

From Niche to Norm

Suggestions by the Group of Experts on a 'Systemic Approach to Eco-Innovation to achieve a low-carbon, Circular Economy'



EUROPEAN COMMISSION

Directorate-General for Research and Innovation
Directorate I — Climate Action and Resource Efficiency
Unit I.2 — Eco-Innovation

Contact: Luisa Prista

*E-mail: RTD-ENV-ECO-INNOVATION@ec.europa.eu
RTD-PUBLICATIONS@ec.europa.eu*

*European Commission
B-1049 Brussels*

From Niche to Norm

Suggestions by the Group of Experts on a 'Systemic
Approach to Eco-Innovation to achieve
a low-carbon, Circular Economy'

***EUROPE DIRECT is a service to help you find answers
to your questions about the European Union***

Freephone number (*):
00 800 6 7 8 9 10 11

(*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you)

LEGAL NOTICE

Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of the following information.

The views expressed in this publication are the sole responsibility of the author and do not necessarily reflect the views of the European Commission.

More information on the European Union is available on the Internet (<http://europa.eu>).

Luxembourg: Publications Office of the European Union, 2015.

ISBN 978-92-79-46832-2
doi: 10.2777/410249

© European Union, 2015.
Reproduction is authorised provided the source is acknowledged.

Printed in Luxembourg

Cover page: © kras99 #48197559 Fotolia, 2014

PRINTED ON ELEMENTAL CHLORINE-FREE BLEACHED PAPER (ECF)

Forward

This Final Report is the result of the work carried out in the second half of 2014 by a Group of external Experts who were asked to advise the European Commission on the subject 'systemic approach to eco-innovation to achieve a circular economy'.

The Group of Experts was established in the context of Societal Challenge 5 'Climate action, environment, resource efficiency and raw materials' of the Horizon 2020 Work Programme for 2014-2015 (EC Decision C(2013)8631 of 10 December 2013), with the aim to contribute to establishing an EU reference policy framework for Research & Innovation on issues related to green economy and sustainable development.

The five experts that were appointed (Raimund Bleischwitz, Françoise Bonnet, Stuart Hayward-Higham, Christiaan Prins, and Hanane Taidi) represent different stakeholder groups, namely research, public authorities, and industry.

The present Final Report – entitled 'From Niche to Norm' – provides the experts' view on the opportunities offered by a 'systemic approach to eco-innovation and circular economy' in terms of jobs, growth, and resource efficiency in Europe. The report includes a roadmap of Research & Innovation, and suggests actions to be implemented in the years to come.

In the framework of their activities, the members of the group had the opportunity to discuss and debate specific issues with other external experts – Guido Braam, Olivier Debande, Aldert Hanemaaijer, Rachel Lombardi, and Richard Miller – who accepted the invitation to share their views and perspectives on systemic eco-innovation and circular economy. A special thanks to these external experts for their availability and contribution.

Contents

EXECUTIVE SUMMARY	4
INTRODUCTION	7
1. CURRENT CHALLENGES FACING EUROPE	8
2. TOWARDS A CIRCULAR ECONOMY.....	10
3. ROADMAP FOR A SYSTEMIC APPROACH TO ECO-INNOVATION.....	13
3.1 Pillar 1: Mapping resource use in Europe.....	16
3.2 Pillar 2: Creating an open space for innovation	19
3.3 Pillar 3: Financing the transition from "niche to norm"	21
3.4 Pillar 4: Fostering a single market for resources.....	25
3.5 Pillar 5: Ensuring Consistent, Conducive, Coordinated (CCC) policy making	30
ANNEX 1: CASE STUDIES OF SYSTEMIC ECO-INNOVATION.....	33
ANNEX 2: PROFILE OF THE EXPERTS	36

Executive Summary

It is clear that the economic challenges Europe is currently facing are not cyclical, but of a structural nature. The existing organisation of production in Europe is not equipped to face a global climate of slow demand growth and price volatility for resources.

Without change, the EU will inevitably become less competitive, less attractive and less economically viable. Making changes now and into the future to a more circular, resource efficient economic model is not without risk. However, as the developing world continues along linear growth path, the EU and its Member States have the opportunity to reinvent their economies and make them globally competitive. They can do this whilst still achieving the shared goal defined by the Group of Experts who drafted this report, namely:

"Maintaining, improving and securing the future of the quality of life currently enjoyed within the European Union through the adoption of a more sustainable, non-linear economic model."

Rather than looking in vain for fresh investment into an outdated linear model of production – based on a 'take, make and dispose' approach – the EU needs to start using its financial capacity and leverage to kick start a circular economic model that treats all resources as valuable and productive.

The world is exploring ways of delivering a new industrial revolution. This involves a radical change to the systems, from production and consumption through to communities. It also means changes to the fundamental systems under which individuals, political and community entities and industries operate.

New smart materials, products and services are emerging, from detergent-free industrial cleaning systems to software-driven reshuffling of metal blankets and e-mobility solutions. New forms of industrial and research partnerships are also appearing. Waste streams from one industrial sector are being used as resources by another sector, and collaboration between the private sector and universities has recently led to breakthroughs such as the commercialisation of CO₂ as a raw material for the production of plastic foam (see case studies in Annex 1 for more detail).

Systemic eco-innovation is at the heart of this paradigm shift. Systemic eco-innovation goes beyond single technologies. It comprises clusters emerging in different areas, including among others: buildings, IT applications, agriculture and food, recycling and industrial symbiosis, water treatment, grid analytics, bio-based materials and many other sources.

Systemic eco-innovation will require new business models that are already beginning to emerge in different areas such as leasing models (rental or continual upgrade models) that bring down upfront costs for new equipment, products or facilities. These new models help maintain and continually upgrade high-quality machineries. They also involve smart sharing services that are starting to replace traditional proprietary models especially in urban markets. This is especially important given that 80% of the European population is expected to live in cities by 2050.

In the opinion of the Group of Experts, research and innovation are key for the EU to achieve a systemic approach to eco-innovation for a circular economy. In their view, funding priorities under Horizon 2020 ('H2020'), the EU's biggest research and innovation programme, should:

- comprise more integrated programmes that cut across the silos of energy, climate, water, materials and waste;
- encourage a more transformative role of research towards systemic eco-innovations, including stronger socio-economic dimensions in science and technology studies;
- allow for the bundling of other funding sources with H2020 in order to create larger knowledge communities and a more rapid dissemination of research findings into innovation and deployment;
- involve a coordinated urgent attempt to set up a database on European resource inter-linkages and anthropogenic stocks, foresight and modelling tools.

With these considerations in mind, the Group of Experts suggests the following roadmap of actions to ensure H2020 funding and broader EU policies can help foster a systemic approach to eco-innovation in the next five years:

Roadmap		
Action	Instrument/Institution	Timeline
Pillar 1: Mapping resource use in Europe		
1.1 Establish a steering group of experts to propose and monitor policy tools for the transition to a circular economy	H2020 'Coordination and Support Actions' or H2020 'Public Private Partnership'	2016-2017
1.2 Encourage industry sectors to deliver specific transition plans	European Innovation Partnership or H2020 'Public Private Partnership'	2015-2018
1.3 Facilitate scenario planning and foresight analysis on supply of key resources and resource inter-linkages	'Market replication' analysis or large-scale demonstration projects under the H2020 'Innovation Actions'	2016-2020
1.4 Mapping availability of unconventional fuel sources	H2020 'Coordination and Support Actions'	From 2016
Pillar 2: Creating an open space for innovation		
2.1 Enhance DG Research and Innovation stakeholder engagement activities	DG Research and Innovation/ Horizontal activity	Ongoing
2.2 Promoting science education and training in Europe	H2020 'Coordination and Support Actions'	2015-2017
2.3 Safeguard innovation spaces	H2020 Public Procurement for Innovation ('PPI') or Pre-Commercial Procurement ('PCP') for (green) procurement activities	2015-2020
Pillar 3: Financing the transition from "niche to norm"		
3.1 Compile and publish open source market data based on innovation trend and foresight analysis	DG Research and Innovation/ Horizontal activity	From 2016
3.2 Continue to promote existing funding mechanisms	DG Research and Innovation/ Horizontal activity	Ongoing
3.3 Establish stronger loan based funding for commercial activities	InnovFin – EU Finance for Innovators instrument	2016
3.4 Establish green municipal bonds and an EU collective municipal bond agency owned by participating local authorities, and encourage green procurement	InnovFin – EU Finance for Innovators instrument and PPI (public procurement for innovation) or PCP (pre-commercial procurement): for (green) procurement activities	2016
3.5 Develop long-term patient finance vehicles for innovations in resource efficiency and a circular economy	InnovFin – EU Finance for Innovators instrument	2016

Roadmap		
Action	Instrument/Institution	Timeline
Pillar 4: Fostering a single market for resources		
4.1 Adopt a holistic approach to resource management beyond waste across EU policies	European Commission	2015-2020
4.2 Strengthen EU policies on waste avoidance to encourage new product designs, and use of recycled or re-used materials	European Commission	2015-2020
4.3 Support consumers in the transition to the circular economy	H2020 'Fast Track to Innovation', H2020 'Innovation Actions', H2020 'Inducement Prizes'	2015-2020
4.4 Resource conservation and replacement plans	H2020 'Coordination and Support Actions'	2016-2019
4.5 Continue progress towards a harmonised Life Cycle Assessment (LCA) dataset and tools	Joint Research Centre	Ongoing
4.6 Produce an EU circular design methodology	H2020 'Research and Innovation Actions'	2017
Pillar 5: Ensuring Consistent, Conducive, Coordinated (CCC) policy making		
5.1 Develop a comprehensive resource roadmap to 2050, updating the previous roadmaps on low carbon and resource efficiency as well as new initiatives on water and land use	European Commission	2017
5.2 Assessment of new targets for sustainable resource use	European Commission	2016
5.3 Creating synergies between other EU funding mechanisms	DG Regional and Urban Policy	2016

Introduction

The European Commission has convened a small Group of Experts¹ from a range of sectors, including the private sector, public authorities and the research community to provide advice, in the form of a roadmap, on future EU research and innovation policies and programmes in the field of systemic eco-innovation. The members of the Group of Experts participated in this process in a personal capacity and their views are not intended to reflect those of their employers. With separate areas of expertise and approaching the issue from different perspectives, they all agree that a common goal for the EU that such roadmap would contribute to attaining is:

"Maintaining, improving and securing the future of the quality of life currently enjoyed within the European Union through the adoption of a more sustainable, non-linear economic model."

This report outlines the suggestions of the Group of Experts. While the primary focus of the report is on the programmes under the responsibility of the Directorate General ('DG') for Research and Innovation, the scope of the recommendations extends to other related policy areas within the remit of the European Commission.

¹ Raimund Bleischwitz, Françoise Bonnet, Stuart Hayward-Higham, Christiaan Prins, and Hanane Taidi.

1. Current challenges facing Europe

It is clear that the economic challenges Europe is currently facing are not cyclical, but of a structural nature. The existing organisation of production in Europe is not equipped to face the global climate of slow demand growth and price volatility for resources.

Between 2003 and 2013 world fuel prices rose fourfold, metal prices trebled and food prices roughly doubled. These trends are likely to continue - steel prices are expected to rise by 80% in the coming decades, and commodity prices by 147%². With 90% of economic growth expected to come from outside Europe, raw material prices will increasingly be decided externally.

Beyond the 'mundane' considerations of unemployment and economic break downs, there are increasingly alarming signals from the Intergovernmental Panel on Climate Change ('IPCC')³. These indicate that we are coming closer and closer to a tipping point in climate change that would cause all life on earth to become extinct without effective measures to keep temperature rises below the internationally agreed target of 2 °C.

Basic needs will also be affected. By 2030 the world will demand 50% more energy and 40% more water. The World Economic Forum's 2014 Global Risks Report places water and food crises among its top 10 global risks, alongside climate change and a greater incidence of extreme weather events. We can also expect ever greater geopolitical tensions over access to strategic resources, along with oil price shocks and escalations of economic and resource nationalism.

The reality is that, over time, the European Union ('EU') will become less and less self-sufficient on domestic resources and more reliant on imported materials. This, combined with relatively high labour costs, consumption patterns, energy costs, and rapidly growing markets elsewhere represents a clear and present danger to the EU's long term prosperity. As the proportional dominance of the EU as a market place for the world's production decreases inevitably over time through not only relative population growth but the increasing wealth generation in developing nations, the ability to sustain our current linear economic model will diminish significantly.

However, European economies are not preparing to meet this challenge. Europe is not in want of money as the EU still represents the largest economy in the world. Neither is Europe lacking in creativity or ideas, as it can boast the highest number of patent applications in the world. What Europe is missing is a new paradigm shift in how it organises its economy against the backdrop of changing global economic conditions. This requires not only ongoing investment in research, but the conditions and political will to turn ground breaking new ideas into market realities.

A synthetic analysis of Strengths, Weaknesses, Opportunities, and Threats ('SWOT') for EU is reported in the table below.

² McKinsey (2011) *Resource revolution: Meeting the world's energy, materials, food and water needs*.

³ See: http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_SPM.pdf

SWOT Analysis	
Strengths	Weaknesses
<p>Educated workforce</p> <p>Access to finance</p> <p>Inherent capacity for innovation</p> <p>Many innovative niches</p> <p>Established multi-level policies and decision-making</p>	<p>Ageing population</p> <p>High labour costs</p> <p>High dependence on imports of raw materials and energy fuels</p> <p>Vulnerability to costs and price volatility</p>
Opportunities	Threats
<p>Shift towards a resource efficient economic model</p> <p>Increased EU competitiveness</p> <p>Emergence from economic crisis</p>	<p>Competition from emerging markets</p> <p>Short timeframe in which to establish competitive advantage on resource efficiency</p>

2. Towards a circular economy

Without change the EU will inevitably become less competitive, less attractive and less economically viable. Change never comes without risk. However, whilst the developing world continues along linear growth path, the EU and its Member States have the opportunity to reinvent their economies and make them globally competitive whilst still achieving the shared goal defined by this Group of Experts.

Rather than looking in vain for fresh investment into an outdated linear model of production – based on a 'take, make and dispose' approach – the EU needs to start using its financial capacity and leverage to kick start a circular economic model that treats all resources as valuable and productive.

Many companies have already responded to the fluctuations in raw material prices by integrating circular economic thinking into their supply chains. The faster Europe is able to scale up these micro-level initiatives to the macro level, *from niche to norm*, the sooner it will bring the tipping point closer where minimisation is hard wired into the economy and re-use and recycling becomes cheaper than extraction of new materials. To achieve this, Europe will need to focus more than ever on creating the right conditions for innovation, making necessary changes to the legislative landscape, and encouraging community engagement.

The sooner the change, the sooner the EU will be able to reap the competitive advantages that will deliver long term growth. A more efficient, knowledge, manufacturing and service based circular economy will help maintain and generate new jobs and industries in the EU Member States. It will also help rejuvenate social and commercial environments and deliver a new economic model to the world.

Economic potential of a Resource Efficient Europe

If we manage to upscaling resource efficiency thinking at a European level, there is enormous potential for economic growth. McKinsey estimates EUR 2.13 trillion in savings by 2030 when the full resource efficiency potential is realised, even rising to EUR 2.7 trillion when carbon emissions are priced correctly, subsidies on water, energy and agriculture are abolished and energy taxes are removed.⁴

One of the key drivers the EU has at its disposal for scaling up circular initiatives is leveraging the Single Market and making it a true 'single market for resources'. Currently the Single Market connects 500 million citizens in 28 Member States, making investment in Europe potentially rewarding. This Single Market is a key initiating tool to scale up activities at company, local, regional and Member State level to a European level – where one market can be developed, where economies of scale can be achieved, and where the resource sharing and balancing can be maximised.

The scale of this single market for resources should be harnessed to:

- to encourage innovation;
- to create the knowledge that can drive domestic change, as well as new solutions and services in export markets;
- to provide a secure test bed to commercialise the data, research and innovation that flourishes within that single market and that can give expression and opportunities to the individual, the community and all scales of industry to deliver a new economic model.

However, scaling up through the Single Market can only work when public, private and non-for profit stakeholders work together in partnerships.

⁴ McKinsey (2011) *Resource revolution: Meeting the world's energy, materials, food and water needs*.

The role of systemic eco-innovation

The world is exploring ways of delivering a new industrial revolution.⁵ This involves a radical change to the system, from production and consumption through to communities. It also means changes to the fundamental systems by which individuals, political and community entities and industries operate.

New smart materials, products and services are emerging, from detergent-free industrial cleaning systems to software-driven reshuffling of metal blankets and e-mobility solutions. New forms of industrial and research partnerships are also appearing. Waste streams from one industrial sector are being used as resources by another sector, and collaboration between the private sector and universities has recently led to breakthroughs such as the commercialisation of CO₂ as a raw material for the production of plastic foam (see case studies in Annex 1 for more detail).

Systemic eco-innovation is at the heart of this paradigm shift. According to the European Commission⁶ eco-innovation is defined as:

"any form of innovation resulting in or aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment, enhancing resilience to environmental pressures, or achieving a more efficient and responsible use of natural resources."

The systemic character comes into play through a more comprehensive definition stressing:

"a series of connected changes improving or creating novel functional systems that reduce use of natural resources and decreases the release of harmful substances across the whole life cycle"⁷.

Systemic eco-innovation goes beyond single technologies. It comprises clusters emerging from different areas, including: buildings, IT applications, agriculture and food, recycling and industrial symbiosis, water treatment, grid analytics, bio-based materials and many other sources.

Systemic eco-innovation will require new business models that are already beginning to emerge in different areas from leasing models (or rental or continual upgrade models) that bring down upfront costs for new equipment, products or facilities. These new models help maintain and continually upgrade high-quality machineries. They also involve smart sharing services that are starting to replace traditional proprietary models especially in urban markets. This is especially important given that 80% of the European population are expected to live in cities by 2050⁸.

A series of connected changes may kick-off from process innovation, as many companies have not yet fully grasped the opportunities of managing resources more efficiently. For example in pipe production industries, a key element for infrastructure development, the focus on increasing resource conservation and efficiency has resulted in some 20% of production now being produced through using offcuts.

Given that more than 50% of European companies are paying at least 30% of their total costs for material inputs and that analyses indicate cost savings in the range of 5% – 20% are possible with resource efficiency, there are significant real saving available in raw material costs.

Fundamentally reducing the resources used in manufacturing also makes those companies more productive, more competitive internationally and therefore more likely to survive and thrive, preserving and growing jobs and wealth. Furthermore, if some of those savings can be reinvested in new eco-innovations, re-training or new facilities then further competitive advantages, jobs and wealth can be delivered.

Why are all companies and economies around the globe not using resources more efficiently? Why does process innovation become stuck at single companies without being transformed into creating novel functional systems? Research findings indicate a 'web of constraints' – from internal barriers

⁵ See e.g.: www.mckinsey.com/Insights/Energy_Resources_Materials; www.greengrowthknowledge.org; www.eco-innovation.eu; www.ellenmacarthurfoundation.org/; TNO (2014) *Systemic Innovation: Concepts and tools for strengthening National and European eco-policies*, TNO report R10903.

⁶ Eco-Innovation Action Plan (COM(2011)899).

⁷ Eco-Innovation Observatory (EIO) (2013) *A systemic perspective on eco-innovation*.

⁸ See: <http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html>.

within firms, to external barriers resulting from both market failures and policy failures. Systemic eco-innovation thus requires technological and institutional changes, both at the level of markets and in terms of policies addressing mind sets and infrastructures.

The Circular Economy is, in fact, a dynamic composition of many different circles for a number of resources used throughout a number of economies with manifold inter-linkages. The challenge faced by everyone, and the opportunity to be gained by those who can master the complex requirements, are significant. Designing the plethora of push and pull mechanisms required to help and make it happen is a significant but vitally important task. EU policy and EU funding programmes such as H2020 have a fundamental role to play in this regard.

3. Roadmap for a systemic approach to eco-innovation

The EU has the potential to deliver a new, viable future by: building on its reputational strengths; leveraging its educational, creative and industrial industries; creating the flows necessary to feed and sustain the market, and; creating resilience through the diversity inherent in its population. Where it has a clear competitive advantage is in using the scale of the EU institutions to give clarity of purpose and direction to all stakeholders and to provide an environment where ideas are created, data is commercialised and innovations are industrialised.

The transition from a linear to circular economic model gives the EU the opportunity to capitalise on its many years of investment in areas such as waste recycling and non-fossil energy, waste water in combination with energy production and nutrient recovery, and new blue green infrastructures. This type of investment can compensate for some of the EU's inherent weaknesses, such as a relative paucity in natural raw materials, as well as partially decouple from an import led and volatile global market place.

The European Commission has the potential to reenergise the creative and design communities in the Member States to deliver new goods and systems that are resource and energy light, labour light in their recovery and reuse (either as goods or deconstructed to their constituent parts), and that can be remanufactured or used in new products. These products can then be used to service not only domestic demand but also export demand. This would dramatically reduce dependency on strategic imports and would drive new manufacturing and activities within the Member States.

Adopting a circular approach in Europe would not only result in an enhanced single market. It also means using the fundamentals of the circular economy to drive the efficiencies and competencies to overcome Europe's inherent limitations and move towards new knowledge, skills, and infrastructures that can combine to deliver a truly internationally competitive economy founded in a long term sustainable future.

These shifts will involve;

- *A more collaborative approach to activities and sharing arrangements.* The EU can play an essential role as a facilitator of new education modules, metrics and assessment tools that will be essential in fostering necessary shifts in mindsets. In this respect, the creation of a European Resource Union could be something the EU could aspire to by 2020.
- *Improving the resilience of current value chains through resource efficiency* – thereby lowering risks of price volatility and geopolitics, and cutting costs of using resources. Value chains are an essential element of this change. The EU has a key role to play in disseminating best practices, in facilitating and promoting communication, and in creating and maintaining a level playing field for each of the value chains and each Member State.
- *Increasing Europe's intellectual wealth.* Creating new wealth is essential, but to provide a firm basis for change it is not only important to deliver new monetary wealth but also to: increase intellectual wealth through education and training; to provide feelings of well-being and happiness, and; to deliver this across the breadth of society. This will involve: clever leveraging of money; the reinvestment of profits from successful loan schemes, and; focussing on research that not only delivers scientific outcomes, but also education and technical training improvements required to populate and support the new industries.
- *Providing consistent and measurable metrics* by which new solutions and technologies can be measured and assessed. These should be clearly understood and adopted by all (politicians, regulators, industries, citizens, municipalities etc.). In this regard, the EU has an essential role to play to make sure these metrics are defined and adopted in the early stages of the circular transformation. This involves defining not only the metrics of measurement but also in helping all involved to understand and appreciate their value.

In the opinion of the Group of Experts, research and innovation is key for the EU to achieve a systemic approach to eco-innovation for a circular economy. As such, funding priorities under H2020, the EU's biggest research and innovation programme, should:

- comprise more integrated programmes that cut across the silos of energy, climate, water, materials and waste;
- encourage a more transformative role of research towards systemic eco-innovations, including stronger socio-economic dimensions in science and technology studies;
- allow for the bundling of other funding sources with H2020 in order to create larger knowledge communities and a more rapid dissemination of research findings into innovation and deployment;
- involve a coordinated urgent attempt to set up a database on European resource inter-linkages and anthropogenic stocks, foresight and modelling tools.

With these considerations in mind, the Group of Experts suggests the following roadmap of actions to ensure H2020 funding and broader EU policies can help foster a systemic approach to eco-innovation based around the following pillars in the next five years:

Roadmap		
Action	Instrument/Institution	Timeline
Pillar 1: Mapping resource use in Europe		
1.1 Establish a steering group of experts to propose and monitor policy tools for the transition to a circular economy	H2020 'Coordination and Support Actions' or H2020 'Public Private Partnership'	2016-2017
1.2 Encourage industry sectors to deliver specific transition plans	European Innovation Partnership or H2020 'Public Private Partnership'	2015-2018
1.3 Facilitate scenario planning and foresight analysis on supply of key resources and resource inter-linkages	'Market replication' analysis or large-scale demonstration projects under the H2020 'Innovation Actions'	2016-2020
1.4 Mapping availability of unconventional fuel sources	H2020 'Coordination and Support Actions'	From 2016
Pillar 2: Creating an open space for innovation		
2.1 Enhance DG Research and Innovation stakeholder engagement activities	DG Research and Innovation/ Horizontal activity	Ongoing
2.2 Promoting science education and training in Europe	H2020 'Coordination and Support Actions'	2015-2017
2.3 Safeguard innovation spaces	H2020 Public Procurement for Innovation ('PPI') or Pre-Commercial Procurement ('PCP') for (green) procurement activities	2015-2020
Pillar 3: Financing the transition from "niche to norm"		
3.1 Compile and publish open source market data based on innovation trend and foresight analysis	DG Research and Innovation/ Horizontal activity	From 2016
3.2 Continue to promote existing funding mechanisms	DG Research and Innovation/ Horizontal activity	Ongoing
3.3 Establish stronger loan based funding for commercial activities	InnovFin – EU Finance for Innovators instrument	2016
3.4 Establish green municipal bonds and an EU collective municipal bond agency owned by participating local authorities, and encourage green procurement	InnovFin – EU Finance for Innovators instrument and PPI (public procurement for innovation) or PCP (pre-commercial procurement): for (green) procurement activities	2016
3.5 Develop long-term patient finance vehicles for innovations in resource efficiency and a circular economy	InnovFin – EU Finance for Innovators instrument	2016

Roadmap		
Action	Instrument/Institution	Timeline
Pillar 4: Fostering a single market for resources		
4.1 Adopt a holistic approach to resource management beyond waste across EU policies	European Commission	2015-2020
4.2 Strengthen EU policies on waste avoidance to encourage new product designs, and use of recycled or re-used materials	European Commission	2015-2020
4.3 Support consumers in the transition to the circular economy	H2020 'Fast Track to Innovation', H2020 'Innovation Actions', H2020 'Inducement Prizes'	2015-2020
4.4 Resource conservation and replacement plans	H2020 'Coordination and Support Actions'	2016-2019
4.5 Continue progress towards a harmonised Life Cycle Assessment (LCA) dataset and tools	Joint Research Centre	Ongoing
4.6 Produce an EU circular design methodology	H2020 'Research and Innovation Actions'	2017
Pillar 5: Ensuring Consistent, Conducive, Coordinated (CCC) policy making		
5.1 Develop a comprehensive resource roadmap to 2050, updating the previous roadmaps on low carbon and resource efficiency as well as new initiatives on water and land use	European Commission	2017
5.2 Assessment of new targets for sustainable resource use	European Commission	2016
5.3 Creating synergies between other EU funding mechanisms	DG Regional and Urban Policy	2016

3.1 Pillar 1: Mapping resource use in Europe

In 2012 the World Economic Forum produced an insight report on Europe 2020, entitled 'Building a more competitive Europe'. The report analysed the competitiveness of the EU and its Member States against seven criteria – referred to as the 7 pillars:

CRITERIA	GROWTH
<u>Pillar 1</u> : Enterprise Environment	SMART
<u>Pillar 2</u> : Digital Agenda	
<u>Pillar 3</u> : Innovation Europe	
<u>Pillar 4</u> : Education and training	
<u>Pillar 5</u> : Labour Market and Employment	INCLUSIVE
<u>Pillar 6</u> : Social Inclusion	
<u>Pillar 7</u> : Environmental Sustainability	SUSTAINABLE

The report considered the EU as a whole and its 28 Member states, analysing their competitiveness against other advanced economies. In comparison to these other economies the EU was judged to perform well in terms of building social and inclusive societies. However, it was seen as trailing significantly in the critical area of smart growth. The report concluded that *'this raises concerns about its innovation capacity, its ability to boost competitiveness and its potential to continue providing high and rising living standards'*. This conclusion is a direct threat to achieving the shared goal defined by this Group of Experts.

In this context, how has the EU performed recently? A report issued by the European chemical⁹ sector on 20th November 2014 described the current outlook as "very serious" and warned of declining competitiveness. The European Chemical Industry Council (CEFIC) commissioned a report by Oxford Economics, which showed that the EU share of global chemical exports fell from 31% in 1991 to 21% in 2012. This was despite a rise in EU chemical sales, which had almost doubled, from EUR 282 billion in 1993 to EUR 527 billion in 2013.

Tellingly the report sought not to be alarmist by introducing the caveat that most big industrial groups are global and less exposed to Europe.

In another example, a recent European Commission staff working document on 'reindustrialising Europe'¹⁰, problems such as lack of investment, access to finance, the price of energy and the necessary structural changes were all identified as common problems.

In this respect, an analysis presented by IMD¹¹ in 2014 indicates that a number of the EU Member States have slipped significantly in their overall competitiveness. Scandinavian countries are generally doing relatively better and the southern European Countries generally worse.

The EU and most of its Member States are not only becoming more reliant on imported resources. They are also suffering as a result of historic structures and a number of policies that have eroded the competitiveness of the EU against the emerging and developed economies. In addition, Europe's status as a leading consumer market is also under threat. Population growth and increasing affluence in the emerging countries and the shale gas boom in the USA are leading to a continual reduction in the importance of the EU as a market place and as a location for the production and export of goods.

⁹ Oxford Economics (2014) *Evolution of competitiveness in the European chemical industry: historical trends and future prospects*.

¹⁰ European Commission (2014) *Reindustrialising Europe Member States' Competitiveness Report 2014 SWD(2014) 278*.

¹¹ IMD, the international business school in Lausanne, Switzerland

Without change, the EU economy will continue to decline. This will eventually lead to an erosion of the living standards of its citizens.

However, some changes are occurring and it is important that the EU monitors and manages these, in order to not only promote and foster the right changes but also to ensure an appropriate balance is maintained. Some Member States are performing better than others and the EU has an important role to play in promoting best practice and transfer of skills.

It is expected that the previous trend of capital ownership, from houses to cars, phones and televisions will gradually be replaced with a service based form of ownership (often called servitisation or the leasing society) that provides rented homes, mobility and communication. This transfer in culture needs to be managed carefully so that people feel empowered to choose, as well as recognise a service based solution that is better for both the environment and the EU economy.

Although servitisation or the leasing society would appear to be an essential component of a circular economy, it is fundamental that it is developed in a coordinated and managed way. The implications of poor delivery range from disenfranchisement of consumers to the model itself, and from poor or inconsistent adoption through to the removal of choice. Therefore, a poor delivery risks leading to the development of a form of consumer slavery where the cost of leasing goods takes up the majority of available income, preventing saving or the opportunity to purchase capital items – in other words, a form of rental servitude. The EU has a fundamental role to play in establishing the guidelines and systems that would ensure the fair and equitable delivery of such a new model.

Designing and managing the transition from a linear to circular economy will require both good data and knowledge as to the current situation, as well as a transition plan that seeks to help manage the process. These transition plans will need to be specific for each industrial sector and value chain and must be designed to deliver the outcome at a speed and in a manner that provides economically sustainable change. Considerations such as reinvestment, re-training, the managed demise of certain industries and their replacement with new ones need to be understood together with relative international competitiveness so that the rate of change leads to a thriving economy.

It is not only important to understand the flows and anthropogenic stocks of materials that would need to be managed or replaced. It is also vitally important to have the skills and infrastructure necessary to manage the recovery from the waste stream - dismantling and resource extraction, logistical transport and reuse in manufacture.

New Master level programmes at universities and new training modules are needed, and H2020 should have a programme to deliver those skills.

The development of an integral strategy would then be possible. This would provide the basis of commodity consolidation, movement or treatment and recovery hubs developed at pre-defined locations. Seed funding for the technologies and facilities necessary to deliver these hubs would then be focussed through H2020 or LIFE+ funding for demonstration or market development or replication projects. Commercialisation on a wider scale could then be managed through the EIB or InnovFin complementary funding systems.

Pillar 1 - Suggested Actions

1.1 Establish a steering group of experts to propose and monitor policy tools for the transition to a circular economy

Under H2020 'Coordination and Support Actions' the European Commission could establish a standing steering group of experts from industry, government and communities with support from academia to propose appropriate policy tools on drivers, barriers and targets, and then to monitor and refine their delivery and success during the transition from a linear to circular economy.

All new rounds on innovation funding would be reviewed and focussed through this group to ensure they are aligned and correctly sequenced through the value chains.

This group would then contribute to setting up pilot projects with early adopter sectors to identify best practices on how to enable the transition to a circular economy.

(Timing: The remit for the group(s) could be agreed by early 2016 and it/they could be operational by mid-2017)

1.2 Encourage industry sectors to deliver specific transition plans

Industries, and especially resource-intensive sectors, should be encouraged through instruments such as a European Innovation Partnership or a contractual Public Private Partnership under H2020 to bid in consortium groups to deliver specific transition and management plans. The objective of the plans would be:

- to clearly lay out what their solution will bring in terms of sustainability over the life cycle with customers and future applications within the constraints of time (when the transition needs to be complete);
- to outline the rate of change and measurement when compared to the wider international markets and the dynamic nature of relative competitiveness and policy implications;

These plans would then cascade into subsequent research, innovation and project calls and delivery, and they should consider the complete value added context (such as social and communities) as well as traditional financial measures.

(Timing – Bid call designed by end of 2015. Bids could then be received in 2016 and projects delivered in 2017/2018.)

1.3 Facilitate scenario planning and foresight analysis on supply of key resources and resource inter-linkages

H2020 could set up a data hub based on an integrative mapping of both primary and secondary supply and facilitate scenarios and foresight analysis for key areas and resource inter-linkages.

This would provide a valuable knowledge driver for call in certain geographies for certain groups of materials (to be defined according to priorities) to be managed and the skills, tools and demonstration facilities to be developed *(where necessary, as they may already exist or can be adapted)*. Spatial funding through H2020 or LIFE can then be used to kick start the key projects.

(Timing - Data collection by 2016/2017. GIS design and hosting would take 2 years, the first of which runs parallel to the data collection. This would then drive projects into funding rounds in 2017/18 with the first demonstration projects delivered before 2020.)

1.4 Mapping availability of unconventional fuel sources

The H2020 'coordination and support actions' instrument could be used to gather accurate data on the EU's energy needs and how these can be met by unconventional, preferably renewable, energy sources in Europe through research which also would evaluate the potential environmental, economic and societal impact of exploration in Europe.

(Timing – This research could be completed by end 2016)

3.2 Pillar 2: Creating an open space for innovation

Systemic eco-innovation requires more than science and technology. It requires new alliances, often with the engagement and the involvement of citizens, communities and municipalities building on a general environment that welcomes and is excited by innovation.

The EU has an opportunity through coordinating, catalysing and facilitating links between industry and innovators and communities and municipalities to promote an environment in which innovators can grow and succeed, and also to bring forward new ideas and opportunities from the social, community and municipal sectors. A key factor is to create demand conditions that lower risks for innovators and facilitate transition processes.

The European Commission and national governments have a role to play in safeguarding 'innovation spaces', both by supporting demand for eco-innovation (e.g. through pre-commercial procurement) as well as by engaging with stakeholders directly in the process of eco-innovation.

EU funding has already been used for this kind of stakeholder innovation, through initiatives such as the VOICES project¹² which gathered opinions and ideas about urban waste from citizens across the EU, and the CASI project on *"public participation in developing a common framework for assessment and management of sustainable innovation"*.¹³

Research should play a more active and transformative role. Crossing disciplinary boundaries and creating new knowledge clusters around the circular economy and resource efficiency is necessary. Research should help to establish evidence on drivers and barriers with a clear view to shaping future visions and pathways. Participation should become a key element for such transformative research, in line with engagement of stakeholders and civil society.

Science is by definition progressive and can be controversial. Nothing is ever certain. However, in science, like in any other discipline, results can be more or less conclusive. When regulation is at stake, policy makers and citizens should rely on the most conclusive science. Hurdles that are likely to impede innovation and investment in R&D in Europe are closely linked to general risk averseness in European society. This leads to a lack of agreement on how to best use science and evidence in decision-making, a lack of trust in the institutions, a lack of understanding of how innovation leads to growth and the creation of long term jobs.

The regulatory environment in which research and innovation take place must provide both opportunities and safeguards. It is essential that the EU establishes clear regulatory conditions that enable new ideas and business opportunities to set up and develop quickly, while also providing appropriate conditions for their long term commercialisation. Overcoming uncertainties in demand is a key. This is where the EU should create the appropriate incentives.

In a 2004 report entitled *'The precautionary principle: protecting the public health, the environment and the future of our children'*, Roberto Bertollini, Director of the Division of technical support, Health Determinants of the World Health Organisation office for Europe stated *"if used intelligently, imaginatively and daringly, the precautionary principle will support efforts to strive towards a healthier and safer world"*.

The key words here are intelligently, imaginatively and daringly. There is a vitally important balance to be struck between the risk of doing something and the risk of doing nothing. Establishing the regulatory environment and wider social understanding of that risk balance is essential to reconciling the potentially conflicting demands of new research, development and innovation and the protection of the wider environment and the public. The lack of clarity around how the precautionary principle should be applied, the potential conflict of the need to build data to inform that very risk assessment and the opportunity that may exist, and the need to allow innovation to occur at market relevant speed is leading to the potential stifling of the very activities the EU wishes to encourage.

Striking this balance will help provide an internationally competitive market position for the EU, attracting innovators and developers to work and establish themselves in the EU knowing that the

¹² See: http://voicesforinnovation.eu/phase_1_new.html.

¹³ See: <http://www.casi2020.eu/about/description/>.

environment is right to undertake the research, to establish the risk and opportunity and to create the basis for both a transitional and long term stable business.

As well as providing the opportunity for research, development and innovation in the EU this Group of Experts also considers it essential that the EU and its Member States seek to inform and develop a social enthusiasm and excitement around the need and opportunity for change. This will not only seed social acceptance but will also encourage further 'closet' innovators and entrepreneurs to step forward.

Against a backdrop of an increasingly risk averse society, industry and policy makers should work together to step up education and communications efforts needed to provide a neutral context to new innovations and the trials required to deliver the certainties around their potential wider adoption. Achieving this goal to help secure acceptance of new technologies at an early stage of development, especially where trials are required is essential to incentivise industry's investment in R&D in Europe and to maintain Europe's leadership in innovation.

Education is at the core of a successful and long-term Research and Innovation policy in Europe. The EU and its Member States must promote and strengthen STEM curriculum, i.e. Science, technology, engineering and mathematics. They should also promote and strengthen curricula of transition management and sustainable resource management with core modules on socio-economic and behavioural knowledge. Above all, cross-disciplinary and impact-oriented skills should be promoted.

Pillar 2 - Suggested Actions

2.1 Enhance DG Research and Innovation stakeholder engagement activities

DG Research and Innovation should enhance its stakeholder engagement activities through the organisation of public events aimed at:

- raising awareness and inviting society to join the innovation journey;
- engaging with the scientific community to revive public fascination and enthusiasm about science;
- mapping out the needs of European society and laying out innovation paths to respond to these needs;
- identifying the best combined use of transformative research, conclusive science and risk management

(Timing: Ongoing as of 2015)

2.2 Promoting science education and training in Europe

DG Research and Innovation could allocate funds via 'H2020 'Coordination and Support Actions' to educational projects geared towards enhancing science in schools and dedicate grants to universities for scientific innovation and socio-economic change with an active transition dimension.

(Timing - Designing the bid call can be completed by end of 2015. Bids could then be received in 2016 and projects could begin as of 2016/2017).

2.3 Safeguarding innovation spaces

The European Commission and national governments have a role to play in safeguarding 'innovation spaces', by supporting demand for eco-innovation (e.g. through pre-commercial procurement)

(Timing 2015 -2020).

3.3 Pillar 3: Financing the transition from "niche to norm"

According to the OECD¹⁴ "to promote resource efficiency and a circular economy, start-up business and other innovators will need to overcome the barriers to the introduction of new mass markets solutions which result from the inertia and dominance from existing technologies and systems. Precisely because the market is still underdeveloped, overcoming all those barriers could lead to a new wave of innovations comparable to those of other major technological revolutions."

The extent of these barriers is amply exemplified by the complexity of the fiscal environment for a start-up business. A recent UK House of Commons Science and Technology Committee report¹⁵ clearly shows the complex environment in which a start-up is required to navigate to succeed. This is why there is the absolute necessity of an informed coordinator and board advisor to support the start-up business.

In many ways grants or loans are simply not enough to ensure the maximum number of start-up niche business become long term job and wealth creating organisations. However, it is encouraging to realize how many niches do exist and manage to survive. The key challenge is to move forward many more start-ups and other innovating businesses to create the mass market adoption required, i.e. from niches to norms.

The provision of valuable support for start-ups at EU level could take many forms and could include:

- market insight, especially policies and policy thinking;
- networking with other complimentary businesses, municipalities, communities, regions and organisations;
- management support and influence to provide skills not normally present in early start up activities and businesses, especially around commercialisation/industrialisation;
- direct funding or facilitation to other funders or forms of funding;
- coordination support to assist with navigation through the policy and regulatory systems present in the host Member State and the EU, ranging from funding mechanisms through to employment and environmental law.

The EU has an opportunity to provide not only financial support for research, development and innovation but also structure such support in such a way that it provides the basis of a sequence of wider market development mechanisms that can provide more assistance through the two main recognised 'valleys of death' for innovation demonstrated in the figure below. The first valley occurs at the start up stage and the second follows in the industrialisation and commercialisation phase (see Figure 1).

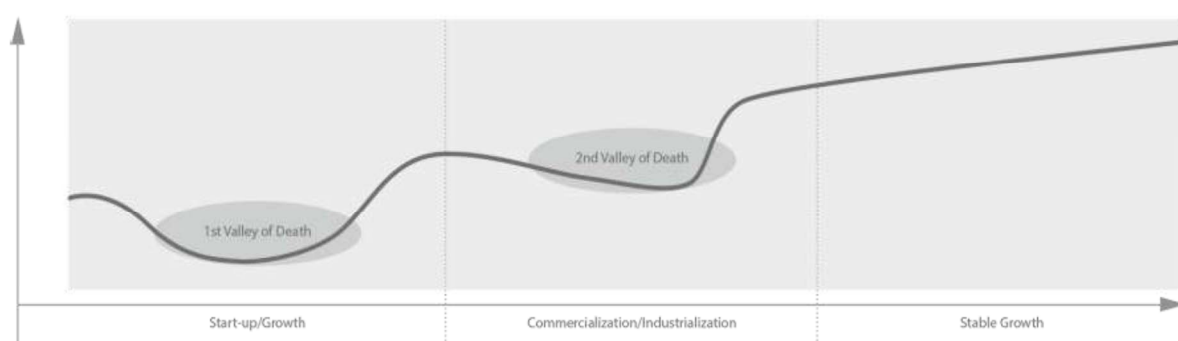


Figure 1: Valleys of Death for Innovation - European Investment Bank

Although the EU should be wary of creating bias or skews in the commercial market, it can very usefully create the push and pull conditions for market actors. To unleash new market trends and to create spill overs, it can provide tools to access informed and peer respected data, trend and foresight analysis, and opinion that will provide valuable insight to others, be they developers, investors or industrial partners.

¹⁴ OECD (2011) *Fostering innovation for green growth*.

¹⁵ House of Commons - Science and Technology Committee (2013) *Bridging the valley of death: improving the commercialisation of research - Eighth Report of Session 2012-13*.

The EU has an opportunity to help provide support in ensuring that large scale demonstration projects and transition pathways in key areas are delivered and that those successful businesses are developed and grow within Europe. Providing access to test facilities and development hubs, and applying lessons learned for a rapid deployment is essential to the creation of a thriving innovative industry.

The EU and its Member States can deliver facilities and services that offer opportunities for start-ups. For example in the UK the Wilton Centre in the North East of England has been set up to help provide an innovative company environment. This ranges from simply providing short lease offices through pilot plant trial facilities with regulatory permissions already in place, to utilities and waste management services to provide pilot plants and start-ups with an easy place to start out. Sites like these can therefore not only provide the physical incubation but also provide the nucleus of knowledge and opportunity sharing between co-hosted innovators.

Funding is an essential element of support currently given through a plethora of schemes initiated and managed by the EU, its Member States and often at a local level. The sheer number of schemes, the complexity of qualification and issues of state aid and competition law lead to an inertia of interest and activity. Furthermore, the provision of 'free' money can often lead to a less rigorous commercial approach to projects. As systemic eco-innovation and the circular economy cut across all sectors, access to easy and smart financing is essential.

Establishing a more loan based activity with stronger potential equity participation provides the ability to establish bridges between each stage of development and should enable the EU and its Member States to carry out more projects through innovation to established growing businesses. Money recovered from loan repayments then supports and potentially increases the budget available to support other projects. It also offers the opportunity to deliver peripheral activities in social and community areas that would assist in cultural or social engagements with the process of change and would be especially useful where they were linked to the local innovation activity and contributed to its success and/or acceptance. The money could also be used in conjunction with or to support crowd funding techniques to provide further community interest and affinity with the innovative activities. It might also be used to help train potential employees for the new business in question.

If funding is used appropriately, the EU has an opportunity to: establish itself as an initiator and collaborator in systemic innovation; to make maximum use of its available financial resources; to firmly establish itself as a globally competitive location for not only research and development but also innovation and new business or activity; and not only for small start-up companies but also established companies. Making the EU 'the' place in the world for these activities is essential if we are to make the change from a linear economy to a more circular one, and to commercialise the research and development data and skills within the EU.

Pillar 3 - Suggested Actions

3.1 Compile and publish open source market data based on innovation trend and foresight analysis

The European Commission should compile appropriate open source market data and trend and foresight analysis that can inform start-ups and their investors and industrial partners. Good examples of this are the market reports produced by the EIB and the Green Investment Bank (GIB) in the UK.

The EU has created significant data banks of research and analysis through its various support mechanisms for research, development and innovation. It is now time to wrap up, to make comparative assessments and rapid reviews and prepare the markets of the future by providing insights (to the nature, extent and type of data and analysis held and then providing efficient access to that resource could deliver significant benefits for established and start-up businesses alike). Simply avoiding the mistakes of predecessors or building upon their success would offer immediate and tangible benefits.

(Timing: Periodic assessments to be carried out as of 2016)

3.2 Continue to promote existing funding mechanisms

The European Commission has a role to play in promoting its funding mechanisms and continuing:

- To provide a simple guide to the funding mechanisms and their rules and limitations. This could be achieved within one year. It is expected that this may require the streamlining, cancellation or consolidation of various existing schemes.
- To provide coordination facilities for individuals, communities and industries such that they can be guided through the process of project definition and viability, partners and funding options and all the way through to assistance in making and managing applications for support.
- To facilitate access to established operating companies who can, where interests are aligned, potentially provide further funding, support or partnership. Such support may also be indirectly supported by the EU through fiscal or other compensatory measures that reward and recompense these industrialising supporting companies. Very simply that compensation could take the form of R&D or innovation tax relief on monies invested in the project as well as more complex Intellectual property, fund matching or other support mechanisms.

(Timing: Ongoing)

3.3 Establish stronger loan based funding for commercial activities

For commercial activities funding should be moved away from the 'free' money grant system and more towards a loan based system – 'blending' loans and grants and leveraging different sources will be important, as well as adaptive types of financing that recognizes changes in the market situation. This change not only requires a real world approach by developers to the cost of money but also provides an opportunity to follow the loan through one or both of the 'valleys of death' and recover money back from successful commercialisations to reinvest in new schemes or to fund social and community based support to accompany some of the innovations.

Such a loan system could be supported through changes to the Innov-Fin – EU Finance for Innovators instrument – a joint initiative of the European Investment Bank/European Investment Fund and the Commission under H2020.

(Timing: Establishment of new schemes by end 2016)

3.4 Establish green municipal bonds and an EU collective municipal bond agency

In addition, InnovFin could be used to bolster the capacity of local authorities to drive green infrastructure locally by enabling the establishment of green municipal bonds and an EU collective municipal bond agency owned by participating local authorities, or Horizon 2020 or PPI (public procurement for innovation) or PCP (pre-commercial procurement): for (green) procurement activities.

(Timing: Establishment of new schemes by end 2016)

3.5 Develop long-term patient finance vehicles for innovations in resource efficiency and a circular economy

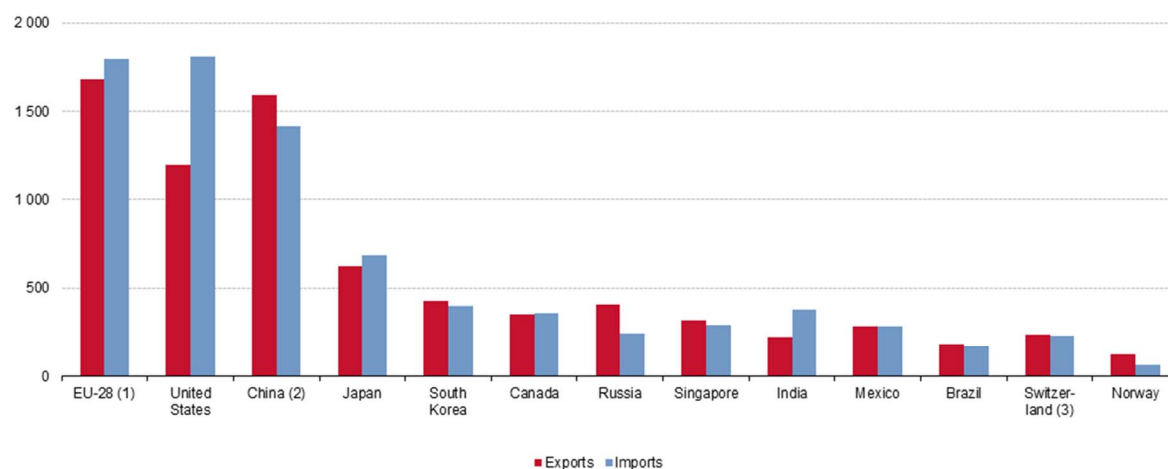
Instruments like InnovFin could also be adapted to develop long-term patient finance vehicles for innovations in resource efficiency and a circular economy such as smart grids and other distribution and recovery infrastructures e.g. the Carbon Trust and ETI in the UK have been valuable vehicles for public investment, which could be upscaled at EU level.

(Timing: Establishment of new schemes by end 2016)

3.4 Pillar 4: Fostering a single market for resources

The EU represents one of the biggest markets in the world in terms of the value of goods and services. It has sought over the last 22 years to build a single market allowing flexibility of movement of people, goods, services and businesses. In doing so, it has increased internal EU exports as a percentage of GDP from 12% in 1992 to 22% in 2011 (EUR 800 billion to EUR 2,800 billion). Exports have also grown but by far less a margin - increasing from 8% of EU GDP in 1992 to 12% in 2011.¹⁶ Leveraging the strength of the internal market to grow exports outside the EU and create a truly internationally competitive position is essential.

Eurostat figures for 2012 (see Figure 2) highlight the scale of the EU's performance in 2012 compared to our trading partners. Maintaining and improving that position, especially in terms of growing exports to markets outside of the EU, is essential to achieving the shared goal of this Group of Experts. With a diminishing call on natural resources and higher costs compared to many world economies in terms of energy & materials, employment and other costs, EU economies must find better and new ways of competing to achieve this key target of export growth.



(1) External trade flows with extra EU-28.

(2) Excluding Hong Kong.

(3) Including Liechtenstein.

Source: Eurostat (online data codes: ext_it_introle and ext_it_intercc)

Figure 2: Main players for international trade, 2012 (billion EUR), Eurostat¹⁷

The figures clearly show that the single market has been particularly successful in driving internal growth. However, a 'single market for resources' approach is about resource sharing, about garnering the knowledge and skills of the EU to use those resources in a smart way that not only continues to deliver internal growth but also substantially increases export growth.

Simply conserving the resources we have within the EU and sharing them in the single market will create a competitive advantage – whether these resources are raw or mined from consumers and industry alike through recycling and recovery. By conserving and using these resources locally, the EU should be able to add value to the dynamic innovative internal market place and make it an even more attractive outlet for inward investment. In addition it would demonstrate and test new goods, services and manufacturing tools and techniques at large scale, which will drive export performance.

The scale the Single Market has to offer has not been exploited to its full potential for resources from waste. The 28 EU Member States are still organising their waste streams along 28 separated waste management infrastructures. To move forward, Europe needs to start developing a single market for waste by target setting and driving harmonised policies on waste prevention, recycling and end of life solutions.

¹⁶ European Commission (2012) *20 YEARS of the European Single Market*.

¹⁷ See: <http://ec.europa.eu/eurostat/statistics-explained/>

(File: Main_players_for_international_trade,_2012_(billion_EUR)_YB15.png)

The adoption of systemic eco-innovation within a circular economy will naturally drive waste avoidance, reduction, reuse prior to recycling, recovery and disposal. As the focus is naturally aligned with the waste hierarchy it is only necessary to provide the basis of push and pull mechanisms that will assist the transition from linear to circular in a financially viable manner.

The EU has focussed on improving its performance in waste by driving materials away from landfill, and towards recycling and recovery solutions. This has generated significant volumes of secondary resources available for the reuse and production of more goods. These materials drive domestic use, internal trade within the EU and export trade to international markets. Figures from Eurostat, for instance, indicate that for glass 15% of the materials collected in a source separated collection are traded within the EU, but exports barely exist. For collected plastics waste, figures show that a substantial part of it is exported (see Figure 3).

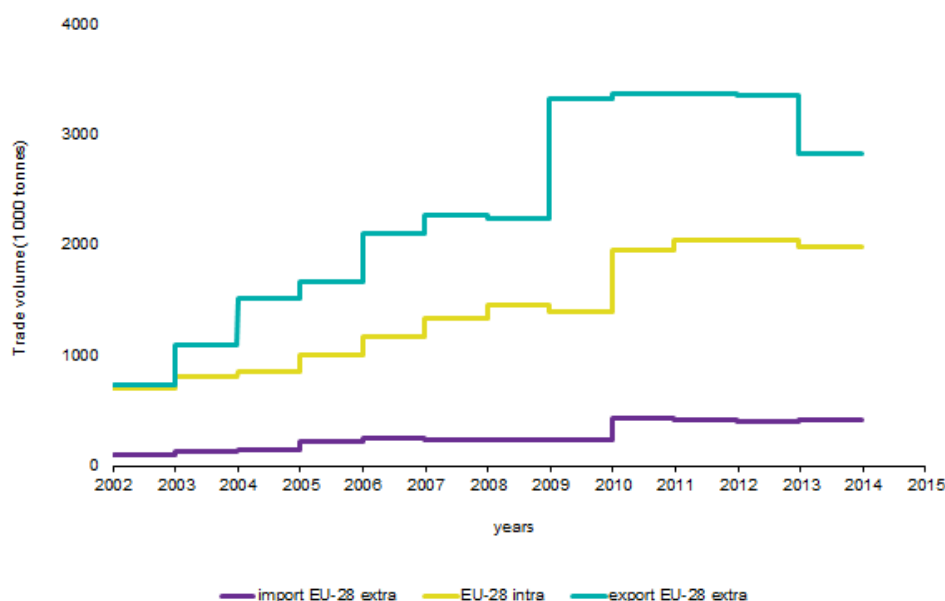


Figure 3: Trade volume of plastic waste in EU-28 according to trade flows update, Eurostat 2014¹⁸

As the EU imports much of its oil, the idea that we export oil in the form of recycled plastics to overseas markets is a missed opportunity. According to Eurostat the EU imports 12 times more raw products than it exported in 2012. A 'single market for resources' approach would support consolidation of the materials within the EU and their use in domestic re-manufacturing. To bolster this internalisation of existing secondary resources, the developments of technologies and resources that can displace virgin imported raw materials are also essential.

Resource efficiency and systemic eco-innovation also require a clear understanding of the full impact (societal, environmental and economic) of a product over its complete life cycle. A harmonised methodology to make such assessments is needed for industry and so-called '*prosumers*' (consumers involved in the design and manufacture of products)¹⁹ to be able to make informed decisions.

In a circular economic model, the role of the consumer, meaning any individual or organization using a product, is as important as the role of the producer. The consumption phase of products is an important element in determining the overall environmental footprint of the product. Moreover, the consumer is the key factor in determining what happens with the residue that remains after consumption. In order to create the right pull factor, the consumption factor needs to be an integral element in the transition of Europe to a circular economy.

¹⁸ See: <http://ec.europa.eu/eurostat/statistics-explained/>

(File: Trade_volume_of_plastic_waste_in_EU-28_according_to_trade_flows_update.png)

¹⁹ Expression coined in 1980 by the futurist Alvin Toffler — in his book *The Third Wave* — as a blend of *producer* and *consumer*.

Finally, to make best use of the knowledge, research and innovation skills prevalent in the EU, a systemic design metric tool should be developed and adopted. This metric would consider and allow the measurement of not only the impact of the design of goods and the design of services but would seek to combine both elements, so that the design of the item, its use, its recovery and then reuse or resource extraction would be considered together. Ideally developed as a tool and open shared, this tool would allow for a commonly adopted, used and understood system to be applied to goods and services sold in the EU and potentially to provide a competitive edge in selling green products and services internationally.

In order to minimize administrative costs, priority should be given to resource-intensive product groups. Combining with organisations such as the RSA in the UK and building on their current thinking, it will be important to create and then enable a model that designers of goods would use to measure the impact of manufacture, distribution and then recovery, reuse, recycle, recovery or disposal at the end of their life. Based on a simplified and widely promoted life cycle methodology this EU metric of measurement could provide a strong basis for differentiation and support more circular products and services, internally and externally.

Using the significant resources available in the EU for brand, design and environmental systems should enable the first demonstrations of products that support the transition of the EU from its current linear economic model to a more circular one.

Pillar 4 - Suggested Actions

4.1 Adopt a holistic approach to resource management beyond waste across EU policies

EU policies should adopt a holistic approach to waste management, which should aim to:

- set ambitious, yet achievable recycling and recovery targets;
- harmonise recycling calculation rates and focus on recycled input to the re-processor;
- create a market for currently non-recycled materials provided performance of those materials are equivalent during the use-phase of the LCA/MFA, by setting clear, binding, input (recycling) targets for secondary materials at EU level;
- ensure equivalent standards for collecting recyclable waste across the EU and cooperate with accession and neighbourhood countries;
- create a single market for recycling materials, provided performance of those materials are equivalent during the use-phase of the LCA so waste can be recycled in those countries where infrastructure is best developed;
- create cohesion amongst EPR schemes in Europe (set minimum requirements): ensure shared responsibility of all actors;
- improve the essential requirements of legislation on eco-design to aid implementation and enforcement.

(Timing: 2015-2020)

4.2 Strengthen EU policies on waste avoidance to encourage new product designs, and use of recycled or re-used materials

With regard to waste avoidance, EU policies should focus on:

- encouraging new product designs that build on the minimisation and avoidance already undertaken but deliver more recycling through easier to identify, separate and recover the base constituents;
- promoting cultural changes that create and establishes the markets for the new products and services;
- encouraging the use of recycled or reused materials through incentives or tax rebates that align with EU single market goals;
- rewarding product formats requiring less resources and less packaging, e.g. via H2020 inducement prizes.

(Timing: 2015-2020)

4.3 Support consumers in the transition to the circular economy

Changing consumer behaviour is difficult, and has to come from a combination of making new concepts understood, easy, desirable, rewarding and a habit. As such, the European Commission has a role to play in supporting the consumer in the transition to the circular economy by:

- making it easy; this involves changes so that even in a situation of no behavioural change, more resource efficient behaviour is achieved;
- making it understood: making sure consumers have all the information required to choose the most resource efficient alternative;
- making it desirable: this involves creating transparency amongst peers on their use of resources. There an important role here for new technologies and online platforms geared towards a common purpose such as saving water and saving energy. The producers of relevant products could play an important role in this respect, rallying consumers behind a specific brand to co-create a desired outcome. Local authorities could also play a key role here (i.e. social housing);
- making it rewarding: this involves driving behavioural change through pricing signals: e.g. lower VAT for resource efficient equipment; products that require less water in their use compared to peer products;
- making it a habit: this involves repeating resource efficiency challenges amongst peers on a regular basis and introducing incentives such as annual awards - e.g. H2020 inducement prizes - for breakthrough inventions on circular economy.

(Timing: 2015-2020)

4.4 Resource conservation and replacement plans

The EU should focus on establishing as quickly as possible a full and comprehensive dataset around the resource nexus with water – energy - food, materials use, consumption and reuse/recycle throughout all the Member States, via the H2020 'Coordination and Support Actions'. The main features of this dataset would be:

- to use this data together with industry to develop individual resource conservation and replacement plans and EU scenarios;
- these should start with the priority material groups established in conjunction with industry and resilient water management systems in conjunction with utilities;
- international collaboration should also be established, in order to capture trade patterns and facilitate exports and international partnerships.

(Timing: These priority areas to be identified by end 2015. Calls for projects under H2020 in 2016, with first results in 2017, and industrialisation and commercialisation projects developed through 2018/2019)

4.5 Continue progress towards a harmonised Life Cycle Assessment (LCA) dataset and tools

It is recommended that the European Commission urgently continues and delivers the activities towards harmonised LCA dataset and tools, and in support of LCA as a tool for the sustainable design of innovative solutions.

(Timing: ongoing)

4.6 Produce an EU circular design methodology

The H2020 'Research and Innovation Actions' could be channelled towards projects involving:

- working with existing designers and design methodologies to produce an EU circular design methodology that not only considers the product, but its users, its brand owners and its recovery and reuse in the system of making more products;
- working with industry, brand owners and communities it would be possible to construct the economic model and system use priorities that, on a product by product basis, would deliver the desired circular outcomes.

(Timing: Design completed with demonstration products and consumer use and recovery testing by 2017. Support should carry on through 2020 where following adoption of the design standard, the EU could fund the roll out of the demonstration products.)

3.5 Pillar 5: Ensuring Consistent, Conducive, Coordinated (CCC) policy making

There is hardly any relevant area in Europe that is not addressed by well-intended policies. While it is good to accomplish tailor-made policies for specific purposes, the overall policy landscape in Europe is often perceived as fragmented and inconsistent. This Group of Experts strongly favours a policy framework that is:

- Consistent in order to mainstream activities and minimize negative side-effects;
- Conducive to transitions towards resource efficiency and a circular economy;
- Coordinated between the EU and Member States, as well as regions, private actors and the European citizens.

At the heart of such a shift should be a European policy encompassing energy and climate, environment and resources, industry and innovation, fiscal policy and macroeconomics.

Past experiences show how the inconsistency between (two) policies can have harmful effects. Inconsistencies in contemporary waste policy illustrate how the EU can overcome existing obstacles and move forward. The long tradition of waste policy dating back to early regulations made in the 19th century at local levels, and a huge step made in the 1990s, have been successful in establishing a strong recycling industry in Europe and reducing environmental impacts of waste. Contemporary waste policy however can be seen as too 'end-of-the-pipe' if benchmarked against the challenges of reducing material leakages in the European part of global value chains and fostering transitions towards a circular economy.

The nexus between energy, water, food, and other resources should become a key trigger for overcoming the current fragmentation and silo-thinking. The potential to innovate and export new solutions is enormous. Integrated planning, supported by research programmes and executed by alliances across private and public actors, will be a key to sustainable growth. Policies and regulations have a role to play in overcoming current bottlenecks and paving the way for new investments. Research programmes on metrics and benchmarks are likely to disseminate widely if carried out in collaboration with relevant stakeholders.

The high level of public debt is a burden on future generations. It is high time to abolish environmentally harmful subsidies (according to OECD definition) and tax breaks that waste taxpayers' money on obsolete practises, with particular emphasis on those existing linear technologies or industries that need help to support the transition to a circular model.

Existing subsidies and support schemes should be reviewed at a European level. A recent report by UK Policy Exchange demonstrates that a more holistic policy approach could also help reduce subsidies for renewable energy projects.²⁰ In the longer term, minimum standards on housing properties will be required to enable a move away from subsidies as the energy and resource performance of properties becomes reflected in their true market value.

The European Commission should use the European Semester process to monitor and propose recommendations and to encourage Member States to shift the tax burden away from jobs to resource use in order to promote resource efficiency and a circular economy. The current focus of green taxes on carbon and/or energy should be broadened to include taxes on extracting construction minerals, as well as on land and water use. At the same time, companies shall be encouraged via appropriate fiscal incentives to invest in R&D collaborations and in the provision of ecosystem services. The aim should be that businesses in transition should face lower overall taxes, while 'business as usual' industries should be provided with incentives to change.

Public Procurement also has an important role to play. As a strategic consumer acting in the public interest, public authorities can drive resource efficient production by integrating resource efficiency conditions into their public procurement policy and trigger deployment of systemic eco-innovation.

Targets for a sustainable resource use and a circular economy will play an important role. Given the weak evidence from environmental science one may not expect an absolute limit on resource use comparable to the 2 °C target as formulated in climate policy. The role of targets would rather be to break out of existing pathways, to trigger innovation and stimulate transition processes. The *implication* of those targets would be a long-term reduction of primary resources used in the EU and an increase in international competitiveness. Acknowledging an international responsibility and energy security considerations would suggest the need for a prioritisation of reduction pathways for

²⁰ Policy Exchange (July 2010) *Greener, Cheaper*.

imported fuels and for rare earth materials, rare earth metals and environmentally expensive base metals and agricultural commodities.

It is clear how essential a robust competition policy and strong enforcement are to the EU. It is also clear that legitimate, pro-competitive collaboration between companies may result in important consumer benefits and other benefits e.g. in the context of sustainability. Competition law should not have a chilling effect on legitimate industry initiatives in the interest of sustainability.

This is a fine but vitally important balance that must be achieved. Europe should also take a broader approach to benefits that can come from agreements, including not only economic benefits for a specific market, but also social and environmental benefits in the near future.

Finally, EU funding programmes beyond H2020, such as regional development funds, should encourage a more transformative role of research towards systemic eco-innovations, including stronger socio-economic dimensions in science and technology studies.

Suggested Actions

5.1 Develop a comprehensive resource roadmap to 2050

The Group of Experts considers it essential to ensure a coordinated approach to resource policy. This should involve a comprehensive resource roadmap to 2050 comprising and updating the previous roadmaps on low carbon and resource efficiency as well as including new efforts on water and land use.

Within such a comprehensive roadmap newly generated sources such as re-used carbon and fertilizers as well as re-used and bio-based materials should also be considered.

(Timing: Roadmap to be published by 2017)

5.2 Assessment of new targets for sustainable resource use

It is recommended to evaluate and make an impact assessment for the potential of:

- doubling the rate of secondary materials used in production processes in the EU by 2030 compared to today's levels, including metals, construction minerals, industrial minerals, and re-used fertilizers. Biogas produced from waste processes is likely to be a better option compared to incineration.
- doubling the rate of resource productivity compared to average GDP growth, preferably measured including the 'material footprints' of international supply chains and complemented by a water-related productivity increase.

(Timing: Impact Assessment to be carried out by 2016)

5.3 Creating synergies between other EU funding mechanisms

The European Regional Development Funds (ERDF) is an important tool to turn current low-growth regions into lead markets for resource efficiency and a circular economy. The Group of Experts recommends that the ERDF:

- streamline its activities on research and innovation, the support for small and medium-sized companies and a low carbon economy.
- have a new focus on integrating sustainable water and resource management: capacity building via agencies and training programmes shall be strengthened as it has been effective in leveraging more activities on the ground.
- Cooperate, wherever possible, with the emerging Knowledge and Innovation Communities (KICs) and the commitments made under the European Innovation Platforms (EIPs).

(Timing: As of 2015)

Annex 1: Case studies of systemic eco-innovation

Case Study 1: Industrial Symbiosis

Industrial symbiosis identifies unused resources and waste streams from one industry for use by another. The idea of industry finding uses for non-product outputs (by-products and waste) is not a new one. The practice fell out of favor in the 20th century due to: cheap and abundant energy, resources, and disposal options; subsidies that discouraged recycling; and regulations preventing reuse. Recent volatility in commodity prices, along with the rise of the sustainable development agenda, is now leading many stakeholders (public and private) to reconsider this position.

Industrial symbiosis is increasingly seen as a strategic tool for delivering economic development, green growth, innovation, and resource efficiency.

Recycled UK Limited was started in 2006 by two individuals who identified a market opportunity to process end-of-life vehicle (ELV) bumpers into a clean plastic feedstock. Car bumpers are made from polystyrene (PS), acrylonitrile-butadiene-styrene (ABS), and polycarbonate/ polybutylene terephthalate (PC/PBT). The average vehicle contains around 10 kg of these materials and at this time almost all this material was destined for landfill with the associated loss of valuable material from the supply chain, lost opportunity for reuse, and potential damage to the environment as the material degrades over time. In 2006 over 995,000 vehicles reached end-of-life (EOL) in the UK representing 970,000 tonnes of material, 97,000 tonnes of plastics and 9,700 tonnes of scrap bumpers. Before the project started, the partners had no employees and no site, but a vision of what they wanted to do. The company was financed by personal savings and bank loans.

The company then started collecting used car bumpers from businesses throughout the West Midlands region of England, separating metal and segregating the different types of polymer, removing paint and shredding the plastic. Remaining small amounts of non-polymer materials were then removed from the shredded material producing a clean resource which could then be sold to a range of manufacturers to make new products for example wheelie bins and storage boxes.

The main drivers for change facing the company were the new market opportunities created by the ELV legislation, and the commitment of management to launch a product deriving from what used to be waste. Recycled UK set out to be one of the UK's most proactive companies in working towards the goal of national compliance with the Directive on End-of Life Vehicle 2000/53/EC.

Recycled UK was able to begin processing material within just 5 months of starting out, saving a substantial amount of time and money. In the first few months of operation, the company was achieving an annualised rate of 1,200 tonnes of material diverted from landfill and saving 4,350 tonnes per annum of CO₂. A sales increase of GBP 200,000 (EUR 251,200) per annum and GBP 150,000 (EUR 188,415) of private investment led to the creation of 5 permanent jobs.

(Source: International Synergies Limited; Desrochers, P (2000) "Market Processes and the closing of "industrial loops"", Journal of Industrial Ecology Vol. 4(1): 29-43; Desrochers, P (2004) "Industrial Symbiosis: The case for market coordination", Journal of Cleaner Production Vol. 12(8-10): 1099-1110)

Case Study 2: From CO₂ to Foam

The idea of using the climate gas carbon dioxide rather than increasingly scarce petroleum for plastics production has been around for more than four decades. Until recently, however, this would not have been cost-effective. It took researchers from Bayer to find a solution – a special catalyst that activates slow-reacting CO₂ and does so without consuming too much energy.

Bayer researchers discovered a very specific catalyst that greatly reduces the amount of activating energy required and enables CO₂ to react with high-energy substances known as epoxides without a side reaction complicating matters. The company was assisted by six prestigious German universities and research institutes. Supported by funds from the German government, the project ran for three years and ended in April 2012 demonstrating that the greenhouse gas carbon dioxide can be used as a basic building block for plastics.

Encouraged by this success in the laboratory, Bayer initiated the follow-on project Dream Production with the aim of putting the new findings into practice. Carbon dioxide from the energy industry is being used for larger-scale plastics production at a test facility in Leverkusen. Following a successful test phase and promising market analysis, Bayer plans to invest EUR 15 million in the construction of a production line at its Dormagen site, which will use CO₂ to produce a precursor for premium polyurethane foam. The line will have an annual production capacity of 5,000 metric tons. The objective of the project 'Dream Production' is to launch the first CO₂-based polyols on the market starting in 2016.

(Source: BayerMaterialScience)

Case Study 3: Intelligent shuffling for blanking metal sheets, Deutsche Mechatronics GmbH

Producing as a SME in the EU and in China, Deutsche Mechatronics GmbH offers systems combining mechanical and electrical engineering solutions. One of their circular economy solutions addresses the needs of metal industry. Up to 40 tonnes of sheet metals are blanked daily, corresponding to almost 100 different individual customer orders. Due to large variety, the blanking process has often been inefficient. A new solution now offers more than 10% savings: combining an intelligent shuffling of the ordered parts in order to avoid inefficient cuts, a computer-driven shuffling, and the existing production planning and control system yields benefits for customers and resources alike.

See: <http://www.deutsche-mechatronics.de/homepage.html>

(Source: Eco-Innovation Observatory, Annual report 2011, p. 18)

Case Study 4: New urban mobility: e.g. Car2Go, Daimler

Owning a car has been the desire for generations. But it's changing. Accessing a car wherever you are and whenever you need it – that's the slogan of today's age. In 2009, Daimler started its Car2Go programme by offering customers flexible mobility options. Once registered the system is based on GPS real-time information on the car availability enabling customers to start and end vehicle use at any point within a certain area. A radio frequency identification (RFID) chip serves as the car key. Users pay by driven minute without fixed costs. The business model is also an ideal lead market for electric vehicles and resource-efficient cars. Companies such as Zipcar offer similar schemes.

See: <https://www.car2go.com> – <http://www.zipcar.com>

(Source: European Parliament, DG for Internal Policies (2012): Leasing Society, IP/A/ENVI/ST/2012-10, PE 492.460)




Case Study 5: Qlean cleaning service with Ultra-pure water, Qlean Scandinavia

Traditional cleaning is a resource-intensive process. The founders of Qlean discovered that the cleaning of surfaces can be done in novel ways: with cold water, low pressure and without detergents, when ultrapure water is used. This reduces environmental pressures, and makes it possible to clean more difficult surfaces like plaster and wood. It is also cheaper because no detergents and less energy are used and the execution time, including the drying process, is shorter. Qlean provides the cleaning service and equipment, not just the ultra-pure water. With the new method, value is re-configured at two locations in the value chain as the cost of certain inputs are reduced, namely chemicals and high-pressure equipment, whereas the client gains value by eliminating residues. With the functional sales business model, Qlean has managed to capture this value and share it with their customers, making the innovation beneficial for both.

See: <http://www.qleanscandinavia.com>

(Source: OECD (2013): Why New Business Models Matter for Green Growth, OECD Green Growth Papers 2013-01, Paris, p. 99)

Annex 2: Profile of the Experts

<p>Raimund BLEISCHWITZ</p> 	<p>Raimund Bleischwitz is BHP Billiton Chair in Sustainable Global Resources at University College London (UCL), and Deputy Director at the UCL Institute for Sustainable Resources (UCL ISR). He was Co-Director on 'Material Flows and Resource Management' at the Wuppertal Institute in Germany from 2003 until 2013. Raimund spent a fellowship at the Transatlantic Academy (TA) in Washington DC in 2011-2012; he had other fellowships at Johns Hopkins University (AICGS JHU) and in Japan (JSPS) and was visiting professor at the College of Europe in Bruges (Belgium) from 2003-2014. Raimund has a PhD and a 'Habilitation' in economics and some 200 publications on resource efficiency/productivity, eco-innovation and enabling conditions, sustainable growth/green economy, raw material markets and conflicts, and governance issues. His recent book written with five international co-authors is "Want, Waste, or War? The Global Resource Nexus and the Struggle for Land, Energy, Food, Water and Minerals", Routledge/Earthscan Publisher 2015</p>
<p>Françoise BONNET</p> 	<p>Françoise Bonnet is Secretary General of the Association of Cities and Regions for Recycling and Sustainable Resource Management (ACR+). In addition to the day-to-day management of the team, Françoise, who is specialised in legal and economic instruments linked to waste/resource policy, is in charge of the EPR Club project.</p> <p>Françoise holds a degree in law from the Liège University, complemented by a diploma in European law from the College of Europe and in specialized studies in environmental law from Saint-Louis Brussels University. She has a thorough knowledge on European waste/resource legislation and policies, as well as broad experience in project management and planning. During her professional life, she worked not only for public authorities such as Brussels Region Administration, the UN or the European Commission, but also for private companies. Thanks to this, she is familiar with local administration systems and North-South cooperation with the countries in the Mediterranean region where she lived and worked for nearly ten years</p>
<p>Stuart HAYWARD-HIGHAM</p> 	<p>Stuart Hayward-Higham is currently responsible for research, innovation and non-bidding emerging development activities at SITA UK, part of Suez Environnement. He is a Director of the Anaerobic Digestion and Bioresources Association and Recoup, a charity organisation focussed on plastic recycling. He is chair or a member of a number of working groups for the Environmental Services Association and Renewable energy Association.</p> <p>Within SITA he has worked through a range of traditional and new business activities, from waste management through green energy and sustainable and circular solutions for the company and its customers.</p> <p>Previously he has worked for a number of environmental consultancies working in the field of waste, contaminated land, site investigation and sustainability.</p>

Christiaan PRINS

Christiaan Prins joined Unilever in May 2008 where he is now Director of European External Affairs.

He holds a Master degree in International Relations from the University of Groningen (NL) and a PhD in Arts from the University of Groningen (NL).

Before joining Unilever, he worked over five years in the European Parliament as a policy advisor to an MEP.

Christiaan Prins heads since January 2014 the Unilever European External Affairs Office in Brussels.

Hanane TAIDI

Hanane Taidi is Regional Marketing Communications Leader EMEA for DuPont Performance Polymers. In this new role that Ms Taidi took on as of February 2015, she leads, develops and directs integrated marketing communications strategies for the Performance Polymers Business. Before joining DuPont, Ms Taidi was Director of Communications at PlasticsEurope where she led PlasticsEurope's communications efforts in Europe together with a team of regional Communications Managers. A graduate of Ablemalik Essaadi University with a Bachelor of Arts in English Language and Literature, she also studied Master of Arts in English Literature at Charles de Gaulles, Lille III University in France. Hanane Taidi started her career with the plastics industry back in 1999. Since then she has gained extensive experience across a range of communication disciplines, and has been responsible for the coordination of both internal and external communications programmes across 27 EU countries.

HOW TO OBTAIN EU PUBLICATIONS

Free publications:

- one copy:
via EU Bookshop (<http://bookshop.europa.eu>);
- more than one copy or posters/maps:
from the European Union's representations (http://ec.europa.eu/represent_en.htm);
from the delegations in non-EU countries (http://eeas.europa.eu/delegations/index_en.htm);
by contacting the Europe Direct service (http://europa.eu/europedirect/index_en.htm) or
calling 00 800 6 7 8 9 10 11 (freephone number from anywhere in the EU) (*).

(*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

Priced publications:

- via EU Bookshop (<http://bookshop.europa.eu>).

"Maintaining, improving and securing the future of the quality of life currently enjoyed within the European Union through the adoption of a more sustainable, non-linear economic model"

Without change, the EU will inevitably become less competitive, less attractive and less economically viable. Making changes now and into the future to a more circular, resource efficient economic model is not without risk. However, as the developing world continues along linear growth path, the EU and its Member States have the opportunity to reinvent their economies and make them globally competitive. And systemic eco-innovation is at the heart of the paradigm shift which is needed.

Studies and reports

