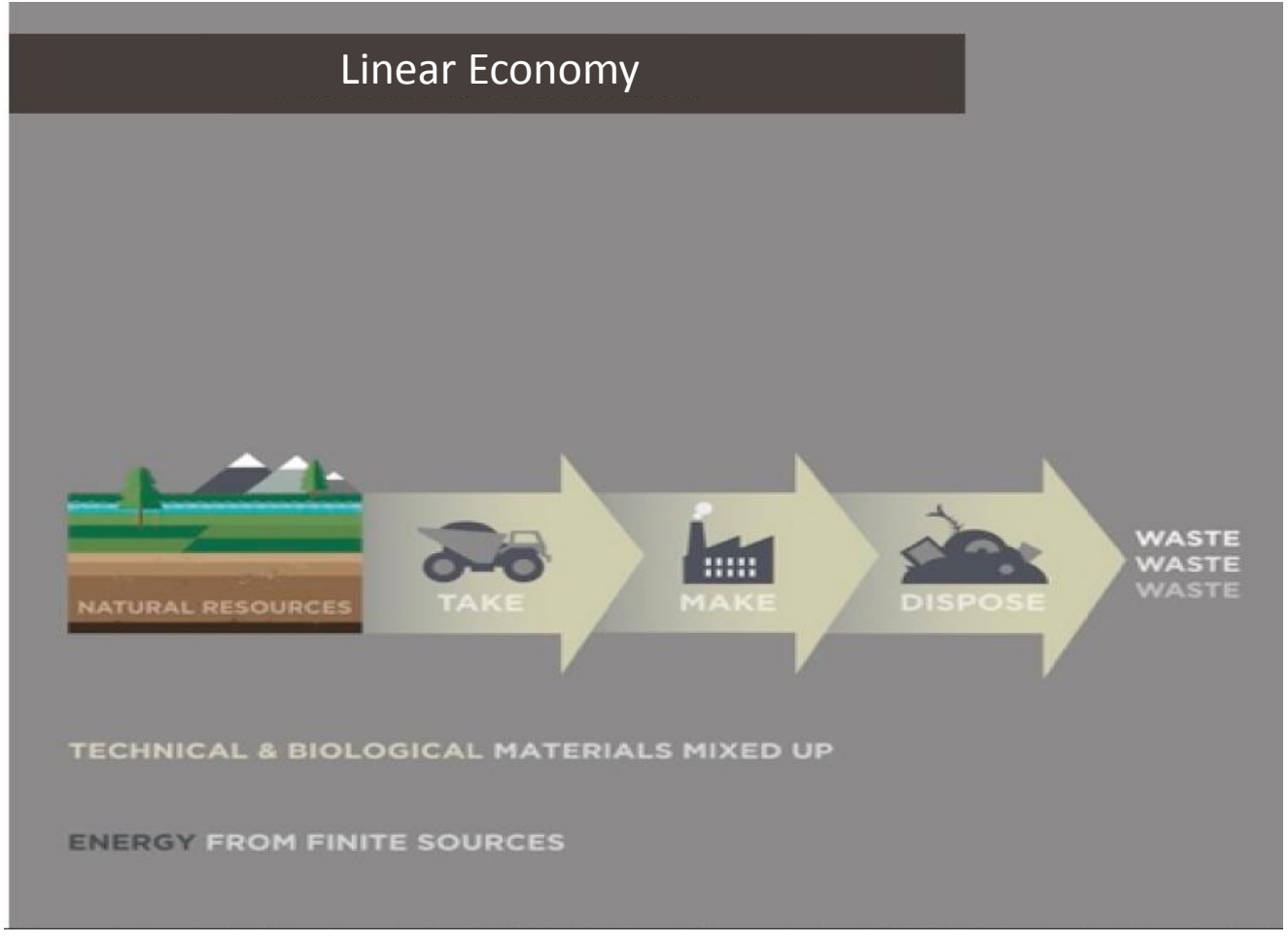




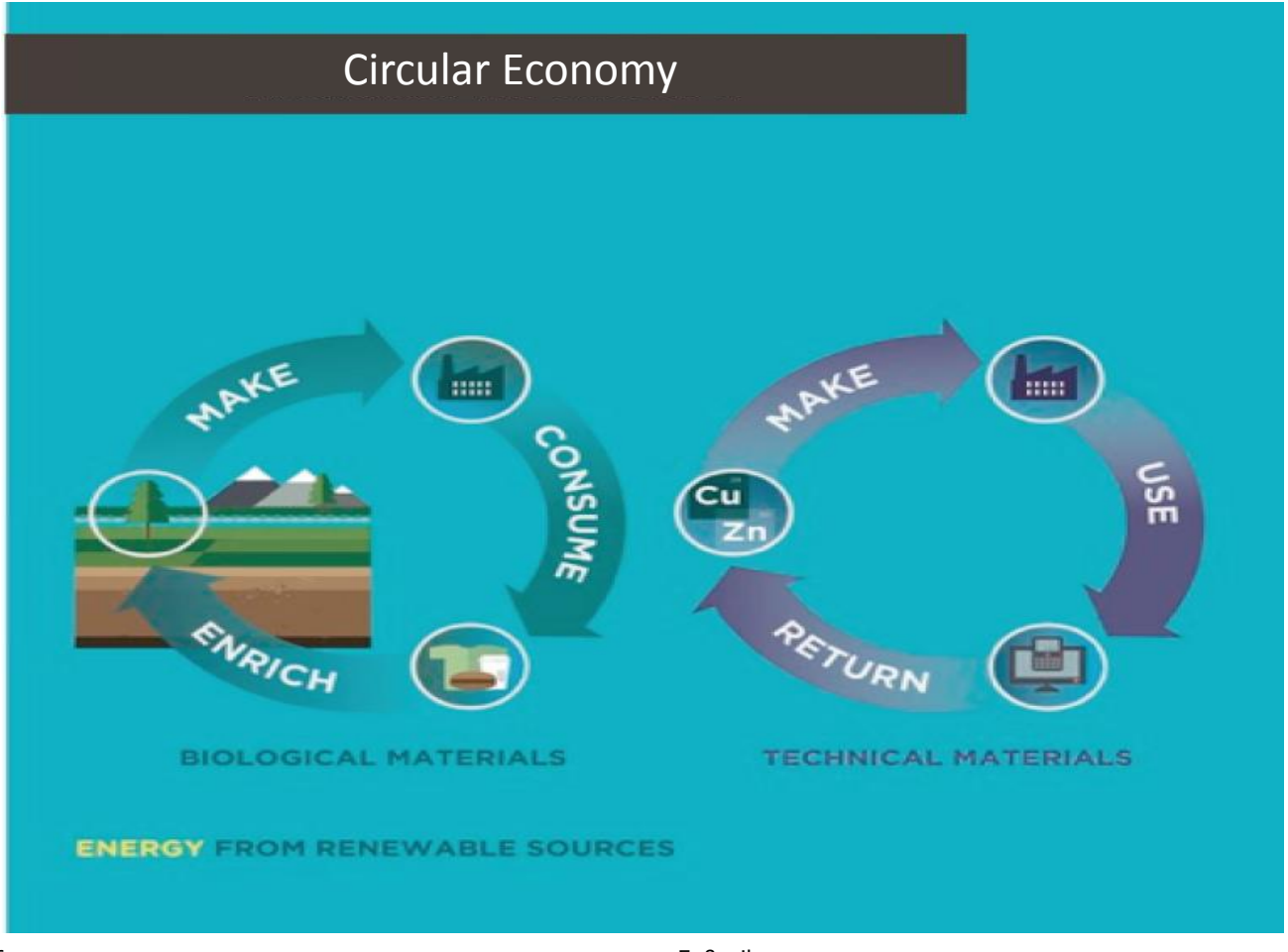
Switching from Linear Economy to Circular Economy a "Mission Impossible" Program for Hong Kong ?



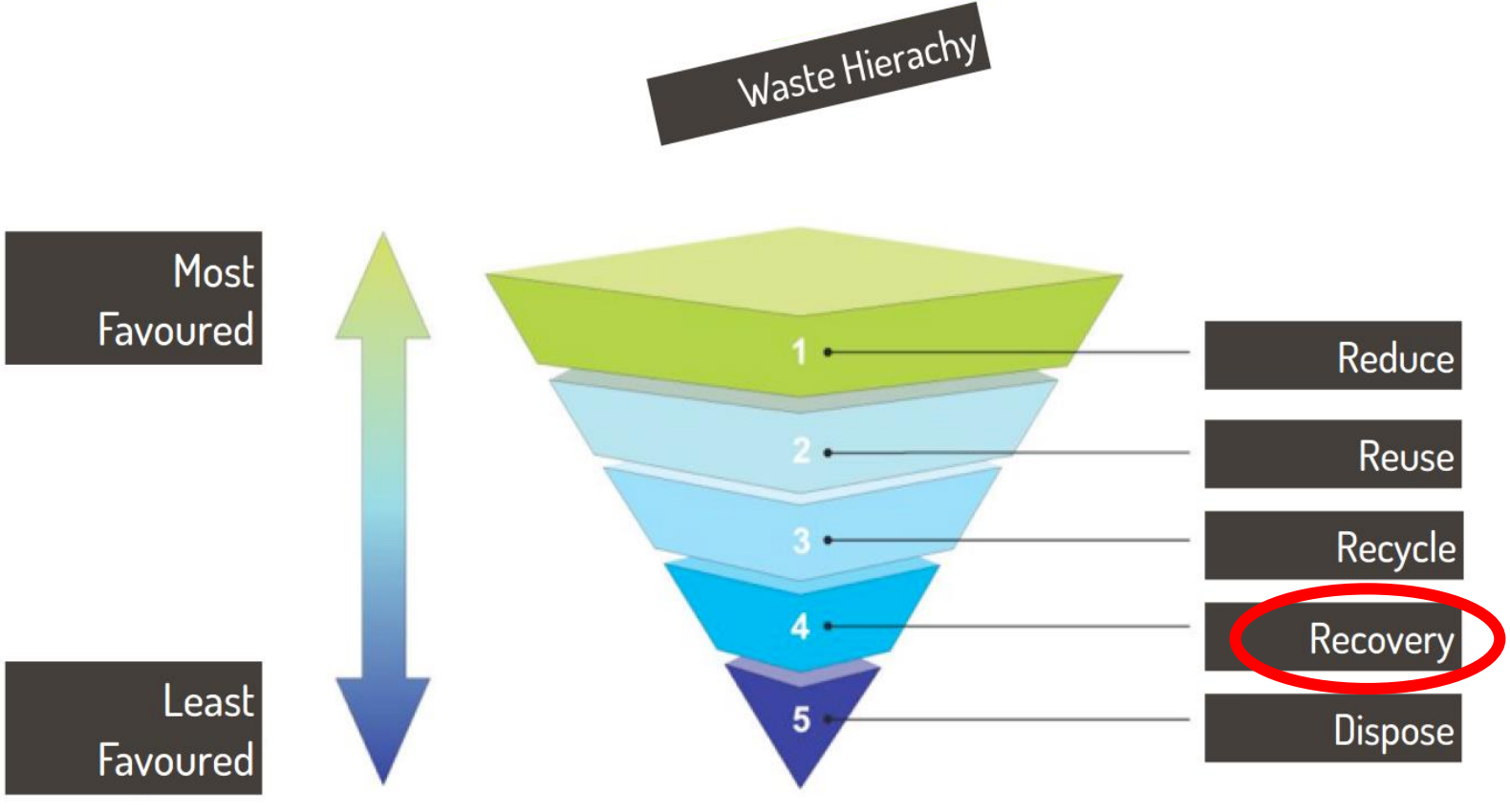
Linear Economy



Circular Economy

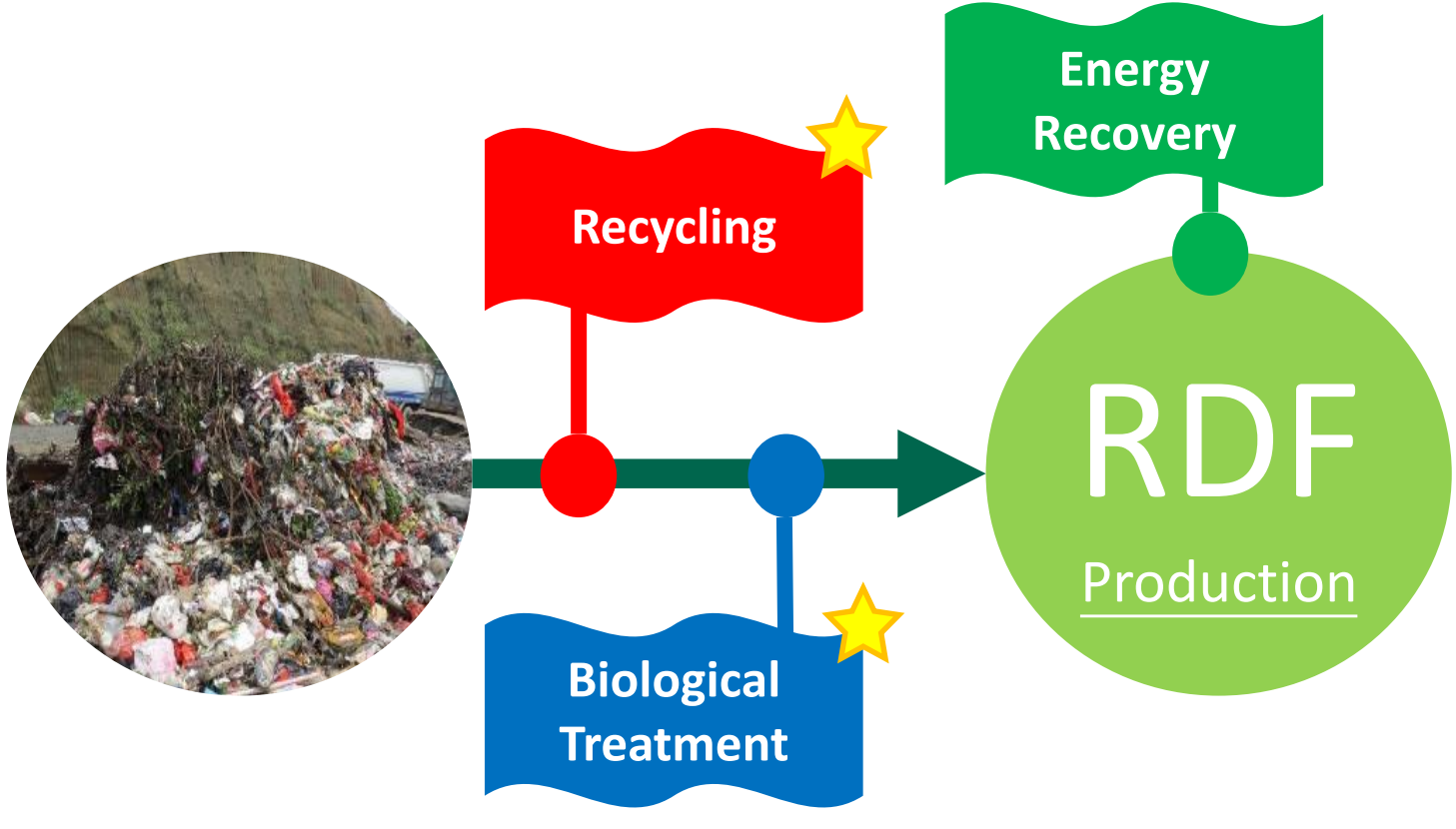


Waste Hierachy today



RDF process is part of a circular economy

BUI Technologies Ltd.
Hong Kong



The Business Case behind RDF

BUI Technologies Ltd.
Hong Kong

Energy Recovery

RDF Production

- **Solid Fuel**
- **Renewable Energy**
- **Uniform calorific value** (approximately 2/3 of coal)
- **Flexible for transportation and storage**
- Able to **combust individually or co-combust** with coal for electricity generation

** the content or factors of RDF are depended on the waste composition.*

TABLE 5
COMPARISON OF RDF vs. COAL

Fuel/Factor	Coal	RDF
Calorific Value (Kcal/Kg)	4000	3500-3700
Equivalent Ton in calorific value	1	1.14
Cost per Ton in Rs.	6000	2000
Sulphur content (weight %)	0.4	0.2-0.5
Moisture content (weight %)	39	10
Ash content (weight %)	4.2	<15
Nox content (weight %)	1.2	1-1.5
Carbon (weight %)	31.4	35-40
Oxygen (weight %)	7.4	25-30
Hydrogen (weight %)	4.3	5-8

TABLE 7
COMPARISON OF RDF vs. FURNACE OIL

Fuel/Factor	Furnace oil	RDF
Calorific Value (Kcal/Kg)	10000	3500-3700
Equivalent Ton in calorific value	1	1.14
Cost per Ton in Rs.	44000	2000
Sulphur content (weight %)	4.0	0.2-0.5
Moisture content (weight %)	1.0	10
Ash content (weight %)	0.1	<15
Nox content (weight %)	0.1	1-1.5
Carbon (weight %)	8-30	35-40
Oxygen (weight %)	5-20	25-30
Hydrogen (weight %)	0.1	5-8

T. Ganesh; P. Vignesh; G. Arun Kumar β. (2013). *Refuse Derived Fuel To Electricity*. IJERT. Vol. 2 Issue 9.

Benefits of RDF as New Energy

RDF can contribute to the upcoming New/Clear Energy Demand:

- ✓ Replace partly fossil fuels (Co-firing)
- ✓ Electricity Generation
- ✓ Lesser pollution (compare with coal)

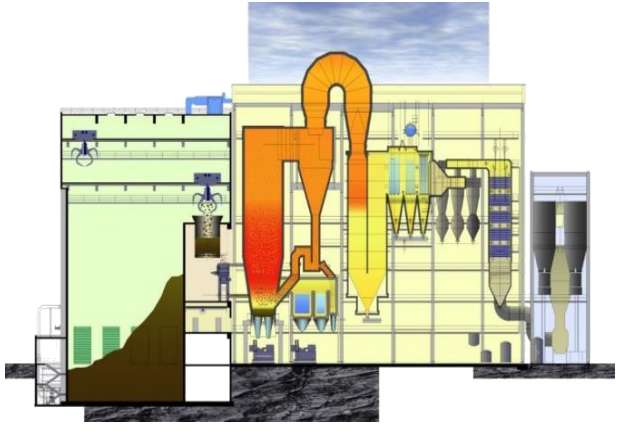
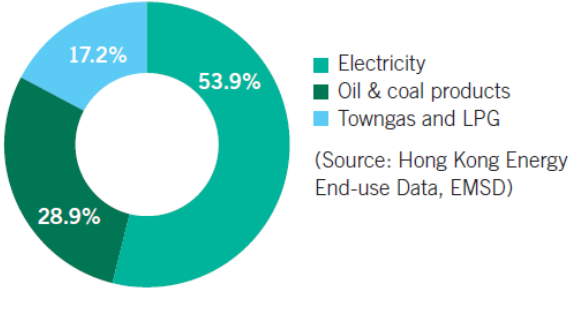


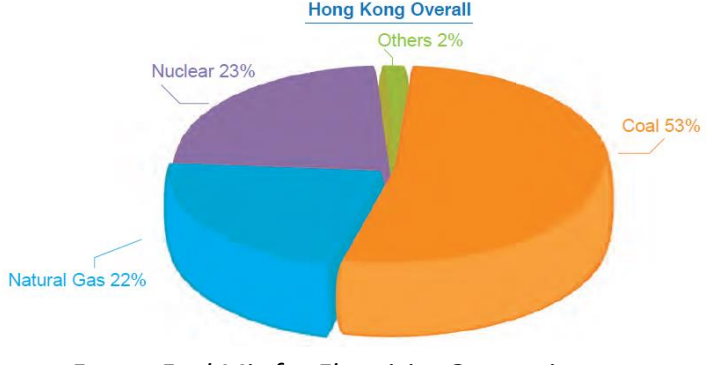
Figure 1 Hong Kong's energy end-use distribution by fuel type, 2012



(Source: Hong Kong Energy End-use Data, EMSD)

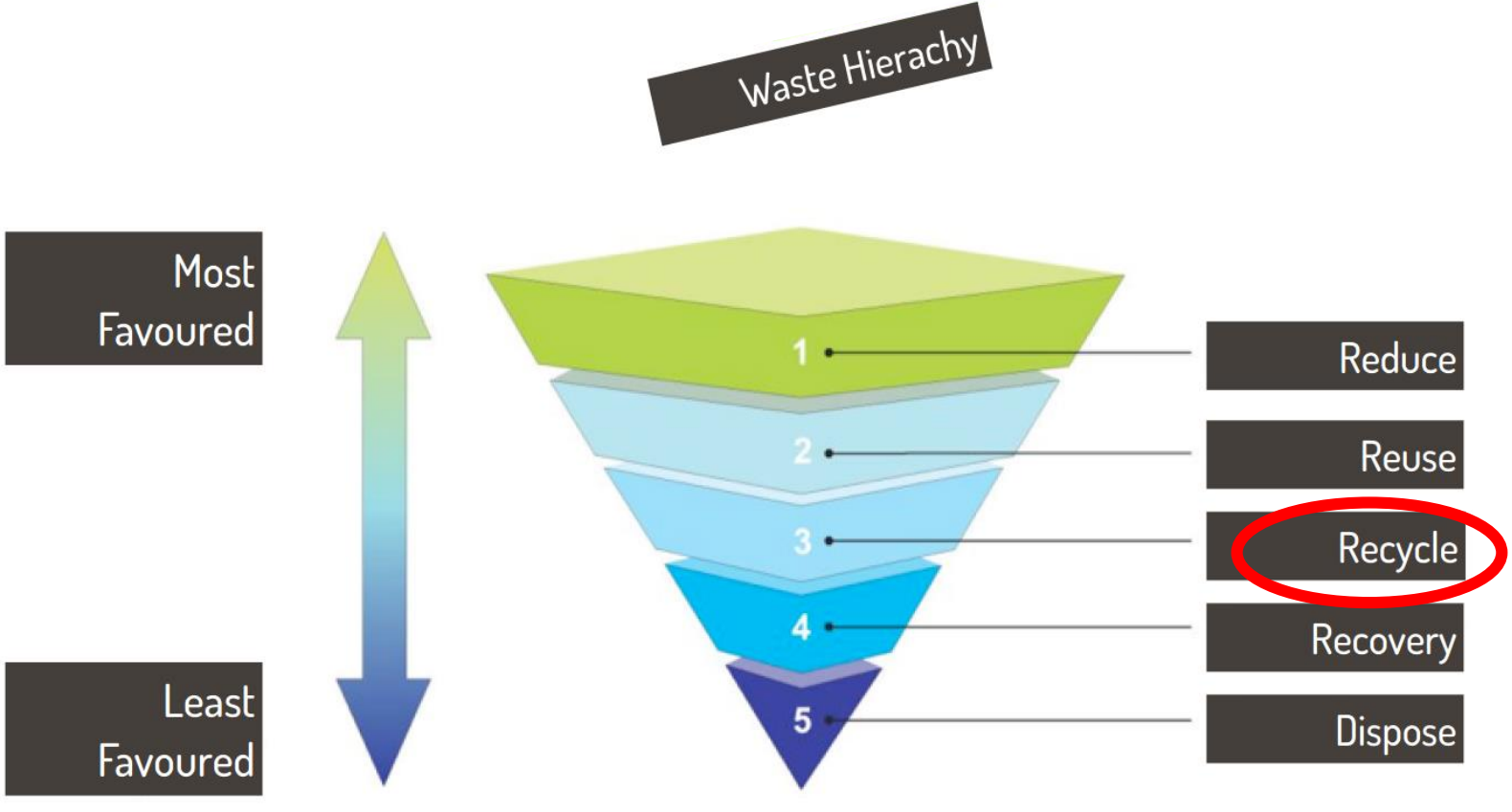
Energy Saving Plan For Hong Kong's Built Environment 2015~2025+, Environment Bureau

Figure 6 : Fuel mix of Hong Kong in 2012



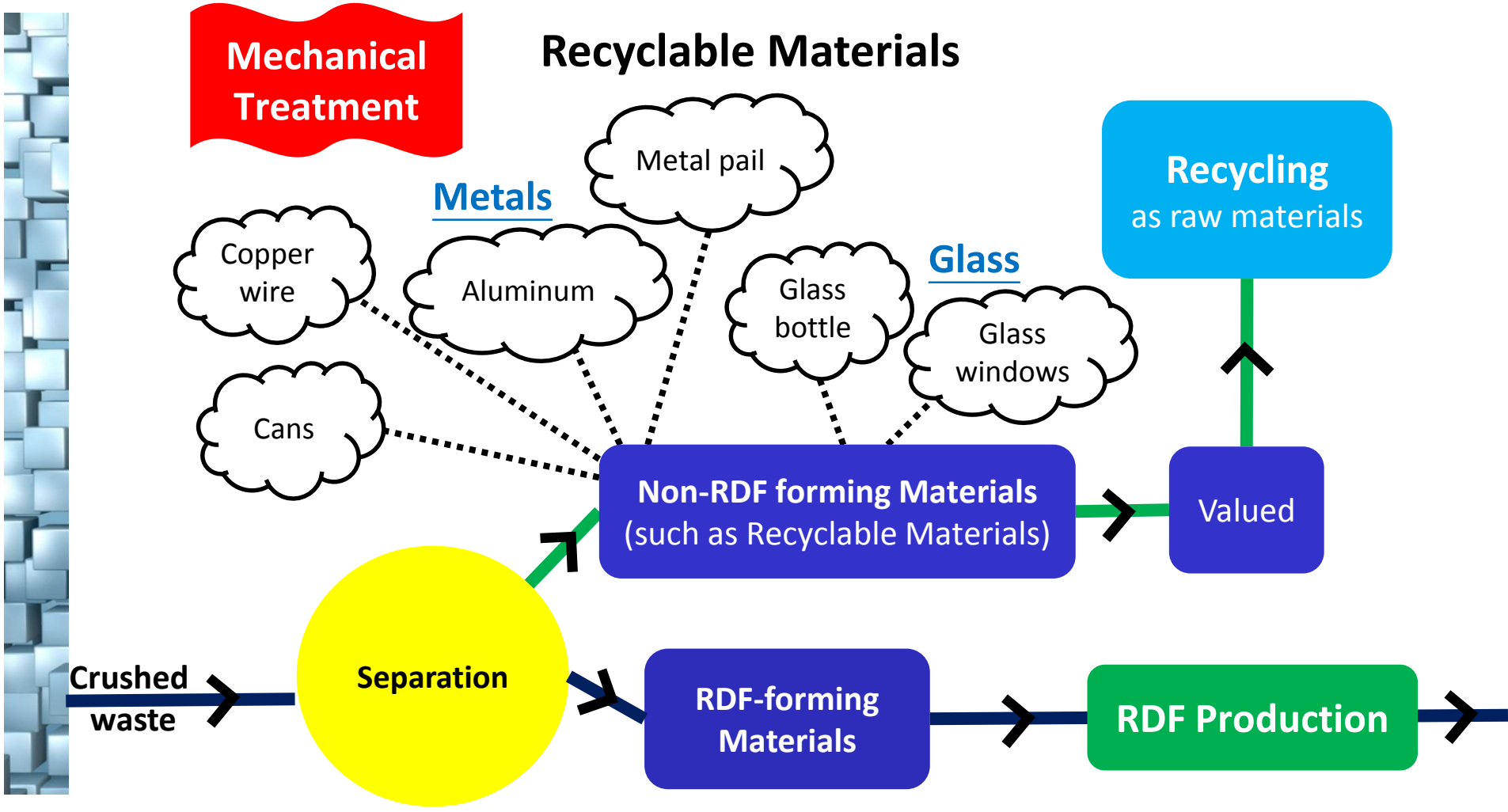
Future Fuel Mix for Electricity Generation Consultation Document, Environment Bureau

Waste Hierachy today



Separation of Raw Materials during RDF Processing

BUI Technologies Ltd.
Hong Kong

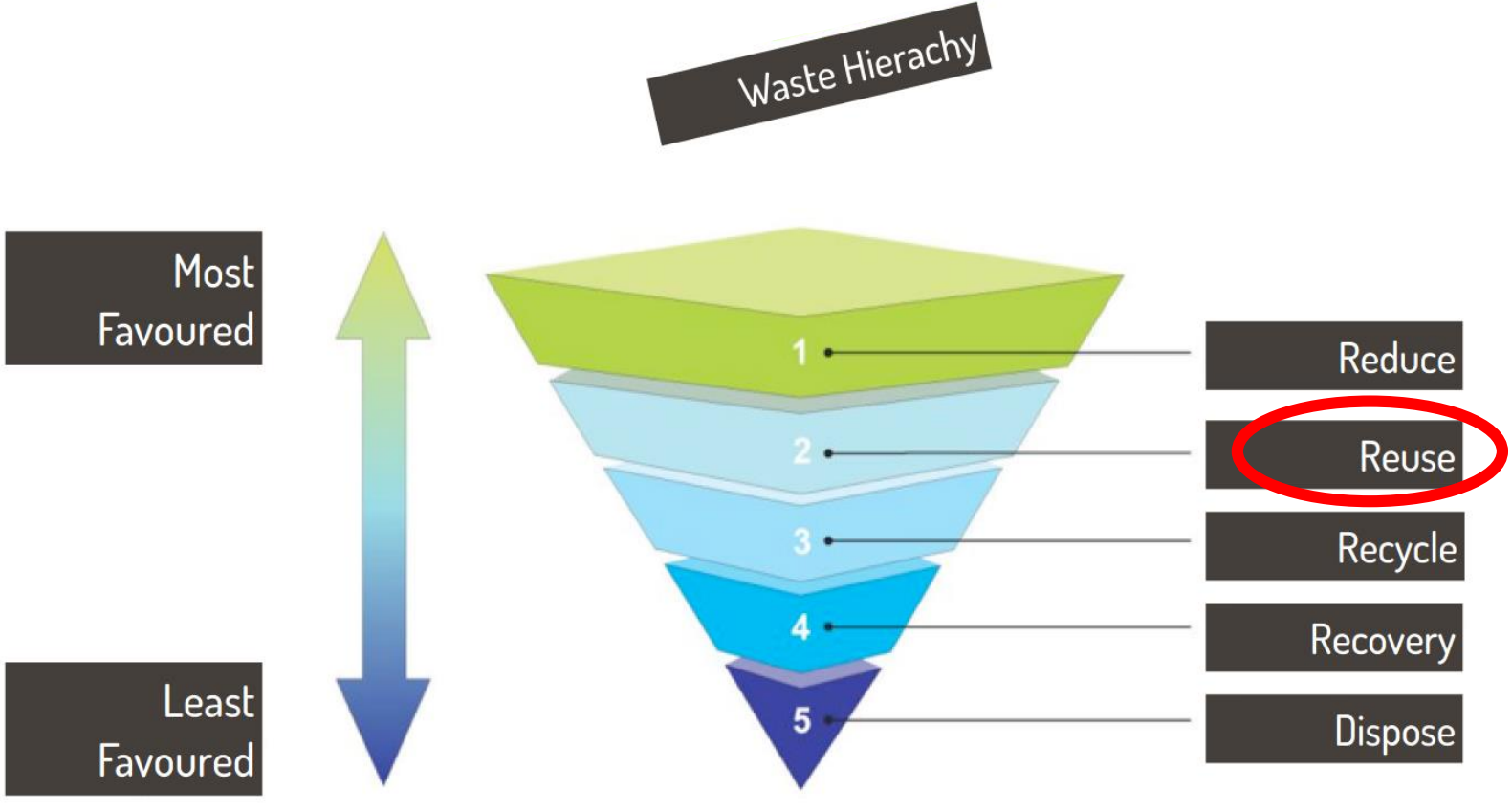


Eco Bricks from Recycled Glass Bottles and Construction & Demolitioin Wastes

BUI Technologies Ltd.
Hong Kong



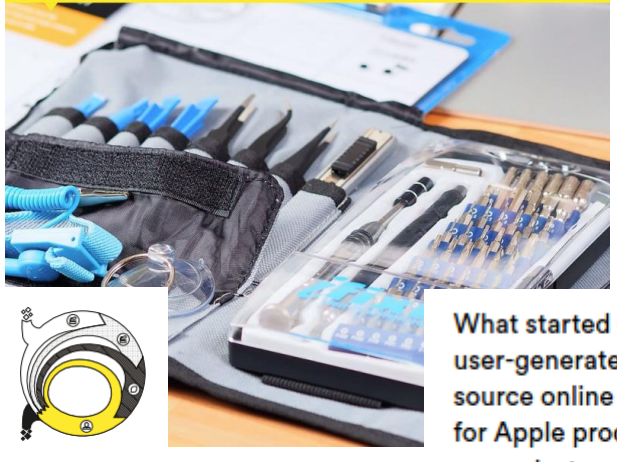
Waste Hierachy today



Business Models for Circular Economy

ifixit Repair Manuals

Design for Longevity



What started out as a user-generated, open-source online community for Apple product repair manuals, turned into a million-dollar business for repair kits, product testing and most recently a new company called "Dozuki" which offers a repair documentation software to OEMs like Bosch or Samsung, and of course Apple.

reBuy GmbH

Design for Reuse



reBuy Berlin started with selling second-hand video games and CDs and turned into a German Amazon for used goods of many kinds with more than € 40 million in sales and 400 employees.
Its mobile app service to scan ISBN codes for books that can be immediately cashed in turned out to be a cash-cow for the company.

Business Models for Circular Economy

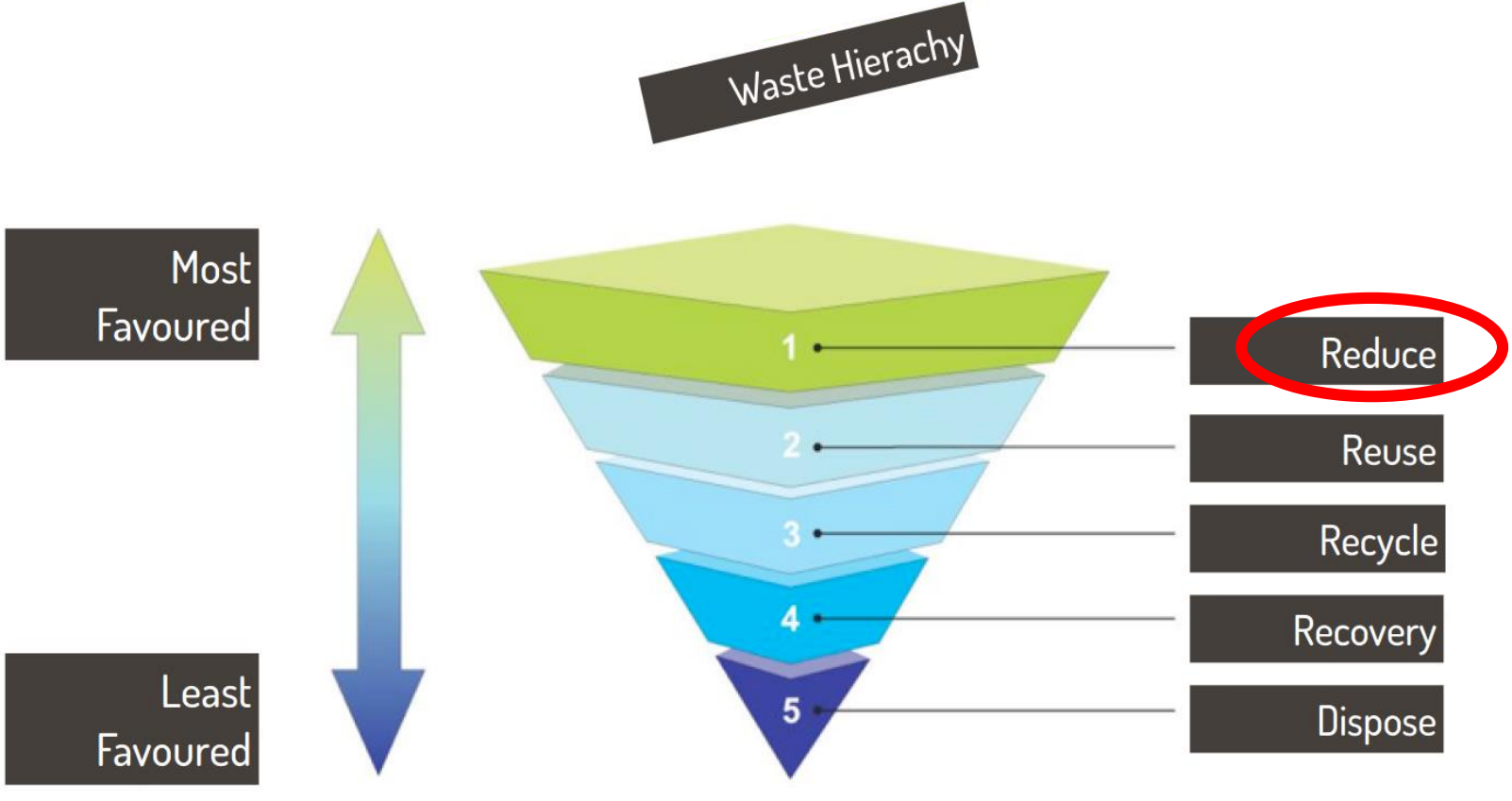


Binee is an intelligent collecting bin for return of small electronic devices. The system compares dropped devices with a growing data base of pictures and identifies kind and brand of the device. Producer gets the possibility to know where and which products were being disposed

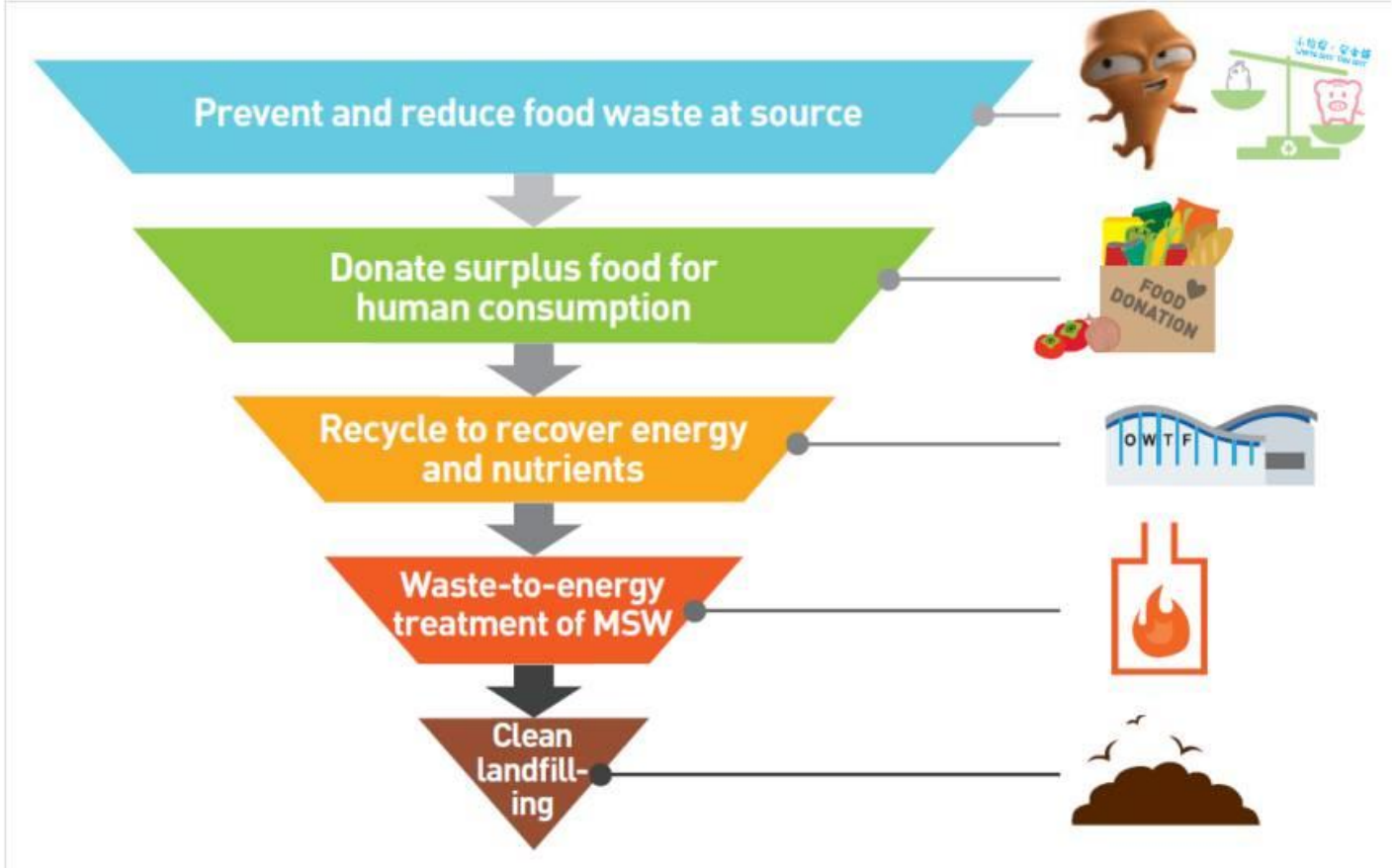


EcoATM is a return system for mobile phones. The machine analyses technical data of the phone via USB-port, evaluates outside conditions via optical sensors and verifies all collected data with actual second-hand market values. The user gets an offer immediately

Waste Hierachy today



Business Models for Circular Economy



Executive Summary:
The Application of RDF in Circular Economy

- It can be seen that Circular Economy is being implemented in Hong Kong in different levels.
- As of today, RDF is one of the areas in Circular Economy that Hong Kong could consider to depoly for advantages discussed above.
- In the areas of Reduce and Reuse, the whole Hong Kong Community is capable to generate more innovative ideas and business models aiming to achieve Circular Economy and at the same time, to generate Economic Growth for Hong Kong.



For further information and support, please contact us.

BUI Technologies Ltd.
Unit G, 7/F., Century Centre
No. 33-35 Au Pui Wan Street, Fo tan, Shatin
N.T. Hong Kong
Tel: +852 2511 0838
Email: bui-technologies@billiongroup.com
www.bui-technologies.com