



A future vision for sustainable packaging – Problems, challenges and solutions

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LOW CARBON, ENERGY & ENVIRONMENT
RESEARCH NETWORK WALES RHWYDWAITH YMCHWIL
CARBON ISEL, YNNI A'R AMGYLCHEDD CYMRU

Single Use Plastic, “what about it?”
Low Carbon Energy and Environment
Research Network
Cardiff 18 October 2018

Limited 2018



SUSTAINABLE SOLUTIONS
FOR POLYMER & RECYCLING

NEXTEK Ltd - What we do

- Recycling plant design and Feasibility studies
- Strategic advice to Multi-National Corporations and Recycling Co's
- Food grade recycling of post consumer plastics – process development
- Research and development of novel materials and processes including plastics and bioplastics
- Business support, productivity improvement and problem solving
- Ground breaking projects for governments and major commercial organisations in the EU, UK, India, Malaysia, USA, South America, Middle East, North Africa and Australia/NZ
- Strong ties to Universities and Scientific Centres of Excellence in the UK and Europe

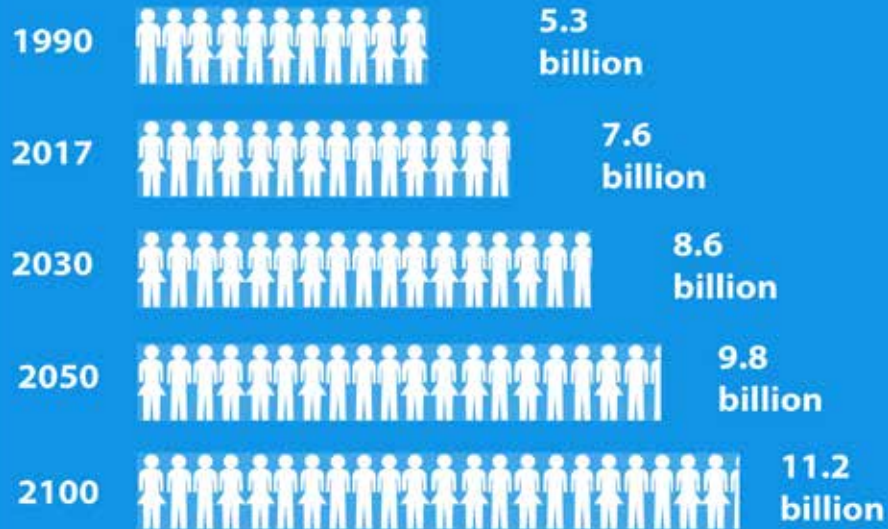
nextek recent awards



Global Population Growth and World hunger trends

World Population

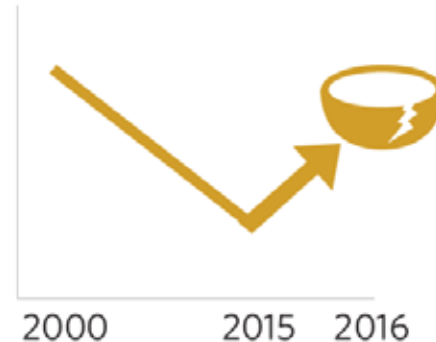
Projected world population until 2100



Source: United Nations Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2017 Revision*
Produced by: United Nations Department of Public Information



World hunger is on the rise again:
815 million people were undernourished
in 2016, up from 777 million in 2015



Ref. UN DESA 2017

Global Food waste

- Roughly one third of the food produced, approx 1.3 billion tonnes gets lost or wasted.
- Food losses and waste amounts to US\$680 billion in industrialized countries and US\$ 310 billion in developing countries.
- Global food losses and waste per year are 30% for cereals, 40-50% for root crops, fruits and vegetables, 20% for oil seeds, meat and dairy plus 35% for fish.
- Consumers in rich countries waste almost as much food (222 million tonnes) as the entire net food production of sub-Saharan Africa (230 million tonnes).
- Europe and North America waste between 95-115 kg/head/yr,
- Sub-Saharan Africa, South and SE Asia, each throw away only 6-11 kg a year.



Even if just 1/4 of the food currently lost or wasted globally could be saved, it would be enough to feed 870 million hungry people in the world.

Expansion of the food and packaging industry could help to reduce the amount of food loss and waste.

18 % of the country's fruit and vegetables produce, worth Rs.133 billion goes to waste



**India loses
40% of food
post harvest**

**Food Wastage Costs
India ₹1 Lakh Crore
(£11 billion) every
Year**

25% of fresh water
used to produce food is
ultimately wasted,
45% of India's land is
degraded primarily due
to deforestation.

300 million barrels of
oil are used to produce
food that is ultimately
wasted

Plastics Packaging for Fresh Food

- **Packaging for Fresh Food** fulfils many functions
- **reduce wastage** by portion control
- **improving the storage stability and shelf life** of food during transit between the producer and the urban consumer,
- **reduce the level of adulteration** via sealable and tamper-evident features,
- **reduce urban solid waste** from spoilt food going to landfill
- **Improve health** and well being of the population by improved retention of nutritional quality and reducing risk of spoilage in fruit and vegetables.
- Packaging needs to be correctly formulated to prevent moisture loss, reduce oxidation, reduce microbiological spoilage, and improve storage-life performance along with enhanced environmental characteristics.



Worlds Plastic Production and Distribution - 50% in Asia

Includes plastic materials (thermoplastics and polyurethanes) and other plastics (thermosets, adhesives, coatings and sealants). Does not include: PET fibers, PA fibers, PP fibers and polyacryls-fibers.

Source: PlasticsEurope (PEMRG) / Conversio Market & Strategy GmbH



China is the largest producer of plastic materials*, followed by Europe and NAFTA. World production of plastic materials in 2016: 280 million tonnes.

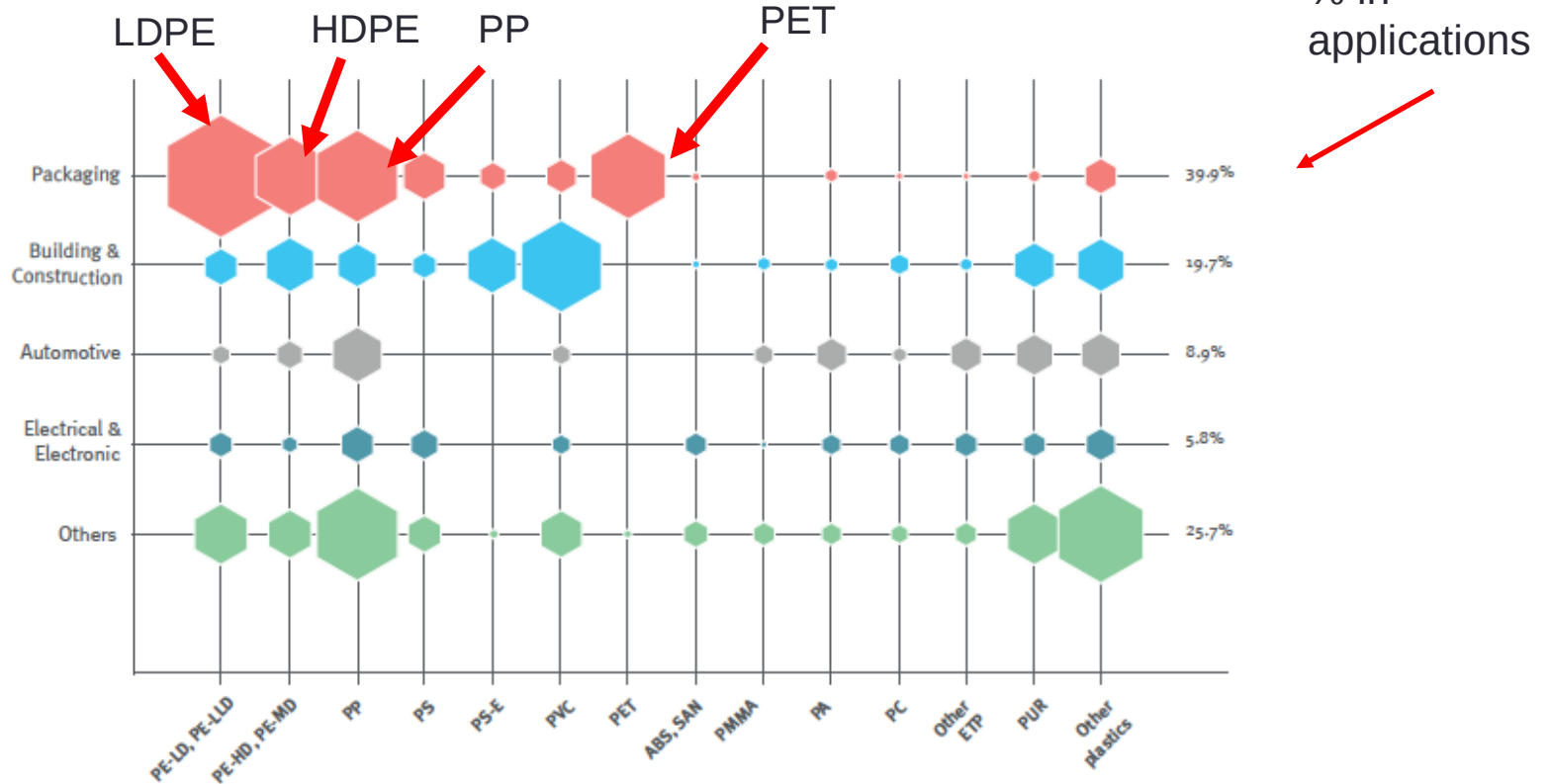
Source: PlasticsEurope Market Research Group (PEMRG) / Conversio Market & Strategy GmbH



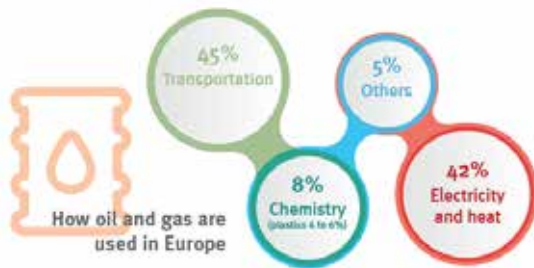
Plastics demand by polymer and market segment

European plastics demand (EU-28+NO/CH) by polymer type 2015.

Source: PlasticsEurope (PEMRG) / Consultic / myCepi



Plastics are made from Oil and Gas - What is in the future ?



Oil price over last 10 years



OIL \$/bbl	\$ 53.29
barrels/tonne	7.148
\$/tonne	381
£/tonne	292

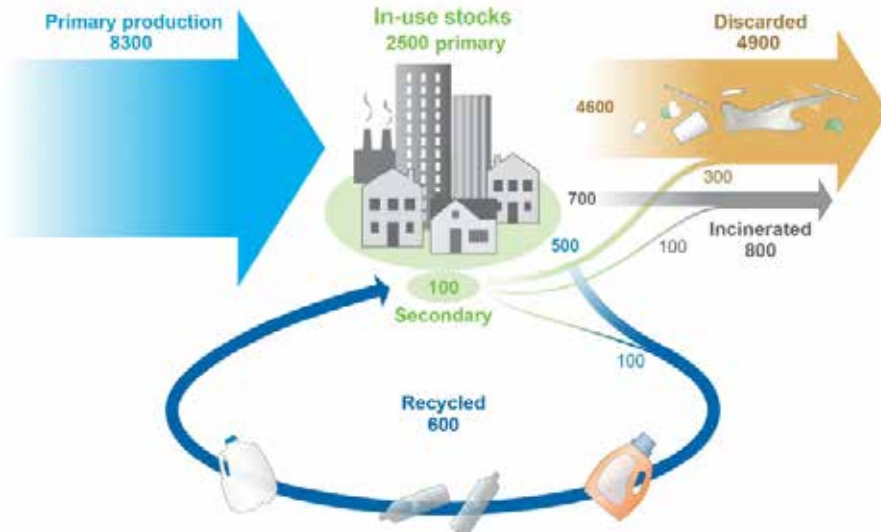
Raw Materials for plastics

	Virgin Resin	Bales	Delta
HDPE NAT	£ 1,175	£ 400	£ 775
PP	£ 1,120	£ 210	£ 910
PET	£ 1,112	£ 150	£ 962

USD\$68/bbl
July 2018

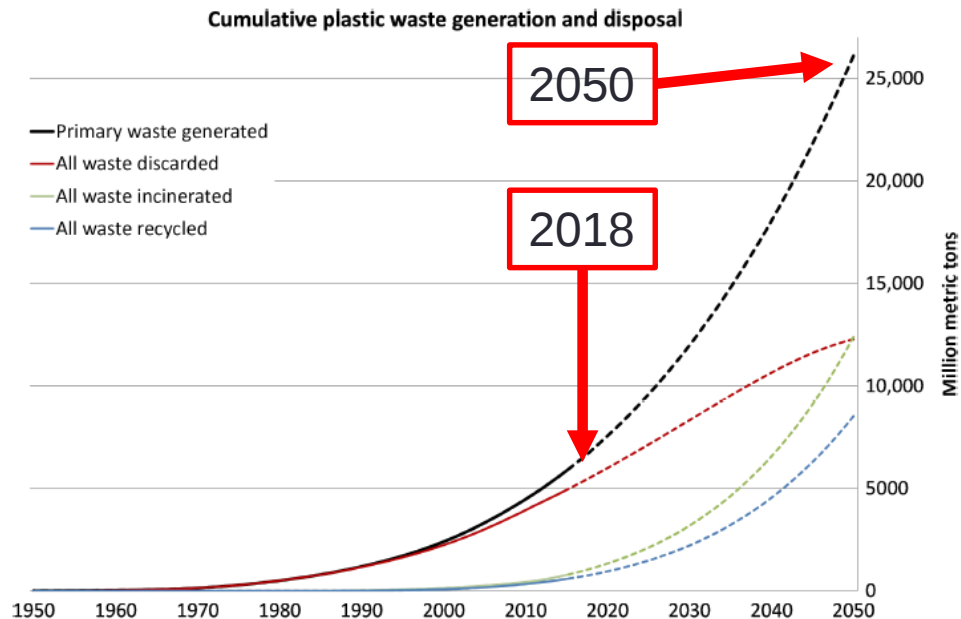
Margin for conversion and ROI for recycling

Global Production Use and Fate of polymers from 1950 to 2015



All numbers in millions of tonnes (2015)

Ref. Geyer et al *Sci. Adv.* July 2017



Plastics production and the incineration of plastic waste give rise globally to 400 million tonnes of CO₂ a year.
Ellen MacArthur Foundation "A new plastics economy" 2016

Plastics and waste on beach after storm in Dominican Republic

- All this plastic has been washed from the **land to the sea** during the storm.
- The **absence of effective waste management** for informal housing is a common feature of developing countries.
- There needs to be international focus **on helping these countries to develop effective waste strategies** to keep these plastics out of the oceans.
- **94 %** of the plastic entering the ocean ends up on the sea floor.
- There is an estimated **70 Kg of plastic** in each **km²** of the sea bed
- Barely **1 %** of marine plastics are found floating at or near the ocean surface. Average global concentration of 0.74 kg/ km²



Media stories point to Brand Owners and retailers as being responsible



Plastics briefing

Ethical Corporation

October 2017



BIEL CALDERON/GREENPEACE

Supermarkets Dump plastics - Iceland and Waitrose

- "80% of customer saying that they would support a supermarket that decided to go plastic-free"
- "two new meals will be in paper-based trays."
- "It is currently in a black plastic tray. **That black plastic is the worst possible option in terms of toxins going into the ground and the ability to recycle that product**"
- "go back to materials that worked well before plastic came along – for example using cellulose, which is made from wood, and returnable glass bottles."
- "**Making this change is going to cost money but we are determined that our customers will not have to foot the bill.**"

Iceland Joint MD Nigel Broadhurst Plastic Free 2023



- "**Not many people realise that black plastic is tough to recycle,**" said Waitrose's head of sustainability and responsible sourcing, Tor Harris. "**As a retailer dedicated to reducing the impact of plastic packaging on the environment, becoming black plastic free across all our own label products is the right thing to do.**"
- Waitrose has already removed 65 per cent of black plastic from its fruit and vegetable packaging, and will stop using the material on all products by 2019.



Circular Economy Announcements by Big Brands on packaging responsibility

- **Coca Cola** making all its consumer packaging **100% recyclable by 2025** and to have **50% recycled content in its packaging by 2030**. It will recycle a bottle for every bottle it sells.
- **Danone-Evian** - whose bottles are already 100% recyclable, will make **all of its plastic bottles from 100% recycled plastic by 2025**
- **MacDonalds** 100% of packaging will come from recycled, renewable or certified sources and **recycle 100% of restaurant packaging by 2025** (currently 10%).
- **Unilever** - all plastic packaging is reusable, recyclable or compostable by 2025; and **recycled plastic content in its packaging to at least 25% by 2025**
- **Pepsico** - to design 100% of its packaging to be recyclable, compostable or biodegradable, increase recycled materials in its plastic by 2025
- **Werner&Mertz** - packaging is already 100% recyclable, to **use 100% recycled plastic in at least 70 million bottles (2017)** -65% of its entire annual bottle volume, then 100% by 2025
- **Ecover** to use **100% recycled plastic in all bottles by 2020**



EU, Germany, UK, Dutch Governments set targets

- GERMANY- by 2019 a minimum of **63% of plastics packaging recycling target**
- NETHERLANDS - from 2021 a deposit on plastic bottles, unless **90% of bottles are recycled** within two years
- EU targets - by 2025 a minimum of **60% of all plastics should be recycled**
- UK WRAP PLASTICS PACT by 2025
 - Eliminate unnecessary single use packaging
 - **100% of packaging to be recyclable**
 - **70% of packaging to be recycled or composted**
 - **30% average recycled content across all packaging**



Plastic Bans – Maharashtra Government

Oxo degradable bags can be detected by a fast test

Banned

One time use / Single use disposable items madeup of Thermocol (Polystyrene) or Plastic. e.g. dish, spoon, cups, plates, glasses, fork, bowl, container.



Banned

Disposable dish / bowl used for packaging foods in hotels and Straw



Banned

Plastic Bags
(With Handle / Without Handle).



Plastic Bag

Non- woven Bags.



Plastic Bag or Non- woven Shopping Bags

Banned

less than 200 ml. Drinking water PET / PETE bottles, having liquid holding capacity



Banned

Plastic Mineral Water Pouch



Allowed

PET / PETE Bottles having a liquid holding capacity 200 ml. and more than 200 ml. (printed with deposit and refund price or buy-back price under EPR)



Bio-Based Packaging for Fresh Food **BIOFRESHPAK**

- Bio-based Packaging for Fresh Food (**BIOFRESHPAK**) is focused on developing packaging materials that will be biodegradable and recyclable
- **reduce wastage** by improving the storage stability and shelf life of food during transit between the producer and the urban consumer,
- **reduce the level of adulteration** via sealable and tamper-evident features,
- **reduce urban solid waste** from packaging going to landfill
- **Improve health** and well being of the population by improved retention of nutritional quality and reducing risk of spoilage in fruit and vegetables.
- To achieve these objectives, the project will develop **innovative bio-based hybrid polymer packaging films** with **selective humidity and permeability control** and improved storage-life performance with enhanced environmental characteristics.



Resin Companies and Recycling of plastics

- Borealis purchases recycler Ecoplast (Austria) that reprocesses 35ktpa of post consumer films and produces LDPE and HDPE that can be converted back into thin films.
- Their first investment into the recycling sector was MTM (Germany)
- Lyondel Basell and Suez have purchased the recycler QCP (NL)
- IKEA has purchased 15% recycler Morsinkoff (NL)
- RPC purchases BPI and PETLON
- This will bring financial stability to the recycling sector that is often subject to economic volatility.



Sustainable Plastics and Terminology

Reduce, Reuse, Recycle, Recover (energy) - Commonly used with petro-based plastics

Renewable resources - can be grown again from current carbon biosphere

Bio-based (Bio-Plastic)- made from renewable resources from the biosphere

Bio-degradable – can be decomposed by aerobic (to CO₂ and water) or anaerobic (to methane) organisms

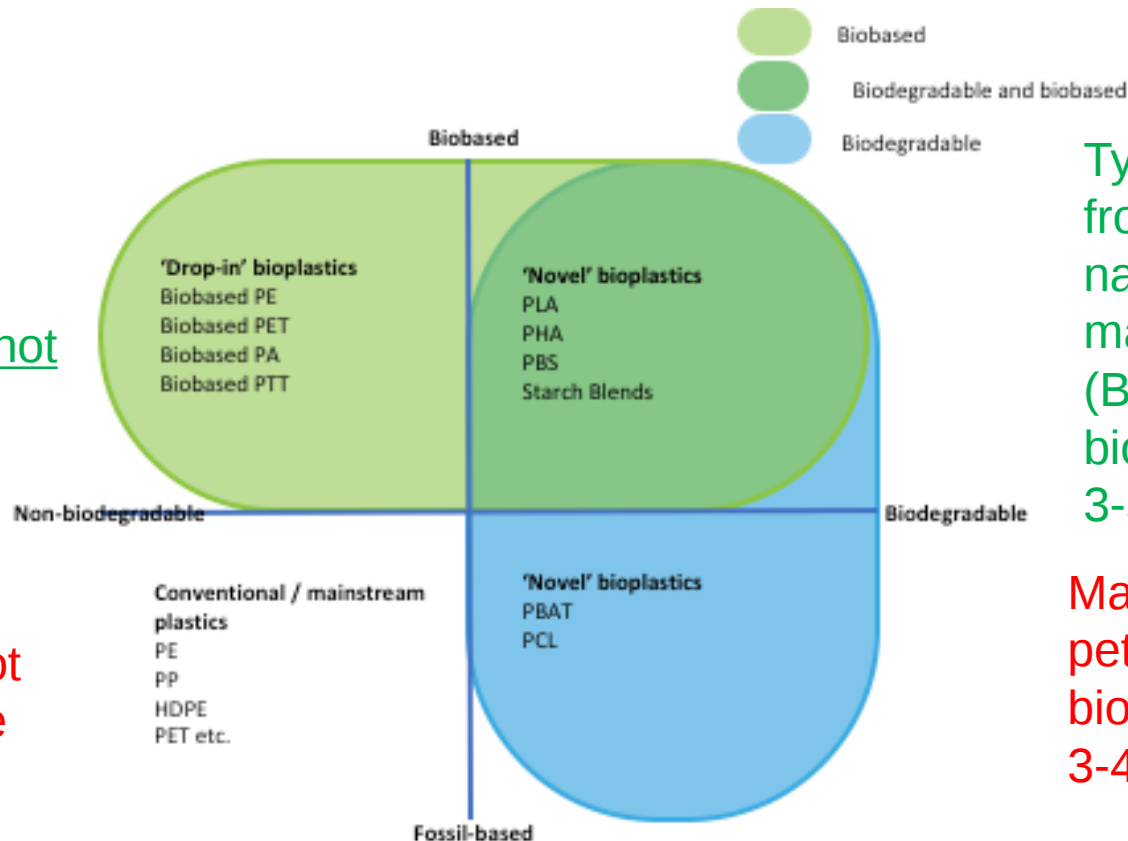
Degradable – decomposed by chemical (oxidation or thermal) or bio-organisms to monomers or fragments

Compostable - can be placed into a composition of decaying materials, and eventually turns into a nutrient-rich material.(Biodegradable)

Bio-based and biodegradable plastics as an option

Typically made from sugars or natural starting materials
(Bio-based but not biodegradable)
1.5-3 x cost

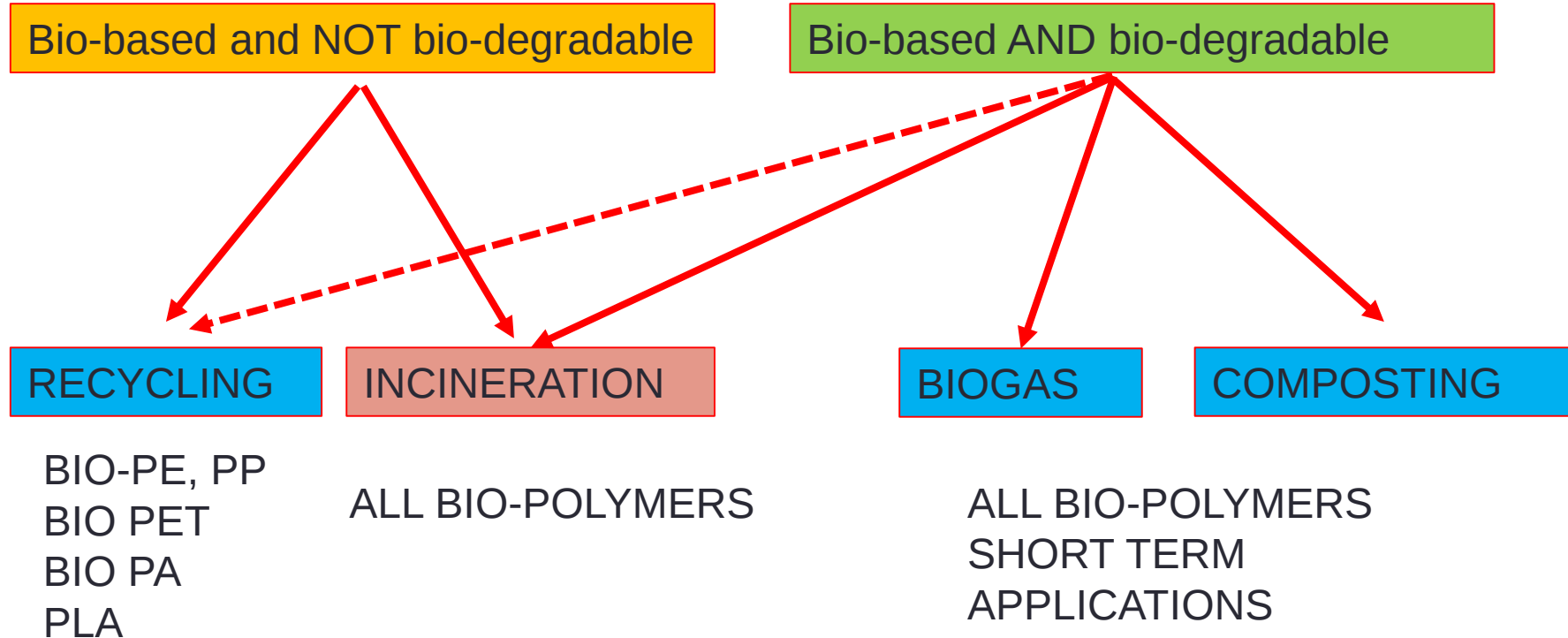
Made from petroleum – not bio-degradable
1x cost



Typically made from sugars or natural starting materials
(Bio-based but bio-degradable)
3-5x cost

Made from petroleum – but bio-degradable
3-4x cost

Destinations for bio-based Packaging



Key Steps in the Plastics Recycling Process

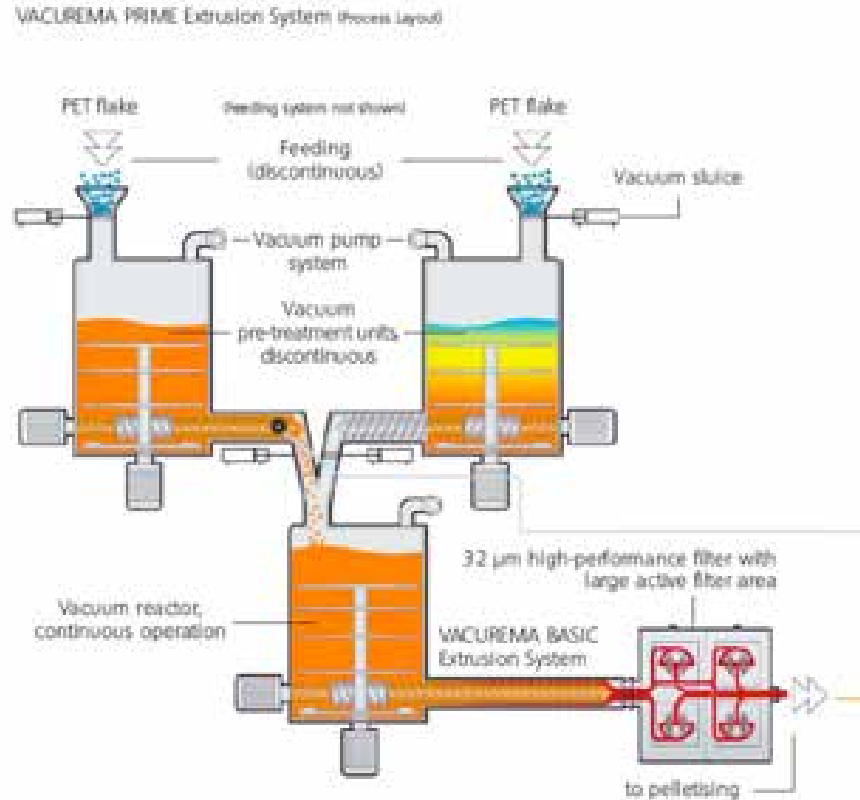
Many bales have significant levels of unwanted plastics, metals and dirt



Decontamination and Extrusion processes

Food Contact Bottle Recycling

- There are many processes for PET food contact flake and pellet production.



List of food grade processes approved by USFDA or EFSA

Erema
Starlinger
Buhler
OHL
Gneuss
Bepex
Krones
NGR
Extricom
URRC
PTI Phoenix
VISY
PTP
etc

Chemical Recycling - Depolymerisation of Polymers to Monomers (PET example)

Main Developing Companies

Company	Specifics	Product
Carbios	Fermentation	PTA / MEG
Garbo	n-Purification steps	BHET
Gr3n	Microwave reactor	PTA / MEG
Ionika	Ionic liquids	BHET
LOOP	Filtration/crystallization	PTA / MEG



GARBO Glycolysis
process back to PET

Chemical Recycling – Solvolysis of POLYMERS – (PP example)



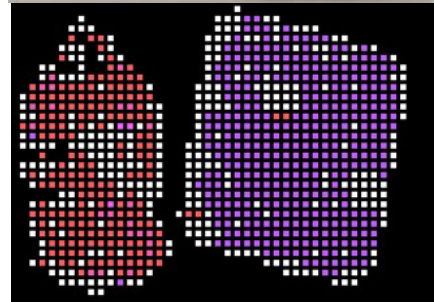
PR Newswire

PureCycle Technologies and P&G introduce technology that enables recycled plastic to be nearly-new quality

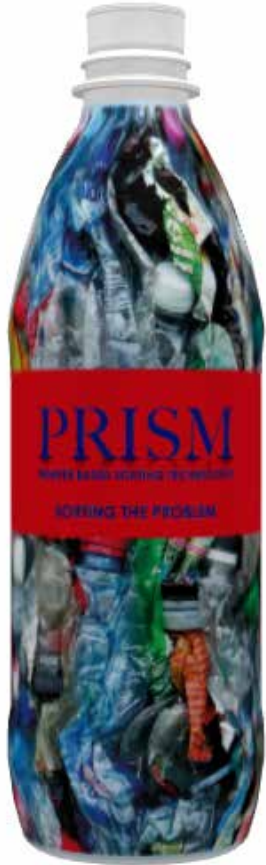
Developed by Procter & Gamble, the process **separates colour, odour and any other contaminants** from plastic waste feedstock to transform it into virgin-like resin.



Solutions Coffee cups -Food Grade PP products – Low odour rHDPE-
Black Plastics



PRISM - Intelligent sorting of packaging using fluorescent markers on labels



What if bottles could talk to the auto detectors!



What MUST we do to end the dig-use-discard era

- **Governments** – Set real and worthy targets for Circular Economy; develop zero-waste management infrastructure; Tightly control leakage to the environment in your borders
- **Businesses** – design sustainable processes and an end-of-life plan for whatever you make or sell; take back your products into your cycle of materials, eliminate “discard”
- **Organizations** – Purchase products that are sustainable and help grow the markets for recycled plastics; Support those repairing our environment.
- **Scientists** – Explore the frontiers and concepts that give us new alternatives to a prosperous healthy life.
- **Homo Sapiens** –preserve the environment we share – pollution and waste free; Use your market strength to purchase what you need; be a guardian for this planet that sustains our life

RESOURCING
THE FUTURE
CONFERENCE
2018



Eliminating Avoidable Plastic Waste by 2042 A use-based approach to decision and policy making – June 2018

Eliminating avoidable plastic waste by 2042:
a use-based approach to decision and policy making

June 2018

Written by: Resource Futures and Nextek

A partnership event brought to you by



An action Agenda for the Future -Taking Responsibility

- To reach the ambitious recycling Goals, the packaging supply chain must link up and
 - **Recover and use recycled content for packaging**
 - **Boost recycling efficiency for recyclers**
 - **Prevent Ocean Plastics. Recovery from Oceans is very difficult and ineffective long term.**
 - **Large Scale Recycling operations for the big four resins (LDPE, PP, HDPE and PET) (100,000 tonnes/yr).**
- Recycling activity should be at least 70% of packaging production.
- Resin companies and Brand Owners should have a stake in recycling operations to close the circle on their products.
- Biodegradable / Compostable plastics for film packaging are beginning to emerge yet there is no pathway for recycling, recovery or biodegradation through collection.
- Energy recovery is the main end-of-life strategy which may surprise many people hoping that “bio-plastics” might just happily disappear without further effort.

FIGURE 3: THREE DISTINCT TRANSITIONS STRATEGIES TO ACCELERATE THE SHIFT TOWARDS THE NEW PLASTICS ECONOMY (SHARE OF PLASTIC PACKAGING MARKET BY WEIGHT)



SOURCE: New Plastics Economy initiative analysis (see Appendix for details)

Recycling & Recyclability



The background of the slide is a composite image. The top half shows a large, detailed view of the Earth from space, with blue oceans and white clouds. The bottom half shows the lunar surface, which is grey and rocky. A small lunar rover is visible in the middle ground of the lunar surface. The text is overlaid on this image.

EVERY PLASTIC ITEM CAN HAVE A CIRCULAR DESTINY

If we can imagine a solution, then we can do it; indeed we must do it.

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NASA Moon
Mission
1961-1969