

Industry Agenda

Project MainStream – a global collaboration to accelerate the transition towards the circular economy Status Update

Prepared in collaboration with the Ellen MacArthur Foundation and McKinsey & Company

January 2015



Foreword

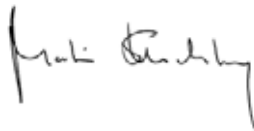
Dame Ellen MacArthur
Founder
Ellen MacArthur
Foundation



**Dominic Kailash
Nath Waughray**
Head of
Public-Private
Partnerships
Member,
Management
Committee
World Economic
Forum



**Martin R.
Stuchtey**
Director of the
McKinsey Center
for Business &
Environment
Project adviser
to Project
MainStream



There is a growing recognition that our current take-make-dispose model of economic growth will not deliver the economic and human development we aspire to in the long term. The circular economy is increasingly being adopted as a practical approach to create an economy that is restorative by intent.

Project MainStream is an initiative to identify and unblock the systemic stalemates that stop circular economic activity getting to scale across global value chains. It is one of the World Economic Forum's global cross-industry projects forming part of its Global Challenge Partnership for Resource Security. Project MainStream brings together some of the world's leading cities, businesses and governments to address areas where a public-private redesign of our systems and global value chains is possible. It focuses on areas where barriers to transforming efficiency of materials use are too big or too complex for any one individual entity to overcome. To do so, MainStream leverages the combined networks and platforms of the World Economic Forum and the Ellen MacArthur Foundation – working with the McKinsey Center for Business & Environment as our valued project adviser.

We are delighted with the progress that Project Mainstream has made in the 12 months since it was launched at the Annual Meeting in Davos in 2014. As you will see in this report, the initiative is now moving from analysis to action.

Following extensive discussions among the companies on our Steering Board, this report identifies specific sectors and value chains in the global economy that are most ripe for practical action. It quantifies the economic case for doing so and sets out a practical project proposition in each case.

The first area Project Mainstream identifies for action centres on plastic packaging. Today's "plastics" economy, despite a multitude of recycling initiatives, remains overwhelmingly linear; for even the most recycled plastic packaging material, polyethylene terephthalate (PET), 93% is still produced from virgin sources. In 2015, Mainstream will work with manufacturers, retailers, recyclers and cities to develop and apply principles for an economy where plastic packaging never becomes waste but re-enters the economy as a valuable biological or technical nutrient. The win is potentially huge. At present, \$2.7 trillion of plastic materials is "lost" from the economy – much of this is packaging from fast moving consumer goods such as food/beverage and home/personal care products which is wasted after a single use. The upside for the economy, for the environment and for new jobs if this waste were turned into an asset is compelling.

Other high impact ideas for public-private collaborations are also emerging from Project MainStream's unique platform and are under development for the year ahead. Leveraging the expertise and insight from across the Forum's industry communities and the Ellen MacArthur Foundation's network of Circular Economy 100, other initiatives are underway in eco-design for paper and board, as well as tracking of components and parts with potential initial focus on consumer electronics and medical device industry.

The potential for Mainstream to transform value chains and unlock clear economic benefit is becoming increasingly apparent.

We would like to thank our Industry Partners and Steering Board Members who have been engaged in this journey to date, and we look forward to the next phase of Project Mainstream as the delivery projects emerge and begin implementation.

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Contents

3	Introduction and topline results
6	Plastic Packaging
12	Paper and Paperboard
16	Asset Tracking
22	Definitions

Introduction

Context and Background

Following the January 2014 publication of the report *Towards the Circular Economy: Accelerating the scale-up across global supply chains*, the World Economic Forum has been working in partnership with the Ellen MacArthur Foundation and with the support of McKinsey & Company on Project MainStream, a collaborative initiative which could help businesses shift towards a circular economy that could save \$1 trillion in materials per annum by 2025 and prevent 100 million tonnes of waste globally.

Project MainStream works with companies to scale the circular economy through materials management, business model innovation, use of information technology and creation of partnerships, among others. It is a multi-industry, chief-executive-officer-led global initiative to accelerate a series of business-driven innovations. Project MainStream focuses on areas of stalemate in the economy, where public-private, or pre-competitive, collaboration is required across industries and value chains to unlock economic opportunity. It aims to establish proof of concept, with the goal of positioning the circular economy as the “new norm”. Project MainStream identifies areas of potential and then brings together unique groups of key stakeholders to identify and execute workstreams that will break through barriers to change. These can range from a global approach to the reuse of a particular material to policy road maps informing governments and regional pilots providing proof of concept of new business- and partnership-models. Many industry leaders have already committed to be part of this effort. The project is driven by a steering board composed of Brambles, Brightstar, BT, Desso, Royal DSM, Ecolab, Indorama Ventures, Kingfisher, Royal Philips, Suez Environnement and Veolia, supported by many other companies and organizations.

Approach to Identifying Focus Programmes

Project MainStream was started at the World Economic Forum Annual Meeting 2014 in Davos-Klosters, Switzerland. Since then, the project team has identified the first wave of focus programmes (Figure 1) to accelerate the transition to a circular economy. The process comprised of the following steps:

1. During the first six months of 2014, the project team screened for focus analysis programmes in consultation with important project members and in close collaboration with industry experts. As a result:

- The team identified 16 material flows including paper, polyethylene terephthalate (PET), glass, steel, aluminium, textiles and food waste, as well as inner-loop circular economy enablers in seven categories including technologies, market exchanges and regulation, from which to identify a short list of potential focus analysis programmes.
- From those options, the team eliminated those judged unattractive (via assessment of user preferences, current leakage, value-add of MainStream, assessed potential of impact (material savings, industry reaction time, scale), and evaluated feasibility of implementation.

2. Three programmes were selected for immediate focus:

- PET and polyester
- Paper and paperboard
- Asset tracking

Further, polymers (polypropylene [PP], polyethylene [PE]) and future materials were identified as next areas of focus.

3. For each programme in immediate focus, the team assessed a number of aspects:

- Current value leakage in the system and overall market trends
- Type and size of value leakage
- Levers to address value leakage and underlying initiatives
- Composition of round tables and identification of necessary participant organizations

Top-Line Results of Focus Programmes

- PET and polyester:

Annual material demand for PET and polyester totals about 54 million tonnes, of which roughly 86% (about 46 million tonnes) leaks out of the system. If Project MainStream can lay the foundation to recycle polyester – which is currently collected but is either landfilled or burned – not only would the volume of non-collected polyester be reduced by 10%, nearly \$4 billion in value could be created.

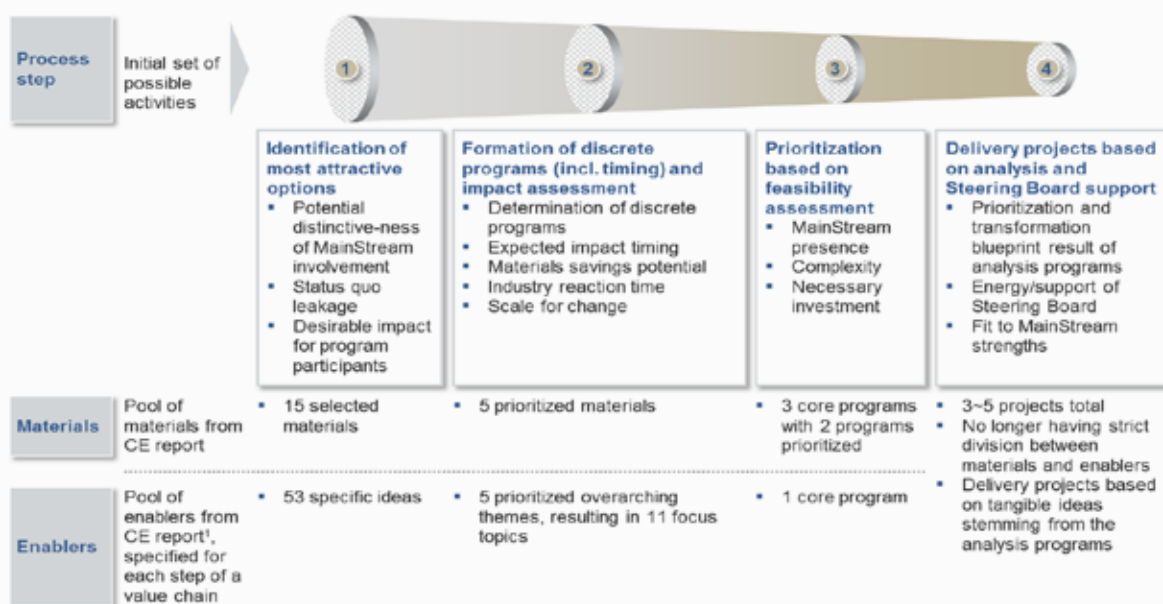
- Paper and paperboard:

Total annual production of paper and paperboard will amount to about 480 million tonnes in 2020. Some 27%, or roughly 130 million tonnes of this total, leaks out of the system and can be addressed by Project MainStream (83% of this leakage is driven by collection in countries below best-in-class). This addressable value leakage is worth about \$10 billion.

- Asset tracking:

Globally, consumer electronics and household appliances with a cumulative input value of roughly \$390 billion reach end of life each year. Consumer electronics produced almost 50 million tonnes of e-waste in 2012. Asset tracking could help unlock a potential value of about \$52 billion annually in these sectors alone, through more reuse, remanufacturing and recycling, in a scenario of modest improvement.

Figure 1. Coupling Analyses and Consultation with Participating Companies Yielded Three Core Programmes



Source: Project MainStream core team analysis

Delivery Projects

Round tables with industry experts and leaders of companies in the three identified focus programmes yielded three potential delivery projects. These projects play to the particular strength of Project MainStream, namely, resolving stalemates by providing a pre-competitive platform to discuss, design and implement industry-wide or even cross-industry solutions – solutions that touch multiple value-chain segments to improve the circularity of materials and goods.

The three delivery projects are:

– **Plastic packaging:**

While the initial analysis programme focused on PET and polyester, subsequent discussions uncovered a major opportunity in the overarching plastic-packaging space. As such, the project team decided that the first polymer-related delivery project would focus on plastic packaging for fast-moving consumer goods (FMCG). At present, \$2.7 trillion of materials from the FMCG segment (e.g. food and beverages, home) are “lost” from the economy. The second Towards the Circular Economy report by the Ellen MacArthur Foundation identified a \$700 billion materials savings opportunity for this sector. Much of the opportunity results from packaging that is currently wasted after a single use. For even the most recycled plastic-packaging material, PET, 93% is produced from virgin sources. Individual cities cannot influence packaging design by multiple global manufacturers. Similarly, individual FMCG companies cannot influence the design of collection, segregation and disposal systems in multiple cities. So the system is in a stalemate, which severely limits circular flows.

This delivery project aims to close the gap between the packaging designs of international manufacturers and the designs of municipal collection systems, by creating an authoritative global plastic-packaging road map. This will be based on facilitated collaboration between a pilot group of around 20 influential cities and FMCG companies.

The project will enable a 20-year transition from plastic packaging made predominantly from virgin material, topped up by recycled material, to packaging made predominantly from recycled material.

– **Paper and paperboard:**

With the global recycling rate standing at about 65%, paper is already widely recycled. The challenge to improve recycling at scale lies in the many kinds of chemical additives used in the product/packaging design process. Increasing paper recycling and reducing recycled fibre cost can unlock up to \$10 billion in value per annum globally. Much of this added value can be achieved via product design for circularity.

The paper delivery project aims to define a set of simple **eco-design rules** to mitigate the inefficiencies of value recovery in the paper and paperboard material stream, with specific focus on chemical additives and inks. These rules provide essential guidance for designers and developers without limiting innovation. The project aims to start with paper to establish proof of concept on establishing eco-design rules that can be replicated in other industries.

The goal is to take public-private collaboration to scale and have a dual-track adoption of eco-design regulation and private enterprise adoption of such guidance. The initial focus will be on graphic/print paper and paper packaging, and on the design-to-manufacturing phase of the value chain.

– **Asset tracking:**

Connected objects and assets are set to unlock multiple new sources of value for sellers, users and service providers – from interactive advertising to personalized services and new business models, as well as preventive maintenance. Largely unexplored, monitoring and connectivity can help recover more value at the end of an asset’s first useful life; for consumer electronics and appliances alone, this value amounts to \$52 billion.

The asset tracking project seeks to overcome the stalemate of information gaps preventing better decision making on what to do with a product when a (first) user is finished with it. Through the collaboration between first-rate technology enterprises and big players in several different asset classes, the project aims to unleash asset tracking’s potential to maximize value. Tackling design all the way through reverse logistics choices, it looks to deliver one or more completed pilots for individual supply chains, a design and implementation toolkit derived from the pilot findings, and a compelling narrative and roadshow to scale up the impact across multiple other industries.

Current Status

All three delivery projects have commenced operations and are ramping up activities as per their respective work plans. The projects aim to kick into a higher gear following Annual Meeting 2015 in Davos-Klosters, Switzerland. In the near term, Project MainStream will focus on this ramp up of the delivery projects and on securing the commitment of more participant organizations.

Plastic Packaging



Initial analysis has identified PET and polyester as a promising area for improvement of circularity. PET is the polymer with the highest collection and recycling rate. However, much room for improvement exists, as only about half of bottle-resin PET (“PET” in this section) is collected, and two-thirds of that is cascaded into production of polyester textile (“polyester” in this section). This cascaded PET makes up the entire recycled portion of polyester demand (about 17%), as almost no polyester is currently recycled yarn-to-yarn. Increasing collection rates, improving material recovery rates (bottle-to-bottle, cascade, yarn-to-yarn) and increasing market attractiveness and efficiency of recycled material will be necessary to improve PET/polyester recycling.

Industry discussions and expert consultations following initial analysis on PET/polyester highlighted that the larger FMCG plastic-packaging industry poses an attractive opportunity for increased circularity. Based on this, the steering board and project cabinet have developed and kicked off a delivery project to create an authoritative global plastic-packaging road map to significantly reduce plastic-packaging waste by harmonizing international packaging design and local collection systems.

Current Material Flow and Overall Opportunity

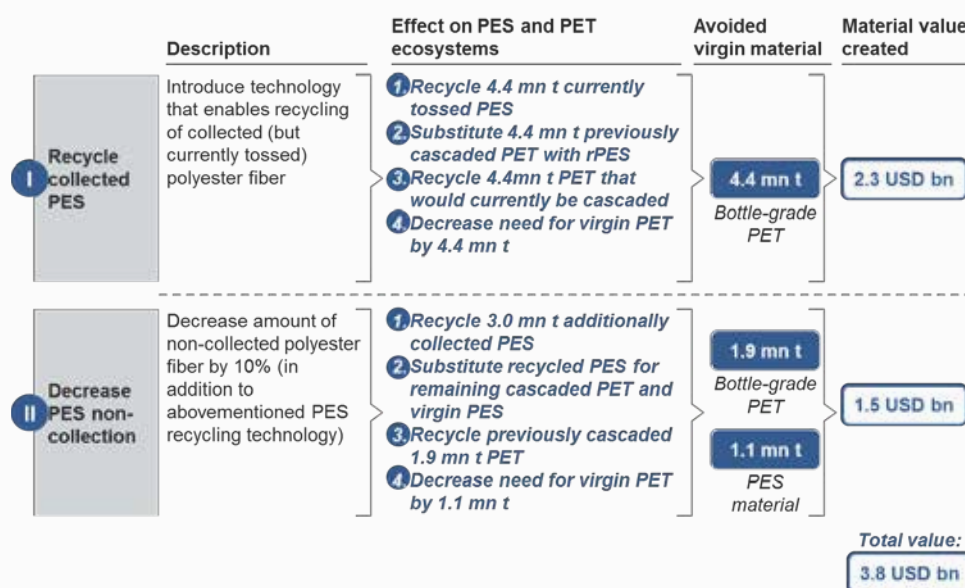
- Annual material demand for PET and polyester totals about 54 million tonnes. Of this, nearly 86% of total weight (or roughly 46 million tonnes) leaks out of the system.
- Annual demand for PET totals about 17 million tonnes. Recycled PET constitutes roughly 7% (1.2 million tonnes)

- of PET demand. About 55% of PET (7.7 million tonnes) is collected post use. Nearly 68% of collected PET (6.3 million tonnes) is cascaded into polyester production.
- Annual demand for polyester in production of new goods totals about 37 million tonnes. Some 17% of polyester demand (6.3 million tonnes) is recycled entirely from cascaded bottles. As much as 82% of polyester (30.5 million tonnes) is not collected. About 77%, or 4.8 million of the 6.3 million tonnes of polyester collected, is landfilled, while the remaining 23% is reused in secondary markets.
- If Project MainStream can lay the foundation to recycle polyester which, although currently collected, is either landfilled or burned, not only would the volume of non-collected polyester be reduced by 10%, nearly \$4 billion in value could be created (Figure 2).

Leakage Dynamics

- While PET bottles are often regarded as a poster child for recycling, much value still leaks from the PET ecosystem, resulting in very little recycled PET in circulation for use in bottles. Recycling technology exists and has been rolled out on a large scale. However, while more than half of the material is collected, most of it is cascaded into polyester production because of textile manufacturers’ higher purchasing power.

Figure 2. Nearly \$4 Billion in Potential Value Created from Reduction of Non-Collected Polyester



Source: Project MainStream core team analysis

- The resin identification coding system of the Society of the Plastics Industry (SPI), which clearly identifies polymer types, enables effective separation of polymers and thus the recycling of pure polymer streams. It has been instrumental in the setting up of PET collection and recycling units. This is a good indicator of the potential power of private-sector alliances and trade associations to shape the economics of the circular economy.
- Meanwhile, polyester suffers from both a lack of collection infrastructure and non-existent recycling technology. Subsequently, the small amount of collected polyester ends up largely in landfills. This also means that the PET cascaded into polyester passes through and, for the most part, does not get recycled further.

Levers

Levers to address leakage of PET and polyester fall into three categories:

- Increased collection of PET bottles and other PET/polyester applications to include in cascading/material recovery, for example through:
 - Increased collection rates of PET bottles
 - Increased collection of polyester fibre applications
- Improved material recovery rates, either bottle-to-bottle or at the lower end of the cascade, or through the cascade, for example through use of:
 - PET bottles designed for recycling
 - Automated material identification
- Creation of more efficient and confidence-inspiring markets for recycled PET, for example by:
 - Establishing grading standards
 - Increasing demand for recycled polyester fibre (e.g. through industry standards or incentives)

Delivery Project – Global Plastic Packaging Road Map

While the initial analysis programme focused narrowly on PET and polyester, subsequent industry discussions and expert consultations uncovered a major opportunity in the larger plastic packaging space. As such, the first polymer-related delivery project focused on plastic packaging in the FMCG sector, as opposed to the PET and polyester material stream. To strengthen value recovery in plastics material streams, the steering board and project cabinet have identified the **creation of an authoritative global plastic packaging road map** as the delivery project.

- **Issue and context:**
Packaging is central to today's linear economy, used across most industry sectors and all geographies. Typically low-value, it is recycled to some extent without downgrading (e.g. PET), and has limited opportunity for reuse intact. Its predominant fate – at best downgrading or incineration, at worst landfill or litter – destroys potentially valuable resources and creates contamination. This applies particularly to “plastic” packaging – durable, highly prevalent, manufactured from a wide range of single and combined polymers.

Circular flows of packaging materials face double fragmentation – of design decisions and the resulting stalemate – as the two groups of designers concerned (of packaging, and of city systems for collection, segregation and reprocessing) – do not work together.

Value losses in plastic packaging can often be traced to packaging design that is disconnected from the needs of local collection, sorting and processing facilities. Similarly, the local systems are designed with little influence over packaging design, which also leads to wide diversity in local systems. Hence, no system-wide view to enable circular flows exists. Furthermore, fragmented choices of city systems for collection, segregation and reprocessing mean far greater diversity than is needed to cater for real variation in requirements.

- **Approach and objectives:**

This delivery project aims to close the gap between the two systems via creation of an **authoritative global plastic packaging road map** to strengthen value recovery in plastics material streams. The road map will be co-developed with a set of around 20 influential cities and companies across the FMCG supply chain. It will enable a 20-year transition from plastic packaging made predominantly from virgin material, topped up by recycled material, to packaging made predominantly from recycled material. The aspiration level will be quantified as part of the project.

By January 2016, this project will deliver the go-to road map for FMCG plastic packaging in a circular economy. The road map will be based on an integrated view of design – of packaging, and of the city systems which collect, segregate and process it after use. It will describe a clear destination, expressed as a limited range of archetypes, with steps to get there from diverse starting points. The aim is to enable convergence, particularly of city systems. The road map will have strong credibility built on the right nucleus of collaborators and evidence of technical and economic feasibility, as well as a clear, simple and attractive mission.

The project will initially be considered a success when its core companies and cities commit to following the road map. There will then be a planned process of wider dissemination, to achieve the scale required to reach tipping points in the major plastic packaging flows. So the road map will be used as a template for many more companies, cities and regulators, driving convergence and expanding the scale of circular flows. This will cover major polymers including PET and polypropylene (PP). If successful, the project could uncover significant economic, employment and environmental opportunities for participating cities, as well as bring cost savings, growth opportunities and gains in reputation for the participating companies.

- **Main actions:**
During 2015, the project will develop a road map, covering (among others): an integrated view of and guidelines for designs (of both packaging and waste systems); guidelines for multiple starting points that converge towards more harmonized endpoints in terms

of circular flows, but without constraining innovation and consumer/citizen experience in use and disposal of packaging. Participants will develop selective evidence to support feasibility and benefits (financial and other) from adopting the road map, including analysis, case studies and pilots. The team will build collaboration around the road map, with a core group involved in its development (around 20 companies and cities) and a wider group offering consultation and preparing to drive the next wave.

Uniqueness:

The project’s uniqueness derives from its application of circular economy thinking to packaging, a perspective different from sustainable packaging or the waste hierarchy. This yields a more positive agenda with greater potential for innovation, consumer benefits and brand building. The project is the first to address both packaging design and collection/processing systems in tandem, and from a circular economy perspective. The outstanding group of participants will lend credibility and rapidly drive adoption and scale-up.

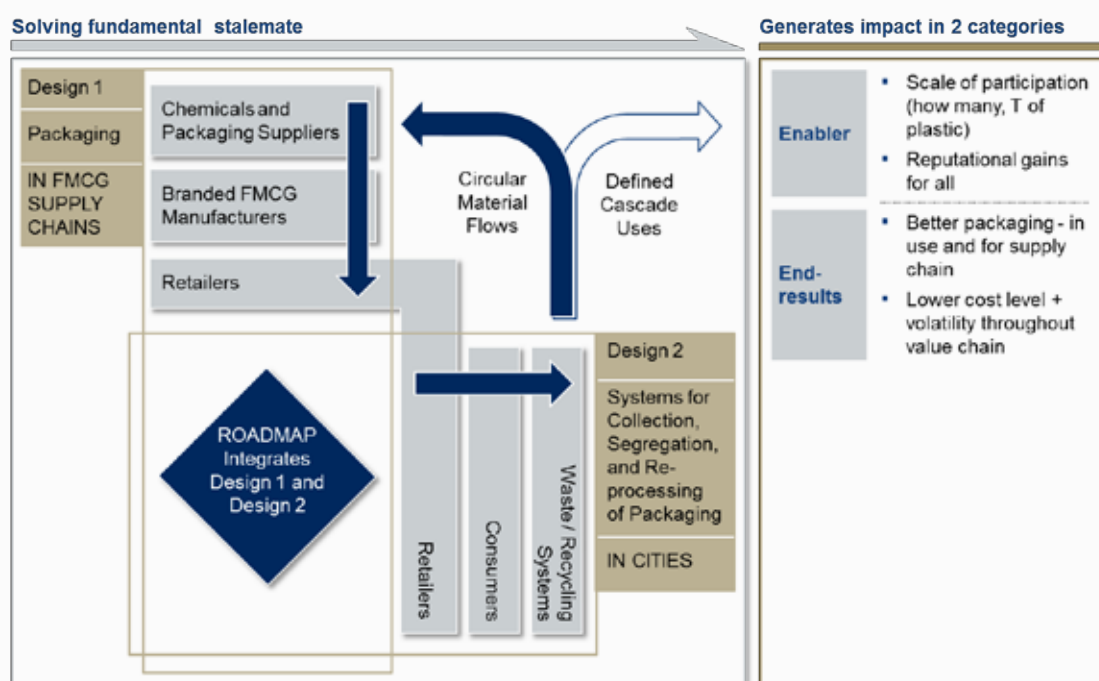
Impact:
See Figure 3.

Actors:
This project is currently driven by Indorama Ventures, the Cities of Atlanta, Copenhagen and New York, the Closed Loop Fund, Coca Cola, Desso, DSM, FEMSA, Suez Environnement, Unilever, Veolia, and the Waste and Resources Action Programme (WRAP), among others, with further supporters in discussion. Actors include municipal governments; important players in retail, collection, segregation and processing; and consumers, teamed with FMCG manufacturers.

Status:
The Global Plastics Packaging Road Map project cabinet has gone through its initial industry round tables to define objectives, deliverables, a work plan and resource requirements. The road map scope and research process is now under development, together with fundraising. The analysis phase will start with a kick-off workshop in the first quarter of 2015.

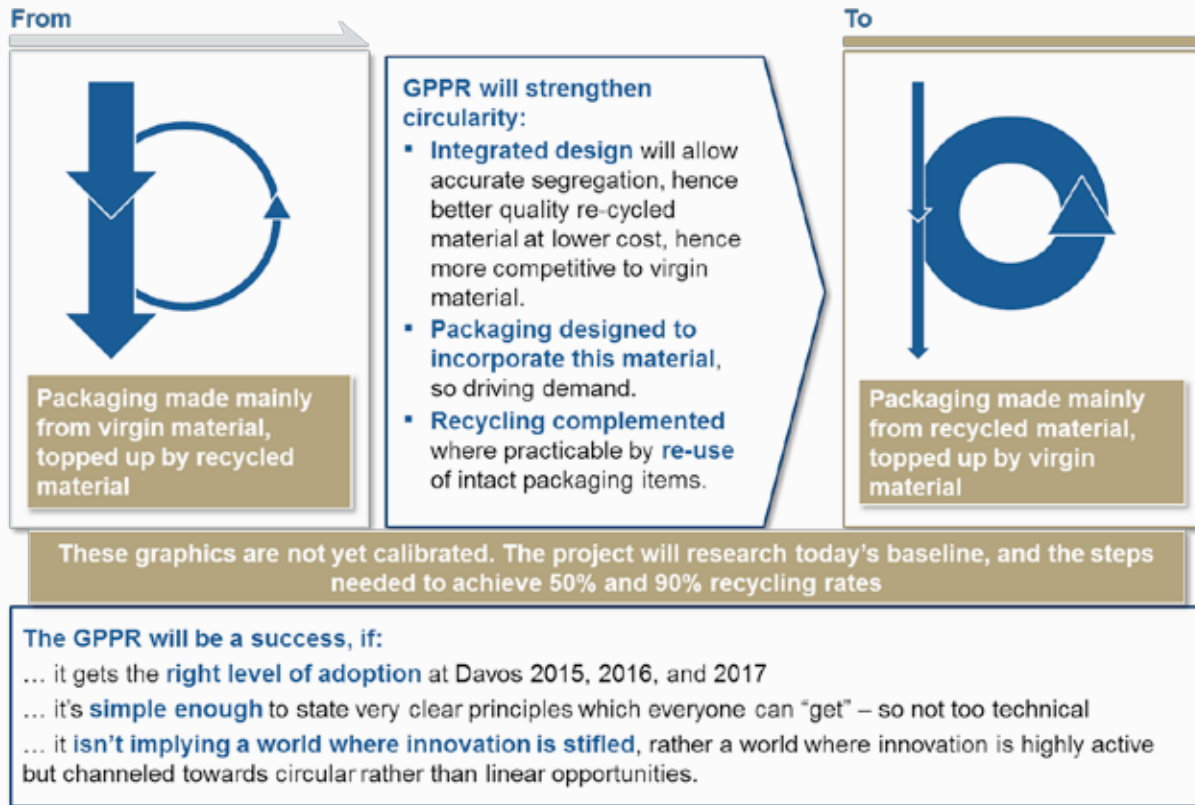


Figure 3. The Global Plastic Packaging Road Map Creates Value by Leveraging Participation into Multiple Stakeholder Benefits



Source: Project MainStream core team analysis, industry round tables

Figure 4. Mission by 2035



Source: Project MainStream core team analysis, industry round tables



Paper and Paperboard



Material recovery rates for paper and paperboard are among the highest in the world for recycled materials. However, collection and recycling rates still vary widely among countries. Additionally, while technologies improve, the resulting increases in yield cannot keep up with the overall decline in the quality of recycling feedstock. Contamination is responsible for much of the decline in feedstock quality. The project team will focus on paper and paperboard as an initial springboard to later address the broader issue of eco-design. The aim is to establish proof of concept to exhibit how design for circularity at the product- and material-level can benefit both industry and the environment.

Current Material Flow and Overall Opportunity

Total annual production of paper and paperboard will amount to about 480 million tonnes in 2020 (Figure 5).

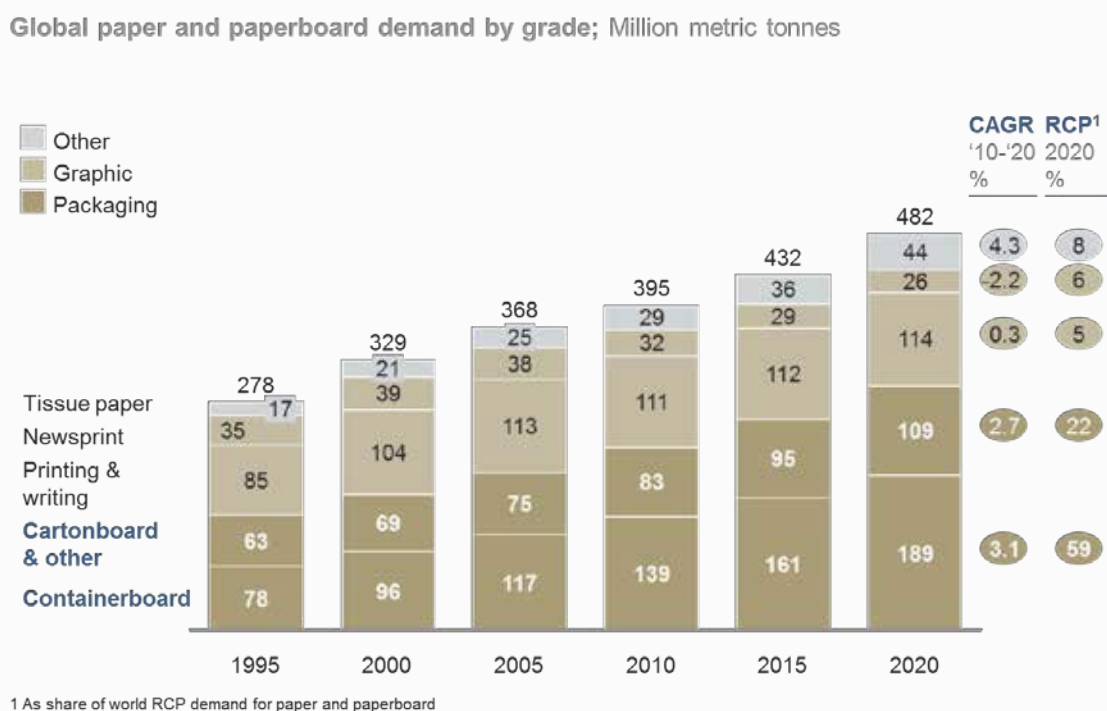
- About 27%, or roughly 130 million tonnes of this total, leaks out of the system and can be addressed by Project MainStream (83% of this leakage is driven by collection in countries below best-in-class). This addressable value leakage is worth an estimated \$10 billion.
- Packaging will drive the bulk of volume in 2020 (62%, up from 56% in 2010), split as containerboard (39%) and cartonboard (23%). These paper grades are also those with the highest recycled share.
- Meanwhile, graphic paper's share of total volume will decline from 36% in 2010 to 29% in 2020, split as printing and writing paper at 24% and newsprint paper trailing at 5%.

- Recovery rates still vary widely among countries. The theoretical maximum recovery rate lies at 80-85% (Figure 6). Japan (74%), Western Europe (70%) and the United States (70%) approach this maximum. The much lower recovery rates in China (45-54%) and the rest of the world (44%) drive the global average recovery rate down to only about 57%.

Leakage Dynamics

- Country policies on paper and paperboard recycling, as well as population awareness, regulation and adherence to recycling rules, vary widely around the world, leaving much upside potential in many countries. However, the local nature of policies and regulation often yields very fragmented recycling potential, to be implemented country by country.
- The decline in quality exceeds the upside gained from improving technologies. The overall yield declines as fibres degrade with subsequent recycling cycles, due to harsh processing and losses during decontamination.
- Various contaminants impact the cost and strength of recycled paper fibre. This contamination can result from chemical additives used in paper design and the ink used in printing, and can also occur during use or recycling.
- Multilayered packaging often makes separation of materials impossible and thus inhibits efficient recycling.

Figure 5. Paper Industry Growth: Concentrated in Grades with Most Intensive Use of Recycled Fibre



Levers

Levers to address leakage out of the paper and paperboard material stream fall into two categories:

- Improved collection, for example through:
 - Increases awareness for residential collection
 - Creation of market pull via tax incentives or increased waste fees
- Increased fibre yield, for example by:
 - Improvement in sorting at source and in material recovery facilities
 - Improvement of design of products and processes to decrease contamination on recyclable paper, resulting in higher recycling yield

Delivery Project

The steering board and project cabinet have kicked off a delivery project to define **eco-design rules**, focusing on the value recovery inefficiencies in the paper material stream.

– Issue and context:

Many people assume paper is already a widely recycled material – and it is, with the global recycling rate already at about 65%. Paper and cardboard are ideally suited for recycling, across a cascade of use-cycles before re-entering the “biological economy”. In reality, however, the challenge of improving the process at scale lies in the many kinds of chemical additives used in the product/ packaging design process. Although originally 100% recyclable, paper is converted by various downstream industries adding other auxiliary materials for various functions that later return to paper recycling mills when closing the loop. These auxiliary materials cannot be

sorted out of paper in the dry sorting steps before paper mills. Examples of these auxiliary materials include wax, tapes, hot melts, printing ink, plastic laminate, latex, calcium carbonate coating, brighteners, anti-slip agents, etc. A possible solution to improve the ability to recycle, reduce the amount of required virgin fibre, and increase the reuse rate of paper products is to develop simple eco-design rules for paper products (including all converted paper and board) which would give essential guidance to designers and developers without limiting innovation and introduction of new techniques.

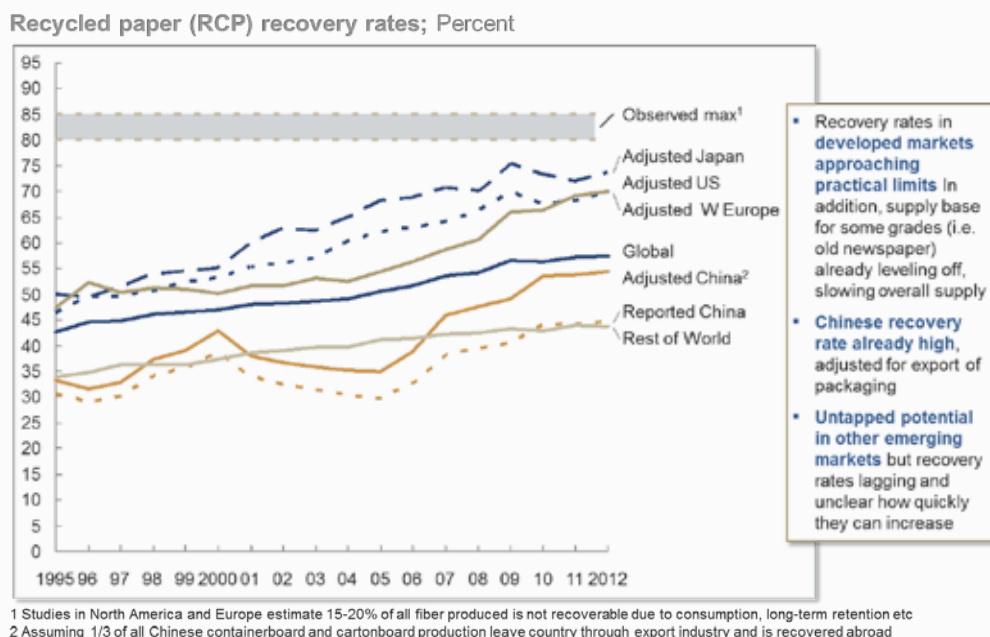
– Approach and objectives:

The paper delivery project aims to define a set of **eco-design rules** (starting with paper) to mitigate the inefficiencies of value recovery in the paper material stream. With a specific focus on chemical additives and inks, the project will seek to reverse declining yields in the paper ecosystem by developing simple eco-design rules for paper products, including printed and converted paper and board.

The project will aim to reduce the overall amount of fibre needed and improve recycle/reuse of fibre in the paper value chain, while reducing water consumption and improving by-streams of the paper and paperboard production process. The project team will consolidate existing pieces of design tools into a set of user-friendly, universal eco-design rules for all value-added elements of the paper and paperboard packaging value chain. The team will leverage the strength of Project MainStream, using a public-private collaboration platform to create a set of rules/policies that private enterprise are already adopting, thereby enabling speedy adoption. Paper is the perfect place for MainStream to start, given its currently high recycling rate, complete infrastructure for

Figure 6. Recovery Rates Are High and Increasing

The most untapped potential remains in emerging markets.



Source: RISI, European Recovered Paper Council, Metafore, AF&PA, McKinsey

recycling, and strong pockets of knowledge on what can be done to make its design circular by nature. By establishing proof of concept with eco-design rules for paper, the lessons can be applied to other materials as well.

– **Main actions:**

The project will convene participants for the delivery project to enhance interest and commitment among key industry players and the public sector. Participants will establish the baseline for eco-design rules for paper via a first draft; they started in January 2015. The team will leverage a thorough syndication process to ensure buy-in of stakeholders into the eco-design rules through 2015. The project will also leverage private sector adoption to speed up, public sector regulatory change, and utilization of changed regulations to ensure compliance from industries, creating a virtuous cycle of adoption in the longer term.

– **Uniqueness:**

The project’s uniqueness derives from its approach of driving public sector regulation and private sector adoption in an iterative manner, enabling them to act on each other to foster adoption of eco-design rules. The project leverages private sector commitment to develop a global standard to help regions/countries shun the silo approach to regulation. The approach builds on an unprecedented, large-scale, cross-industry, cross-supply chain and pre-competitive collaboration between all key stakeholders. It has a dedicated core team with a global network, extensive knowledge of the circular economy and world-class analytical capabilities.

– **Impact:**

See Figure 7.

– **Actors:**

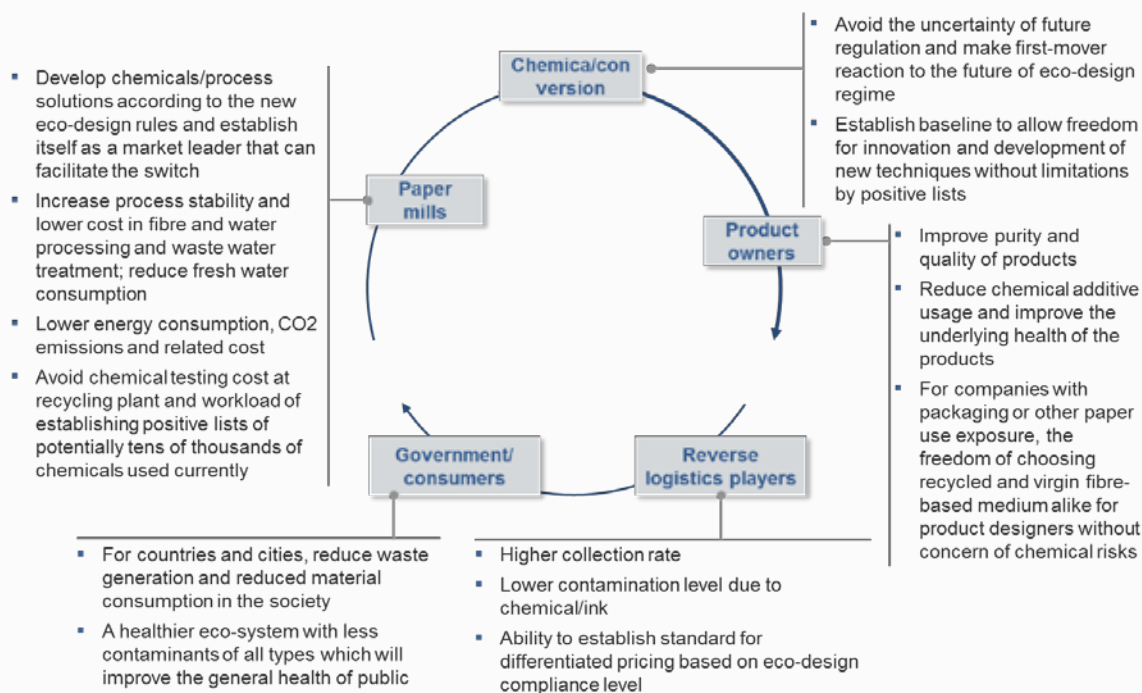
This project is currently driven by Ecolab, the Confederation of European Paper Industries, Desso, DSM, Ecofolio, Hewlett-Packard Company, Océ, Smurfit Kappa, Suez Environnement and Unilever, among others, with further supporters in discussion. Targeted actors come from papermaking, printing and converting sectors, covering the consumer goods and retail industries, and potentially others with printing exposure. Waste management companies and the public sector will also play an important role in the project. Only this kind of cross-value chain collaboration can effectively identify the value drivers in the circular economy in paper and cardboard.

– **Status:**

The Eco-Design Rules project has been officially kicked off. The project team, led by CEPI and Ecolab, commenced the drafting of a set of eco-design rules in January 2015. The project is on track to deliver a set of syndicated eco-design rules by the end of 2015 and is ready to welcome additional relevant paper/cardboard industry players to the push to revolutionize the landscape for paper and paperboard.



Figure 7. Eco-Design Rules Will Create Impact for Players Involved along the Entire Value Chain



Source: Project MainStream core team analysis

Asset Tracking



For most product categories, hardly anyone but the user knows the product whereabouts after the point of sale and its quality over the course of its useful life. The user is most often not aware of the residual value of the product at any given point in time. Both factors combine to prevent companies from fully valuing products' extended life and/or end-of-life condition.

At the same time, devices of all types and values are increasingly connected for various commercial reasons and for consumer, manufacturer or seller benefit. This opens up an unprecedented opportunity to capture and communicate information about whereabouts, state and residual value: passively through scanners, actively via transmitters, or interactively through autonomous systems that process and act upon information without active human guidance.

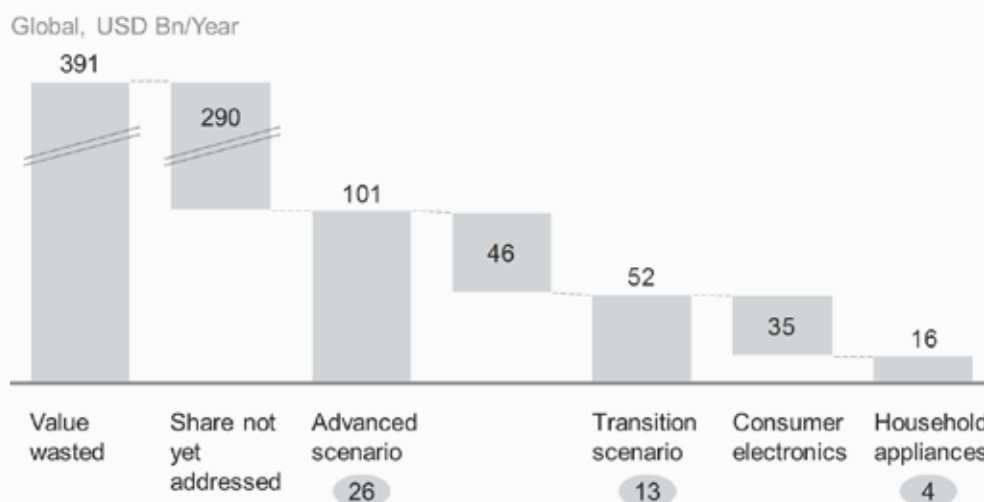
Consumer electronics are at the forefront of connectivity, but are still managed in a linear system and do not take advantage of the end-of-use applications of connectivity. This presents tremendous potential value for asset tracking. Some high-value product groups (e.g. medical devices) have already started to adopt product monitoring and active or passive communication to improve repair and warranty programmes. Yet even in such asset classes a lot of potential is left unrealized, because monitoring and connectivity are not deployed systematically or holistically.

To realize the value potential, value chain participants need to a) gain confidence that the net value of implementing such a system is positive and b) be able to tap into know-how and guidance on how to go about designing, implementing and operating such a system. Project MainStream proposes to contribute on both fronts by coordinating relevant stakeholders and launching a pilot in one or more product categories. The asset tracking programme cabinet, bringing together industry leaders and technologists, is developing the project goals and scope. Working groups will implement the pilot(s) and develop the toolkit/guidance based on the pilot and complementary insights gathered and generated in various asset classes.

Current Material Flow and Overall Opportunity – Consumer Electronics and Household Appliances Example

- Globally, consumer electronics and household appliances with a cumulative input value of roughly \$390 billion reach end of life each year (Figure 8). In a transition scenario, 13% of value leakage in these two product categories could possibly be captured.
- Consumer electronics are currently managed in a very linear system, with almost 50 million tonnes of e-waste produced in 2012.

Figure 8. Impact Potential and Advanced Scenarios for Consumer Electronics and Household Appliances



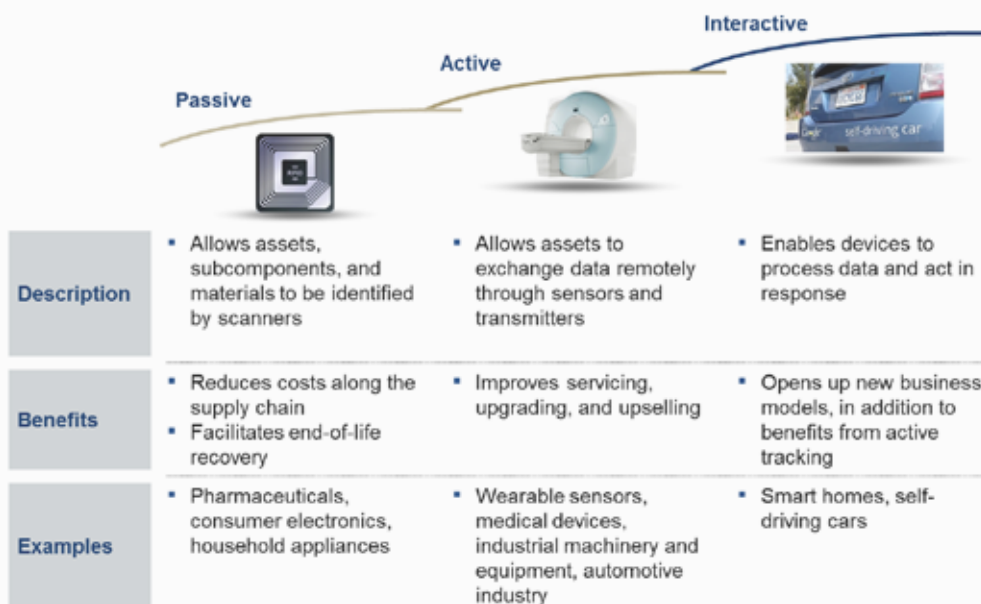
Source: Euromonitor, Ellen MacArthur Foundation Report 1, Project MainStream core team analysis

- In a scenario reflecting modest improvement, a potential value of about \$52 billion could be recovered annually in consumer electronics and household appliances through reuse, remanufacturing and recycling, aided by asset tracking:
 - \$38 billion through reuse/redistribution
 - \$10 billion via refurbishment/remanufacturing
 - \$4 billion through recycling
 - An additional \$4 billion could be captured via new business models (e.g. improved maintenance) and disposal cost savings.
- This scenario assumes improvements in reverse logistics skills and product design, but not in legislation or reverse technologies and infrastructure.

Levers

- Asset tracking can be based on statistics and/or consumer or product registration data, but it can also encompass a range of technology-driven systems and applications (Figure 9), roughly grouped into three categories: passive, active and interactive tracking.
 - *Passive tracking* (e.g. pharmaceuticals, consumer electronics, household appliances) allows assets, subcomponents and materials to be identified by scanners, and reduces costs along the supply chain while facilitating end-of-life recovery.
 - *Active tracking* (e.g. medical devices, industrial machinery and equipment, automotive industry) allows assets to exchange data remotely through sensors and transmitters, and improves servicing, upgrading and up-selling.
 - *Interactive tracking* (e.g. smart homes, self-driving cars) enables devices to process data and act in response, and opens up new business models, in addition to providing benefits from active tracking.
- Asset tracking is instrumental in the establishment of a transparent marketplace for recovered products and components between life cycles (Figure 10).

Figure 9. A Broad Range of Systems and Applications (not exhaustive)



Source: Project MainStream core team analysis

Focus

Setting up an asset-tracking infrastructure is a multifaceted effort with a wide range of angles. In its first wave, the asset tracking system will focus on strengthening the inner circles of the technical cycle for complex durables, with a regional multibrand focus.

- The system will focus on the inner loops of the technical cycle: the tracking and tracing of complex durables with substantial subcomponent value.
Consumer goods and electronics are a promising group for the first set of inner-loop asset-tracking round tables.
Products with higher-value components and moderate innovation cycles stand to gain the most from inner loops.
- Initially, to balance impact and feasibility, the programme will likely focus on a few high-potential, multi-brand product categories at the regional level.

Delivery Project

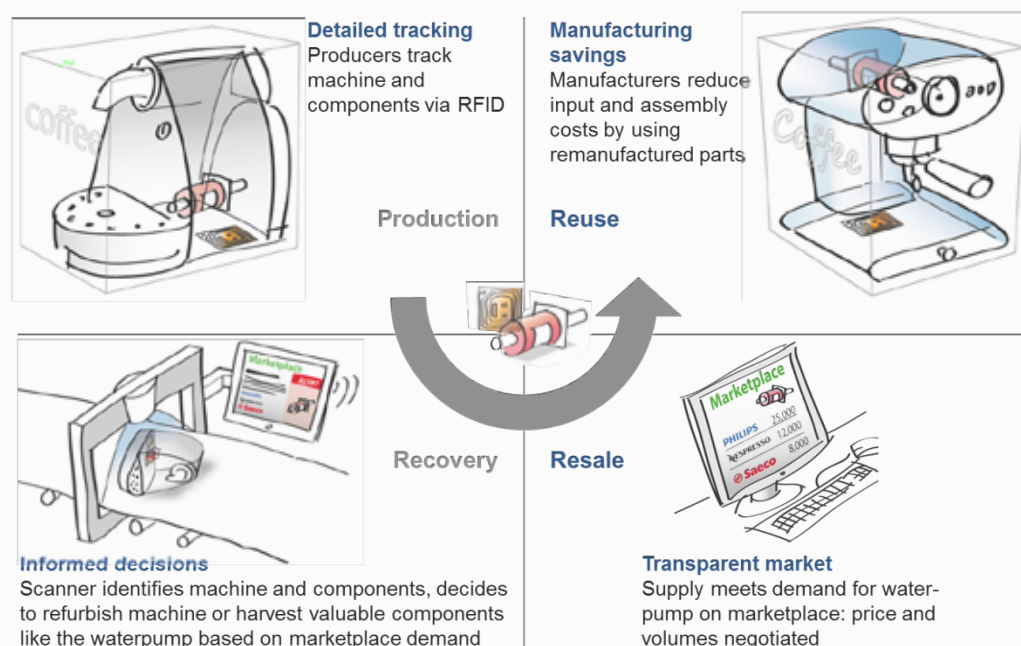
The steering board and project cabinet have identified a delivery project to accelerate the adoption of asset tracking in the marketplace.

– Issue and context:

Connected objects and assets, with more sensors, larger networks and smarter systems, are set to unlock multiple new sources of value, from interactive advertising and multi-channel sales, to personalized services and new business models. At the same time it is recognized that having better information about the condition, location and status of objects and assets could help maximize value extraction over the entire lifetime of such assets – and hence support a shift from today's linear “take-make-dispose” economy to one that is more circular.

Riding the Internet of Things (IoT) wave to unlock this asset value maximization opportunity requires concerted action on many fronts: a willingness to exchange data (and possibly novel user incentives) and an infrastructure and protocols to support such an exchange, new algorithms to link monitoring data with the appropriate end-of-use intervention, and above all an unparalleled collaboration along and possibly across supply chains. This need for complex coordination is currently one of the main obstacles to rolling out Asset Tracking at scale.

Figure 10. Use Case Example: Establishing a Transparent Marketplace



– **Approach and objectives:**

This delivery project aims to accelerate the adoption of asset tracking by installing pilot programmes in industry-specific value chains (initial focus on medical equipment and consumer electronics/small home appliances), using IoT-connected devices in combination with infrastructure to input and update traditionally “offline” assets. The project would use database information integrated with enterprise data (e.g. asset maintenance schedules) to help gauge useful life and assess options to recover residual value (for refurbishing, replacing, remanufacturing and recycling, among others uses).

The Asset Tracking delivery project is a collaboration between top-notch technology players and heavy-hitters in several different asset classes (e.g. consumer electronics/appliances, medical equipment, office equipment, mobile phones). It aims to unleash asset tracking’s potential for value maximization – \$52 billion for consumer electronics and appliances alone. The project aims to deliver one or more completed pilots for individual supply chains, a design and implementation toolkit derived from the pilot learnings, as well as a compelling narrative and roadshow to scale up the impact.

– **Main actions:**

The project team will investigate participation incentives (supply chain and user side), i.e. why suppliers, users or asset managers would participate in a scheme and how motivation gaps can be overcome. Participants will establish how exactly better information would drive better (i.e. more value-capturing) end-of-use decisions. Key drivers in technology selection, regarding

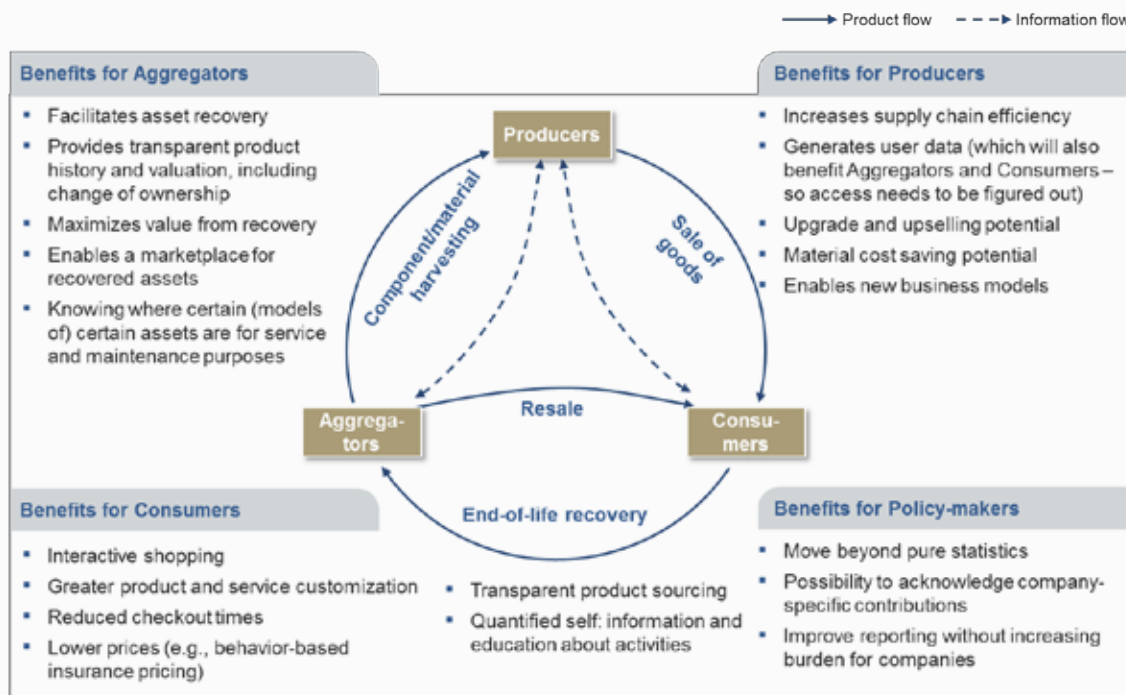
both monitoring/sensors and connectivity, will be assessed. Furthermore, the team will design information architecture, management and governance, i.e. how data flow, where and how they turn into information, and who manages this data and information.

During the first three quarters of 2015, project participants will establish proof of concept via pilots for medical devices and small household appliances. The team will extract, test and adapt pilot insights for a further set of asset classes (some of which could turn into a full-fledged pilot). During the fourth quarter of 2015, the team will prepare for scale-up via synthesis of findings into a compelling narrative and data points for implementation, a toolkit of guidelines for at-scale implementation, and potentially policy implications. Full mobilization will start in 2016.

– **Uniqueness:**

The project plays into all the loops of the consumer electronics model – and associated new business models – with increased value capture through improved product and component maintenance, refurbishment and reuse as well as more recycling. This approach will inform several very current debates: By explicitly linking asset tracking and remanufacturing, the project has the potential to bring about true “extended producer responsibility” through improved policies. Furthermore, the effort can lead to the design of more efficient products and reduction of waste through increased knowledge about product-user interaction. Lastly, better information can help adjust financial tools to reflect true cost, benefits and risks of linear as well as circular models.

Figure 11. Asset Tracking Benefits All Players in the Value Chain



Source: Project MainStream core team analysis

– **Impact:**

The asset tracking project offers a unique opportunity for each stakeholder group, from producers and consumers to aggregators (third-party service providers) and policy-makers. Figure 11 provides details.

– **Actors:**

This project is currently driven by Royal Philips, Brightstar, De Lage Landen, Veolia, Wipro and the Waste and Resources Action Programme (WRAP), among others, with further supporters in discussion.



– **Status:**

The Asset Tracking project cabinet is currently developing a detailed work plan for the pilot and the toolkit, centred on the four questions outlined above. Moreover, an initial hypothesis for each of the four elements is being developed through a series of virtual “hackathons” with participants from the businesses representing the various asset classes as well other value chain players and technology providers.

Delivery Project

Project MainStream focuses on areas of stalemate in the economy where public-private or pre-competitive collaboration across industries and value chains is required to unlock economic opportunity. The unique three-party cooperation between the World Economic Forum, the Ellen MacArthur Foundation and McKinsey & Company drives change by bringing top industry players, policy-makers, experts and other stakeholders together. Such multistakeholder gatherings are key to generate the necessary level of collaboration, illustrate the economic benefits of transitioning to a circular economy, and drive towards cross-value chain dialogue and consensus. To scale impact for existing delivery projects, as well as initiate dialogue about future projects, MainStream welcomes the involvement of all relevant stakeholders that can further the scaling of the transition to a circular economy by overcoming crucial stalemates. The Project MainStream team would like to invite such public and private organizations to join up for pushing forward the circular economy revolution.



Definitions

Analysis programme: A programme chosen from a long list of materials and circular economy enablers that were screened with respect to their current system's value-leakage areas (see "Value leakage") and overall market trends; type and size of value leakages; levers to address value leakage and underlying initiatives; and potential composition of Round Tables (see "Round Tables") and necessary participant organizations to discuss the aforementioned points and derive concrete projects to deliver identified potential value
Currently, three analysis programmes are in focus: PET and polyester; paper and paperboard; and asset tracking.

Asset tracking: Tracking of location, usage status, health of assets and other parameters, at the product, component, subcomponent and even materials level

This is done through the entire value chain – from sourcing, production, sale, usage period and second, third or more uses, to disposal into collection systems or directly back into production.

Bottle-resin PET: A polymer resin of the polyester family, used in synthetic fibres and, for the purposes of this document, in food, beverages and other containers for liquids

Cartonboard: A type of paperboard used, for example, in the manufacture of folding cartons

Cascade: The use of products, components, subcomponents and materials in applications other than their originally intended use
Often, these alternative uses require less strict specifications than the original use.

Chemical additives: Compounds added to a material (e.g. paper, polymers) to adjust its properties (improved performance, lower costs)
Examples include fire retardants, fillers to reduce costs (e.g. clay in paper), colourants (for polymers; ink for paper) and plasticizers to increase flexibility.

Circular economy enablers: Technologies, policies, rules and collaborations, among others, that enable industries or material streams to become more circular (see "Circularity")

Circularity: The degree to which assets, components, subcomponents and materials are kept "circling" within value chains, without meeting a definite end; includes landfilling and burning

Complex durables: Products more durable than fast-moving consumer goods (for example, household appliances)

Confederation of European Paper Industries: A Belgium-based organization representing European pulp and paper associations in European institutions, when analysing and acting on European Union legislation and other relevant activities

Containerboard: A type of paperboard used in the production of corrugated fibreboard

Corrugated fibreboard: A paper-based material consisting of a corrugated sheet attached to one or two flat boards, used in the manufacture of shipping containers and boxes

Delivery project: A project to deliver all or part of the potential value identified in an analysis programme

Eco-design: A product design approach that specifically incorporates an assessment of life-cycle environmental impacts

E-waste (electronic waste): Discarded electrical or electronic devices, even if the product or its subcomponents have not yet reached the end of their useful lives

Fast-moving consumer goods (FMCGs): Also referred to as consumer packaged goods (CPGs), products with relatively low costs and quick selling cycles
Toys, processed foods and drinks, toiletries and other non-durable goods fall into this category.

Fibre yield: The length of paper fibres, as a product of individual fibre length/quality and number of fibres, resulting as output of a recycling process as a share of its fibre input

Inner loops: Reuse, remanufacture and refurbishment
As value chains "close the loop" from the point at which a product is currently disposed, landfilled or burned, back to earlier parts of the value chain, tighter ("inner") loops reintroduce products or components into the value chain (via reuse, remanufacture and refurbishment).

Internet of Things (IoT): Terminology used to refer to the connection of traditionally "offline" devices to the internet, with the goal of automating actions and services far beyond the direct connection between devices

Leakage: see "Value leakage"

Material streams: The entire pathway a material (e.g. paper, polymer, glass, steel) takes from its raw constituents to assembly into components and products, through its use phase and, subsequently, in either disposal to landfill/burning/etc. or handover into value recovery via recycling/remanufacturing/etc., to be reintroduced at an earlier point in the value chain

Multilayer packaging: Packaging where several layers of different materials are closely joined together and difficult, if not impossible, to separate after use

Outer loop: As value chains "close the loop" from the point at which a product is currently disposed, landfilled or burned, back to earlier parts of the value chain, tighter ("inner") loops reintroduce products or components into the value chain (via reuse, remanufacture and refurbishment)
The loosest or "outer" loop stretches all the way back to the beginning of the value chain, to reintroduce materials via recycling.

Paperboard: Paper-based material, generally thicker than paper (weight >224 grams per square metre, as defined by the International Organization for Standardization), including cartonboard and containerboard

Polyester: A category of polymers including bottle-resin PET and polyester textile
For purposes of this document, polyester refers to "polyester textile".

Polyester textile: PET-containing fibres and fabrics (used, for example, in apparel and carpets); industrial polyester fibres (e.g. ropes, yarns for tires, safety belts) and cushioning/insulating materials

Polyethylene (PE): The most common plastic, with primary use in packaging, including bottles and other containers, and plastic bags

Polyethylene terephthalate (PET): A polymer resin of the polyester family, used in synthetic fibres for bottle/container production and polyester textiles
For purposes of this document, PET refers to "bottle-resin PET".

Polymer: A large synthetic or natural molecule composed of many repeated subunits
Polymers include synthetic plastics, such as polystyrene, and natural biopolymers, such as DNA and proteins that are fundamental to biological structure and function.
For purposes of this document, polymers refers loosely to "plastics".

Polypropylene (PP): A thermoplastic polymer, used to manufacture a variety of products, including automotive components, containers, electronics, packaging, stationery and textiles (e.g. ropes)
Products made from PP are typically more durable than those made from PE.

Project cabinet: A group of company delegates steering the direction of specific delivery projects

Radio-frequency identification: Information tags attached to assets/products that can be used to wirelessly identify and track stored information

Recycling: Turning materials regarded as waste in a linear production system into materials that can be substituted for virgin materials in new products
Recycling often has lower energy-input requirements and a lower emissions footprint, and can drastically reduce landfilling and incineration.

Refurbishing: Redistribution of products, usually electronics, that have been returned to a manufacturer and are inspected for functionality and defects before being resold (after no more than minor adjustments, such as cleaning or exchange of consumable parts)
The main difference between refurbished and "used" products is that the former have been verified (and maybe adjusted) to be free of defects.

Remanufacturing: Disassembly of assets at the end of a use cycle, and recovery of components and subcomponents
This includes the repair and replacement of components, as well as the upgrading of assets to improved specifications. The resulting asset should live up to the same specifications of an equivalent new asset.

Residual value: Remaining value of an asset at any time in its life cycle. In the context of this report, residual value not only expresses the share of the asset's initial value before depreciation but also refers to all remaining value for further use, or as input into the value chain in the form of recycled raw material, or refurbished or remanufactured product or part.

Resin identification coding system: An international set of symbols (developed by the Society of Plastics Industry) of plastics components to identify the polymer type.

The system was primarily introduced to make the separation of different polymers with a similar appearance easier for the purpose of recycling pure pools of materials.

Round tables: Discussion rounds of representative companies within an analysis programme area (currently PET and polyester, paper and paperboard, and asset tracking) to discuss the direction of the programme and define delivery projects.

Society of the Plastics Industry (SPI): A trade association representing members along the US plastics supply chain.

Steering board: The governing body of Project MainStream, steering its overall direction and currently comprised of the chief executive officers (and/or their delegates) of Brambles, Brightstar, BT, Desso, Royal DSM, Ecolab, Indorama Ventures, Kingfisher, Royal Philips, Suez Environnement and Veolia, supported by a host of other companies and organizations. The steering board is chaired by Frans van Houten, Chief Executive Officer, Royal Philips.

Strategic Approach to International Chemicals Management: A policy framework to improve sound worldwide management of chemicals (e.g. performing risk assessments, harmonizing labelling, dealing with obsolete products).

United Nations Environment Programme: An agency that coordinates the United Nations' environmental activities and assists developing countries in implementing environmentally sound policies and practices.

Value leakage: Value leaving a value chain permanently, in the form of products, components, subcomponents and materials, by means of landfilling or burning, among others.

The value in these products, components, subcomponents and materials is embedded in raw material inputs, energy, labour, shaping and assembly.

Value recovery: Capturing value by bringing products, components, subcomponents and materials currently landfilled or burned back into the value chain via reuse, refurbishing, remanufacturing or recycling.

Waste & Resources Action Programme (WRAP): A not-for-profit organization in the United Kingdom not affiliated with any public or private body, which collaborates with municipalities and private businesses to support the reduction of waste, the development of sustainable products and the efficient use of resources, to strengthen the circular economy.

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World Economic Forum
91–93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744

contact@weforum.org
www.weforum.org