Barriers & Drivers towards a Circular Economy

Literature Review
A-140315-R-Final

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Author
Freek van Eijk
Managing Director Acceleratio

Acceleratio B.V.
Postal address: van Ostadelaan 49, 1412 JH Naarden, The Netherlands
T: +31651080847
e-mail: info@acceleratio.eu
Look at www.acceleratio.eu

Abstract: general observations

"We cannot solve our problems with the same thinking that created them."
- Albert Einstein

The circular economy is rapidly rising up political and business agendas. In contrast to today's largely linear, 'take-make-use-dispose' economy, a circular economy aims to decouple economic growth from the use of natural resources and ecosystems by using those resources more effectively. By definition it is a driver for innovation in the areas of material-, component- and product reuse, as well as new business models such as solutions and services. In a circular economy, the more effective use of materials enables to create more value, both by cost savings and by developing new markets or growing existing ones.
The circular economy also holds great economic potential for the Netherlands, TNO estimated the total market opportunities of a more circular economy to be nearly € 7.3 billion a year, roughly 1.4% of the GDP. Furthermore there is the potential of approximately 54,000 new jobs. The majority of these benefits, nearly € 3.3 billion per year could be achieved in the short-term.

The circular economy requires a system change.
Today we experience rapid change in our society. We are not in an era of change but in the change of an era.
Our present set of regulation, aimed to protect consumers, companies and environment, has been drafted in the past and is by definition outdated. "*We are looking with old spectacles to new initiatives*". We tend to be late and reactive in our adjustments of regulation which is frustrating new initiatives.

A deep transformation of production chains and consumption patterns and a shift in financial, fiscal and reporting instruments is envisaged to keep materials circulating in the economy for longer, re-designing industrial systems and encouraging cascading use of materials and waste. Some elements of circularity in the linear economy, such as recycling and composting need to be maintained.
But a circular economy goes far beyond the pursuit of waste prevention and waste reduction to inspire technological, organisational and social innovation across and within value chains.

From the combined studies included in this review a picture comes forward that a Circular Economy demands a system change with parallel actions along the value chain rather than a purely sector and/or product focused approach.
It requires actions in not only the regulatory field but also requires institutional changes, cultural changes, technological innovation and knowledge development & exchange just as closer cooperation and transparency between all actors (governments, businesses,

inhabitants and the science & education community). In other words there is a need for a mix of complementary instruments and approaches across different parts of the circular economy (e.g. regulatory measures complemented by economic incentives to ensure pricing of a related product or resource, funding for innovation etc.) and efforts to engage and link actors along the value chain (to ensure circular thinking and identification of opportunities for greater circularity across the entire chain).

The present regulatory system is pre-dominantly sectorial and has a one sided orientation on risks. This hampers new opportunities. In many circular economy business cases perceived environmental risks will have to be balanced against the new economic opportunities. That could also be interpreted as a call not for more regulation but for better regulation and even a call for deregulation: less detailed and specific regulation and more performance based regulation. A Circular Economy also needs room for experimentation within the boundary conditions set by the government. This asks for courage of our regulators

Moreover, the need for policy intervention (if any) and the type of intervention needed will vary according to the issue at hand. It is important that the value chain structure and the business case for circularity for the different actors is understood in detail when considering policy intervention.. There is "no ones size fits all" approach. In some areas, the transition to a circular economy might materialise without intervention (i.e. where products have high embedded material values, where the private sector moves towards more circular and/or service-based models independently as it seek opportunities), while in other areas support including public intervention is needed to encourage the transition.

There is a need for policies which can support existing efforts and opportunities (revising existing policies, removing barriers, supporting bottom-up initiatives); moving beyond the current focus on recycling to support other loops in the circular economy (re-use, repair, refurbish, remanufacture); developing skills and providing incentives for innovation and closer collaboration between different actors along the value chain.

Actions towards a circular economy to date have mainly been driven by value maximization along the value chain and the interest in continually reintroducing assets to markets. Once a material is seen as an investment and customers as users, it makes business-sense to maintain the customer relationship during multiple cycles. The extensive *Circular Economy Scoping Study* (EU Scoping Study to identify potential circular economy actions, priority sectors, material flows & value chains, 2014 for DG Environment) states that the policies which enable business models and value chains to be more circular, in every sector and along any value chain, are the ones which:

- Encourage manufacturers to design products with asset recovery in mind and to take into account the true cost of materials;
- Encourage the development of product lines that meet demand without wasting assets;
- Incentivise businesses to source material from within regenerative loops, rather than from linear flows;

- Enable businesses to develop a revenue model that generates value at all parts of the value chain; and
- Get customers/ consumers to change their consumption and ownership patterns.

Based on this, a case for policy supporting the circular economy can be made where analysis indicates that there are gaps in what the private sector are incentivized to do. In doing so, policy may take on any of the following roles:

- Ensuring the right incentives by for example fiscal reforms, removal of legislative barriers, better implementation, action on marketing or green public procurement.
- Removing market structure barriers such as tackling market distortions and unhelpful power concentrations, changing existing legislation, creating extended producer responsibility type markets.
- Reducing transition costs of the shift to a circular economy by providing necessary infrastructure, promoting technical and structural innovations and GPP practices.
- Encouraging value chain collaboration, knowledge provision and brokering.
- Supporting citizen or community-led initiatives– e.g. social investing, repair cafes, etc.

The transition to a circular economy requires a systemic approach which makes use of a wide toolkit of policies and measures, across different points of value changes and affecting the full set of private and public stakeholders. Given the multi-level governance approach needed, options can be structured across different actors (e.g. EU, Member State, regional and local authorities, private sector, civil society, citizens), levels and timeframes, keeping in mind that in some areas circular economy benefits will materialise as a result of own initiatives by the private sector, while in other areas support (including public intervention) will be needed to encourage transitions.

Obstacles hampering a transition towards a circular economy

A broad range of barriers still hampers the transition to a circular economy. Various (international) studies already outlined a variety of institutional, cultural, financial, regulatory and technological barriers. Just un-blocking existing regulatory barriers that entrepreneurs encounter in their quest to start new circular business will not be enough to make this transition happen.

This literature review has confirmed the gaps that act as barriers to the development of a circular economy, and therefore where further consideration of policy action may be beneficial in promoting the circular economy:

- The lack of internalisation of externalities through policy or other measures and the lack of resource pricing (cost recovery and pricing for the resource itself), which lead to economic signals that do not encourage the efficient use of resources (i.e. as there are greater

incentives to use materials more effectively) or a transition to a circular economy (i.e as resources become more costly there are increased incentives to reuse/recycle materials);

- The lack of skills and investment in circular product design and production which could also facilitate re-use, repair, remanufacturing & recycling;
- The lack of enablers to improve cross-cycle and cross-sector performance due inter alia to non-alignment of power and incentives for transformation between actors within and across value chains;
- The lack of consumer and business acceptance regarding consumer-as-user e.g. leasing rather than owning, and performance-based payment models;
- The lack of know-how and economic incentives including for repair and reuse;
- The lack of consumer information on origins and perishability of products is not helping to raise consumer awareness on Circular Economy aspects;
- The lack of waste separation at source (especially for food waste and packaging);
- The lack of sustainable procurement incentives by public authorities;
- The lack of investment and innovation in recycling and recovery infrastructure and technologies, (related to this is the lock-in of existing technologies and infrastructure);
- The lack of harmonisation of transport flows systems within and between municipalities, which leads to confusion among shippers and transporters.
- Weaknesses in policy coherence (e.g. bioenergy and waste policies);
- Challenges in obtaining suitable finance for new Circular Economy Business Models;
- Widespread planned obsolescence within product chains.

This list is non-exhaustive but covers the main barriers to the development of a circular economy.

What can (local) governments do?

Regulatory changes at European level might easily take up 5 years before action materializes at national level. For international alignment, like for example at the UN Climate Conferences, a timespan of a decade is probably an optimistic estimate.
On the contrary, many circular economy initiatives could start within less than a year at local level. The combined energy from all the bottom-up initiatives might create a dynamics that can over shadow the dynamics of changes introduced by politicians (that often are discouraged to plan for initiatives outside their electoral life-span).

In Governments going circular; a global scan by De Groene Zaak (Dutch Sustainability Business Association), EY, Accenture, RoyalHaskoningDHV and IMSA from February 2015 the following conclusion are drawn with regard to the role of Governments.

- The vast majority of the governments still lack a clear sense of urgency.
- The circular approach is not only relevant for established economies.
- Governments are particularly active in waste reduction and resource optimisations programmes.
- The implementation of large-scale circular and / or sustainable procurement by local, regional and national authorities as launching customer, have yet to be applied by virtually all governments in the world.
- Governments use a very different set of instruments to achieve goals.
- Local governments put forward many initiatives.
- There is no universal solution to boost the transition to a circular economy.

With many inspirational examples they conclude with a practical approach that you can use to implement circularity in your country, province, or city. Please be aware that the (rather general) actions described below do not form a step-by-step plan, but run parallel.

- Understand the circular necessity
- Lead by example
- Map circular economy principles to your local context
- Create a comprehensive vision or strategy
- Engage stakeholders: Start the dialogue
- Choose instruments & Start initiatives.
- Monitor, adjust and scale

The Dutch NGO Circle Economy published a blog on March 9, 2015 with the same scope: *How governments are key for a circular economy*. They came up with the following additional recommendations

- Create an interdepartmental program (collaborating Ministries)
- Create experimental business areas with flexible regulation
- Buy patents and make them available to entrepreneurs
- Have a vision! You can only facilitate when it's based on your own framework

- A Circular Economy will have many winners but also losers. Find clever solutions for the 'losers' of the circular economy (for example stranded assets)

Companies can start today

A system change doesn't mean companies cannot start a transition towards the circular economy. In most transitions first movers and early adapters have the largest business potential. In their recent book "Resource Revolution: How to Capture the Biggest Business Opportunity in a Century (2014) Stefan heck and Matt Rogers from McKinsey mention five principles that should be the first area a company should look at when thinking through its resource position.

- Finding opportunities to substitute away from scarce resources;
- Eliminating waste throughout the system, from production through end use;
- Increasing "circularity"- upgrading, reusing or recycling products;
- Optimizing efficiency, convenience, safety and reliability;
- Moving products, services and the process that develop or deliver them out of the physical world and into the virtual realm.

Abstract: EU and national Policy options in detail

The conclusions from the recent and extensive *Circular Economy Scoping Study* (EU Scoping Study to identify potential circular economy actions, priority sectors, material flows & value chains, 2014 for DG Environment) describe accurately the obstacles and way forward. From an (EU and national) policy standpoint, addressing the identified barriers means:

- Encouraging economic players to take into account the economic value of their environmental externalities through:
  - Regulatory requirements such as the ones posed by the Extended Producer Responsibility (EPR) principle. EPR promotes the integration of environmental costs associated with goods throughout their life cycles into the market price of the products, and, thanks to financial incentives, encourages manufacturers to design eco-friendly products by holding producers responsible for the costs of managing their products at end of life. This policy approach differs from Product stewardship (where responsibility is shared across the value chain of a product), and attempts to relieve local governments of the costs of managing certain priority products by requiring manufacturers to internalize the recycling cost within the product price.
  - Economic incentives to encourage the recovery of more secondary raw materials, such as the phosphate levy which fosters the recovery of phosphate from sewage and the use of high quality, secondary sources of phosphate in agriculture.
  - Tax measures and subsidies strong enough to change business behavior.

- Encouraging the development of skills, curricula (for students and professionals), awareness and investment in circular product design and production, as well enabling to improve cross cycle and cross-sector performance, through:
  - Support programmes for businesses investing in eco-innovation (technological and non technological innovation). Example: the Competitiveness and Innovation Framework Programme (CIP) which aims to encourage the competitiveness of European small and medium-sized enterprises, in particular in the field of eco-innovation. The CIP provides access to finance and delivers business support services in the regions.
  - Support programmes for companies that avoid using combinations of materials and include reusable parts in the design of products (eco-design) – e.g. Framework Programme Renewable Resources (Germany, € 800m fund).
  - The development of an extensive raw materials information service and increase the dissemination of knowledge about the development of new materials.
  - The promotion of cleaner production methods in SMEs by offering a production-integrated environment protection tool where the relevant material flows and current level of production technology are analysed, and where recommendations are made.

- Encouraging the improvement of cross-cycle and cross-sector performance, through:

- The development of free-to-business advice and networking Programme at a regional level to identify resource exchanges between companies for sustainable resource management solutions – e.g. National Industrial Symbiosis Programme (NISP) (UK).
- The development of local networking for industrial symbiosis opportunities, perhaps via an internet application.
- The availability of planning agencies who would perform, in a given territory and for the industries of this territory, every function required to turn the industries' by-products into feedstock's, including finding appropriate uses, dealing with regulatory agencies, brokering necessary agreements, and even transporting the materials from the waste/by-product generator to the user.

- Encouraging the change in consumption patterns through:
  - The support and promotion of innovative leasing and rental contracts (pay-per-use instead of ownership). When goods vendors embrace the idea of themselves as service providers, this can lead not only to an effective hedge against cost volatility but also strengthens the customer relationship and increases the upsell, such as in Vodafone's Red-Hot plan (customers can rent the latest phone for a year and keep on exchanging it for a newer version; while Vodafone is engaged in collecting the old phone, which enables material collection and pooling and creates deeper customer relationships).
  - The support and protection of the 'peer economy' (collaborative consumption) and of initiatives promoting repair and reuse, such as the creation of 'repair cafes' (see table below for further detail).
  - The development of consumer knowledge/ awareness on perishability of products (e.g. GS1 DataBar, informational barcode about the shelf life of a product) and on origins of products (certification, labeling).
  - The development of incentives such as PAYT (Pay as you throw) or DIFTAR, a system of differentiated tariffs where citizens are charged according to the amount and type of waste they generate *(or similar non financial incentive systems that facilitate good behavior separation at the source and disincentive undesired behavior like the Dutch Inverse collection)*
  - The set-up of a regulation to separate food and packaging waste at source.
  - The development of obligations for public-sector agencies and government departments to purchase resource-efficient and circular or cradle-to-cradle products.

- Encouraging the investment and innovation in recycling and recovery infrastructure and technologies through:
  - Investment support in regional infrastructure and for companies seeking to develop innovative recycling and recovery technologies (e.g. Starbucks actually aims to turn thousands of tons of its waste coffee grounds and food into everyday products by using bacteria to generate succinic acid which can then be used in products such as detergents, bio-plastics and medicines.

- The set-up of Business parks, Business Improvement Districts and other clusters of SMEs to facilitate collective long term contracts for recyclable waste collections. This will make it cheaper to invest in collection and recycling infrastructure.
- The harmonisation of the quality criteria of the end-of-waste (EoW) status across the whole of the EU. Furthermore, progress remains to be made regarding the status of a 'by-product' or the concept of 'reuse', to comply with the waste management hierarchy, which emphasizes reuse before recycling.
    - A new approach to the concept of 'waste' is needed to facilitate private initiatives based on the philosophy 'from waste to resource'. Production residues should in some cases be qualified as byproducts or as a resource for new products instead of waste (e.g. animal by-products), and for certain waste streams end-of-waste criteria should be developed (with environmental protection and public safety in mind). The practical implementation of waste legislation can more effectively be based on the actual risk of illegal disposal. In revising the waste legislation, sufficient consideration should given to relating policy domains, such as REACH, renewable energy, fertilizers, animal feed and animal byproducts, in order to ensure policy coherence.
      Note: the Waste Framework Directive allows for some freedom that could lead to options that Allow Member States freedom to act in the most economically and environmentally advantageous way and to go faster than Europe as a whole. In the absence of an European EoW status, Countries could provide a national EoW status. The Dutch concept of the North Sea Resource Roundabout suggests that countries could mutually align or harmonise the EoW and by-product criteria between the North Sea bordering countries in combination with mutually agreed simplified regulations for waste shipments between these countries. They would do so in consultation and coordination with the monitoring and enforcement authorities (concept by Acceleratio 2015).
- The removal of a number of regulatory obstacles to the use of biotic waste streams, such as in the Dutch Environmental Management Act (chapter 10).
- The development of knowledge for biotic waste to be reused and transformed through bio refining (potatoes, maize, straw, potato haulm, draff, sugar beet).
- Incentives for suppliers and retailers to establish mandatory take-back arrangements if a product remain unsold (magazines, bread, etc.)

- Encouraging the harmonisation of transport flows systems between municipalities, which lead to confusion among shippers and transporters

Specific Policy actions in short-medium turn

The *Circular Economy Scoping Study* has identified some concrete areas where 'low-hanging fruit' have yet to be explored and can be used to support transition in the EU. Some key areas for more specific policy action in the EU in short-medium term include:

- **Better implementation and coherence** – in particular implementation of waste related legislation (e.g. landfilling, recycling), definitions in waste legislation, coherence between waste and bioenergy legislation or coherence between waste and manure legislation; improved implementation across environ-mental and wider product legislation as well as horizontal legislation and policies (e.g. on product policy, procurement, VAT).
- **Integration of wider circular economy considerations** in policy review processes (e.g. 'fitness checks' and other planned legislative reviews) and in impact assessment procedures could support the transition to a circular economy as well as smart regulation principles and improve the added value of EU legislation.
    - Note related to Resource security. For the EU to become more resource independent, it is necessary to identify resource vulnerabilities, limit the exposure to risks of supply and increase resource efficiency. The existing EU policies for resources, mainly 1) circular economy (e.g. the Circular Economy package and the Bio-economy for Europe), 2) resource efficiency (e.g. a Resource Efficient Europe) and 3) resource security (e.g. the Raw Materials Initiative), are currently insufficiently integrated. Streamlining industrial policy within other EU policies is of pivotal importance, to raise productivity, integrity an sustainability of the EU industry. Streamlining and incorporating industrial policy with Resource efficiency and a circular economy is therefore of key interest.
- **Revise key legislation**, particularly in the area of product design to set minimum requirements for products (e.g. eco-design, labeling) so as to provide a useful starting point to move forward by integrating circular concepts in the design phase to ensure detoxification, modularity, upgradability, disassembly, durability, recyclability in subsequent phases. In addition, increased use could be made of take-back requirements and extended producer responsibility (e.g. via product end of life requirements). Furthermore, a review of the minimum warrantee period could be merited for certain products (i.e. review Directive on the sale of consumer goods and associated guarantees, 1999/44/EC).
- In some cases there may be a **need for new regulation** such as strengthened or new targets (e.g. new targets on food waste), restrictions or bans (e.g. on landfilling of plastics or recyclable materials, on the use of certain toxic chemicals, coupled with strong legislation on energy recovery to avoid incineration). Another option could be to introduce mandatory requirements (e.g. mandatory phosphorous recovery from sewage sludge, development of action programmes to tackle food waste, mandatory requirements for the separation of waste). There is also a need to develop adequate indicators that show progress towards a resource-efficient economy, thus providing insights, raising public awareness and support for relevant measures.
  Note: When updating the legal framework at national and local level aim at Deregulation and Performance Based Approaches

A circular Economy asks for collaboration between all actors and transgresses various sectors in society. Our present Dutch regulatory system is pre-dominantly sectorial and has a one sided orientation on risks. This hampers new opportunities. In many circular economy business cases perceived environmental risks will have to be balanced against the new economic opportunities. We need deregulation: less detailed and specific regulation and more performance based regulation. A Circular Economy also needs room for experimentation within the boundary conditions set by the government. This asks for courage of our regulators

- **Increase/leverage funding to support industrial symbiosis, clustering, and citizens initiatives** (e.g. Cohesion Policy, link to smart specialisation strategies) as well as **investment in skills, training and education** (e.g. through European Social Fund). There is also a need to **leverage private funding** (e.g. through innovative financial instruments, disclosure, accounting and transparency) and **public funding** (e.g. through GPP and whole life costing) for investment in R&D and innovation and/or procurement of products or services that support the transition to the circular economy. There is also a need for **funding to support research** to understand opportunities and needs for systemic eco-innovation, how to overcome current lock in to the linear economy, the existing use and pathways of different resources, particularly those of biological origin (e.g. through use of COSME and Horizon 2020). Furthermore, the potential to use other EU funding instruments such as LIFE+, European Fisheries Fund, and the CAP to support the transition to the circular economy should be systematically explored (e.g. to support cascading use of biological materials).
- Fiscal reform to change incentives at different points in the value chain – i.e. upstream for materials inputs (e.g. resource pricing, cost recovery), product charging (e.g. deposit-refund schemes), waste charging (e.g. greater use of PAYT for household waste). Such efforts will need to be take forward at the national or local level, however EU levers could be used to support this where available, e.g. implementing cost recovery principles of the Water Framework Directive, using open method of coordination (OMC) approaches such as encouraging progress through the European Semester, sharing lessons and best practices.
  Note: the work undertaken by ExTax (2014) in the Netherlands has researched the options and calculated the effects of a shift in taxation from labor to natural resources and is quite insightful on how such measures could work.
- Improved understanding, awareness and transparency to encourage greater innovation (e.g. research funding for product and materials innovation), citizen action (e.g. bring back products), and inform purchasing and procurement decisions (e.g. via labeling and information). Furthermore, there is a need to support greater transparency (including through reporting on subsidies, and increased use of environmental economic accounting at both national and corporate level. Greater non-financial reporting and disclosure on corporate resource use and pollution impacts can help leverage additional funding to support circular economy activities (e.g. from ethical investment funds and pension funds). There is also a need to develop and use relevant indicators to help raise public awareness and support for relevant measures. Finally, better understanding the global impacts of EU consumption and waste (e.g. from resource extraction, to waste treatment and disposal) can usefully inform policies, investment decisions and purchasing choices.

- Multi-stakeholder engagement across the value chain that takes into account geographic aspects (proximity principle, global value chains and impacts) is needed.
  Note: While EU and international regulatory changes might take years to materialize many circular economy initiatives could start within less than a year at local level. The combined energy from all the bottom-up initiatives might create a dynamics that can over shadow the dynamics of changes introduced by politicians (that often are discouraged to plan for initiatives outside their electoral life-span).
- The EU but also countries, regions and local governments could usefully support and engage with such a wider group of actors, for example establishing catalysts or 'facilitators' at regional/national level across European regions which can connect companies and other actors to discuss how to move towards a circular economy, identify perceived barriers and how they can be overcome and practical steps to be taken; setting up platforms to share best practices between policy makers, businesses including SMEs and consumers across different sectors; and projects to work together to create the enabling conditions for progress in the transition to a circular economy.

Note that discussions and action on the circular economy should reflect both technical and biological resources as well as the interplay between them (i.e. move to bio-economy solutions as well as nature based solutions). Furthermore the interactions, synergies and potential trade-offs between the circular economy and related initiatives on, bio-economy, dematerialisation etc., need consideration to ensure overall coherence of policy initiatives. For example:

- The bio-economy seeks to make greater use of biological resources including residues and wastes in place of fossil based resources (e.g. bio-plastics, bio-refineries, biofuels). This could deliver environmental and economic gains and support the circular economy and resource efficiency agendas. Nature based solutions (e.g. bio-mimicry for products and materials, water and waste regulation, adaptation to climate change) can also reduce the need for technological solutions and impact on the flow of materials and availability of waste for recycling. However, care is needed to ensure hierarchies are respected (i.e. use of biomass for energy and fuels) and that biological resources are managed and used within their sustainable limits (IEEPc, 2014 forthcoming).
- Dematerialisation can support a move toward greater reliance on functions or services rather than on the purchase of products, and on concepts of 'sharing rather than owning' elements within a circular economy. As with resource efficiency, dematerialisation can have negative implications for certain circles or loops within the circular economy, i.e. the viability of certain types of recycling or the generation of energy from waste.

These issues are not problems per se, but it is important that policies and investment decisions take into account these synergies and interconnections and encourage appropriate hierarchies of activities, i.e. not supporting investment in incineration and energy recovery that then becomes dependent on certain waste streams and creates contracts that reduce the availability of the waste resource for more societally beneficial solutions within the circular economy.

Abstract: anticipating future barriers (Dutch Programme Better Regulation towards Green Growth)

The Dutch government has started a programme to identify and possibly mitigate regulatory obstacles that entrepreneurs encounter in their quest to a transition towards new circular economy business; obstacles that prevent investments in the economy. Initially the Programme focused on barriers that prevented a transition to a Biobased Economy (BBE). In 2014 the program has been expanded with "from waste to resource" (VANG) topics. The Programme will run till mid 2018 and eventually aims to address all obstacles that block Green Growth.

The objectives of RRGG are:

- Identify and analyse approximately 50 obstacles for the domains BBE and VANG together;
- Analyse 4 fundamental barriers and bring forward recommendations (for example related to Certification, Sustainable Criteria for biomass (versus lacking criteria for primary resources)
- Publication of the barriers and obstacles as well as the completed analysis to show that the government listens to businessmen, entrepreneurs questions lead to actions and the program RRGG provides solutions or good argument if follow-up is not feasible;
- Avoid obstacles by explaining better within the government institutes of the effect of laws and regulations on innovative entrepreneurs.

Within the bio-based obstacles the main categories of obstacles found were related to:

- (Complex and expensive) Certification, Sustainable Criteria for biomass (versus lacking criteria for primary resources)
- Subsidies (like SDE) for the use of biomass for sustainable energy and lack of subsidies for sustainable materials out of biomass
- Waste regulation: agro-food residuals often qualify as waste and that prevents to a large extend optimal re-use
- Issues related to the manure legislation and the Nitrates Directive (usage limitations of digistate from digestion, removal of plant residues from land, ..)
- Access to financing

With the obstacles related to "Waste-to-Resource" barriers the main categories are related to

- Waste or resource classification (reuse of a product, waste, by-product, end-of-waste)
- Waste Shipment Regulation
- REACH

Fundamental obstacles were related to:
- Level Playing Field
- Certification in relation to Sustainability
- Taxes and levies
- Financial feasibility for innovative entrepreneurs
- Modification/crop breeding
- REACH
- Waste / Non-waste (End-of-Waste/By-product)
- Waste Shipment and waste coding (WSR & EURAL)
- Mechanism

In both domains it was found that the obstacles preventing circular initiatives originate from decentralised authorities unaware of regulatory options available within national regulation or too risk-adverse to experiment (referred to as "Mechanism" by RRGG). Communication therefore should be directed to not only entrepreneurs but also this target group.

The barriers identified in the Dutch running governmental "RRGG" Programme ("Better Regulation towards Green Growth/Ruimte in Regels voor Groene Groei") have been compared with the barriers found in this literature review with the objective to find blank spots. Those blank spots can be either specific obstacles not yet identified or future obstacles that can be expected when the transition towards a circular economy is progressing. Within the institutional and regulatory barriers the Programme has focused sofar on Bio based Economy and Waste-to-Resource related Issues.

The intentions are to extend the Programme to the whole domain of Green Growth – Energy, Water, Building, Climate, Mobility and Food. As such, in the present RRGG inventory, these categories and their associated barriers will not be present.

Since the governmental Programme focuses pre-dominantly on specific regulatory obstacles within the current "linear economical system" that can be linked with an entrepreneur, the obstacles related to Institutional Aspects, Design and Production related aspects and Logistic aspects are far less present (or absent).

If we zoom in on types of barriers we can see that barriers from institutional nature (to some extent), barriers concerning cultural and awareness factors, barriers related to (lack of) access to financing and barriers related to technological challenges and knowledge gaps are underrepresented in the inventory. If however business associations or NGO's are asked about the barriers encountered by their followers they do mention both the non regulatory and the more fundamental aspects that can be found in the literature review. Some circular business models are simply not viable (yet) within the current (linear) economical system to be accepted as a obstacle by the Programme RRGG.

It seems fair to say that focusing only on the removal of the present regulatory Circular Economy obstacles that entrepreneurs face today (in their quest to start new circular business) however useful that is, will not be sufficient to make a transition to a Circular Economy. In a way a Circular Economy demands a system change with parallel actions along the value chain rather than a purely sector and/or product focused approach. It requires actions in not only the regulatory field but also requires institutional changes, changes in accounting and financial instruments, cultural changes, technological innovation and knowledge development & exchange just as closer cooperation and transparency between all actors (governments, businesses, inhabitants and the science & education community).
The table on the next page lists the blank spot and future barriers that have not or only to a limited extend been identified in the "RRGG" Programme.

Filters/Lenses	General Framework	Design & Production	Recovery & recycling	Logistics
Institutional / Organisational	• Linear Accountancy Rules • Encourage experimentation • Increased collaboration versus antitrust, data protection and security	•	•	•
Cultural/Awareness	• Green Public Procurement • Power play vested Interests • Reaching the SME target Group	• Eco-label • Awareness & behavior • Education • Consumer acceptance of models based on service and usage instead of ownership	• Industrial Symbiosis • Food waste: best before and use by confusion • Bio-degradable versus bio-based confusion • Consumer apps	• Lack of standar-disation and collaboration between cities
Policy & Regulation	• (Value-chain) collaboration versus Antitrust • Harmonisation of standards and definitions	• Certification & Industry Standards (other than bio-based) • Dynamic standards; from prohibition to effect based controls • Eco-Design (of for example non electrical appliances, link with resources and energy efficiency) • Substitution of critical substances or substances of high concern	• Extended Producer Responsibility • Certification & Industry Standards • Dynamic standards [check] • Preferred position in hierarchy for re-use-repair-refurbish-remanufacture • Conflicting regulation & subsidies energy-waste/recycling • Status of Bio-fuels preparation in waste hierarchy: energy recovery or recycling? • Lack of Resource Passport • No tradable permits [check]	• Antitrust in joint logistics concepts for inner cities/ between cities
Access to financing	• Removal of distorting subsidies • Private funding (not only focus on governmental subsidies) • Impact of stranded	•	• Lack of VAT differentiation based on sustainability (for example no reduced VAT for recycled content)	•

	assets • Transparency, Integrated Reporting and more ESG consideration • Liability, insolvency and insurance challenges with lease models			
Technological/Infrastructural/ Economical	•	• Lack of Competences & Knowledge • Importance of new Business Models and Design for sustainable footprint (eco-design, circular design, design for reuse- repair-refurbish-remanufacture-recycling, design for services instead of ownership)	• Lack of Specific Skills	•

Table: comparing the R2G2 Programme findings with literature findings. Blank spot and future barriers for R2G2

Content

Preface

In September 2014 in an assignment for the Dutch Ministry for Infrastructure and the Environment, a coalition of research and not for profit organisations started the RACE Programme (Realising acceleration towards a Circular Economy). The RACE coalition will collaborate closely to position the Netherlands as a frontrunner in creating a Circular Economy.

The RACE Programme consists of the following activities:

- Work Programme 1: Defining and stimulating circular design
- Work Programme 2: Studying and stimulating high-value reuse
- **Work Programme 3: Making an inventory of (perceived) barriers**
- Work Programme 4: Stimulating and accelerating new value chains
- Work Programme 5: Creating a portfolio of circular project examples
- Work Programme 6: Raising public awareness around the topic of circular economy
- Work Programme 7: Involving young people in the transition towards a circular economy

As part of Work Programme 3, Acceleratio B.V. has performed a **quick scan** of available Literature Studies on barriers towards the Circular Economy.

The main objective of Theme 3 of the RACE Programme is to make an inventory of barriers that obstruct the transition to a circular economy. More specifically the review will make a link with the running governmental "RRGG" Programme ("Better Regulation towards Green Growth/Ruimte in Regels voor Groene Groei") and accelerate the inventory of obstacles.

About this literature review

At the time of execution of this study various excellent studies on Circular Economy aspects were available. We have used the structure and conclusions of the recent in-depth *Circular Economy Scoping Study* (EU Scoping Study to identify potential circular economy actions, priority sectors, material flows & value chains, 2014 for DG Environment)) as a basis for integrating the additional information and insights from new sources used in this review.

In this literature review different lenses have been applied to study the many barriers identified in the various sources. In the first chapter the results have been presented in tables. Drivers and barriers have first been described and analysed for various stages in the value-chain.:

- The general framework conditions necessary to move towards a circular economy, before being examined for each major stage of value chains/ supply chains:
- Design and production;
- Consumption;
- Recycling and recovery;
- Logistics flows at all scales.

A second set of lenses has been applied to the type of barriers:

- Institutional or organisational
- Cultural and consumer/business acceptance
- Policy and Regulatory
- Access to Financing
- Technological, Infrastructural and Economical

A third "geographical lens" lens has been applied to the recommendations that could be found, linked to specific barriers. The recommendations are cutting through all kinds of action holders at different socio-economical levels. We have distinguished different geographical levels of action for the recommendations that can be found in each of the sub-categories:

- Local
- National
- Europe
- Global

This geographical division has been inserted in the two tables with the other lenses. This geographical lens makes it easier to address the policy challenges at the right level and ensure follow-up.

This report also includes the (mapping of the coverage by existing EU policies and) scope for further measures in identified priority areas (EU Scoping study to identify potential circular economy actions, priority sectors, material flows & value chains).

In Chapter 4, this Literature review zooms further in on identifying best practices by analysing government initiatives worldwide. We examined governments that are: using their powers to shape circular market conditions at a national level; creating the right conditions for change; outlining ambitious plans; choosing to fund and coordinate various initiatives by companies and individuals; or adopting the circular economy via their own large organisations and supply chains.

As part of the study the barriers identified in the Dutch running governmental "RRGG" Programme ("Better Regulation towards Green Growth/Ruimte in Regels voor Groene Groei") have been compared with the barriers found in this literature review with the objective to find blank spots. Those blank spots can be either specific obstacles not yet identified or future obstacles that can be expected when the transition towards a circular economy is progressing. This helps the Programme RRGG to anticipate on future Barriers.

It is advised to use the findings, summarised in the abstract general observations and the various tables in this literature review, as an extensive check-list and subsequently as input for a workshop with stakeholders.

1 Overview of Challenges and Barriers through different lenses

1.1 Value-chain approach of policy-oriented drivers

The first lens use is the one of a Value-chain approach of policy-oriented drivers. We have used: general framework, design and production, consumption, recycling and recovery, logistics. Most of the publications analysed in this literature review address the key drivers and barriers towards circular economy. These drivers, as well as the possible challenges and associated policy recommendations, are summarised in the table below.

Drivers and barriers have first been described and analysed for the general framework conditions necessary to move towards a circular economy, before being examined for each major stage of value chains/ supply chains: Design and production; Consumption; and Recycling and recovery. Lastly, as the transition to a circular economy has implications for logistics flows at all scales, drivers of a circular economy and associated barriers have been considered in the field of logistics. Logistical issues and solutions are cross-cutting, i.e. relevant at any stage of a value chain.

Whether drivers and obstacles are stemming from policy, regulation or the legal framework, or linked to social, cultural, economic, technological or infrastructural contexts, there is rarely only one driver in one sector or value chain. Typically several factors are in play and often the factors influence each other. The list of examples below is non-exhaustive but primarily targets policy-oriented drivers. The recommendations and other data are as described in the literature and they concern all levels of policy (European, national, and regional levels). Included in the table (in red) are the different geographical levels of action for the recommendations that can be found in each of the sub-categories.

Description of lever / economic importance	Associate Challenge or Barriers	Policy Recommendation
Lever: General Framework		

Take into account the Economic Value of Environmental Externalities
• **Economic Incentives** (Internalising of Externalities)
• **Tax Measures** strong enough to change behaviour
• **Subsidies** to support eco-friendly behaviour
	• Lack of Internalising of Externalities
	• Lack of Resource Pricing
	• Challenge: get the prices right (true costs of resources)
	• Challenge: **implementation of economic incentives and fiscal measures**
	  ○ Administration
	  ○ Monitoring
	  ○ Enforcement
	• Resistance to change
	• Perverse incentives
	• Barriers to EPR
		➔Main action: National & EU
		• **Regulation and choice restriction** (phase out light bulbs) as a partial means of appreciating externalities.
		  • **Extended Producer Responsibility**
		• **Fiscal Measures**
		➔Main action: National
		  ○ **Fiscal Incentives** to put materials back into circulation (land-value-taxes, value-extracted tax, product levy, and "recovery rewards" (for example phosphate levy)
		  ○ **Resource Taxes** (for example: mineral oil tax)
		  ➔Main action: National (& EU & Global)
		  ○ **Removal of Distorting Subsidies** on resources , energy and land
		  ○ **Subsidy Schemes:** enable business that use environmental friendly resources to write of a random% of the cost of their resources for a random year (e.g. VAMIL, NL)

Description of lever/economic importance	Associate Challenge or Barriers	Policy Recommendation
Lever: Design and Production		
• Improving material selection & product design and change production method (standardisation, modularisation of components, purer material flows and design for disassembly)	• Lack of Skills in Circular Product Design and Production • Lack of practice & infrastructure for segregation of biological from technological nutrients; phasing out toxic materials • Knowledge development for design process • Substitution does not always have environmental benefits • Risk averse behaviour by local governments regarding innovation • Lack of dissemination best practices (E.G. SME's) • Lack of information on Green Suppliers • Over communication • Need a Champion: individuals or businesses who can promote resource efficiency	➔Main action: National & EU • **Investment and support programmes in eco-design and eco-innovation** • Support investment in key technologies e.g. in 3D printing • Avoid using combinations of materials and include reusable parts in the design of products e.g. Resource Efficiency Science Programme [UK] • Encourage foundation of an extensive Raw Material Information Service & knowledge dissemination about new materials ➔Main action: Local, National & EU • **Promoting cleaner production methods in SMEs** by offering a **production-integrated environment protection tool** e.g EFA PIUS-Check initiative in North Rhine Westphalia • **Support programmes** for existing local initiatives and networks (e.g. Resource Efficiency Clubs [UK] • **Information networks** E.g. Green Purchasing Network [Japan] • **Local advertising and awareness raising campaigns** especially via radio • **Free (to business) advice and networking program at regional level** to identify resource exchanges between companies e.g National Industrial Symbiosis Programme [UK]

• **Rethinking Supply Chains by taking industrial symbiosis possibilities into account** i.e. developing good knowledge of energy &material flows of an industrial sector or geographical region to spot improvements	• Lack of enablers to improve cross-cycle and cross-sector performance
	  ○ Unawareness of origin or composition of raw materials in use
	  ○ Symbiosis requires exchange of information that can be difficult or costly
		➔Main action: Local, National
		• Mitigation of lack of inter-firm trust an collaboration by institutional mechanisms such as brokers or planning agencies. Service includes identification of flows but also appropriate uses, regulatory dealings, brokering agreements or transportation
		• Regulatory system would benefit from being open, consultative and flexible instead of defensive. The Danish example of Kalundborg shows that **a key aspect of the flexibility is that requirements are mainly in the form of performance standards stating the degree of the desired decrease** instead of technology standards as is common in the US.

Description of lever/economic	Associate Challenge or Barriers	Policy Recommendation

importance		
Lever: Consumption		
• Move from product to service for consumers is instrumental in translating products designed for reuse into attractive value propositions • A peer to peer economy enables access access to products and services instead of ownership • Repair and reuse is key to create economic loops • Improving consumer knowledge on origins and perishability and incentivising consumers to generate less waste is key to built a circular economy • Waste separation at source is key • Public Authorities as consumers. Sustainable procurement measures for public authorities	• Changing from ownership to usage and performance-based payment models. Product definition with embedded services based on knowledge of needs and continuous innovation • Consumer acceptance of "access to service" rather than ownership needs to grow significantly. Realignment of cultural values and incentives (particularly in sales) • Anti-trust concerns. Users can become dependent on the producers because of long term contracts • Risk of cannibalisation. There will be winners and losers in a circular economy. • Lack of information on product perishability and confusion between "best before" and "use by" labels • Lack of standardisation of methodologies applied in different countries for labelling products; cost of assessing resource consumption for companies; absence of widely recognised independent organisation to award on resource efficiency/circular economy criteria • Lack of incentives for households from generating waste • Lack of **education** on the opportunities and drivers of a circular economy	➔Main action: National & EU • Support and promote innovative leasing and rental contracts (Michelin pay-per-use tyres for truck fleet) • Expand the product definition to embed it in related services (powertool with building kit and training) • Public Procurement obligations for public sector agencies and government departments to purchase resource efficient and cradle-2-cradle products. Creates a powerful market pull effect ➔Main action: Local & National • Encourage the peer-economy (Peerby. LETS circles) • Encourage repairs through internet services (Lenovo tools for searching spare parts and manuals for repairs • Support initiatives promoting repairs and reuse such as the creation of repair cafes. There is also the example of iFixit website communities helping to repair things supported by online advice and video ➔Main action: National & EU • Develop customer knowledge on the perishability of products (e.g. ES1 databar, a barcode with shelf life information) • Develop customer knowledge on origins; a certification or labelling system for circular economy products to create awareness, encourage pick up by companies, reward leading companies by allowing them to capture a green premium ➔Main action: Local & National • Develop incentives such as PAYT (Pay as you throw) or DIFTAR (differentiated tariffs) where citizens are charged according to the amount of waste they produce • Waste collection at the source: e.g. separate foodwaste collections to become widespread for households and business • Municipalities can develop mobile phone apps to inform citizens about waste collection points and repair shops • Circular Economy concept could be fostered in University Curricula (e.g. Ellen MacArthur Foundation Fellowship Program)

Description of lever/economic importance	Associate Challenge or Barriers	Policy Recommendation
Lever: Recycling and Recovery		
• The development of recycling and recovery infrastructure, processes and technology is an important feature to support a circular economy	• Complexity of consumer products, making effective and efficient recycling a massive challenge • Future uncertain market developments make investing in large scale recycling very risky • Although reduction in raw material use is positive the lack of economical viable recycling has let to suboptimal material reuse • Availability of product component for repair by independent operators is often blocked by businesses that have a monopoly of components/products	➔Main action: National & EU • There may be a role for Government to stimulate recycling and recovery through investment support in regional infrastructure and for companies seeking to develop this market ➔Main action: Local & National • Set up Business parks, Business Improvement Districts and other Clusters of SME's to facilitate collective long term contracts for recyclable waste collections. This will make it cheaper to invest in collection and recycling infrastructure ➔Main action: National & EU • End-of-waste criteria facilitate recycling and allow precious natural resources to come back into the economy. Legal Clarity of regulation is needed and can be achieved by harmonising quality criteria across the whole of the EU. Furthermore progress remains to be made regarding the status of a "by-product" or the concept of "reuse" to comply with waste management hierarchy which emphasises reuse before recycling. Legal status of of by-products should help promote direct eco-industrial synergies (if defined as non waste) ➔Main action: (Local &) National (& EU & Global) • Removal of a number of regulatory obstacles to the use of biotic waste streams could make it easier to use them as bio-based (e.g. Dutch environmental act March 2011/WFD amendment: some agricultural waste streams are no longer waste under conditions. ➔Main action: National & EU • Develop knowledge for biotic waste to be reused and transformed through bio-refining (potatoes, maize, straw,.., sugerbeer) • Incentivise suppliers and retailers to assume mandatory take-backs if a product remains unsold (magazines, bread, ..)

Description of lever/economic importance	Associate Challenge or Barriers	Policy Recommendation
Lever: Logistics		
• The transition to the circular economy has implications for logistics flows at global, national and local levels. Logistics is primarily a matter of organising, planning, managing and handling cargo flows, from purchasing via production and distribution to the end user, including return flows and supply chain management in general. At the global level, the more control companies wish to exercise over the full lifecycle of a product, the more attractive it becomes to operate close to the customer (near-sourcing). At the national level, the transit functions will change. At the local level, an increase in transport movements will occur due to the increase in near sourcing and ecommerce, but also to	• Each city develops its own transport flows system, which leads to confusion among shippers and transporters. • Policies between municipalities for transport need to be harmonized (loading times, weights and measures, etc.) • Network design and management need to be improved and better interconnected so as to switch to a different mode of transport in the case of disruptions.64	➔Main action: Local & National • Streamline transport flows and urban distribution: o Business-to-business concepts such as Green City Distribution, o Binnenstadservice, Cargohopper (in the Netherlands); o Business-to-consumer concepts such as DHL; o System solutions (partnership between retailers on the same street or by sector/product; cooperation between transport companies). Digitisation is one of the tools available to shape partnerships. • Municipalities could invite shippers to develop concepts for city logistics through innovative (i.e. flexible and incentivising) tendering and supply chain-transcending cooperation. Tenders would formulate clear end goals, including noise and air emissions, maximum number of transport movements, and load factor for both inbound and outbound flows, service logistics, and involvement of all stakeholders.

an increase in service logistics and reverse logistics.		

1.2 Clustering of Barriers/Drivers type

A second set of lenses has been applied to the type of barriers. We distinguish between:

- Institutional or organisational
- Cultural and consumer/business acceptance
- Policy and Regulatory
- Access to Financing
- Technological, Infrastructural and Economical

Included in the table (in red) are the different geographical levels of action for the recommendations that can be found in each of the sub-categories.

Examples of Drivers and Strategies	Possible Challenges / Barriers
Type of Barrier / Driver Institutional or organisational	
EMF volume 1 & 2 ➔Main action: Local & National & EU & Global • New business models: 'Consumer as user', i.e. that products become services such as in a deposit payment and leasing model, rental schemes, reverse logistics chains to cascade materials • Circular Design Products and Production • Cross-cycle and cross-sector collaboration facilitating factors e.g. joint product development and infrastructure management through: o IT-enabled transparency and information sharing; o Joint collection systems; o Industry standards; o Aligned incentives; o Match-maker mechanisms	• In a leasing business model, challenges may arise in the cooperation with business partners, which can hinder a new business model from becoming effective and profitable. Adopting more circular business models will therefore require skills in new forms of collaboration and alliance building.
TNO 2013 ➔Main action: National (& EU) • The government should encourage the foundation of an extensive raw materials information service • To deal with uncertainty and still provide direction when possible requires the government to assume a learning attitude	• If the potential costs of a new design/ using different materials, and the benefits resulting from the more intensive use of parts/ materials occur in different parts of the value chain, there is no incentive to redesign a product
Aldersgate Group; Resilience in the Round - Seizing the growth opportunities of a circular economy 2011	•

➔Main action: EU & Global • Moving to valuation methods that properly take into account the economic value of environmental damages avoided or caused. Without these market signals, the transition to a circular economy could be delayed by not making visible the true cost of many of our resources.	
AEA; Business Resource Efficiency 2009 (UK) ➔Main action: National • The number of business support programmes caused confusion and there were calls for more consistent messages and language on resource efficiency - • Business Link will be used as a primary channel from now on • Communications should be tailored to the sectors targeted • More follow-ups are needed to monitor progress with businesses after support initiatives are provided • Limited funds make 1 to 1 support unsustainable so a new approach such as 'one-to-many' needs to be found • Regionally focused funding is required	•
COWI for DG Environment; Economic Analysis of Resource Efficiency Policies 2011 ➔Main action: National & EU • Voluntary Top ten – e.g. Market Pull for High Efficiency Products, Euro-Top ten Plus (2009-11) will be expanded to 16 countries and include 20 partners • 'Green Purchasing' for the electric appliances sector	•
IAU; Economie circulaire, écologie industrielle, Eléments de réflexion à l'échelle de l'Ile-de-France 2013 ➔Main action: Local & National • Creation of a mediation structure to encourage and sustain cooperation between businesses • Public instances and local authorities should be more or less involved to support projects • Support actors that incorporate recycled materials in their products	•
Environmental Services Association UK; Going for Growth: A practical route to a Circular Economy 2013 ➔Main action: Local & National • Separate food waste collections to become widespread for households and businesses • Business parks, Business Improvement Districts and other clusters of SMEs to facilitate collective long term contracts for recyclate collections	•
Environmental Innovation and Societal Transitions; New business models for a radical change in resource efficiency 2013 ➔Main action: National & EU & Global • Need for new financial models implies a shift from quick returns on investment toward a constant stream of cash, with a need for major upfront financing for manufacturers • Cost of ecosystem degradation (and necessary maintenance and repair). These costs could be passed on to those firms and industries that make use of the associated ecosystem services, which would accelerate the process. Since 2000, commodity prices have started increasing instead of decreasing, which led to:	➔Main action: National & EU • How to set up new businesses as intermediaries that own the material content and sell it back to the producer at the end of the life cycle e.g. Dutch company Turntoo

• A much tighter "balance" between supply and demand. • A tightening of short-term availability • The creation of new business opportunities e.g. a ton of discarded mobile phones can yield over 200 g of gold when a ton of ore from a gold mine produces only 5–10 g, giving the incentive for mining landfills for precious materials (urban mining)	
Council for the Environment and Infrastructure; Dutch Logistics 2040, Designed to last 2013 ➔Main action: Local & National • Predictable travel times so that companies can use them as a starting point for their operations • Streamline transport flows and urban distribution (both B2B and B2C) - e.g. Green City Distribution, Binnenstadservice, Cargohopper, DHL • System solutions (partnership between retailers on the same street or by sector/product; cooperation between transport companies)	• Network design and management need to be improved and better interconnected so as to switch to a different mode of transport in the case of disruptions • Policies between municipalities for transport need to be harmonized (loading times, weights and measures, etc.)
Council for the Environment and Infrastructure; Dutch Logistics 2040, Designed to last 2013 Agrifood sector: move from retail to consumers as pivot in the chain ➔Main action: National • Reuse grain residues as food for fish farmers or livestock companies • Collect household food waste to transform into biogas or nutrients for agriculture – e.g. added value of 1.5 billion USD in the UK	• Some important challenges to limit waste are cost-margin distribution issues, the right incentives, transparency of the supply chain and control
Corporate Citizenship; Ahead of the curve 2014 ➔Main action: National & EU & Global • Building a critical mass: Traditional fossil fuel based raw materials remain cheaper than more effective substitutes. Integrated global supply chains mean that businesses find they lack the critical mass needed to start large-scale efforts to substitute resource scarce or hazardous materials with cleaner, restorative or more regenerative ones.	•
IMSA; Unleashing the Power of the Circular Economy 2013 Mainstreaming steps ➔Main action: National & EU & Global • Replace traditional financial reporting by mandatory and accountable integrated reporting and develop the concept of True Value • Create a tax shift from labor towards natural resources • Implement a new economic indicator beyond GDP that steers towards circularity • Establish international independent systems to organise materials flows, including data gathering and exchange,	Obstacles • Unlevel playing field created by current institutions • Financial governmental incentives support the linear economy • Circularity is not effectively integrated in innovation

labeling and certification, impact assessment, standardization and material pooling • Adjust national and international government policies for corporate governance, accounting, competition, recycling, and health, safety and environment	policies • Competition legislation inhibits collaboration between companies • Recycling policies are ineffective to obtain high quality recycling • Governance issues concerning responsibilities, liabilities and ownership
ExTax; New era. New plan. Fiscal reforms for an inclusive, circular economy. Case study the Netherlands. 2014 Policy toolkit ➔Main action: National (& EU & Global) • Collecting data with regard to the geographic area under review. • Making an inventory of tax base options to implement the Ex'tax principles. • Choosing a focus group of tax bases, in order to create a workable scope. • Identifying a focus group of measures. • Elaborating on the expected impacts of the proposed measures in terms of their goals and main challenges.	Five barriers to the implementation of a tax shift are: • International coordination is essential to achieve a level playing field and to solve transnational problems. • There have been doubts about the stability of environmental taxes and faith in the stability of the prevailing labor taxes. • The benefits of lower taxes on labor have been insufficiently highlighted in the past. • An interdisciplinary approach is needed. • There is a lack of information on the impact of a tax shift from a business perspective. •

Examples of Drivers and Strategies	Possible Challenges / Barriers
Type of Barrier / Driver: Cultural and consumer/business acceptance	
EMF volume 1 & 2 ➔Main action: Local & National & EU & Global • Free servicing, easy trade-in for upgrades, convenience/ incentive to return goods, high-end machines with hardly any upfront costs, etc., should be marketed adequately.	➔Main action: National & EU • Raising awareness for rental schemes among consumers
TNO 2013 ➔Main action: National & EU & Global • Try to develop substitution of a material/ product/ service in the long term, and not simply when there are supply shortfalls of the original • The concept of a circular economy has to be introduced into education • Develop the use of services instead of ownership • A harmonious discourse is necessary: A call to consume more and a simultaneous call to promote services that could have a negative impact on consumption will create a disjointed impression and will not lead to the desired unity of direction	• With many 'examples' of substitution the purpose has not been to improve raw material efficiency but to radically redesign products to provide a different/better service, marketed on that basis – e.g. Digital Cameras have displaced film cameras • Acceptance that the circular economy means new ways of working and thinking that people will have had little or no experience with • Users can become dependent on the producers, because of long-term contracts for example • Consumers tend to look more at the price of a product and less at the entire lifecycle costs
Aldersgate Group; Resilience in the Round - Seizing the growth opportunities of a circular economy 2011	➔Main action: National & EU & Global • While there has been a discernible societal shift towards access rather than ownership (such as leasing mobile phones and car clubs),

	consumer acceptance needs to grow significantly. In addition, there must be realignment of cultural values and incentives – particularly in the sales functions of businesses.
Chatham House; A Global Redesign? Shaping the Circular Economy 2012 ➔Main action: National & EU & Global • To reach the mass market, a product certification or labeling system may be needed, like those which have been introduced for energy and carbon.	• Key barriers include the lack of standardization of methodologies applied in different countries, the cost of assessing resource consumption for individual firms, and the absence of a widely recognized, independent organization to award certification on resource efficiency or a CE.
AEA; Business Resource Efficiency 2009 ➔Main action: National (& EU & Global) • SMEs often believe that they are too small to benefit from efforts to improve business resource efficiency – given that they represent 99.9% of enterprises in the UK it is crucial to explore what else can be done to 'reach out' • Change the perception that resource efficiency is a distraction from the core purpose of a business and show it can help them achieve their core objective better and more efficiently • Convince businesses that environmental advisors have sufficient expertise to provide useful advice and have a good understanding of a business's processes by making advice relevant to the industry • Sustainable public procurement is increasingly moving up the priority list due to consumer and business community pressures	• Other types of businesses such as those situated in more rural areas are also hard to reach. • There is a lack of knowledge on how they can meet the desired environmental policy requirements, how they can get support and on the importance to act on the subject
COWI for DG Environment; Economic Analysis of Resource Efficiency Policies 2011 ➔Main action: National & EU & Global • Resource efficiency targets (sustainability strategy, road maps) – e.g. Fundamental Plan for Establishing a Sound Material-Cycle Society (2000), Japan; Sustainability Strategies of Member States, The National Eleventh Five-year Plan for Environmental Protection (2006-2010), China • Information Networks – e.g. Environmental Sustainability Knowledge Transfer Network, UK; Green Suppliers Network, US; Green	•

Purchasing Network, Japan	
IAU; Economie circulaire, écologie industrielle, Eléments de réflexion à l'échelle de l'Ile-de-France 2013 ➔Main action: National (& EU) • Inform the public about successful synergies so as to bring awareness of this new businesses model • Make recycled products attractive to clients so they can actually close the loop by consuming them, via a purchasing charter for instance • Develop a culture of cooperation and trust between businesses so they can coordinate their strategies • Promote recycling and its benefits and encourage a 'user' instead of 'buyer' approach to consumption	•
Environmental Services Association UK; Going for Growth: A practical route to a Circular Economy 2013 ➔Main action: National (& EU) • To engage with and inform consumers, politicians and business regarding the benefits of the circular economy and the need for future change	•
Environmental Innovation and Societal Transitions; New business models for a radical change in resource efficiency 2013 ➔Main action: National & EU (& Global) • Need to find new ways of generating profit for the model to flourish in the long-run pay-per-use instead of ownership • Car share schemes • Michelin pay-for-use tires for truck fleets	• Anti-trust concerns led firms to end pay-per-use schemes in the past (e.g. Xerox and IBM formerly rented their machines)
Council for the Environment and Infrastructure; Dutch Logistics 2040, Designed to last 2013 ➔Main action: National & EU & Global • Strengthen the knowledge infrastructure regarding the circular economy, both through the training of future knowledge workers and a knowledge centre of international esteem	•
Council for the Environment and Infrastructure; Dutch Logistics 2040, Designed to last 2013 The High Tech sector: move from product to service ➔Main action: National & EU & Global • Encourage a move from product to service for consumers – e.g. thrift stores, Markplaats, Lenovo, LETS circles	• Consumer arguments for convenience and status to defend ownership
Council for the Environment and Infrastructure; Dutch Logistics 2040, Designed to last 2013 Agrifood sector: move from retail to consumers as pivot in the chain ➔Main action: National & EU & Global • Develop consumer knowledge on origins and perishability;	• There is confusion between 'Best before' (BB) and 'Use by' (UB) labels for instance - e.g. GS1 DataBar (informational barcode about the shelf life of a product)
Corporate Citizenship; Ahead of the curve 2014 ➔Main action: National & EU & Global Transforming mind-sets • Industry actors and policy makers need to speak in a common language that Executive Board members can	Changing consumer behavior • The efforts of business moving towards a circular economy require attitudes and behaviors of the mass

relate to and therefore shift perceptions. The circular economy serves as a concept which can be communicated in terms of cost savings, new investment opportunities and enhanced value. • The roll-out of global policies collectively signals to industry that policy is rapidly shifting. • Industry platforms such as the Better Cotton Initiative, Pharmaceutical Supply Chain Initiative, Electronic Industry Citizenship Coalition and the Sustainability Consortium are examples of how leading companies are proactively lobbying for better standards and policies based upon circular principles. • Using lifecycle approaches, these platforms are highlighting supply chain hotspots which display risks faced by the entire industry. • Stakeholder pressure being placed on companies to become more transparent in their reporting disclosure means it will be difficult to hide behind short term solutions. • The financial industry is also heading towards a tipping point- as investors and insurers are increasingly considering ESG (environmental, social, and governance) factors into their investment decision making. Goldman Sachs' GS Sustain, a long-term investment framework focused on sustainable industry leaders, has outperformed the MSCI All Country World Index by over 43% since its inception in June 2007.29 Applying circular thinking will help companies hedge against volatile and expensive commodities and improve their environmental resilience - whilst maintaining investment capital. Practical guidance on moving towards the circular economy • Looking at the bigger picture o Revisit your purpose. o Get the C-suite and key members of management on board. • Looking inside your company o Conduct a supply chain review. o Conduct lifecycle analysis. o Rethink your employment and skills development strategy. o Change expectations via good communication. • Looking outside your company o Stay on top through horizon scanning. o Conduct a stakeholder engagement exercise. o Seek external opportunities. o Benchmark yourself against key peers.	consumer to change. While there are signals of changing consumer taste, it is difficult to shift old habits. The challenge for business is therefore to make changes or innovations with minimal need for consumers (or users) to feel that they are dramatically adjusting or adopting behavior. •
McKinsey "Resource Revolution: How to Capture the Biggest Business Opportunity in a Century 2014 The five principles that should be the first area a company should look at when thinking through its resource position. ➔Main action: Local, National & EU & Global • Finding opportunities to substitute away from scarce resources; • Eliminating waste throughout the system, from production through end use;	•

• Increasing "circularity"- upgrading, reusing or recycling products; • Optimizing efficiency, convenience, safety and reliability; • Moving products, services and the process that develop or deliver them out of the physical world and into the virtual realm.	
IMSA; unleashing the power of the Circular Economy 2013 Niche steps ➔Main action: National & EU & Global • Set up a simple index for circular performance. Organisations can use this to give incentives to their value chain partners encouraging circularity • Integrate circular economy principles in education and training programmes • Develop a long-term company vision identifying linear risks and circular economy opportunities • Promote circular products using modern marketing techniques and social media ➔Main action: Local & National & EU & Global • Prepare roadmaps for established economic sectors • Initiate and stimulate stakeholder fora about the circular economy • Encourage experimentation, innovation and redesign. • Gather and spread successful business examples	Societal obstacles • Lack of awareness and sense of urgency, also in businesses • GDP does not show the real progress or decline of our society • Resistance from powerful stakeholders with large interests in status quo
C2C Bizz; Guided Choices towards a circular Economy 2013 Skills you need to have ➔Main action: Local & National & EU & Global • Entrepreneurial and developing • Systems thinking and capable of identifying causal loops • Future oriented and out-of-the-box • Celebrate diversity • Address insecurities • Design circular systems, products and services • Creative, innovative and connected	•
Opai; Ondernemen in de Circulaire Economie 2014 (Dutch only)	Social Obstacles • Social factors play a roll in choosing for recycled /secondhand products. Last ones are often considered inferior and new products get the preference. Secondhand • Customer Perception: thinking in terms of functionalities is

	more troublesome than thinking in terms of products. • Transition takes time and needs small steps at the time to get used to the idea. • Value chain Transparency needs to be improved in order for value chain collaboration to succeed Mental Obstacles • Owning something still gives a positive feeling. Giving on ownership (inheritance) is under pressure. • In the B2C market there is sensitivity towards tempo-rarily ownership (a.o. status). • Managing thousands of service contracts is different from selling thousands of products • Reuse and refurbished are associated with inferior products. Thinking in value should be promoted • Current corporate planning, budgeting and strategy cycles are much shorter than circular economy concept time frames
Governments going circular; a global scan by De Groene Zaak (Dutch Sustainability Business Association), EY, Accenture, RoyalHaskoningDHV and DHV February 2015 They propose a practical approach to implement circularity in your country, province, or city. ➔Main action: Local & National Action 1. Understand the circular necessity Action 2: Lead by example Action 3: Map circular economy principles to your local context Action 4. Create a comprehensive vision or strategy	• The vast majority of the governments still lack a clear sense of urgency. • The circular approach is not only relevant for established economies. • Governments are particularly active in waste reduction and

Action 5: Engage stakeholders: Start the dialogue Action 6. Choose instruments & Start initiatives. Action 7. Monitor, adjust and scale	resource optimisations programmes. • The implementation of large-scale circular and / or sustainable procurement by local, regional and national authorities as launching customer, have yet to be applied by virtually all governments in the world. • Governments use a very different set of instruments to achieve goals. • Many initiatives are being put forward by local governments. • 7. There is no universal solution to boost the transition to a circular economy.
(The Dutch NGO) Circle Economy published a blog on March 9, 2015: *How governments are key for a circular economy*. They came up with the following recommendations ➔Main action: Local & National 1. Be an entrepreneurial and investing government 2. Create an interdepartmental program 3. Create experimental business areas with flexible regulation 4. Buy patents and make them available to entrepreneurs 5. Have a vision! You can only facilitate when it's based on your own framework 6. Be a launching customer 7. Find clever solutions for the 'losers' of the circular economy (for example stranded assets)	

Examples of Drivers and Strategies	Possible Challenges / Barriers
Type of Barrier / Driver: Policy and regulatory	
EMF volume 1 & 2 ➔Main action: (Local &) National & EU & Global • Resource and labor market economists have long argued that labor as a 'renewable factor input' is currently penalised over material and non-renewable inputs in most developed economies. They promote a shift of the tax burden away from labor/income and towards non-renewable resources. • Furthermore, EU should consider adding products with high recycled content to the list of VAT reduced goods. • More Extended Producer Responsibility regulation, for instance to help accelerate the scale-up of circular packaging systems, by transferring the burden (or the incentive to innovate) to manufacturers. EPR would deliver better design of product packaging for reducing, reusing and recycling. It would also encourage investment in better end-of-life solutions, for example collection, sorting and recycling infrastructure. • Ban toxic materials (e.g., PVC) and modify accounting systems to price in externalities (e.g., landfill costs, energy consumption and carbon emissions). • Taxes and mandatory deposits on single-use packaging. • Establish standards and guidelines, but limited certification guidelines.	• Taxation today largely relies on labor income.
TNO 2013 ➔Main action: National & EU (& Global) • Subsidy schemes – e.g. the Random Depreciation of Environmental Investments (VAMIL); reduced rates of VAT • Innovative leasing and rental contracts • More reactivity is needed by EU directives to accept new biobased products with different properties so that they can be accepted by consumers • The EU's WEEE directive should set targets for waste collection based on the value of raw materials and not on weight • Member states can even decide to hold producers responsible for processing waste generated by their products	• The rules and regulations for plastics vary for each type of plastic, complicating the recycling of plastics
Green Alliance: Reinventing the Wheel 2011 Metals: ➔Main action: National & EU • Product standards that embody design for durability, recovery and recycling, with the addition of a product levy, to help give preference to such products in the market place as well as potentially funding the development of good recycling infrastructure. • A recovery reward to drive higher rates of return to ensure that products can be reprocessed and valuable resources reclaimed. • Better life cycle analysis to inform the choice of substitutes for some materials, which could also be promoted through a product levy.	•

Phosphorus: ➔Main action: National & EU • A range of incentives to encourage the recovery of more secondary phosphate from sewage and the use of high quality, secondary sources of phosphate in agriculture. • Examination of a phosphate levy, not just because this might help to ensure careful use of the product, but also to raise money for phosphate recovery and recycling. Water: ➔Main action: National & EU (& Global) • Universal metering, more effective tariffs for consumers, and abstraction charging that reflects scarcity. • Increase awareness of embedded water in the goods we buy, whether from home or abroad, by promoting water stewardship and by encouraging greater transparency from companies. • Make water stewardship part of an approach that sets environmental standards for products. *Resource stewardship: the development of the 'circular economy plus' where extraction of all raw materials, both renewable and non-renewable, as well as water and energy production, is achieved under a flexible but powerful ethos of stewardship by companies.*	
Aldersgate Group; Resilience in the Round - Seizing the growth opportunities of a circular economy 2011 Product collection and reuse: ➔Main action: National & EU (& Global) • An infrastructure to support the efficient collection of products after use (reverse cycles) is an essential component for a circular economy. This can be heavily influenced by government policy (such as landfill tax), producer responsibility, new business models and take back schemes. As resource scarcity leads to further increases in prices, it is likely that companies will not be paid for waste collection in the future but bid to take waste (resources) away from customers. System changes: ➔Main action: National & EU (& Global) • The alignment of incentives would help to create stronger drivers for the adoption of circular economy approaches. These include industry standards and collaboration, access to finance and revision of the regulatory and fiscal framework.	Cannibalisation: • There will be a number of winners and losers in the shift to a circular economy. As new business models develop and there is a shift from ownership to services, the result will be various "cannibalisation rates" where certain businesses lose market share to innovators. Vested interests will seek to maintain the status quo and be resistant to change.
Chatham House; A Global Redesign? Shaping the Circular Economy 2012 Fiscal measures: ➔Main action: National & EU (& Global) • Pricing in the externalities associated with resources and encouragement of minimal resource use, waste and pollution. • Incentives for owners to put materials back into circulation – e.g. land-value taxes, value-extracted taxes and 'recovery rewards'. • Removal of distorting subsidies on resources, energy and land.	• Political obstacles to putting an appropriate price on resource use

End-of-life regulations: ➔Main action: National & EU (& Global) • These are already applied in countries including the EU, Japan and South Korea, especially for consumer electronics, electrical equipment and vehicles. The focus should be on rates of remanufacturing and reuse. Just as important will be the removal of any unnecessary regulatory obstacles to the use of 'waste', remanufacturing and new business models. Public procurement: ➔Main action: National & EU (& Global) • Obligations on public-sector agencies and government departments to purchase resource-efficient and cradle-to-cradle products. In many countries this is a powerful lever for creating markets for more sustainable goods and encouraging innovation. Public support for Innovation: ➔Main action: National & EU (& Global) • Policy is crucial in setting the framework to encourage private-sector investments in innovation, for example in new materials or supply-chain resource tracking Addressing legal Frameworks: ➔Main action: National & EU (& Global) • Review of the legal implications of company-to-company cooperation – e.g. anti-trust frameworks and data protection and security.	
AEA; Business Resource Efficiency 2009 ➔Main action: National & EU (& Global) • The carrot and stick approach should be drawn on to improve incentives to act through economic instruments and increased funding • Keeping track of their resource consumption should be mandatory for all businesses • Require better environmental standards in order to get loans	•
COWI for DG Environment; Economic Analysis of Resource Efficiency Policies 2011 ➔Main action: National & EU & Global • Resource taxes (ad quantum) – tax base is the physical amount of the resource extracted – e.g. Aggregates Tax, (implemented in 16 European countries); Mineral Oil Tax (implemented in almost all European countries); Peat (Latvia, Lithuania, Sweden) • Resource taxes (ad valorem) – percentage of the cost of extracted mineral raw materials • Tradable permits • Differentiated VAT rate (products, product groups, sectors) – e.g. in EU usually not implemented for resource efficiency reasons, apart from tax reduction schemes in Czech Republic from 1993 to 2003, Portugal since 2001, UK since 2000 • Subsidies – e.g. in the United States companies producing liquid biofuels receive direct subsidies for every gallon of ethanol produced	Negative aspects of taxes: • Administrative costs, monitoring (if infrastructure is not given) • Potential reduction of employment in raw materials industry • Less effective in guaranteeing a given environmental outcome • Resistant to change; tax breaks require active decision

• Dynamic standards / Top-runner to improve adaptation and information deficits and increase secondary material use – e.g. Top Runner program in Japan • Governmental loan programs – e.g. Recycling Market Development Revolving Loan Program, State of California, US	by lawmakers to eliminate them • Has to be re-approved with each budget cycle
IAU; Economie circulaire, écologie industrielle, Eléments de réflexion à l'échelle de l'Ile-de-France 2013 ➔Main action: National & EU • Modify regulations so that they encourage recycled materials usage in new products; shorten and simplify the process for authorisations; develop European regulations to develop an exit procedure from the waste status to encourage reuse	
Environmental Services Association UK; Going for Growth: A practical route to a Circular Economy 2013 ➔Main action: National & EU • A BIS Ministerial post should be created to lead on Resource Efficiency across Government, linking the current emphasis on industrial policy with the material resources agenda • Material Recycling Facilities (MRF) Sampling proposals should be strengthened in line with ESA input to Defra so as to have robust data on the quality of material entering and leaving the plant • EU to use powers within the Eco Design Directive to set recyclability requirements for selected products to help shape the design and investment decisions of manufacturers on the EU market • Specifications for recycled products/content in Government Buying Standards (GBS) to be increased • EU should consider adding products with high recycled content to the list of VAT reduced goods • Development of standard clauses in local authority collection contracts to enable better allocation of of recyclate price risk between partners	• Recyclate markets are volatile due to limited UK demand and the challenge of extracting new sources of saleable recyclate from waste streams • Waste feedstocks are heterogeneous and changing consumption and production patterns change waste stream composition over time. This can be difficult to manage and makes it risky for investors

Environmental Innovation and Societal Transitions; New business models for a radical change in resource efficiency 2013
➔Main action: National & EU & Global
Incentives are needed to speed up the transition to a circular model - labor tax is a barrier to that
• Creating a tax on non-renewable resource extraction. This would:
  ○ create business opportunity and employment
  ○ save costs on ecosystem services
	•

Council for the Environment and Infrastructure; Dutch Logistics 2040, Designed to last 2013 ➔Main action: National & EU • European standardization for the business concept of new products / packaging can have a stimulating effect for a company and prevent unfair competition – e.g. using the NLIP (raw materials passport) to indicate those used in a product • Set requirements as regards the reuse percentage of components and raw materials in new products • The setting of end-goals should be harmonized at the national level (CO2, noise, movements) • Legislation should progress from prohibition oriented (safety requirements, competition law, definition of waste) to effect-based control in order to stimulate innovation	• Lack of standardization makes reuse difficult

• Stimulate the implementation and acceptance of new technologies through tax measures which reward 'good behavior' by consumers (e.g. driving style) and companies • Try to limit perverse incentives (incinerators that are too cheap, energy levy that decreases with consumption, subsidies, etc.)	
Droit de l'environnement, n° 218; Évolution du statut de déchet : une contribution à l'économie circulaire ? **Drivers waste ceasing to be waste (end-of-waste/ byproducts)** ➔Main action: National & EU • "Legal clarity" of regulations is needed and can be achieved by harmonising quality criteria across the whole of the EU. • Furthermore, progress remains to be made regarding the status of a 'by-product' or the concept of 'reuse', to comply with the waste management hierarchy, which emphasizes reuse before recycling. The legal status of by-products should help promote direct eco-industrial synergies in so far as by-products defined as such remain non-waste. • The study develops the idea that the evolution of the waste status can significantly contribute to the emergence of a circular economy model (yet no quantitative impact is estimated). Giving the end-of-waste status for various waste streams leads to the reintroduction of recycled materials in production chains, and refers to the concept of creating closed loops.	**Barriers** • Member States may each adopt national criteria for end-of-waste status, • Regardless of criteria established by the EC. In a country like France for instance, the decree (..) on quality management system required to transform waste into products requires the ISO 9001 norm as a condition of giving the end-of-waste status to the recycled waste; yet this might be a burden for small and medium companies. • Another practical issue regarding the end-of-waste status is the implementation of the 'traceability principle'. French recyclers that turn waste into products must keep records of incoming and outgoing flows to "ensure that the traceability between the incoming waste and substances or objects have ceased to be waste." Since 2013 this issue remains for facilities that recycle waste without undergoing the process of end-of-waste status.

	As national criteria only have a national scope. The traceability principle is for example not applied the same way in all European countries hampering relations between European economic actors.
Corporate Citizenship; Ahead of the curve 2014 ➔Main action: National & EU (& Global) Setting clearer government signals • To transform the current system, business needs the support and incentives of government. • Governments at all levels therefore need to advance policy instruments to create the right enabling environment. Investing in research and acting as the intermediary between business and consumers is a key role. Updating the legal framework • The shifting economic paradigm has encouraged new forms of exchange, collaboration and knowledge sharing. Moving towards new business models such as leasing or sourcing from secondary markets will drive new liabilities and service obligations. The legal framework needs to be updated to accommodate these developments. Developing material and design standards • There is currently a lack of consensus for the way we make products in terms of the materials used and how they are developed. One material or component may be developed in a resource effective way, but loses this value if mixed with an ineffective one. This is inextricably linked to complex global supply chains, which can cause materials to leak value as they move across international markets. This global issue may be solved if there are clearer standards across industries for how and where our products are made. Mitigating risk from future policy and industry shocks • Changes to economic instruments such as taxes, charges, permits and subsidies could have a significant impact on companies in terms of cost adjustments. These often involve abatement technology or a process innovation. Companies staying alert to regulatory changes are mitigating public policy shocks. • The European Union Commission recently released a communication advancing its support for the circular economy, by establishing a non-binding resource productivity target for member states – 'GDP relative to Raw Material Consumption'. o There are a number of supportive measures the Commission is taking to help implement and encourage this target - such as resource stress tests for companies, green public procurement and funding for circular economy initiatives. o Periphery policies such as the EU waste framework directive (Directive 2008/98/EC) and Eco design directive (Directive 2009/125/EC) similarly follow circular principles.	
Opai; Ondernemen in de Circulaire Economie 2014 (Dutch only) ➔Main action: Local & National & EU & Global	Legal Obstacles

• The practice of significant subcontracting (70% in some building projects) complicates (management of) collective ownership. New contracts might offer future solutions: DBFMO (Design, Build, Finance, Maintain and Operate) and CDPC (Cooperative Design & Performance based Contracting) as well as Innovative or Circular Procurement	• Open issues with leasing constructions: take back possibilities and legal versus contractual ownership issues in case of insolvency • Permanently fixed assets in buildings like lamps or energy systems: legal versus contractual ownership issues in case of insolvency. Building specific equipment cannot be reused else ware.

Examples of Drivers and Strategies	Possible Challenges / Barriers
Type of Barrier / Driver: Access to financing	
EMF volume 1 & 2 ➔Main action: Local & National (& EU) • Shift local authority spending from landfill to anaerobic digesters or industrial composters, e.g. via incentives or higher landfill taxes. • Give access to preferred credit conditions to companies taking innovating initiatives. • Besides government funding, public- private organisations also play a crucial role, for example in circular systems for soil nutrients.	•
	Chatham House; A Global Redesign? Shaping the Circular Economy 2012 High up-front costs: • At macro level, a successful CE would foster growth and reduce vulnerability to resource price shocks. But in the short term, there will inevitably be significant up-front investment costs and risks for businesses – e.g. retooling machines, relocating whole factories, building new distribution and logistics arrangements, and retraining staff. Attempting to transform a company's core business model is a risky task in itself and a strong business case will be needed. Clear, strong and predicable policy frameworks will be crucial to encourage investment and experimentation.
Corporate Citizenship; Ahead of the curve 2014	Financing the transition ➔Main action: National & EU (& Global) • Without the finance and

	investment community understanding the shift towards circular economy practices, companies that want to explore product and service innovations face cost barriers. At the transitional stage, investors need to develop a longer term mind-set in order to encourage and support business changes.
IMSA; unleashing the power of the Circular Economy 2013 ➔Main action: National & EU & Global • Implement a new economic indicator beyond GDP that steers towards circularity • Gather and spread successful business examples	**Financial Obstacles** • Major up-front investment costs • Environmental costs (externalities) are not taken into account • Shareholders with short-term agenda dominate corporate governance • Recycled materials are often still more expensive than virgin • Higher costs for management and planning
Opai; Ondernemen in de Circulaire Economie 2014 (Dutch only) •	**Financial obstacles** ➔Main action: National & EU (& Global) • The huge vacancies and low book value of buildings do not make it interesting to use them as "resource banks". • Within waste management financial resource (re-use) opportunities need to be matched with the primary and regulated objective of waste

	management: protecting health and environment. When does waste cease to be waste? • Accountancy rules are linear based • Leasing and performance based contracting of products is neither a sale nor hiring. Residual value is not accounted for. • Value chain organisers have to be financially strong because they will become owner (balance sheet). Banks are often incapable of financing this.

Examples of Drivers and Strategies	Possible Challenges / Barriers
Type of Barrier / Driver: Technological, infrastructural and economical	
EMF volume 1 & 2 • Design and production: ➔Main action: National & EU & Global o Material choice optimised for circular setup; o Design to last; o More modularisation/ standardisation; o Easier disassembly and higher refurbishment potentialities; o Production process efficiency	•
EMF volume 1 & 2 ➔Main action: Local & National & EU & Global • Develop anaerobic digester and/ or industrial composter technology and operating procedures to readily turn biodegradable packaging into digest compost (e.g. facilitated via incentives for accepting biodegradable packaging). • Designing packaging intentionally for durability and reuse (thicker walls, anti-scuffing technologies)	• There is a lack of infrastructure for biodegradable packaging, and lack of volume.
TNO 2013 ➔Main action: National & EU (& Global) • Ecodesign to avoid using combinations of materials • Including reusable parts in the design of products • Knowledge development is needed for biotic waste to be reused and transformed through bio refining (potatoes, maize, straw, potato haulm, draff, sugar beet) • Weaken the dominance of incineration plants in the processing of biotic and abiotic waste streams to encourage recycling/reuse ➔Main action: Local & National & EU (& Global) • Increase the dissemination of knowledge about the development of new materials • Develop mobile phone apps to inform citizens about waste collection points • Develop incentives – e.g. DIFTAR, a system of differentiated tariffs where citizens are charged according to the amount and type of waste they generate • Frontrunners face additional costs because of uneven distribution of power/resources in the chain so it is difficult to establish a viable business: they should have priority over incentives • A study of the financial incentives should also focus on 'perverse' incentives that could potentially have a negative impact on circular business cases – e.g. An energy tax is only levied on fossil fuels, but not on products based on fossil raw materials	• Although reduction in the use of raw materials is positive, in the case of some products, economically viable recycling is no longer possible and has led to the suboptimal reuse of materials • Over the last decade consumer products have become considerably more complex, so that effective and efficient recovery is a massive challenge • Future market developments are highly uncertain (shifting geopolitical alignments, complexity of markets, volatility of raw material prices, rapid changes in technologies/ products):

	investing in large-scale recycling is perceived as very risky • A substituted product does not necessarily helps to reduce pressure on the environment but lead to increases in energy consumption e.g. plasma display panels • Knowledge development for the design process will have to focus on the art of combining constantly evolving standardization with designs that still allow manufacturers to distinguish themselves from their competitors • Knowledge management is fragmented and rarely cuts across sectors • Many businesses are unaware of the exact origin of the composition of the raw materials they use • Many of the fastest-growing young businesses are in fields such as IT services, software, apps, webshops and gaming, but are all but absent from the heavy industry sector, which is extremely important for the development of a circular economy • Availability of products components for repair by independent operators is often blocked by businesses

	that have a monopoly on supplies of components or products
Aldersgate Group; Resilience in the Round - Seizing the growth opportunities of a circular economy 2011	• Large companies and their tier one suppliers might be big enough, in their own right, to adopt the principles of a circular economy but the majority of companies are reliant on external providers to create closed loops. Recycling rates for many materials are still low and perhaps an opportunity exists to 'leap frog' the linear economy (such as investment in recycling and waste incineration plants) and move directly to the circular economy, with the associated higher added value. There may be a role for Government to stimulate this through support for regional infrastructure and for companies seeking to develop in this market.
AEA; Business Resource Efficiency 2009 ➔Main action: National & EU (& Global) • SMEs and sole traders have difficulties to keep up to speed with what is required due to a lack of funds for conferences – more information should be disseminated through platforms such as trade associations or similar organisations • Linking support programmes with financial institutions that collaborate with businesses in day-to-day operations so they could provide advice on resource efficiency and lessen the impact on businesses' bottom-lines • Measures should be put in place to help environmental champions share their experiences with other businesses	•
COWI for DG Environment; Economic Analysis of Resource Efficiency Policies 2011 ➔Main action: National & EU (& Global) • Eco-innovation – e.g. Framework Programme Renewable Resources, Germany (€ 800 million fund), Resource	•

Efficiency Science Programme, UK	
IAU; Economie circulaire, écologie industrielle, Eléments de réflexion à l'échelle de l'Ile-de-France 2013 ➔Main action: National & EU (& Global) • Government support for innovation and development • Promote principles of eco-design through informational workshops and ongoing monitoring of new developments in different sectors • Development of new technologies for information and communication so that: economic actors are aware of the environmental impacts of their production processes at different scales; continuous information is available on offer and demand for energy and on the quantity of material that can be reintroduced into economic circuits ➔Main action: Local & National & EU (& Global) • Analytical accounting of material flows and linked costs at a sub-national scale in 2014 • Recovery of currently exported waste to lessen the need for raw materials – it would cover 9% of current needs • Develop a good knowledge of the energy and material flows of an industrial sector or geographical area so as to optimize their use and see where they can be improved • Make symbiosis between businesses for waste recovery more economically attractive compared to sending all waste to landfill • Develop synergies between businesses for workers services, energy flows, infrastructure… • Encourage the development of new sectors for waste recovery (such as rare metals) • Ongoing surveillance strategy for supply chain risks to help manage regional resources • Financial support at a regional level to encourage ecological industry measures and make them permanent • Take symbiosis possibilities into account when developing a new area of economic activity • Create recycling platforms close to production sites (proximity principle) • The priority in terms of energy should be heat recovery because of the region's numerous heating networks before it starts developing renewable energies	• Material and energy-flow and industrial symbiosis kind of knowledge is hard to access due to competition and privacy policies within business. This new model based on interdependence is riskier economically for businesses
Environmental Services Association UK; Going for Growth: A practical route to a Circular Economy 2013 ➔Main action: National (& EU) • Waste management companies to contribute experts to help designers understand the practical impacts of design choices	Demand for recycled content in products made in the UK remains limited because of: • The decline of manufacturing • A focus on recycling rather than use of recycled content in new products • The public procurement standards are not specific enough on recycled products

	• Many of the 'easy wins' in recycling have been taken: the potential recyclate in the waste stream's composition makes it harder to aggregate cost-effectively

Environmental Innovation and Societal Transitions; New business models for a radical change in resource efficiency 2013
➔Main action: Local & National & EU (& Global)
• Solutions for the food industry using circular design principles:
  ○ optimise protection whilst avoiding waste from food packaging
  ○ moving production of food closer to consumption
• Better shelf management
• Need for regulation – e.g. an integrated modern metal processing complex like Umicore in Hoboken, Belgium can recover up to 17 metals with recovery efficiencies of 95% or more.
• Unavoidable 'waste' from food processing could be 'designed in' as nutrients to be returned to natural ecosystems
	• Lack of good collection systems – e.g. electronic waste in many countries is collected by scavengers and shipped to low-wage and environmentally unregulated parts of the world where only 25% of precious metals are recovered and the rest is incinerated in the open (leaching cyanide and nitric acid)

Council for the Environment and Infrastructure; Dutch Logistics 2040, Designed to last 2013 ➔Main action: Local & National (& EU) • Incorporate logistical challenges such as urban distribution in local spatial plans • Encourage technological innovation as it represents half of the energy gains on the supply chain where limiting transport only accounts for 5% of benefits • Use environmentally friendly modes of transport across the supply chain • Shorten (international) supply chains	•
Council for the Environment and Infrastructure; Dutch Logistics 2040, Designed to last 2013 The High Tech sector: move from product to service ➔Main action: Local & National (& EU) • Creation of 'repair cafés' where residents take their broken goods to repair them with the assistance of experts • Invest in 3D printing as a key technology and determine which components are most suitable to it • Develop 'urban mining': recovery of scarce resources from domestic waste and sewage	•
Council for the Environment and Infrastructure; Dutch Logistics 2040, Designed to last 2013 The Chemical industry: move from stand-alone to networks ➔Main action: Local & National (& EU) • Make the supply chain as transparent as possible, as this will allow it to be organised more efficiently • Encourage chemical leasing, where the focus is not on selling as much volume as possible, but on ensuring the product is optimally efficient and effective by providing technical information – e.g. a trial in Austria led to a	• Bulk chemicals: this subsector is vulnerable to economic balances of power and the market is consequently not transparent • Chemical leasing is usually

reduction in costs of 15% on raw materials used and of 1/3 in the amount ofsolvent used per car	not the core business so is often not organized efficiently
Council for the Environment and Infrastructure; Dutch Logistics 2040, Designed to last 2013 Agrifood sector: move from retail to consumers as pivot in the chain\ ➔Main action: (Local &) National (& EU) • Logistics service providers: invest in tools to optimise the information link between retailer and consumer to assess consumer needs more accurately - extend the supply chain to the consumer (planning, shopping, cooking and eating) and take it into consideration • Supplier and retailer: assume mandatory takebacks if a product remains unsold (magazines, bread, etc.) • Find innovative solutions to prevent food waste in supermarkets (600 million euros/ years' worth) – e.g. processing fruit and vegetables which are close to their expiry date into juice and soup instead of throwing them away ('Too Good to Waste')	•
Corporate Citizenship; Ahead of the curve 2014 ➔Main action: Local & National & EU & Global Developing skills • Core business functions currently lack the STEM (science, technology, engineering and maths) based skills necessary to drive strategy, design and innovation towards the circular economy. These subjects are not mutually exclusive yet many business departments are silo-ed. It is important to see the opportunity of placing integrated knowledge in one room to solve resource challenges. Developing material and design standards • There is currently a lack of consensus for the way we make products in terms of the materials used and how they are developed. One material or component may be developed in a resource effective way, but loses this value if mixed with an ineffective one. This is inextricably linked to complex global supply chains, which can cause materials to leak value as they move across international markets. This global issue may be solved if there are clearer standards across industries for how and where our products are made.	•
IMSA; unleashing the power of the Circular Economy 2013 Niche steps ➔Main action: Local & National & EU & Global • Set up a simple index for circular performance. Organisations can use this to give incentives to their value chain partners encouraging circularity • Encourage experimentation, innovation and redesign. In NL, use Green Deals to remove legislative obstacles and support access to finance and a resource passport • Gather and spread successful business examples • Integrate circular economy principles in education and training programmes • Develop a long-term company vision identifying linear risks and circular economy opportunities • Search for material pooling opportunities • Promote circular products using modern marketing techniques and social media	Technical obstacles • Limited attention for end-of-life phase in current product designs • Limited availability and quality of recycling material • New challenges to separate the bio- from the techno cycle • Linear technologies are deeply rooted Infrastructural obstacles • Limited application of new

• Prepare roadmaps for established economic sectors • Initiate and stimulate stakeholder fora about the circular economy	business models • Lack of an information exchange system • Confidentiality and trust issues hamper exchange of information • Exchange of materials is limited by capacity of reverse logistics •
Opai; Ondernemen in de Circulaire Economie 2014 (Dutch only) •	Operational obstacles • Mutual dependency on value chain collaborators • Circular procurement asks for professional buying organisations. Buying services is more complex than buying products. Long term circular contracts introduce new risk management challenges

1.3 High potential areas and strategies for waste

	Design (13)	Extraction (14)	Production (15)	Distribution (16)	Consumption (17)	Waste (18)	End-of-waste (19)
Legal instruments	Product standards (9) Prevention targets (8) Green public procurement (4)	Technology standards (11) Product standards (9) Prevention targets (8)	Technology standards (11) Product standards (9) Prevention targets (8)	Prevention targets (8) Market entries (2)	Prevention targets (8)	Prevention targets (8) Technology standards (11)	Product standards (end-of waste criteria) (9)
Economic instruments	Positive/negative financial stimuli (7) Extended producer responsibility (3)	Positive/negative financial stimuli (7)	Positive/negative financial stimuli (7)	Extended producer responsibility (3) Positive/negative financial stimuli (7)	Positive/negative financial stimuli (7)	Extended producer responsibility (3) Positive/negative financial stimuli (7)	
Communication / other	Labelling (5) Awareness raising/education (1) Voluntary agreements (12)	Awareness raising/education (1) Voluntary agreements (12)	Awareness raising/ education (1) Voluntary agreements (12)	Awareness raising/ education (1) Voluntary agreements (12)	Labelling (3) Awareness raising/education (1) Marketing (6) Voluntary agreements (12) Green public procurement (4)	Awareness raising/ education (1) Voluntary agreements (12)	Awareness raising/ education (1) Green public procurement (4) Marketing (6) Voluntary agreements (12)
Technical instruments	Ecodesign (2)	Technology standards (11)	Reuse (through remanufacturing) (10) Technology standards (11)	Reuse (of packaging) (10)	Reuse (reuse shops etc) (10)	Reuse (reuse of parts) (10)	

High potential areas and strategies for waste prevention across the value-chain. (ARCADIS 2010): Analysis of the evolution of waste reduction and the scope of waste prevention. European Commission DG Environment Framework contract ENV.G.4/FRA/2008/0112

		strategies											
		awareness & education	ecodesign	EPR	GPP	labelling / certification	marketing	positive/neg. financial stimuli	prevention targets	product standards	reuse	technology standards	voluntary agreements
material flows		1	2	3	4	5	6	7	8	9	10	11	12
mineral	1	7,77	5,59		7,85	4,13	8,28	8,24	6,15	8,48	8,28	7,88	7,15
wood	2	7,06	5,24		7,14	7,55	7,57	7,53	2,72	7,77	3,79	7,17	6,44
bio-waste	3	8,89			8,97	4,69	9,4	9,36	3,64	9,6		9	8,27
plastics	4	8,63	12	7,7	8,71	9,12	9,14	9,1	7,01	9,34		8,74	8,01
paper and cardboard	5	6,19	4,8	5,26	6,27	6,68	6,7	6,66	4,57	6,9		3,15	5,57
glass	6	6,34	4,88	5,41	6,42	6,83	6,85	6,81	4,72	7,05		3,23	5,72
metals	7	9,99	6,7	9,06	10,1	10,5	10,5	10,5	8,37	10,7		10,1	9,37
hazardous	8	10	13,4	4,55	10,1	5,26	5,27	10,5	4,2	10,7		10,1	9,4
household (MSW)	9	8,96						9,43	3,67				8,34

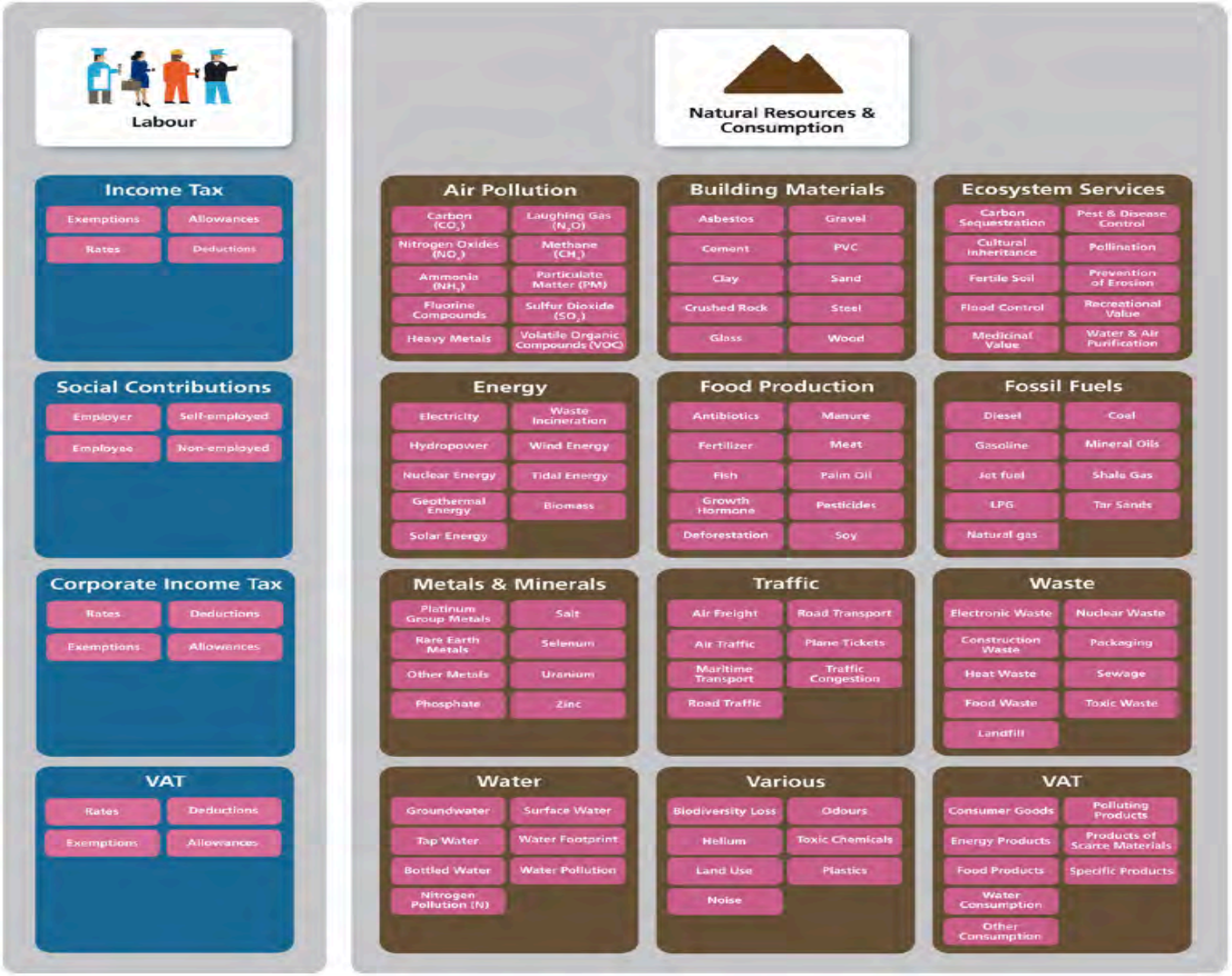
Matrix for high potential areas for prevention (ARCADIS 2010): Analysis of the evolution of waste reduction and the scope of waste prevention. European Commission DG Environment Framework contract ENV.G.4/FRA/2008/0112

1.4 Options for shifting the tax base from labor to natural resources (ExTax 2014)

Below is an inventory of potential tax base options to implement the ExTax principles, in other words, the 'buttons' governments could push to shift taxation from labor to natural resources. On the left side of the figure are (in blue) the tax bases with regard to labor, and on the right hand side (in brown) potential tax bases with regard to natural resources and consumption. The building blocks available to governments to lower labor taxes, and more generally the costs of labor, are: income tax, social contributions, corporate income tax and VAT.

Within each category there are several options, with regard to tax rates, deductions, exemptions and allowances. Governments could increase taxes on resources, and the costs of consumption and pollution in general, by raising taxes on air pollution, building materials, ecosystem services, energy, food production inputs, fossil fuels, metals and minerals, traffic, waste, water and VAT. Within each category there are several sub-categories. Within the waste category, for example, there is electronic waste, sewage, nuclear waste and other types of waste. VAT plays a special role as it can be found on both sides.

Although legally, VAT is a consumption tax, in practice consumers pay VAT both on products (such as cans of paint) and services added to those products (the efforts of a painter). This toolkit has been based on the Dutch Case study. The goal is to further develop the toolkit in the upcoming years. Clearly, tax systems cannot be static; they will evolve with new circumstances. When the new system works properly, the tax base can be extended to other categories within the Toolkit, in order to guarantee a stable government income. Rates and tariffs can be raised or lowered too. Current Levels of taxation are not carved in stone and there is no reason why a system based on 'extracted value' instead of 'added value' should be either.


Labour
Income Tax
Exemptions
Allowances
Rates
Deductions
Social Contributions
Employer
Self-employed
Employee
Non-employed
Corporate Income Tax
Rates
Deductions
Exemptions
Allowances
VAT
Rates
Deductions
Exemptions
Allowances
Natural Resources & Consumption
Air Pollution
Carbon (CO_2)
Laughing Gas (N_2O)
Nitrogen Oxides (NO_x)
Methane (CH_4)
Ammonia (NH_3)
Particulate Matter (PM)
Fluorine Compounds
Sulfur Dioxide (SO_2)
Heavy Metals
Volatile Organic Compounds (VOC)
Building Materials
Asbestos
Gravel
Cement
PVC
Clay
Sand
Crushed Rock
Steel
Glass
Wood
Ecosystem Services
Carbon Sequestration
Pest & Disease Control
Cultural Inheritance
Pollination
Fertile Soil
Prevention of Erosion
Flood Control
Recreational Value
Medicinal Value
Water & Air Purification
Energy
Electricity
Waste Incineration
Hydropower
Wind Energy
Nuclear Energy
Tidal Energy
Geothermal Energy
Biomass
Solar Energy
Food Production
Antibiotics
Manure
Fertilizer
Meat
Fish
Palm Oil
Growth Hormone
Pesticides
Deforestation
Soy
Fossil Fuels
Diesel
Coal
Gasoline
Mineral Oils
Jet fuel
Shale Gas
LPG
Tar Sands
Natural gas
Metals & Minerals
Platinum Group Metals
Salt
Rare Earth Metals
Selenium
Other Metals
Uranium
Phosphate
Zinc
Traffic
Air Freight
Road Transport
Air Traffic
Plane Tickets
Maritime Transport
Traffic Congestion
Road Traffic
Waste
Electronic Waste
Nuclear Waste
Construction Waste
Packaging
Heat Waste
Sewage
Food Waste
Toxic Waste
Landfill
Water
Groundwater
Surface Water
Tap Water
Water Footprint
Bottled Water
Water Pollution
Nitrogen Pollution (N)
Various
Biodiversity Loss
Odours
Helium
Toxic Chemicals
Land Use
Plastics
Noise
VAT
Consumer Goods
Polluting Products
Energy Products
Products of Scarce Materials
Food Products
Specific Products
Water Consumption
Other Consumption

2 The EU perspective: barriers and how to overcome them, priority materials, products & sectors, supporting and blocking policies options

(Summary EU Scoping Study to identify potential circular economy actions, priority sectors, material flows & value chains, 2014 for DG Environment)

2.1 Barriers to the circular economy

While the benefits of the circular economy are increasingly recognised, there remain a range of barriers to the transition which include:

- Insufficient skills and investment in circular product design and production which could facilitate greater re-use, remanufacture, repair and recycling;
- Current levels of resource pricing which create economic signals that do not encourage efficient resource use, pollution mitigation or innovation;
- Lack of sufficient incentives due inter alia to the insufficient internalisation of externalities through policy or other measures;
- Non-alignment of power and incentives between actors within and across value chains (e.g. between producers and recyclers) to improve cross-cycle and cross-sector performance;
- Still limited consumer and business acceptance of potentially more efficient service oriented business models, e.g. leasing rather than owning, performance-based payment models;
- Limited information, know-how and economic incentives for key elements in the supply and maintenance chain, e.g. for repair and reuse, on chemical composition of certain products such as substances in electronic devices;
- Shortfalls in consumer awareness (e.g. perishability of food products);
- Insufficient waste separation at source (e.g. for food waste, packaging);
- Limited sustainable public procurement incentives in most public agencies (i.e. Green Public Procurement);
- Insufficient investment in recycling and recovery infrastructure, innovation and technologies (related to this is the lock-in of existing technologies and infrastructure);
- Challenges in obtaining suitable finance for such investment;
- Weaknesses in policy coherence at different levels (e.g. bioenergy and waste policies);
- Widespread planned obsolescence in products.

- Many of these barriers are specific to particular materials, products and sectors; requiring different types of action at the EU, national, regional and local level according to the nature of the barrier faced.

2.2 Priority materials, products and sectors for the EU

The circular economy is a complex concept encompassing a range of materials, products and actors, different stages in product and value chains, with varying potential for circularity across different sectors, products and value chains. Furthermore, the transition to a circular economy is a multi-level governance challenge, where actions can be taken at different levels (EU, Member State, local authority, private sector, citizen). Thus, there is a need to identify priority areas for action at different governance levels.

A number of key existing studies explore the opportunities for actions to enhance circularity in various resource areas and product sectors from different perspectives. For example, the Ellen MacArthur Foundation in its 2013 report analyses the consumer goods sector to identify priority goods where the most substantial and underexploited opportunities for circularity lie, highlighting products such as furniture and washing machines as priorities within this sector (EMF, 2013). In contrast, a study by Green Alliance takes the priority materials of metals, water and phosphorus as a starting point due to their role as key inputs to the economy and the large quantities of these currently lost (Green Alliance, 2011).

This study identifies the following priorities where accelerating the circular economy would be beneficial and where EU policy has a particular role to play:

- **Priority materials include: agricultural products and waste, wood and paper, plastics, metals and phosphorus.**
- **Priority sectors include: packaging; food; electronic and electrical equipment; transport; furniture; buildings and construction.**

To better understand circular economy opportunities in different areas that could be supported through targeted policy interventions, the following cases were developed in the study:

- Mobile and smart phones since they are a high profile and economically significant example of high-tech products with signs of growing consumer interest and participation in the circular economy. There are also major potential benefits in terms of material savings and a need to reduce health and environmental impacts of disposal at present.
- Food supply chains are large in volume terms, significant in economic and environmental terms and central to the management of many biological materials.

- These chains currently generate significant amounts of waste (despite major global challenges of ensuring adequate nutrition) and are associated with high environmental impacts.
- The use of large volumes of high-strength steel and the associated potential for dematerialization within different products illustrates how a priority material has systems level links with a number of product supply chains, including construction and transport.
- Plastics have a huge range of applications including in packaging and food products as well as lightweight structural applications such as in automobiles. They are also an important example to explore the range of cascading options for materials and the transition to a bio-based economy.

The analysis in these case studies indicates that the relationship between actors in the value chain can be an important limitation on the realisation of opportunities from the circular economy, particularly when innovation (in products, organisational structure, knowledge, or value chain relationships) is required. This is an additional barrier to the transition to a circular economy beyond the barriers frequently emphasised in the literature and may require policy intervention to be overcome.

2.3 Policy options to support a circular economy in the EU

There is a range of policies and measures already in place at EU, national, regional and local levels, and a range of initiatives underway by private actors and other stakeholders that address part of the transition to a circular economy. These efforts are closely related to parallel policy discussions including:

- The Circular Economy Package published in July 2014 which includes an overarching communication (COM2014)398), a proposal to amend aspects of six EU waste Directives (COM(2014)397), and related communications on sustainable buildings (COM(2014)445), green employment (COM(2014)446) and green action for SMEs (COM(2014)440). The Circular Economy package has been ditched by the new European Commission and will be replaced it with "more ambitious" legislation in 2015;
- Implementation of the Roadmap to a Resource Efficient Europe (COM(2011)571), the 7th Environmental Action Programme - 7th EAP (Decision No 1386/2013/EU) and the recommendations of the European Resource Efficiency Platform (EREP);
- Taking forward ambitions on advancing the green economy within and beyond the EU (including work on the post-2015 development framework and the drafting of global Sustainable Development Goals);
- Taking forward the bio-economy in the EU building on inter alia the Bio Economy Strategy (COM(2012)60) and on-going work in DG ENTR, DG AGRI, DG RTD and DG ENV to identify new value chains and markets in this area;

- Implementation of the Europe 2020 Strategy, including relevant roadmaps and flagship initiatives beyond resource efficiency, e.g. Innovation Union, Industrial Policy, Skills and Jobs, and;
- The associated on-going European Semester process (including the adoption of country-specific recommendations).

These commitments and initiatives offer a good base on which to build and will generate interesting insights to encourage further action. However while useful, by themselves they are insufficient to secure progress towards the circular economy in the EU as they address only certain parts of the transition focusing on individual sectors, products or policy 'silos'.

The transition to a circular economy requires systemic change and a more holistic, integrated approach which takes into account the myriad of inter-linkages within and between sectors, within and across value chains and between actors. Such an approach would help to take into account the different incentives in play, the distribution of economic rewards and impacts of specific measures along a value chain, across different sectors and policy areas.

This transition requires a mix of complementary instruments and approaches which can be taken forward by actors at different levels from the private sector, to individuals and public actors at all levels from local to the EU. Potential policy actions include regulatory measures, economic incentives, targeted and increased funding, efforts to engage and link actors along the value chain and initiatives to raise awareness of the benefits of the circular economy and available solutions.

There is a need for policies which can support existing efforts and opportunities (by revising existing policies, removing barriers); building on current efforts on waste management and recycling to support other loops in the circular economy (i.e. expanded reuse, remanufacturing and refurbishment); provide support for bottom-up initiatives, develop skills and provide incentives for innovation and closer collaboration between actors along the value chain.

Opportunities for increased circularity vary considerably across different firms, sectors, products and value chains. Moreover, the need for policy intervention beyond private initiatives (if any) and the type of intervention needed will vary according to the issue at hand. In some areas, the transition to a circular economy might materialise without intervention (particularly where products have high embedded material values, where incentives within the private sector allow moves towards more circular and/or service-based models independently); while in other areas support including funding and targeted public intervention is needed to encourage the transition. It is therefore important that the value chain structure and the business case for circularity for different actors is understood in detail and taken into account in the policy development process.

Given its key role in a range of related policy areas, including inter alia resource efficiency, recycling and waste management, product policy, trade policy, industrial policy, the bio Economy, research and development it is important to include an appropriate EU *(or global fo that matter)* dimension in any catalogue of measures to advance the circular economy. The aim of this study has been to provide a first scoping assessment of potential options for EU consideration across a range of areas which could be taken forward, each with different strengths and weaknesses.

The study identified a number of areas where EU action might most productively focus in the short to medium term to support the transition to a circular economy on a European scale. The study has not been designed to explore these options in detail, but rather provides an initial assessment of potential areas of interest that could be explored in further detail in the future.

These options can be clustered into three broad areas as briefly described below.

- Regulatory instruments including better implementation and enforcement of related existing legislation (e.g. on waste, product policy etc.); revisions to relevant legislation including those which act as barriers to a circular economy (e.g. definitions in EU waste legislation) and those which can better integrate circular concepts (e.g. eco-design, extended producer responsibility (EPR) related legislation, requirements on packaging and packaging waste, labelling, reporting and accounting, REACH); and new measures or regulations such as new targets (e.g. on food waste as proposed in (COM(2014)397)), restrictions or selective bans (e.g. on landfilling of plastics or recyclable materials as proposed in (COM(2014)397)), mandatory product or process requirements (e.g. mandatory phosphorous recovery from sewage sludge), potential measures to address issue of intentional obsolescence (e.g. broad policy objective, extended warrantee/guarantee periods).
- Other instruments and approaches to support legislative measures *or* voluntary agreements (e.g. between retailers and government, between actors along a supply chain); fiscal incentives including taxes, charges and levies at the national or local level (e.g. taxes/charges on aggregates or construction materials, products (e.g. phosphorous in mineral fertilizers), pollution (e.g. CO2) and waste disposal (e.g. PAYT schemes, landfill taxes) and encouraged at EU level (e.g. through the European Semester and adoption of country-specific recommendations in this area); targeted information and advisory services (e.g. for companies on alternative uses for their by-products) awareness raising campaigns (e.g. among consumers on ways to reduce food waste, producers and local authorities).
- Public investment could play a useful supporting role alongside substantial private financing of relevant activities for example to support further R&D and innovation (e.g. through the Horizon 2020 and COSME programmes, leveraging both public and private financing and building on existing efforts such as the European Innovation Partnerships (EIPs), develop skills and training in the current workforce (e.g. on refurbishment or remanufacturing, skills of food chain personnel) as well as in the future workforce (e.g. through young designer awards etc.) e.g. through the European Social Fund, support investments in infrastructure including specific infrastructure (e.g. centralised collection points) and better use of existing infrastructure/services (e.g. postal service for

collection) e.g. through EU Structural and Cohesion Funds. Public investment could also support clustering, industrial symbiosis and best practice platforms , e.g. EU Cohesion Policy funding could be used to set up 'facilitators' at regional/national level across European regions which connect companies and other actors including municipalities. Further action to encourage Green Public Procurement (GPP) can also be useful in incentivising more circular procurement practices among public authorities.

- Furthermore, the potential to use other EU funding instruments such as LIFE+, European Fisheries Fund, and the CAP to support the transition to the circular economy should be systematically explored (e.g. to support cascading use of biological materials) as well as avoid or minimise EU funding of investments that go against the circular economy, e.g. investment in energy recovery from untreated waste.
- Policy discussions on the circular economy should reflect both technical and biological resources as well as the interplay between them (i.e. move to a bio-economy and nature based solutions). Furthermore the interactions, synergies and potential trade-offs between the circular economy and related policy initiatives on resource efficiency, bio-economy, green economy, dematerialisation etc., need consideration to ensure the overall coherence of policy initiatives. The recently published circular economy package from the Commission can be an useful framework for taking forward EU initiatives that support the transition to a circular economy, engaging a range of stakeholders across sectors, value chains and countries both within the EU and internationally.

2.4 Barriers to a circular economy and how they can be overcome

Drivers and barriers have first been described and analysed for the general framework conditions necessary to move towards a circular economy, before being examined for each major stage of value chains/ supply chains: Design and production; Consumption; and Recycling and recovery. Lastly, as the transition to a circular economy has implications for logistics flows at all scales, drivers of a circular economy and associated barriers have been considered in the field of logistics. Logistical issues and solutions are cross-cutting, i.e. relevant at any stage of a value chain.

Whether drivers and obstacles are stemming from policy, regulation or the legal framework, or linked to social, cultural, economic, technological or infrastructural contexts, there is rarely only one driver in one sector or value chain. Typically several factors are in play and often the factors influence each other. For instance, the infrastructure to support the efficient collection of products after use, i.e. "reverse cycles" (Ellen MacArthur Foundation, 2012) or "reverse logistics" (Hawks, 2006), which is an essential component for a circular economy, can be heavily influenced by various levers: policy instruments (such as landfill tax), extended producer responsibility (EPR), new business models and take-back schemes. The list of examples below is non-exhaustive but primarily targets policy-oriented drivers. It is shown in Annex 1.

Actions towards a circular economy to date have mainly been driven by value maximization along the value chain and the interest in continually reintroducing assets to markets. Once a material is seen as an investment and customers as users, it makes business-sense to maintain the customer relationship during multiple cycles. The policies which enable business models and value chains to be more circular, in every sector and along any value chain, are the ones which:

- Encourage manufacturers to design products with asset recovery in mind and to take into account the true cost of materials;
- Encourage the development of product lines that meet demand without wasting assets;
- Incentivise businesses to source material from within regenerative loops, rather than from linear flows;
- Enable businesses to develop a revenue model that generates value at all parts of the value chain, and;
- Get customers/ consumers to change their consumption and ownership patterns.

This literature review has identified the following gaps which currently act as barriers to the development of a circular economy, and therefore where further consideration of policy action may be beneficial in promoting the circular economy:

- The lack of internalisation of externalities through policy or other measures and the lack of resource pricing (cost recovery and pricing for the resource itself), which lead to economic signals that do not encourage the efficient use of resources (i.e. as there are greater incentives to use materials more effectively) or a transition to a circular economy (i.e as resources become more costly there are increased incentives to reuse/recycle materials);
- The lack of skills and investment in circular product design and production;
- The lack of enablers to improve cross-cycle and cross-sector performance due inter alia to non-alignment of power and incentives for transformation between actors within and across value chains;
- The lack of consumer and business acceptance regarding consumer-as user, and performance-based payment models;
- The lack of know-how and economic incentives including for repair and reuse;
- The lack of consumer information on origins and perishability of products;
- The lack of waste separation at source (especially for food waste and packaging);
- The lack of sustainable procurement incentives for public authorities;
- The lack of investment and innovation in recycling and recovery infrastructure and technologies, (related to this is the lock-in of existing technologies and infrastructure);
- The lack of harmonisation of transport flows systems between municipalities, which leads to confusion among shippers and transporters;
- Weaknesses in policy coherence (e.g. bioenergy and waste policies);

- Widespread planned obsolescence within product chains.

This list is non-exhaustive but covers the main barriers to the development of a circular economy.

From a policy standpoint, addressing these barriers means:

- Encouraging economic players to take into account the economic value of their environmental externalities through for example:
    - Regulatory requirements such as the ones posed by the Extended Producer Responsibility (EPR) principle. EPR promotes the integration of environmental costs associated with goods throughout their life cycles into the market price of the products, and, thanks to financial incentives, encourages manufacturers to design eco-friendly products by holding producers responsible for the costs of managing their products at end of life. This policy approach differs from Product stewardship (where responsibility is shared across the value chain of a product), and attempts to relieve local governments of the costs of managing certain priority products by requiring manufacturers to internalize the recycling cost within the product price.
    - Other relevant regulatory requirements include those related to product design and standards.
    - Economic incentives and tax measures strong enough to change business behaviour, and to encourage the recovery of more secondary raw materials, such as the phosphate levy which fosters the recovery of phosphate from sewage and the use of high quality, secondary sources of phosphate in agriculture.

- Encouraging the development of skills, awareness and investment in circular product design and production, as well enabling to improve cross-cycle and cross-sector performance, through for example:
    - Support programmes for investment in R&D and eco-innovation (e.g. support investment in 3D printing technology and determine which components are most suitable to it).
    - Support integration of circular design concepts and reusable parts through investment support (e.g. Framework Programme Renewable Resources Germany, €800m fund).
    - The development of an extensive raw materials information service, providing –inter alia - data on primary and secondary raw material production, prices, and supply risks, and increase the dissemination of knowledge about the development of new materials.
    - The promotion of cleaner production (CP) methods, in particularly in SMEs, by offering a production-integrated environment protection tool (e.g. a guidance manual or electronic tool) where the relevant material flows and current level of production technology are analysed, and where recommendations are made. CP methods emphasize on prevention rather than control of pollution, waste, etc.

- Encouraging the improvement of cross-cycle and cross-sector performance, through for example:
    - The development of a free-to-business advice and networking Programme at a regional level to identify resource exchanges between companies for sustainable resource management solutions – e.g. National Industrial Symbiosis Programme
    - (NISP) (UK).
    - The development of local networking for industrial symbiosis opportunities, perhaps via an internet application.
    - The availability of (public or private) planning agencies who would perform, in a given territory and for the industries of this territory, every function required to turn the industries' by-products into feedstock, including finding appropriate uses, dealing with regulatory agencies, brokering necessary agreements, and even transporting the materials from the waste/ by-product generator to the user.

- Encouraging a change in consumption patterns, through for example:
    - The support and promotion of innovative leasing and rental contracts (pay-per-use instead of ownership). When goods vendors embrace the idea of themselves as service providers, this can lead not only to an effective hedge against cost volatility but also strengthens the customer relationship and increases the upsell, such as in Vodafone's Red-Hot plan3 (customers can rent the latest phone for a year and keep on exchanging it for a newer version; while Vodafone is engaged in collecting the old phone, which enables material collection and pooling and creates deeper customer relationships).
    - The support and protection of the 'peer economy' (collaborative consumption) and of initiatives promoting repair and reuse, such as the creation of 'repair cafés' (see table below for further detail).
    - The development of consumer knowledge/ awareness on perishability of products (e.g. GS1 DataBar, informational barcode about the shelf life of a product) and on origins of products (certification, labelling).
    - The development of incentives such as PAYT (Pay as you throw) or DIFTAR, a system of differentiated tariffs where citizens are charged according to the amount and type of waste they generate.
    - Regulation to separate food and packaging waste collection at source.
    - The development of obligations for public-sector agencies and government departments to purchase resource-efficient and cradle-to-cradle products. *[1]

* See Vodafone website: https://www.vodafone.co.uk/shop/pay-monthly/vodafone-red-hot/

- Encouraging investment and innovation in recycling and recovery infrastructure and technologies through for example:
    - Investment support in regional infrastructure and for companies seeking to develop innovative recycling and recovery technologies (e.g. Starbucks actually aims to turn thousands of tons of its waste coffee grounds and food into everyday

products by using bacteria to generate succinic acid which can then be used in products such as detergents, bio-plastics and medicines). *[1]
    - The set-up of Business parks, Business Improvement Districts and other clusters of SMEs to facilitate collective long term contracts for recyclable waste collections. This will make it cheaper to invest in collection and recycling infrastructure.
    - The harmonisation of the quality criteria of the end-of-waste status across the whole of the EU. Furthermore, progress remains to be made regarding the status of a 'by-product' or the concept of 'reuse', to comply with the waste management hierarchy, which emphasizes reuse before recycling.
    - The removal of a number of regulatory obstacles to the use of biotic waste streams, such as in the Dutch Environmental Management Act (chapter 10).
    - Developing understanding of the feedstock base, competing uses and consequences for upcycling, e.g. using straw for the bio-economy removes it from fields where it acts as a soil improved. A key question is to understand when wastes are truly waste with no other competing uses .
    - Incentives for suppliers and retailers to establish mandatory take-back arrangements if a product remains unsold (magazines, bread, etc.)

- Encouraging the harmonisation of transport flows systems between municipalities, which currently often leads to confusion among shippers and transporters through for example:
    - Streamline transport flows and urban distribution through business-to-business concepts such as Green City Distribution, Binnenstadservice, Cargohopper (in the Netherlands);
    - Business-to-consumer concepts such as DHL;
    - System solutions (partnership between retailers on the same street or by sector/product);
    - Cooperation between transport companies.
    - Digitisation is one of the tools available to shape partnerships.
    - Inviting shippers to develop concepts for city logistics through innovative tendering (i.e. flexible and incentivising) and supply chain-transcending cooperation. Tenders would formulate clear end goals, including noise and air emissions, maximum number of transport movements, and load factor for both inbound and outbound flows, service logistics, and involvement of all stakeholders. *[2]

* See Starbucks website
** Dutch Logistics 2040, Designed to last , Council for the Environment and Infrastructure study (2013)

2.5 Current EU policies which support the circular economy

A range of policies and measures are already in place in the EU that support (or have the potential to support) the transition to a circular economy. This starting point implies that in a number of areas, the transition to a circular economy has an existing policy base and range of activities already underway on which it can usefully build.

On the next page you'll find an illustrative overview of the range of policies and approaches at EU, national, regional and local levels that already play a role in different parts of the circular economy. This figure builds on the work in the 2012 report by the Ellen MacArthur Foundation.
It does not aim to be comprehensive, but rather serves as an illustration of the myriad of interlinked policies and measures that support the circular economy in the EU.

Existing policies support different stages in the circular economy. The table on the following page provides an overview of the different stages in the circular economy (distinguishing between technical and biological materials) and sets out some generic examples of supporting EU policies at each stage.

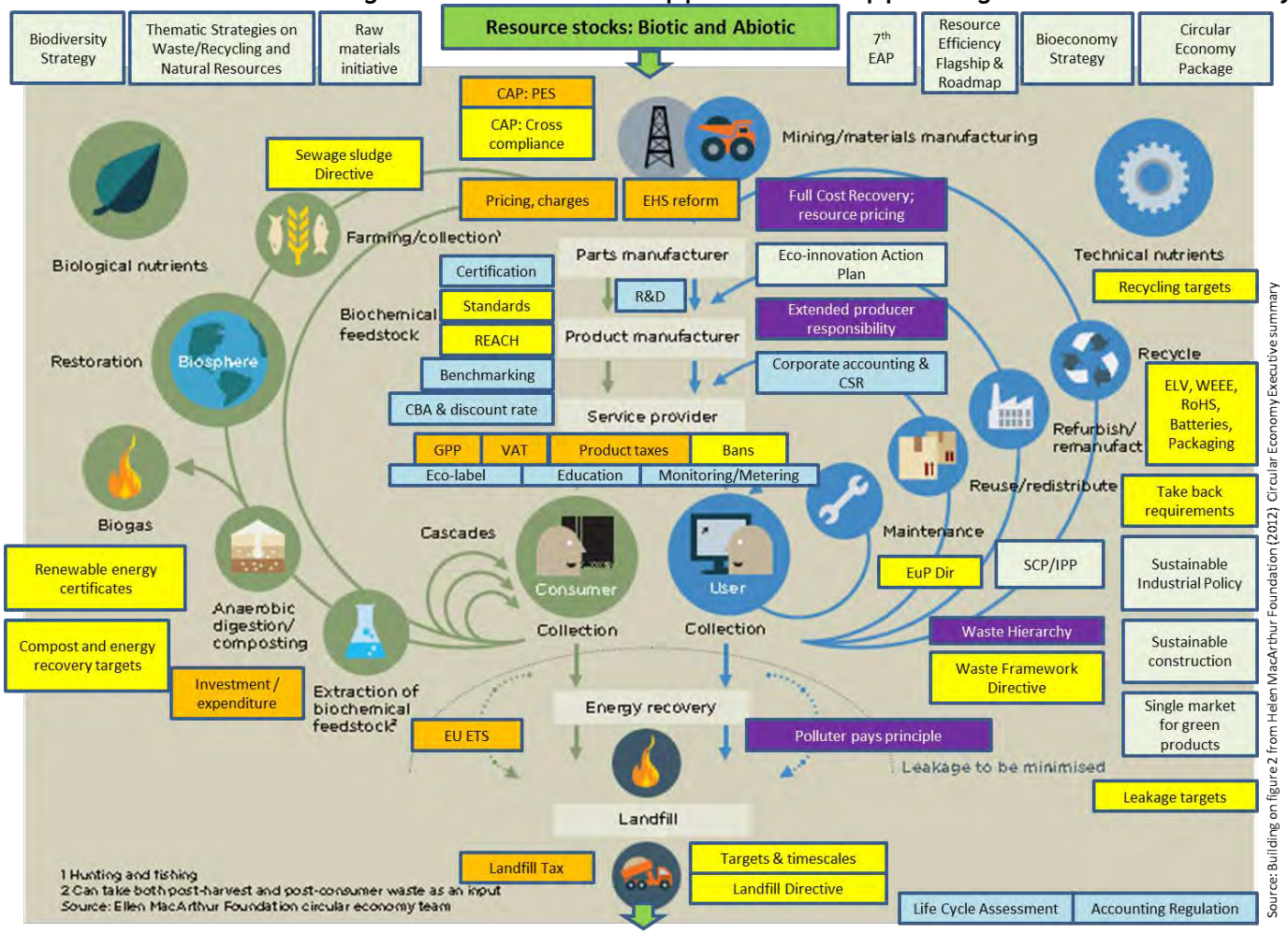
The table includes some policies that are already driving the circular economy and those that have potential to support the circular economy, but have not yet reached their capacity for various reasons (e.g. inadequate implementation and/or limited scope.

This overview illustrates that current efforts are focused on certain stages of the circular economy, notably manufacturing, collection and recycling (technical materials) and cultivation/collection (biological materials), with varying coverage, implementation and effectiveness across different measures (e.g. collection rates, infrastructure etc.).

Policies to date have focused primarily on recycling, while various 'inner circles' or loops such as reuse, repair, refurbishment, remanufacturing and upgrading have received limited policy attention. The private sector, civil society and citizens have initiated some efforts in these inner circles or loops – see Box 2.

These 'inner circles' have significant untapped opportunities, and could be supported through targeted action to ensure they are not neglected or overlooked (Expert input, April 2014). However these 'inner circles' are also more difficult for policy-makers to address and would require new approaches that involve more collaborative support and engagement of actors within and across value chains.

Illustrative overview of existing instruments and approaches supporting a circular economy in the EU



Source: IEEP, building on Figure 2 from Ellen MacArthur Foundation (2012)
Key: Regulation- yellow; Market based instruments – orange; Information tools – blue; Principles – purple; Strategies - light green

Stage	Some examples of supporting EU policies
Technical materials	
Extraction	Environmental Impact Assessment Directive (2001/42/EC); Mining Waste Directive (2006/21/EC); Raw Materials Initiative (COM(2008)699); Water Framework Directive (2000/60/EC)
Manufacturing	Construction Products Regulation (305/2011); Take-back requirements; Eco-design Directive (2009/125/EC); Waste electrical and electronic equipment Directive (WEEE) (2012/19/EU); Restriction of Hazardous Substances in Electrical and Electronic equipment Directive (RoHS) (2011/65/EU); Batteries Directive (2006/66/EC and 2013/56/EU); End-of-Life Vehicles Directive (ELV) (2000/53/EC); Type-approval of motor vehicles Directive (2005/64/EC); Packaging and Packaging Waste Directive (2004/12/EC); Directive on Industrial Emissions (2010/75/EU); Water Framework Directive (2000/60/EC); VOC Solvents Emissions Directive (1999/13/EC); REACH Regulation (1907/2006); Illegal Timber Regulation (995/2010); Ecolabel Regulation (No 66/2010); Energy labelling Directive (2010/30/EU), Product environmental footprinting (PEF).
Collection	Waste Framework Directive (2008/98/EC) requirements for setting up separate collection schemes for certain recyclables; Packaging and Packaging Waste Directive (2004/12/EC); Waste Electrical and Electronic Equipment Directive (2002/96/EC); Batteries Directive (2006/66/EC); Waste Shipment Regulation (EC/1013/2006). Investment in waste collection infrastructures supported by the EU Structural and Cohesion Funds.
Maintenance / Repair	Directive on the sale of consumer goods and associated guarantees (1999/44/EC)
Consumption	Funding awareness raising campaigns; voluntary commitments; product environmental footprinting (PEF), Eco-design Directive (2009/125/EC), Ecolabel Regulation (No 66/2010); Energy labelling Directive (2010/30/EU); PAYT systems for municipal waste; mandatory take-back requirements; Green Public Procurement Practices.
Reuse	Funding for R&D and innovation, investment in collection infrastructure, awareness raising campaigns, industrial symbiosis; Waste Framework Directive (2008/98/EC); Urban waste water treatment Directive (91/271/EEC); ELV Directive (2000/53/EC) targets on reuse; Packaging and Packaging Waste Directive (2004/12/EC) provisions on reuse and reusability; WEEE Directive (2012/19/EU) targets and provisions on reuse.
Refurbish / Remanufacture	Funding for R&D and innovation, investment in collection infrastructure, awareness raising campaigns
Recycle	Waste Framework Directive (2008/98/EC); End-of-Life vehicle Directive (2000/53/EC); Packaging and Packaging Waste Directive (2004/12/EC); WEEE Directive (2012/19/EU); Batteries Directive (2006/66/EC and 2013/56/EU); Funding for R&D, innovation and infrastructure; PAYT systems for municipal waste
Biological materials	
Cultivation / collection	Fertiliser Regulation (2003/2003); Pesticides legislation (including Directive 2009/128/EC); Raw Materials Initiative (COM(2008)699); Nitrates Directive (91/676/EEC); Sewage Sludge Directive (86/278/EEC); proposed Soil Directive; CAP; CFP; product quality and marketing standards Regulation (1221/2008); Renewable Energy Directive (RED) (2009/28/EC); Biomass Action Plan (COM(2005)628); Forest Action Plan (COM(2006)302); Water Framework Directive (2000/60/EC)
Extraction/ harvesting of biological resources	CAP; Landfill Directive; Eco-labels; Packaging and packaging waste Directive; RED (2009/28/EC); proposal on Indirect Land Use Change (ILUC)
Storage/ processing/ transport	Packaging and Packaging Waste Directive (2004/12/EC); Extended Producer Responsibility schemes; Investment in infrastructure, R&D, innovative business practices, clustering for industrial symbiosis
Consumption	Funding awareness raising campaigns; voluntary commitments; product environmental footprinting (PEF), Ecolabel Regulation (No 66/2010); Energy labelling Directive (2010/30/EU);; PAYT systems for municipal waste; mandatory take-back requirements; Green Public Procurement Practices
Anaerobic digestion (AD)	Renewables obligations, incentives and feed-in tariffs; investment in R&D and infrastructure; Animal by-products Regulations; CAP; Renewable Energy Directive (RED)
Composting	Waste Framework Directive; standards for compost and digestate; proposed Soil Framework Directive; Landfill Directive; REACH Regulation; Classification, Labelling and Packaging Regulation; Communication on future steps in biowaste management in EU (COM(2010)235)

Box 2: Some examples of private sector and civil society initiatives supporting a circular economy

Leasing tyre scheme by Michelin: In the 1920s, Michelin pioneered leasing tyres under a pay-per-kilometre programme. As of 2011, Michelin Fleet Solutions had 290,000 vehicles under contract in 23 countries, offering tyre management (upgrades, maintenance, and replacement) to optimise the performance of large truck fleets. Currently in Europe, 50% of large truck fleets externalise their tyre management. By maintaining control over tyres throughout their usage period, Michelin is also able to collect them at the end of the leases and extend their technical life (e.g. by re-treading) and ensure a proper reintegration into the material cascade at their end-of-life (Ellen MacArthur Foundation 2013, p. 28; Stahel 2010, pp.122-123).

A food-business incubator in Chicago: The plant is an energy efficient, local-centric food business incubator which features a brewery, a commercial kitchen, an anaerobic digester, and research/education space. The waste produced by the micro-brewery are used to grow mushrooms, turned into compost for farming, or turned into briquettes and burned in the masonry oven used by bakeries in the building. Spent grains from the brewery are also fed to tilapia fish, while solids from the tilapia waste are fed to the mushrooms. The waste from one part of the farm thus serves as raw material for another part in order to create a net-zero energy system (Madden, 2013).

Recyclable cargo ships by Maersk: In 2013, Maersk Line together with the Korean shipyard DSME introduced the Triple-E class cargo ship which is engineered with the intent to be almost completely recyclable. The ship features a "Cradle-to-Cradle" passport which documents almost 95% of materials used during the construction of the vessel (MAERSK Line 2012; pp. 8-9).

'Power-by the-hour' contracts for Rolls-Royce: In 1962, Rolls-Royce introduced 'power-by-the-hour' contracts under which engine operators are charged accordingly to flying hours while the manufacturer operates maintenance of single engines (Bagnall, Shaw and Mason-Flucke, 1999).

Remanufacturing at Caterpillar: A remanufacturing division was set up in 1972. The company now has a remanufacturing portfolio of hundreds of parts which handled more than 70,000 tonnes of remanufactured products in 2010 (an increase from 45,000 tonnes in 2005) (Ellen MacArthur Foundation 2012; p. 28).

Reuse at Desso: The Dutch carpet manufacturer Desso was one of the first companies to actively implement a circular economy model and a "reverse supply chain". A polyolefin introduced in the manufacturing process enables carpets to be reused several times. All toxic chemicals within its carpets have been eliminated. Desso managed to increase its market share (from 15% in 2007 to 23%) and at the same time increase its profit margin per carpet from 1% to 7% (Ellen MacArthur Foundation 2012; p. 28).

WorldLoop is an international non-profit organisation which provides high-quality used computers donated by companies, after making them ready for use, to education, medical and social projects in developing countries. This is combined with collection and recycling systems that reduce the negative impact of electronic waste in developing countries (WorldLoop, 2014).

Sources:

Bagnall, S.M., Shaw, D.L., Mason-Flucke J.C. (1999), "Implications of 'Power by the Hour' on Turbine Bladed Lifing", paper presented at the RTO AVT Specialists' Meeting on "Design for Low Cost Operation and Support", pp. 1-12, URL: http://ftp.rta.nato.int/public/PubFulltext/RTO/MP/RTO-MP-037/MP-037-12.pdf [03/06/2014]

Ellen MacArthur Foundation (2013), 'Case Studies: Caterpillar', URL: http://www.ellenmacarthurfoundation.org/case_studies/caterpillar [03/06/2014]

Ellen Macarthur Foundation (2012), 'Towards the Circular Economy: Economica and Business rationale for an accelerated transition Vol. 1', URL: http://www.ellenmacarthurfoundation.org/business/reports/ce2012 [03/06/2014]

MAERSK Line (2012) 'Sustainability Progress Update 2012 - Route 2', URL: http://www.maerskline.com/~/media/maersk-line/Countries/int/Images/Sustainability/Sustainability%20overview/maersk-sustainability-progress-update-2012.pdf [03/06/2014]

Stahel, W.R. (2010), 'The Performance Economy (Second Edition)', Palgrave Macmillan, UK.

Madden, N. (2013) 'Waste to Energy'. URL http://www.producemag.com/pg1013-biogas-anaerobic-digestion-benefits.aspx [03-06-2014]

WorldLoop (2014) URL: http://worldloop.org/ [03-06-2014]

2.6 Current policies that (may) act as Barriers to the Circular Economy

The analysis undertaken for the study and input from discussions at the experts' workshop of the EU Scoping study has also identified some EU policies which can act as barriers to the transition to a circular economy. Some examples of such barriers and their implications for the circular economy are briefly set out below. This is an initial identification of barriers which merit further, detailed assessment to determine the precise nature of the barrier posed and relevant action to overcome this.

Definitions in EU waste legislation currently leave room for some uncertainty over when materials should be classified as waste, a product/secondary material (often based on specific end-of-waste criteria) or a by-product. There is at least anecdotal evidence that this lack of clarity can cause difficulties with regard to the reuse of certain materials, hampering their re-injection into the value chain/production cycle (Expert input, 2014).

This may, for example, take the form of legal restrictions e.g. export restrictions, or the classification of usable secondary raw materials as waste, resulting in reduced market value. In addition, although there is a definition of recycling provided in the Waste Framework Directive, there can still sometimes be a lack of transparency on recycling processes used or the recycled content present in products. This could perhaps be addressed through enhanced provisions in eco-design criteria to improve the visibility of recycled content in products, or to encourage the use of recycled and/or recyclable materials.

Definitions in EU waste legislation could also be revised, or further guidance provided, to increase clarity and coherence across different pieces of legislation, e.g. to further clarify when materials should be classified as waste, a product/secondary material or a by-product; what constitutes recycling and recycled content.

There is also, to some extent, a lack of clarity in the application of the waste hierarchy to specific types of waste, despite the Waste Framework Directive's call for Member States to 'support the use of recyclates [...] in line with the waste hierarchy [and] not support the landfilling or incineration of such recyclates whenever possible'. The lack of methodical application of the waste hierarchy can result in some waste materials being used in a way that is sub-optimal in terms of environmental impacts/benefits.
On this point, further research into the 'cascading use' *[1] of certain types of waste may be beneficial as well as improved understanding of when wastes are truly waste with no other competing uses, e.g. using straw for the bio-economy removes it from fields where it acts as a soil improved.

The Renewable Energy Directive (RED) (2009/28/EC) contains targets to deliver 20% of the overall share of energy from renewable sources by 2020 and within this 10% of energy from renewable sources in transport. The Fuel Quality Directive (30/2009/EC) also requires a 6% reduction in the greenhouse gas intensity of fuels by 2020.

Most Member States have primarily sought to meet their volume based targets through biofuels as opposed to other options (e.g. energy efficiency, electrification, hydrogen etc.), opting for conventional biofuels (from food and feed crops) rather than more advanced conversion techniques that utilise wastes and biomass which, depending on the feedstock have already been through a cascade *[2].

While the drive towards renewable energy is critical for a low carbon Europe, current policies combined with market readiness and lower costs associated with the use of biomass for energy have in some cases been incentivising the use of biological resources (including forest products and agricultural crops) as biofuels and solid biomass for heat and electricity, over their 'cascading use' (Keegan, Kretschmer et al. 2013).

To adopt the 'cascading use' concept to deliver a more efficient management of biological resources requires a common or at least coordinated policy approach to ensure decisions on use and prioritisation of use are based on the collective whole and the added value delivered to society.

This would require a more comprehensive approach to biomass and biowaste (e.g. through a framework directive on biomass or biological resources or a roadmap) which ensures coherence with other policies and goes beyond the current focus on energy to explore other opportunities for cascading use (IEEP 2014c, forthcoming). This could be complemented by a revision to the RED which requires Member States to consider the most effective use of resources to generate energy when drafting their National Renewable Energy Action Plans.

* i.e. that activities are prioritised based on the level of added value they provide to society and the ability to 'reuse' the biomass after the original use (e.g. combined digestion, composting) (Keegan, Kretchmer et al. 2013)
** Some biological resources have already been down the cascade and are used for energy (municipal waste incineration, AD from manure etc.), whereas others have

The VAT Directive (2006/112/EC) provides an EU-wide common system of VAT on goods and services bought and sold for consumption within the EU. Reduced rates of VAT may be applied to supplies of certain goods and services which include for example foodstuffs or drinking water. In some cases, the application of reduced VAT rates can be seen as going against circularity and resource efficiency related objectives, e.g. by encouraging greater levels of food and water consumption (Withana et al., 2012).

This is for example recognised in a 2012 consultation paper by the European Commission which questions whether a reduced VAT rate on water is compatible with resource efficiency objectives and whether social objectives could be better achieved by other means (European Commission 2012).

In some cases the application of reduced VAT rates can support the circular economy – for example, 13 Member States interpret previsions under the Directive which allow VAT rates to be fairly low, or close to zero, for donated food close to its 'best before/use by' date, Belgium applies reduced VAT rates on reused clothes etc.

Given preferences for a single VAT rate with as little exceptions as possible and concerns about the actual benefits of reduced VAT rates, the scope for action in this area may be limited. However one option could be to review the scope of reduced rates allowed under the VAT Directive and develop further clarification and guidance on what is and is not allowed within the scope of the Directive.

Lack of knowledge on relevant EU Food Hygiene Legislation (including Regulation (EC)852/2004 and Directive 2004/41/EC) and concerns about the unclear legal liability that might arise from food donations (EC, 2013c) may discourage the donation of surplus food to food banks. EU Food Donation Guidelines for food donors and food banks on how to comply with EU Food Hygiene legislation (types of food suitable for donation, conditions for transport and traceability, legal liability, etc.) could improve this situation, as for example is already provided in German legislation *[1] (European Commission, 2013b).

* Bundesministerium fu□r Ernährung und Landwirtschaft (2012), 'Leitfaden fu□r die Weitergabe von Lebensmitteln an soziale Einrichtungen – Rechtliche Aspekte', URL: http://www.bmelv.de/SharedDocs/Downloads/Broschueren/LeifadenWeitergabeLMSozEinrichtungen.pdf?__blob=publicationFile [07/07/14]

The Good Samaritan Law is a legal framework originally adopted in the US that limits the liability exposure of food companies for products donated to charities. Italy is the only European country to date to have passed similar legislation ('Legge del Buon Samaritano', 155/2003) in 2003. The Law only covers companies that make good-faith donations of products they know to be fit for consumption at the time of the donation.

For example, the Law allowed Italian food banks to recover surplus meals from mass catering and surplus food from retailers. Such approaches are, however, controversial and there have been warnings of potential perverse consequences, e.g. providing a disincentive to reduce food waste, could be considered a 'solution looking for a problem' (House of Lords, 2014).

EU Animal By-products Regulation (EC 142/2011) prohibits the feeding of animals with catering waste that contains or has been in contact with animal by-products. As most food waste at the retail stage is mixed, it is difficult to separate out food that has come into

contact with animal by-products and food that has not. However, it has been said that restrictions could be removed, as long as robust systems are in place for the safe and centralised collection and processing of such waste in order to protect animal and human health.

For example, a UK organisation The Pig Idea *[1] is advocating reform of the EU Regulation on animal by-products to allow food waste, including catering waste, to be diverted for use as pig and chicken feed; introduce a robust legal framework to ensure that it is processed safely and that outbreaks of animal diseases are prevented.

Some countries, such as Japan and South Korea, operate such a robust system, however, opponents argue that concerns over exotic animal diseases are currently too sensitive to relax existing measures. The discussion would benefit from a review of the applicable legislation (House of Lords, 2014).

Legislation on the provision of information to consumers on labelling, presentation and advertising of foodstuffs (Regulation 1169/2011) requires use-by and best-before dates and instructions on special conditions of storage and use of packaging. Best before dates provide a stock management and food quality function within the food supply chain.

* The Pig Idea (2014). URL: thepigidea.org/the-solution.html [14/07/14]

Consumer confusion regarding durability of food based on information provided in these labels, and particularly best before dates, is considered an important cause of food waste (European Parliament, 2011). Targeted information campaigns could help increase consumers understanding of these labels. While food producers are cautious in determining minimum durability dates, the European Commission could explore possibilities to extend the list of foods that do not require best-before dates (e.g. those which currently only have them for quality rather than safety reasons). Promoting an alternative stock management practice within the food supply chain could support this action.

Directive on the sale of consumer goods and associated guarantees (1999/44/EC) sets out a framework for the sale of consumer goods in the EU which seeks to guarantee a uniform minimum level of consumer protection, in particular, with regard to the event of goods not conforming to contract. The Directive requires that the total duration of the limitation period provided for by national law not be shorter than two years while consumers should have at least two months in which to inform the seller that a lack of conformity exists.

This sets certain minimum time frames that could serve as default periods and/or limit consideration of longer periods. Alternatively it could form a basis to move to extended guarantees and warrantees, differentiated by the technical lifetime of the product. There is also a

lack of awareness of the minimum two-year guarantees as well as on the rights of consumers to take back products and sellers to take back products that could be addressed through better information and awareness raising activities.

In addition there are a number of other EU policies which may act as barriers to the transition to a circular economy for example, consumer protection legislation (e.g. misleading green claims could undermine efforts to inform consumers on more circular consumption practices), legislation on product safety (e.g. which require specific standards and rules on the safety of products sold in the single market could affect approaches to the more circular design of certain products), transport safety and logistics (e.g. which set specific criteria for the transport of certain products and/or components such as car batteries could have cost, infrastructure or administrative implications for reuse/remanufacture/refurbishment/recycling). These areas together with those briefly outlined above merit further, detailed assessment to determine the precise nature of the barrier posed and relevant action to overcome this.

The role of international trade in the circular economy is a contentious issue. On the one hand, international trade can be seen as a driver to a circular economy as certain elements in the chain of circularity (e.g. refurbishment, remanufacturing and reuse) could take place outside a particular country or the EU, where practical and appropriate, respecting relevant standards in processing and recycling and supported by due investments in these countries which can also contribute to broader goals of sustainable development.

On the other hand, international trade can be seen as a barrier to further circularity, for example where trade leads to increased export of cars and other products such as electronic waste which may lead to a loss of important materials (i.e. catalytic converters) and reduced efficiency in extraction processes where these take place in countries with less stringent requirements and may le ad or contribute to problems of overcapacity in the EU, e.g. in the recycling sector (EU Scoping study Expert input, 2014).

In some cases, international value and supply chains can also complicate efforts to increase transparency and labeling (for example given difficulties in certifying sustainability of processes in third world countries). Some observers suggest that the 'proximity principle' could be applied to encourage 'inner circles' of repair, upgrade, remanufacture etc., at the local level (Expert input, 2014). This is, however, a complicated issue and needs further assessment (which goes beyond the scope of this study).

3 The EU Perspective: scoping & policy options for identified EU priority area's

(summary EU Scoping Study to identify potential circular economy actions, priority sectors, material flows & value chains, 2014 for DG Environment)

3.1 Scoping the extent to which additional action is needed for identified EU priority area's

Building on an understanding of the different stages of the circular economy and the types of policy instruments which can be used to support them or act as barriers to them, the study has sought to scope the extent to which current policies already support the circular economy and the extent to which additional action is needed in the identified priority areas (see section 3). A synthesis of this scoping exercise is set out in Table below which maps the priorities identified by the study team, their coverage by existing EU policies and opportunities for the further development of policies in these areas.

On the following pages you'll find tables: Mapping coverage by existing EU policies and scope for further measures in identified priority areas (EU Scoping study to identify potential circular economy actions, priority sectors, material flows & value chains)

Identified priority areas	Coverage by existing policies, instruments & approaches	Potential policies, instruments and approaches
Sectors		
Transport – personal motor vehicles, trucks and motorcycles	- ELV Directive target to reuse and recover vehicles and components - Environmental Liability Directive (2004/35/EC) - Eurovignette Directive (2011/76/EU) - Directive on industrial emissions (2010/75/EU) - VOC Solvents Emissions Directive (1999/13/EC) - Renewable Energy Directive (RED) (2009/28/EC) and current proposal for revision - Fuel Quality Directive (30/2009/EC) and current proposal for revision	- **Improve product design requirements**: e.g. eco-design criteria, use recycled/recyclable materials, stricter CO_2 emission requirements - **Extended producer responsibility**: e.g. take-back requirements (e.g. on vehicles and/or specific components such as batteries), improve coverage of schemes; extended warrantees, expand scope of ELV to additional types of vehicles - **Fiscal incentives**: e.g. revise vehicle registration and annual circulation taxes (e.g. link to CO_2, pollution standards; recyclability); increase fuel taxes, bonus-malus schemes - **Improve implementation**: e.g. ELV Directive and WEEE Directive targets to reuse and recover - **Investment**: e.g. R&D and innovation, infrastructure in alternative transport modes, skills - **Information**: e.g. product passports detailing embodied emissions, impacts etc., encourage car sharing through development of online platforms etc., increase public awareness, design awards
Transport - industrial motor vehicles, ships, trains and airplanes	- Environmental Liability Directive (2004/35/EC) - Ship Recycling Regulation (1257/2013) - Green public procurement (GPP) - Directive on industrial emissions (2010/75/EU) - VOC Solvents Emissions Directive (1999/13/EC) - Renewable Energy Directive (RED) (2009/28/EC) and current proposal for revision - Fuel Quality Directive (30/2009/EC) and current proposal for revision	- **Improve design requirements:** e.g. extend eco-design criteria, use recycled/recyclable materials, CO_2 emission requirements - **Extend producer responsibility:** e.g. expand scope of ELV to other transport modes, e.g. 'End-of-Life Trains, Planes and Ships' Directive(s), extended warrantees, take-back requirements - **Improve implementation:** e.g. EU Ship Recycling Regulation - **Targets/bans:** e.g. recycling targets, landfill bans - **Fiscal incentives**: e.g. increase fuel taxes, reduce kerosene exemptions - **GPP:** e.g. criteria for materials, environmental performance, recyclability, warrantee lengths - **Investment**: e.g. R&D and innovation, infrastructure, skills, education - **Information**: e.g. increase public awareness and design awards
Construction – buildings and public infrastructure	- Construction Products Regulation (305/2011) standards for materials in construction - Waste Framework Directive (2008/98/EC) target for 70% of non-hazardous construction & demolition waste to be recycled by 2020 - Extraction charges in some MS - Mining Waste Directive requirement for environmentally sound treatment of extractive	- **Regulation:** e.g. design to integrate recycling requirements in construction products regulation, integrate disassembly / recycling requirements in building legislation, extended warrantees - **Targets/bans:** e.g. landfill ban on certain construction materials: e.g. clay, timber - **Fiscal incentives**: e.g. materials taxes/charges on aggregates or construction materials, increased landfill charges on demolition waste, refundable compliance bonds for contractors if certain criteria met - **Information:** e.g. labelling on the environmental performance of buildings, material use, recyclability and recycled content in construction materials, etc.,

Identified priority areas	Coverage by existing policies, instruments & approaches	Potential policies, instruments and approaches
	wastes, including minimising disposal, prioritising recovery and recycling. - Energy performance of buildings Directive (2010/31/EU) - Communication on Resource Efficiency Opportunities in the Building Sector (COM(2014)445)	- **Improve implementation**: e.g. Waste Framework Directive, Mining Waste Directive - **GPP:** e.g. as in Netherlands and Japan where public authorities are encouraged to use recycled materials in construction practices - **Investment**: e.g. R&D and innovation, infrastructure, skills of construction workers and architects
Products		
Home appliances	- Eco-design Directive (2009/125/EC) and implementing measures (Regulations by product group) - Waste electrical and electronic equipment Directive (WEEE) (2012/19/EU) - Restriction of Hazardous Substances Directive substances in electrical and electronic equipment (RoHS) (2011/65/EU) - Directive on industrial emissions (2010/75/EU) - VOC Solvents Emissions Directive (1999/13/EC) - Waste Framework Directive (2008/98/EC) - Directive on sale of consumer goods and associated guarantees (1999/44/EC)	- **Improve product design requirements:** e.g. revise eco-design Directive to integrate reparability requirements, use of recycled/recyclable materials, information on expected lifetime etc. - **Extend producer responsibility:** e.g. improve coverage of schemes/access of consumers/businesses, extend warranty periods for certain products - **Information:** e.g. awareness raising campaigns on how/where to recycle - **Targets/bans:** e.g. tougher targets in WEEE Directive, landfill ban - **Fiscal incentives:** e.g. primary materials taxes/product taxes [MS action], incentives for leased goods/goods with extended manufacturer guarantees, higher recyclability and other key environmental performance – e.g. vouchers, tax credits, reduced VAT rates - **Investment:** e.g. innovation, improved collection/recycling infrastructure, skills and education -
Smart phones and mobile phones	- Waste Electrical and Electronic Equipment Directive (2012/19/EU) target for collecting electronic waste - Restriction of Hazardous Substances Directive substances in electrical and electronic equipment (RoHS) (2011/65/EU - Directive on industrial emissions (2010/75/EU) - VOC Solvents Emissions Directive (1999/13/EC)	- **Improve product design requirements**: e.g. revise eco-design Directive to include use of recycled/recyclable materials, require provision of instructions for repair, increase availability of spare parts, information on expected lifetime, etc. - **R&D funding for innovation:** e.g. to allow modulation of components, to provide tools that safely delete personal data from devices such as smartphones, etc. - **Extend producer responsibility**: e.g. take-back requirements, improve coverage, extend warrantees - **Standardisation of certain elements:** e.g. screws, bolts, batteries and connectors

Identified priority areas	Coverage by existing policies, instruments & approaches	Potential policies, instruments and approaches
	- Waste Framework Directive (2008/98/EC);	- **Information:** e.g. awareness raising campaigns on how/where to recycle, design awards and software to delete sensitive information from devices such as smartphones. - **Targets/bans**: e.g. strengthen targets in WEEE Directive, landfill ban - **Fiscal incentives:** e.g. primary materials taxes/product taxes on use of rare earth materials, incentives for leased goods/goods with extended manufacturer guarantees, higher recyclability etc. e.g. with vouchers, tax credits, reduced VAT - **Investment**: e.g. innovation, centralised collection points, skills, education
Furniture	- Directive on Industrial Emissions (2010/75/EU) - VOC Solvents Emissions Directive (1999/13/EC) - Waste Framework Directive (2008/98/EC);	- **Improve product design requirements:** e.g. eco-design criteria, use recycled/recyclable materials and or reduction in use of flame retardants, modularity - **Extend producer responsibility:** e.g. establish take-back schemes for furniture, building on existing experiences e.g. in France - **Investment:** e.g. in improved collection/recycling infrastructure, skills and education - **Information:** e.g. eco-label for furniture - **Targets/bans:** e.g. landfill ban for waste wood, ban/restrict use of certain hazardous chemicals - **Fiscal incentives:** e.g. taxes/charges on material extraction, incentives for leased goods/goods with extended manufacturer guarantees, higher recyclability etc.
Material flows		
Plastics	- Packaging and Packaging Waste Directive (PPWD) set target of 25.5% recycling of plastic packaging by weight by 2008.[11] - Waste Framework Directive includes plastic in target to recycle 50% of household waste by 2020.[12]	- **Improve product design requirements**: e.g. revise eco-design directive, strengthen requirements in PPWD - **Extend producer responsibility**: e.g. extend coverage & scope, coordinate schemes for packaging with other product/waste streams - revise Waste Framework Directive / new Directives to address specific waste streams / amend existing producer responsibility Directives. - **Targets and bans**: e.g. tougher targets in PPWD for recycling plastic packaging, ban plastics in

11 NB The recent proposal to amend existing EU waste legislation (COM(2014)397) would introduce a 45% recycling target for plastic packaging for 2020 and a 60% target for 2025.
12 NB The recent proposal to amend existing EU waste legislation (COM(2014)397) would amend this to be a 50% by weight recycling and preparation for re-use target for all municipal waste, and introduce a new target for 1 January 2030 of 70% by weight recycling and preparation for re-use.

Identified priority areas	Coverage by existing policies, instruments & approaches	Potential policies, instruments and approaches
	- Proposal to revise the PPWD to reduce the consumption of lightweight plastic carrier bags (COM(2013)761), and proposal to ban landfilling of recyclable plastics by 2025 (COM(2014)397) - Some MS have introduced charges on plastic bags while others have introduced bans. -	landfill - **Fiscal instruments**: e.g. expand use of charges/bans on plastic bags, deposit refund schemes - **Increase investment in infrastructure**: e.g. centralised collection points, home/office pick-up - **Improve implementation:** e.g. of waste hierarchy, PPWD, Waste Framework Directive - **Investment in R&D and innovation:** e.g. multiple re-use bags, enhance plastics recyclability, biodegradable and/or compostable plastics.
Metals and steel	- ELV Directive for car components, - European Innovation Partnership on Raw Materials (RARE) - Packaging and Packaging Waste Directive target for 50% of metal packaging by weight to be recycled by 2008.[13] - Waste Framework Directive includes metallic waste in target to recycle 50% of household waste by 2020.[14] - Environmental Liability Directive	- **Improve implementation:** Strengthen Shipment of Waste Regulation (1013/2006/EC), ELV Directive - **Targets and bans**: e.g. tougher targets in PPWD for recycling metal packaging, tougher targets in Waste Framework Directive for recycling household metallic waste - **Improve product design requirements** Extend scope of Eco-design Directive (2009/125/EC) - **Extend producer responsibility**: e.g. extend coverage & scope, take-back requirements - **Increase investment in infrastructure**: e.g. centralised collection points, home/office pick-up - **Investment in R&D and innovation**: e.g. development of new technologies for substitution of critical raw materials
Phosphorus	- Fertiliser Regulation Raw Materials Initiative (COM (2011)25) and (COM(2014)297) - European Innovation Partnership on Raw Materials (RARE) - Nitrates Directive (91/676/EEC)	- **Fiscal incentives:** e.g. levy on primary phosphate consumption (or primary phosphorus extraction), tax on phosphorus in mineral fertilizers (e.g. DK) - **Regulation and targets:** e.g. Phosphorus recycling target (e.g. SE), mandatory phosphorus recovery from sewage sludge (e.g. DK), revise existing legislation (fertiliser Regulation, water) - **Subsidies:** e.g. subsidy for optimisation of sewage sludge treatment (e.g. in FR)

13 NB The recent proposal to amend existing EU waste legislation (COM(2014)397) would introduce a 70% recycling target for metal packaging by 2020, an 80% target for 2025 and a 90% target for 2030.

14 NB The recent proposal to amend EU waste legislation (COM(2014)397) would amend this to be a 50% by weight recycling and preparation for re-use target for all municipal waste, and introduce a new target for 1 January 2030 of 70% by weight recycling and preparation for re-use.

Identified priority areas	Coverage by existing policies, instruments & approaches	Potential policies, instruments and approaches
	- Water Framework Directive - Targets for phosphorus recovery - Phosphate levies in some MS - Organic production regulation - Regulation (EU) No 259/2012 amending Regulation (EC) No 648/2004 as regards the use of phosphates and other phosphorus compounds in consumer laundry detergents and consumer automatic dishwasher detergents - Communication on the sustainable use of phosphorus COM(2013) 517	- **Revise product standards:** e.g. to reduce/fix maximum amount of phosphorus per kg/tonne of a certain product. (e.g. soaps, fertilizers) - **Investment in innovation:** e.g. use of more efficient technologies to reduce waste during extraction, increase phosphorus recovery from sewage sludge at farm level (e.g. using 'manure injection' technologies)
Food and food waste	- Landfill Directive - Food waste target in Resource Efficiency Roadmap - Voluntary commitments in some MS (e.g. existing/forthcoming bans on landfilling of biowaste) - Awareness raising campaigns in some MS - Renewable Energy Directive (RED) - Forthcoming communication on sustainable food, and a new target in proposal to amend EU waste legislation (COM(2014)397) to reduce food waste by 30% between 2017 and 2025	- **Regulation, targets and bans**: e.g. ban landfill of bio-waste, mandate separate collection of bio-waste, target, revise legislation on labelling, presentation and advertising of foodstuffs (**use-by and best-before dates**), standards for compost and digestate, clear definitions of wastes & residues eligible for support under RED, clarify status of by-products, encourage donations by addressing liability issues e.g. Good Samaritan laws - **Better implementation:** e.g. of waste hierarchy - **Fiscal incentives:** e.g. tax/pay-as-you-throw charges on biowaste disposal, tax breaks to encourage donations of edible unsold food. - **Encourage food waste as fodder policy:** e.g. lift ban on feeding (heated) catering waste to animals - **Voluntary commitments and supply chain cooperation:** e.g. between retail sector & government (e.g. UK), between retail chains and suppliers (e.g. NL). - **Labelling**: e.g. on product footprints (embedded carbon, water), sustainability (e.g. for social and environmental criteria) to encourage more conscious purchases - **Awareness raising campaigns**: e.g. public (on food storage, low meat diets etc.), retailers - **Investment:** e.g. technology upgrades, post-harvest technologies, skills of food chain personnel, infrastructure such as centralised collection points, clustering activities.

3.2 Policy options to support a circular economy in the EU

The aim of this study is to provide a first scoping assessment of potential options for consideration across a range of areas rather than focus on sector or product specific policy recommendations that only address a fraction of the challenge. The proposed policy options build on the assessment undertaken in the study and related work such as the recommendations of the European Resource Efficiency Platform (EREP, 2014) – see Box 3.

Box 3: Policy recommendations of the European Resource Efficiency Platform (EREP)

At the end of March 2014, the European Resource Efficiency Platform (EREP) adopted a set of policy recommendations entitled 'Towards a resource efficient and circular economy' which are summarised below:

1. ***Promoting new, resource efficient business models*** for resource efficient production and end-of-life management, and support service-based business models, e.g. through sector-specific good practice, adapted accounting frameworks, information and incentives. Public authorities should take environmental criteria into account and move to performance-based public procurement contracts.
2. ***Boosting Extended Producer Responsibility*** for producers to improve waste management beyond end-of-life of products, promote better product design, remanufacturing and recycling. Schemes need to become more transparent, operate according to certain minimum principles, better monitoring and enforcement, improved data collection and reporting.
3. ***Enabling consumers to make more sustainable choices*** through fiscal, financial and pricing policies, marketing campaigns, education, counselling and labelling, and actions such as take-back schemes. There is a need for product standards on resource use and reparability, EU principles and methods for measuring environmental impacts, extended warranty periods for some products, and policies, surveillance and enforcement to remove the most unsustainable products from the market.
4. ***Developing employment and skills*** through an EU strategy for greening jobs, skills and education which *inter alia* mobilises EU funding, supports exchange of good practice, promotes awareness raising, and ensures follow-up in the European Semester.
5. ***Financing to enable the transition*** including green investment and resource-efficiency R&D, greater company reporting on resource use, a review of accounting rules and investors' responsibilities, and the potential of the bonds market further explored.
6. ***Speeding up the development and use of indicators*** that show progress towards a resource-efficient economy, distinguishing between efficient and sustainable use of materials.

Source: EREP (2014) European Resource Efficiency Platform, Towards a resource efficient and circular economy, 31 March 2014, http://ec.europa.eu/environment/resource_efficiency/documents/erep_manifesto_and_policy_recommendations_31-03-2014.pdf [accessed 30/5/2014]

The options developed by the study team include a mix of general approaches and policies which are applicable to different areas and policies including regulation; information tools; market-based instruments; research and innovation policy including support for market

take up of developed technologies; voluntary approaches etc.

The transition to a circular economy requires a systemic approach which makes use of a wide toolkit of policies and measures, across different points of value changes and affecting the full set of private and public stakeholders. Given the multi-level governance approach needed, options can be structured across different actors (e.g. EU, Member State, regional and local authorities, private sector, civil society, citizens), levels and timeframes, keeping in mind that in some areas circular economy benefits will materialise as a result of own initiatives by the private sector, while in other areas support (including public intervention) will be needed to encourage transitions.

For ease of presentation, the study has clustered potential policy options into three broad areas or clusters:

- regulatory instruments (including better implementation);
- other instruments (fiscal instruments, voluntary agreements, information) and;
- public investment.

These areas cover a number of different types of instruments and approaches, which can be taken forward by actors at different levels and over different timescales. There are also overlaps between these areas and the clusters should not be seen as mutually exclusive but rather complementary and part of a wider policy mix that is needed to support the transition to a circular economy.

These broad areas are discussed in further detail below, bringing together insights from the analysis and input from experts at the workshop organised in the context of the EU Scoping study to identify potential circular economy actions, priority sectors, material flows & value chains.

The role of regulatory instruments and approaches in encouraging circularity

Better implementation and enforcement of existing regulation There are a number of regulatory instruments and approaches in place at EU, national, regional and local level which already support (or could support) a circular economy. Thus, an important part of the transition to a circular economy could be facilitated by better implementation and enforcement of existing policies (e.g. Waste Framework Directive, Packaging Waste Directive, ELV Directive, Ship Recycling Regulation, Waste Shipment etc.).

Implementation varies across Directives (e.g. Landfill Directive, producer responsibility under WEEE, ELV, Packaging and Packaging Waste and Batteries Directives, application of waste hierarchy etc.), not only at Member State level (e.g. southern and CEE countries where there is a need to improve implementation of basic waste legislation), but also within countries at the regional level (e.g. Catalonia versus Andalucía in Spain or Trentino-Alto Adige/Sudtirol versus Campania in Italy) (Expert input 2014). The reasons for this poor

implementation record relate inter alia to costs (of compliance, administration), administrative burdens, complexity, transposition (delays, interpretation), lack of information, data and awareness, poor enforcement checks, different cultural/political contexts, corruption, lack of political will etc. (IEEP, 2014).

Improving implementation of the environmental acquis continues to be a key strategic objective of the EU that is reiterated in the 7th Environment Action Programme (7th EAP). It requires a range of different actions at different stages of the policy cycle and across governance levels. Although the better implementation agenda is not necessarily something new, there is a need for systemic change and the involvement of different partners across the value chain to be able to better address this challenge, particularly as it relates to the circular economy transition. For example, local authorities could support better implementation by introducing supporting instruments such as bans or restrictions on certain waste streams at the local level as a way of improving recycling rates.

It should also be noted that existing legislation has been designed to meet certain objectives (e.g. encourage waste-to-energy, increase recycling), and that this is not always fully compatible with various other stages in a circular economy such as reuse, refurbishment, cascading use, up-cycling etc. Thus, there is a need for reviews of existing measures to assess whether they are 'fit for purpose' and relevant to current and future priorities. These reviews can be used as an opportunity to revise legislation in line with current policy priorities, keeping in mind technological developments, the availability of alternatives (e.g. to incineration) and wider impacts across the value chain and between sectors or areas (Expert input, 2014).
The current programme of 'fitness checks' could include reflections on how existing legislation could be improved to encourage the transition to a resource efficient, circular economy.

Revising existing regulation

In some areas there is a need for revisions to current regulation so that it can better support the circular economy. An example of a recent revision to EU non-environmental legislation which supports a circular economy was the phasing-out of minimum marketing or cosmetic standards for 26 types of fruits and vegetables (e.g. the notorious "Cucumber Regulation" EEC No 1677/88 and the "Carrot Regulation" EEC No 730/1999), which allows less aesthetically perfect vegetables to be sold, preventing the unnecessary discard of various types of produce.

There is also a need to revise legislation that acts as barriers to a circular economy (e.g. definitions in EU waste legislation, RED, etc.) Indeed, some action has already been seen at the EU level, with a proposal to amend aspects of six EU waste Directives (2008/98/EC on waste, 94/62/EC on packaging and packaging waste, 1999/31/EC on the landfill of waste, 2000/53/EC on end-of-life vehicles,

2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EU on waste electrical and electronic equipment) (COM(2014)397) included in the circular economy package published by the European Commission in July 2014.

Looking ahead, other areas where revisions to existing EU legislation could be considered include for example, extended producer responsibility (EPR) related legislation, which could for example include an expansion in the coverage and scope of existing schemes such as take back requirements (e.g. to white goods and furniture), deposit-return schemes (see Box 4) and extended warrantees for certain product categories (taking into account the technical lifetime of a product).

Another area could be in relation to packaging and packaging waste, where for example provisions in the Packaging and Packaging Waste Directive (PPWD) could be strengthened (e.g. increased targets for recycling, expanded scope as conceived in the current proposal to revise the Directive to better address issue of plastic bags). The Commission has also recently proposed 'minimum requirements' for EPR schemes, included as an annex in the proposal to amend existing EU waste legislation (COM(2014)397).

Box 4: Extended producer responsibility in Germany

German packaging waste recycling rates are among the highest in the EU-27 with 72.7% in 2010, and total recovery rates of 97% in 2011 (GVM, 2013). These rates have been achieved by regulation based schemes, adopted under the Closed Substance Cycle Act ('Kreislaufwirtschaftsgesetz' since amendment in June 2012), which use Producer Responsibility Organisations (PROs) to recover and recycle metals, glass, paper and plastics. These schemes have created incentives and the institutional framework for high rates of recycling and recovery of consumer packaging in Germany.

The success of the schemes arise from their attention to incentives for all actors involved in the material cycle; as well as the creation and support of market structures that provide cost-effective recycling and recovery. The schemes incentivise consumers to sort and collect waste, through a combination of cost savings for households and information campaigns. They also allocate full responsibility for the cost related to packaging recovery to industry and the retail sector, which has led to packaging recovery being viewed as a business activity.

While the use of extended producer responsibility (EPR), involving PROs, is widespread in the EU and is mandated under EPR related legislation; deposit return schemes for beverage containers are less common. There are key lessons to be learned from the German experience in successfully setting up PROs which could help improve implementation of similar schemes elsewhere. In particular costs can be reduced through competitive tendering in a well-developed waste-treatment market; provision of adequate collection and treatment infrastructure; explanatory information campaigns to assist consumer behavioural change; and provision of adequate price incentives (i.e. high deposit fees) to motivate action.

Sources:

Gesellschaft für Verpackungsmarktforschung (GVM) (2013). Verwertung von Verkaufsverpackungen - Private Endverbraucher. http://www.umweltbundesamt.de/daten/abfall-kreislaufwirtschaft/entsorgung-verwertung-ausgewaehlter-abfallarten/verpackungsabfaelle [accessed [10/01/2014]

See detailed case study in Annex 4 for related sources and further information on this case.

Another area where there is scope for action relates to product design including related standards and requirements where relevant product policies can be revised to encourage greater circularity from the start. This is an area where the EU's role is particularly important given links to the single market. Furthermore there is an existing base of legislation on which to build. In this regard, the forthcoming review of the EU eco-design and the energy labeling Directives (expected to be launched in November 2014) could be considered a potential window of opportunity to extend existing legislation beyond the area of energy.

The Eco-design Directive has the potential to deal with modularity, recyclability, reusability and durability if its scope is expanded beyond the current focus on energy. Revised eco-design requirements or principles for certain products which take into consideration 'end-of-life' and integrate requirements on defined recycled content could encourage more circular practices (from the start) and support greater transparency throughout the value chain.

However, this would require a robust approach including appropriate standards and technical specifications for relevant concepts such as product durability, reparability, reusability, recyclability, recycled content, product lifespan etc. One option could be to start off with reporting obligations and gradually move towards a system with minimum requirements (e.g. a minimum percentage of defined recycling content of products according to the sector/product characteristics). Issues of cross-brand standardization, e.g. with phone chargers, could also be taken into consideration in the review of the Directive (Expert input, 2014).

There is also a need to strengthen requirements on reporting, labeling and accounting to increase information and transparency. For example, revised energy labeling and eco-labeling legislation, further development of methodologies to measure the environmental footprint of products (PEF) as part of the Single Market for Green Products Initiative (European Commission, 2013) could play a role in fostering the circularity of products.

In addition there could be measures to improve or encourage repair such as requiring the provision of product repair manuals and easy access to them (e.g. online), increased information on recyclability, e.g. through product passports to be used in Business-to-Business (B2B) transactions or through enhanced recycling logos that also indicate the recycling destination of materials (e.g. plastics) could be useful measures to increase transparency on the origin of products, resources and materials and thus support greater circularity, e.g. by increasing purity of cycles.

Provisions could also be introduced which require manufacturers to provide information on the expected or intended lifetime of a product (e.g. as already done for light bulbs, recharging potential for batteries, etc.) and on product durability as a means of addressing issues related to planned obsolescence. Such information could then be collected by consumer associations, which could in turn inform and communicate this to consumers (EU Scoping Study Expert input, 2014).

Some work has been done which could provide insights on this issue, e.g. 'products that last' work by CE Delft together with industry as well an on-going study for the European Commission on product durability *[1].

On accounting, national environmental-economic accounts such as material flow accounts, accounts on taxes (as currently required under the on European environmental economic accounts Regulation (No 691/2011) as well as accounts for subsidies (not yet required) and natural capital accounting (part of UN SEEA experimental accounts *[2]) could form an important evidence base and regular window of opportunity for policy change.

Similarly, there are needs for greater corporate disclosure, wider use of organisational environmental footprints (OEFs) and of environmental profit and loss accounts (EP&L), e.g. as piloted by Puma, to support greater transparency, ensure internal visibility of key issues for company management and hence facilitate the transition to different business models that take resource use and impacts into account. This will also support the information available to the finance sector when making investment decisions (e.g. pension funds and ethical investment funds), and over time could support increased funding for circular economy vanguard companies.

There could also be potential scope for revision in the context of the REACH Regulation which for example could be expanded to cover a wider range of toxic chemicals which when used in products and materials may prevent greater circularity, i.e. by limiting reuse, recycling etc.

Furthermore, it has been noted that current cut-off thresholds for the provision of information under REACH could be reviewed which although simplifying administrative burdens, exclude a range of products containing chemical substances which has implications for business-to-business communication and assessments of compliance at later stages (e.g. recycling) (Expert input, 2014).

* For more information about the on-going project, please see project website: http://www.productdurability.eu/
** The System of Environmental-Economic Accounting (SEEA) is the main guidance on environmental economic accounting developed by the United Nations Statistics Division.

New measures and regulation

In some cases there may be a need for new regulation such as new targets (e.g. new targets on food waste as proposed in (COM(2014)397) to reduce food waste by 30% between 2017 and 2025 as part of new circular economy package), restrictions or bans (e.g. on landfilling of plastics or recyclable materials as proposed in (COM(2014)397) that after 1 January 2025, a maximum of 25% of the quantity of waste generated in the previous year to be landfilled; by 1 January 2030, only residual waste to be accepted in landfills, so

that the total waste going to landfill does not exceed 5% of total municipal waste generated in the previous year, on the use of certain toxic chemicals, coupled with strong legislation on energy recovery to avoid incineration).

Another option could be to introduce mandatory requirements (e.g. mandatory phosphorous recovery from sewage sludge, qualitative requirements on recycling, development of action programmes to tackle food waste, mandatory requirements for the separation of waste). Explore potential measures to address issue of intentional obsolescence (Expert input, 2014).Creating new regulation on intentional obsolescence would likely prove challenging to implement in practice given the difficulty in proving intentional obsolescence, even if the burden of proof is placed with product manufacturers.

Nevertheless, it could be useful to enshrine the principle of non-intentional obsolescence into a broad policy objective (e.g. within product design legislation) to help provide due signals to the market and explore other potential instruments such as increased warrantee or guarantee periods.

There is also a need to develop adequate indicators (as reiterated in the 7th EAP and the EREP recommendations – EREP 2014) that show progress towards a resource-efficient economy. As noted in the Circular Economy Communication (COM(2014)398), the Resource Efficiency Scoreboard used to monitor indicators of the use of resources other than carbon and materials (in particular, land and water) will be developed further and national statistical offices are to work to establish a commonly accepted methodology within the European Statistical System to calculate raw material consumption at national level.
Such information can be used to provide insights on progress, raise public awareness and build support for relevant measures. These indicators could be monitored and reviewed through the European Semester processes and feed into discussions on the review of the Europe 2020 Strategy.

Other instruments to incentivise action towards a circular economy

Legislative measures will need to be supported by other instruments and approaches. A number of voluntary agreements are already in place and include for example agreements between retailers and government, between actors along a supply chain such as retailers and suppliers such as those supported through WRAP – see Box 5 below, the World Business Forum, certain purchasing agreements, etc.

These approaches have been rather selective and ad hoc to date, driven by internal factors (e.g. CSR and branding purposes) and external developments (e.g. rising resource prices, awareness raising activities by actors such as the Ellen MacArthur Foundation and the World Economic Forum) (Expert input, 2014).

Box 5: Waste & Resources Action Programme in the UK

WRAP was setup in 2000 to support recycling and create a market for recycled materials. WRAP's work focuses on overcoming barriers to waste reduction and recycling. Today, WRAP emphasises the circular economy. In doing so, WRAP works with a wide range of partners, from major UK businesses, trade bodies and local authorities through to individuals looking for practical advice.

WRAP has launched a number of campaigns including the successful 'Love Food Hate Waste' campaign, 'Recycle Now' and 'Love Your Clothes'. WRAP's research and funding helped create the first food-grade and mixed plastics recycling facilities in the UK. More than a million people each year view WRAP's websites recyclenow.com and Lovefoodhatewaste.com. WRAP also manages voluntary agreements with various business sectors including:

- The Courtauld Commitment working with the grocery sector
- The Home Improvement Sector Commitment worked with retailers to reduce packaging and help consumers to recycle more.
- The Hospitality and Food Service Agreement, which is a voluntary agreement to support the sector in reducing waste and recycling more.
- The Voluntary reduction in Carrier Bag Agreement with seven major supermarket chains.
- The Federation House Commitment, a voluntary agreement which aims to help reduce overall water usage across UK Food and Drink industry by 20% by 2020.
- The Business Recycling and Waste Services Commitment intended to boost recycling rates.

A key driver behind WRAP's activities has been government policies to reduce waste and to increase recycling including producer responsibility for packaging waste, the Landfill Tax and targets set in the Waste Strategy. This shows the complementary and interacting role between different types of instruments.

Germany and the Netherlands have been in discussions with WRAP about replicating similar initiatives. An important element of WRAP's successes lays in the institutional setup behind WRAP as not-for-profit-company with the freedom to recruit and achieve its remit in each particular sectoral cultural context that it faces. This approach would need to be translated into any new cultural setting, rather than necessarily replicated.

Sources:
See detailed case study in Annex 4 for related sources and further information on this case

Fiscal incentives including taxes, charges and levies are other important instruments that can be introduced at the national or local level (and encouraged at EU level) to increase the value/prices of materials and incentivise action towards more circularity. Such incentives can be particularly useful in cases where the value of the product or material does not initiate a spontaneous effort to encourage circularity.

These can combine increased resource pricing (e.g. on aggregates or construction materials) upstream to influence production choices as well as taxes and charges downstream on products (e.g. phosphorous in mineral fertilizers), pollution (e.g. CO2) and waste disposal (e.g. PAYT schemes, landfill taxes) (see Withana et al., 2014a; 2014b).

Due exemptions and reductions can also be considered for high-performing sectors/products (e.g. vouchers or tax credits for leased goods or for goods with extended manufacturer guarantees/ higher recyclability). Such instruments can be effective in changing incentives of different actors, e.g. municipalities, producers and consumers. Box 6 provides an example from experience in France where economic and fiscal incentives can be seen as encouraging greater circularity.
Given the unanimity requirement in relation to fiscal instruments at EU level, this is an area where the scope of EU action is more limited, and where national, regional and local level action has an important role to play.

Box 6: Economic and fiscal incentives in France

France has both economic and fiscal incentives in place that support the transition to a circular economy. An important economic incentive is provided through modulated fees under many EPR schemes where fees paid by producers to PROs for managing waste from their products is varied according to different eco-design related criteria. In addition to weight and number of items collected, criteria currently applied include: amount of recycled material used in the product, whether certain materials used interfere with the recycling process and other eco-design criteria such as the absence of universal chargers for mobile phones. In some cases (e.g. packaging), a bonus can be given if actions to raise awareness about separate waste collection are undertaken. A draft law is currently being discussed which reflects on the possibility of extending the criteria to product lifetime guarantee and the availability of spare parts.

Other fiscal tools in place include the 'Taxe Générale sur les activités polluantes' (General Tax on Polluting Activities) which is levied on polluting activities in proportion to the level of pollution generated and a tax reduction for food donations of 60% of the given sum which is limited to 0.5% of pre-tax turnover. A number of proposals are also being discussed including an upstream tax for products that are not currently covered by EPR systems (and therefore not recycled) to discourage consumers from buying them and further encourage eco-design and an incentive-based pricing policy for waste collection (PAYT scheme) as is already implemented in a number of other European countries.

Sources:
See detailed case study in Annex 4 for related sources and further information on this case.

Other important supporting instruments are targeted information and advisory services for companies (e.g. on alternative uses for by-products), awareness raising campaigns among both consumers (e.g. on ways to reduce food waste) and producers (e.g. major UK supermarket Tesco has various internal policies which seek to raise awareness among employees), local authorities as well as labels (e.g. on building performance and car CO2 emissions and recyclability including real life performance, eco-labels for furniture and foods). Such tools can play a critical role in supporting the transition and engaging consumers and producers – see Box 5.. Increased

information and transparency can be useful between different actors, for example between producers and end users (e.g. feedback from recyclers to consumers on how much waste has been collected in their region and what it has been used for can also help encourage greater separation of waste) and between actors along the supply chain (e.g. through harmonised reporting tools such as on bill of materials, disassembly schemes, the use of hazardous materials, etc.) (Expert input, 2014).

In some cases despite the availability of information, it remains difficult to engage certain actors, e.g. SMEs, end users. Thus there is a need to reflect on how to ensure greater interest and engagement through more effective training, education, new targeted messaging (e.g. focusing on related aspects that are important and can appeal to a wider audience such as business logic, cost savings, consumer demand for healthy products, etc., avoiding over complex concepts to ensure messaging is understandable and does not risk confusion) and continuous repetitive communication which is supported by governments, civil society and industry to ensure a coherent and strong message. Depending on the nature of the information and awareness raising tools, this could for example be an area where local and regional authorities have an important role to play (Expert input, 2014).

The role of public investment in encouraging circularity Increased public investment is another key element in the transition to a circular economy that could play a useful supporting role alongside substantial private financing of relevant activities. Public investment could for example be used to support further R&D and innovation to ensure greater circularity (e.g. to allow modulation of phone components, to support innovative initiatives such as Phonebloks18, to encourage connections within and between value chains to enhance circularity, reduce marginal costs and ensure a fair allocation of costs between different actors along the value chain); together with investment in pilot projects to prove things work and encourage market up-take. In this area, EU funding including through for example the Horizon 2020 and COSME programmes could be used to support circular economy activities, leveraging both public and private financing.

It could also build on existing efforts such as the European Innovation Partnerships (EIPs) that are considered a different and effective way of bringing together different stakeholders, strengthening dialogue between policy-makers and innovators, and providing an EU-wide platform of practice to encourage innovation and systemic change. Such efforts can be further supported and improved, taking into account identified shortcomings in the process to date (DG Research and Innovation, 2014).

Public investment could also be used to support the development of the knowledge base to support better policy making. This could include support for example through the Horizon 2020 Programme for improved information and data on the existing use and pathways of different resources, particularly those of biological origin, support for the development of robust indicators to monitor progress towards the circular economy etc.

Public funds could also be used to raise awareness of circular economy opportunities for example with support for information and

awareness raising campaigns as elaborated above as well as wider public information campaigns, e.g. TV documentaries, design awards etc. (Expert input, 2014).

In some cases, public action could be structured around a more strategic approach to the circular economy, aligning public funding and other activities towards an overarching goal and vision on the circular economy– see Box 7.

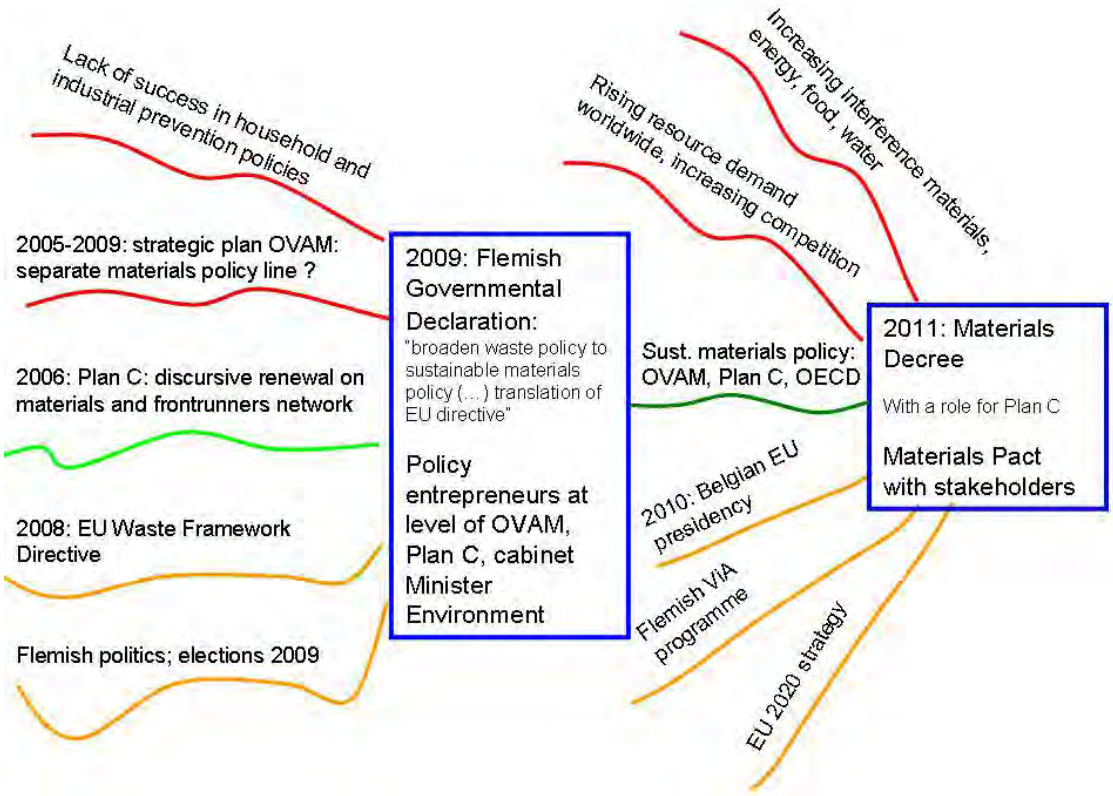
Box 7: A regional approach to the circular economy: Materials Programme in Flanders (Belgium)

The Flanders' Materials Programme was launched in June 2012, bringing together different stakeholders, to develop long-term visions and experiments, policy-relevant research and concrete actions. The Programme is taken forward through a transition network Plan C, Policy Research Centre for Sustainable Materials Management (SuMMa), and Agenda 2020 - an operational action plan with nine levers and 45 actions.

The Programme aims to establish a basis for a green circular economy with the lowest possible use of raw materials, energy and space, and the smallest possible impact on the environment in Flanders and elsewhere (Vlaamse Regering, 2012). As the Materials Programme was launched only two years ago it is not yet possible to identify any specific impacts. Nonetheless, the Programme can be considered an interesting case of a regional approach to supporting the circular economy, through a strategic, overarching plan which has managed to engage 33 parties in the transition towards a circular economy including research institutes, industry, environmental NGOs, and public authorities. Moreover, it uses an integrated approach across a number of different areas, involving concrete agreements with different parties, set objectives and indicative timeframes for action (Ibid.).

Several factors have driven or enabled the development of the Flemish Materials Programme – See Figure 6: Drivers of the Flanders' Materials Programme. The programme has increased cooperation, created a new discourse in Flanders about sustainable materials management (SMM) and started a network of frontrunners (Paredis and Block, 2013). Similar initiatives are also being discussed in some other regions, notably Catalonia and Denmark, thus there may be scope for further regional approaches in the future, with the success of implementing a similar programme elsewhere dependent on knowledge available, experience, waste management practices, and previous collaboration between stakeholders (Expert input, 2014).

Figure 6: Drivers of the Flanders' Materials Programme



Source: Paredis and Block (2013)

Public funding for clustering and industrial symbiosis, as well as for relevant platforms that bring together different actors and stakeholders across the value chain (e.g. the EPR Club which is an ACR+ initiative *[1]) could also be useful – see Box 8. Such support could be particularly helpful in identifying appropriate partners at regional and national level, improving communication and aligning incentives of different actors in the value chain through multi-stakeholder partnerships (Swiss Academy of Arts and Sciences, 2014).

* ACR+ EPR Club, URL: http://www.eprclub.eu/about_epr_Club [08/07/2014]

EU funding can play a role in this context, for example as seen in the case of the Frisian province in the Netherlands which developed a 'cradle-to-cradle island with support from European funding under the INTEREG programme (CGDD, 2014).

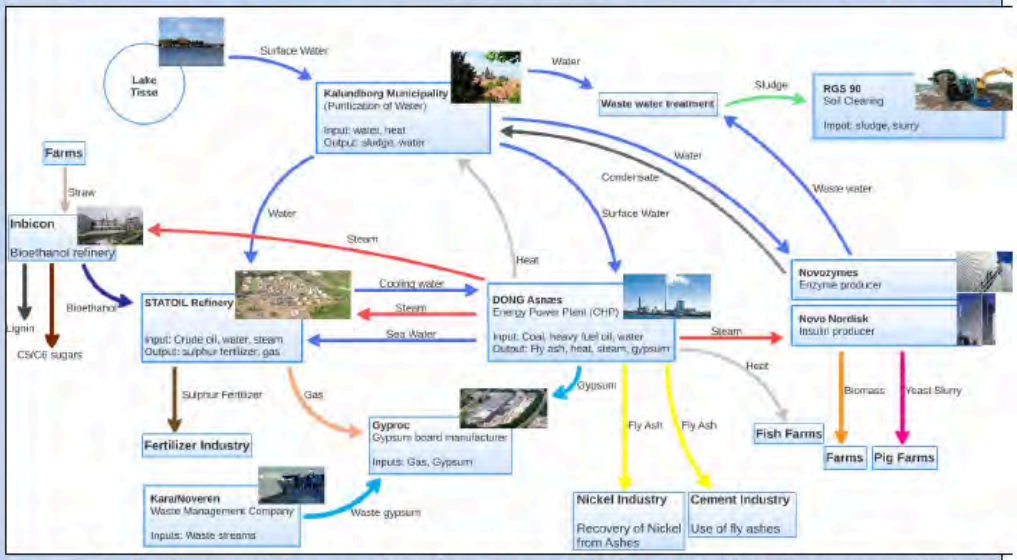
EU Cohesion Policy funding (ERDF and INTERREG) could be used to set up a node of catalysts or 'facilitators' at regional/national level across European regions which connect companies and other actors including municipalities etc. to discuss how to move towards a circular economy, identify perceived barriers and how they can be overcome and practical steps to be taken (Expert input, 2014).

Public funding could also be used to set up a platform to share best practices between policy makers, businesses including SMEs and consumers across different sectors.

Box 8: Industrial symbiosis at the municipal and national level

Industrial symbiosis in Kalundborg (Denmark) is considered as one of the first and most successful cases of industrial symbiosis implemented to date. Since its beginnings as a form of cooperation between a local power plant and oil refinery in the 1960s, the number of companies involved as well as the network of exchanges between the companies has increased – see Figure 7. This has led to substantial reductions in the consumption of virgin materials, reduced GHG emissions, cascading use of energy, reduced environmental impact of companies and the exchange and re-use of several types of waste streams (Domenech & Davies 2011, p.81). The programme has also led to important economic savings for the actors involved. It has been facilitated by a number of factors including contractual obligations between the companies involved, the enforcement of environmental regulations and a continuous negotiation process between public authorities and companies (Jacobsen & Anderberg 2004, pp. 322-323).

Figure 7: Graphical representation of the Kalundborg industrial symbiosis project



Source: Author's own elaboration based on Domenech & Davies (2011), Jacobsen (2006), Kalundborg Symbiosis (2014a)

The example provided by the Kalundborg symbiosis has inspired initiatives in other parts of the

world including for example Barceloneta/Guayama (Puerto Rico), Kwinana (Australia) and Rotterdam (the Netherlands) (Chertow 2007, p.22). Therefore, there may be opportunities to implement similar initiatives in other areas and could lead to substantial benefits. For example, it has been estimated that replicating a similar programme at EU level to the National Industrial Symbiosis Programme (NISP) in the UK could yield up to €1.4 trillion savings and more than €1.5 trillion additional turnover, with a public expenditure of €250 million (COWI 2011).

Sources:
See detailed case study in Annex 4 for related sources and further information on this case.

Further action to encourage Green Public Procurement (GPP) can also be useful in incentivising more circular procurement practices among public authorities. While current EU public procurement directives (2004/18/EC and 2004/17/EC) contain specific reference to the possibility of including environmental considerations in the contract award process these could be further revised to better support circularity for example through revised criteria to include 'recyclability requirements' for public procurement practices and tenders (Expert input, 2014) and a systematic implementation of whole lifecycle costing (WLC) criteria which could also be a useful means to encourage product and investment choices that take lifecycle impacts into account (Hjerp et al., 2012).

There are a number of GPP initiatives already underway which support the circular economy and could serve as good practice examples to stimulate action among other public authorities – see Box 9.

Box 9: GPP in Ferrara (Italy)

The LOWaste (Local Waste Market for Second Life products) programme was launched in the city of Ferrara, in the Emilia-Romagna Region of Northern Italy in 2011. The programme aims to increase recycling of municipal waste by 70%, decrease CO_2 emissions (through the diversion of material from landfills) and increase recovery of raw materials. It targets four waste streams: hospital textiles, street furniture (e.g. public benches), food waste, demolition and construction waste. It also establishes specific GPP criteria to be integrated into purchases by the municipality.

Between 2011-2014, the LOWaste programme has supported the diversion of 90 tonnes of hospital textiles annually from landfill and 2,159 tonnes of avoided CO_2 emissions, at least 11,200 tonnes of recycled construction and demolition waste materials used in the construction of roads and cycling lanes resulting in up to 593 tonnes of avoided CO_2 emissions; the refurbishment of old street furniture has helped save 90 tonnes of virgin raw materials and realized savings equivalent to 67 tonnes of CO_2; and oil and food waste used for the production of compost, biodiesel and glycerine has led to an annual saving of 30 tonnes of food waste and the production of 4,500 kg of compost material (LOWaste 2014).

This case illustrates how circular economy activity can be driven through initiatives at the local level and the role of municipalities through the adoption of GPP practices and specific programmes. The adoption of legislation at both the regional and national levels has also supported efforts at the local level. The LOWaste has benefitted from EU funding under the LIFE+ programme. The case also highlights some opportunities for revising legislation, particularly at the national level to better support local action, e.g. clarifying 'end of waste' criteria, promoting reuse centres, clarification of definitions of 'special waste' and product labelling (especially of food products).

Sources:
See detailed case study in Annex 4 for related sources and further information on this case

Public funding could also be used to support citizen-led platforms encouraging greater circularity e.g. platforms on how to repair / reuse products, car/house sharing networks, local, non-profit swap networks. It could also be used to support bottom-up financing sources for these activities such as Crowdfunding which pools the time, cooperation and money of individuals to support initiatives by individuals, communities, organisations or companies *[1].

For example, DG Internal Market is exploring how to raise awareness and increase transparency in this relatively new and growing area(European Commission, 2014).

In certain cases, there may also be a need for investment in specific infrastructure (e.g. centralised collection points, pick-up-at-door services) as well as better use of existing infrastructure and services which can for example be used to improve collection, e.g. using the postal service to collect CDs, DVDs and VHS tapes (e.g. as is being trialed in Portugal and France) and offer new spaces for community initiatives (e.g. reinventing public libraries as community centers to encourage greater reuse and repair) (Expert input, 2014). Such investments can be supported through EU Structural and Cohesion Funds and can for example help support greater velocity of cycles so products come back faster, people hoard less, transport times are reduced, and circles are made more efficient.

While there is a need to increase public funding towards activities that support the circular economy, there is also a need to avoid or minimise public funding of investments that go against the circular economy, e.g. investment in energy recovery from untreated waste, fossil fuels etc. (Expert input, 2014). This links to the need to reform ineffective or harmful public subsidies which has long been recognised and has been a contentious point of discussion for several years (Oosterhuis and ten Brink, 2014).

The EU has a long-standing commitment to removing or phasing out environmentally harmful subsidies (EHS) which was reiterated in the Resource Efficiency Roadmap and the 7th EAP. Commitments to reform such subsidies have also been adopted at the global level (e.g. in the context of the Convention on Biological Diversity (CBD) and the G20) as well as at the national, local and regional level (Withana et al., 2013). These discussions are also linked to efforts to modernise and strengthen the result orientation of the EU budget.

* European Crowd Funding Network, URL: http://www.europecrowdfunding.org/ [accessed 19/3/2013]

4 "Governments going Circular"

(Governments going circular. A global scan by De Groene Zaak (Dutch Sustainability Business Association), February 2015)

All over the world, a growing number of companies have started to develop and apply circular businessmodels. These business models replace the traditional linear, "end-of-life" concept. Companies are now employing restoration rather than destruction and are shifting away from fossil fuels towards renewable energy. Manufacturers are stopping the use of toxic chemicals and aiming towards the elimination of waste through superior material, product and system design.
Companies have good reasons to move in this direction as the current economic climate exerts increasing pressure on the availability of vital natural resources. Those who foresee the potential consequences of the predicted resource scarcity have begun to develop business models to help reduce dependencies on fossil fuels and finite natural resources.
Governments have good reasons to act as well: Besides strengthening the economy by saving hundreds of billions of euros per year on finite resources, the shift to a more circular economy not only stimulates innovation, it also offers the promise of new employment opportunities.
While companies are the driving force in the shift towards what is now commonly known as "the circular economy", governments play an equally crucial role. Governments have the ability to strengthen business efforts and upscale small niche activities into powerful circular measures that can impact entire economies. Successfully tackling a systematic reshaping of the traditional production and consumption model that has dominated the past 250 years requires a coherent set of government actions, including incentives to encourage all companies to apply circular business models.
Given the importance of government intervention in establishing sustainable national economies, we set out on a journey to identify best practices by analysing government initiatives worldwide. We examined governments that are: using their powers to shape circular market conditions at a national level; creating the right conditions for change; outlining ambitious plans; choosing to fund and coordinate various initiatives by companies and individuals; or adopting the circular economy via their own large organisations and supply chains.

Based on what we now know, however, the following conclusions are warranted:

1. The vast majority of the governments still lack a clear sense of urgency.

The majority of governments are not yet convinced of the necessity of a circular economy. The (Northern) European and Asian governments are clearly ahead when it comes to forward steps in understanding and realisation: elsewhere in the world, there is, at most, only talk of interest in circularity. The sense of urgency appears to be connected in the first instance to the level of import-dependence on raw materials (Japan, Europe) and environmental pollution (e.g., China).

2. The circular approach is not only relevant for established economies.

Emerging economies are still struggling to get the basics of waste management organised. In these countries, circular initiatives do exist but they are set up and managed by the private sector.

3. Governments are particularly active in waste reduction and resource optimisations programmes.

This is logical, since activities in this field directly connect to the classic waste management system that have long been the responsibilities of governments.

4. The implementation of large-scale circular and / or sustainable procurement by local, regional and national authorities as launching customer, have yet to be applied by virtually all governments in the world.

Here is a huge opportunity for the circular economy. It seems that governments give too little attention to instruments aimed at the development and production of circular products or the dissemination of knowledge about it.

5. Governments use a very different set of instruments to achieve goals.

There is remarkably little evidence of standardisation in the approach to circular economy and there are many creative customisations in place.

6. Many initiatives are put forward by local governments.

These are often more appealing and concrete than large national programmes. The latter, however, have a much greater potential impact. In many cases it is a combination of national policy that is developed locally, that succeeds.

7. There is no universal solution to boost the transition to a circular economy.

Yet there is a general approach that every government can use to implement circularity.

Throughout the report, several national and local governments are using their power to initiate and develop circular economic business models. By using laws and regulations, offering financial support or penalties and using their own purchasing power, governments are crucial to opening a path towards circularity.

With many inspirational examples we conclude with a practical approach that you can use to implement circularity in your country, province, or city. Please be aware that the (rather general) actions described below do not form a step-by-step plan, but run parallel.

Action 1. Understand the circular necessity

The first step is to truly understand the necessity of the circular economy. Get to know the basics: why our current model can't be sustained, and the fundamental changes that need to take place to abandon the linear economy. But more importantly, comprehend the opportunities that a circular approach will deliver.

Action 2: Lead by example

The most powerful way to show the need for circularity is to start acting. Therefore, it is strongly advised to become the leading circular organization yourself. By transforming your own processes and using governmental procurement power to stimulate suppliers, the government can learn how to implement and become aware of the practical challenges. A government will also learn which regulations it should be adjusting in order to take the circular path. It gives a strong signal to the market that the government takes the transformation seriously.

Action 3: Map circular economy principles to your local context

Circular economy principles should be placed in your local context. Define which sectors and policy areas are most affected. This may be within Waste, Resources, or Spatial Planning. Think in terms of overcrowded landfills that are bursting at capacity; materials that are susceptible to price and supply fluctuation; or overpopulation in urban areas causing traffic and high residential pressure. Based on this first local context assessment, certain "hotspots" can be identified.

Action 4. Create a comprehensive vision or strategy
Although not all implications and changes will benclear at this stage, it's important to draw a long-term vision on circularity. Define long-term goals and a clear roadmap for the next couple of years.
Action 5: Engage stakeholders: Start the dialogue
To facilitate the transition, engage all stakeholders and involve them in an early stage. Challenge them to bring ideas and solutions themselves, and provide input for the overall vision, strategy and policy instruments. This will create involvement, buy in, and produce the most promising solutions.
Action 6. Choose instruments & Start initiatives.
After the identification of the hotspots and stakeholder engagement, one should find the most effective policy instrument. To change and promote a circular economy, a government has multiple instruments at its disposal: laws and regulations, fiscal measures, grants, partnerships and public procurement. The government can decide which instrument is most effective in its own context. Remember, inspiration and details from experts worldwide can be found via the website. Once it has been decided where and with what instrument, the circular economy will be implemented, and it is time to put effective initiatives in place. At the beginning, these can be standalone projects. This is not the final goal but the first step towards a circular economy, in which the "Start Small, Scale Fast" approach can be used. Of course the results should be measured and evaluated over time.
Action 7. Monitor, adjust and scale
The transition towards the circular economy will take several years, during which the progress should be measured and the roadmap adjusted. Initiatives that prove to be successful will be implemented on large scale. Step by step the circular economy will be put in Practice.

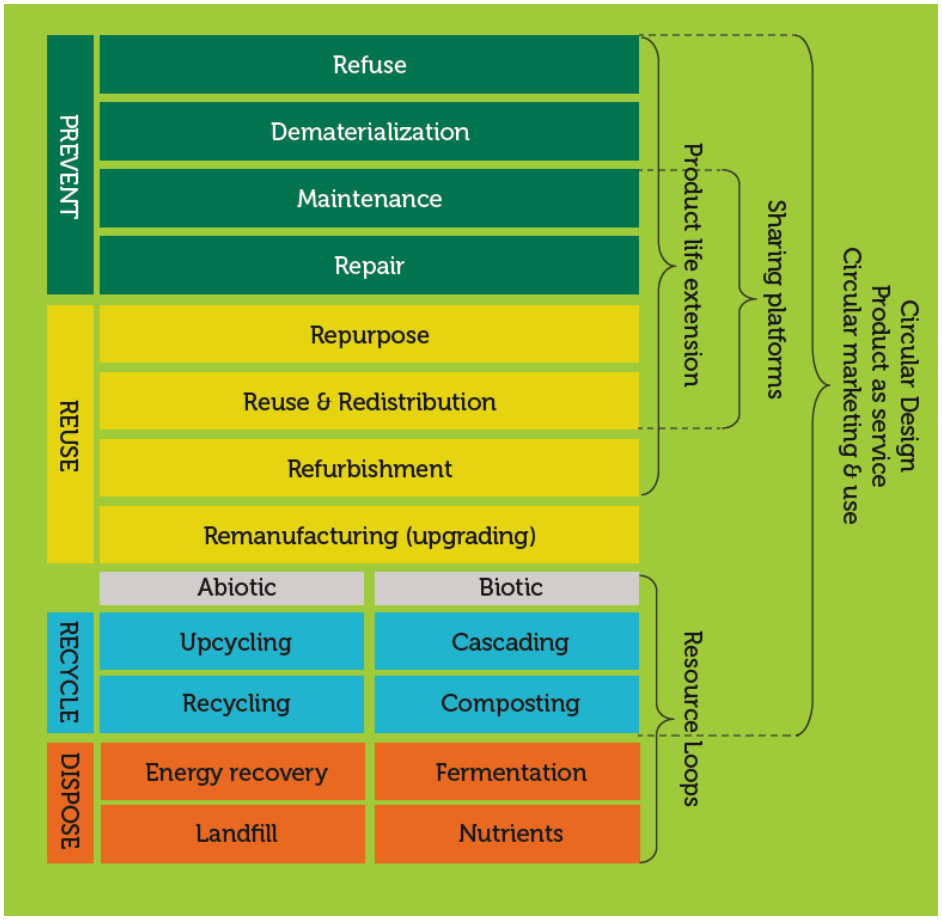


Figure: Circularity Ladder

This "Circularity Ladder" presents economic activities with an increasing "degree of circularity". On the left we see the familiar EU Waste Hierarchy of Prevent, Reuse, Recycle and Dispose.
Here, Prevention represents the highest degree of circularity, and Recycling represents the lowest, with Disposal to be avoided. In the middle, each of these stages represent circular activities such as maintenance, repair and refurbishment, and cascading of biomass.
On the right, six circular business models (or strategies) such as Circular Design and Productas-a-Service are shown that can set these activities in motion.
When looking at the six circular business models we see two important things. First, all business models impact different activities, but some impact a wider range of activities than others. For example, circular design impacts all aspects, whereas a sharing platform does not directly lead to refurbishment or recycling (although it is possible). Second, some business models are able to achieve higher degrees of circularity than others. For example, using biomass or recyclates as input materials only has a direct impact on recycling – although admittedly they have an indirect impact on prevention of also usingvirgin material.

The Dutch NGO Circle Economy published a blog on March 9, 2015 with exactly the same scope: *How governments are key for a circular economy*
They came up with the following recommendations

- **Be an entrepreneurial and investing government**
  The biggest innovator in history turns out to be the government. Mariana Mazuccato points out in her book 'The Entrepreneurial State' that without a US government, the iPhone, the internet and many other disruptive innovations would not exist today.
- **Create an interdepartmental program**
  Most governments are organized in silos. Just like in most companies, work is structured in a Taylorian manner; dividing the work, creating single ownership and accountability. Whereas now the question often is whether the circular economy should fall under the Ministry of Economic Affairs or the Ministry of Environment, The NGO Circle Economy argues argue that the circular economy requires a holistic approach and should be part of an interdepartmental program, with the Ministries of Finance and Labour involved as well.
- **Create experimental business areas with flexible regulation**
  The circular economy concept is all about innovation. And all too often, innovative circular business models do not fit into the current system. They go beyond our current understanding of ownership and usage, or are based on using waste as a resource – which is often not allowed under current regulations. By providing some space for experimentation, governments can easily support these groundbreaking pioneers.
- **Buy patents and make them available to entrepreneurs**
  The word "patent" means open to the public, readily visible or intelligible. Patents were meant to allow inventors of new devices or methods to reveal their work to the public so that people could learn from them. In exchange for that the patentee is given the exclusive right to make and use the invention for a period of time. Unfortunately, patents are predominantly used by big corporates to prevent disruptive innovation from killing their current business models. A flaw in the system, that can be solved by governments who can start up funds to buy these patents and make them available to entrepreneurs or start-ups along with challenges as described in action point number 1.
- **Have a vision! You can only facilitate when it's based on your own framework**
  In the Netherlands the government wants to play a facilitating role to an active, self-organizing society. That attitude fits well with the civil servant movement, the power of the crowd and bottom up initiatives. However, governments should not just facilitate random initiatives that arise in the crowd. They need to have a strong vision, backed by a framework to base decisions upon. Circle Economy learned from experience that the transition towards a circular economy will not succeed by doing as many projects as possible, but by doing the right projects: impact by creating irreversible chain reactions. Governments play an

important role by formulating a vision of where these chain reactions should happen, and in finding the right stakeholders to make them happen.

- **Be a launching customer**
  Circular economy examples need demand, demand from parties willing to choose non-proven, but very promising, technology. Governmental organizations have an immense buying power that they can use to stimulate circular business models. From office furniture to city lighting to complete city halls. There are many opportunities for circular procurement that are, for example, explored by Dutch frontrunners in the "Green Deal Circular Procurement". Their role as frontrunners does not stop with their buying power. By changing the way governmental organizations operate, collaborate and empower their employees, they can become inspiring icons of circularity.
- **Find clever solutions for the 'losers' of the circular economy**
  A lot of reports mention the millions and billions that can be gained with the switch to a circular economy, let alone the new jobs. We also believe that the circular economy can contribute to some good old fashioned monetary growth. But let's not forget that in this paradigm change, there will also be losers. Foreseeing the stranded assets in an early change can cause investors and entrepreneurs to stick to their linear lock-in situation too long. Governments can help prevent upcoming stranded assets by warning entrepreneurs, but also by creating budget neutral smart incentive systems.

5 Matching the literature findings with the Dutch Programme "Better Regulation towards Green Growth (R2G2)"

(With input from **SIRA Consulting: Removing Obstacles in the Bio-based Economy (Wegnemen van belemmeringen in de bio-based economy 2011-2013)**)

4. 1 Background Programme R2G2

The Dutch government has started a programme to identify and possibly mitigate regulatory obstacles that entrepreneurs encounter in their quest to a transition towards new circular economy business; obstacles that prevent investments in the economy.
Initially the Programme focused on barriers that prevented a transition to a Biobased Economy (BBE). In 2014 the program has been expanded with "from waste to resource" (VANG) topics. The Programme will run till mid 2018 and eventually aims to address all obstacles that block Green Growth.

The objectives of RRGG are:

- Completing approximately 50 obstacles for the domains BBE and VANG together;
- Analyse 4 fundamental barriers and bring forward recommendations; Complex and expensive) Certification, Sustainable Criteria for biomass (versus lacking criteria for primary resources)
- Publication of the barriers and obstacles as well as the completed analysis to show that the government listens to businessmen, entrepreneurs questions lead to actions and the program RRGG provides solutions or good argument if follow-up is not feasible;
- Avoid obstacles by explaining better within the government instances of the effect of laws and regulations on innovative entrepreneurs.

Barriers experienced by entrepreneurs have been divided into operational (solution-ready), structural (adjustment regulation or execution of policy needed), fundamental (new policies needed) and conflicting (government has other regulatory priorities but can sometimes soften administrative measures).
As entrepreneurs do not always experience that the regulatory solution provided is working out in practice special attention has been paid to the "mechanisms" behind the solution provided to the barrier in practice. For examples legislation would allow room for experimentation but local law enforcers prefer not to take any risks.

Out of the barriers in the inventory 30% were classified as operational, 30% structural, 30% fundamental and 10 % conflicting (like REACH). 50% of all the newest 20 barriers to the bio-based economy are structural which means according to Sira that regulation is a barrier to a circular economy.

The background of the obstacles found in the category operational, structural and conflicting were mainly:

- Dung & Digestion
- Wood
- Waste
- Green Building
- Agro-Food
- Plastics

4.2 Identifying future barriers

The Programme RRGG is very useful to de-block present operational en structural obstacles and introduce policy proposals for adjusted or new regulation. So far the Programme has been focusing on Bio-based economy and waste to resource obstacles of a regulatory nature that prevent entrepreneurs from growing and investing in the circular economy.

Within the bio-based obstacles the main categories of obstacles found were related to:

- (Complex and expensive) Certification, Sustainable Criteria for biomass (versus lacking criteria for primary resources)
- Subsidies (like SDE) for the use of biomass for sustainable energy and lack of subsidies for sustainable materials out of biomass
- Waste regulation: agro-food residuals often qualify as waste and that prevents to a large extend optimal re-use
- Issues related to the manure legislation and the Nitrates Directive (usage limitations of Digistate from digestion, removal of plant residues from land, …)
- Access to financing

With the obstacles related to "Waste-to-Resource" barriers the main categories are related to

- Waste or resource classification (reuse of a product, waste, by-product, end-of-waste)
- Waste Shipment Regulation
- REACH

Fundamental obstacles were related to:
- Level Playing Field
- Certification in relation to Sustainability
- Taxes and levies
- Financial feasibility for innovative entrepreneurs
- Modification/crop breeding
- REACH
- Waste / Non-waste (End-of-Waste/By-product)
- Waste Shipment and waste coding (WSR & EURAL)
- Mechanism

In both domains it was found that the obstacles preventing circular initiatives originate from decentralised authorities unaware of regulatory options available within national regulation or too risk-adverse to experiment. Communication therefore should be directed to not only entrepreneurs but also this target group.

The barriers identified in the Dutch running governmental "RRGG" Programme ("Better Regulation towards Green Growth/Ruimte in Regels voor Groene Groei") have been compared with the barriers found in this literature review with the objective to find blank spots. Those blank spots can be either specific obstacles not yet identified or future obstacles that can be expected when the transition towards a circular economy is progressing. Within the institutional and regulatory barriers the Programme has focused sofar on Bio-based Economy and Waste-to-Resource related Issues.

The intentions are to extend the Programme to the whole domain of Green Growth – Energy, Water, Building, Climate, Mobility and Food. As such, in the present RRGG inventory, these categories and their associated barriers will not be present.

Since the governmental Programme focuses pre-dominantly on specific regulatory obstacles within the current "linear economical system" that can be linked with an entrepreneur, the obstacles related to Institutional Aspects, Design and Production related aspects and Logistic aspects are far less present (or absent).
If we zoom in on types of barriers we can see that barriers from institutional nature (to some extent), barriers concerning cultural and awareness factors, barriers related to (lack of) access to financing and barriers related to technological challenges and knowledge gaps are underrepresented in the inventory. If however business associations or NGO's are asked about the barriers encountered by their

followers they do mention both the non regulatory and the more fundamental aspects that can be found in the literature review. Some circular business models are simply not viable (yet) within the current (linear) economical system to be accepted as a obstacle by the Programme RRGG.

It seems fair to say that focusing only on the removal of the present regulatory Circular Economy obstacles that entrepreneurs face today (in their quest to start new circular business) however useful that is, will not be sufficient to make a transition to a Circular Economy. In a way a Circular Economy demands a system change with parallel actions along the value chain rather than a purely sector and/or product focused approach. It requires actions in not only the regulatory field but also requires institutional changes, changes in accounting and financial instruments, cultural changes, technological innovation and knowledge development & exchange just as closer cooperation and transparency between all actors (governments, businesses, inhabitants and the science & education community).

The table below lists the blank spot and future barriers that have not or only to a limited extend been identified in the "RRGG" Programme.

Filters/Lenses	General Framework	Design & Production	Recovery & recycling	Logistics
Institutional / Organisational	• Linear Accountancy Rules • Encourage experimentation • Increased collaboration versus antitrust, data protection and security	•	•	•
Cultural/Awareness	• Green Public Procurement • Power play vested Interests • Reaching the SME target Group	• Eco-label • Awareness & behavior • Education • Consumer acceptance of models based on service and usage instead of ownership	• Industrial Symbiosis • Food waste: best before and use by confusion • Bio-degradable versus bio-based confusion • Consumer apps	• Lack of standar-disation and collaboration between cities
Policy & Regulation	• (Value-chain) collaboration versus Antitrust • Harmonisation of standards and definitions	• Certification & Industry Standards (other than bio-based) • Dynamic standards; from prohibition to effect based controls	• Extended Producer Responsibility • Certification & Industry Standards • Dynamic standards • Legal clarity/standards for EoW and ByProducts • Preferred position in hierarchy for re-	• Antitrust in joint logistics concepts for inner cities/ between cities

Policy & Regulation		• Eco-Design (of for example non electrical appliances, link with resources and energy efficiency) • Substitution of critical substances or substances of high concern	use-repair-refurbish-remanufacture • Conflicting regulation & subsidies energy-waste/recycling • Status of Bio-fuels preparation in waste hierarchy: energy recovery or recycling? • Lack of Resource Passport • No tradable permits	
Access to financing	• Removal of distorting subsidies • Private funding (not only focus on governmental subsidies) • Impact of stranded assets • Transparency, Integrated Reporting and more ESG consideration • Liability, insolvency and insurance challenges with lease models	•	• Lack of VAT differentiation based on sustainability (for example no reduced VAT for recycled content)	•
Technological/Infrastructural/ Economical	•	• Lack of Competences & Knowledge • Importance of new Business Models and Design for sustainable footprint (eco-design, circular design, design for reuse- repair-refurbish-remanufacture-recycling, design for services instead of ownership)	• Lack of Specific Skills	•

Table: comparing the R2G2 Programme findings with literature findings. Blank spot and future barriers for R2G2

5 Bibliography

- Arcadis. (2010). Analysis of the evolution of waste reduction and the scope of waste prevention. Retrieved from European Commission DG Environment: http://ec.europa.eu/environment/waste/prevention/pdf/report_waste.pdf
- Bio Intelligence. (2010). Technical support to identify product categories with significant environmental impact and with potential for improvement by making use of ecodesign measures, A report by Bio Intelligence services for European Commission. DG EN, Reference: 07.0307/2008/51.
- Chatham House. (2012). Resources Futures. Retrieved from http://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/1212r_resourcesfutures.pdf Commissariat Général au Développement Durable. (2014). Comparaison international des politiques publiques en matière d'économie circulaire.
- Circle Economy (2015) Blog March 9, 2015. *How governments are key for a circular economy*
- Council for the Environment and Infrastructure of the Netherlands. (2013). Dutch Logistics 2040, Designed to Last. Retrieved from http://en.rli.nl/sites/default/files/dutchlogistics2040designedtolastukversie.pdf
- COWI. (2011). Economic Analysis of Resource Efficiency Policies. Retrieved from http://ec.europa.eu/environment/enveco/resource_efficiency/pdf/economic_analysis.pdf
- Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet' Text with EEA relevance , OJ L 354, 28.12.2013, p. 171–200. (n.d.).
- DG Research and Innovation. (2014). Outriders for European Competitiveness – European Innovation Partnerships (EIPs) as a Tool for Systemic Change - Report of the Independent Expert Group.
- De Groene Zaak et all. (2015). Governments going circular. A global scan Dutch Sustainability Business Association.
- EEA. (2013). Environmental pressures from European consumption and production: A study in integrated environmental and economic analysis, EEA Technical report No 2/2013.
- Ehrenfeld , J., & Gertler , N. (1997). Industrial Ecology in Practice – The Evolution of Interdependence at Kalundborg. Journal of Industrial Ecology, p67-79.
- Ellen MacArthur Foundation. (2012). Towards the circular economy: Economic and business rationale for an accelerated transition, Vol. 1.

- Ellen MacArthur Foundation. (2013). Towards the circular economy: Opportunities for the Consumer Goods Sector, Vol. 2.
- ESA. (2013). Going for Growth: A practical route to a Circular Economy. Environmental Services Association UK.
- European Commission. (2011). Communication from the Commission, Roadmap to a Resource Efficient Europe, (COM(2011)571), 20/9/2011. Brussels: European Commission.
- European Commission. (2012). Consultation paper - Review of existing legislation on VAT reduced rates, TAXUD/C1.
- European Commission. (2012a). Communication from the Commission - Innovating for Sustainable Growth: A Bioeconomy for Europe, (COM(2012)60), 13/2/2012. Brussels: European Commission.
- European Commission. (2013a). 2nd meeting of the WORKING GROUP ON FOOD LOSSES/FOOD WASTE in the context of the Advisory Group on the Food Chain, Animal and Plant Health. Retrieved from http://ec.europa.eu/dgs/health_consumer/dgs_consultations/docs/summary_08022013_pt3_en.pdf
- European Commission. (2013b). Communication from the Commission to the European Parliament and the Council - Building the Single Market for Green Products Facilitating better information on the environmental performance of products and organisations, (COM(2013)196), 9/4/2013. Brussels: European Commission.
- European Commission. (2014a). Communication from the Commission to the European Parliament and the Council - Unleashing the potential of Crowdfunding in the European Union, (COM(2014)172), 27/3/2014. Brussels: European Commission.
- European Commission. (2014b). Stop food waste. Retrieved from http://ec.europa.eu/food/food/sustainability/
- European Commission. (2014c). Communication from the Commission - Towards a circular economy: A zero waste programme for Europe, (COM(2014)398), 2/7/2014. Brussels: European Commission.
- European Commission. (2014d). Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directives 2008/98/EC on waste, 94/62/EC on packaging and packaging waste, 1999/31/EC on the landfill of waste, 2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and. Brussels: European Commission.
- European Commission. (2014e). Communication from the Commission on resource efficiency opportunities in the building sector, (COM(2014)445), 1/7/2014. Brussels: European Commission.
- European Commission. (2014f). Communication from the Commission - Green Employment. Initiative: Tapping into the job creation potential of the green economy, (COM(2014)446), 2/7/2014. Brussels: European Commission.
- European Commission. (2014g). Communication from the Commission - GREEN ACTION PLAN FOR SMEs- Enabling SMEs to turn environmental challenges into business opportunities, (COM(2014)440), 2/7/2014. Brussels: European Commission.
- European Commission DG ENTR. (2014). Report on Critical raw materials for the EU. Retrieved from http://ec.europa.eu/enterprise/policies/rawmaterials/files/docs/crm-report-on-critical-raw-materials_en.pdf accessed 6 June 2014

- European Commission DG ENV. (2014). Scoping study to identify potential circular economy actions, priority sectors, material flows and value chains. Funded under DG Environment's Framework contract for economic analysis ENV.F.1/FRA/2010/0044, August 2014
- European Parliament. (2011). How to avoid food wastage: strategies for a more efficient food chain in the EU. Report by the Committee on Agriculture and Rural Development.
- European Resource Efficiency Platform (EREP). (2014). Towards a resource efficient and circular economy, 31 March 2014. Retrieved from http://ec.europa.eu/environment/resource_efficiency/documents/erep_manifesto_and_policy_recommendations_31-03-2014.pdf
- Expert input. (2014). Input from discussions at experts' workshop 'Towards a circular economy in the EU – priorities and options to move forward', 8th May 2014. Brussels.
- German Federal Environment Agency. (2000). How to do ecodesign: a guide for environmentally friendly and economically sound design.
- Green Alliance. (2011). Reinventing the Wheel. Retrieved from www.greenalliance.org.uk/uploadedFiles/Publications/reports/Reinventing%20the%20whel_dbl.pdf
- Hawks, K. (2006). What is Reverse Logistics? Reverse Logistics Magazine.
- Heck, S., Rogers, M. (2014). Resource Revolution. How to capture the biggest business opportunity in a century.
- Hislop, H., & Hill, J. (2011). Reinventing the wheel: a circular economy for resource security. Green Alliance.
- Hjerp, P., Medarova-Bergstrom, K., Cachia, F., Evers, D., Grubbe, M., Hausemer, P., et al. (2011). Cohesion Policy and Sustainable Development, A report for DG Regio, October 2011. Retrieved from http://www.ieep.eu/assets/910/CP_and_SD_Final_Synthesis_Report.pdf
- House of Lords. (2014). Counting the Cost of Food Waste: EU Food Waste Prevention.
- IAU. (2013). Économie circulaire, écologie industrielle, Éléments de réflexion à l'échelle de l'Ile-de-France.
- IEEP. (2014a). Make it Work - Towards a roadmap for future EU environmental regulation. Background paper for the Expert workshop, 2-3 April 2014.
- IEEP. (2014b). EPR study.
- IEEP. (2014c forthcoming). Why a New Policy Framework for Bioresources in Europe?, Key Questions and Answers. 2014 forthcoming.
- IPTS. (2006). Environmental Impact of Products (EIPRO): Analysis of the Life Cycle Impacts related to the final consumption of the EU-25, JRC EUR 22284 EN.
- Keegan, D., Kretschmer, B., Elbersen, B., & Panoutsou, C. (2013). Cascading use: a systematic approach to biomass

- Kok, L., Wurpel, G. & Ten Wolde, A. (2013). Unleashing the Power of the Circular Economy. Report by IMSA Amsterdam for Circle Economy
- Lund, R. (1998). Remanufacturing: An American Resource. In Proceedings of the Fifth International Congress on Environmentally Conscious Design and Manufacturing. NY: Rochester.
- McDonough, W., & Braungart, M. (2002). Cradle to Cradle: Remaking the Way We Make Things.
- McKinsey Global Institute. (2011). Resource revolution: Meeting the world's energy, materials, food, and water needs. Retrieved from http://www.mckinsey.com/insights/energy_resources_materials/resource_revolution
- Oosterhuis, F., & ten Brink, P. (2014). Paying the Polluter. Environmentally Harmful Subsidies and their Reform. Cheltenham: Edward Elgar.
- One Planet Architecture institute, Amsterdam, MVO Nederland (2014). Ondernemen in de Circulaire Economie.
- Project C2CBizz (2013). Guided Choices Towards a Circular Business Model.
- Raksit, A. (2014). Ahead of the curve. How the circular economy can unlock business value.
- Schulte, U. (2013). New business models for a radical change in resource efficiency.
- Singhal, P. (2006). Integrated Product Policy Pilot on Mobile Phones Stage IV Final Report: New Environ-mental Initiatives & Experiences from the pilot. Retrieved from http://ec.europa.eu/environment/ipp/pdf/final_report_mobile.pdf
- SIRA Consulting (2011-2013). Wegnemen van belemmeringen in de bio-based economy.
- Swiss Academy of Arts and Sciences. (2014). Circular economy – Improving the management of natural resources.
- The Ex'tax Project (et al.) (2014). New era. New plan. Fiscal Reforms for an inclusive, circular economy. Case Study the Netherlands.
- TNO . (2011). Analysis of the future application of product policy instruments in the EU: Summary Report integrating key results of Task 1, 2 and 3, TNO-034-DTM-2010-03627-O104830-DZF-PEM-24039 | 1.4.
- TNO. (2013). Opportunities for a Circular Economy in the Netherlands, The Netherlands Organisation for Applied Scientific Research.
- VHK. (2011). Study on Amended Working Plan under the Ecodesign Directive, Final Report Task 1 & 2, Final Report Task 1 & 2 Version: 16 December 2011.
- Withana, S., ten Brink, P., Franckx, L., Hirschnitz-Garbers, M., Mayeres, I., Oosterhuis, F., et al. (2012). Study supporting the phasing out of environmentally harmful subsidies. A report by the Institute for European Environmental Policy (IEEP), Institute for Environmental Studies (IVM), Ecologic Institute and VITO for the European Commission. Brussels: DG Environment.

- Withana, S., ten Brink, P., Illes, A., Nanni, S., & Watkins, E. (2014a). Environmental tax reform in Europe: Opportunities for the future, A report by the Institute for European Environmental Policy (IEEP) for the Netherlands Ministry of Infrastructure and the Environment. Final Report. Brussels.
- Withana, S., ten Brink, P., Mazza, L., & Russi, D. (2014b). Hidden subsidies: the invisible part of the EHS iceberg. In F. Oosterhuis, & P. ten Brink, Paying the Polluter. Environmentally Harmful Subsidies and their Reform. Cheltenham.
- World Economic Forum & Ellen MacArthur Foundation. (2014). Towards the Circular Economy: Accelerating the scale-up across global supply chains. Retrieved from http://www3.weforum.org/docs/WEF_ENV_TowardsCircularEconomy_Report_2014.pdf

Appendix I: Barriers and drivers for a circular economy

(Summary EU Scoping Study to identify potential circular economy actions, priority sectors, material flows & value chains, 2014 for DG Environment)

To address part of the wider picture of the circular economy, a range of policies and measures are already in place in the EU:

- Regulations (e.g. landfill bans, or product standards that embody design for durability, recovery and recycling),
- Market-based instruments (e.g. taxes on consumption of non-renewable resources, for both materials and energies),
- Information tools (e.g. labelling, certificates),
- Principles (e.g. producer responsibility) and hierarchies (e.g. the waste hierarchy),
- Voluntary approaches (e.g. CSR, reporting),
- Trade rules, etc.

Despite these efforts, there remains a range of opportunities to be realised, costs to be avoided, and a series of obstacles to address in order to go further and move towards a circular economy.

Most of the publications analysed in this literature review address the key drivers and barriers towards circular economy. These drivers, as well as the possible challenges and associated policy recommendations, are summarised in the table below.

Drivers and barriers have first been described and analysed for the general framework conditions necessary to move towards a circular economy, before being examined for each major stage of value chains/ supply chains :

- Design and production;
- Consumption;
- Recycling and recovery;

Lastly, as the transition to a circular economy has implications for logistics flows at all scales, drivers of a circular economy and associated barriers have been considered in the field of Logistics.

Logistical issues and solutions are cross-cutting, i.e. relevant at any stage of a value chain. Whether drivers and obstacles are stemming from policy, regulation or the legal framework, or linked to social, cultural, economic, technological or infrastructural contexts, there is rarely only one driver in one sector or value chain.

Typically several factors are in play and often the factors influence each other. For instance, an infrastructure to support the efficient collection of products after use (”reverse cycles” *[1] or ”reverse logistics”, i.e. ”a process of moving goods from their typical final destination for the purpose of capturing value, or proper disposal” *[2]), which is an essential component for a circular economy, can be heavily influenced by various levers: policy instruments (such as landfill tax), extended producer responsibility (EPR), new business models and take-back schemes. The list of examples below is non-exhaustive but primarily targets policy-oriented drivers. The recommendations and other data are as described in the literature and they concern all levels of policy (European, national, and regional levels).

* Towards the circular economy: Economic and business rationale for an accelerated transition, EMF (2010)
** Hawks, Karen. "What is Reverse Logistics?”, Reverse Logistics Magazine, Winter/Spring 2006.

Type of lever	Description of the lever and of their importance for circular economy	Associated challenges or barriers	Policy recommendations
General framework conditions	It seems necessary to move to valuation methods that **take into account the economic value of environmental externalities** (damages avoided or caused).[33] Three ways to promote circular economy by making the true cost of many of our resources visible are : - Economic incentives (internalisation of	• A barrier is the lack of internalisation of externalities[34] and the lack of resource pricing (cost recovery and pricing for the resource itself) which lead to economic signals that do not encourage a transition to a circular economy • The challenge is to get the prices right, i.e. to m**ake the true cost of resources apparent** in prices: proper evaluation of environmental externalities requires the correct understanding of environmental cost (not only the cost of compliance with	• **Regulations and choice restrictions** (such as the transition from incandescent light bulbs to energy-efficient lighting alternatives) can be used as **a partial means of appreciating externalities** so that circular economy based approaches can compete on a more even footing.[35] - **Extended Producer Responsibility (EPR) policies** are a way to internalise waste negative impacts. In the field of waste management, EPR is a strategy promoting the integration of environmental costs associated with goods throughout their life cycles into the market price of the products. It makes the manufacturer of a product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal. EPR policies have the advantage to incentivize producers

33 Various sources among which the Aldersgate Group (2011) and the IAU (2013) studies
34 Internalisation of externalities: incorporation of an externality into a market decision through pricing or regulatory interventions. For instance, internalisation can be achieved by charging polluters with the damage costs of the pollution generated by them, in accordance with the polluter pays principle. [Source: European Conference of Ministers of Transport. Social costs glossary. CEMT/CS (97) 12.]
35 Example: a carpet manufacturer's circular economy based product competes against 'one use' manufacturing processes coupled with low cost landfill disposal for the end of life product. In EU countries where landfill disposal of carpet is prohibited, the circular economy product is increasing in market share. See Resilience in the Round: Seizing the growth opportunities of a circular economy, Aldersgate Group (2011)

	externalities); - Tax measures strong enough to change business behaviour - Subsidies to support virtuous and eco-friendly behaviours.	existing regulations and standards), choice of valuation technique, setting the time horizon, assessing distributional impacts and issues at different points in time, and evaluating risk, uncertainty, and ethical considerations. • Challenges regarding the **implementation of economic incentives and fiscal measures** supporting the development of a circular economy: - Administrative costs and monitoring of fiscal measures; - Lack of enforcement of legislation; Resistance to change – tax breaks require active decision by lawmakers to eliminate them; - Some incentives are perverse (incinerators that are too cheap;	to design more sustainable, less toxic, and easily recyclable products. • **Fiscal measures** - **Fiscal incentives** for individuals and companies to put materials back into circulation can help the transition to a circular economy – e.g. land-value taxes, value-extracted taxes, product levy and 'recovery rewards'. Example of a possibly impactful product levy: the phosphate levy.[36] - **Resource taxes** – tax base is the physical amount of the resource extracted – e.g. Aggregates Tax, (implemented in 16 European countries and reduced sales of virgin aggregates by 18m tons); Mineral Oil Tax (implemented in almost all European countries); Peat (Latvia, Lithuania, Sweden).[37] - **Removal of distorting subsidies** on resources, energy and land.[38] • **Subsidy schemes** - Enable businesses that use environmentally-friendly resources to write off a random percentage of the costs of

36 Phosphate fertiliser underpins modern agriculture, and there is no substitute. Agriculture currently depends on ready access to phosphate rock, while considerable losses of phosphorus, between farm and plate, are not being addressed and while secondary sources of phosphate (in manure, human sewage, food and crop residues) are treated as wastes rather than as valuable nutrient resources. Green Alliance recommends the examination of a phosphate levy to raise money for phosphate recovery and recycling.
Source: Hislop. H. and Hill, J. (2011), Reinventing the Wheel: A Circular Economy for Resource Security (Green Alliance).
37 Economic Analysis of Resource Efficiency Policies, COWI (2011)
38 A Global Redesign : Shaping the Circular Economy, Chatham House (2012)

		taxes only levied on fossil fuels, but not on products based on fossil raw materials; subsidies, etc.). - Barrier to Extended Producer Responsibility policies: critics are concerned that manufacturers may use take-back programs to take second-hand valuable products (e.g., electronics) off the reuse market, by shredding rather than reusing or repairing goods that come in for recycling.	their business resources for a random year (e.g., The Random Depreciation of Environmental Investments, VAMIL, in the Netherlands). In the United States companies producing liquid biofuels receive direct subsidies for every gallon of ethanol produced.
Design and production	**Improving material selection, product design** (standardisation/modularisation of components, purer material flows, and design for easier disassembly) and **changing production methods** are levers for a circular economy.[39]	**Lack of skills in circular product design and production** • Lack of practice and infrastructure for the segregating of biological from technical nutrients and phasing out toxic materials are under-used and are therefore a priority. [40] • Knowledge development for the design process will have to focus on the art of combining constantly evolving standardization with designs that still allow manufacturers to	• **Investment and support programmes in eco-design and eco-innovation** - Support the investment in key technologies, e.g. in 3D printing and determine which components are most suitable for it. - Avoid using combinations of materials and include reusable parts in the design of products – e.g. Framework Programme Renewable Resources (Germany, € 800m fund), Resource Efficiency Science Programme (UK), piloting resource efficiency elements in under EU Ecodesign. - Governments could encourage the foundation of an extensive raw materials information service and increase

39 Towards the circular economy: Opportunities for the Consumer Goods Sector, EMF (2012)
40 Towards the circular economy: Opportunities for the Consumer Goods Sector, EMF (2012)

		distinguish themselves from their competitors.[41] • A substituted product does not necessarily help to reduce pressure on the environment but leads to increases in energy consumption e.g. plasma display panels. • Risk-averse behaviour by local governments regarding innovation (e.g., long wait for licences for technologies unfamiliar to new or low level local government officials). • Lack of dissemination about best practices – e.g. **SMEs** and sole traders have difficulties to keep up to speed with what is required due to a lack of funds for dissemination • Lack of information about green suppliers • Over communication, e.g. mail shots • Need a champion, i.e. individuals/ businesses who can promote resource efficiency[42]	the dissemination of knowledge about the development of new materials [43] • **Promoting cleaner production methods in SMEs** (metal processing, metal finishing, and food processing industries[44]) by offering a **production-integrated environment protection tool** where the relevant material flows and current level of production technology are analysed, and where recommendations are made. Example: EFA PIUS-Check initiative: the North Rhine-Westphalia (NRW) Ministry developed a toolbox to help SMEs improve their resource efficiency through avoiding pollution and improving re-source conservation in the production process. Scaling up the results of the PIUS policy pursued in the NRW to all SMEs in EU27 would create a potential economic benefit of EUR 776 million.[45] • **Support programmes** for existing local initiatives and networks – e.g. Resource Efficiency Clubs (UK) which provide opportunities for SMEs to engage in a range of activities, such as workshops, networking, best practice exchange, expert lectures, local projects, online forums and joint procurement.[46] • **Information Networks** – e.g. Environmental Sustainability

41 Opportunities for a circular economy in the Netherlands, TNO (2013)
42 Business Resource Efficiency, AEA (2009)
43 Opportunities for a circular economy in the Netherlands, TNO (2013)
44 The PIUS-Check initiative has been particularly successful in introducing cleaner pro-duction methods in the metal processing, the metal finishing and the food processing industries. For more details see Economic Analysis of Resource Efficiency Policies, COWI (2011)
45 Economic Analysis of Resource Efficiency Policies, COWI (2011)

			Knowledge Transfer Network (UK), Envirowise website (UK), Green Suppliers Network (US), Green Purchasing Network (Japan),[47] TUV (certifier of products in Germany). • Local advertising and awareness raising campaigns especially via radio • **Free (to business) advice and networking program at a regional level** to identify resource exchanges between companies for sustainable resource management solutions Example: National Industrial Symbiosis Programme (NISP) is a national programme, applied at a regional level across the UK. Each of the UK regions has a team of 'Industrial Symbiosis Practitioners' working closely with businesses in their area to recruit members to the programme and help them form symbiotic relationships with each other. As of May 2010, membership of NISP exceeded 13,400 companies of all sizes, and 40% of these have actively been involved in at least one synergy project. All NISP facilitation costs are covered by government; hence the members do not pay any fees. The potential cost saving of NISP at UK level is EUR million 187, and at the EU level it is EUR million 1 411.[48]
	Rethinking supply chains by taking industrial symbiosis possibilities into account, i.e. developing a good knowledge	**Lack of enablers to improve cross-cycle and cross-sector performance** • Many businesses are unaware of the	• The absence of a cultural context for inter-firm trust and collaboration can be mitigated through institutional mechanisms such as brokers or planning agencies, whose role is more than a waste exchange. Where typical waste exchanges

46 Resource Efficiency Clubs (RECs) enable businesses to work with each other in their area to reduce their resource consumption and waste production, as well as increase their energy efficiency, overall environmental performance and sustainability. See business success stories here.
47 Economic Analysis of Resource Efficiency Policies, COWI (2011)
48 Economic Analysis of Resource Efficiency Policies, COWI (2011)

	of the energy and material flows of an industrial sector or geographical area so as to optimize their use and see where they can be improved	exact origin or the composition of the raw materials they use. • Symbiosis requires exchange of information about nearby industries and their inputs and outputs that is often difficult or costly to obtain. In the Kalundborg model (*see Figure 1 in part* A), the city's small size of about 12,000 residents and its relative isolation have created a tight-knit community in which employees and managers interact socially with their counterparts on a regular basis. If, in Kalundborg, no deliberate institutional mechanism was needed to promote inter-firm trust, elsewhere, especially where there is a strong tradition of company privacy, such natural communication is much more difficult to find.[49]	merely list available by-products, such planning agencies would perform every function required to turn a by-product into a feedstock, including finding appropriate uses, dealing with regulatory agencies, brokering necessary agreements, and even transporting the materials from the generator to the user.[50] • As in Denmark (see description of Kalundborg industrial symbiosis in in Figure 1), the regulatory system would benefit from being be consultative, open, and flexible: instead of being put on the defensive (characteristic of a command-and-control framework), firms, in Denmark, are required to be proactive by submitting plans to the overseeing county government detailing their efforts to continually reduce their environmental impact. A key aspect of the flexibility required here is that **regulatory requirements are mainly in the form of performance standards stating the degree of the desired decrease**, instead of technology standards as is common in the United States. Indeed, technology standards assure that uniformly effective pollution-control methods are adopted throughout a given industry but tend to hinder technological or infrastructural innovation. Yet, there are disadvantages to the Kalundborg system (see description of Kalundborg industrial symbiosis in in part **Error! Reference source not found.**): potentially lower levels of technical compliance and high transaction costs incurred in extensive consultations around permitting.

49 "Industrial Ecology in Practice – The Evolution of Interdependence at Kalundborg", J. Ehrenfeld and N. Gertler (1997), Journal of Industrial Ecology
50 "Industrial Ecology in Practice – The Evolution of Interdependence at Kalundborg", J. Ehrenfeld and N. Gertler (1997), Journal of Industrial Ecology

			Although U.S. technology standards are inflexible, they ensure a certain minimum level of pollution control.[51]
Consumption	• The move from product to service for consumers (consumer-as-user)[52] is instrumental in translating products designed for reuse into attractive value propositions. • The 'peer-to-peer' economy' (e.g. for transportation and housing, like Lyft and Airbnb) also enables access to products and services instead of ownership. • Repair and reuse is key to create economic loops • Improving consumer knowledge on origins and perishability and incentivising consumers to generate less waste is key	• Changing from ownership to usage and performance-based payment models and expanding the product definition to embed it in related services require good knowledge of value chain participants' needs and ongoing innovation. • While there has been a discernible societal shift towards access rather than ownership (e.g. carpool), consumer acceptance needs to grow significantly. In addition, there must be a realignment of cultural values and incentives – particularly in the sales functions of businesses (consumers tend to look more at the purchase price of a product and less at the entire lifecycle costs).[53] • Anti-trust concerns led firms to end pay-per-use schemes in the past (e.g. Xerox and IBM formerly rented their	• Support and promote innovative leasing and rental contracts to (pay-per-use instead of ownership) – e.g. Michelin pay-for-use tires for truck fleets. • Expand the product definition to embed it in related services (e.g., power tools combined with building kits and training).[55] • Encourage the 'peer economy' – e.g., LETS circles (local, non-profit swap networks where goods and services can be exchanged without the need for money)[56] • Encourage repairs through Internet services[57] – e.g. Lenovo (offers a tool for searching for spare parts on the Internet and provides manuals for repairs), Logitech (has an online parts store), or Fixya.com (an online community that provides people with tips and instructions to solve problems themselves). • Support initiatives promoting repair and reuse, such as: • The **creation of 'repair cafés'** (referenced at www.repaircafe.org, for any country where 'repair cafés' exist) where residents take their broken goods to repair them with the assistance of experts. • The iFixit website (www.ifixit.com), an interesting pilot project: it is a global community of people helping each other

51 "Industrial Ecology in Practice – The Evolution of Interdependence at Kalundborg", J. Ehrenfeld and N. Gertler (1997), Journal of Industrial Ecology
52 Dutch Logistics 2040, Designed to last , Council for the Environment and Infrastructure study (2013)
53 Resilience in the Round: Seizing the growth opportunities of a circular economy, Aldersgate Group (2011)

	to build a circular economy • Waste separation at source is key • Public institutions are also consumers: sustainable procurement measures for public authorities should be taken into account in designing a more circular economy	machines). Users can become dependent on the producers, because of long-term contracts for example.[54] • Risk of "cannibalisation": there will be a number of winners and losers in the shift to a circular economy. As new business models develop and there is a shift from ownership to services, the result will be various 'cannibalisation rates' where certain businesses lose market share to innovators. Vested interests will seek to maintain the status quo and be resistant to change. • Lack of information on product perishability: there is confusion between 'Best before' (BB) and 'Use by' (UB) labels • Lack of standardization of methodologies applied in different countries for labelling products:, the cost of assessing resource consumption for individual firms, and	repair things (online advice and video), and iFixit has its own online shop of repair tools and replacement parts (for all popular gadgets, from iPhone batteries to MacBook displays) • Develop consumer knowledge on perishability of products (e.g. GS1 DataBar, informational barcode about the shelf life of a product). • Develop consumer knowledge on origins: a certification or labelling system for circular economy products would help to build awareness among consumers, encourage rapid uptake by companies and reward leading companies by allowing them to capture a green premium. • Develop incentives such as. PAYT (Pay as you throw) or DIFTAR, a system of differentiated tariffs where citizens are charged according to the amount and type of waste they generate • Waste separation at source: separate food waste collections to become widespread for households and businesses • Municipalities can develop mobile phone apps to inform citizens about waste collection points and 'repair shops'. • The circular economy concepts could be fostered in university curricula (e.g. fellowship program of the Ellen MacArthur Foundation, aimed at fostering aimed at fostering the circular

55 Towards the circular economy: Opportunities for the Consumer Goods Sector, EMF (2012)
56 "LETS circles use tax-free, local forms of credit, so people do not have to trade over there directly. A member of a LETS circle can for example earn credit looking after the child of one member and later spend it on a carpentry service performed by another member in the same LETS circle. The local LETS circle centrally registers credit earned and spent and this credit is visible to all members of the LETS circle. The members also determine the amount of credit necessary for specific c goods and services." (LETS, 2011 and Wikipedia, 2013b)
57 Dutch Logistics 2040, Designed to last , Council for the Environment and Infrastructure study (2013)
54 Opportunities for a circular economy in the Netherlands, TNO (2013)

		the absence of a widely recognized, independent organization to award certification on resource efficiency or circular economy criteria. • Lack of incentives preventing households from generating waste • Lack of **education** on the opportunities and drivers of circular economy	economy issues which encompass participation of Imperial College London, London Business School and Cranfield University)[58]. • Public procurement: obligations for public-sector agencies and government departments to purchase resource-efficient and cradle-to-cradle products. In many countries this is a powerful lever for creating markets for more sustainable goods and encouraging innovation.[59]
Recycling and recovery	The development of recycling and recovery infrastructure, processes and technology is a important feature to support a circular economy.	• Over the last decade consumer products have become considerably more complex, making effective and efficient recovery a massive challenge. • Future market developments are highly uncertain so investing in large-scale recycling is perceived as very risky. • Although reduction in the use of raw materials is positive, in the case of some products, economically viable recycling is no longer possible and has led to the suboptimal reuse of materials • Availability of products components	• There may be a role for Government to stimulate recycling and recovery through investment support in regional infrastructure and for companies seeking to develop in this market. [60] • Set up Business parks, Business Improvement Districts and other **clusters of SMEs to facilitate collective long term contracts for recyclable waste collections.** This will make it cheaper to invest in collection and recycling infrastructure.[61] • The end-of-waste criteria allow precious natural resources to come back into the economy by facilitating and promoting the recycling in the EU. Legal clarity of regulations is therefore needed and can be achieved by harmonising quality criteria across the whole of the EU. Furthermore, progress remains to be made regarding the status of a 'by-product' or the concept of 'reuse', to comply with the waste management hierarchy,

58 http://www.ellenmacarthurfoundation.org/education/schmidt
59 A Global Redesign : Shaping the Circular Economy, Chatham House (2012)
60 Towards the circular economy: Opportunities for the Consumer Goods Sector, EMF (2012)
61 Going for Growth: A practical route to a Circular Economy, ESA UK (2013)

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62 Évolution du statut de déchet : une contribution à l'économie circulaire ?, Droit de l'Environnement n°128 (2013)
63 Opportunities for a circular economy in the Netherlands, TNO (2013)

		for repair by independent operators is often blocked by businesses that have a monopoly on supplies of components or products.	which emphasizes reuse before recycling. The legal status of by-products should help promote direct eco-industrial synergies in so far as by-products defined as such remain non-waste.[62] • Removal of a number of regulatory obstacles to the use of biotic waste streams could make it easier to use them as bio-based. Example: "An amendment to Dutch waste regulations (Dutch Environmental Management Act, chapter 10), which came into effect in March 2011, has meant that some agricultural and forestry waste streams are no longer regarded as waste products, so that the waste regulations no longer apply. The amendment originates from the European Waste Framework Directive and has removed many obstacles, although there are conditions. Materials such as crop residues and wood shavings must be used for agricultural or forestry purposes, or to generate energy, and they must not be harmful to humans or the environment."[63] • Develop knowledge for biotic waste to be reused and transformed through biorefining (potatoes, maize, straw, potato haulm, draff, sugar beet) • Incentivize suppliers and retailers to assume mandatory take-backs if a product remains unsold (magazines, bread, etc.)

62 Évolution du statut de déchet : une contribution à l'économie circulaire ?, Droit de l'Environnement n°128 (2013)
63 Opportunities for a circular economy in the Netherlands, TNO (2013)

Logistics	The transition to the circular economy has implications for logistics flows at global, national and local levels. Logistics is primarily a matter of organising, planning, managing and handling cargo flows, from purchasing via production and distribution to the end user, including return flows and supply chain management in general. At the global level, the more control companies wish to exercise over the full lifecycle of a product, the more attractive it becomes to operate close to the customer (near-sourcing). At the national level, the transit functions will change. At the local level, an increase in transport movements will occur due to the increase in near-sourcing and e-commerce, but also to an increase in service logistics and reverse logistics.	• Each city develops its own transport flows system, which leads to confusion among shippers and transporters. Policies between municipalities for transport need to be harmonized (loading times, weights and measures, etc.) • Network design and management need to be improved and better interconnected so as to switch to a different mode of transport in the case of disruptions.[64]	• Streamline transport flows and urban distribution : - Business-to-business concepts such as Green City Distribution, Binnenstadservice, Cargohopper (in the Netherlands); - Business-to-consumer concepts such as DHL; - System solutions (partnership between retailers on the same street or by sector/product; cooperation between transport companies). Digitisation is one of the tools available to shape partnerships.[65] • Municipalities could invite shippers to develop concepts for city logistics through innovative (i.e. flexible and incentivising) tendering and supply chain-transcending cooperation. Tenders would formulate clear end goals, including noise and air emissions, maximum number of transport movements, and load factor for both inbound and outbound flows, service logistics, and involvement of all stakeholders.

64 Term used in logistics to refer to the transport of people and goods across the last metres to the final destination.
65 Dutch Logistics 2040, Designed to last , Council for the Environment and Infrastructure study (2013)

Appendix II: Barriers and Drivers for a Circular Economy

(IMSA: unleashing the power of the circular economy, 2013)

	Obstacles	Niche steps	Mainstreaming steps
Financial	1. Major up-front investment costs 2. Environmental costs (externalities) are not taken into account 3. Shareholders with short-term agenda dominate corporate governance 4. Recycled materials are often still more expensive than virgin 5. Higher costs for management and planning	1. Set up a **simple index** for circular performance. Organisations (companies, harbours, governments, investors) can use this to give incentives to their value chain partners encouraging circularity	10. Replace traditional financial reporting by mandatory and accountable **integrated reporting** and develop the concept of True Value 11. Create a **tax shift** from labour towards natural resources
Institutional	6. Unlevel playing field created by current institutions 7. Financial governmental incentives support the linear economy 8. Circularity is not effectively integrated in innovation policies 9. Competition legislation inhibits collaboration between companies 10. Recycling policies are ineffective to obtain high quality recycling 11. Governance issues concerning responsibilities, liabilities and ownership	2. **Encourage experimentation**, innovation and redesign. In NL, use Green Deals to remove legislative obstacles and support access to finance and a resource passport 3. Gather and spread **successful business examples** 4. Integrate circular economy principles in **education and training** programmes (leadership, in-company, MBA, economics, engineering, design and policy sciences)	12. Implement a **new economic indicator** beyond GDP that steers towards circularity 13. Establish international **independent systems to organise materials flows,** including data gathering and exchange, labelling and certification, impact assessment, standardisation and material pooling
Infrastructural	12. Limited application of new business models 13. Lack of an information exchange system 14. Confidentiality and trust issues hamper exchange of information 15. Exchange of materials is limited by capacity of reverse logistics	5. Develop a **long-term company vision** identifying linear risks and circular economy opportunities 6. Search for **material pooling** opportunities	14. Adjust national and international government **policies** for corporate governance, accounting, competition, recycling, and health, safety and environment
Societal	16. Lack of awareness and sense of urgency, also in businesses 17. GDP does not show the real progress or decline of our society 18. Resistance from powerful stakeholders with large interests in status quo	7. **Promote circular products** using modern marketing techniques and social media 8. Prepare **roadmaps** for established economic sectors 9. Initiate and stimulate **stakeholder fora** about the circular economy	
Technological	19. Limited attention for end-of-life phase in current product designs 20. Limited availability and quality of recycling material 21. New challenges to separate the bio- from the technocycle 22. Linear technologies are deeply rooted		

Table 1 Overview of obstacles, niche steps and mainstreaming steps for the circular economy. For the analysis of obstacles see Appendix I; for the steps see sections 4.2. and 4.3.