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COMMISSION STAFF WORKING DOCUMENT

Analysis of an EU target for Resource Productivity

Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Towards a circular economy: a zero waste programme for Europe

{COM(2014) 398 final}
{SWD(2014) 206 final}

Contents

1 INTRODUCTION

We depend on natural resources — metals, minerals, fuels, water, land, timber, fertile soil, clean air and biodiversity — for our survival. They all constitute vital inputs that keep our economy functioning. Resource efficiency means optimising the use of these resources with a view to ensuring that we remain within planetary boundaries in the long term.

Becoming more resource efficient will contribute to delivering the Europe 2020 objective of sustainable growth by boosting Europe's productivity and so creating growth and jobs.

Resource savings will come from wasting less, and using what is available better. They will be based on new ways to reduce inputs, minimise waste, improve management of resource stocks, change consumption patterns, optimise production processes, management and business methods, and improve logistics. This can lead to the development of innovative products and services and so provide a competitive edge to our economy.

Resource efficiency covers such a wide range of resources, with the materials that are normally measured (minerals, fossil fuels, metals) being a proxy for the wider set. Smarter use of these resources will nearly always translate into fewer greenhouse gas emissions, less pollution and a better environment.

As announced in the Roadmap to a Resource Efficient Europe, the Commission has engaged with stakeholders to develop indicators and potential resource efficiency targets. Results of this work are outlined here, without pre-judging the outcome of the mid-term review of the Europe 2020 strategy. This document discusses the potential for a target on Resource Productivity to measure progress in making Europe more resource efficient. Setting such a target in the context of the European Semester would help guide action at the European and national levels, allow progress to be monitored, and encourage the sharing of best practice.

As the 7th Environment Action Programme[1] says "*A long-term and predictable policy framework … will help to stimulate the level of investments and action needed to fully develop markets for greener technologies and promote sustainable business solutions. Resource efficiency indicators and targets underpinned by robust data collection would provide the necessary guidance for public and private decision-makers in transforming the economy. Once agreed at Union level, such indicators and targets will become an integral part of the 7th EAP*."

2 THE POLICY CONTEXT

Europe 2020 is the EU's growth strategy setting out how the EU can become a smart, sustainable and inclusive economy. Concretely, the Union has set five ambitious objectives - on employment, innovation, education, social inclusion and climate/energy - to be reached by 2020. Each Member State has adopted its own national targets in each of these areas, so there is a clear linkage between targets set at the level of the European Union and then national targets. Concrete actions at EU and national levels underpin the strategy, and deliver the targets.

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:354:0171:0200:EN:PDF

The resource-efficient Europe flagship initiative is part of the Europe 2020 Strategy. It supports the shift towards sustainable growth via a resource-efficient, low-carbon economy. The "Roadmap to a Resource Efficient Europe" (hereafter "the Roadmap")[2] is one of the main building blocks of the flagship initiative, and outlined the structural and technological changes needed by 2050, including milestones to be reached by 2020.

The Roadmap also committed the European Commission to discussing and assessing the appropriateness of resource efficiency indicators and targets. To start the debate, the Commission conducted a public consultation on the options for resource efficiency indicators[3].

A European Resource Efficiency Platform (hereafter "the Platform" or "EREP")[4] also provided high-level guidance to the European Commission, Members States and private actors on the transition to a more resource-efficient economy. The Platform specifically recommended setting up indicators and targets as guiding tools for economic policy-making in view of the mid-term review of the Europe 2020 Strategy that will start in 2014. The members include European Vice-President Tajani, Commissioners Potočnik, Hedegaard, Šemeta and Rehn, members of the European Parliament (MEPs), national environment ministers, selected business CEOs, academia and representatives of NGOs and civil society.

The Platform stated in June 2013 that:

> *"Targets are essential for guiding action, for making sure that we are moving in the right direction, while indicators are needed to measure progress. The EU should set ambitious, credible targets as soon as possible to improve the overall resource productivity of the EU economy, with a view to achieving the EU 2020 objective of overall decoupling of resource use and its environmental impacts from economic growth. Indicators to measure progress towards these targets should, in addition to carbon, include three key resources: materials (material productivity, as measured by GDP/Raw Material Consumption), water and land. This approach will be further refined and accompanied by the Platform with a view to being integrated into the Europe 2020 Strategy and monitored in the European Semester process."*

The Platform subsequently endorsed a target in its final recommendations of March 2014:

> *"We call upon the EU to set a target for a substantially increased decoupling of growth from the use of natural resources, in order to improve competitiveness and growth as well as quality of life. The target should aim to secure at least a doubling of resource productivity as compared with the pre-crisis trend. This would be equivalent to an increase of well over 30% by 2030.*
>
> *We therefore call upon the European Commission to make a proposal for a headline target as soon as possible."*

[2] COM(2011) 571

[3] Details of the stakeholder consultation including responses are available at http://ec.europa.eu/environment/resource_efficiency/targets_indicators/stakeholder_consultation/index_en.htm

[4] http://ec.europa.eu/environment/resource_efficiency/re_platform/index_en.htm

3 A TARGET FOR RESOURCE EFFICIENCY

3.1 The benefits of a target

A target (even non-binding) is useful in generating political attention and in developing policies.

Setting a target for Resource Productivity could help promote an approach which will cut costs for industry and society as a whole. It could spur business and our societies as a whole to make a better use of natural resources. Resource Productivity is no different from any other type of productivity (labour, infrastructure etc.) in that it would contribute to growth and jobs although Resource Productivity would also contribute to a better environment.

A target will allow decision makers to assess whether potential improvements in resource efficiency are being enjoyed, allowing for costs to the economy to be cut, generating growth and jobs at the same time as reducing pressure on the environment.

At the same time, the inclusion of a target in the European Semester process would ensure proper monitoring, and sharing of good practice as to which resource efficiency policies are most beneficial.

3.2 Criteria for choosing a target

In order to be understandable for the general public and politically relevant then the target needs to relate to simple concepts, and should be:

- supported by data (therefore measurable in a reliable way);
- set at an appropriate level (i.e. achievable);
- cover a broad set of resources;
- applicable where possible to different levels of economic activities (EU, Member States, sectors, firms, products);
- avoiding negative side effects (such as showing a positive trend simply because environmental impacts are shifted outside the EU).

3.3 The choice of an indicator for a target

Resource Productivity, defined as the unit of GDP produced with one unit of Raw Material Consumption (RMC) is the indicator which satisfies best those requirements.[5] Including GDP in the target ensures that the link is made between resource use and economic growth. RMC is the most relevant indicator upon which to base a Resource Productivity target, as it touches upon every sector of the economy and covers a wide range of resources.

There are some limitations to the measure for Resource Productivity: for example, RMC does not include other resources such as land and water. This is why Resource Productivity is

[5] Explanations of how the Material Flows Accounts are developed and material consumption is measured are available at: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Material_flow_accounts

complemented by a second tier dashboard of complementary macro indicators on land, water and carbon.

Moreover, RMC is an aggregated indicator using the sum of the weights for the different resources covered. This aggregation limits its suitability for deciding on the appropriateness of specific policies as it does not differentiate between the economic and environmental impacts of the resources it covers. However, there is a broad link between the indicator and both environmental and economic impacts. Moreover, the indicator can monitor the move to the circular economy as increased recycling will lead to less primary demand, and so reduced RMC.

In terms of the choice of the indicator, the consultation process has shown a broad consensus that Raw Material Consumption (RMC) is most appropriate because it best takes account of the resource use outside Europe, whilst Direct Material Consumption (DMC) - although more directly obtained from Material Flows accounts - ignores the international dimension of European material consumption. Using RMC in the Resource Productivity formula therefore fulfils two imperatives:

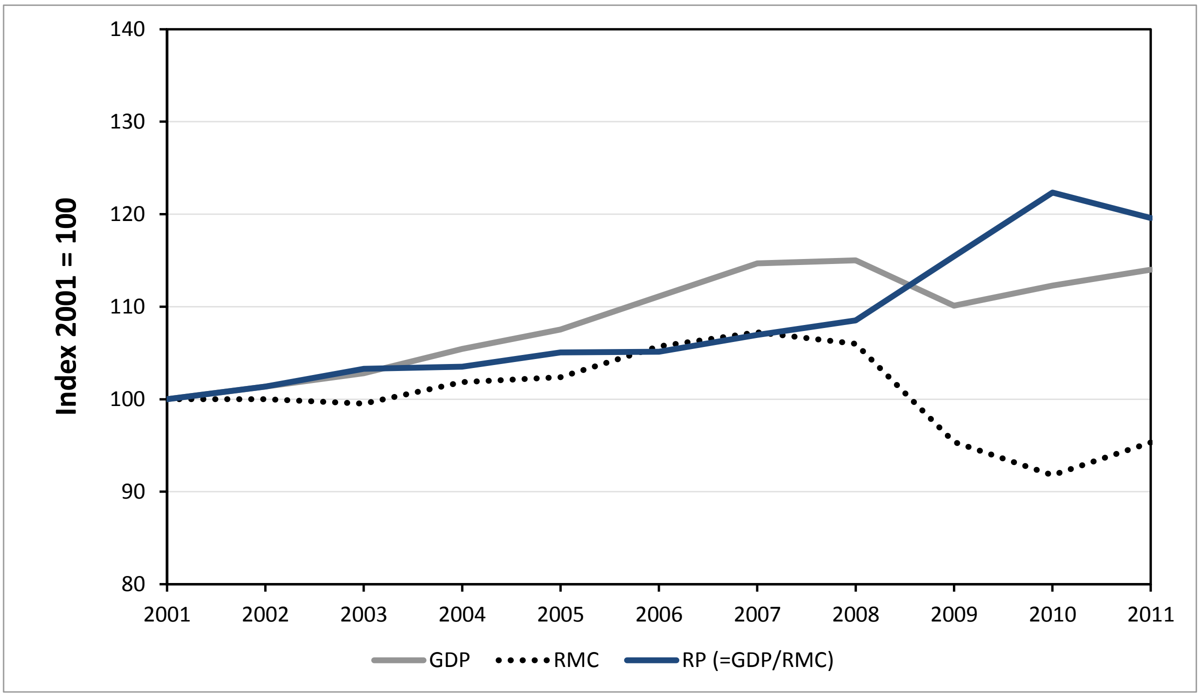
- It allows setting the European economy in the wider context of planetary boundaries;
- It favours production in Europe where industry is more resource efficient than in developing countries.
- Whilst the indicator is weight-based, it reflects environmental impacts reasonably well.

4 TRENDS FOR RESOURCE PRODUCTIVITY

4.1 Past trends

Figure 1 shows a steady increase of RMC between 2001 and 2007 with a total increase of 8%. This upward trend ended with the recession and total RMC dropped by 11% over the following few years. In 2010 there are signs of a recovery as total RMC begins to pick up. Broadly speaking, RMC tends to increase during periods of economic growth but at a slower pace than GDP growth.

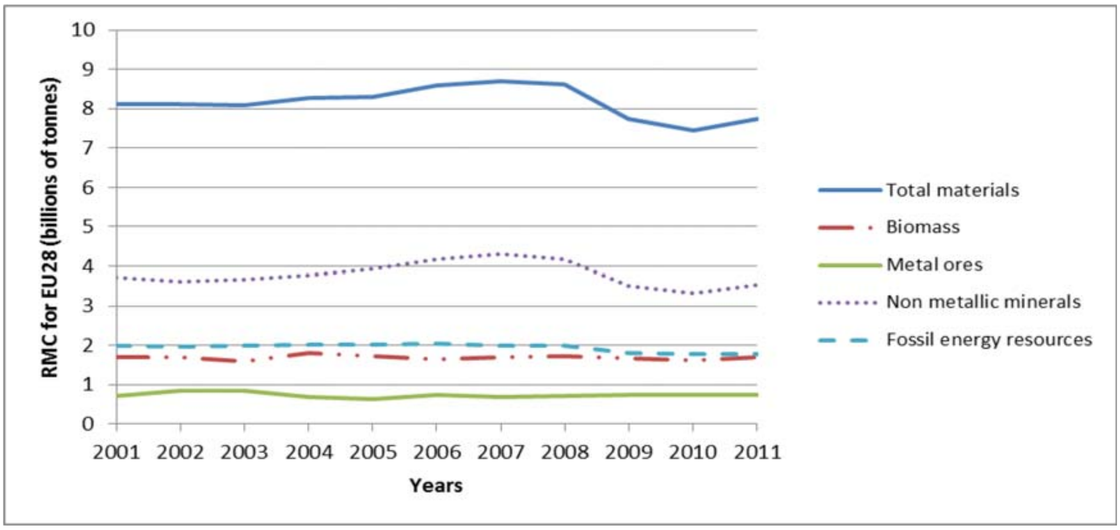
Figure 1: Evolution of GDP, RMC and Resource Productivity (RP) in the EU between 2001 and 2011



Non-metallic minerals (construction materials) showed a significant increase of 19% between 2002 and 2007, followed by a decrease of 23% between 2008 and 2010 during the economic crisis. The RMC of biomass, metal ores and fossil energy resources remained relatively stable over the same period (Figure 2).

As well as showing RMC, Table 1 also shows the change in GDP and hence Resource Productivity (GDP/RMC) over time.

Figure 2: Evolution of EU RMC (billions of tonnes RME) between 2001 and 2011



Before the economic crisis the trend rate for improvement in Resource Productivity was around 1.2% per annum. During this period, the construction sector in particular expanded quickly leading to increased use of construction materials: this means that the period before the crisis was unusual, and during this period in the business cycle a downwards pressure was exerted on Resource Productivity. During the crisis the construction sector was hit hard, resulting in a significant reduction in use of low value non-metallic minerals: again, the period during the crisis is exceptional.

The most appropriate time period for identifying the trend rate of improvement for Resource Productivity is to take as full a business cycle as possible. Using all of the available data from 2001-11, the longer term trend for improvement in Resource Productivity is 1.9% per annum.[6]

Looking at the period before the crisis, there was partial decoupling of material consumption from economic growth: including the period of the crisis there was absolute decoupling between 2001 and 2011.

On a per person basis, the resource consumption of Europe is increasing: from 16.2 tonnes per person in 2001 to 17.2 tonnes per person in 2008. Although per person consumption then fell back as the economy shrank, it began to grow again with the economic recovery.

Table 1: Composition changes for Resource Productivity, between 2001 and 2011

	Average annual change during period 2001-2011	Absolute change during period 2001-2011
RMC	-0.5%	-5%
GDP	1.3%	14%
Resource productivity (GDP/RMC)	1.9%	20%

4.2 Future trends

Projections of future trends (the baseline or business as usual scenario) suggest that Resource Productivity will continue to increase, but at a slower rate than in the past.

Central to any estimate of how resource consumption will evolve is the assumptions on GDP growth. GDP is forecast to increase by around 30% between 2014 and 2030[7]. RMC is forecast to increase by around half that level, or by around 14% by 2030. The underpinnings of this RMC projection are set out in Annex 3, and take into account past trends, and projections for economic growth, population changes and other drivers and a wide range of resource specific forecasts from across the European Commission.

The baseline projection is therefore that Resource Productivity will have improved by around 15% by 2030 (and by 7% by 2020) at a trend rate of 0.9% per annum.

To sum up, under a business as usual scenario, Resource Productivity would continue to improve because of a mixture of technological improvements and business efficiencies driven by rising resource prices. There would be relative decoupling in the future albeit with

[6] Clearly, the choice of timeframe is an imprecise science. More historical data would be welcomed, but is not easily available and there is no indication (based on the available information on material flows) that it would change the figures in a way that it would suggest a different policy response.

[7] Source: "The 2012 Ageing Report, Economic and budgetary projections for the 27 EU Member State (2010 – 2060)", European Commission – DG for Economic and Financial Affairs of the European Commission

Resource Productivity increasing more slowly than it did during the period 2001-2011[8] (0.9 per cent per annum compared to 1.9 per cent per annum since 2001).

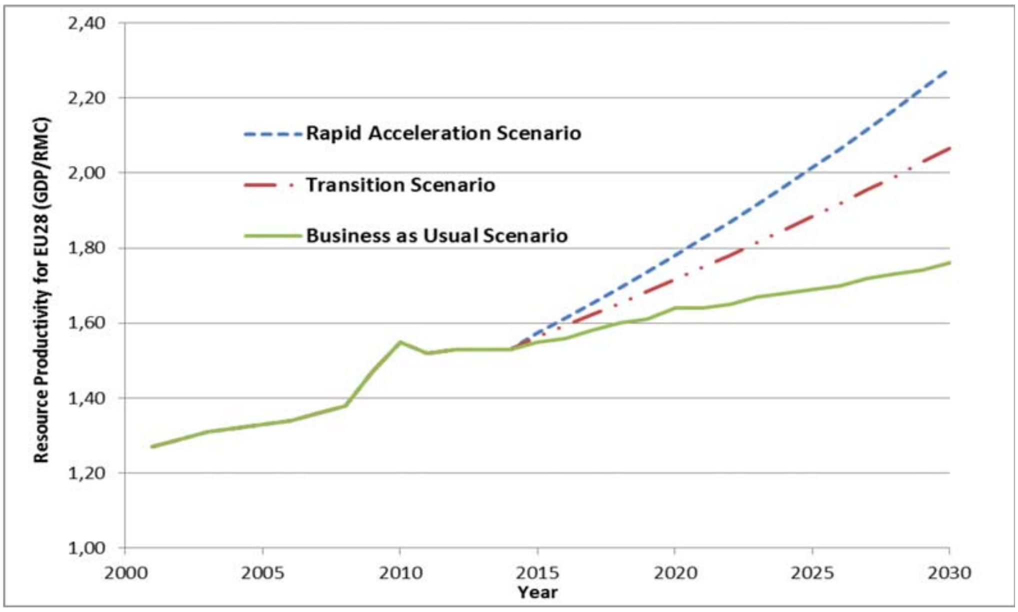
4.3 Scenarios for Resource Productivity

The baseline analysis shows that the rate of improvement for Resource Productivity will decline in the future as compared to the period 2001-2011. A target to drive policy could help increase Resource Productivity and to keep it improving at its current rate (as measured over 2001-2011).

Figure 3 shows the projections up to 2030 based on future projections for GDP and RMC from 2014 onwards (in turn based on projections for population growth and other factors).

- The **Business as Usual scenario**: improvement of Resource Productivity is forecast to be 15% between 2014 and 2030 (an improvement rate of just under 1% per annum), a slowdown from the current improvement rate (as measured over 2001-2011).
- The **transition scenario**: If the same annual rate of increase as over the period of 2001-2011 was to be maintained in the future (around 2% per annum) then this would result in a 30% improvement in Resource Productivity between 2014 and 2030. With this scenario, RMC declines marginally over the period, so there is absolute decoupling of economic growth from resource use.
- A **rapid acceleration scenario**: if the rate of improvement was to be faster than in the past then obviously a larger gain in Resource Productivity would be managed by 2030. Figure 3 shows a scenario based on an improvement rate of 2.5% per annum, which leads to a 40% improvement in Resource Productivity between 2014 and 2030.

Figure 3: Historical trend and possible scenarios for Resource Productivity (GDP/RMC) of EU between 2001 and 2030



[8] Please note that during this period there was a period of unsustainable growth followed by an economic crisis with a severe drop in manufacturing output and related resource use. This period is abnormal, and so the future should not be seen as a simple projection of this abnormal past.

5 IMPLEMENTING A TARGET

A limitation is that RMC is not currently available for all European countries. Eurostat will work closely with Member States to find a rigorous and consistent approach to estimating RMC on the basis of the statistics collected as part of the Material Flows accounts. In the meantime, Member States can be flexible over the methodology they use for estimation, whilst trying to draw a clear picture on the rate of Resource Productivity improvement and the way in which it is being achieved. Until RMC is available at country level, DMC can be used as proxy.

For a target to be associated with a boost to growth and jobs, then it should be achievable at no net cost for the economy and indeed deliver cost savings. For this to happen, a target needs to be delivered through smartly designed policies. To facilitate this, Resource Productivity could be established within the European Semester as a headline target for the EU.

Member States could set their own related targets at national level, identify the relevant policies and report on their implementation, allowing for identification of best practice. They might wish to set sectoral targets but there would not be any expectation that they do so. As the EU target would be established in the European Semester, each Member State would be monitored on its Resource Productivity performance.

Given the numerous ways to deliver any target, there should be complete flexibility for Member States over what action they take. The optimal policy mix would though imply a contribution from EU policies to complement national efforts. Clearly, meeting the target will be easier if the right knowledge and skills are in place: for example, it is estimated that more than 4 million workers in the construction sector need up-skilling to meet the 2020 energy-efficiency targets.

Policies would therefore recognise that resources vary considerably in terms of their economic and environmental relevance. All actors should concentrate their efforts on policies that will not just reduce the weight of resource use[9], but also ensure that reductions are economically and environmentally as advantageous as possible.

The Resource Productivity target has been explicitly designed to complement and be mutually reinforcing with: the target to increase Europe's manufacturing base to 20% of the economy; the legally binding waste targets, given its wider scope; and, existing Europe 2020 targets on carbon and energy efficiency, which by themselves are not sufficient to cover the whole domain of Resource Efficiency.[10] Similarly, the delivery of a Resource Productivity target would be consistent with efforts to strengthen Europe's bioeconomy. RMC includes both fossil fuels and biomass, and so would provide a link between these different targets as well as economic targets, and reflect efforts to meet them.

A non-binding Resource Productivity target would be useful in generating political attention and in stimulating specific policies. For example, the 3% research spending target has existed

[9] As RMC is a weight-based indicator, it is not by itself a suitable basis for policy decisions. As always, decisions need to be based on an integrated assessment of the economic, social and environmental impacts of alternative policy options.

[10] Section 6.2 examines the relation to other targets and their complementarity.

for more than a decade with no suggestion that it should become binding whilst still providing a clear objective.

6 Improving resource efficiency: policies and impacts

6.1 The economic context

The EU is not self-sufficient in many resources and imports six times more materials and resources than it exports. Access to raw materials - some of which are considered as 'critical' - is indispensable for EU industry with at least 30 million jobs depending on this.[11] For some of the materials considered as critical by the EU, the dependency is significant.

On average, real prices increased by more than 300% between 1998 and 2011 for resources. [12] The prices of commodities are expected to rise further due to the expected increase of demand for resources, in turn driven by a growing world population and even faster growth in the world economy.[13]

These rising prices for resources mean that improved resource efficiency is needed to improve the competitiveness of EU firms. Resources make up a significant part of the cost base for business: for example, recent studies on the steel and aluminium sectors show that raw materials make up around 30 to 40 per cent of the sectors' cost structures (not including energy costs)[14].

Despite the argument that increasing commodity prices will deliver resource savings, both theoretical and empirical evidence suggests that there are significant market failures due to externalities, information deficits, adaptation and coordination deficits:

• Positive externalities associated with eco-innovation that pose barriers to entrepreneurs and product innovation,

• Wide-spread information deficits as regards to potentials for saving material purchasing costs within companies and across industries,

• information deficits concerning uncertainties about future demand for new eco-innovations, including in critical areas such as construction,

• Adaptation and coordination deficits with regard to existing market power, path dependencies and difficulties to finance mass market development of radical innovations.

6.2 Sector and issue specific analysis of resource efficiency potential

Because of the importance of resources to the economy, using resources more efficiently can have direct impacts on growth. The analysis in this section shows the potential for concrete

[11] Source : Note of the Interservice group set-up by BEPA on Raw materials – November 2013

[12] Mapping resource prices: the past and the future (2012)

[13] Eurobarometer surveys of business show that despite the current slowdown in price increases (during the economic crisis) they expect resource prices to increase as growth picks up again to a more normal level.

[14] "Assessment of cumulative cost impact for the steel and aluminium sectors" (2013), CEPS for DG Enterprise and Industry. This is a fairly consistent finding across industrial sectors, that resources (and their associated processing) is a dominant element of costs and often outweighs labour etc.

actions to be taken that improve Resource Productivity and hence the efficiency of the economy. These actions respond to the market failures that mean that economically beneficial resource practices are not being adopted.

The European Commission published an overview of Member State policies in place during 2011-2012 in areas of priority for Resource Efficiency and the Europe 2020 Strategy.[15] The overview examined changes in resource efficiency policies for the following policy areas: economic, fiscal and financial aspects (i.e. budgetary issues, market-based instruments, environmentally harmful subsidies and state aids), waste management, support to SMEs and air quality. A range of both performance and policy approaches was found, suggesting scope for sharing of best policy practice and for additional improvements in resource efficiency to take place.

The "Roadmap to a Resource Efficient Europe"[16] set out a framework for the design and implementation of future actions. This framework recognised the scope for proven resource efficiency policies, at the EU and national level, to be more widely adopted in a way that would be economically and environmentally beneficial. A range of analysis and studies show this potential:

- An analysis of the **use of resources within businesses** examined bottom-up industry data and case studies and found economic opportunities for businesses in three example sectors (Food and Drink manufacturing, Fabricated Metal Products, and Hospitality and Food Services). [17] Companies in these sectors could act in a number of ways ranging from better use of ecodesign, waste prevention and reuse: some measures would pay off almost straight away, others require up-front investment. Across industry, the study suggests that the net benefits for business from improved resource efficiency could be in the range of between 3% and 8% of annual turnover.

- **Information provision programmes**, such as knowledge transfer, industrial symbiosis, direct consulting and auditing services, training workshops and self-help tools and guides. [18] These programmes by help businesses to reduce their use of resources and so cut their costs, and could be more systematically applied.

- In the **built environment**, it is possible to reduce significantly (perhaps by up to 15%) the EU's Raw Material Consumption through a range of different technical measures.[19] This would only marginally affect GDP, and could perhaps increase it depending on policy design.

- Standard practice in the UK shows that **construction and demolition waste** recycling could by itself replace 25% of current consumption of construction minerals. This figure is based on current technologies, and is likely to increase in future as good and best practices suggest considerably higher potential. Further improvements could come from reduced demand for construction materials (regardless of source).[20] Efforts

[15] " Steps towards greening in the EU: Member States' resource efficiency policies" (2013). Previous studies have also identified successful policies at Member State level that could be more widely replicated: see, for example, "Economic Analysis of Resource Efficiency Policies" (2012), IVM et al

[16] COM(2011) 571

[17] The opportunities to business of improving resource efficiency (2013), AMEC et al

[18] The opportunities to business of improving resource efficiency (2013), AMEC et al

[19] Assessment of Scenarios and Options towards a Resource Efficient Europe (2014), TNO et al

[20] This can be seen as an indication of how, in general, secondary material will not entirely replace primary material.

to tackle this are discussed in the Communication on Sustainable Buildings COM(2014)445.

- Modelling of reducing **food waste** in the EU shows it would deliver very significant net economic benefits, to accompany the environmental benefits.

- In relation to **waste management**, existing EU policy has already reduced material consumption by between 5 and 14 per cent.[21] The proposals in the Circular Economy package, would save 32 million tonnes of waste (and not necessarily of low value: 16 million tonnes of paper/cardboard, 7.7 million tonnes of plastics, 1.9 million tonnes of metals, and just under 7 million tonnes of glass), a saving of 0.4% of RMC. Full implementation of the Construction and demolition waste target would save an additional 1.6%, but focused on lower value resources.

- In relation to the **energy and climate** package, this will lead to a decrease in consumption of fossil fuels. And contribution to a more than 20% reduction in fossil fuel RMC by 2030, and a reduction of around 5% of total RMC from this category. The **average annual additional investments** needed over the period 2011 to 2030 to meet the targets are projected to amount to 38 billion Euros for the EU, largely compensated for by fuel savings.

- **Environmental tax reform** is both environmentally effective (it reduces resource consumption), and neutral or beneficial for the wider economy. Model-based simulations of the impact of an environmental tax reform in Europe that includes energy and material taxes of 5% of their price in 2010 and up to 15% of their price in 2020, lead to a 5% reduction of material consumption in 2020, in particular for construction minerals and ores[22]. The analysis of potential for environmental tax reform in 12 MS[23] indicates that the additional tax revenue could rise to 1.62% of GDP (which could be used to lower labour taxes). In addition, in 2016, around 0.41% of GDP could be saved by removing some environmentally harmful subsidies.

The findings above - indicating scope for resource efficiency that can cut costs and reduce the pressure on the environment - hold also for a number of global actions on global resources. [24]

6.3 Macroeconomic analysis of resource efficiency potential

Macroeconomic analysis tells broadly the same story as the sector and issue specific analyses. Modelling suggests we could realistically reduce the total material requirements of the EU economy by 17% and that this could boost GDP and create additional jobs. [25]

Further analysis was recently undertaken to specifically analyse the linkages between RMC and the economy and the environment through looking into the evolution of Resource

[21] "Analysis of the key contributions to resource efficiency", (2011), BioIS et al
[22] Ekins P., Speck S. (eds.), 2011 Environmental tax reform, Oxford University Press
[23] Belgium, Czech Republic, Estonia, France, Hungary, Italy, Lithuania, Romania. Austria, Slovakia, Croatia and Poland: ongoing study
[24] EU Resource efficiency perspectives in a global context (2011)
[25] Macroeconomic modelling of sustainable development and the links between the economy and the environment (2011), GWS et al

Productivity.[26] Figure 4 shows the impacts of different scenarios compared to the baseline (a 15% improvement in Resource Productivity by 2030, at an annual rate of improvement of 0.9% per annum ie a slowdown in the annual rate of improvement of Resource Productivity):

- The **Business as Usual scenario**: improvement of Resource Productivity is forecast to be 15% between 2014 and 2030 (an improvement rate of just under 1% per annum), a slowdown from the current improvement rate. In the model, this is taken as neutral and so at 0% on the y-axis. In practice, this would deliver economic benefits but in this context it is assumed to be the baseline against which the other scenarios are compared.

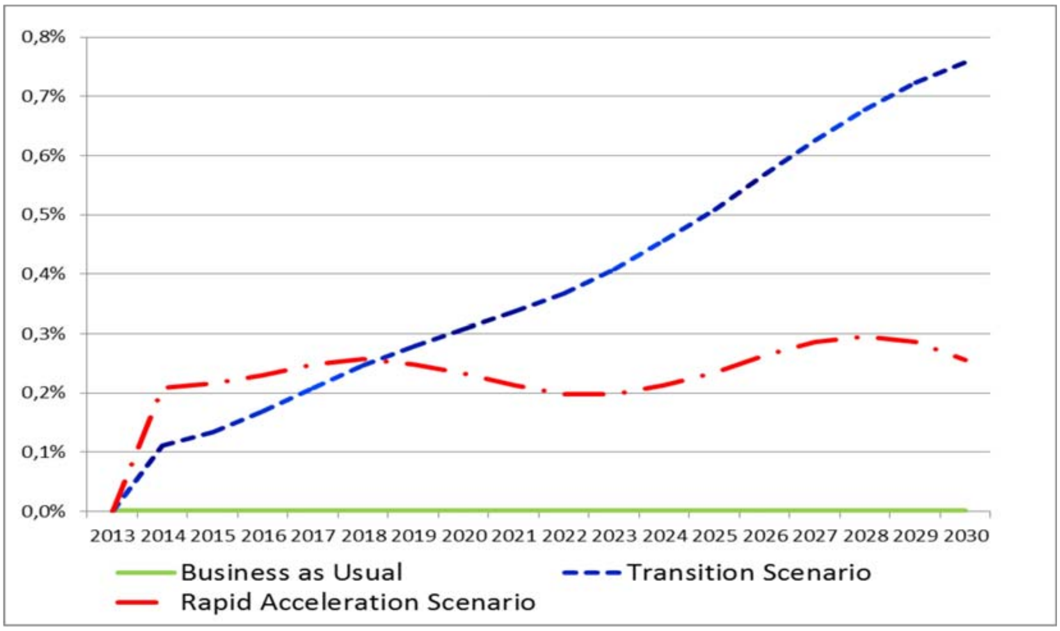
- A **transition scenario**: a 30% improvement in Resource Productivity by 2030, at an annual rate of improvement of 2% per annum. This delivers an increase in GDP of 0.8% by 2030, and more than 2 million additional jobs.

- More **rapid acceleration scenarios**: a 40% improvement in Resource Productivity by 2030, at an annual rate of improvement of 2.5% per annum. In the medium term, this scenario delivers a smaller increase in GDP than under the transition scenario. The reason why rapid acceleration is less good for growth is that to make further improvements, resource efficiency policies need to be put in place that have costs for the economy. Whilst the first improvements are beneficial to the economy, the additional steps come at a cost and in the end the net effect is negative.

These model runs are based on existing evidence about the scope for resource efficiency technical improvements at different costs, but it needs to be recognised that there is still considerable uncertainty over the unit costs of these improvements. Nevertheless, the sectoral and issue specific analysis reported in Section 6.2 provides confidence in the main message of the macroeconomic analysis in Figure 4: smart policies can deliver Resource Productivity improvements at a faster rate than business as usual would allow, and this would deliver additional growth and jobs.

Figure 4: EU GDP impacts, % difference from baseline

[26] The study uses data for RMC using Eurostat's methodology for estimation. The model used was the econometric model E3ME and results are in "Modelling the Economic and Environmental Impacts of Change in Raw Material Consumption (RMC)", Cambridge Econometrics et al, (2014). Please note that other models corroborate these general results (ie that resource efficiency is economically and environmentally advantageous). Most noticeably, the GINFORS model was used for modelling of resource efficiency scenarios, and produced results that were economically more beneficial than those from E3ME.



In terms of the policy mix to deliver the technical improvements, an equal contribution was assumed for the modelling between market based instruments (such as taxes), support to business (such as a recycling or information campaigns but also regulation) and improvements in the capital stock (such as investment in machinery to cut down raw material consumption per unit of production).[27]

The benefits of the different scenarios are clearly dependent on the Business as Usual scenario. There are very significant benefits in delivering the Business as Usual scenario as compared to keeping the current level of Resource Productivity. It is also the case though that the Business as Usual scenario may be faster or slower than predicted, not least because economic growth may be faster or slower than predicted. As for other targets, this will need to be reviewed periodically.

Sensitivity analysis[28] of increasing manufacturing suggests that a shift from services to manufacturing within the EU will have only a marginal impact on resource use as measured by RMC, and it may be positive. This may appear surprising, as manufacturing is considered to be resource intensive. However, one of the explicit reasons for using RMC and not DMC was to account for resource use outside the EU, and capture some of the hidden resource use associated with services.

More generally and leaving aside the purely indicator issues, the increased demand for resources in the future and the likely increase in their prices means that Europe's manufacturing sector will need to become more resource efficient if it is to maintain a

[27] In terms of the modelling undertaken, the key underlying point is - based on a range of evidence including that identified in Section 6.2 - that our economy currently uses resources inefficiently. A more efficient use of resources, like productivity improvements related to labour or capital, will be positive for growth and jobs. The policies chosen to deliver this in terms of the modelling are secondary, and the modelling results should not be particularly sensitive to their choice. For example, taxes are part of the modelled policy mix but it will be up to Member States to identify if they are the right policy tools in their situation from the wide range of policy tools available.

[28] "Modelling the Economic and Environmental Impacts of Change in Raw Material Consumption (RMC)", Cambridge Econometrics et al, (2014). Modelling was based on increasing the share of manufactring in the economy to 17.5%. An increase to 20% would show the same direction of impacts (ie neutral or positive), but obviously to a higher magnitude.

competitive lead. Improvements in resource productivity will be necessary to maintain the strength of manufacturing and facilitate the sector's growth. It would be fully in line with the philosophy of, for example, the European Innovation Partnership on Raw Materials as it would contribute to reducing risks relating to the supply of raw materials. Therefore, improving resource efficiency is coherent with meeting the goal set by the European Commission that industry's share of GDP should be around 20% by 2020, and RMC is the best indicator for measuring progress.

7 CONCLUSIONS

Discussion within the European Resource Efficiency Platform reflected a general consensus that GDP divided by Raw Material Consumption (GDP/RMC) is currently the most appropriate indicator on which to set a target. This is available for the EU and already a number of Member States. Eurostat should continue working on this indicator, also at the level of individual Member States, whilst in the meantime Direct Material Consumption could be used as a good proxy.

Recent trends suggest that further progress on resource efficiency is possible and can bring economic benefits. Resource Productivity in the EU grew by 20% in the period 2000-2011 (as measured by GDP/RMC).

Looking ahead, the forecasted baseline would result in an improvement of Resource Productivity of 15% between 2014 and 2030 (an improvement rate of around 1% per annum). If the same annual rate of increase as in the past was to be kept in the future (around 2% per annum) as occurred over the last economic business cycle, then this would result in a 30% improvement in Resource Productivity by 2030. The EREP endorsed this level of ambition as realistic.[29]

Estimates suggest that maintaining the current rate of improvement could boost GDP by nearly 1%, and create over 2 million jobs, compared to the baseline.[30] This would also help improve security of resource supply and bring environmental benefits such as reductions in greenhouse gas emissions.

Certain industries have raised concerns over the possibility of a complex web of binding targets reaching down to the sectoral level, or that a single indicator would be used to determine policy choices without proper consideration of the full economic, social and environmental impacts of decisions. This aspirational target is obviously not designed for that, but to provide the right policy signal and to encourage Member States to establish the necessary policy framework.

The Commission has launched a public consultation linked to the mid-term review of the Europe 2020 Strategy. This review covers all targets and aspects of the Strategy and the Semester and is seeking views on which targets should be included in the revised strategy to

[29] See http://ec.europa.eu/environment/resource_efficiency/documents/erep_manifesto_and_policy_recommendations_31-03-2014.pdf

[30] " Modelling the Economic and Environmental Impacts of Change in Raw Material Consumption (RMC)", Cambridge Econometrics et al, (2014)

be adopted by the next Commission.[31] Resource Productivity could be considered in this context.

A non-binding Resource Productivity target could be set at EU level, leaving Member States free to set their individual objectives and decide on an optimal policy mix. A combination of national and EU policies, for example policies to deliver a Circular Economy, would lead to meeting the target.

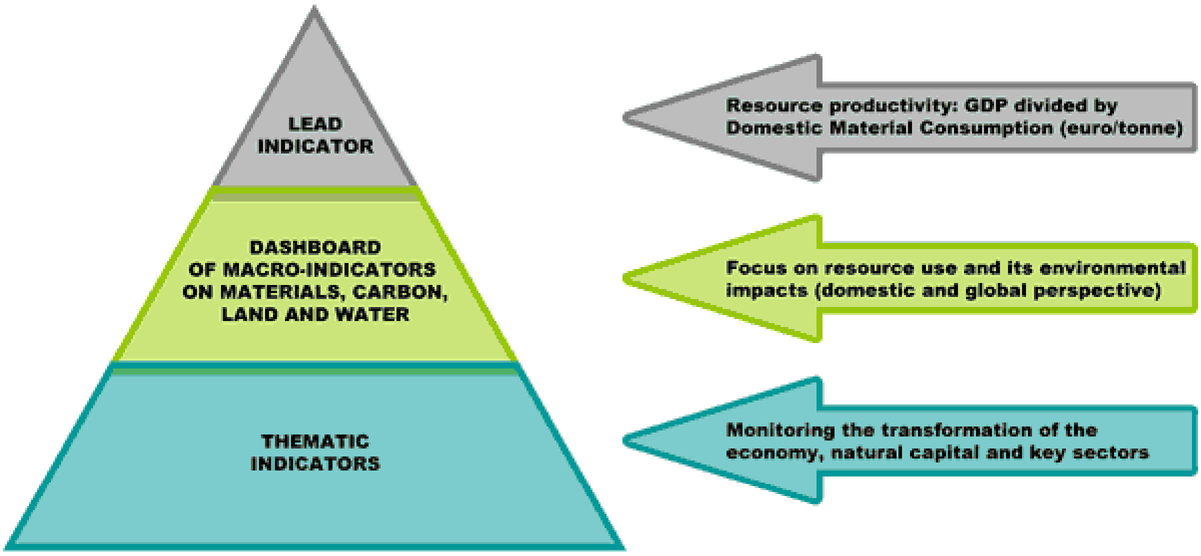
Policies undertaken should not be designed to just reduce the weight of resources used, but ensure that reductions are economically and environmentally advantageous ('no regret' actions that make sense simply on a financial basis). This will ensure consistency with existing targets in the Europe 2020 Strategy.

[31] http://ec.europa.eu/europe2020/public-consultation/index_en.htm

ANNEX 1 – THREE LAYER APPROACH OF INDICATORS

Annex 6 of the "Roadmap to a Resource Efficient Europe"[32] set out a provisional indicator set organised in a 3 layer approach:

1. One headline
2. indicator,
3. a dashboard of complementary macro indicators, and
4. a set of theme specific indicators to measure progress towards the specific objectives and actions.



First layer / lead indicator: focus on resource productivity

Measured by GDP divided by Domestic Material Consumption (euro/tonne) the Commission proposed to continue to use 'resource productivity', as the lead indicator.

However, even though this indicator is felt to be the most appropriate indicator available, it still has some considerable shortcomings:

- GDP/DMC as an indicator takes a national production perspective, which implies that it is insensitive to changes in environmental pressures that occur outside the national borders.
- DMC measures resources by weight, which impedes telling the full story of resources' scarcity and economic value and the environmental impact of their use.

The Roadmap also indicated that a development underway is the integration of indirect or embodied material consumption into material flow accounts in order to reflect the life cycle or value chain perspective. The indicator that will come out of this improvement is Raw Material Consumption (RMC).

Second layer / dashboard: focus on resource and its environmental impacts

[32] COM(2011) 571

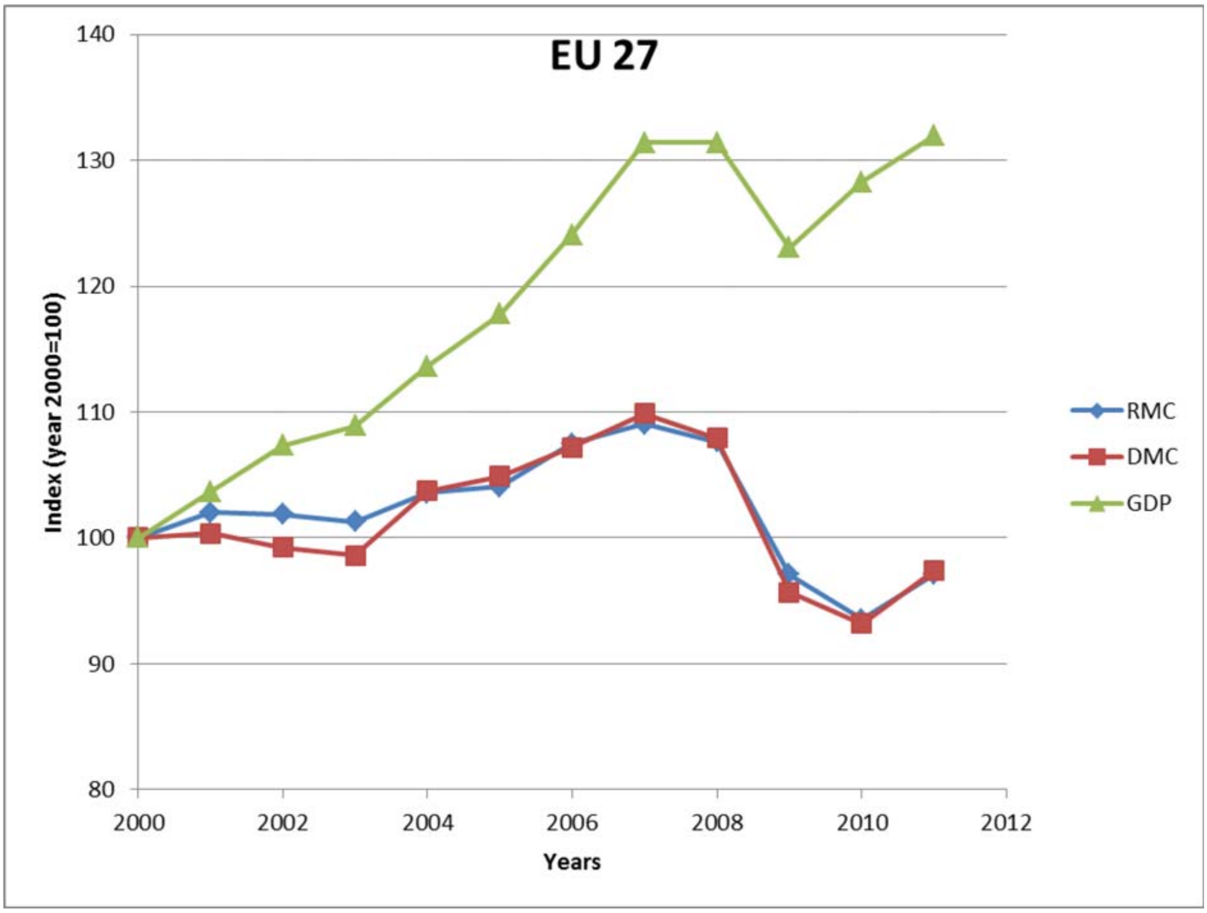
The Commission chose to complement the lead indicator with a concise dashboard of macro consumption and production indicators on materials, water, land and carbon. This dashboard of indicators – in conjunction with the lead indicator – has the advantage that it focuses on clear stocks or flows of main resources. As such it can be easily understood, measured and communicated.

Third layer: thematic indicators to monitor policy effectiveness

To measure performance on the actions and milestones proposed in the Roadmap the Commission proposed a wide range of thematic indicators. Here the approach was to limit the number of indicators to one relevant indicator per theme.

ANNEX 2 – COMPARISONS OF PAST TRENDS IN RMC AND DMC

The Figure below shows the movements in RMC and DMC over time for the EU27. As can be seen, the trends are broadly the same, but with some divergences. At the level of individual Member States, it would of course be possible to have bigger divergences between the two measures.



ANNEX 3 – PROJECTIONS OF FUTURE RESOURCE PRODUCTIVITY

Overview

During the ten years after 2001, Resource Productivity (RP) as measured by Gross Domestic Product / Raw Material Consumption (GDP/RMC) increased by 19.6% from 1.27 to 1.52 €/kg (+1.8% increase per year on average). The trend was not constant, with the fastest increase in 2008-2009 during the crisis, and a slower increase both beforehand and then especially after between 2010 and 2011. Regarding the total RMC of the EU-28, there was a first stable increase of 7% between 2001 and 2007 (+1.2% increase per year on average). Then, this trend stopped because of the recession, and the total RMC dropped by 11.1% over the next few years (which explains the strong increase in RP between 2008 and 2010). In 2010, the effect of a recovery can be seen in an increase of the total RMC.

An important factor underlying the trend is the construction sector, which represents between 33% and 37% of EU-28 RMC over this period. The sector “Services” corresponds to the second most important sector in terms of contribution to the EU-28 RMC (21% for the whole period), whereas "Food, Drink and Tobacco", “Engineering”, and “Energy” represents about 11-13%, 8-10% and 7% respectively. The other sectors have an even lower contribution (< 5%) to the EU-28 RMC.

Thus, the general RMC trend can be to a large extent explained by the evolution of RMC of non-metallic minerals (primarily construction materials). Indeed, this element increased by 19.1% between 2002 and 2007, and then decreased by 22.7% between 2008 and 2010 during the economic crisis. Meanwhile, the RMC of biomass, metal ores, and fossil energy resources remained relatively stable between 2002 and 2010.

The improvements in RP manifested in a partial decoupling from economic growth will relate, at the underlying level, to a mixture of technological improvements, efficiency driven by rising resource prices and the effects of resource efficiency policies over the period.

Forward projections

Looking forward, the baseline assumption is that these underlying trends will continue, and the analysis below of the different categories of resources is consistent with this hypothesis. With GDP forecast to grow at a rate of 1.6-1.9% per annum, the baseline assumption is that RMC will increase by 14% between 2014 and 2030 (5% between 2014 and 2020) and that RP will increase by an average of 0.85% per annum between 2014 and 2030 (1.07% between 2014 and 2020).

		2014-2020	2020-2030	2014-2030
GDP	absolute	11.7%	16.9%	30.6%
	annual	1.87%	1.57%	1.68%
RMC	absolute	4.8%	8.8%	14%
	annual	0.79%	0.85%	0.83%
RP	absolute	6.59%	7.4%	14.5%
	annual	1.11%	0.73%	0.86%

Trends per category of resources:

1. **Biomass**
   a. Past trends

Category	RMC past trends
Cereals	Stable over the period 2001-2011 (+0.3%), with significant annual variations (from -16% to +34%)
Other food	Gradual decrease (-7%) between 2001 and 2011
Feed	Stable over the period 2001-2011 (+0.6%) with moderate annual variations (from -8% to +10%)
Bioenergy	Small category; gradual growth over the period
Wood	Slight change between the level in 2001 and 2011 (+2.4%); a gradual increase until 2007, followed by a drop and recovery
Other biomass	Stable between 2001 and 2011with moderate annual variations (from -9% to +24%)

Biomass consumption is mainly linked to agricultural (food, animal feed, biofuel, natural fibre production) and forestry activities (wood products, paper and pulp products and bioenergy).

Thus, the main drivers of biomass consumption are related to food, feed, renewable energy demand and construction materials needs, which are themselves linked to population growth (increase of food, energy needs, housing needs for example), consumption behaviour (rising incomes or food trends that lead to more meat consumption, less vegetables, an increase in the demand of individual houses) and EU policy to increase the share of renewable energies for energy security and climate protection reasons..

The EU-28 population increased by 4% between 2000 and 2011. Thus, the stable trends of cereals and feed RMC can be explained by a compensation between growing exports and changes in diets, while the negative trend of the 'other food' product category can be explained by a decrease in fruits and vegetables in diets. The increase in wood consumption is the result of an increasing demand for paper products. The significant increase of bioenergy is the result of EU energy policies, which aim to increase the share of renewables in the energy mix.

   b. Future trends

Category	RMC future trends
Cereals	Modelled on the basis of the 2009-2022 projection (source: DG AGRI), assumption: between 2022 and 2030, the annual trend will be the same as between 2020 and 2022 (about 0.1% per year); overall trend for 2010-2030: +9% growth ➔ +0.77% per year between 2010 and 2022 and 0.12% per year between 2022 and 2030.
Other food	Food consumption: 33% increase between 1983 and 2050 in Europe (source: Kearney, 2010). Trend of food consumption between 2010 and 2030 modelled as 10% (about +0.5% per year), assumption: linear growth.
Feed	Feed consumption (driven by meat and dairy consumption): +6% in

	Europe between 2010 and 2030 (source: PBL, 2011). Average consumption of meat in Europe: 52 kg, and 300 kg of milk and milk products. Per-capita consumption of animal products in Europe: increased by around 50% over the 1961-2007 period (due to increased welfare and relatively lower prices), expected to continue to grow until 2030.
Bioenergy	Bioenergy consumption (driven by energy policies that promote the increase of renewable energy): +90% g between 2013 and 2020, i.e. 10% per year (JRC's, 2013). Assumption: same annual trend between 2020 and 2030 ➔ overall increase of 233% between 2010 and 2030.
Wood	Wood consumption (mainly driven by the construction and paper industry): +15% in Europe between 2010 and 2030, i.e. 0.7% per year (FAO, 2011).
Other biomass	Modelled on the straw consumption evolution: +26% between 2000 and 2020, i.e. 1.2% per year (IEEP's, 2012). Assumption: same trend will apply annually between 2020 and 2030 ➔23% global increase 2010-2030.

2. Metal ores

a. Past trends

Category	RMC trends
Ferrous ores	Gradual increase until the crisis, then strong drop (-48%), and finally solid recovery. At the end of the period in 2011, overall ferrous ores RMC decreased by 9.9% compared to 2001 due to the recession.
Copper	Global decrease (-7.4%) between 2001 and 2011.
Other non-ferrous ores	Gradual increase until 2007, then strong drop (-20%), and finally solid recovery. At the end of the period in 2011, non-ferrous ores RMC increased by 6.4% compared to 2001.
Bauxite and other aluminium	RMC stable between 2001 and 2011 (+0.6%) with moderate annual variations (from -7% to +7%).
Gold-gross ores	No reliable data.

Metal ores consumption is strongly related to industrial and construction activities, which are in turn strongly correlated with economic growth as measured by GDP. The trends of copper, aluminum, ferrous and non-ferrous ores globally increased until the crisis, then dropped and finally recovered.

b. Future trends

Category	RMC trends
Copper	Related to the activities of the construction sector; overall 2010-2030 trend : +29.3% (about 1.3% per year), in line with European GDP

Ferrous ores and Other non-ferrous ores	based on the evolution of the economic activities of the engineering sector; overall trend : +30.4% between 2010 and 2030, i.e. about 1.34% per year
Bauxite and other aluminium	Driven by construction and industry: 2% per annum increase in Europe until 2030, i.e. 49% growth from 2010 to 2030 (source: JRC, 2008)
Gold-gross ores	Based on the evolution of GDP: 1.2% per year between 2010 and 2015, 1.5% per year between 2015 and 2020 and then +1.7% per year between 2020 and 2030 (source: EU 2012 Ageing Report), overall increase: 31% from 2010 to 2030

3. Non-metallic minerals

a. Past trends

Category	RMC trends
Sand and gravel	Increase in the pre-recession period, decrease during the recession, recovery post-recession, now 6.3% below its 2001 value.
Construction minerals	Increase in the pre-recession period, decrease during the recession, now 6.7% higher than in 2001.
Industrial minerals	Steady growth followed by a fall during the recession period (-24%, high percentage because of the small total quantity of this category); in general: quite stable compared to the larger categories (above), but general fall over the period (-19.2%).
Other non-metallic minerals	Steady growth followed by a fall during the recession period (-42%, high percentage because of the small total quantity of this category); in general: quite stable compared to the larger categories (above), but general fall over the period (-24.5%).

The main activities that use non-metallic minerals are construction and industry. In the construction sector, sand and gravel but also marble, granite, or sandstone, are used as raw materials to produce construction materials such as concrete. In the industry sector, these non-metallic minerals are used in the production of paper, fertilizers or are integrated within the chemical industry. Population growth is also an important driver for this category (demand for housing and infrastructure).

The impact of the economic crisis (which hit the construction sector particularly hard) is observable and demonstrates the strong link between non-metallic minerals and economic growth. Indeed, all non-metallic mineral sub-categories of RMC decreased during the economic crisis: between -14% and -24% between 2008 and 2009.

Finally, the increasing importance of recycling can also explain the decrease of the non-metallic minerals RMC of almost all sub-categories between 2001 and 2011. For example, sand and gravel have been more and more recycled in aggregates for the production of concrete or for road applications. This is also the case for the chemical industry, which led to a reduction in raw materials consumption.

b. Future trends

All sub-categories within the non-metallic minerals are related to the construction sector.
Thus, the 2010 – 2030 RMC trend for these sub-categories is coupled with the trend in the construction sector, which is forecast to be +29.3% over the 2010 – 2030 period. There would also be some increased demand for nickel, uranium, silver, molybdenum and to a lesser extent for copper and aluminium as part of the switch to a non-fossil electricity mix.

4. Fossil energy resources

a. Past trends

Category	RMC trends
Hard coal, and crude oil, condensate and natural gas liquids	Overall decrease of RMC (between -22.8% and -16.2%) between 2001 and 2011
Lignite	Declined slightly over this period (-3.1%), recovery in 2010
Natural gas	Declined slightly over this period (-0.8%)
Oil shale and tar sands	RMC grew between 2001 and 2011 (+76.3%).
Peat	RMC was stable between 2001 and 2011 (+1.5%) but is subject to very strong annual variations (from -50% to +35%)

Fossil energy resources consumption is related to the energy demand (related to economic and population growth), the energy production systems, and the EU climate change policy. Fossil energy resources combustion is an important source of anthropogenic greenhouse gases (GHG), hence the creation of several programs and targets: the energy and climate "20-20-20" targets (-20% of GHG emissions in 2020 in comparison to 1990 levels; 20% of the EU energy consumption should come from renewable resources; + 20% improvement of the EU's energy efficiency), and the EU Emissions Trading Scheme (EU ETS) to reduce the GHG emissions from energy (power and heat) production systems and other energy-intensive sectors.
Both polices influenced the consumption of fossil energy resources. Indeed, the RMC of crude oil and hard coal, two high-carbon energy resources, decreased between 2001 and 2011 by 16.2% and 22.8% respectively. In the meantime, the consumption of other 'low-carbon' fossil energy resources (e.g. natural gas) was constant. This reflects the shift made to replace high-carbon energy resources with low-carbon fossil energy technologies.
Finally, the increase in oil shale and tar sands consumption over the 2001 – 2011 period is due to the investments made in these materials after the 2003 oil crisis, which led to the development of new extraction techniques and thus higher consumption of these two fossil energy resources.

b. Future trends

Over the period 2010-2030, these are the forecast developments:

- Hard coal: -2.5%
- Crude oil, condensate and natural gas liquids: -10.5%
- Lignite (brown coal): -2.5%
- Natural gas: -17.8%
- Oil shale and tar sands: -10.5%
- Peat: -2.5%

ANNEX 4 – THE STATISTICAL CONTEXT

In order to have a holistic view of the various aspects of sustainable development, the existing framework for measuring the economy – in other words, the system of national accounts – is supplemented by satellite systems representing environmental or social indicators. The material flow accounts of Eurostat are the data framework systematically recording the inputs of materials to European economies. The data in the accounts is provided to Eurostat by the Member States and conforms to agreed standards in terms of concepts, definitions, classifications and accounting rules. As such it brings environmental data together with economic data in a coherent and comparable framework.

The indicator derived from MFA accounting that is most referred to in policy making is domestic material consumption (DMC). In accounting terms:

- Direct Material Input (DMI) = Domestic Extraction Used (DEU) + Imports (IMP)

DEU is the aggregated amount of all materials (excluding water and air) extracted inside the national economy. IMP is the import of products measured as their mass weight when crossing the border. Adding IMP to DEU gives DMI, which is the amount of materials (excluding water and air) actually available as a physical basis for domestic production activities.

- Direct Material Consumption (DMC) =Direct Material Input (DMI) - Exports (EXP)

When the mass weight of exported products (EXP) is subtracted from DMI, then this gives DMC. DMC is the actual direct consumption of material (excluding water and air) in Europe.

The DMC of the aggregated EU-27 economy is dominated by bulk minerals – about half is sand and gravel and other non-metallic minerals such as natural stones, clay etc. Fossil energy materials make up around one fourth. Crop residues & grazed biomass and other biomass together contribute another fourth. Metal ores constitute the smallest category.

A criticism of DMC is that imports and exports are measured in terms of the mass weight of goods crossing the boundary. However, this does not take account of how far the traded products have been processed: the traded good may have involved considerable additional material use outside Europe, but this will not be captured in DMC meaning that the material footprint outside Europe is partially missed.

A more comprehensive picture is be obtained by converting the traded goods into their raw material equivalents (RME), i.e. amounts of domestic extraction used (DEU) required to provide the respective traded goods. Doing this for imports and exports allows RMC to be calculated.

Of course, the question is what coefficient to apply to imports to account for these hidden material uses outside Europe. Eurostat has developed a model to estimate the RME of imports and exports for the aggregated EU-27 economy (essentially, the coefficient to apply to imports and exports). However, this is outside the MFA and so Member States can choose to apply their own RME coefficients, leading to data for RMC that whilst being more complete than the data for DMC, is statistically less rigorous and less comparable.

ANNEX 5 – OVERVIEW OF THE MODELLING

The model

The model used is the macroeconomic E3ME model which has a material sub-model.[33] This is a computer-based model of Europe's economies, linked to their energy systems and the environment. The model was originally developed through the European Commission's research framework programmes in the 1990s.

The economic structure of E3ME is based on the system of national accounts, with further linkages to materials, energy and environmental emissions. The labour market is covered in detail, with estimated sets of equations for labour demand, supply, wages and working hours. International trade is modelled at sectoral level.

Relationships in the E3ME model are estimated empirically, and the model covers the components of GDP (consumption, investment, and international trade), prices, energy and material demands. Each equation set is disaggregated by country and by sector. The main dimensions of the model are:

- 33 countries (the EU Member States, Norway and Switzerland and three candidate countries)
- 69 economic sectors, defined at the NACE (rev2) 2-digit level, linked by input-output relationships
- 43 categories of household expenditure
- 13 types of household, including income quintiles and socio-economic groups such as the unemployed, inactive and retired, plus an urban/rural split
- 14 users of 7 different material types
- 22 different users of 12 different fuel types

E3ME models material consumption at Member State level with the following material types are included:

- Food
- Animal feed
- Forestry
- Construction minerals
- Industrial minerals
- Ferrous ores
- Non-ferrous ores

E3ME principally uses Domestic Material Input (DMI) as its measure of material consumption. In order to produce RMC in the model, a set of Raw Material Equivalent (RME) coefficients from Eurostat[34] is applied. The Eurostat RME coefficient estimates are disaggregated by material and product for the EU27. The EU27 RME coefficients are apply to Croatia as well to give EU28 results.

The method of feedbacks in the materials model is similar in nature to that of the energy module. It is assumed that all material consumption meets intermediate demands (i.e. materials are used as part of the production process and not bought by households directly). A

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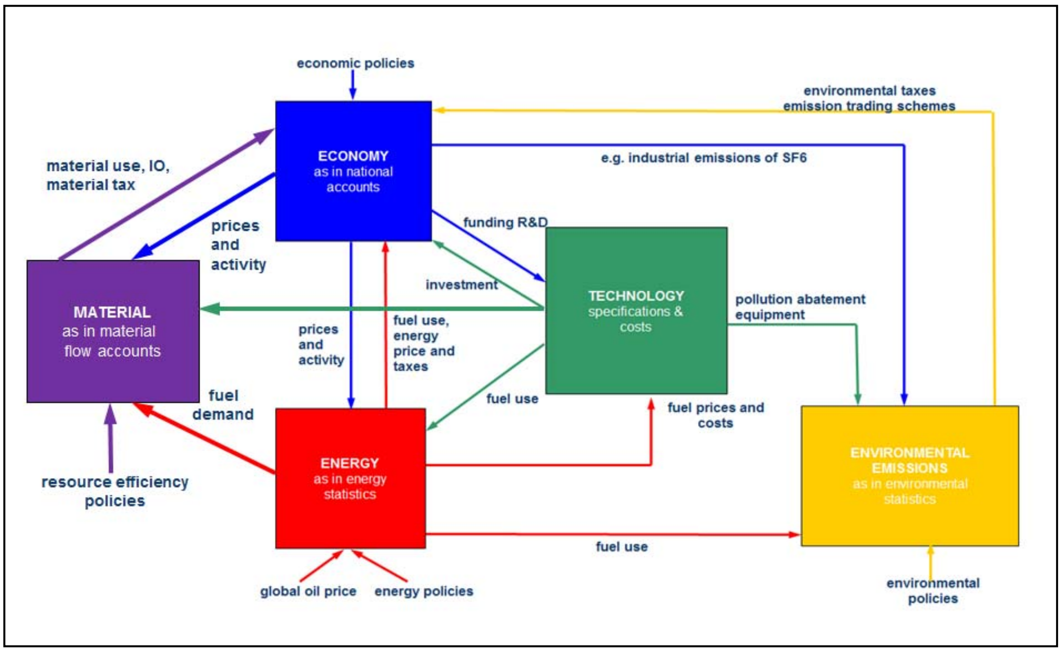
[33] See www.e3me.com for details

[34] http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/Project_Estimates_for_Raw_Material_Consumption_(RMC)_and.pdf

relatively small number of sectors produce the materials: agriculture and fishing produce food and feed; the forestry sector produces forestry; and other mining produces all mineral categories. The feedback is through adjustments to economic input-output coefficients at the Member State level.

Energy-Environment-Material-Economy linkages



Scenario assumptions

The policy assumptions in the scenarios are designed to be transparent and simple. For each scenario, improvement in resource productivity comes from:

- 1/3 investments in capital stock to improve resource efficiency
- 1/3 behavioural change delivered through policies such as recycling or information campaigns
- 1/3 market-based instruments (MBI) (such as tax)

The policy assumptions apply to all the materials groups (and the three fossil fuels groups) and start from 2014.

Fossil fuels are assumed to contribute to the RMC RP targets in the scenarios in line with the improvement in other materials. However, since fossil fuels in the baseline already see RP improvement of around 2.5% pa (DG Energy 2010), there is only further improvement where the overall RMC RP target is 3% pa.

For the MBI share, a tax on the consumption of raw materials is introduced. Tax revenues are collected by national governments and recycled back at Member State level through lower income taxes and employers' social security contributions (i.e. labour taxes) in order to achieve revenue neutrality. It is assumed that material taxes collected by government are used to pay for investment in resource efficiency, the remaining revenues are available for recycling.

One third of the reductions in material consumption are met by improvements in the capital stock, e.g. investment in machinery to cut down raw material consumption per unit of production. This requires estimates for the amount of investment required per tonne of material saved; although figures are available for energy consumption[35], little is available for materials. For example, the UNEP (2010) report estimates that around 10% of global annual global capital investment is needed for making the world economy more resource efficient. However, there is no clear description of what this means in terms of actual reductions in resource consumption. Therefore, an estimate is used in line with the figure quoted for reduction in energy consumption: €31.4bn annual investment is required in the EU for each 1% reduction in energy consumption (IEA, 2010). This investment figure is assumed to be the same for other non-fossil fuel materials.

In order to determine the most cost-effective ways of reducing RMC in the scenarios, a pre-analysis was set up to calculate the abatement cost for each user of each material, using each of the three policy types: MBIs, regulation, and investment. In this analysis, the model worked out a level of cost or investment in order to achieve a one percent reduction of RMC for each material/user/policy from the baseline in 2030. The GDP outcomes are calculated as difference from baseline and the euro per tonne costs of RMC reduction are obtained. The euro/tonne results are ranked, per policy, to indicate the least-cost (or most beneficial) options to be included in each scenarios.

Scenario results

The main scenarios run are as follows:

Scenario	Description	Approximate Improvement (2014-30)
Scenario 1	Baseline	14 %
Scenario 2	Modest and flexible improvement	20%
Scenario 3	Enhanced and flexible improvement	30%
Scenario 3.5	Further enhanced and flexible improvement	40%
Scenario 4	Ambitious and flexible improvement	50%

The EU macroeconomic impacts are as follows. These are shown as percentage changes from the baseline (S1). This means that the benefits are additional to the baseline, and the benefits of S1 are not indicated.

[35] *World Energy Outlook*, IEA (2010).

Table 1: EU28 macroeconomic impacts, % difference from baseline (S1)

	S2	S3	S3.5	S4
2020				
GDP	0.2	0.3	0.2	0.2
Employment	0.2	0.3	0.4	0.5
Consumer spending	0.3	0.5	0.2	-0.2
Investment	0.2	0.4	0.8	1.2
Imports (extra-EU)	0.1	0.0	-0.2	-0.9
Exports (extra-EU)	-0.1	-0.4	-0.9	-1.4
Consumer price	0.2	0.4	1.1	2.5
2030				
GDP	0.6	0.8	0.3	-0.1
Employment	0.7	1.0	0.8	0.9
Consumer spending	0.9	1.3	0.3	-0.8
Investment	0.4	0.6	0.6	0.8
Imports (extra-EU)	0.2	0.0	-0.7	-1.9
Exports (extra-EU)	-0.2	-0.7	-2.0	-3.0
Consumer price	0.6	0.8	2.4	5.3

To put this another way, the benefits of S3 (consistent with the 30% improvement in Resource productivity) is by 2030 GDP would increase by around 130 billion Euros (0.8% of around 17 trillion Euros in 2030) or by around 40 billion Euros (0.3% of around 14 trillion Euros in 2020). In terms of employment, it would generate over 2 million additional jobs by 2030 and around 600,000 additional jobs by 2020.