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The circular economy: reconciling economic growth with the environment

POLICY PAPER NOVEMBER 2016

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There is no desire more natural
than the desire of knowledge

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Since the Nobel Peace Prize was awarded in 2007 to the members of the Intergovernmental Panel on Climate Change (IPCC), a genuine international consensus has formed around the need to curb climate change. This objective was enshrined during the COP21[1] in Paris, in December 2015. The same attention should fall on other major environmental challenges that need to be tackled, including access to water, increasing soil degradation, loss of biodiversity, local atmospheric pollution, etc.

Without claiming to offer a definitive solution, this report sheds light on a major area – the circular economy – which can help us to face such challenges whilst safeguarding economic development. By reducing waste throughout the value chain (from producer to end-user) and by coming up with new models that reduce negative externalities for society, a circular economy transition provides levers for economic growth that can help preserve the natural capital as well as the raw material that exist only in limited amounts.

A few figures suffice to demonstrate that such growth potential exists: in Europe, a car spends 90% of the time parked; 31% of agricultural raw materials are lost during market uptake or by final consumers; and 50% of the inhabitants indicate living in a too big housing for them. The list goes on. In response to this situation, a few pioneers are imagining innovative and value-added solutions, for example to promote carpooling or limit food waste. Such examples are found in almost all sectors of the economy and in countries all over the world. China and the Japan are developing new approaches; in Europe, countries such as Denmark and the Netherlands are leading

[1] 21st Conference of the Parties to the United Nations Framework Convention on Climate Change.

the way, and interesting initiatives also exist in France. Many companies have made innovative changes to their business models, products or processes.

The transition to a more circular economy is underway. But what can be done to speed it up? It appears that five principles must be the driving force behind our actions:

- **Focusing on innovation:** the above-mentioned opportunities for «circular growth» will rely on new technologies and organisations, which will in turn have to be supported by public authorities;

- **Adopting a comprehensive, global approach regarding the offer as well as the demand:** developing reliable indicators; this means influencing behaviour on every level, from producers to consumers;

- **Taking into account the differences between sectors and enhancing public/private cooperation:** the challenges are different for every sector, and a dialogue must be established between public authorities and economic actors, with the latter providing suggestions as to how the barriers to a more circular economy can be removed;

- **Measuring progress:** developing reliable indicators, that cover the entire value chain, for example in order to adequately evaluate imported products, or the way in which consumers use final products;

- **Not being limited to more developed countries:** the principles of the circular economy can be applied at all stages of development,

and much like Africa has adopted the mobile phone by bypassing the home phone, it can move onto an industrialisation based on the circular economy without dealing with the foibles of a linear system.

Upon the COP22 in Marrakesh, and with the Circular Economy Package that will soon be unveiled by the European Commission, we hope that the recommendations within this report will contribute to developing solutions that combine economic growth and environmental protection.

I

WHAT IS THE CIRCULAR ECONOMY?

The concept of the circular economy comes from the idea that waste, once adequately treated, can become a resource again become a resource, thereby forming a loop in the production-consumption chain. Nevertheless, it is also a wide-reaching concept with a number of accepted meanings that should at present be analysed. This next section therefore compares the most common definitions, to arrive at the one adopted in this report:

"The transition to a circular economy encompasses all of the changes which allow different economic actors (including end-users) to continue creating value whilst preserving the natural capital and using increasingly fewer limited resources."

The point is to ensure that economic activity consumes less natural capital than it can regenerate, by mobilizing all levers, from the most traditional (such as recycling) to the most innovative (and notably the digital technology and its many possibilities: sharing platforms, virtualization, 3D printing, etc.).

a. An evolving concept

The concept of the circular economy is **rooted in the observation of physical phenomena and natural cycles.** A famous saying attributed to Lavoisier, "nothing is lost, nothing is created, everything is transformed", is often evoked as the best summary of the circular economy. This expression, from his 1789 *Elementary Treatise of Chemistry*, was a reformulation of an idea expressed by the pre-Socratic Greek philosopher, Anaxagoras: *"nothing comes into*

existence nor is destroyed, but there is mingling and separation of things that are".

The concept however became grounded in its **opposition to the linear economy.** The latter, a product of the industrial revolution, relies on the following chain: *"extraction of raw materials – transformation into a product – consumption of the product – production of waste".* The viability of such an economic model began to be questioned once the international community became aware that the resources used by man were becoming increasingly scarce. As such, the report[2] published by the Club of Rome in 1972 established the first cyclical economic models.

This report created a model of global growth by simulating the consequences of resource use, population growth, pollution and soil erosion. These simulations suggested that there was a real risk of the terrestrial ecosystem collapsing in the medium-term[3], as it would be destabilised by exponential growth. The report notably urged for a change in minds, with the aim of maintaining the population and per capita rate of industrial production within a range that was sustainable in the long term. This approach is based on the idea that infinite growth cannot be envisaged in a world of finite resources. The term itself was employed for the first time in 1989 by two environmental economists, David W. Pearce and R. Kerry Turner, in *Economics of Natural Resources and the Environment*.

[2] *The Limits to Growth,* 1972, Dennis L. Meadows, Donella H. Meadows Jørgen Randers, Club of Rome.

[3] According to the report's scenarios, the collapse would occur during the 21st century, and in come cases from 2030.

The concept of the circular economy is therefore based on **two simple ideas:** on the one hand, the awareness that **what is considered waste can be re-used as a resource,** much like the process at work within natural cycles; on the other hand, **the need to decouple economic growth from natural resource use.**

b. Definitions converging towards one main objective: sustainable economic growth

Many definitions are focused on **efficiently using resources and prolonging the life of materials through recycling and reuse.** In particular, the European Union refers to such a definition. This is how the European Commission described the model when it published the Circular Economy Package in December 2015.

In France, article L. 110-1-1 of the Environmental Code, introduced by the Law of 18th August 2015 on energy transition to green growth, reflects this approach and specifies the means by which it is to be implemented.

Thus, *"the circular economy is usually defined by the idea of saving and recycling raw materials to avoid the depletion of their stock"*[4], as Christian de Perthuis exposes. Natural resources are then perceived as reserves. The limitations of such an approach have already been evidenced in the fact that it is based on incorrect forecasts of resource depletion. This was demonstrated by the peak oil scare of the early 1970s, which anticipated the disappearance of oil reserves at the beginning of the 21st century.

[4] Christian de Perthuis, "Économie circulaire et transition écologique", *Annales des Mines – Responsabilité et environnement*, April 2014

Today, however, this approach to the environment is disputed, notably by Christian de Perthuis, who has a more dynamic vision of the production and consumption of natural resources. According to him, the environment should be considered as a set of regulatory functions that we should learn to preserve, rather than as an accumulated stock to be efficiently managed. He explains: *"As such, the problem is not determining at what rate we should be using up a stock, but rather ensuring that our behaviour, in terms of production and consumption, is compatible with the natural regulatory functions that make up the true natural capital, our 'green capital'."*

The definition of a circular economy usually includes the protection, if not the regeneration of the environment. The Agency for the Environment and Energy Management (ADEME) explicitly introduces the idea of environmental preservation The Ellen MacArthur Foundation, on its part, lays out the two essential elements of the circular economy – the regeneration and protection of the natural capital on the one hand, and the efficient use of natural resources on the other[5].

Indeed, according to Christian de Perthuis, *"the real challenge of the circular economy is to align our production and consumption cycles with these natural regulatory functions. Going even further, the challenge is to rebuild an economy which uses these natural cycles as veritable factor inputs, in which we need to invest".* However, *"the underlying reason for the destruction of natural capital is that its use is free".*

[5] The different definitions mentioned in this report are presented in extenso in the appendix.

c. Many available levers

The objectives to achieve *via* the development of the circular economy globally reach a consensus. We should therefore identify the concrete levers of action to achieve them.

In France, the ADEME and the Ministry of the Environment split potential circular economy initiatives into six categories:

1. **Sustainable supply,** aiming at reducing the impact of the raw materials supply or replacing non-renewable raw materials by renewable ones,

2. **Eco-design,** aiming at taking environmental impacts into account throughout a product life cycle and integrating them from the very first design stages, (e.g. creation of biodegradable supermarket bags for businesses; manufacturing of machines which are easily repairable and, at the end of their life cycle, recyclable or with a reduced environmental impact.In order to minimise the environmental and health impact of its products, the flooring company Tarkett has implemented a transparent and traceable system to track each of the materials and components making up its products. It thus seeks to ensure that all the raw materials used are assessed, and that towards the end of their life cycle, products can be properly recycled, since information about their components is readily available),

3. **Industrial and local ecology:** establishing a method of industrial organisation characterised by an improved management of stocks and flows of materials, energy and services within the same geographic area,

4. **Function-oriented business models:** focusing on usage rather than ownership; selling services rather than goods. For trucks, Michelin no longer sells tyres but a mobility service that includes the rental and maintenance of tyres, which are insured for a certain number of kilometres,

5. **Prolonging usage through:**
   - **Reuse:** placing products that no longer correspond to the primary needs of the consumer back into the economy (e.g. remanufacturing old computers for Emmaüs communities),
   - **Recovery:** recovering certain waste products or parts of these products still in working order, to use in the development of new products, e.g. composting in homes and the growing popularity of DIY or the reuse of spare parts in cars,
   - **Repair:** giving broken products a second life, e.g. social networks for household maintenance, as illustrated by the local odd-jobs service company *Lulu dans ma rue* ("Lulu in my street"),

6. **Recycling:** reusing waste materials, or even recovering energy from them.

Inset 1: On its own, recycling cannot achieve a decoupling between growth and resource use

Since the beginning of the 20th century, the production and use of steel has been increasing quite steadily at an average rate of 3.5% per year. As such, we have gone from 50 million tonnes in 1900 to over one billion tonnes at the start of the 21st century, doubling every twenty years.

Such an increase in use cannot be provided for by recycling the smaller quantities produced a few years earlier. **In the case of iron, global recycling efforts throughout the 20th century will only have delayed the depletion of mineral ore reserves by around 12 years:** the total amount extracted between 1900 and 2012 (with recycling) would have been reached by the year 2000 if no recycling had taken place during the 20th century.

Iron is not yet considered a scarce resource, and it is already recycled at a high rate in Europe (around 60%, a figure which varies depending on what criteria are used). To pursue global growth and value creation, a medium-term goal must be to find alternative resources or to decrease the use of this resource for economic growth. The issue is far more pressing when it comes to rare-earth elements for instance.

Source : "Les limites du recyclage dans un contexte de demande croissante de matières premières", François Grosse, *Annales des Mines – Responsabilité et environnement 2014/4 (N°76).*

The Ellen MacArthur Foundation offers an even broader scope of action, since in addition to these levers, it includes **other possibilities such as virtualisation** (selling an e-book rather than a paper book, for example) or substitution of raw materials or processes by solutions with a smaller environmental impact (due to the increased efficiency of these new materials or processes; this lever can be compared to the notion of sustainable supply).

This long list of levers demonstrates that the border between the circular economy and the conventional economy is sometimes a subtle one. We may wonder, for example, whether simply extending a product's life by means of technical progress contributes to the circular economy.

In another area, carpooling solutions form part of the circular economy as long as they allow people to share in the use of existing assets (private cars), and more individuals to be transported with as many vehicles. The situation changes when such initiatives take over from greener forms of transport, like trains, or even when individuals purchase a second car to work as private drivers.

Still in the realm of the sharing economy, shared housing solutions form part of the circular economy when individuals rent their home during holidays or offer up a vacant room. However, when accommodation is being rented to tourists throughout the year and never used as a main residence, the solution becomes a substitute for traditional hotels and reduces the availability of housing (potentially leading to new construction); in this case, the desired circularity is not achieved.

In conclusion to this overview of existing definitions, we offer up the following as a concise summary trying to adopt a decompartmentalised approach:

> ***"The transition to a circular economy*** *encompasses all of the changes which allow different economic actors (including end-users)* ***to continue creating value*** *while preserving the natural capital and using increasingly fewer limited resources (whether non-renewable or renewing too slowly compared to consumption)."*

Finally, we should note that whilst recycling is an important part of the circular economy, it cannot be the only one: even an extraordinarily high rate of recycling would not lead to a sustainable decoupling of economic growth from resource use (see Inset 1).

d. Essential characteristics: growth, innovation, collaboration

To complement the definition proposed earlier, it seems important to highlight certain essential characteristics of the circular economy and to specify what it is not.

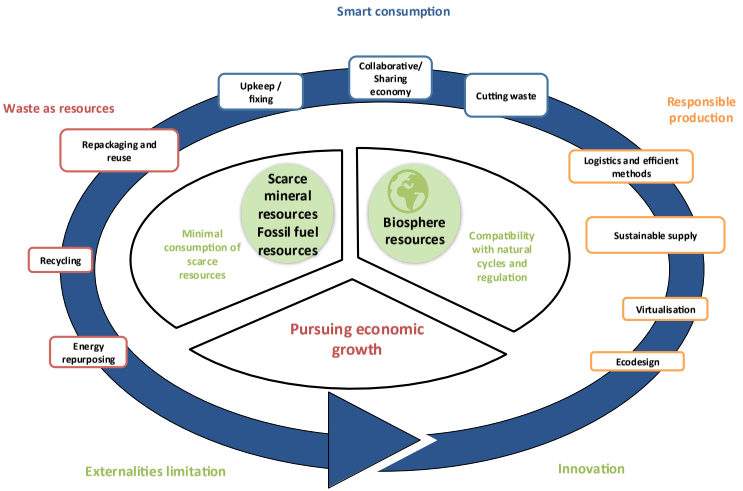
Firstly, the circular economy is not a shrinking economy. Its aim is to provide goods and services, sometimes new ones, to end-users, while minimising the impact on non-renewable resources and natural regulatory functions. **Its objective is not to slow economic growth nor to diminish the benefits for end-users.**

In the same manner, the circular economy is not synonymous with the concept of the frugal economy, as developed by the economist Navi Radjou, which can briefly be defined as "doing better with less". "The frugal economy shares many essential characteristics with the circular economy even if they differ in some aspects. Both of them rely on the existence of profitable business models that allow industrial actors to invest and develop new types of value chain. They both aim to be sources of innovation and growth. However, the circular economy also refers to heavy industry with huge capital expenditures, which is quite far from frugal models".

Compared to a linear economy, which is primarily transactional, **the circular economy encourages greater collaboration between economic actors.** For example, a packaging manufacturer who wants his products to be part of the circular economy needs to collaborate with companies that will provide renewable materials compatible with his industrial processes, as well as with recycling professionals who will collect and recycle used packaging. Similarly, recycling or reusing end-of-life aircraft components requires a close collaboration between recycling professional and aircraft manufacturers who have detailed knowledge of the aircraft design and materials, and who are able to check the quality of a detached piece.

Finally, **the circular economy is not necessary local.** Even though some levers promote an economy based on short-loop and local recycling and reuse, as well as local manufacturing initiatives, certain economies of scale or global value chains can lead to more wide-reaching models, like in the example of the aeronautical sector described above.

Figure 1: Flow chart for a new virtuous economy



The circular economy: many levers to pursue growth and preserve natural capital.

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II

WHAT ARE THE EXPECTED BENEFITS OF A CIRCULAR ECONOMY TRANSITION?

There are many benefits associated with activating the various levers of the circular economy, both for the environment and for economic growth. It is a process of innovation and transformation of business models, which, despite having a very positive overall impact, could see both winners and losers, notably among companies whose value chain will be affected.

a. Earth and humanity: environmental benefits and resource savings

i. Resource savings

A large number of commodities are facing important supply pressures due to limited stocks and an explosion in demand following increases in population and per capita GDP.

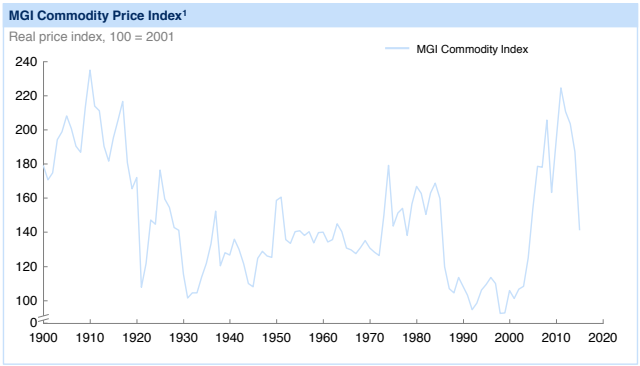
The first advantage of the circular economy is its capacity to limit this pressure, which otherwise leads to high costs, increased price volatility, and, in the long-run, risks of global shortages.

During the 20th century, the cost of the principal natural resources was almost halved on a constant currency basis; meanwhile, the earth's population has quadrupled and there has been a 20-fold increase in global economic output, leading to a rise in demand ranging from 600% to 2,000% depending on the resource. In the first decade

of the 21st century, this trend of falling resource prices was inverted (see Figure 1 from the McKinsey Global Institute - MGI index). This price jump has made the need to save finite natural resources more evident.

It should be noted that, after resisting the 2008-2009 financial crisis and reaching their peak in 2013, commodity prices have dropped significantly over these past three years. It is therefore far from certain that high commodity prices will prove to be a long-term trend. However, and as a consequence of this, we have recently witnessed high price volatility, with variations of almost 100% on the MGI index over 1-2 year periods. In some ways, this increased volatility is both a strong incentive for a fast circular economy transition (to safeguard against such volatility), and a stumbling block in its path (increasing some investment risks (see section IV)).

Figure 1: MGI commodity price index (1992-2016)



[1] Based on arithmetic average of four commodity sub-indexes: food, non-food agricultural raw materials, metals, and energy.

Source: *McKinsey Global Institute.*

ii. Environmental and social benefits

In 2009, an international team of about 20 researchers, led by Johan Rockström from the Stockholm Resilience Centre, identified nine planetary boundaries which, if crossed, would result in abrupt, potentially catastrophic and highly unpredictable changes in the environment. The nine thresholds identified by this team of scientists, and summarised in Table 1, are not all at the same stage. According to the authors, some have already reached alarming levels, such as CO_2 concentration in the atmosphere or the rate of extinction of plant and animal species; others, such as ocean acidification or land use, remain within acceptable levels. Finally, certain thresholds, like the levels of chemical pollution or of fine particles in the atmosphere, are more localised and less easily measurable.

Table 1: Planetary boundaries affected by global growth

Earth-system process	Parameters	Proposed boundary	Current status	Pre-industrial value
Climate change	• (i) Atmospheric carbon dioxyde concentration (parts per million by volume) • (ii) ÉClimate change in radiative forcing (watts per meter squared)	350 1	387 1,5	280 0
Rate of biodiversity loss	• Exctinction rate (number of species per million species per year)	10	> 100	0,1-1,0
Nitrogen cycle (part of a boundary with the phosphorus cycle)	• Amount of N2 removed from the atmosphere for human use (millions of tonnes per year)	35	121	0
Phosphorus cycle (part of a boundary with the nitrogen cycle)	• Quantity of P flowing into the oceans (millions of tonnes per year)	11	8,5-9,5	– 1
Stratospheric ozone depletion	• Concentration of ozone (Dobson units)	276	283	290
Ocean acidification	• Global mean saturation state of aragonite in surface sea water	2,75	2,90	3,44

Earth-system process	Parameters	Proposed boundary	Current status	Pre-industrial value
Global freshwater use	• Consumption of freshwater by humans (km^3 per year)	4 000	2 600	415
Change in land use	• Percentage of global land cover converted to cropland	15	11,7	Low
Atmospheric aerosol loading	• Overall particulate concentration in the atmosphere, on a regional basis	To be determined		
Chemical pollution	• For example, amount emitted to, or concentration of persistent organic pollutants, plastics, endocrine disrupters, heavy metals and nuclear waste, in the global environment, or the effects on ecosystem and functioning of Earth system thereof	To be determined		

Source: Rockström, Johan, et al. "A safe operating space for humanity." Nature 461.7263 (2009): 472-475.

The thresholds and limits put forward in this report are still a topic of scientific debate. Nevertheless, they remain pertinent in that they offer a clear overview of the main environmental risks which humanity is facing. With regard to most of these aspects, **a circular economy transition has a positive role to play, including in the fight against climate change**, the eutrophication of land and water-based environments, atmospheric pollution, and soil degradation.

The issue of climate change took central stage during the last Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21), with the adoption of the Paris Agreement aiming to limit global warming to a level *"well below 2°C above pre-industrial levels"*. The levers of the circular economy can have an impact on these goals. All mechanisms which aim to share or better utilise existing goods, to increase energy efficiency, or to reuse materials

help to reduce CO_2 emissions. In general, this is also the case for recycling, because manufacturing recycled products rather than new products leads to fewer CO_2 emissions. For example, recycling steel from scrap iron produces five times less CO_2 than making new steel in a blast furnace (each tonne of ferrous materials collected saves 1.2 tonnes of CO_2 equivalent). Similarly, recycling aluminium produces 19 times less greenhouse gas than creating aluminium by electrolysis (7.1 t saved per tonne collected). This is the case for all other materials apart from cardboard (see table 2).

Table 2: Reductions in greenhouse gas emissions by material

kg CO_2-eq/ tonne collected	MF	MNF + copper	MNF + alu	Paper	Card-board	Glass	HDPE plastic	PET plastic	Aggre-gates	Textiles
Selective waste collection from private households	0,4	0	0,6	35,9	16,0	38,7	53,8	53,8	0	21,2
Sorting and outbound transport	18,7	9,8	9,2	40,3	32,2	8,7	43,9	43,9	3,4	58,3
Production and outbound transport of primary raw materials	42,4	83,6	72,4			25,4	160,5	322,2		8,7
Processing of primary raw materials	866,4	1 187,5	458,7	243,6	623,5	– 532				
Production avoided	– 2 157	– 1 431	– 7 666	– 297	– 390		– 1 512	– 1 263	– 4	– 5 608
End of life collection avoided	– 4,6	– 20,6	– 3,9	– 79,0	– 23,6	5,4	– 1 359,7	– 916,3	– 6,5	– 140,8
Total	– 1 233	– 171	– 7 129	– 56,0	258	– 454	– 2 614	– 1 760	– 7	– 5 660

Source: An environmental assessment of recycling in France based on the Life Cycle Analysis method, FEDEREC/ADEME

For example, collecting one tonne of PET plastics and one tonne of textiles means reducing emissions by 1.7t and 5.6t of CO_2 equivalent respectively.

Remanufacturing products also leads to a significant reduction in greenhouse gas emissions, as do certain new production methods. For example, additive manufacturing techniques for metallurgy increase material yield by up to 70 %, when traditional processes are limited to around 40 %; less material is used up, and less CO^2 is produced.

Circular economy levers can also help tackle the **eutrophication of land and water-based environments,** a phenomenon which principally results from the use of phosphate and nitrogen fertilisers in agriculture. In fact, according to the Ellen MacArthur Foundation[6], 31% of food in Europe is wasted all along the value chain, when implementing precision farming could reduce the use of water and fertilisers by 20-30%. These levers are also relevant in the **fight against particulate matter pollution,** with carpooling, for example, helping to reduce the number of cars on the road. These same actions can help fight ocean acidification (which is mainly a result of excess emissions of CO_2 dissolving into the oceans) or significantly improve air quality in urban areas, thereby curtailing health problems linked to pollution.

Beyond this, the circular economy provides far more indirect answers to the remaining major environmental challenges highlighted by Rockström, such as the issue of the hole in the ozone layer (which is today considered to be under control after global production of certain chlorine compounds was terminated) or the loss of biodiversity.

Finally, by reducing waste at every stage of the value chain, the circular economy plays an essential role in decoupling economic growth from natural resource use, thereby helping to preserve the environment.

[6] "Growth within: a circular economy vision for a competitive Europe", SUN Foundation, Ellen MacArthur Foundation, McKinsey Center for Business and Environment, July 2015.

b. For countries and regions: generating economic value and employment, improving the trade balance, securing access to strategic resources

Every country and region naturally benefits from the global impacts of a circular economy transition, in terms of both the environment and resource use.

Moreover, the most advanced countries take the lead thanks to a competitive asset from an environmental point of view. **They shall (i) benefit from a certain safeguard against strategic resource shortages, an improved trade balance (with certain imports being avoided); and (ii) create jobs and growth opportunities, economic analyses report.**

(i) Protection against strategic resources shortages

At the end of 2010, China announced its intentions to reduce its exports of rare-earth elements. These substances are notably used in the production of semi-conductors, and are essential to the functioning of most electronic equipment. In addition, as their name suggests, they are present in very low quantities on the surface of the earth. At that time, China controlled around 90% of global production.

A number of European countries, including France, were forced to sit up and take notice, and proceeded to identify the raw materials critical to their industries. This initiative led to the publication of a list of 14 critical raw materials, which was completed in 2014 with

the addition of another six[7], including some that are used in very large quantities (such as chromium, see Table 3). **By reducing the consumption of these elements, needed to create value, the circular economy is in itself a strategic lever, allowing Europe to limit its supply problems.**

Table 3: The EU's critical mineral raw materials list

Raw materials	Main producers (2010, 2011, 2012)	The EU's main import sources (mainly 2012)	Substitutability Index*	Percentage of materials derived from recycling
Antimoine (Stibine)	China 86%	China 92% (unwrought and in powder form)	0.62	11
Béryllium	United States 90%	United States, China and Mozambique	0.85	19
Borates	Turkey 41% United States 33%	Turkey 98% (natural borates) and 86% (refined borates)	0.88	0
Chromium	South Africa 43% Kazakhstan 20%	South Africa 80% Turkey 16%	0.96	13
Cobalt	RDC 56%	Russia 96% (cobalt ores and concentrates)	0.71	16
Coking Coal	China 53% Australia 18%	United States 41% Australia 37%	0.68	0
Fluorspar (fluorite)	China 56% Mexico 18%	Mexico 48%	0.80	0
Gallium	China 69% Germany 10%	United States 49% China 39%	0.60	0
Germanium	China 59% Canada 17%	China 47% United States 35%	0.86	0

[7] Communication of 26 May 2014 from the European Commission to the European parliament, Council, Economic and Social Committee and Committee of the Regions on the review of the EU critical raw materials list and the implementation of the "Raw Materials Initiative"; see also the publication of the working group led by the Commission on this topic: "Report on Critical raw materials for the EU", May 2014.

Raw materials	Main producers (2010, 2011, 2012)	The EU's main import sources (mainly 2012)	Substitutability Index*	Percentage of materials derived from recycling
Indium	China 58%	China 24% Hong Kong 19%	0.82	0
Magnesite	China 69%	Turkey 91%	0.72	0
Magnesium	China 86%	China 91%	0.64	14
Natural graphite	China 68%	China 57%	0.72	0
Niobium	Brazil 92%	Brazil 86% (Ferro-niobium)	0.69	11
Phosphate minerals	China 38%	Morocco 33%	0.98	0
Platinum group metals	South Africa 61% Russia 27%	South Africa 32% United States 22%	0.83	35
Heavy rare-earth elements	China 99%	China 41% (all rare-earth elements) Russia 35% (all rare-earth elements) United States 17% (all rare-earth elements)	0.77	0
Light rare-earth elements	China 87%		0.67	0
Silicon	China 56%	Norway 38% Brazil 24%	0.81	0
Tungsten (Wolfram)	China 85%	Russia 98%	0.70	37

* The Substitutability Index is a measure of the difficulty in substituting a material with other similar materials; a score of 1 means that a material is very difficult to substitute.

Source : *European Commission, communication of 26 May 2014 on the review of the EU critical raw materials list.*

(ii) Jobs and growth opportunities

The circular economy transition could also have significant impacts on employment and economic growth.

However, we must tread carefully when it comes to offering up precise predictions. New jobs will indeed be created in certain sectors leading the transition, such as waste sorting and recycling, the thermal rehabilitation of buildings, and the development of alternative modes of transport. At the same time, other jobs will disappear, like those in car dealership. It is not easy to quantify the overall consequences, nor to judge whether the final balance will be positive or negative. **Nevertheless, recent studies suggest that the circular economy would have a positive effect on employment.**

France Stratégie[8] estimates that the circular economy sector represents roughly 800,000 full-time equivalent jobs in France, or 3% of the total workforce. This figure does not take into account certain other activities linked to the circular economy, including those within the leasing sector and reuse/recovery, as they are impossible to draw out from the available statistics. These jobs are mostly represented by the repair and leasing sectors, notably in the automotive industry. Between 2008 and 2014, there was a drop in the number of people working in car repair, due to falling sales and an increase in car reliability; this has been counterbalanced by rising employment figures within the leasing sector, responding to an evolution in consumer behaviour.

A macroeconomic study done on behalf of the European Commission[9] estimates that each percentage point reduction in resource use through increased efficiency would generate €12-23 billion, and between 100,000 and 200,000 jobs across Europe. When ADEME

[8] *France Stratégie, Note d'analyse n° 46, "Economie circulaire : combien d'emplois ?",* April 2016.

[9] "Macroeconomic modelling of sustainable development and the links between the economy and the environment" (2011), Bernd Meyer (GWS group) for the European Commission.

applied this ratio to France, they calculated that a 17% reduction in resource use through increased efficiency would generate between 200,000 and 400,000 jobs nation-wide.[10]

At a more microeconomic level, we can already see the impact on employment. For example, a study of the *Île-de-France region*[11] suggests that every tonne of domestic waste that is sorted and recycled generates ten times more jobs than if it were incinerated, and thirty times more than if it were deposited on a landfill.

It is important to state that these jobs will require new skills and will therefore rely on relevant training programmes being available (through higher education or continuing vocational training), especially for eco-design- and digital-related jobs.

Thus, for public authorities, supporting the circular economy transition is both a way of fighting against the depletion of natural resources, and of managing various externalities (waste, pollution and unemployment when the resource is depleted and private actors relocate). Furthermore, it presents a significant opportunity to develop unique skills and know-how, while preserving and developing employment on a local level.

[10] A simulation of the following combination of public policies led to these results: fixing a minimum rate of recycled raw materials sold by raw material producers; taxing the raw materials used by the producers of capital goods; creating an ambitious advisory programme for eco-design and resource use aimed at producers of consumer goods.

[11] *"Mieux gérer les déchets : une chance pour l'emploi ?" Observatoire Régional des Déchets d'Ile-de-France,* April 2013.

c. For businesses: improved access to resources, new opportunities for value creation, and a chance to anticipate future challenges in terms of environmental responsibility

Outside of all public incentive schemes, businesses are already activating the levers of the circular economy. And there are about as many different motivations behind this as there are levers (see I.c). Indeed, all of these companies identify opportunities for value creation, both on the part of producers and clients, and in this manner seek to increase their competitiveness and differentiate themselves.

The levers of the circular economy can therefore help to provide an answer to the challenges of resource access in a context of increased volatility (see II.a.i). As an example, polyethylene is made from petroleum. This substance, much like petroleum itself, is highly volatile. To protect against this volatility, Michelin and the IFPEN (French Institute for Petroleum and New Energies) set up a project in France to produce synthetic rubber from bio sourced alcohol.

In another area, an increasing number of large businesses are grasping at the opportunity to create significant added value through the **transition from ownership to use.** This allows them to build stronger client relationships and gain customer loyalty. For instance, Philips has integrated this approach into its lighting business: rather than sell light bulbs, Philips commits to providing its customers with a certain quantity of light for a determined period of time (11 years, for example), for a set price. The company is therefore still the owner of the light bulbs which it installs, and is in charge of their maintenance. Customers can benefit from the company's expertise to

improve their lighting and minimise overall spending, while the company gains long-term commitment from its clients and secures its income source.

Implementing product-to-service strategies (as illustrated above) requires companies to make some significant changes, and in particular concerning product design. With certain technologies, complex and costly manufacturing adjustments can be avoided, and new kinds of products can be directly introduced.

Reuse and **remanufacturing** are also two important levers for businesses, helping to reduce the costs of goods and services. Two concrete examples illustrate how such innovations are applied to business models:

- Armor, a company specialised in the production of inks and technical printing solutions, has developed a recycling service for used ink and toner cartridges for its professional clients. The company repackages or recycles the cartridges (depending on its state, a cartridge can either be reused by being cleaned, repaired and refilled, or taken apart for its components to be recycled), and can still make a profit by selling them at 20-30 % less than the new cartridge price;
- The Engie group has created a structure called "The Workshop" *(l'Atelier),* which, in the context of maintenance contracts for domestic and commercial boilers, recycles old boilers by re-purposing individual components and handing over any unusable parts as scrap metal. This allows them to offer replacement parts to clients at a price 65 % lower than that of new components.

Beyond such examples of immediate economic returns, businesses may turn towards the circular economy in order to anticipate future economic or regulatory constraints.

The Ellen MacArthur Foundation has calculated that, in terms of the European market, if mobile phones were eco-designed to be more easily remanufactured – on the one hand by reusing their most expensive components (camera, screen, battery and charger), and on the other by recycling precious materials at the end of their life-cycle (gold, silver and rare-earths) – the European trade balance would improve by $1-2 billion. Such a major economic and ecological issue will soon call for new regulations, and businesses would do well to anticipate them.

Tackling the issue of food waste is a priority for the European Commission (see III.ii.1) and a cause for concern at an international level. Producers and distributors are getting involved and attempting to raise consumer awareness. Some producers are even developing "smart packaging", like TetraPak which launched cartons that change colour to indicate when the milk inside is spoiled.

Other companies are tackling waste by reducing how much of it their own processes produce. They create **closed "zero waste" loops** by fully reusing the waste produced by one industrial processing phase in another. This is the case with Bunge, one of the world's largest agri-food groups, which has identified synergies between soya bean and sugar cane processing. The company has created a virtuous cycle by reusing the waste from any one of their kombucha tea, beer or tilapia production facilities to be used in another. By applying this process, and treating any remaining waste through anaerobic digestion, the overall system produces zero waste.

Environmental excellence is becoming almost as crucial as economic excellence, especially for large groups: the potential risk to the brand's image is enough to justify this. There are many examples

that illustrate the persistent negative effects on brand reputation due to environmental negligence or wrongdoings.

For businesses, transitioning towards the principles of the circular economy enables to shield against risks and constitutes the opportunity to build competitive advantage as well as better customer relationship.

d. For consumers: innovative and cheaper services, new revenue sources, an overall reduction in the cost of owning certain goods

From the point of view of the consumer, the new opportunities brought on by the circular economy, which directly benefit the producers of goods and services, also eventually lead to **lower prices and a new offering.**

The examples introduced earlier, notably regarding the reuse of ink cartridges and boiler parts, show how the circular economy can provide consumers with more affordable goods and services. Similarly, if we take the example of eco-friendly mobile phones, these new designs prolong the life-cycle and increase the salvage value of these products, all of which benefits the consumer.

Practices stemming form the circular economy in areas such as the agri-food industry can also have a **major impact on health.** One example is organic farming, which is making headway in Europe, and which turns away from the use of synthetic and chemical products. As such, with a growing demand for locally-grown, fresh and healthy food within cities, organic and peri-urban agriculture is evolving.

Characterised by short-chain distribution channels between local farms and consumers, it aims to reduce food wastage linked to transport and to preserve product freshness. Local initiatives are being formed around this new supply chain. *La Ruche qui dit Oui* (The Hive that Says Yes) is one such example. It constitutes a network of consumers who buy directly from local producers without going through the traditional intermediaries of the food supply chain. This system gives people access to healthy food products, often competitively priced.

Our future lifestyles may be considerably improved by the arrival of technologies which promote the ideals of the circular economy. Electric cars are a good example. While their price is at present not competitive enough to rival traditional cars, they represent a massive potential to greatly improve air quality in urban areas.

All the business models based on share economy provide the consumers with more value without requiring initial investments.

The development of the circular economy is an opportunity for additional value for the consumer, either providing him or her with the same good or service at a lower price or with additional functions.

III

. HOW FAR HAVE WE COME? AN OVERVIEW OF THE CIRCULAR ECONOMY ACROSS DIFFERENT REGIONS AND BASED ON KEY INDICATORS

To develop the circular economy, we must be able to measure how much progress has been made, and to assess the importance of different levers and potential public policies. We need to come up with appropriate indicators, both on a macroeconomic and microeconomic level.

a. Measurement tools

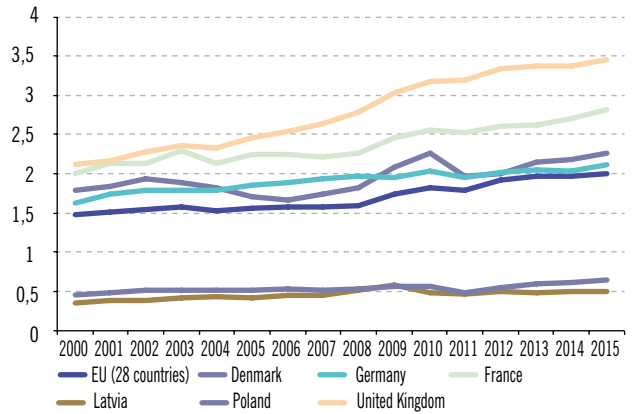
A wide variety of circular economy indicators already exists.

The OECD and the G8 generally use the notion of "resource productivity", which is the ratio between an economy's real GDP and its raw material consumption. However, this measure only takes into account the raw materials directly used up by the economy (extraction + import - export), and not those contained in imported finished goods, thereby diminishing its relevance.

When seen through the prism of this indicator, the circularity of an economy is largely determined by its structure. In particular, the importance of industry, a major consumer of raw materials, can have a significant effect on the results. As such, Germany's weak performance compared to that of France or the UK, as shown in Figure 2,

should be replaced in the context of their respective economic structures: 30% of Germany's GDP comes from its industries, compared to roughly 20% in France and Britain. It appears difficult to correct the bias resulting from the import and export of finished goods, because this would require knowing the direct material cost of imported and exported products, and such information is not readily available to statistical bodies.

Figure 2: Resource productivity



Source : Eurostat.

Other indicators have been developed at the EU level. Through Eurostat, the European Commission has set up an annual resource efficiency scoreboard. It includes the following indicators:

- per capita material consumption;
- productivity of artificial land;

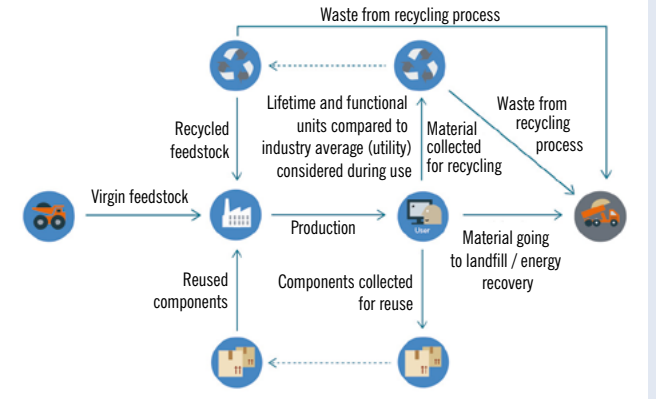
- water productivity;
- per capita greenhouse gas emissions;
- volume of waste generated per capita.

Finally, on a more microeconomic level, over-arching indicators have been developed to measure the circularity of manufacturing companies (e.g. the Material Circularity Indicator developed by the Ellen MacArthur Foundation - Inset 2). If they prove to be inspiring, they also have their limitations, since they do not take into account how end-users actually use the produced goods. This type of indicator therefore complements the information given by the rate of use or the life-cycle of products.

Inset 2: an over-arching indicator of circularity within a consumer goods company

The Ellen MacArthur Foundation has developed several over-arching circularity indicators. Among them, the MCI (Material Circularity Indicator), which measures how restorative the material flows of a product or company are. It also includes a measure of the durability of a product compared to a similar industry average product.

Material flow can be shown as follows:



The circularity measured by this indicator typically varies between 0 and 1. A product made solely from "virgin" (non-recycled) raw materials and which ends up on a landfill is considered to be fully "linear". Conversely, a product made with no "virgin" raw materials, and whose waste is recycled with a 100 % recycling efficiency, is considered perfectly "circular".

Source: Ellen MacArthur Fondation.

Each type of indicator has its own value and aims. **However, there is no over-arching indicator that can give us information about the circularity of a whole region or area of activity.** As mentioned earlier, the closest one (the resource productivity indicator) is in fact rendered biased since imports and exports are only partially accounted for. At this stage, it is therefore not possible to clearly rank countries

by circularity, nor even to analyse changes over time within a specific geographic region in an unbiased way. Nevertheless, within the following paragraphs we attempt to compare the development of different geographical areas in the most objective way possible.

b. An overview of Europe

i. Regulatory initiatives of the European Commission

As far as the European Commission is concerned, the circular economy forms part of an effort reaching beyond environmental policy; it is above all, according to the Commission, a means of promoting growth and job creation.

A first draft of the Circular Economy Package was published in July 2014. This first package received a mixed response: it was mainly criticised for having overly ambitious objectives and for lacking proposals to stimulate demand for products created by the circular economy, and in particular secondary raw materials.

As a result, a new draft was presented on 2 December 2015. It includes an **action plan** made up of a series of measures to be deliberated and specified with the aim of being implemented by 2019, as well as **legislative proposals for waste and recycling** that could be adopted more quickly. Notably, measures to stimulate demand for recycled raw materials have not been examined at this stage and are yet to be deliberated upon. Overall, the architecture of this action plan is relatively ambitious, since many activity sectors are tackled individually, but the details of these measures are not yet known.

Inset 3: Key points of the Circular Economy Package, December 2015

The action plan

The key actions include:

- measures to reduce food waste;
- quality standards for secondary raw materials to stimulate demand from economic actors;
- a review of fertiliser regulations, with the aim of promoting organic fertilisers;
- a strategy concerning plastic materials covering the following topics: recycling, biodegrading, the presence of hazardous substances in certain plastics, and marine debris;
- measures for the reuse of water.

€650 million in funding will be provided by the Horizon 2020 programme (the EU Framework Programme for Research and Innovation), in addition to €5.5 billion provided by the structural funds for waste management.

A timetable and a monitoring framework have been set out for these actions.

The main elements include:

- **"a common EU target for recycling 65% of municipal waste by 2030";**
- **"a common EU target for recycling 75% of packaging waste by 2030";**
- "a target to **reduce landfill to a maximum of 10% of municipal waste by 2030";**

- a **"ban on landfilling of separately collected waste"** and the "promotion of economic instruments to discourage landfilling";
- "the adoption of **simplified and improved definitions and harmonised calculation methods for recycling rates** throughout the EU";
- "concrete measures to **promote reuse** and stimulate industrial symbiosis";
- "economic incentives for producers to put **greener products on the market** and support reclamation and recycling schemes".

Source : European Commission press release, December 2015.

This new package is also generating criticism, particularly on the part of NGOs and MEPs. Its waste reduction targets are deemed disappointing by certain actors, who deplore the fact that these have been scaled back compared to the previous package (concerning the rate of recycling or landfilling), that there are not enough binding measures (for separate organic waste collection) and that there are no new measures regarding fundamental areas such as eco-design and incineration.[12]

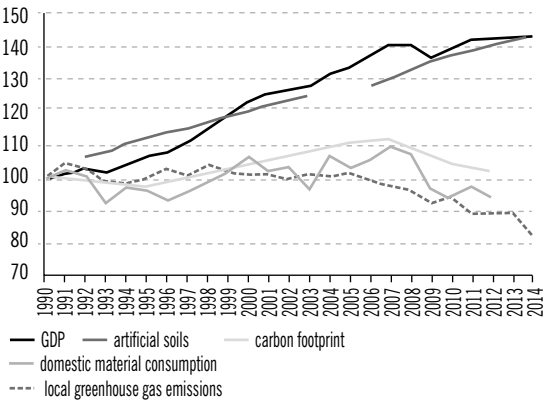
One of the major challenges facing this plan is the notable discrepancy among member countries in terms of their progress and expectations of the circular economy.

[12] *L'actualité professionnelle du secteur de l'environnement,* (Professional news of the environment sector), December 2015.3.

ii. In France

One of the main objectives of the circular economy transition is a decoupling between economic growth and increased resources use. A certain degree of decoupling already exists within the French economy (see Figure 3). However, it can probably be further amplified.

Figure 3: Decoupling between French GDP and the main environmental indicators
(index base 100 in 1990)
(base 100 en 1990)



Source: France Stratégie, according to the Department for Observation and Statistics (data gathered from INSEE national accounts, SSP-Agrest, the Teruti-Lucas study, Customs and Excise, and Citepa).

This transition is being encouraged in France **through the progressive implementation of more restrictive regulations** on the one hand, and **relevant incentives** on the other. This is notably the case with the

extended producer responsibility (EPR) schemes, which aim to place certain waste processing constraints on producers and on those who bring products to the market, so that consumers do not bear full responsibility. The initial producers are in fact responsible for the waste generated by the economy. These systems can signal to consumers how recyclable or reusable a product may be through its sale price, notably by means of an eco-tax.

Inset 4: Extended producer responsibility

The principle of Extended Producer Responsibility (EPR) is codified by law since 1975. It states that *"producers, importers and distributors of such products, or of the elements and materials used in their manufacture, may be required to dispose of, or contribute to the disposal of the resulting waste."*

- In over twenty years, more than twenty types of waste products and waste streams have been impacted by this law. This notably includes batteries and accumulators, electrical equipment, electronics, cars, household packaging and medicines.
- When this principle is implemented within a particular sector, its actors have a certain freedom in how they choose to operate. There are three main systems of organisation, with producers taking on varying levels of responsibility:
  - **The "individual" system:** producers are fully responsible for the collection and treatment of the waste generated by their products;
  - **The "shared" system:** those responsible for bringing a product onto the market delegate waste collection and treatment to an outside contractor, often collaborating with other producers. The actors who place the product on the market are still responsible for the waste;

– **The "collective" system of environmental organisations:** producers transfer their responsibility onto collective environmental organisations of which they are members, and often shareholders. In return, these organisations benefit from an eco-tax to cover their operating costs and the producers' liability. Within this system, environmental organisations can cover three types of producer liability: financial (in which case they often finance local communities), operational (often using outside contractors) or mixed.

- Here, the rate of eco-contribution depends on the quantity of products placed on the market, and on the cost of processing different types of waste. It is adjusted in such a way as to encourage producers to invest in eco-design. The eco-contribution is paid by the consumer, transferred by the salesperson to the producer, and then to the environmental organisation. The rate charged by these organisations for the collection and treatment of waste depends on the sector. For waste generated by everyday household goods, the cost is in part covered by local authorities. For electrical equipment and electronics, the environmental organisation takes care of 100% of the cost.

Source: Extended producer responsibility sectors, Panorama, 2015 edition, ADEME.

Taxation is a second type of lever widely used in France, notably through 'general taxes on polluting activities' (TGAP).

Inset 5: General tax on polluting activities

The general tax on polluting activities (TGAP) is applied to companies whose activity or products are considered to be polluting: waste, noxious emissions, oils and lubricants, washing preparations, mined materials, etc.

The tax amount and rate vary depending on the business sector and product type (whether or not it is classified as hazardous). These categories are based on "components". Each component has a particular tax base (based on the total weight of waste collected) and a tax rate which is adjusted each year. For example, in 2016, for "waste arriving at an unauthorised, non-hazardous waste storage centre", the rate applied in France was €150.60 per tonne.

Source: French Government website: https://www.service-public.fr/professionnels-entreprises/vosdroits/F23497

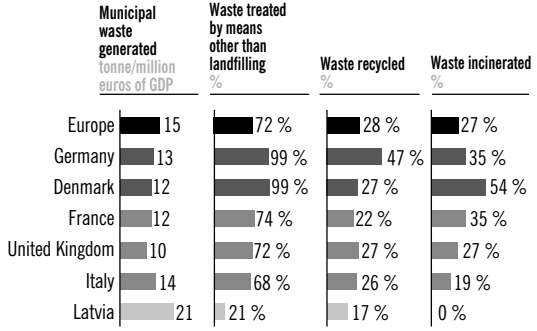
iii. Elsewhere in Europe

The level of development of the circular economy varies greatly from one European country to the other. There is an important discrepancy between more developed countries like Denmark, the Netherlands or Germany, and less developed places such as Latvia. The selection of indicators below (see figure 3) illustrates this gap. Denmark is one of the countries that uses landfills the least (for less than 1 % of its waste) and recycles the most (27 % of all waste is recycled).

In Latvia, landfilling is still the most common type of waste disposal (concerning 80% of all waste).

The different approaches reflect varying degrees of commitment to this issue. Germany is one of the few countries to have adopted a comprehensive circular economy strategy. In other countries, initiatives are often more isolated and only partially address the issue.

Figure 4: Comparison of waste treatment performances across European countries



Source : OECD, 2014, EEA.

1. Denmark

Denmark has a long tradition of implementing innovative policies which promote the development of the circular economy.

It was the first country to implement the deposit-refund scheme for drink containers as of the 1980s. A landfilling tax was introduced in 1987 and has been increasing ever since. In 2011, the country announced its objective to be entirely independent of fossil fuels by 2050.

In the meantime, Denmark still has significant progress to make on its path towards a circular economy. Notably, recycled materials are not being used to their full potential. This is reflected in a recycling rate which is merely average for Europe, and a high rate of incineration, (see figure 3).

Denmark recently developed a national strategy, "Zero Waste Denmark", with the aim of transitioning from incineration towards recycling and waste prevention. In parallel, its government set up think tanks and panels to treat related topics such as the "Task Force for Resource Efficiency" or the "National Bioeconomy Panel".

In 2006, the Danish Government also launched a programme to integrate the concepts of the circular economy in public procurement (for example through the use of non-toxic chemicals, sustainable products and recycled materials): the "Partnership for Green Public Procurement" (GPP)[13]. This collaboration has had a significant impact since it represents a procurement value of €5 billion. Denmark is also contributing to international initiatives such as the CE100 platform launched by the Ellen MacArthur Foundation.

[13] "Denmark: Public procurement as a circular economy enabler", Ellen MacArthur Foundation.

Overall, Denmark exemplifies the results that can be achieved by implementing an ambitious programme which is coordinated at the national level. If it successfully grasps all of the opportunities outlined above, the country could see a GDP increase of 0.8% to 1.4% by 2035, and an additional 7,000 to 13,000 jobs created compared to the "status quo" scenario[14].

2. Other countries in action

Very few European countries have adopted a comprehensive circular economy strategy or implemented policies going beyond the traditional steps of reducing waste and energy consumption.

Since the early 2000s, Germany has embraced the "PROGRESS" framework, with a focus on optimising raw material use. This approach is based on ecological but also economic concerns, since German industries are highly dependent on raw materials. The objectives of this initiative are as follows:

- to secure supplies of strategic raw materials,
- to maintain the competitiveness of businesses,
- to reduce resource-related environmental effects,
- to develop sustainable production and consumption (by promoting eco-design and renewable resources),
- to improve waste management methods.

The "circular economy promotion law" overlaps with this holistic approach. It focuses on the "prevention and recycling of waste", basing itself on the European Framework Directive. It notably mentions an education campaign on waste sorting and collection, aimed at individual consumers and communities, as well as clear goals for municipal waste treatment.

[14] "Delivering the circular economy, a toolkit for policymakers", Ellen MacArthur Foundation

The United Kingdom is among the countries which have not yet established a policy framework for the development of the circular economy. Private or associative initiatives have taken the place of public policy. Groups have organised to educate economic actors on this topic. Since 2009, the Ellen MacArthur Foundation, a non-profit association financed by large corporations, has been disseminating the principles of the circular economy in the world. Similarly, since its creation in 2000, the WRAP association has been working towards the development of the circular economy by focusing on the issues of waste reduction and resource efficiency. These organisations play a major role in the adoption of circular economy initiatives, both in the UK and on an international level. They inform and advise public and private actors on best practice, and facilitate collaboration between them.

In September 2016, Finland published a national road map for the circular economy, with the goal of consolidating the actions of corporations, public administrations and citizens to help create new solutions in the face of climate change, resource depletion and urbanisation.

3. Latvia

As a member of the European Union since 2004, and of the euro zone since 2014, Latvia has one of the lowest rates of GDP per capita in the EU (in 2014 it was ranked 25th out of 28 Member States in purchasing power parity). The development of the circular economy is relatively low on Latvia's priorities compared to more developed countries such as France and Denmark (see figure 3).

This can notably be explained by its infrastructure deficiencies. As such, when a sample of Latvian citizens was surveyed, they expressed a desire to be more involved in recycling, and bemoaned the lack of

organisation on a local level. To transform this desire to recycle into concrete action, individuals first have to store their waste before transporting it to designated containers, which are often far from their homes.

It would also appear that the State provides relatively little support to businesses in this regard. A study by the European Commission shows that Latvian businesses do not spontaneously adopt circular economy initiatives, and that those which do are self-financed.

In February 2016, the Latvian Ministry for Environmental Protection and Regional Development (VARAM) confirmed its support for the proposals within the Circular Economy Package. It nevertheless went on to comment that these should give greater consideration to the levels of development of different Member States, and that Latvia was unlikely to reach the European goal of recycling 65% of household waste within the set time frame.

c. Elsewhere in the world

Other parts of the world display widely varying rates of progress in this area. The approaches set out by different countries may be comprehensive, formalised or thorough to a greater or lesser extent.

In the United States, there is at present no federal mechanism dealing with the circular economy as a whole. The degree to which various circular economy initiatives are adopted very much depends on each State. Some States enthusiastically apply the principle of the 3Rs (reduce, reuse, recycle): California - probably the most advanced State in this regard - introduced a zero waste objective into its legislation in 2002. Other States have launched no particular initiatives.

Countries such as China and Japan have adopted a framework law on the circular economy. These two countries are demonstrating a structured and systematic approach to the issue. Their legal provisions come with multi-year plans which set the transition pace by laying out specific goals on national and regional levels, as well as for each sector.

Both Japan and China see the circular economy as a lever for economic growth and not merely as an environmental issue. But each country has determined a specific scope for its actions: Japan has a traditional approach focusing on waste management, whereas China has a more large-scale approach encompassing various resources.

i. The circular economy in China

Considering the size of its economy and its weight in terms of global industrial production, China represents a major challenge in transitioning to a circular economy on a worldwide scale. It is both a big consumer of raw materials and a major producer of waste. However, the reclamation of this waste is limited, with only 1% of the waste being recovered and 13% incinerated in 2009 (compared to 16% and 34% respectively in France).

China has launched a number of initiatives to alter this situation, notably by adopting comprehensive legislation on the circular economy. This text is not limited to the issues of raw materials and waste management, but also covers areas such as water and property. Enacted on 29 August 2008, the law defines the circular economy as *"a general term for the activities of reducing, recycling and recovering in production, distribution and consumption"*. It goes on to specify that:

- reducing means the decrease of resource consumption and waste generation in production, distribution and consumption;

- recycling means the full or partial reuse, repair or remanufacturing of waste;
- recovering means the reuse or regeneration of waste as raw materials[15].

The law includes a comprehensive set of measures which aim to accelerate the circular economy transition by activating every available lever: boosting both supply and demand, and taking externalities into account (see inset 4). It also sets out statistical indicators (including a list of 80 individual indicators) and quantitative goals.

The five-year plan for 2010-2015 set a goal of increasing resource productivity by 15%, which was then developed on a regional level.

Inset 4: China's Circular Economy Promotion Law

1 - Indicators which can help evaluate local governments and businesses (such as the rate of reduction in resource use, recycling, reclamation and others)

2 - Support for circular supply initiatives and innovative projects:

- The creation of local funds (provincial governments, regions and municipalities) that provide financial help and technical advice for all projects related to the development of circular economy technologies and products. Highly innovative projects will be integrated into regional development programmes and benefit from tax incentives;

[15] Circular Economy Promotion Law of the People's Republic of China.

- The creation of incentives, and in particular financial incentives, by the tax and finance authorities;
- Tax relief for all industrial activities that promote the development of the circular economy;
- The promotion of imports of technology, equipment or products that contribute to energy savings, and the restriction of exports of high energy-consuming or polluting products;
- The prioritisation of projects based on their ability to save energy, water and material resources, in municipal investment plans. Similarly, financial institutions must as a priority lend to such projects and reject those involving a technology, equipment, material or product listed in the catalogue of "abandoned" projects;
- The establishment of a reward system for teams and individuals who have significantly contributed to the development of the circular economy.

3 - Stimulating demand:

- The creation of a catalogue listing the products and packaging materials which must be recovered;
- For the products and materials listed in the catalogue, the issuing company will be fully responsible for waste treatment;
- The promotion of deposit systems for waste;
- The implementation of a preferential purchasing policy for products stemming from the circular economy.

4 - The creation of disincentives for negative externalities and resource-intensive activities:

- The implementation of a control index for the rates of pollutant emissions, as well as water and land use;
- The application of deterrent pricing for electricity produced through energy-intensive means, as well as for landfilling;
- An increased monitoring of energy-intensive and water-intensive industries (steel, non-ferrous metals, coal, electricity, building materials, etc.).

Source: Circular Economy Promotion Law of the People's Republic of China (English translation by the agency Invest in China; http://www.fdi.gov.cn/1800000121_39_597_0_7.html.)

The law also outlined which levers of the circular economy were to be used in each sector. For example, construction businesses are encouraged to reuse the waste they produce.

The framework law is aimed at various actors (the state, local authorities, businesses, associations, etc.) who have well-defined roles, and whose cooperation is an important factor of success. As such, local governments must include the principles of the framework law in their local planning documents (notably in terms of R&D and urban planning).

Initial results are already visible: in 2010, 78% of municipal waste was sent to landfills; in 2014, this figure fell to 65%[16]. This quick implementation was notably encouraged by the use of **a pragmatic and iterative method** known as "10-100-1000" (a multi-phase

[16] China statistical yearbook.

implementation, first in 10 geographic areas, then in 100, and finally 1,000).

ii. The circular economy in Japan

Japan became interested in this issue as early as 1991 and has developed a framework law governing all actions related to the circular economy. The stakes for this country are even higher given that space and natural resources are limited (only 20% of the land area is habitable).

Japan has developed a structured approach, with a legislative package made up of three levels:

- the framework law for a "Sound Material Cycle Society" (SMC): it defines the waste hierarchy, stakeholder responsibility, etc. (2000);
- the law on the promotion of resource efficiency (3Rs: reduce, reuse, recycle) and waste management (recycling and incineration) (2000);
- sector-specific laws: the specificities of different sectors, such as the development of recycling methods and the quantity of waste generated, are taken into account.

These texts focus on the reduction and management of waste (the 3Rs). Particular emphasis is placed on eco-design (which optimises material use and facilitates repair, maintenance and recycling). Energy efficiency is also a key focus (biomass as a substitute for fossil fuels).

The implementation of this approach relies on a programme which sets out specific goals and includes macro indicators (resource productivity, rates of circular resource use, landfilling rates, greenhouse gas emissions) and "effort indicators" (e.g. 50% of local authorities must implement green purchasing by 2015).

This framework is both structured and flexible. It does not prescribe specific actions, but rather encourages voluntary action and creates a positive environment for the adoption of circular practices on the part of every stakeholder (companies and public authorities). Such initiatives include:

- incentive programs, such as "Eco Town", whose objective is to develop networks of excellence; eco-labels, such as the "top runner" programme, which sets out energy performance standards for product groups; and reward schemes for top initiatives, such as the "3R Awards";
- the implementation of quality standards for certain recycled products in order to stimulate demand for these products;
- the creation of a waste exchange programme for the recycling of waste through other industries;
- incentives, for example through the promotion of green public procurement (which is the subject of a specific law).

This approach has a view to continuous improvement. A regular revision of the goals is planned for, based on technological advances and perceived results; an annual progress report is produced, and the plan is thoroughly re-evaluated every 5 years.

Finally, **cooperation between all economic actors on a local level is highly encouraged.** Such local collaboration favours virtuous recycling systems based on economies of scale.

The latest data on recycling rates in certain industries are promising. The packaging industry has a recycling rate close to 100%, the electrical appliances industry around 83%, and the construction materials industry (concrete and wood) of 95%.

iii. The circular economy in developing countries

Few countries in the developing world have made steps to transition to a circular economy. The recycling rate for household waste is low (less than 5% for Cameroon and Niger compared to an average of around 30% in Europe). In addition, almost 100% of collected waste is sent to landfills.

In developing countries, certain practices favoured by the circular economy arise spontaneously due to the low living standards of part of the population. In the context of an economic system which is mostly informal and relies on interpersonal networks, this «System D», forming part of the circular economy, can exist on a considerable scale.

Practices stemming from the circular economy can therefore prove to be a genuine lever for growth in developing countries. Most of them are now fully aware of this, as shown by their commitment to reducing greenhouse gas emissions during the COP21. In most of them, better waste management must play a role in this reduction (see IV, Proposal no.8).

d. At the level of a company or sector

i. Greater circularity at the company level

Whether in developed or developing countries, many companies have launched initiatives to implement practices stemming from the circular economy. As demonstrated by the above-mentioned examples, such initiatives represent increasingly evident economic benefits, helping to significantly improve competitiveness and provide a response to environmental issues (see II).

The most visible initiatives are those launched by industrial actors who are closest to the consumer, since they have more direct ties to the daily lives of end-users. The agri-food and automotive industries are useful examples.

The agri-food sector

Massive waste production is a characteristic of this sector: one third of all food produced in Europe is spoiled without being consumed. Multiple initiatives have been launched for each link in this chain, from the farm to the table.

Some producers have started making ambitious changes to their business models. For example, the Danone company is a pioneer when it comes to adopting circular economy practices. Over the past fifteen years, they have developed a holistic approach integrating waste recycling, optimised resource management, and a reduction in greenhouse gas emissions along the entire value chain, including its agricultural suppliers. Danone's goal is to reduce its greenhouse gas emissions by 50% between 2015 and 2030, reaching a net-zero carbon footprint by 2050.

Distributors, both in Europe and elsewhere, have developed virtuous systems for reducing large-scale losses resulting from unsold, expired produce. As an example, Tesco has developed a **consumer awareness** scheme, with a real-time price-adjustment mechanism that depends on the product expiration date and therefore incentivises consumer purchases. The Carrefour group has created a **short-loop** system, allowing it to extract energy from organic waste, and transforming this into biofuel for its delivery trucks.

The automotive sector

The automotive sector is also being transformed at full speed. It has a lot at stake since the industry is largely responsible for air pollution in urban areas, and public policy has been quick to address this

topic by adopting stringent regulation. Manufacturers are greatly influenced by large-scale implementation of circular economy methods and practices. Renault, for example, has created a department dedicated to the circular economy, focusing on the "second life" of products and short-loop recycling. At its disassembly and remanufacturing facility in Choisy-le-Roi, 43% of car bodies are reused, 48% of the materials are recycled at the foundry to produce new parts, and the remaining 9% is reclaimed.

ii. Increasing cooperation among actors along the whole value chain

By its very nature, the circular economy relies on cooperation among actors from different sectors all along the value chain, but equally among competitors at specific links in this chain, as well as between public and private actors.

The motivation behind such collaboration can be:

- **economies of scale in terms of waste management or new energy supplies:** for instance, many competing business have come together to form Aliapur, a management company which collects and reclaims tyres across a number of European countries. In a different sector, in November 2014, the eco-friendly steam generation facility, ROBIN, was launched just south of Lyon to supply energy to companies of the Roches-Roussillon Chemical Platform. These businesses united within an economic interest group to optimise their energy procurement. This production facility uses previously unreclaimed waste as fuel. Similarly, in 2012 the Recy'go programme was launched by the La Poste group, so that postmen could collect paper and card from local households and SMEs. In this way, the

postal service could use it network of postmen to create a centralised collection system which would otherwise be too costly and restrictive for small businesses,

- **the creation of new synergies between businesses for the reuse of waste products:** for instance, Tarkett (a producer of floor coverings and sporting floors) was unable to recycle all of its offcuts alone, and is therefore collaborating with companies from various sectors in order to find new uses for its waste products. This can take the form of downcycling (for example by turning waste material into traffic cones) or upcycling, although creating higher-quality products from their materials remains a more difficult task,
- **gaining customer loyalty by offering products that are better adapted to their needs,**
- **larger investments that require a certain degree of partner commitment.** Serge Ferrari, a manufacturer of composite membranes, has made massive investments in recycling technologies, and has run a joint-venture factory with Solvay in Italy since 1998 to develop innovative solutions,
- **an exchange of know-how:** in this regard, many businesses have started working with large companies specialising in waste management in order to benefit from their know-how and develop efficient recycling methods,
- **the need to remove barriers linked to restrictive regulations or deeply ingrained consumer habits.** Public-private partnerships are a powerful driver to address this challenge. For instance, "green deals" have become increasingly popular. They are a means by which industrial and public actors can mutually commit to the circular economy and sustainable development: businesses improve their practices while the State simplifies and adapts corresponding regulations (see inset 5). These partnerships can also lead to major evolutions, as is the case for mobility and other services.

Inset 5: The first Green Deals in France[17]

In France, the first Green Deals were signed during a seminar of the French National Business Council (CNI), in April 2016. One of them concerns a project for the recycling and reclamation of plaster waste, bringing together a professional association and three companies from the plaster industry (Knauf, Placoplatre and Siniat). These actors notably agreed to create a mapping of waste collection on a national level, and to publish common technical specifications for gypsum. In return, the State agreed to support waste management and new sorting sites, as well as to work on informing public agencies leading such projects.

Source: "Circular Economy" Seminar, French National Business Council, April 2016.

iii. A profusion of start-up initiatives

Start-ups can be important vectors of the circular economy transition.

Some of them are **capitalising on new technologies to address consumers directly,** whether they operate in sales, work to repair and exchange electronics to give them a second life, or facilitate crowdfunding for green technologies (biogas, energy efficiency, etc.). All of these actions help innovative solutions to flourish.

[17] Green Deals: a new contractual arrangement for environmental innovation, "Circular Economy" Seminar, French National Business Council, April 2016.

Another category of actors positions itself as a **key partner for big business in their transition to a circular economy:**

- **ADN** (the Agence du Don en Nature or Agency for Donations in Kind) helps companies recycle unsold commodities (such as surplus stock) through donations. These products are placed into an online catalogue and distributed through local associative networks;
- The start-up *Zéro-Gâchis* (Zero Waste) helps distributors who want to sell end-of-life products at reduced prices, but who don't have the means to reach out to consumers. In answer to this problem, the start-up has created a real-time referencing system of all locally-sold products that are nearing their expiration date and being sold at much lower prices.

Finally, many start-ups are being developed in the **social and environmental sector.** This is the case of *"Lulu dans ma rue"* (Lulu in my street), which is recreating social ties between neighbours by putting to use the skills of some to help others. A virtuous economic approach is created, notably for the repair of household electrical appliances.

Overall, both with regard to established businesses and start-ups, the circular economy transition is made up of individual, scattered initiatives, rather than a coordinated strategy at the national or international level.

Nevertheless, companies are increasingly seeing the benefits of this transition, and some are tackling the issues head-on in order to trigger a virtuous cycle[18].

[18] AFEP Report, *"Les entreprises s'engagent pour l'économie circulaire",* December 2015.

IV

PROPOSALS

The circular economy transition is underway, both in Europe and elsewhere. Accelerating this process means providing a better response to global environmental challenges and, for both businesses and countries, reaping its economic benefits and competitive advantages

The eight following proposals and their operational variations are based on five essential principles that our work brought to the foreground.

1. **Focusing on innovation:** the above-mentioned opportunities for "circular growth" will rely on new technologies and organisations, which will in turn have to be supported by public authorities.

2. **Adopting a comprehensive, global approach regarding the offer as well as the demand:** developing reliable indicators; this means influencing behaviour on every level, from producers to consumers.

3. **Taking into account the differences between sectors and enhancing public/private cooperation:** the challenges are different for every sector, and a dialogue must be established between public authorities and economic actors, with the latter providing suggestions as to how the barriers to a more circular economy can be removed.

4. **Measuring progress:** developing reliable indicators, that cover the entire value chain, for example in order to adequately evaluate imported products, or the way in which consumers use final products.

5. **Not being limited to more developed countries:** the principles of the circular economy can be applied at all stages of development, and much like Africa has adopted the mobile phone by bypassing the home phone, it can move onto an industrialisation based on the circular economy without dealing with the foibles of a linear system.

PROPOSAL N°1: Promote the circular economy transition on an international level as part of the solution to global environmental issues.

The transition to a circular economy should be part of the response to environmental issues such as global warming, biodiversity, air and water quality, etc. During recent international negotiations, and notably during the COP21, certain countries like China and Morocco made concrete commitments through their INDCs ("Intended Nationally Determined Contributions") to reduce their greenhouse gas emissions, including through improved waste management (see III.c.iii).

These commitments should be extended and elevated to more ambitious heights during the forthcoming COP meetings. More generally, the circular economy transition should be at the heart of future international talks. Development aid could for example be focused on promoting circular economy projects, including through the provision of specific technical assistance.

A global approach to the circular economy transition will require more reliable global indicators of resource use. With this in mind, an international group of experts, modelled on the IPCC, could be created in order to objectively assess the progress of the circular

economy on a worldwide scale, and to promote best practices within all UN member States. Their role could also be to verify that the steps being taken are indeed reducing negative externalities.

PROPOSAL N°2: develop harmonised measurement tools at the european level and set mid-term goals.

- **At the level of France and Europe, develop a single indicator or a small number of indicators for a circular economy transition within a given geographic area.**
- **Ensure that these indicators are measuring the overall circularity of a process (and not merely one phase in order to avoid adverse effects), adequately assessing the different resources according to how scarce they are, and fairly treating imports, local consumption, and exports.**
- **Measure the current levels for these indicators and set clear and realistic goals for 2030 and 2050.**

We must develop, at least at a European level, a single indicator or a small number of indicators for a circular economy transition within a given geographic area. **At present, there are no recognised indicators for measuring circularity at a national or regional level.** This is mainly because they are difficult to define, especially since measuring the cost and material content of imported and exported products is rather complicated. **Yet these indicators are of paramount importance since they provide us with the necessary tools to measure progress, and help to guide public and private actors in the right direction.** Indeed, both at a macro and microeconomic

level, they help to channel investments towards the best initiatives and therefore speed up changes in the behavioural patterns of various economic actors.

In order to set goals on a European level, these measurement tools and methods of analysis must be common to all member States, giving access to a sufficiently large and unified market without distorting competition. For a start, **we must use common definitions** (for example, what makes a product "recyclable", and what is waste?) and reliable statistical methods to measure the stock and flow of resources used by the economy. For instance, at present it is impossible to know to what extent the raw material reserves actively being used by the economy (i.e. those used in construction, factories, transport, etc.) are increasing, stagnating or diminishing. A first step might be to measure these flows for a representative sample of raw materials.

In any case, adverse effects can be limited if the indicator or indicators adopted have the following capacities:

- **to measure the circularity of the production process from start to finish,** and not only at certain stages of the value chain (since less virtuous behaviour in certain links in the chain could be compensated for by seemingly virtuous methods in other areas);
- **to adequately evaluate the different input products** (in contrast to the indicator of GDP/kg of used materials): using up one tonne of rare-earth metals is not the same as using up one tonne of steel;
- **to have a neutral stance regarding local and imported products** (fewer production sites will feel the need to relocate in order to avoid restrictive regulations based on these indicators, and regions or countries with different specialisations will be placed on a more level playing field, notably with regard to their production capacity).

Once these indicators have been developed, the current level will need to be measured and medium-term goals identified. This visibility is necessary to allow economic actors to invest in innovative projects or physical assets.

PROPOSAL N°3: adapt the regulatory framework to support the circular economy transition.

- **Create a real internal market for recyclable and recycled raw materials.**
- **Adapt a regulatory framework for new initiatives stemming from the circular economy (especially within the sharing economy), and remove unjustified barriers.**
- **Promote proactive and innovative business methods, by standardising the use of "green deals" at the French and European level.**

With regard to regulations, there are two issues at stake: first, existing regulations developed for a linear system must evolve so as not to impede upon the circular economy transition; second, new regulations must be put in place to support the development of circular practices.

The **unification of markets** represents a first area for progress: important barriers still exist between European States, and even more so outside of Europe. The following are some possible initiatives in this area:

- **Review and harmonise the definitions of waste material** and how these can be altered in order to allow recycled material to be

exchanged within Europe and with our main trade partners. For instance, the conventions and directives which were adopted at the international and European level, with the aim of controlling cross-border movements of hazardous waste (notably electronic and electric waste material, and end-of-life vehicles) in the context of a linear economic model, are at times restrictive, and even counter-productive, in a circular economy. Certain recyclable waste products fall under this legislation. For example, it is impossible to export old tyres for retreading towards Turkey as they are considered "hazardous waste".

- **Develop quality standards for secondary raw materials.** Creating a market for recyclable raw materials should influence the behaviour of certain manufacturers who are not in the habit of reusing spare parts to repair faulty products. The value of secondary materials is still very much underestimated compared to that of new materials, especially when the former are not competitively priced.

Another important area, notably in terms of the sharing economy, is the **adoption of regulations to support the most innovative initiatives,** which sometimes suffer from an inadequate legal framework or a legal void. To use just one example, a supermarket which wants to allow its employees to deliver their neighbours' shopping when they go home after work (for a flat-rate fee) is faced with complex and often insurmountable obstacles in terms of labour law, when such a solution would in fact create value for everyone involved and would avoid unnecessary travel.

- Whether in revising existing regulations or creating new ones, companies must take the initiative in order to create more circular business models and identify regulatory barriers. As such, **both at the French and European level, "green deals" should be**

applied more systematically. They are a means by which industrial and public actors can mutually commit to the circular economy and sustainable development: businesses improve their practices while the State simplifies and adapts corresponding regulations (see III.d.ii). These initiatives are in a sense experiments; they represent an opportunity to reinvent the way in which private actors, public authorities and civil societies cooperate with each other. Promoting a local stakeholder dialogue on concrete issues will help to progressively align their various interests. The digital sphere can be an important driving force for such initiatives.

PROPOSAL N°4: set a price for negative externalities to create a level playing field for the circular economy.

- **Provide medium-term visibility on the price of carbon, at least at the European level if not globally.**
- **Study the possibility of promoting other types of externalities, whether positive or negative, for example impacts on biodiversity.**
- **Harmonise the cost of landfilling throughout Europe, setting it at an adequate level to promote recycling, reuse and energy recovery.**

Adequately pricing externalities provides a strong incentive for economic actors to adopt virtuous, and therefore more circular, behaviour, contributing to a visibility needed for innovation. As such, **it is crucial to set a price (and provide medium-term visibility) for the externality that has the greatest impact today – greenhouse**

gas emissions – at least at the European level if not globally. In many countries, the price of greenhouse gas emissions is still too low or non-existent, and therefore does not provide an adequate incentive. The numerous carbon-pricing methods that exist today indicate the difficulty in measuring how many tonnes of CO_2 are actually emitted.

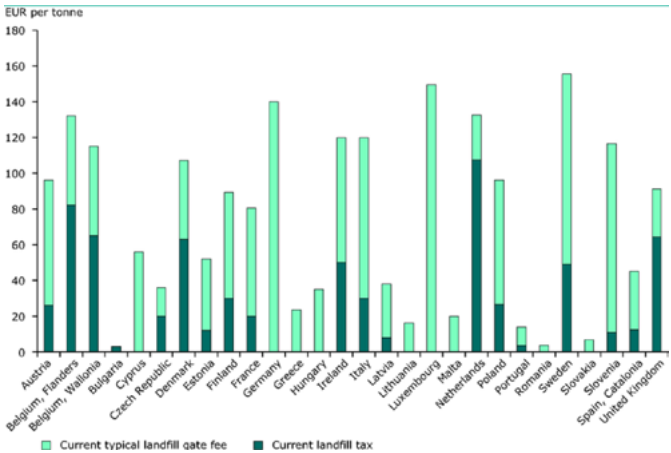
The problem of assigning emissions is a delicate one, and providing a uniform solution appears to be rather challenging. Measuring the carbon footprint of a product would entail incorporating the emissions of all the parties involved in its life cycle, from suppliers (who can often number in the thousands) to end-users, and not forgetting distributors. There are many practical difficulties to such an incentive-based pricing policy, and these have been the subject of numerous debates and studies, including the carbon-pricing report published in June 2016 by the Canfin-Grandjean-Mestrallet Commission, which gives a good overview of the issue.

Beyond the issue of carbon pricing, **it would be useful for other externalities, whether positive or negative, to be fairly priced by economic actors.** This notably includes issues of biodiversity and nitrogen and phosphorus cycles (see II.a.ii). Detailed scientific studies could be undertaken to precisely measure and determine fair prices for these externalities. In the short-term, funding could be provided for certain initiatives, especially for the preservation of biodiversity.

Finally, within the European Union, **the price paid by economic actors to landfill or incinerate waste varies widely** (see figure 5). Such incentives have a major impact; countries with high prices (such as Germany and Sweden) send almost no municipal waste to landfills, compared to 30% for France and 80% for Greece (in 2010),

countries where the rates are far lower and therefore less of a deterrent.

Figure 5 : Typical price for the landfilling of non-hazardous waste (tax + gate fee) within EU countries (2013)



Source: European Commission, 2013.

Levelling the cost of landfilling at a sufficiently high rate throughout Europe would be a way of promoting recycling and reuse, notably with a view to creating a single market for recycled raw materials.

Such a harmonised price increase must however be accompanied by a strategy for treating the waste which has been diverted from landfills so as not to produce negative impacts such as unauthorised dumping or illegal export of waste products. For instance, as they increased the price of landfilling, Germany, the United Kingdom and

Denmark also established new policies promoting the recovery of energy and usable materials from waste. There is however no consensus in France as to how to promote such initiatives, notably concerning thermal recovery.

PROPOSAL N°5: increase funding opportunities for circular economy transition projects

Both public investors (the European Investment Bank, the Caisse des Dépôts group including Bpifrance, etc.) and private ones (notably institutional investors) must become more pro-active and prepared to consider the following factors:

- Projects oriented towards the circular economy often have specific characteristics: they are highly capital-intensive and their cost efficiency can be affected by raw material price fluctuations; they have a high rate of fixed costs; their return on investment is below average or more long-term; they also generate an added social and environmental value which is part of their advantage.
- These projects at times involve a profound transformation of the company's business model, and hence an important change in their risk profile (going from a limited dependency on strategic natural resources, to an increased and long-term customer loyalty linked to the provision of services rather than goods). The challenge is therefore to take into account this modified risk profile in the funding proposal. The European Commission and certain private actors, including some banks, have successfully identified these issues and are already developing a specific approach to fund circular economy initiatives.

Developing green bonds and integrating the circular economy into the criteria for socially responsible investments will also help to

improve funding for circular economy projects. Finally, specific funding mechanisms can be creates to support the most innovative projects.

PROPOSAL N°6: build a comprehensive strategy for France.

- **In the context of the legally enacted national strategy for a circular economy transition, define priority sectors and an action plan, and determine expected benefits in the medium (2030) and long term (2050).**
- **Determine an appropriate organisation system at the ministerial level.**
- **Include and engage local authorities in this strategy.**

The energy transition law enacted in August 2015 included a chapter on the circular economy. This was a decisive step in the transition process. Creating a concerted action plan on a national level (in the form of a national strategy for circular economy transition) as set out in the text, is now a matter of urgency.

This plan will need to:

- define priority sectors for France and a specific action plan for each sector. The priority sectors for this transition should notably be selected based on their contribution to the economy, the impact they can have on the environment, and their potential to make quick progress in this area. For example, this may include the construction industry and the organic waste sector among others;

- tackle transversal issues, such as waste-to-energy recovery and training;
- quantify the expected benefits for France by 2030 and 2050: impact on the trade balance, impact on GDP, impact on the environment and expected funding requirements.

A centralised organisation of the circular economy will be required. At present this is split between the Ministry of the Environment and Energy, and the Ministry of Industry. This interdepartmental governance could rely on the French National Business Council's[19] "eco-industry" strategy, which would expand the Council's sphere of action and optimise its structure. This organisation system will need to have a concrete form and visibility in order to give this topic the weight that it deserves.

Finally, **local authorities will need to be involved in the implementation of this plan,** since they have a key role to play, notably in waste disposal.

PROPOSAL N°7: promote innovation and the evolution of a circular supply.

- **Endorse training for the skill areas and professions of the circular economy.**
- **Encourage the creation of hubs and accelerators specialised in circular economy technologies.**
- **Provide funding for the most socially, technologically or structurally innovative projects.**

[19] An advisory body specialising in industrial policy and presided over by the Prime Minister.

Developing the circular economy should not be limited to the recycling and reuse of goods. **Innovation must be encouraged** since it is at the heart of business model transformations and will help create the products of the future. In particular, this transition depends on a fundamental change in design and production methods, in order to optimise resource use and reduce negative externalities all along the product life cycle.

First and foremost, adequate skills will be required, and ensuring this will involve **endorsing training for the skill areas and professions of the circular economy:**

- by identifying what new skills will be required and by offering courses that integrate innovative technologies;
- by including specialised courses in training programmes focusing on design (eco-design, design to sustainable value), agronomy (precision farming to limit input products or even substitute them with natural, eco-friendly alternatives), economics (adapting organisations to the circular economy), business management (smart purchasing, promotional marketing, etc.), and in technical areas (courses on the environment and sustainable development);
- by insuring that these modules are available through continuing vocational training.

Breaking down barriers and fostering collaboration are often at the heart of circular economy transition. It is therefore useful **to encourage the creation of hubs and accelerators specialised in circular economy** technologies (modelled on the Institute for Remanufacture in Scotland[20]). These groupings could take the form of public-private

[20] The Scottish Institute for Remanufacture (SIR) finances and supports projects that help businesses to increase their rate of reuse, repair and remanufacturing; the institute collaborates with universities and businesses of all sizes and from all sectors.

partnerships, collaborations between actors along a single value chain, or they could link different sectors and even R&D clusters. They will help to remove barriers linked to high transaction costs or limited access to competitive technologies.

Finally, **the most socially, technologically or structurally innovative projects must be able to access public funding.** This should especially concern projects that involve collaborations between different types of actors (the government, local authorities, laboratories, big industries and SMEs) or that develop ground-breaking innovations.

PROPOSAL N°8: stimulate demand for the circular economy.

- **Launch an awareness programme for citizen-users.**
- **Inform industrial consumers.**
- **Promote the circular economy through public procurement.**
- **Develop incentives at the local level, notably for recycling.**

The development of the circular economy cannot merely rely on new types of supply. We must also stimulate demand for goods created through the circular economy, especially since the value of such products is not immediately obvious to the consumer. They may even be perceived as inferior, as is the case for used parts.

If the circular economy is to become widespread, behaviours will have to undergo significant changes. And this requires a huge and coordinated effort.

The first aspect of this awareness programme concerns citizen-users, whohave a key role to play in the development of the circular economy, both as consumers and producers of waste. Even though the European, American and Chinese consumers surveyed[21] share in the view that the current resource management model is not viable and that it has to change, the strength of this conviction varies and people do not always act upon it.

Consumption patterns are grounded in habits and values that are firmly embedded in consumers' minds; changing them is therefore a difficult process. Various elements are involved: the perception of the quality of used materials, a tendency to over-consume, a preference for packaging that may be unnecessary, etc. **Consumers should therefore be made aware of the benefits and, where appropriate, shown that these can be economic as well as environmental and social.** They need to have easy access to transparent and clear information, in order to understand both the advantages and disadvantages of every offer (notably through eco-labelling and marketing campaigns). This information should be simple and precise (consumers generally complain about being given overly abundant, unclear and fragmented information), based on criteria which directly interest the consumer: the proportion of recycled or recyclable materials in products (and the resulting positive impact), how sustainable and repairable these are, and their potential salvage value after a certain period.

Furthermore, as waste producers, citizens should improve their own patterns of behaviour in order to sort more of their waste material. This is rendered even more challenging by the fact that consumers

[21] *Global Resource Observatory – Suez Environnement,* March 2015.

have a biased view of their own accomplishments in this area. Western consumers already feel very invested in resource protection: half of all Americans and 80% of Europeans say that they already sort household waste or limit their travel. Yet these actions are insufficient. For instance, more can be done in terms of sorting waste: in France, only one out of every two bottles is recycled[22], and plastics are imported from Germany to supply recycling plants. Not enough waste is sent to recycling centres. Waste sorting is particularly poor when it comes to organic matter: only 44% of organic waste in Europe is collected and recycled[23]. Citizens must become aware that throwing away a product, and therefore potentially the raw materials, has an environmental and economic cost.

These changing mindsets should be accompanied by the actions of local authorities, who organise waste collection. A number of levers are available at this stage, depending on the progress and degree of acceptance on the part of the population:

- **establishing individual waste sorting facilities for households.** The city of Milan is a prime example of a successful local policy for the collection, sorting and treatment of organic waste. In 2012, the city introduced a separate system to collect household organic waste for anaerobic digestion. It provided funding for waste collection agencies and launched a large-scale consumer awareness programme. As a result, the amount of organic waste processed rose from 53kg per head in 2013 to 92kg per head in 2015;
- **supporting individual composting initiatives.** This may be done by educating the public or by helping households purchase mini compost bins;

[22] Source: Chambre Syndicale des Eaux Minérales Naturelles (the French Association of Mineral Water producers).

[23] Eurostat.

- **providing more incentive-based pricing for households** (for example on the basis of how much waste is collected, or by enforcing the use of specific bin bags provided by local government, more expensive than standard bin bags), as set out by the "Grenelle environmental initiative"[24].

Regarding this last point, there is some controversy as to the acceptability of such schemes on the part of the population and their possible negative effects (illegal dumping for instance). A 2016 study of French communities which have implemented such schemes appears to show that the benefits outweigh these drawbacks[25], as long as an adequate public campaign is also launched. Similar evidence at an international level is also mostly reassuring. For instance, in Denmark (see Inset 6), the implementation of a charging scheme has had very positive effects. In Italy, the introduction of incentive-based rates in 95 municipalities has led to 12.2 % more waste being sorted, with no notable effect on the total quantity of waste produced[26]. These positive outcomes can be contrasted with some less favourable examples, such as illegal dumping or disposal in neighbouring communities, as was the case in Charlottesville, USA.

[24] The law from 03/08/09 set out an obligation for local authorities to include a price-based incentive for waste within a 5-year period. Yet today, only 5.4 million citizens (around 220 communities) have met the challenge (through a waste-collection fee [REIOM] or household waste tax [TEOM incentive]).

[25] *"In this study, we estimate the impact of the adoption of a pay-as-you-throw system on the quantities of municipal waste. We find that unit-based pricing reduces unsorted waste (by 67kg/inhabitant, which represents –28%), and increases sorted waste (by 14 kg/inhabitant for plastic, paper and packaging, which represents +33%). The first impacts start to appear the year before the new fee system is in place, likely due to information and communication campaigns preceding the pricing change. In addition, the increase in sorted waste quantities does not seem to go with careless sorting, in the middle run."* (La tarification incitative de la gestion des ordures ménagères : quels impacts sur les quantités collectées ? CGDD, March 2016)

[26] Incentive pricing for household waste management, French Commissioner-General for Sustainable Development, March 2012

Inset 6: The weight-based charging scheme for household waste in Denmark

In Denmark, the town of Bogense introduced a weight-based charging scheme for household waste in 1993. Households are equipped with standardised bins which allow people to separate organic waste from other types of waste products. The fees depend on the type of the service that individuals request from the municipality, and are made up of a fixed rate (for a collection of 5 kg of waste) and an add-on rate which varies according to the total weight collected (beyond the initial 5 kg).

Studies have shown that the quantity of waste is reduced by 359 kg per household in areas where this weight-based charging scheme is imposed. This system also leads to an increase in the amount of card and paper waste produced.

Source: Financing and Incentive Schemes for Municipal Waste Management, Case Studies - Final Report to Directorate General Environment, European Commission

The actions of public authorities should not however be limited to waste disposal. **Public procurement is an excellent way to influence behaviour:** it is notably possible to include "circular" performance criteria in public tenders. Public procurement represents 19% of European GDP and constitutes a major lever for the circular economy transition (see the example of Denmark – III.b.iii.1).

Finally, industrial actors have a major role to play in this process and must also change their habits. Cultural barriers and numerous

practices stall the development of the circular economy: B2B clients are rarely prepared to adapt their specifications in order to support the use of recycled materials (this is the case for recycled plastic, which is slightly grey rather than white like virgin plastic, and which can then be coloured during the manufacturing process with no impact on the end product) or reused spare parts.

APPENDIX

SOME DEFINITIONS OF A CIRCULAR ECONOMY

The European Commission described the model when it published the Circular Economy Package in December 2015: *"in a circular economy, the value of products and materials is maintained for as long as possible; waste and resource use are minimised, and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value. This model can create secure jobs in Europe, promote innovations that give a competitive advantage, and provide a level of protection for humans and the environment that Europe is proud of. It can also provide consumers with more durable and innovative products that provide monetary savings and an increased quality of life."*[27]

In France, **the law on energy transition to green growth** defines the transition to a circular economy as follows: *"the transition to a circular economy aims to improve upon the linear economic model – extract, produce, consume and discard – by calling for a thoughtful and responsible use of natural resources and primary raw materials. In addition to this, and in order of priority, it calls for waste prevention – including through the re-use of products – and, following the waste treatment hierarchy, reuse, recycling or, if those are not possible, reclamation of waste. This renewed prosperity will rely on: the promotion of industrial and local ecology and eco-design; the use of materials made from renewable natural resources which are sustainably managed and part of the recycling process; sustainable*

[27] *"Circular Economy Package: Questions & Answers"*, European Commission Press Release, 2 December 2015.

public procurement; prolonged product life cycles; waste prevention; the reduction or controlled release of pollutants and toxic substances; treating waste by following the waste treatment hierarchy; cooperation between economic actors within a relevant geographic area, who uphold the proximity principle and develop values associated with the use and sharing of information on environmental, economic and social costs."[28]

The **Agency for the Environment and Energy Management** (ADEME) explicitly introduces the idea of environmental preservation: *"the circular economy can be defined as an economic system of exchange and production, designed to increase the efficiency of resource use and to diminish environmental impacts at all stages of the product life cycle (of goods and services). The overall purpose of a circular economy is to drastically reduce resource waste in order to decouple resource use from GDP growth, whilst ensuring that environmental impacts are limited and that well-being is preserved. It is a case of doing more and better with less."*

The Ellen MacArthur Foundation defines the circular economy as follows: *"a circular economy is one that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles. As envisioned by the originators, a circular economy is a continuous positive development cycle that preserves and enhances natural capital, optimises resource yields, and minimises system risks by managing finite stocks and renewable flows. It works effectively at every scale."*

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THERE IS NO DESIRE MORE NATURAL THAN THE DESIRE FOR KNOWLEDGE

The circular economy: reconciling economic growth with the environment

50% of the European citizens find the house they live in too big for them; 31% of agricultural raw materials are lost during market uptake or by final consumers; cars are parked 90% of the time. These examples highlight the limits of a growth path that does not meet the commitments undertaken by the international community regarding the environment.

The transition towards a circular economy would therefore embody the solutions to deal with these challenges. By reducing waste throughout the value chain (from producer to end-user) and by coming up with new models to reduce negative externalities for society, a circular economy transition create innovative levers for an economic growth that preserves natural capital as well as the scarce raw materials.

At which levels should this transition be impulsed? Who should be its key players? What levers should be used to accelerate it? The Institut Montaigne formulates 8 concrete proposals that confirms circular economy as the best model for a sustainable economic growth.

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