One big market failure

Systemic look at plastic waste in the light of plastic marine litter

Report of the Plastic Marine Waste Project,
discussed at the Stakeholder Meeting Eenhoorn Amersfoort, March 28 2013

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About this report

- This report summarises the results of the Plastic Marine Waste project (June 2012-April 2013).
- The draft results were discussed at a stakeholder meeting on March 28 in Amersfoort, the Netherlands.
- The project was carried out by IMSA Amsterdam and sponsored by the European industry association PlasticsEurope, Cradle to Cradle flooring company Desso and the Dutch Ministry of Infrastructure and the Environment (Rijkswaterstaat).

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An Executive Summary (PMW023a) can be downloaded on www.plasticmarinelitter.eu.

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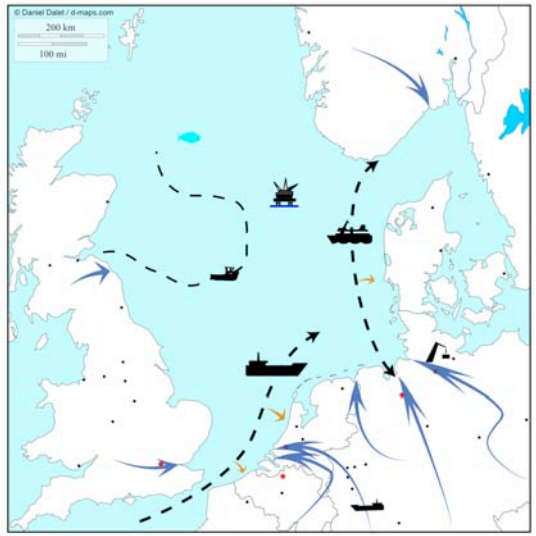
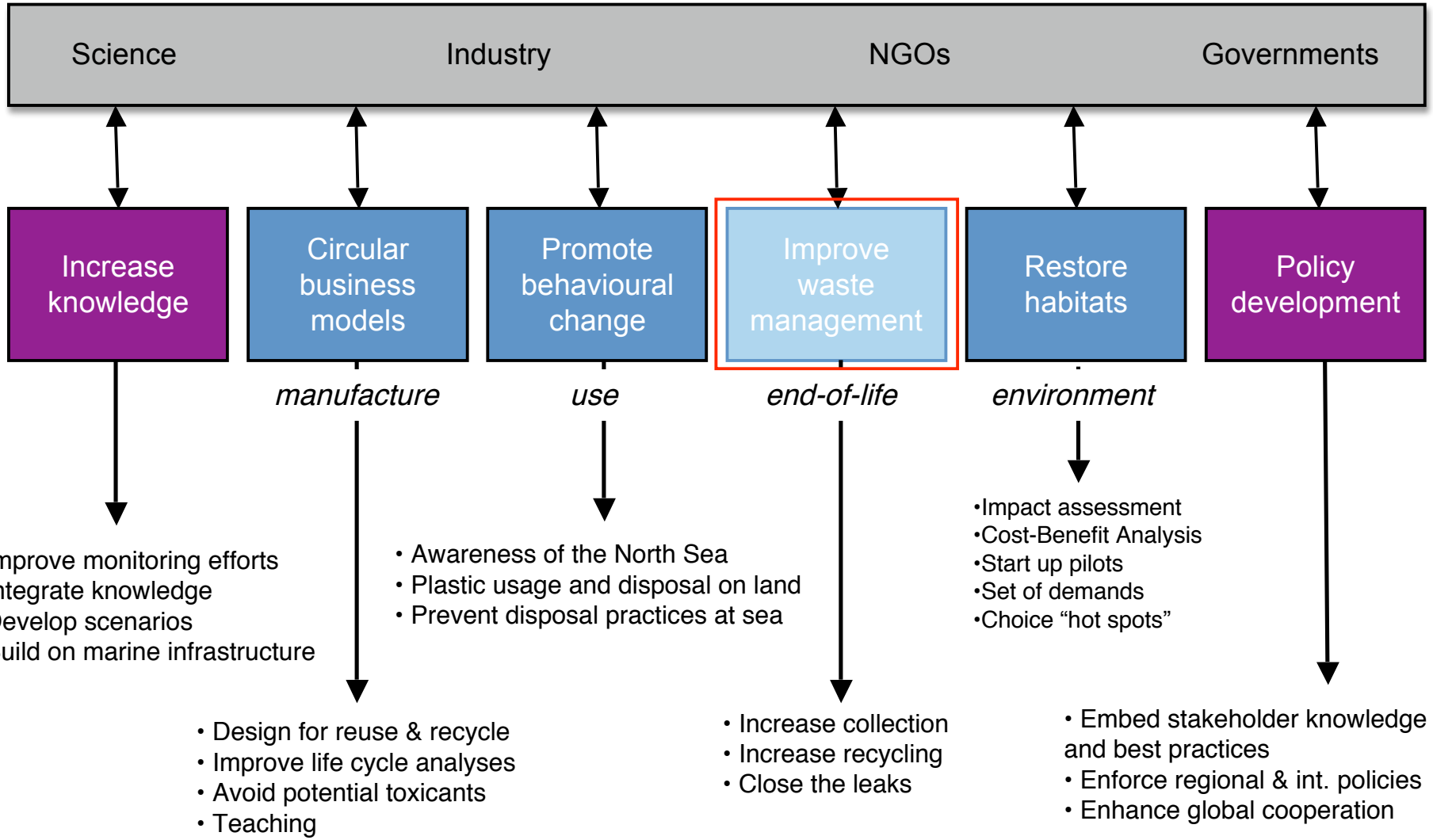
1a. Plastic Marine Litter Programme

- In 2011, the Plastic Marine Litter Programme initiated and coordinated by IMSA Amsterdam, produced a report supported by strong Dutch stakeholder network.
- An integral approach and concrete projects aimed at a plastic-free North Sea.
- Flagship project of PlasticsEurope in 2012-2013.
- Science based, aiming at win-win-win solutions, beneficial to all stakeholders who contribute to sustainable developments.
- Aiming for improved waste management, behavioural change, circular business models, habitat restoration, science and policy development
- First project successfully completed in the Netherlands in 2011; 3 projects running; Mosa Pura (River Litter Foundation), 0.5l Plastic Bottle (DPI) and this project.
- Successes to be used in North Sea and other seas.



1b. Work streams of the PML Programme



1c. Project phase 1: Main conclusions

- The first phase of the Plastic Marine Litter programme (2011) provided an analysis of the plastic marine litter issue.
- Although the North Sea has no oceanic gyre, plastic marine litter has serious environmental impacts.
- Plastic marine litter is one of the persistent pollutants that adds to existing threats to ocean health.
- PML directly harms marine species like seabirds and mammals and hundreds of other species.
- The indirect effects of micro-plastics on marine food webs and human health require further assessment. GESAMP is working on this.
- PML causes economic damages as well. Costs in the North Sea region have been estimated at 100 million euros/year (IMSA Amsterdam, 2011).
- The unsustainable life cycle of plastics, and especially the “leakage” in the end-of life phase, forms a major cause of PML.
- Action is required at all levels of the current life cycle of plastics. Scenarios are lacking and need to be developed for the North Sea.

1d. Project phase 2: Plastic Marine Waste project

- In June 2012 IMSA started the Plastic Marine Waste project (PMW), sponsored by the European industry association PlasticsEurope, flooring company Desso and the Ministry of Infrastructure and the Environment (Rijkswaterstaat).
- It came forth from the first phase of the Plastic Marine Litter (PML) programme which provided an analysis of the plastic marine litter issue. One of the solutions identified was to 'improve waste management systems' (IMSA Amsterdam, 2011)
- The project was carried out by IMSA Amsterdam and Stuf Kaasenbrood (PlasticsEurope).

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1e. Project objectives

- The objectives were to gather and share knowledge on waste management systems in relation to PML in order to: 1) increase collection; 2) increase recycling and 3) close the leaks.
- The main questions addressed are:
    1. How could plastic waste management be improved in relation to plastic marine waste?
    2. What are the main issues of stakeholders in the plastic value chain?
    3. What are the biggest barriers to improve waste management systems and enable circular plastic value chains?
    4. How can the transition to a circular economy for plastics be accelerated?
- The scope of the project was land-based sources of plastic marine litter, with a focus on municipal solid waste and packaging waste.

1f. Project activities

- 2012: Interviews with key (mostly) Dutch stakeholders in the area of plastic value chain and/or waste management to identify their issues and dilemmas
- 2012: (Limited) scientific desk research on marine litter and plastic waste management
- 2013: Stakeholder meeting with Dutch stakeholders (March)
- 2013: Report with conclusions and recommendations on plastic waste management in relation to plastic marine litter (April)

2. Science Update

a. Effects: Ingestion by marine species and transfer in food

b. Effects: Toxicity

c. Effects: Human Health

d. Main sources in the North Sea

e. Concentrations in the North Sea

2a. Effects: 1) Ingestion by marine species and transfer in food webs

- There are big knowledge gaps on the impacts on different marine species, in particular in vulnerable life stages (larval and juvenile)
- Outcome of studies are highly dependent on the accuracy of dealing with plastic dust particles present in the atmosphere of research facilities
- The growing number of studies shows that marine organisms at all levels of the food web ingest (micro-)plastics. (Micro-)plastics are thus entering the food chain.

Species	Effect	Source
Northern fulmar	95% of dead birds: 35 plastic particles, weight 0,3 gram in stomach	Van Franeker, 2012
Porpoise	North Sea porpoise contains plastic contamination, results expected this year	IMARES, 2013 expected
North Sea mussels	Each gram of North Sea mussels contains 1 micro-plastics particle	University of Gent, 2012
Fish	Ingested plastic 4-12,5% depending on fish specie	Foekema, 2012
Fish	30% of fish in the English Channel contains plastic contamination	Thompson, 2013

2b. Effects: 2) Toxicity

- Potential toxic effects of marine plastics and micro-plastics could occur by transfer of toxicants to marine organisms (either directly applied in plastics or absorbed by plastics once in the environment).
- Few studies have as yet analyzed the potential transfer of plastic derived chemicals to biological tissues of marine species, like fish, filter feeders and mammals.
- Tanaka et al have analyzed polybrominated diphenyl ethers in the fatty tissues of short-tailed shearwater birds in the North Pacific Ocean, which frequently ingest plastics. Some of the ethers found have not been detected in the fish species that are prey of the shearwater, but are detected in marine plastics, as they are applied in specific commercial plastics and textiles as flame retardants.
- This suggests that plastic-derived chemicals from ingested plastics are transferred to the tissues of marine-based organisms (Tanaka et al. 2013).

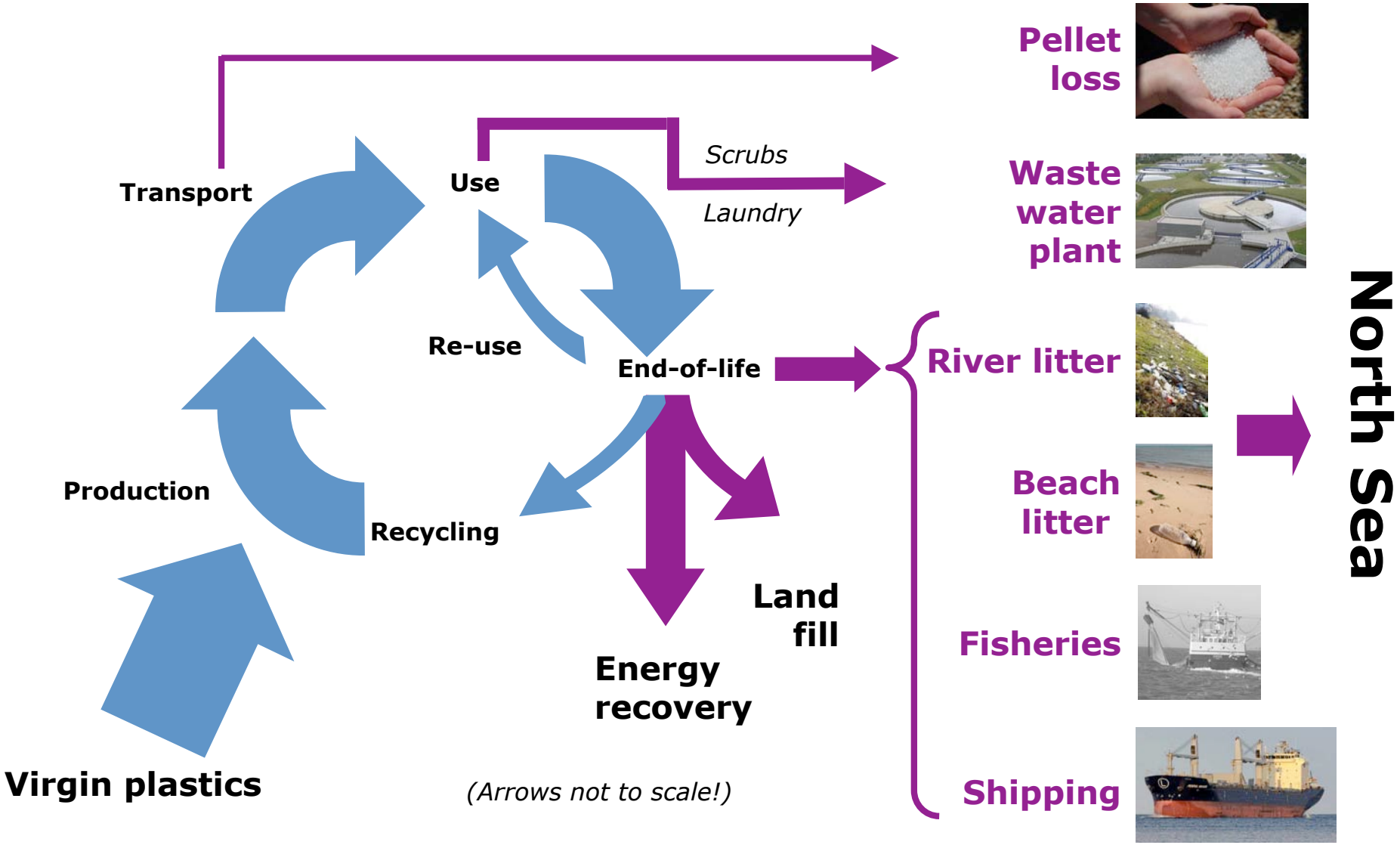
2c. Effects: 3) Human health

- Little is known about human health risks of plastic marine litter and micro-plastics. Potential toxicity effects of ingestion of fish and sea food with plastic contamination is not yet examined and seems an indirect exposure route compared to people's daily contacts with plastics.
- Ingested and inhaled micro-plastics have been found to harm humans, as they damage tissues and cells (Pauly et al., 1998).
- Some scientists claim that the physical dangers of plastic are well enough established and chemical dangers are sufficiently worrying, to take action. They call to classify plastic waste as hazardous waste and suggest 'to classify as hazardous the most harmful plastic materials'(Rochman et al., 2013).

2d. Main sources in the North Sea (1)

- The main source of PML from plastic waste in the North Sea is littering, by people either on land or at sea, with the exception of micro-beads in cosmetics.
- River litter could be an important source. Recent measurements in the Meuse river suggest that 15.000 items can be transported per hour (Kastoro Consulting, 2013).
- Sewage effluents are another source of micro-plastics. Dutch effluent contains ca. 10 - 20 particles per liter of effluent (Leslie et al., 2012)
- Direct sources of micro-plastics in the sea are pellet loss, micro-beads in cosmetics and fibres of textiles. These sources are limited in terms of weight, but not in terms of particles. GESAMP is working on this.
- Plastic marine litter in general mainly consists of low value, cheap, single-use plastics.
- The situation is deteriorating by the steady growth of plastics production and consumption and the long lifetimes of plastic materials (low degradation rates).

2d. Main sources in the North Sea ()



2e. Concentrations in North Sea

- The influx of most sources of plastic marine litter is unknown. The often quoted annual total influx of litter into the North Sea of 20,000 tonnes/year lacks scientific basis (Johannsen, 2013).
- 300 micro-plastic particles/kg of sediment (University of Gent)
- Plastic marine litter is a growing problem worldwide and occurs in the most remote marine environments.
- The amount of marine waste on the seabed in the Arctic Ocean has doubled from 1 to 2% of the surface covered since 2002 (Alfred Wegener Instituut, 2012).

3. Main findings: where do we stand?

a. EU policy on marine litter
b. EU policy on waste management
c. EU policy on resource efficiency
d. EU policy on plastic waste management
e. Dutch policy on packaging
f. Business strategies on plastic marine litter
g. NGO campaigns on plastic marine litter
h. Littering campaigns
i. New approaches to waste
j. Future issue development

3a. EU Policy on Marine Litter

- EU and national policies on marine litter are currently in development under the terms of the Marine Strategy Framework Directive.
- Member states are currently formulating policy indicators and objectives and exploring potential measures for their action programs.
- The European Commission has recently published and overview of marine litter policies (EC, 2012) has commissioned various studies (Arcadis, 2013 & Bipro, 2013, Marlisco, RPA, 2013) and an EU-wide stakeholder project to raise awareness and co-responsibility (Marlisco)
- There is, however, a lack of urgency and political will of the EU member states to address plastic marine litter and general waste management issues, as they give economic recovery priority over environmental policies. Most member states only formulate qualitative objectives on marine litter reduction.
- PML is furthermore considered as a minor issue in the North Sea region. On a global scale, Europe is not the main PML problem. Within Europe, the North Sea may be the least polluted and of the North Sea countries the Netherlands has the best waste management system in terms of recovery and recycling.
- The EU organises an international conference in April to define commitments and actions of industry partners and member states.

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Stopping Marine Litter Together

3b. EU Policy on Waste Management

- EU waste policy is based on the European Waste Hierarchy which ranks the desirability of different waste-management approaches according to their environmental impact.
- The EC has developed a general EU Waste Framework Directive and specific sector-based directives. The targets of some key directives (Waste Framework Directive, Landfill Directive and Packaging and Packaging Waste Directive) will be revised, based on a stakeholder consultation in 2013.
- There are major differences in waste management performance of different member states. In Southern- and Eastern-European regions waste management systems are generally poor, whereas waste management in the North Sea region, and in the Netherlands in particular, is relatively outstanding.
- EU waste policy is mainly approaching the waste hierarchy 'from bottom to top'. EU policy is effective in gradually decreasing landfilling and incineration rates, the least favourable steps in the waste hierarchy. Incremental steps are being made.

3c. EU Policy on Resource Efficiency

- EU policy is as yet not effective in stimulating the most favourable step in the waste hierarchy: waste prevention. New policies, however, are in development to enhance resource efficiency.
- The EU Raw Materials Initiative started in 2008 to ensure a sustainable supply of raw materials for the EU industry and to stimulate companies to put innovative technologies on the market. The initiative is based on raw materials supply, best practice in legislation and resource efficiency.
- The EU Roadmap to a Resource Efficient Europe puts a focus on the environmental impact of products and services over their life-cycle and on treating waste as a valuable resource.
- These general policies are now translated in concrete policies for specific material flows.
- In general, the EU needs to recognize the economic benefits of waste prevention and circular supply chains and to reform market conditions for virgin and recycled materials.

3d. EU Policy on Plastic Waste Management

- A Green Paper on plastic waste has been published by the EC and aims to launch a broad reflection on policy challenges which are at present not specifically addressed in EU waste legislation. A public consultation on the policy proposals lasts until June 7, 2013 (EC, 2013).
- Measures for End-of-Waste criteria for plastic are currently designed. End-of-waste criteria intend to shift material flows with a waste status to a resource status (JRC, 2013).
- A public consultation and impact assessment for a legislative proposal on reducing the use of non-reusable plastic bags is ongoing.

3e. Dutch Policy on Packaging

- Without additional measures, the future volume of packaging waste will most likely increase.
- With 62% plastics make up the largest volume packaging materials. Consumption of plastic packaging in EU-15 rose by 31.3% between 1998 and 2010, an average annual increase of 2.3% (Europen, 2012).
- In the Netherlands plastic packaging consumption was 454.000 tonnes in the Netherlands in 2010 (Europen, 2012). Since the year 2000 packaging policies have not led to a reduction of packaging (Worrell & Van Sluisveld, 2013). The majority of packaging waste is currently incinerated and only a small part is recycled (Annex 1).
- Dutch policy on packaging is arranged in the new Packaging Agreement between the Ministry of Infrastructure and the Environment, packaging and retail sector and municipalities. The Packaging Agreement sets no quantitative prevention targets have not been made sets an absolute high-quality reuse of 90 kton (35% of annual plastic packaging use by households in 2010) and a reuse target for plastics of 53% in 2022 (1% increase/y). Quantitative prevention targets have not been made. Qualitative targets are set to reduce some packaging sources, like PVC packaging and single-use plastic bags in shops.

3f. Business strategies on plastic marine litter

- Companies in the plastic value chain have no direct advantage in solving the plastic marine litter issue, but face reputation risks when they are directly related to plastic marine litter.
- The plastics industry recognizes their indirect producer responsibility. They are involved in a number of marine litter projects and currently working on knowledge development, cleaner production and communication and awareness.
- The Dutch Food and Beverage industry and Retail as a whole are committed to increase recycling of packaging but does not recognize responsibility for (marine) litter.
- The Cosmetics industry is the main target of NGOs and takes a reactive and defensive approach as well. Some companies, however, including Unilever and several retailers, have decided to phase out micro-beads in their products.
- The Recycling industry recognizes their responsibility and see PML as a business opportunity. They are involved in the cleanup and recycling of marine litter, communication and awareness.
- Overall, waste prevention is not covered and the total of activities and budgets seem by far insufficient to achieve substantial reductions.

3g. NGO campaigns on plastic marine litter

- NGOs are currently building national and international coalitions. Some national NGOs are very active.
- Powerful *international* NGOs, e.g. Greenpeace, WWF, are joining these coalitions, but have not yet taken up PML as an international priority.
- NGOs are mainly creating public awareness, but are until now exerting insufficient pressure on industry and politics to steer structural action.
- NGO actions are most effective when individual companies are directly attacked, e.g. Micro-bead campaign of Plastic Soup Coalition.

3h. Littering campaigns

- In the Netherlands there is a lot of recent knowledge and experience present on how to accomplish littering reduction, e.g. at Nederland Schoon, Gemeente Schoon, The North Sea Foundation and the Waddenvereniging. Nederland Schoon's Cleanest Beach Contest in NL claimed a 50% reduction.
- Monitoring shows that 20% of street litter is caused by leakages in waste management systems, the rest is caused by littering behaviour of people.
- Littering cannot be fully avoided since some of it is accidental while certain groups of people simply don't care and enforcing is very difficult.
- The littering study by RPA (EC, 2013) identifies as important factors with regards to littering: individual behaviour and people's attitudes and perceptions, context (e.g. cleanliness of the area, administrative capacity and competences) and available waste infrastructure.
- Monitoring of littering is incomplete: some areas and/or sources relevant for PML are not covered, e.g. rivers and agricultural land.

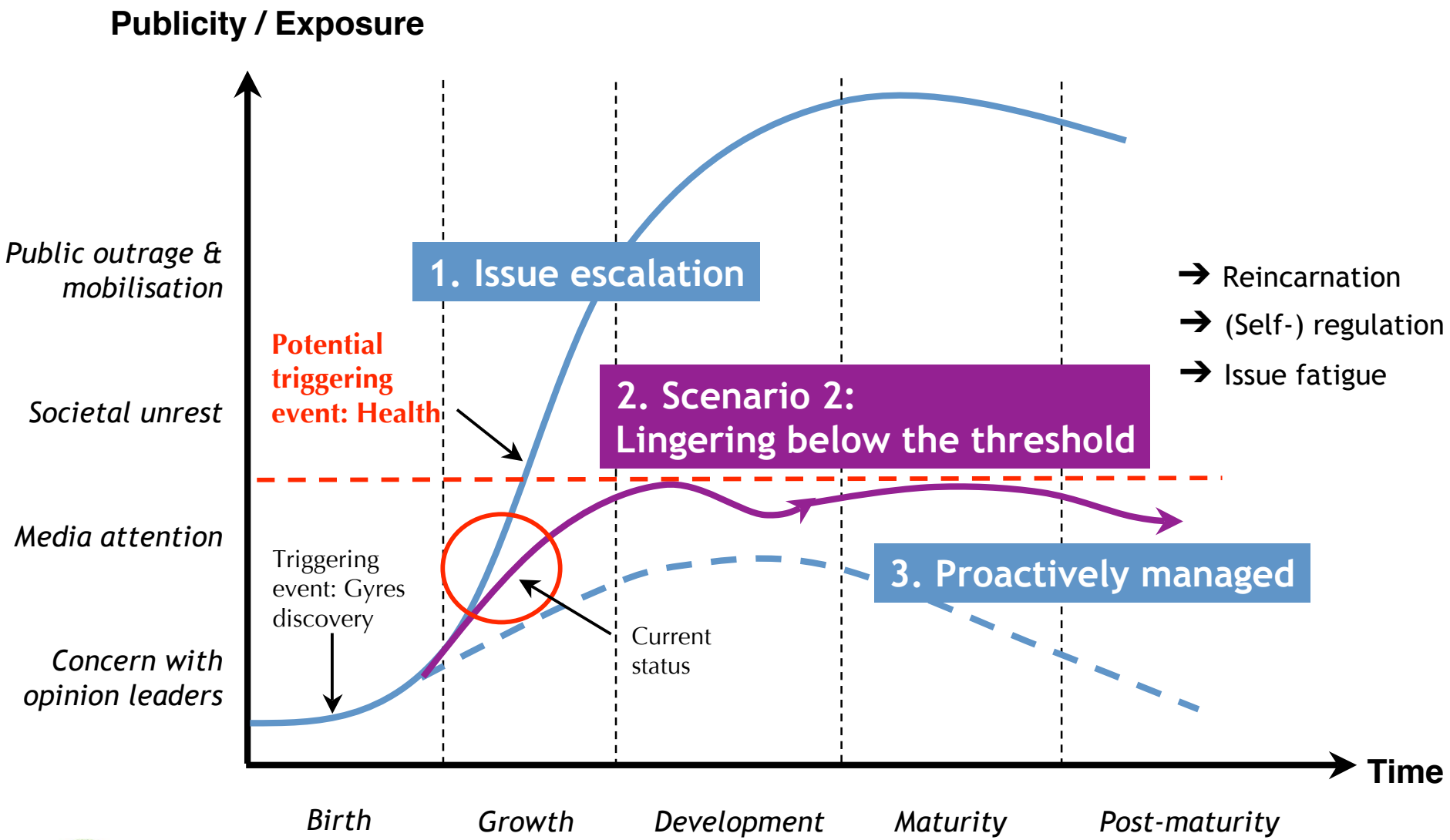
3i. New approaches to waste

- New approaches to waste, based on the principles ‘waste is a resource’ and ‘recycling pays off’, show opportunities for considerable improvement.
- Many local authorities have set up pilots to maximize collection rates of municipal (plastic) waste and compare costs and benefits of different collection schemes.
- E.g., the ‘Afval loont’ pilot in municipality of Pijnacker rewarded citizens for collection of plastic waste at home (0,25 € per kg of waste), resulting in higher collection and lower littering rates. The approach contains a whole range of non-traditional elements including improved communication, flexible arrangements, awards, customer care, tidiness, oversight, participation of children and schools, and donations to charity.

3j. Future issue development (1)

- Plastic marine litter has become a lingering issue. It is difficult to predict how the issue will evolve in the near future. There are two other potential scenarios (see next slide), but it seems likely that the issue can linger for years.
- **Scenario 1: Issue escalation**: Public outrage could suddenly occur if studies would identify a direct link between plastic marine litter (or plastics in general) and public health (potential triggering event).
- **Scenario 2: Lingering issue**: Despite frequent media attention and concerns of citizens, public unrest is not strong enough to enforce significant solutions. Attention of stakeholders public could slowly fade if there is no threat to human health, no viable solutions for marine litter come up and/or other environmental threats are more pressing.
- **Scenario 3: Pro-active issue management**: If viable solutions are pro-actively developed and both causes and effects of plastic marine litter are addressed, the issue will be settled and the public will be reassured.

3j. Future issue development (2)



4. Towards Circular Plastic Value Chains

a. Circular Economy Concept
b. Circular examples
c. What could this mean for plastics?
d. Current plastic value chains
e. Plastic waste treatment options
f. Status quo of plastic waste management
g. Main driver for decoupling and closing plastic loops: Environmental impacts
h. Other drivers for decoupling and closing plastic loops
i. Benefits & Opportunities of circular plastics value chains
j. Barriers: 1) Costs of Recycling Systems, 2) Volume of plastic solid waste, 3) Quality of plastic solid waste, 4) Demand for recyclate, 5) Policy and 6) Coordination & Cooperation

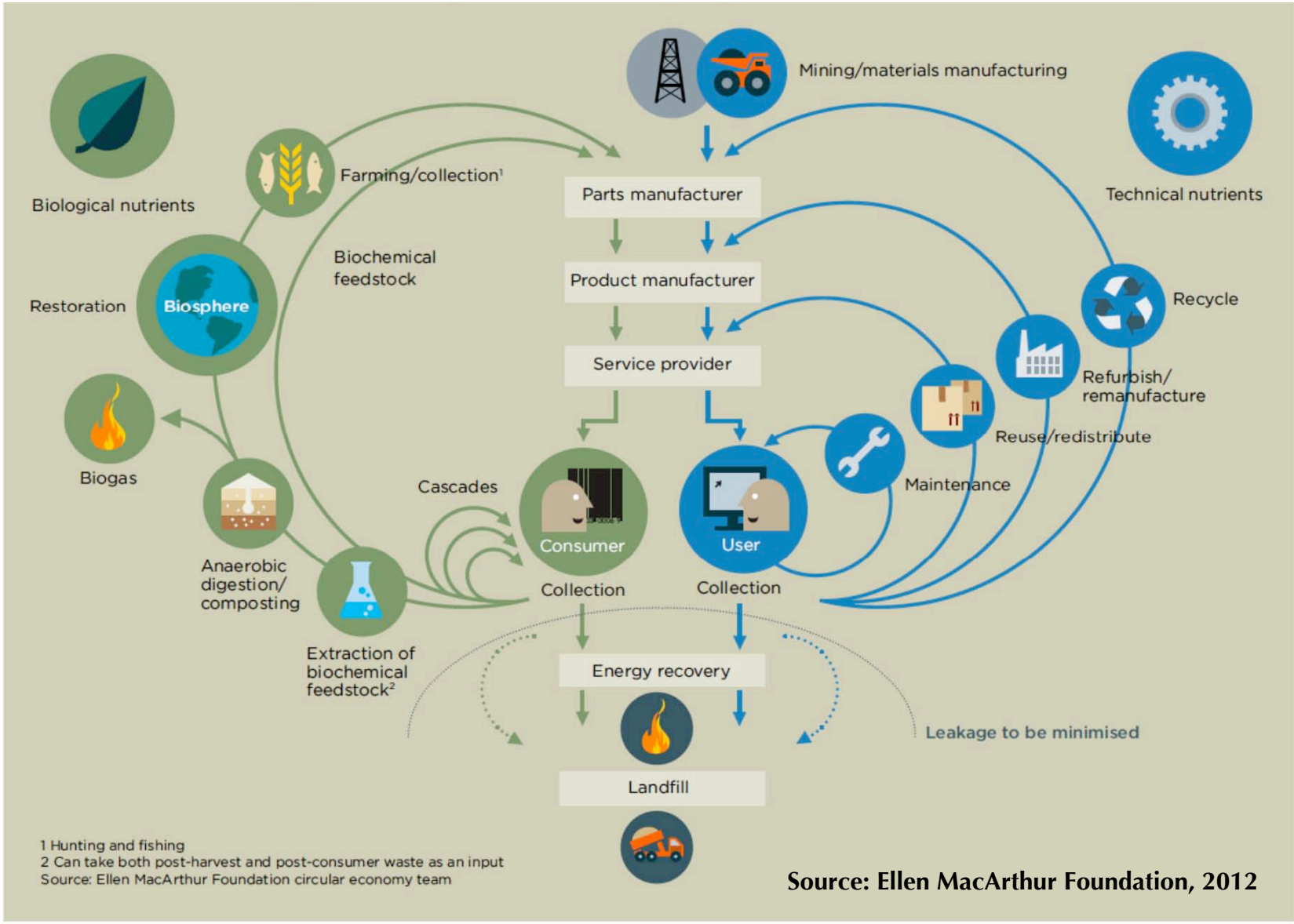
4a. Circular Economy Concept (1)

- The concept of a Circular Economy (see also slide 31) stresses the economic opportunities and benefits of circular business models for business partners, which makes it an inherently appealing concept.
- The business opportunity for the circular economy is estimated at 290 - 490 billion euro for Europe alone (Ellen MacArthur, 2012).
- BIOIS has furthermore estimated that full implementation of general EU waste legislation could save 72 billion a year, increase the annual turnover of the EU waste management and recycling sector by € 42 billion and create over 400,000 jobs by 2020 (BIOIS, 2011).
- Specific cost savings and profits of plastics circular value chains in the EU are not yet estimated.
- In the U.S., an annual materials saving of $7.3 billion and a profit of $2.4 billion - approximately $200 per tonne of plastic collected - could be achieved by separating and recycling five main high volume plastics (Ellen MacArthur, 2013).
- Other additional benefits for companies include better relations with clients and stakeholders, more stable prices, technical and societal innovations.

4a. Circular Economy Concept (2)

- The circular economy recognizes a biocycle and a technocycle with distinctly different design criteria.
- A basic circular design principle is that in general, consumables belong in the biocycle, whereas durables belong in the technocycle (see next slide).
- In the biocycle, biomass returns into the biosphere after product use, either directly or in a cascade of consecutive use. It forms nutrients in the end-of-life phase, e.g. for the soil, without adding to environmental pressures.
- The technocycle contains inorganic products and materials such as metals and plastics. These materials should stay in closed loops to ensure circular use of non-renewable resources and to prevent potential pollution.
- Other principles are to design out waste, to generate more durable products, facilitate disassembly and refurbishment, and shift from products to product service systems (e.g. “leasing” the product).
- The debate around the circular economy is, until now, still based on high level systems thinking with little real-life cases on how circularity might work in practice.

4a. Circular Economy Concept (3)



Source: Ellen MacArthur Foundation, 2012

4b. Circular Examples

- For some products, mostly durables, inspiring circular product designs and business models, do exist:
  - Senseo coffee machine (Van Gansewinkel and Philips)
  - Herman Miller chair (Cradle-to-cradle)
  - Lease a Jeans (Mud jeans)
- Several initiatives have recently been started to accelerate the transition to a circular economy and to realize new circular projects:
  - Circle Economy, a Dutch platform

    (Members a.o., Van Gansewinkel, Desso, DSM, AkzoNobel, FrieslandCampina, Philips, IMSA Amsterdam)
  - CE100 programme of the Ellen MacArthur Foundation

    (Members a.o. Coca-Cola, IKEA, Marks & Spencers, Morrisons)

the circle economy

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THE CIRCULAR ECONOMY
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4c. What could this mean for plastic value chains?

Technocycle:

- Increase total share of durables: e.g. rethink single-use packaging and short-lived products
- Optimise cascading steps: improve mechanical and chemical recycling
- Optimise cascading routes: or mix of of cascading levels for different material flows
- Design for reduce, reuse,recycling
- Avoid potential toxic substances and material diversity
- Design for non-littering of plastics and for minimal impact of littered plastics

Biocycle:

- Develop 100% biobased and/or biodegradable materials
- Design cascading routes
- Control degradation processes: keep degradation circumstances and possible impacts from resulting substances in mind
- Develop new separation technologies to connect the two cycles for plastics, e.g. biodegradable from conventional plastics

Packaging:

- Single-use packaging should be designed for 'decomposition' and subsequent regeneration, whether through the biological sphere, or — if it can be isolated and processed easily and at extremely high levels of recovery — the technical sphere. [EMF, 2013]

4d. Current Plastic Value chains (1)

- At this moment plastic materials are almost exclusively circulating in the technocycle, as most plastics are non-biodegradable.
- Bio-inputs can be used as feedstocks for plastics, but bioplastics make up only 0.1-0.2% of total EU plastics (Mudgal et al., 2010). By 2020, worldwide bio-plastics capacity could technically increase to about 1.5% of 2007 consumption (Shen et al., 2009).
- Most of these bioplastics end up in the technocycle, as only 42% of bioplastics is currently biodegradable (European Bioplastics, 2012) (Annex 2).
- 60% of all plastics in the EU is used for long cyclic applications (automotive, construction, electronics), the so-called *durables* (Plastics Europe, 2012)
- 40% is used in short cyclic or single-use applications (packaging, medical applications, gadgets, etc.) (Plastics Europe, 2012). These *consumables*, however, are part of the technocycle.

Figure: 85.3 billion bags EU/y (BIOIS, 2011)

4d. Current Plastic Value chains (2)

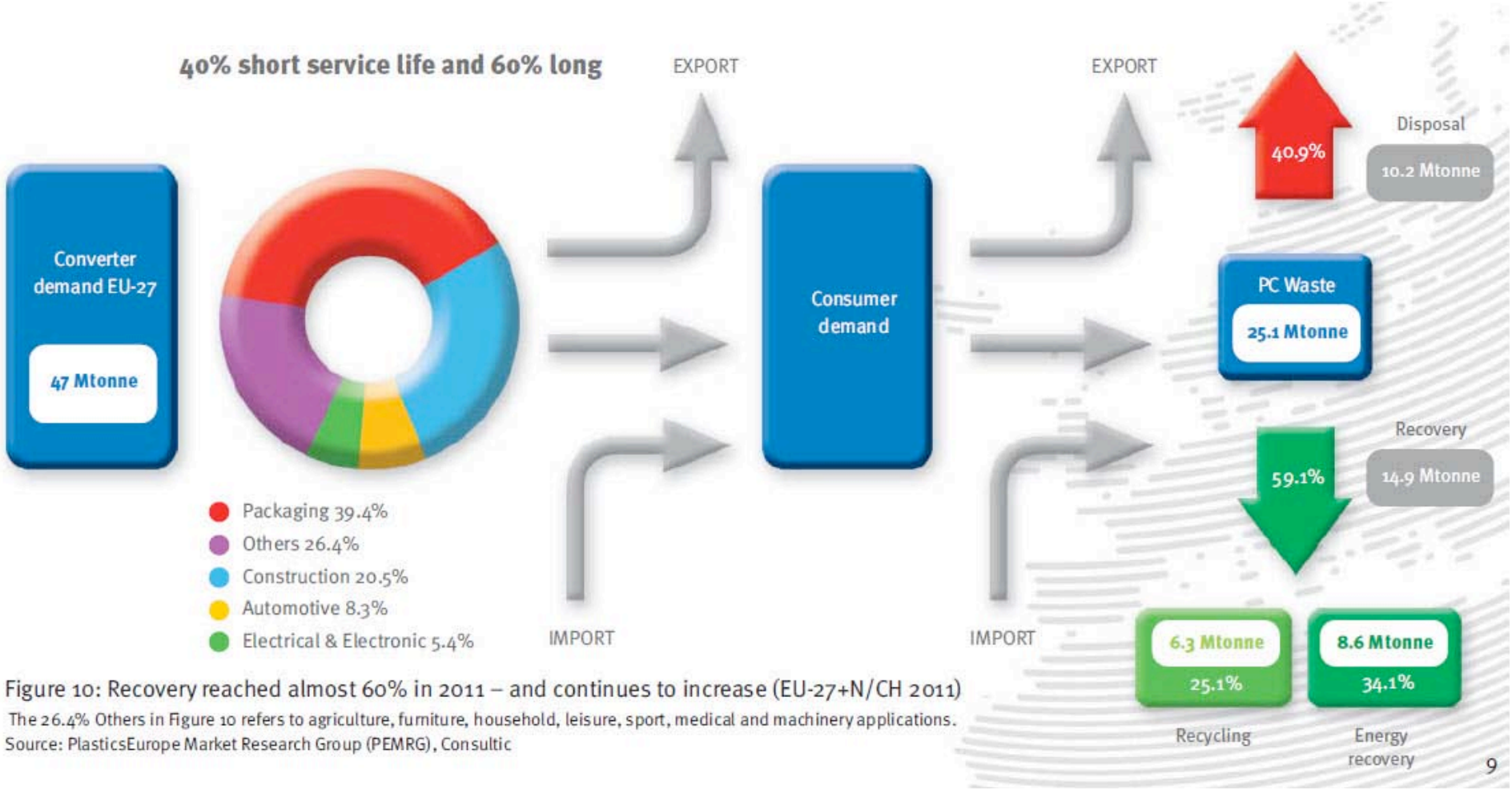
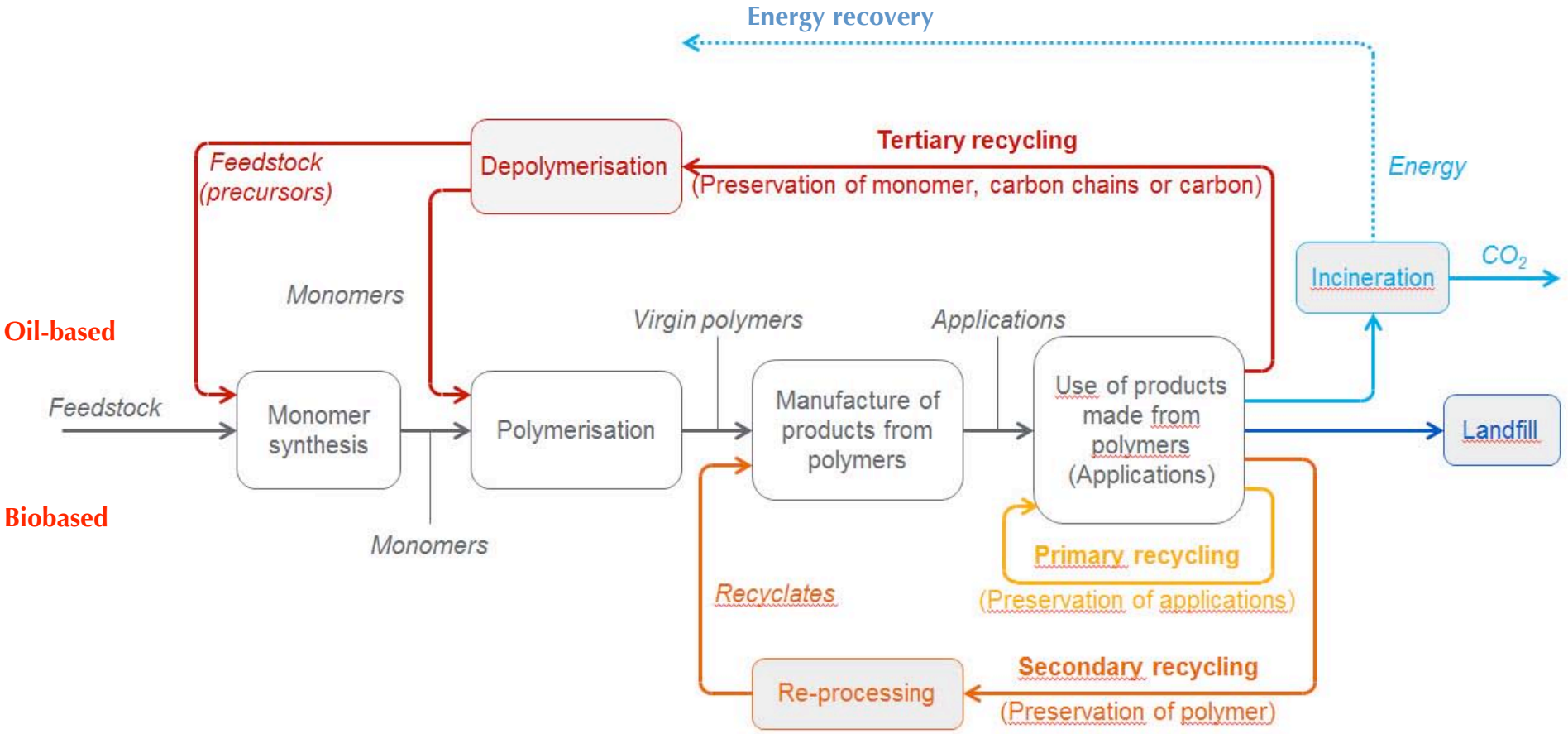


Figure 10: Recovery reached almost 60% in 2011 – and continues to increase (EU-27+N/CH 2011)

The 26.4% Others in Figure 10 refers to agriculture, furniture, household, leisure, sport, medical and machinery applications.
Source: PlasticsEurope Market Research Group (PEMRG), Consultic

Source: PlasticsEurope, 2012

4e. Plastic waste treatment options (1)



Adapted from: SABIC, 2012

4e. Plastic waste treatment options (2)

There are four main treatment options for waste plastics: 1) Primary Mechanical recycling, 2) Secondary Mechanical recycling, 3) Chemical recycling, 4) Incineration (W-to-E) with many sub options (see previous slide):

1. Primary or closed-loop mechanical recycling is to reintroduce plastic scrap or single-polymer materials in order to produce products of similar material. The recyclate replaces part of the virgin material.
2. Secondary Mechanical recycling is to recover plastic waste for reuse in various plastic products; virgin material is not necessary.
3. Tertiary or Chemical recycling is to convert plastic materials into smaller molecules, liquids or gases, suitable for use of feedstock for production of petrochemicals and plastics via advanced technology processes.
4. Incineration with energy recovery is to burn plastic waste to produce energy in the form of heat, steam and electricity (Salem et al., 2009).

4f. Status quo of plastic waste management (1)

- The general waste hierarchy is considered as a legitimate guideline for directing plastic waste management policy: from most to least favourable.
- (Meta) LCA studies show that mechanical recycling is the most favorable treatment option, followed by feedstock recycling, incineration and landfilling (Lazarevic et al., 2010) (Annex 3 and 4).
- The development of recycling pathways should however be placed in a broader context of long-term waste, resources and energy system developments.

4f. Status quo of plastic waste management (2)

- In 2011 25.1 Mtonne of waste plastics was produced in the EU: 25.1% was recycled, 34.1% was incinerated with energy recovery and 40,9% was land filled (PlasticsEurope, 2012).
- Recycling: In 2008 21% of the waste plastics was mechanically recycled and 0.3% was chemically recycled (PlasticsEurope, 2009).
- Energy recovery: In 2008 10% of the waste plastics were incinerated in cement kilns and the rest in regular waste incineration plants (JRC, 2012).

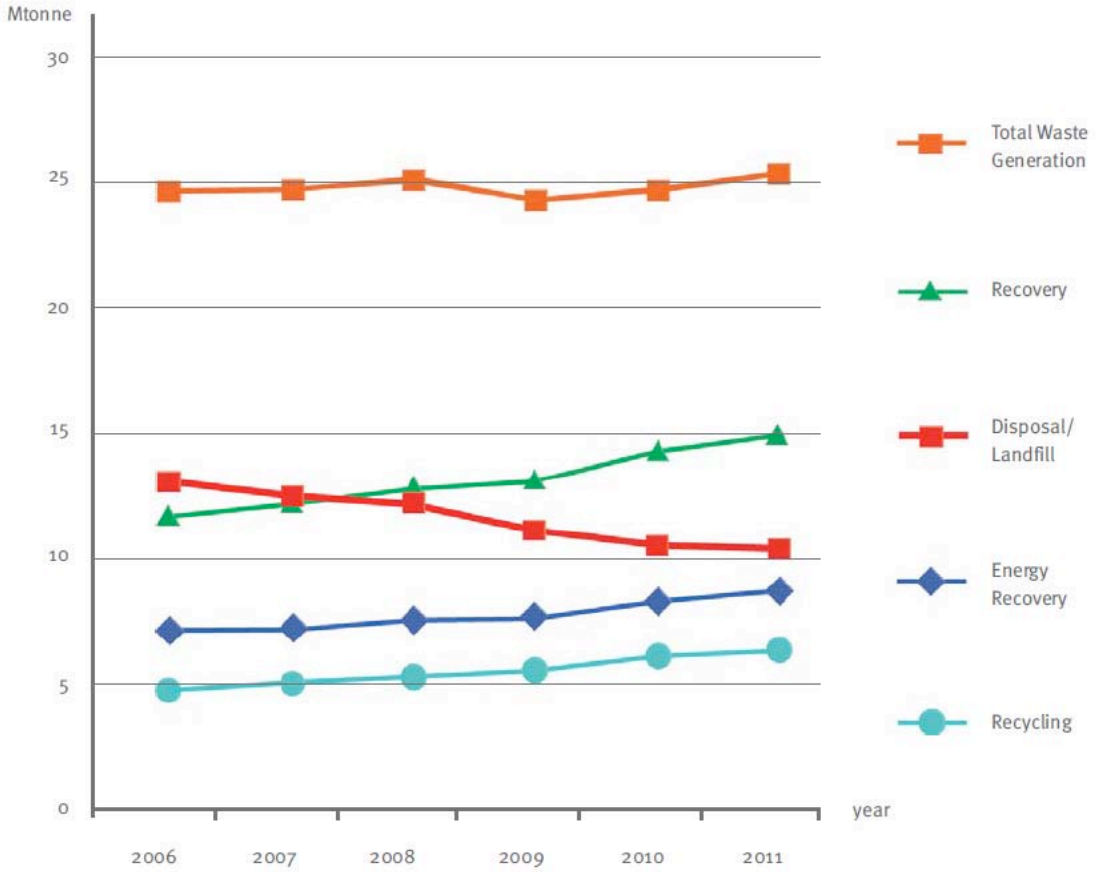


Figure: Progress of plastic waste treatment (PlasticsEurope, 2012)

4f. Status quo of plastic waste management (3)

- A significant part of plastic waste treatment takes place outside of the EU.
- Exports of waste plastics increased by a factor of five between 1999 and 2011 (EEA, 2012)
- 3.36 million tonnes of waste plastics of EU member states (13%) was exported to Asia in 2011 (EUWID, 2012).
- The export of waste plastics had a total value of €961 million in 2011 (EUWID, 2012). This is a lost opportunity for Europe.
- China and other Asian countries are currently making a profit from the recovery of resources from low-value waste streams.

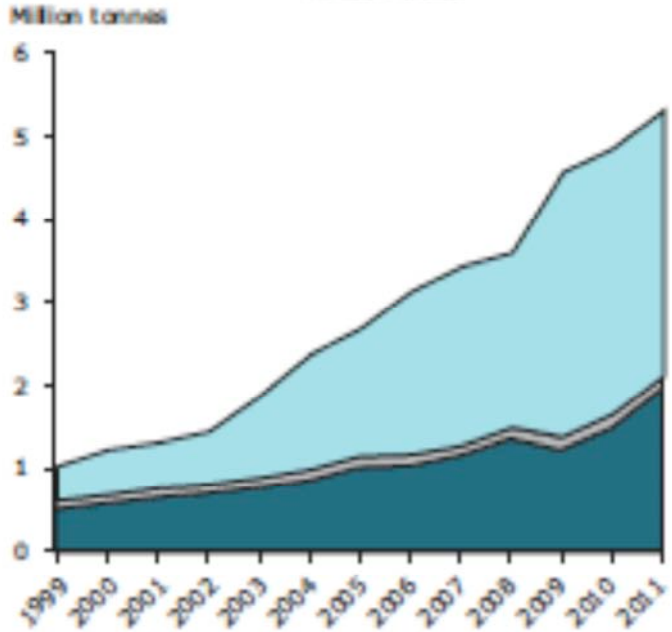
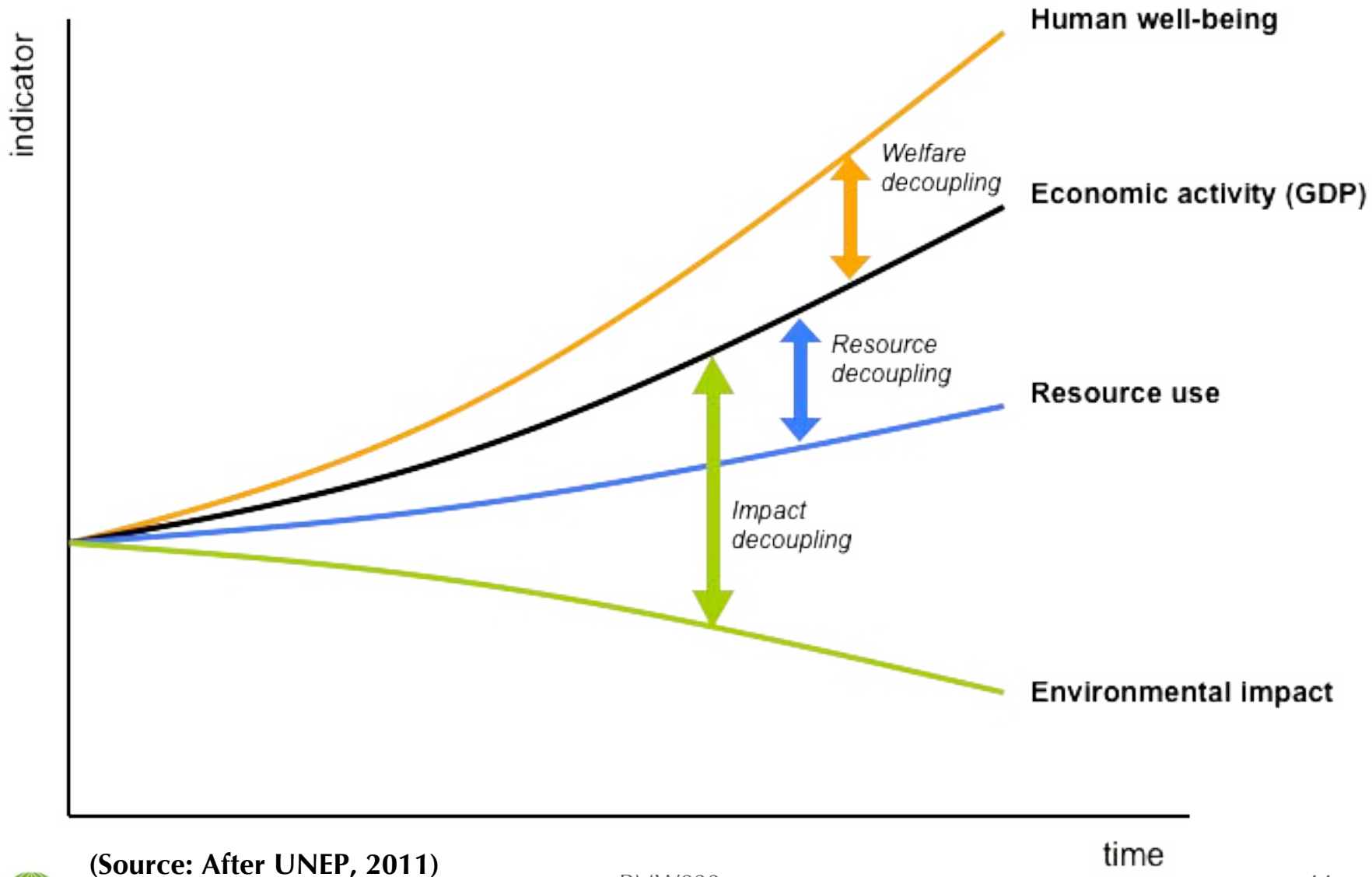


Figure: Exports of Waste Plastics from EU member states 1999-2011 (EEA, 2012)

4g. Main driver: Environmental impacts as main driver (1)

- Without a transition to a circular economy the environmental impacts related to the plastics life cycle are expected to increase. Environmental impacts could in time be the main driver for circular plastic value chains.
- The environmental impacts of plastic production and usage are expected to increase due to overall growth in production and increased impacts of resource extraction.
- The environmental impacts of plastics are currently not included in the price. The average total ecocosts of the production of thermoplastic virgin materials, for instance, is approximately 1 euro/kg (based on Eco-Costs approach), which is comparable to the current returns on the material.
- The total environmental impacts of a kg of plastics should, however, always be related to the total life cycle of the end applications, and can be highly positive. These ecocosts do not imply that plastics need to be substituted by other materials, as the lightweight and durable characteristics of plastics often make them a preferred material from a life cycle perspective.
- *True pricing*, inclusion of social and environmental life cycle costs in product prices, is an important step to stimulate development of mainstream markets for circular products.

4g. Main driver: Environmental impacts as main driver (2)



(Source: After UNEP, 2011)

4h. Other drivers

- Cost reduction by slashing unnecessary waste.
- Business opportunities, e.g. in recycling.
- The high volume of plastic waste flows as such forms an opportunity for the circular economy.
- Resource scarcity is *not* the main driver. The plastics industry is heavily relying on finite sources of hydrocarbons. As there are sufficient reserves of oil, gas (e.g. shale gas in USA) and coal, physical resource scarcity is unlikely in the coming decades. Renewable hydrocarbons furthermore offer an alternative for fossil hydrocarbons (oil). Economical scarcity might, however, occur, resulting in price volatility and price rises.

4i. Benefits & Opportunities of circular plastic value chains (1)

- The turnover of plastic recycling in the EU has increased rapidly during the last decennium. The total value of plastic recycling in the EU was 2,084 million euro in 2008 (EEA, 2012).
- Much recycling and energy recovery potential, however, still remains unrealized. Many companies in the plastic value chain recognize the major business opportunities in some of the plastic value chains.
- In the EU 40.9% of waste plastics was landfilled in 2011 with an energetic value of 12 million tonnes of crude oil (Potocnic, 2012), which represents a value of 3.6-6.0 billion euro (based on a crude oil price range of 300-500 euro/tonne) (JRC, 2012)
- **Recycling and energy recovery potential:** 25,1 Mtonne plastic waste was produced in 2011 (PlasticsEurope, 2012). Current recycling percentage is 25,1 (6,3 Mt) and energy recovery percentage is 34.1% (8,6 Mt) (PlasticsEurope, 2012). A future recycling percentage of 70% (EC, Green Paper, 2013) and an energy recovery percentage of 30% should be feasible.
- **Economic potential of recycling:** The prices of recyclable waste plastics range between 20-530 euro/t in Germany in 2009 (JRC, 2012), depending on many factors such as polymer type, source (pre- or post-consumer) and degree of contamination. Prices of recycled plastic grades varied from 250-600 euro/t in Germany in 2007 (JRC, 2012). Recycling of 9,0 Mt of waste plastics corresponds with an economic value in the range of **180 million - 5 billion euro**.

4i. Benefits & Opportunities of circular plastic value chains (2)

- **Economic potential of energy recovery:** The price range of low quality waste plastics is 25-100 euro/t. The energy content ranges widely between 14-30 GJ/t. The average cost of low value waste plastics is 2-3 eur/GJ (JRC, 2012). The cost price of low quality waste plastics would range between 42-135 million euro. With an efficiency rate for conversion into electricity of at most 30% 6,300,000-13,500,000 GJ could be generated. With an electricity price of 0.14 euro/kWh for household consumers in the EU27 ex tax and levies in 2012 (Eurostat, 2012), this corresponds with an economic value of **245-525 million euro**.
- Based on a 70% target, plastic recycling in 2020 could generate **160,000 jobs** in the EU (EC, Green Paper, 2013).
- Of all materials resource efficiency strategies, those for plastics have the highest ecological potential to prevent climate change, abiotic resource depletion and freshwater aquatic toxicity (BIOIS, 2011).

4j. Barriers: 1) Costs of Municipal Solid Waste Recycling Systems

- The recycling system of plastic (packaging) in municipal solid waste is currently not profitable, in contrast to other municipal recycling systems, like paper, metals and glass.
- High costs are mainly caused by collection costs due to the high volume of waste plastics. The costs for plastic collection by municipalities in the Netherlands, for instance, are €470-580 per tonne (DRIFT, 2012). For comparison, the costs of municipal solid waste are €104 per tonne and € 1.8 billion per year (Agentschap NL, 2012). For Plastic Heroes, the net costs for PET amount to 2.6 cent per bottle, with a projected decrease to below 1 cent per bottle (FNLI, 2012).
- In the Netherlands, the diverse approaches to waste management by municipalities lead to higher total system costs.
- The key issue in the debate on required system changes is the distribution of costs and benefits among stakeholders, e.g. costs of non-recycleable or easy littering products are passed to others in value chain.
- Recycling costs are increasing as well by decreasing waste flows, e.g. limited collection volumes and lightweight products (PET-bottles) (EUPR, 2013).

4j. Barriers: 2) Volume of Plastic Solid Waste

- In the Netherlands collection rates of plastic waste of households can be improved. Some cities do not yet participate and others offer insufficient collection facilities. There is a lack of coercive measures to persuade reluctant municipalities.
- Collection systems for waste from businesses - including SMEs and offices - are separate.
- There is an ongoing 'war on waste', a struggle over who gets high-value and low-value waste streams. After collection a large share of recyclable plastics is exported to China for recycling or incinerated, whereas these waste flows could be recycled in the EU as well.
- As a result, recycling companies leave part of their capacity unused (e.g. up to 75% for PET), which makes recycling more expensive (EUPR, 2013).

4j. Barriers: 3) Quality of Plastic Packaging Waste

- Low quality waste flows complicate treatment and make recycling less beneficial from a financial and environmental perspective.
- Low quality is caused by non-recyclable products, mixed (plastics) waste streams, organic contamination and chemical contamination.
- Major improvements can still be made in separation, sorting and recycling technologies.
- Successful high-quality collection requires a disciplined population and good recycling habits. This is facilitated by a logical and consistent waste disposal system with clear disposal instructions enabling automatic behaviour.

4j. Barriers: 4) Demand for Recyclate

- The quality of plastic recyclate is poor in general. There is major gap in quality of virgin and secondary plastics.
- End-markets are not willing to pay for secondary materials (Plastic recyclers Europe, 2012, p. 7) and expect lower prices than virgin materials.
- Virgin prices are related to the price of raw oil and the prices of recycled plastics are related to virgin prices. Customers often only choose for recycled alternatives when they are considerably cheaper than virgin plastics.
- Due to legislation secondary plastics are difficult to use in certain applications, e.g food packaging.
- High quality standards often prescribe the use of virgin materials and exclude the use of recycled materials.
- Some standards for recycled plastics, e.g. DKR-specifications, are old and need to be revised.

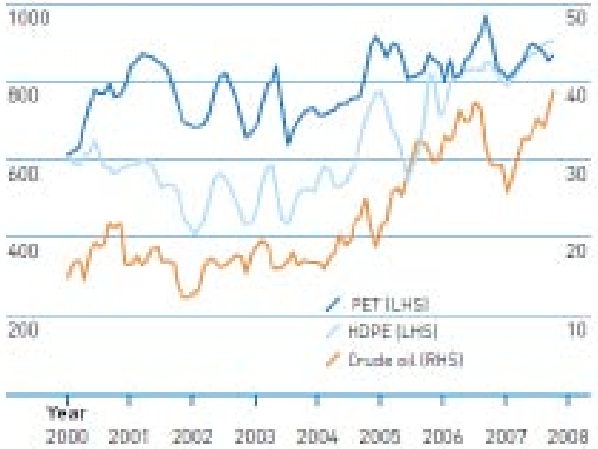


Figure: Crude oil and virgin polymer prices in GBP/tonne (Source: JRC, 2012)

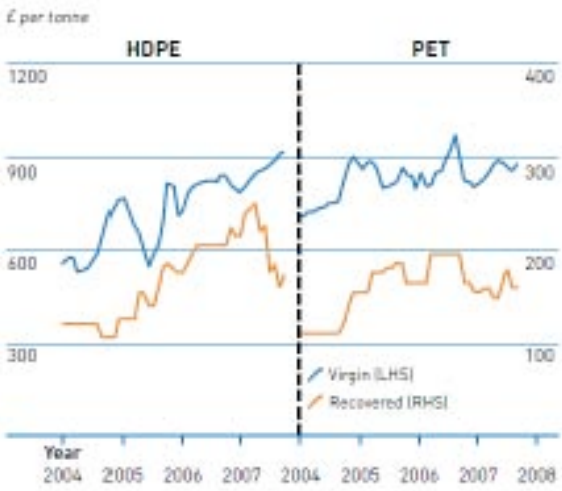


Figure: Virgin and recycled polymer prices in GBP/tonne (Source: JRC, 2012)

4j. Barriers: 5) Policy

- There is a major implementation gap. Many countries, mostly in South and Eastern-Europe lag behind in their waste systems. There are insufficient enforcement and controlling mechanisms (EC Green paper, 2013).
- There is a lack of ambitious and binding recycling targets and targets are often not specific for material (Plastic Recyclers Europe, 2012, p. 3).
- The sector based approach of the Waste Framework Directive not always suitable to optimise recycling of specific material flows (Hannequart & Bonnet, 2012). Many sectors are not covered at all.
- The legislative force of EU is under pressure, due to the economical and political crises. Some member states call for a review of environmental policies which have an impact on industrial competitiveness and stimulate economic recovery and environmental departments are facing reduced budgets.

4j. Barriers: 6) Coordination & Cooperation

- Plastic waste is seen as a new business opportunity by many value chain partners.
- As there is growing competition for feedstock, ‘a war on waste’ needs to be averted.
- Too many value chain partners, both industry and governments, still have interests in the linear value chain. The benefits of circular value chains are often only indirectly beneficial for those parties involved.
- The distribution of costs and benefits is a key issue.
- The debate on plastic waste is dominated by some stakeholders, while other key stakeholders are absent, e.g. end-markets.
- Governments have transferred part of the control of plastic waste management matters to industry.
- There is insufficient coordination on the general societal benefits of plastic waste management.

5. Conclusions & Recommendations of IMSA Amsterdam

a. Conclusions on: 1) plastic marine litter, 2) in relation to plastic waste management and 3) the Circular Economy.

b. Recommendation 1: Prevent Littering

c. Recommendation 2: Accelerate Circular Plastic Value Chains

d. Recommendation 3: Decouple Economic Growth from material use Specific recommendation on Barriers: 1) Costs, 2) Volume, 3) Quality, 4) Demand, 5) Policy and 6) Cooperation & Coordination

e. Recommendation 3: Decouple Economic Growth from material use

5a. Conclusions on plastic marine litter (1)

- Besides causing substantial damage to the North Sea animal life and costs for economical sectors, plastic marine litter (PML) has also entered our food chain.
- Policies on plastic marine litter and plastic waste management, as currently developed, are not expected to lead to an absolute reduction of plastic waste (in marine environments) and to solve the issue within one generation.
- Reduced littering is expected as a small indirect effect of improved waste management.
- Plastic marine litter is mainly caused by littering, either on land or at sea. Litter mainly consists of short-cyclic packaging materials, which should be a priority area for plastic marine litter and general waste policies.
- Overall, waste prevention is not covered in the business strategies while corporations consider littering to lie outside their producer responsibility.

5a. Conclusions on plastic marine litter (2)

More action on plastic marine litter is needed to:

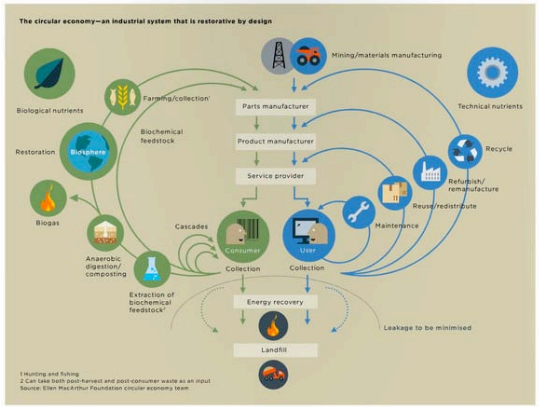
1. **Reduce littering**
2. **Accelerate Circular Plastic Value Chains**
3. **Achieve absolute decoupling** between plastics use and its environmental impact. Even with a Circular Economy for plastics, there will always be leaks. Additional measures are needed to reduce the total volume of (new and recycled) plastics used by replacing them with better alternatives where possible.

5a. Conclusions on plastic marine litter in relation to plastic waste management (2)

- Poor waste management systems are a major cause of marine litter in some European regions, but waste management in the North Sea region, and in the Netherlands in particular, is relatively outstanding.
- Improving waste management systems here will most likely not have a major impact on marine litter, as littering is the main cause.
- However, there is still an enormous potential to improve plastic waste management systems in North Sea regions, which would have substantial ecological and economical benefits.
- Perceptions on (plastic) *waste* are already shifting towards *resources*:
  'A revolution in waste management is upcoming'.
- (EU) policy is mainly approaching the waste hierarchy 'from bottom to top'. EU policy is effective in gradually the least favourable steps in the waste hierarchy, but more focus in needed in further development of resource policies to keep up with societal developments.
- Market failures at several levels need to be addressed to accelerate the development of circular value chains for plastic applications.
- Reduced littering is expected to be a small indirect effect of improved waste management.

5a. Conclusions on plastic marine litter in relation to the circular economy (3)

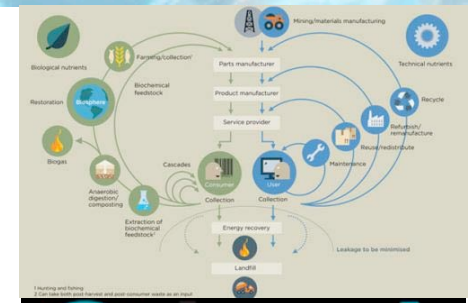
- The plastic marine litter issue might lose its momentum.
- To boost action against PML it is essential to couple it to the concepts of Circular Economy and Resource Efficiency.
- The CE philosophy is inherently appealing as it is positively framed in terms of ecological *benefits*, economical *benefits* and *enhanced cooperation* instead of ecological *impacts*, economic *costs* and *responsibilities*.



5b. Recommendation 1: Prevent Littering

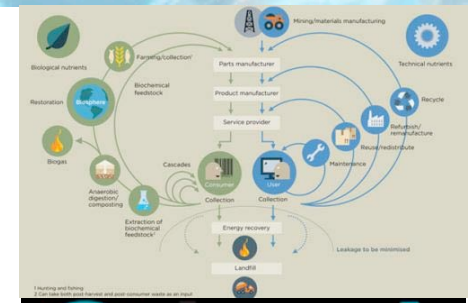
1. Make marine litter a *priority* of existing littering reduction campaigns and prevention schemes.
2. Apply new insights in influencing *behaviour of people* to littering *prevention* schemes.
3. Make *waste infrastructure* logical and consistent to enable automatic behaviour.
4. Develop additional *incentives* for consumers to separate and recycle their waste, e.g. innovative pay-back schemes.
5. Encourage *clean-up* of street litter, e.g. voluntary clean-up campaigns and structural schemes.
6. Share *best practices* in littering approaches and intensify *cooperation* between public, business and NGO initiatives.

5c. Recommendation 2: Accelerate Circular Plastic Value Chains (1)



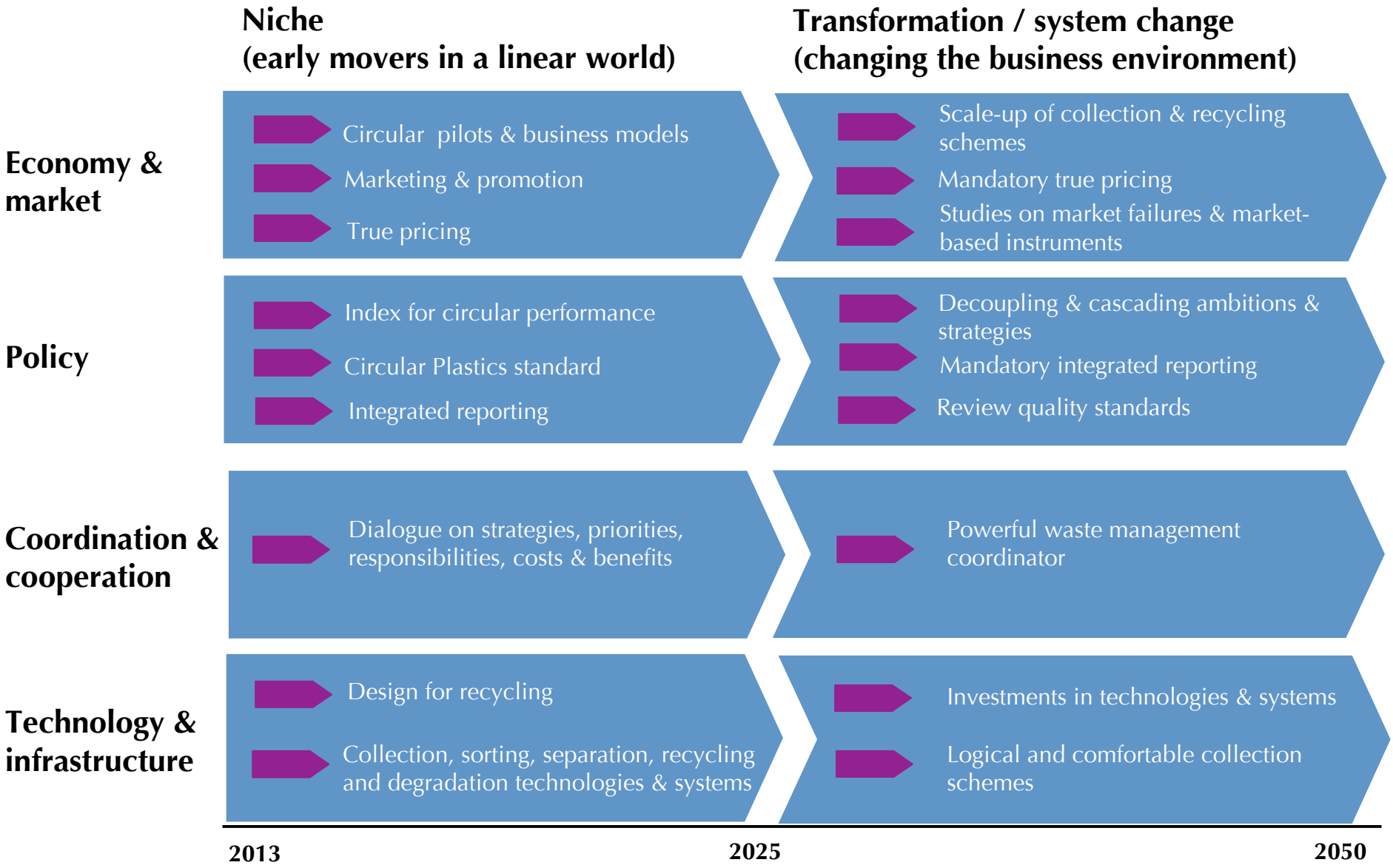
1. Launch a *powerful initiative* aiming at a circular supply chains for priority plastic value chains, e.g. packaging, textiles, toys.
2. Initiate *circular pilots* for plastics applications and spread the results of successful business examples.
3. Start a *science-based dialogue* on long-term decoupling strategies and optimal pathways for plastics materials.
4. Start an *open dialogue with all stakeholders* on responsibilities and distribution of costs and benefits over the value chains.
5. With frontrunners, develop an accessible and appealing *circular plastics index* based on a simple index for circular performance, starting with kg and euros recycled.

5c. Recommendation 2: Accelerate Circular Plastic Value Chains (2)

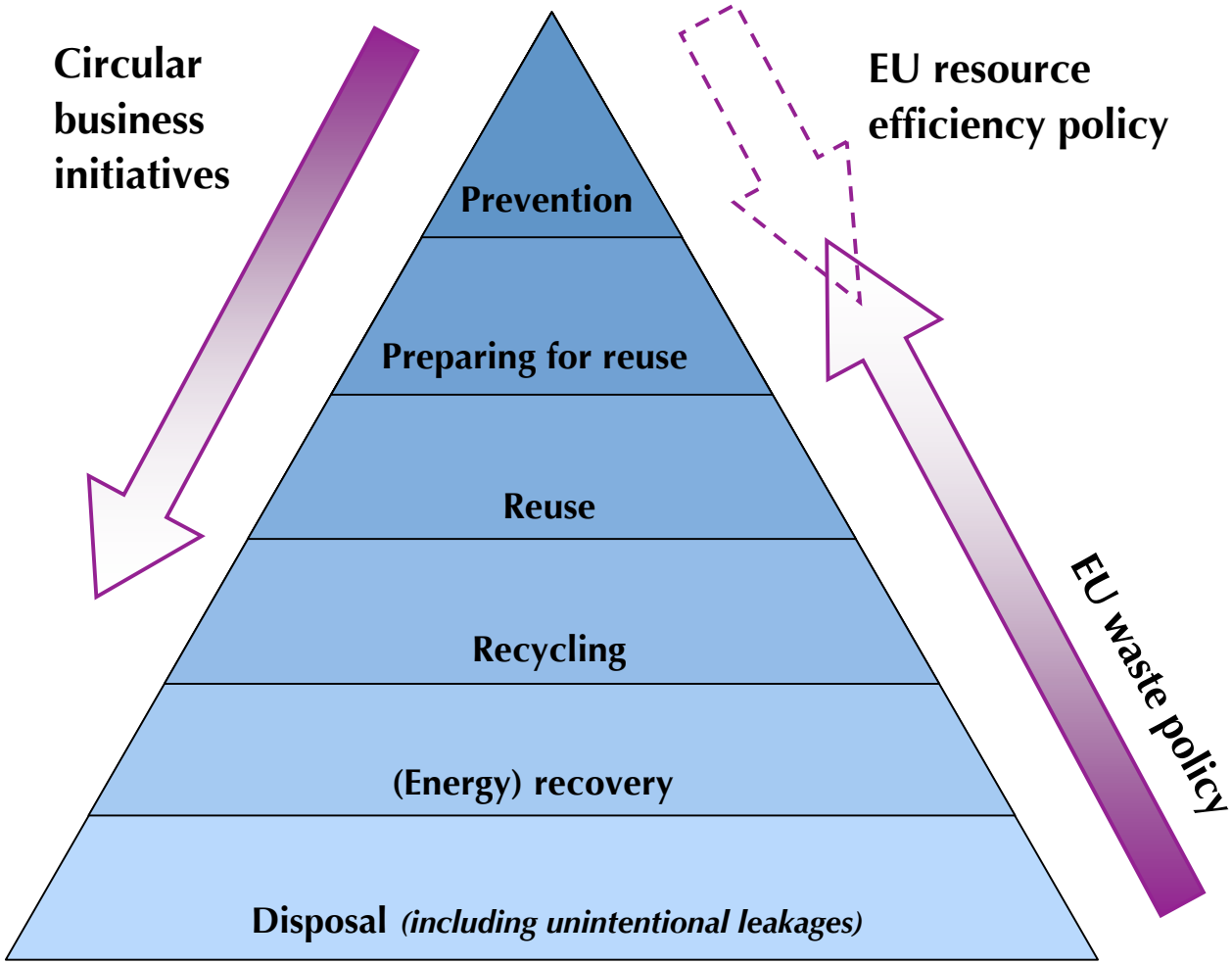


6. To work towards *True Pricing*, start with Integrated Reporting within the plastic value chains to include the environmental damage of plastic(marine) litter using extended life cycle assessments. As a basis, look at PUMA's Environmental Profit and Loss account and at the concept of True Value worked on by the World Business Council for Sustainable Development (WBCSD).
7. Base company decisions on material choices on the outcome of True Pricing (or similar) comparisons with possible alternatives. This provides a science-based approach to stimulate designing packaging that is, e.g., truly biodegradable in the marine environment, or is made of materials with the lowest possible impact, or is a part of an innovative service system preventing littering.

5c. Recommendation 2: Accelerate Circular Plastic Value Chains (3)



5c. Recommendation 2: Accelerate circular chains (and decouple) (4)

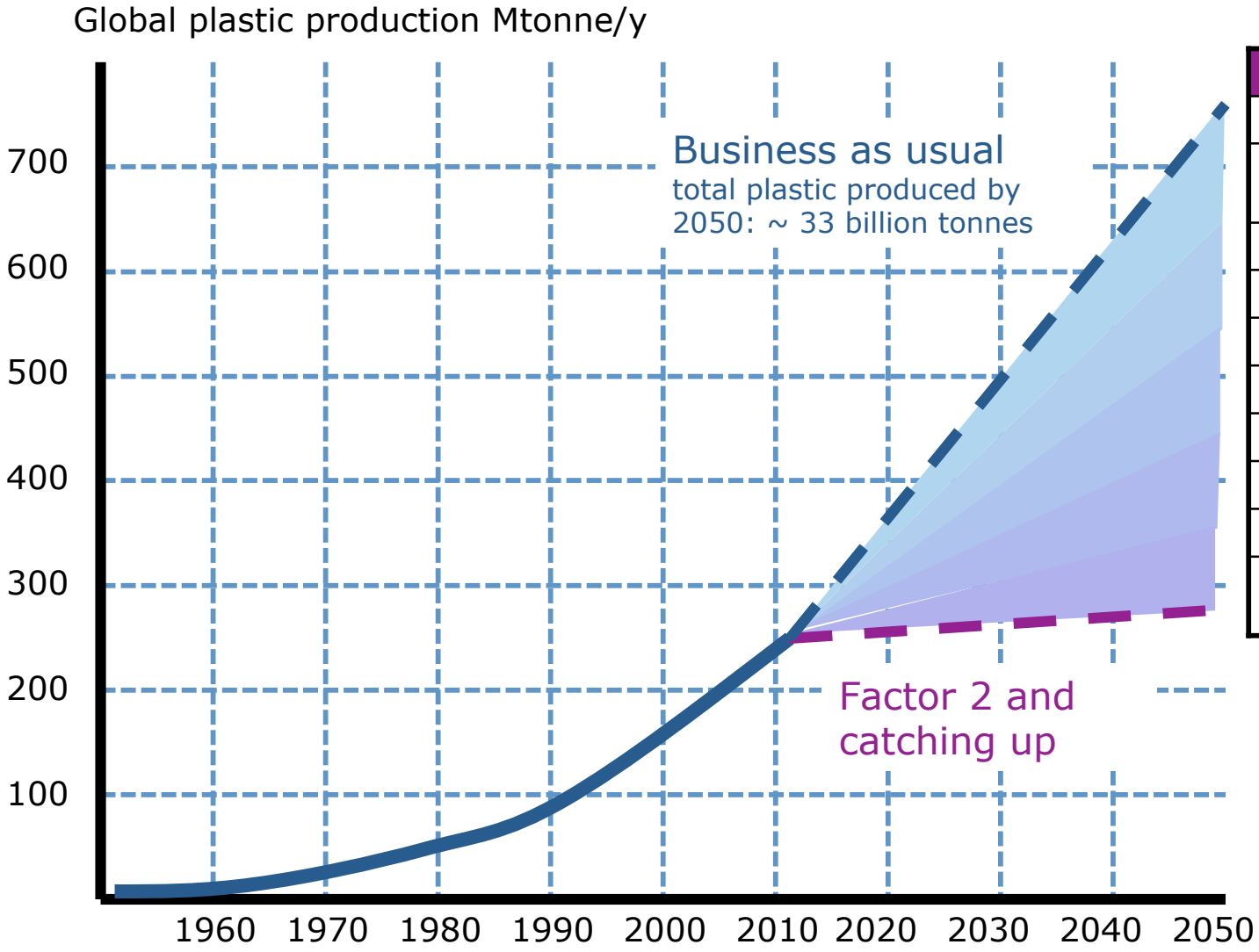


5d. Recommendation 3: Decouple economic growth from material use (1)

1. Decouple economic growth from material use (including plastics) by employing of a mixture of effective absolute reduction strategies (see next slides).

- Global plastic usage is expected to triple up to 2050 to 750 Mtonne/y (Wurpel et al., 2011), caused by population growth and economic growth.
- The wedge model (see next slide) lists effective absolute strategies to reduce (virgin) plastics usage and intends to quantify expected reduction potential of these strategies. It is based on on wedge model for carbon strategies (Socolow, 2005; Wurpel et al., 2011; Allwood et al., 2013)
- In the case of plastics the reduction potential of these strategies are in general not yet underpinned by scientific data. It is not yet clear which strategies are most effective.

5d. Recommendation 3: Decouple economic growth from material use (2)



Strategy
Optimize lightweight design
Minimize single-use disposable products
Prolong product lifetimes
Cleaner production
Reuse products
Reuse components
Mechanical recycling
Chemical recycling
Replace products by services
Ban of high impact plastic products

5e. Specific Recommendations on Costs

1. Reduce costs by better value chain coordination: establish a powerful value chain coordinator for (municipal) waste management.
2. Reduce costs of plastics recycling systems by scale-up.
3. Develop a cost-effective, uniform collection scheme.
4. Start a market study on prices of virgin and recycled plastics and potential effects of different market-based instruments
5. Make secondary plastics economically attractive, e.g. by true pricing.

5e. Specific Recommendations on Volume

1. Develop an optimal mix of for pre-separation and post-separation to maximise recovery of both high- and low-value waste flows.
2. Increase collection rates of municipal waste and stimulate municipalities by market-based instruments, e.g. bonus-malus systems.
3. Evaluate connection of certain SMEs business waste flows to the municipal system (offices, shops, restaurants).
4. Evaluate connection of waste flows in public space and potential introduction of a uniform recycling-on-the-go system.
5. Optimise the 'comfort'-factor for citizens and SMEs.
6. Prevent leakage of good recyclate by market-based instruments, e.g. incineration tax.

5e. Specific Recommendations on Quality

1. Optimise the quality of plastics waste streams by pre-separation to maximise benefits of recycling.
2. Create a logical and consistent waste disposal system with clear disposal instructions enabling automatic behaviour.
3. Invest in cost-effective sorting and separation technologies.
4. Simplify cost-effective sorting and separation by *design for recycling*.
5. Implement (combinations) of new solutions to waste management such as *Afval Loont*.

5e. Specific Recommendations on Demand

1. Accelerate the ongoing professionalisation and consolidation process in mechanical recycling industry.
2. Invest in sorting and separation technologies and mechanical recycling technologies to increase the quality of recycled plastics.
3. Develop and invest in chemical recycling technologies.
4. Make recycled materials more attractive for end-markets, by price incentives such as a VAT reduction.
5. Reward early movers, e.g. by bonus systems.
6. Make recycled products more attractive for consumers.
7. Review existing quality standards for recycled plastics and for end market products.

5e. Specific Recommendations on Policy

1. With respect to plastic marine litter and plastic waste management, policies should focus on packaging.
2. Develop strategies to balance supply and demand, e.g. to reduce the current Dutch overcapacity of incineration.

5e. Specific recommendations on Coordination & Cooperation

1. Improve value chain coordination and give mandate and to one powerful value chain coordinator.
2. Identify potential trade-offs among stakeholders and win-wins to overcome lock-in situations in waste management.

6. Results of the stakeholder meeting

This chapter lists the priority recommendations according to the stakeholders who participated in two working groups during a stakeholder meeting at 28 March 2013:

a. **Programme of the Stakeholder Meeting**
b. **Stakeholder Priorities to Prevent Littering**
c. **Stakeholder Priorities to Accelerate Circular Plastic Value Chains**

6a. Programme of the Stakeholder Meeting

- Opening (Elfrieke van Galen, chair)
- Presentation en discussion on results of the Plastic Marine Waste study (Janneke Pors)
- Pitch 'Towards a programme of measures for marine litter' (Lex Oosterbaan, RWS)
- Pitch 'Afval loont, a revolution in waste collection' (Jørgen van Rijn, Ryck B.V)
- Introduction to 'Insights of Nederland Schoon, a littering programme in the Netherlands' (Henk Klein Teeselink, Nederland Schoon)
- Introduction to 'Plastic waste management' (Ulphard Thoden van Velzen, Wageningen UR)
- Discussion in two working groups:

  1. Littering (moderator Elfrieke van Galen, expert Henk Klein Teeselink)

  2. Circular value chains (moderator Janneke Pors, expert Ulphard Thoden van Velzen)

  All presentations can be downloaded at www.plasticmarinelitter.eu.

6b. Stakeholder Priorities to Prevent Littering (Working Group 1)

1. Education and awareness on marine litter and on the value of seas and marine ecosystems.
2. Develop additional incentives for consumers to separate and recycle their waste.
3. Ban harmful applications if education and incentives do not result in changed behavior.
4. Focus on water ways.
5. Make marine litter a priority of existing littering reduction campaigns and prevention schemes.
6. Apply new insights in influencing *behaviour of people* to littering prevention schemes.
7. Tighten enforcement.

6b. Stakeholder Priorities to Prevent Littering (Working Group 2)

1. Apply new insights in influencing *behaviour of people* to littering prevention schemes.
2. Coordinate waste management approaches of organisations responsible for land and water management.
3. Stimulate 'product design' which inherently prevents littering.
4. Make producers and retailers responsible for 'end-of-life'. Make littering obligations part of the license of entrepeneurs, e.g. to unpack ice creams or hand out disposal bags.
5. Optimize waste infrastructure to prevent waste after disposal, e.g. cover bins in public space.
6. Make waste infrastructure attractive and accessible, e.g. clean bins.

6c. Stakeholder Priorities to Accelerate Circular Plastics Value Chains (Working Group 1)

1. Start with long term vision and strategy development up to 2050 and define both desirable and non-desirable scenarios.
2. Develop effective governmental policies. Draw a lesson from policy development in the past, e.g. transition from landfilling to incineration.
3. Develop adaptive measures which can be adjusted at a later stage.
4. Explore 'true pricing mechanism' for plastic materials at EU level.
5. Stimulate 'design for recycling' to enhance recyclability of products, e.g. consider toxic substances and large material diversity.

6c. Stakeholder Priorities to Accelerate Circular Plastics Value Chains (Working Group 2)

1. Establish a powerful waste management coordinator to overcome special interests of stakeholders.
2. Develop more flexible short term tendering and contracting procedures for local authorities and enable review of long term waste handling contracts.
3. Bring 'ownership of waste & end-of-life' back to the producer.
4. Stimulate 'design for recycling' to enhance recyclability of products (*just like Working Group 1*).
5. Provide public-private investments to stimulate companies that are trying to develop recycling technologies and infrastructure.
6. Organize a discussion on implications, opportunities and limitations of circular plastics value chains.

7a. Follow-Up on Plastic Marine Litter

1. Ongoing stakeholder initiatives, a.o. of Ministry of Infrastructure & Environment (NL) and Marlisco (EU).
2. EU DG Environment organises a conference on Prevention and Management of Marine Litter in European Seas (Berlin, April 2013).
3. IMSA Amsterdam will bring in her conclusions and recommendations and the priorities as established during this stakeholder meeting.

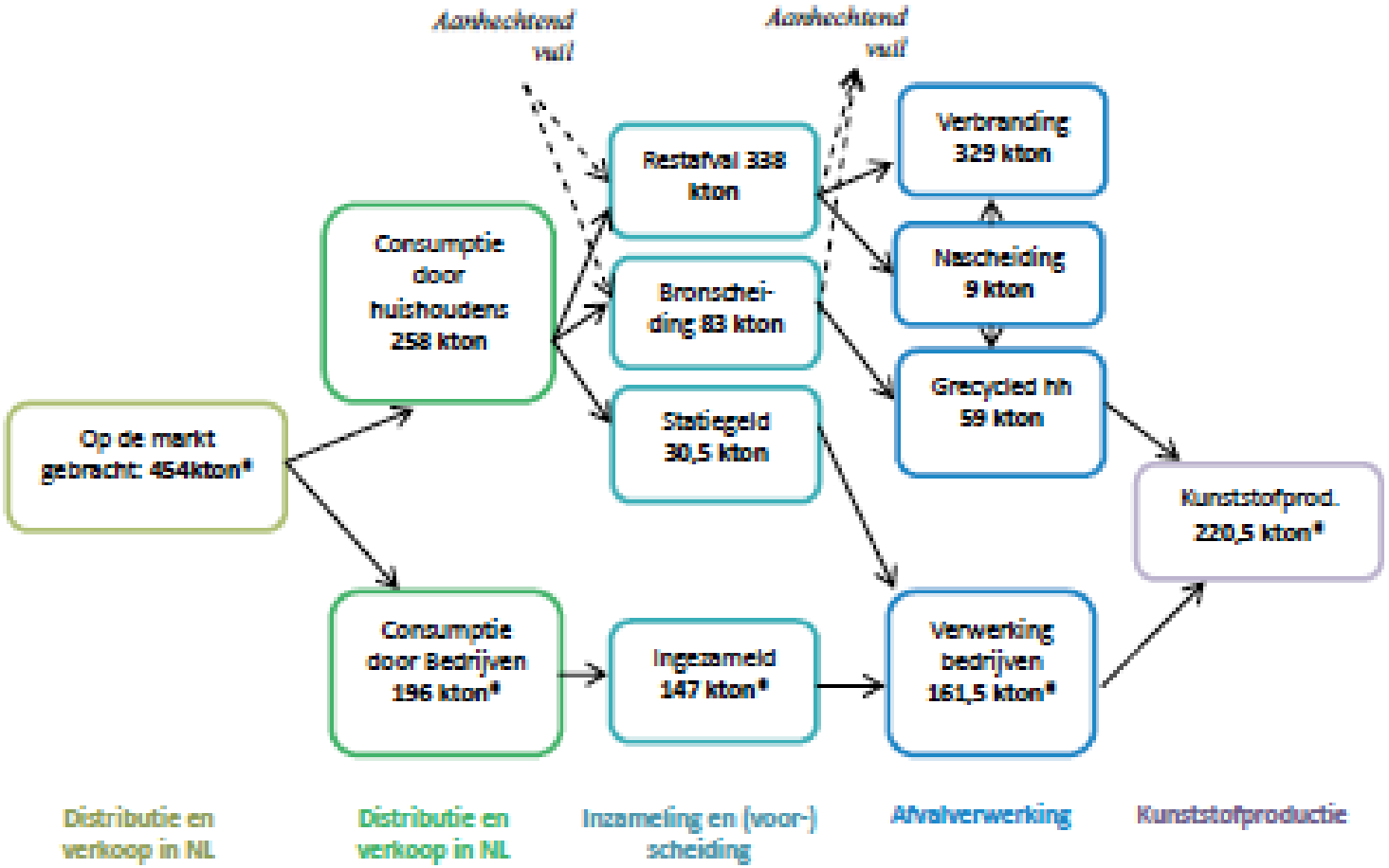
7b. Follow-Up on Circular Plastic Value Chains

1. The EU Green Paper will to a large degree shape EU policy on plastics in different stages on the life cycle.
2. The Dutch Knowledge Institute Sustainable Packaging (KIDV) will address many, but not all of the plastic packaging issues related in the Netherlands.
3. Outcomes of both initiatives strongly depend on the stakeholders involved, issues regarded, policy options considered and the funding made available.
4. IMSA Amsterdam will bring the results of this study and stakeholder meeting to the attention of these initiatives.
5. The Circle Economy platform is working with breakthrough partners, still looking for new ones and is organizing a Circular Economy Boostcamp (Randstad, NL, 24-26 May 2013).
6. Funding and commitments are needed for concrete, science-based pilots and projects to create circular loops and improve waste management, both for IMSA and other stakeholders.

Annexes

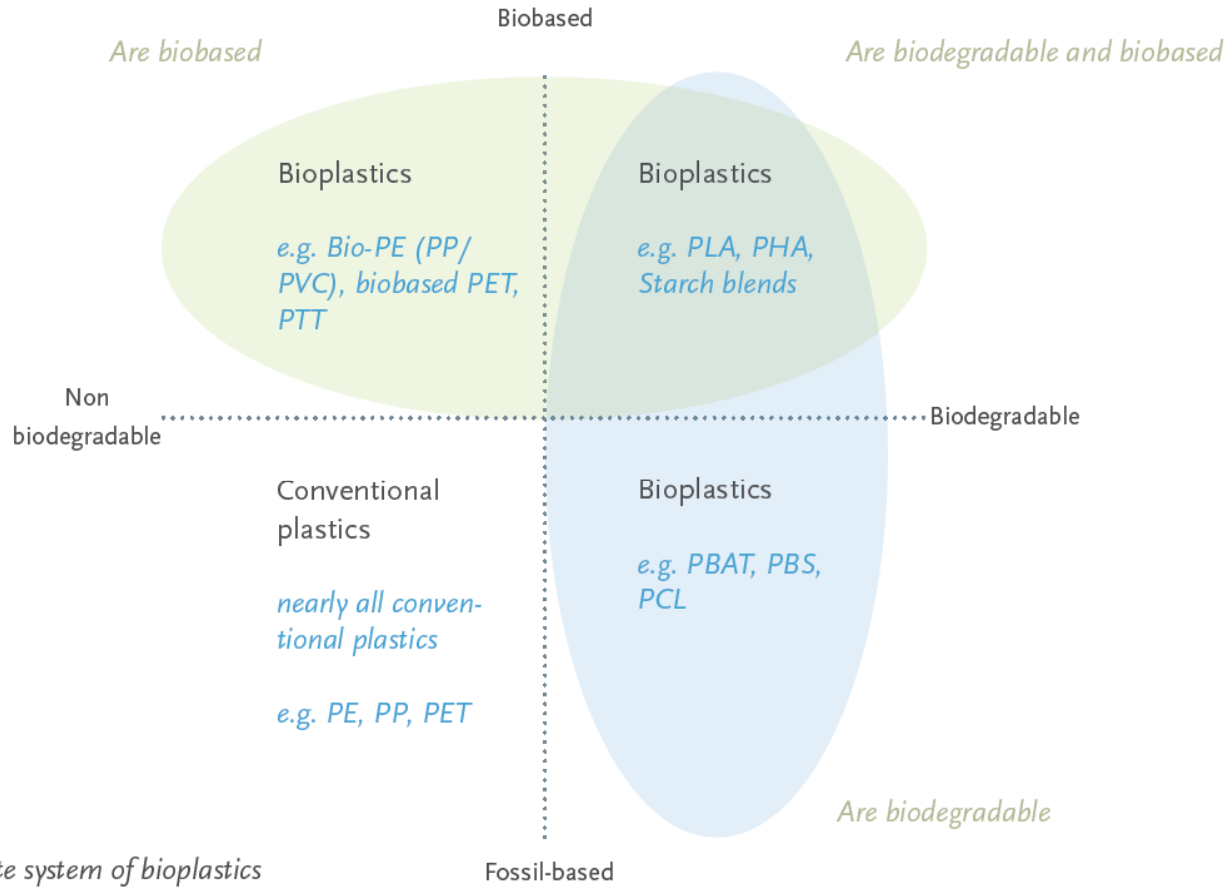
1. Annex 1: Mass flows of plastic packaging in the Netherlands
2. Annex 2: System of plastic materials
3. Annex 3 Environmental comparison of mechanical recycling & incineration
4. Annex 4: Greenhouse Gas comparison on Municipal Solid Waste treatment options
5. Annex 5: List of interviewees
6. Annex 6: List of participants of the stakeholder meeting March 28 2013

Annex 1: Mass Flows of Plastic Packaging in the Netherlands



Source: Drift, 2012

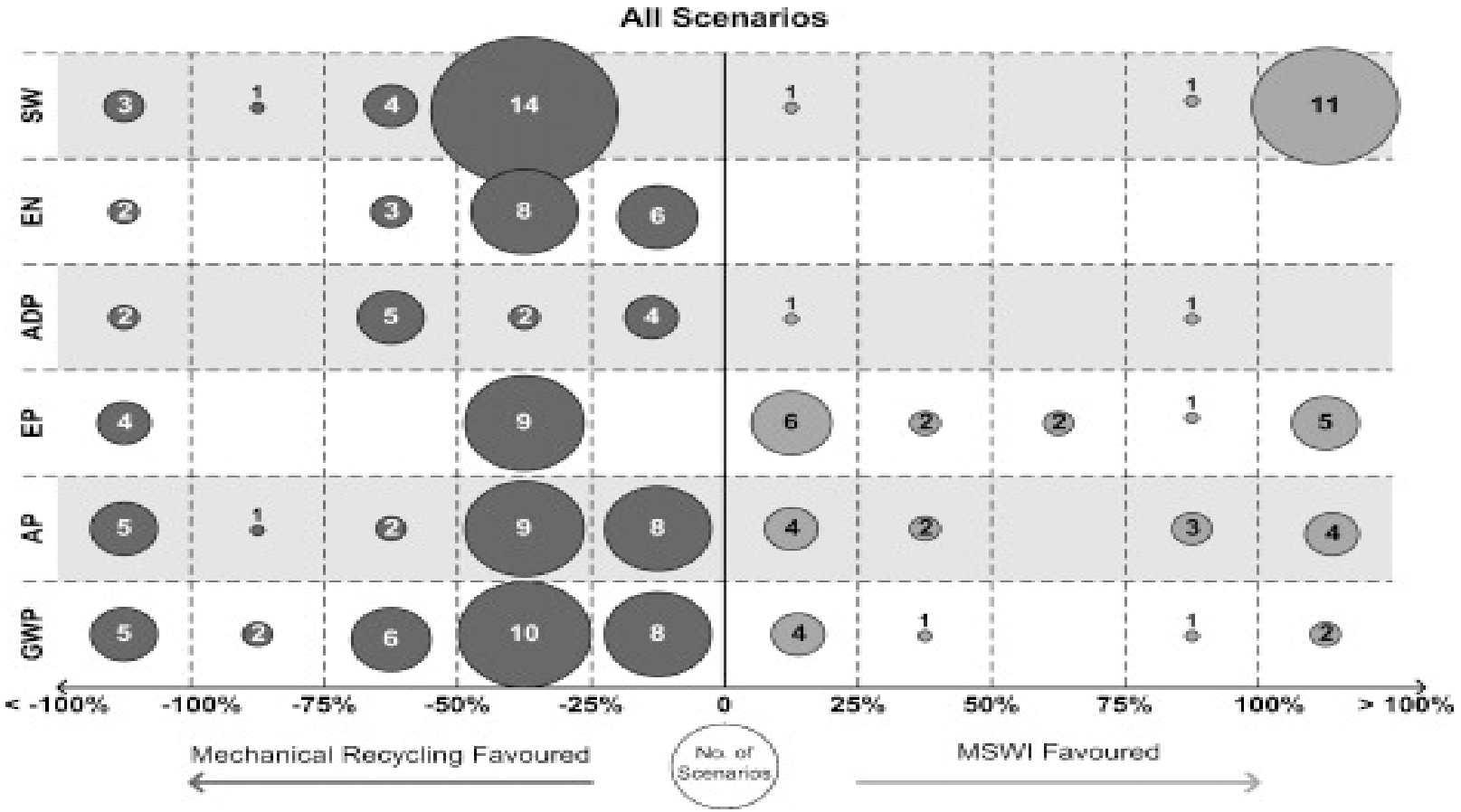
Annex 2: System of plastic materials



Graph:
Material coordinate system of bioplastics
Prof. Dr. Ing. H.-J. Endres, IfBB
University of Applied Sciences and Arts

Source: European Bioplastics, 2012

Annex 3: Environmental Comparison of Mechanical Recycling & Incineration (1)

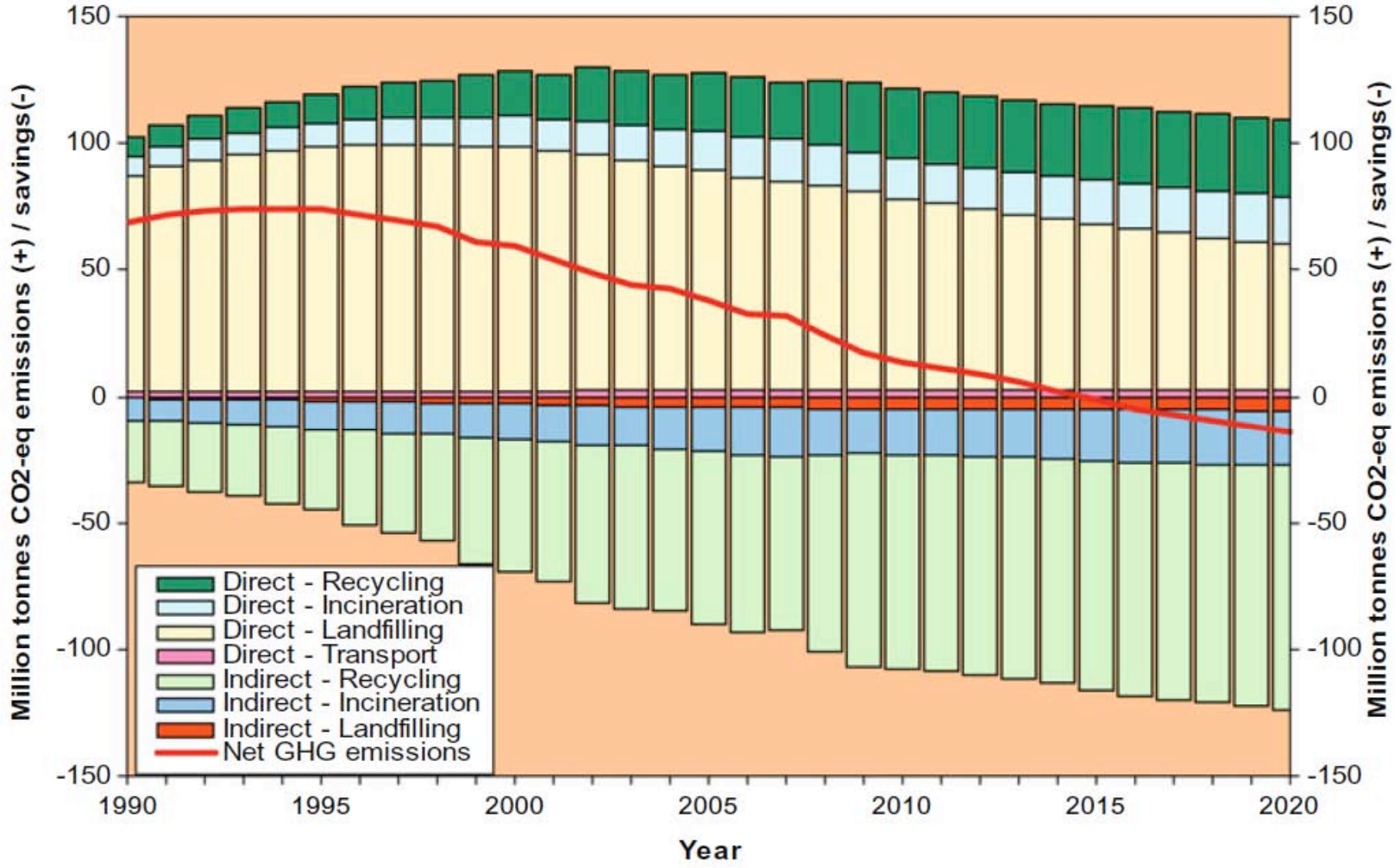


The circle size indicates the number of LCA studies showing environmental impacts in the corresponding range (see also next slide)

Annex 3: Environmental Comparison of Mechanical Recycling & Municipal Solid Waste Incineration (2)

- The meta LCA study of Lazarevic compares different waste management scenarios for municipal solid waste: mechanical recycling, chemical recycling, incineration with and without energy recovery and landfilling (based on 10 LCA studies assessing 27 scenarios) (Lazarevic et al., 2010)
- The figure shows relative comparisons on several impact categories: GWP = global warming potential, AP = acidification, EP = eutrophication, ADP = abiotic resource depletion, EN = energy use, SW = residual solid waste for landfill.
- Most studies show that mechanical recycling has 25-50% less impact than Municipal Solid Waste incineration (with energy recovery).
- The study in general indicates that the waste hierarchy is a legitimate guideline for waste management policies.

Annex 4: Greenhouse Gas Comparison of Municipal Solid Waste treatment options in EU-27 (1)



Annex 4: Greenhouse Gas Comparison of Municipal Solid Waste treatment options in EU-27 (2)

- This study has examined effects of municipal solid waste management on GreenHouse Gas (GHG) emissions (not specific for plastics) in the EU-27 plus Switzerland and Norway (Bakas et al, 2011).
- To see the overall effect, avoided emissions (negative emissions) are added to direct emissions of treatment options (landfilling, incineration and recycling), giving net GHG emissions from Municipal Solid Waste (MSW) management.
- The figure shows that direct emissions are decreasing after 2005 in spite of growing MSW generation as a result of better waste management.
- The benefit of material recovery (recycling) is much bigger than the benefit of energy recovery and constitutes more than 75% of the total avoided emissions.
- Recycling is assumed to reach a level of 49% and energy recovery 23% in 2020, based on a business-as-usual scenario.
- Improved MSW management, mainly recycling and to a lesser degree incineration with energy recovery, leads to a relative reduction of net GHG emissions over time.

Annex 5: List of interviewees

- Frans Beckers and Ruud van Mierlo, Van Gansewinkel
- Rudi Daelmans, Desso
- Kees Donker, Unilever
- Jan Andries van Franeker, IMARES
- Roberto Gomez, PlasticsEurope
- Hester Klein Lankhorst, Kennisinstituut Duurzaam Verpakken
- Jos Koster, Gemeente Pijnacker
- Helmuth Maurer and Leo de Vrees, European Commission
- Bernard Merkx, European Plastics Recyclers
- Joris van der Meulen, Kunststof Hergebruik B.V.
- Cees de Mol van Otterloo, Afvalfonds Verpakkingen
- Lex Oosterbaan, Ministry of I&M/RWS
- Jørgen van Rijn, Ryck B.V.
- Aafko Schanssema, VMK
- Ulphard Thoden van Velzen, Wageningen University (WUR)
- Helene van Zutphen and Henk Klein Teeselink, Nederland Schoon

Annex 6: List of participants of the stakeholder meeting

- Floris van Hest, Adessium
- Eric-Jan Tuininga, Crystal Sea Foundation
- Myra van der Meulen, Deltares
- Rudi Daelmans, Desso Group
- Monique Bruining, DPI
- Jos Koster, Gemeente Pijnacker
- Elfrieke van Galen, IMSA Amsterdam
- Janneke Pors, IMSA Amsterdam
- George Wurpel, IMSA Amsterdam
- Janne van den Akker, IMSA Amsterdam
- Yvon Wolthuis, ISI
- Heather Leslie, IVM
- Gijsbert Tweehuysen, Kastoro
- Bert Veerman, KIMO Nederland/België
- Joris van der Meulen, Kunststof Hergebruik B.V.
- Louisa Crijns, Ministerie van I&M
- Mareike Erfeling, Ministerie van I&M
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