OPEN:EU

Summary Evaluation:

EUREAPA as a tool for informing policy decisions on the basis of the Footprint Family of indicators

Project Report

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Abbreviations

BISE	Biodiversity Information System for Europe
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CCS	Carbon Dioxide Capture and Storage
CF	Carbon Footprint
CFP	Common Fisheries Policy
CSD	Commission on Sustainable Development
DG	Directorate General
DWD	Drinking Water Directive
EC	European Commission
EET	Emissions Embodied in Trade
EF	Ecological Footprint
ETS	Emission Trading System
EU SDS	European Sustainable Development Strategy
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GPP	Green Public Procurement
NAMEA	National Accounting Matrix including Environmental Accounts
MRIO	Multi-regional input-output model
MS	EU Member State
OPEN:EU	One Planet Economy Network: Europe
SCP	Sustainable Consumption and Production
SERI	Sustainable Europe Research Institute
SDS	Sustainable Development Strategy
TEEB	The Economics of Ecosystems and Biodiversity
WF	Water Footprint

EXECUTIVE SUMMARY

This report assesses the usefulness of the EUREAPA tool for policy makers in terms of, firstly, its capability in integrating the Footprint Family of indicators and a multi-regional input-output (MRIO) model of the global economy; and secondly its usefulness for policy makers in the policy cycle and across relevant policy areas.

Three indicators were selected for inclusion within the Footprint Family; all are characterized by the capacity to represent the environmental consequences of human activities. The Ecological Footprint can be used to inform on the pressure placed on the *biosphere* by estimating the amount of bioproductive area people demand because of resource consumption and waste emission. The Carbon Footprint informs on the pressure humanity places on the *atmosphere* by quantifying the effect of resource consumption on carbon emissions. The Water Footprint can be used to inform on the pressure humans place on the *hydrosphere* by tracking both direct and indirect water used to produce goods and services that are consumed.

The OPEN:EU project is innovative in its integration of the Footprint Family of indicators with an economic model which allocates environmental pressures associated with multi-regional (incorporating trade) production and supply chain processes to groups of final demand products. The integrated model created as part of the project is referred to as an Environmentally Extended Multi-Region Input-Output model, or EE-MRIO. The EUERAPA tool is the front end interface which allows users to access the rich data and analytical capabilities provided by this modelling system.

The policy decision making process can benefit from the EUREAPA tool's two main functions: 'Viewing data' and 'Creating scenarios'. In particular, the detailed scenario functions are powerful as scenarios can be tailored to allow users to both forecast[1] and backcast.

The tool is most helpful in the first half of the policy cycle, as it allows users to assess the environmental impacts of current issues. It can also help illustrate future impacts of policy options through the scenario function. Specifically, the stages of the policy cycle in which the tool is most likely to be useful are:

- Problem recognition. The EUREAPA tool can help to provide useful information on the magnitude of impact on the three footprint indicators, to help identify which issues need to be addressed most urgently (e.g. carbon footprint of European countries).
- Agenda setting: By identifying footprint 'hot-spots', the EUREAPA tool can help policy-makers prioritise action (e.g. carbon footprint of the food sector).
- Problem exploration: The EUREAPA tool can help improve understanding of the problem, enable comparisons across countries/best practices and provide arguments to raise awareness among stakeholders (e.g. carbon footprint of food consumption in the UK compared with other European countries).
- Identification of possible solutions: The EUREAPA tool can be used to set up different scenarios developed by policy makers – these scenarios can help explore the

[1] It is noted that forecasting is on the basis of historical data only. This is discussed in limitations (Section 7).

effectiveness of different policy options (e.g. reduce consumption of meat in the UK to decrease carbon footprint).

- Selection of policy options: the EUREAPA tool can help policy-makers to assess the relative effects of different policy approaches and help to prioritise among them (e.g. by testing the impact of different targets for reducing meat consumption).

The EUREAPA tool can be used to help inform policy making across several of the policy areas identified as key components of the framework for delivering the Flagship Initiative for a Resource-efficient Europe under the Europe 2020 Strategy. For example:

- In agriculture, the scenario function of the EUREAPA tool could be useful in the ongoing reform of the CAP by helping in the identification of possible solutions, the impact and analysis of different policy options, and in the selection of particular policy options.

- In climate and energy, the tool provides a complementary consumption-based perspective to the EU's commitments under the Kyoto Protocol, which are based on production emissions. While climate and energy issues are already high on the policy agenda, this perspective can be helpful in reinforcing awareness on issues relating to individual responsibility for climate change. The scenario function of the tool also allows users to model different energy mixes and explore how changing the spend on energy products such as oil, coal and natural gas can impact on emissions levels both inside and outside of the EU.

- In sustainable consumption and production, the tool could be useful in the problem recognition and agenda setting stages by providing information on particular problem areas modelled by an industrial sector or consumption category.

- In transport, the tool's scenario editor could be useful in the identification and development of possible actions in line with the objectives set out in the EU's Transport Roadmap (EC 2011a). The EUREAPA tool could also be useful in the prioritisation and final selection among different options.

- In water, the tool can help highlight the most water-intensive products and assist in targeting the sectors or products which require action most urgently. The scenario editor could be useful in exploring the relative effectiveness of policy options to address and mitigate the challenge posed by water scarcity and drought.

A number of limitations have been identified. Further development of the tool would be required in order for it to be useful in the later stages of the policy cycle, such as monitoring, reporting and evaluation. The Footprint Family does not measure soil quality and land degradation, release of toxic compounds, depletion of non-renewable resources or levels of nuclear waste. Substantial research would be required before it is possible to expand the Footprint Family to include such additional metrics.

In view of these limitations, areas for further development have been identified. Additional environmental extensions could be added to the MRIO model, which could generate new indicators in the tool. The usability of the EUREAPA tool could be further enhanced, tailored to specific user groups and additional features could be added (for example, the ability to carry-over settings and compare multiple scenarios at once). The current trade model that underpins the MRIO model and thus the EUREAPA tool uses

data from 2004. It would be desirable to update this trade model with more recent data once it becomes available.

The EUREAPA tool successfully brings together the Footprint Family of indicators and the MRIO model in order to inform decision makers not only of the impacts of humanity upon the planet but also the implications of future policy decisions.

Introduction

The OPEN:EU project[2] centres on the goal of transitioning Europe to a One Planet Economy[3] by 2050 and understanding what it would take to make this transformation. The first aim is to support policy makers in their thinking about what sort of effort is necessary and how effective different policy settings are likely to be in transforming Europe into a One Planet Economy. The second aim is to assist policy makers by providing them with a practical tool for illustrating the magnitude of the impact of different policy decisions on delivering on this goal.

To this end, the project team has brought together a set of three Footprint indicators - Ecological, Carbon, and Water - to measure the EU's progress towards the goal of a One Planet Economy. The three indicators were then brought together under an input-output ecological-economic modelling system to allow direct comparison of the indicators. The model created as a result of this project is referred to as an Environmentally Extended Multi-Region Input-Output model, or EE-MRIO.

The EUREAPA tool was created to enable the insights provided by this highly complex model to be accessible and relevant to a policy audience. Thus the Footprint Family of indicators - when integrated and combined within the EUREAPA tool - allows policy makers to measure the impact of consumption and production on key environmental pressures and compare this to relevant thresholds or benchmarks.

This report outlines the parameters of the Footprint Family of indicators (Section 2), the capabilities of the EUREAPA tool (Section 3), and assesses the capabilities and usefulness of the EUREAPA tool in terms of the different stages of the policy cycle (Section 4) and specific policy areas (Section 5). It also provides a practical example of how to use the EUREAPA tool (Section 6) and opportunities for further development (Section 7).

[2] http://www.oneplaneteconomynetwork.org/

[3] *A One Planet Economy is an economy that respects all environmental limits and is socially and financially sustainable, enabling people and nature to thrive.*

1. Parameters of the Footprint Family of indicators

Introduction to the Footprint Family

The Footprint Family of indicators is defined as a set of resource accounting tools characterised by a consumption-based perspective able to track human *pressure* on the surrounding environment, where pressure is defined as appropriation of biological natural resources and CO_2 uptake, emission of GHGs, and consumption and pollution of global freshwater resources.

Three indicators were selected for inclusion within the Footprint Family; all are characterized by the capacity to represent the environmental consequences of human activities, though they are built around different research questions and tell different stories. By looking at the amount of bioproductive area people demand because of resource consumption and waste emission, the Ecological Footprint can be used to inform on the pressure placed on the *biosphere*. By quantifying the effect of resource consumption on carbon emissions, the Carbon Footprint informs on the pressure humanity places on the *atmosphere*. Lastly, by tracking both direct and indirect water flows, the Water Footprint can be used to inform on the pressure humans place on the *hydrosphere*. These individual indicators are briefly discussed below, but full discussion of the strengths and weaknesses of the indicators within the Footprint Family can be found in Galli et al (2011).

The Footprint Family indicators

Ecological Footprint

By tracking a wide range of human activities, the Ecological Footprint provides an aggregated indicator for some anthropogenic pressures that are more typically evaluated independently (carbon dioxide emissions, fisheries collapse, land-use change, deforestation, agricultural intensification, etc.) and can thus be used to understand, in an integrated manner, the environmental consequences of the pressures humans place on the biosphere and its composing ecosystems.

Six key ecosystem services widely demanded by the human economy are tracked by the Ecological Footprint and associated with a type of bioproductive land: 1) plant-based food and fibre products (cropland); 2) animal-based food and other animal products (cropland and grazing land - agricultural land); 3) fish-based food products (fishing grounds); 4) timber and other forest products (forest); 5) absorption of fossil carbon dioxide emissions (carbon uptake land); and 6) the provision of physical space for shelter and other infrastructure (built-up area). It should be noted that the demand for the biosphere's capacity to uptake CO_2 is usually also referred to as "Carbon Footprint", though this should not be confused with the "Carbon Footprint", a methodology in its own, used in the climate change debate and in this project to account for the emission of a wider set of greenhouse gases (GHGs).

Despite the Ecological Footprint's unique ability to relate natural, renewable resource use and generation of emissions to carrying capacity through the comparison of the Footprint to available biocapacity, use of the Ecological Footprint is limited. For example, carbon

dioxide is the only greenhouse gas accounted for and its associated Footprint relies on the assumption that all emissions must be absorbed only by forests, neglecting carbon uptake by other biomass. Also, the Ecological Footprint may not be able to directly show the decoupling from resource use (i.e. an increase in the productivity of a resource) and the impacts upon, for example, biodiversity. However, a comparison of the Ecological Footprint of production (production in this context excludes embodied footprint in imports) and GDP trends allows users to link changes in Footprint intensiveness with changes in GDP. A further refinement of the analysis, to compare GDP, material use, and Footprint intensity trends, shows the links between economic growth, material use and pressure on ecological assets.

Carbon Footprint

The Carbon Footprint is a measure of the total amount of GHG emissions that are directly and indirectly caused by an activity or are accumulated over the life stages of a product. This includes activities of individuals, populations, governments, companies, organizations, processes, industry sectors, etc. Products include goods and services. In any case, all direct (on-site, internal) and indirect emissions (off-site, external, embodied, upstream, and downstream) need to be taken into account. More specific aspects such as which GHGs are included and how double-counting is addressed can vary.

The Carbon Footprint relates to consumption of goods and services by households, governments, and other 'final demand' categories such as capital investment. It also relates to the GHG emissions embodied in trade: the Carbon Footprint of a country is the sum of all emissions related to a country's consumption, including imports, but excluding exports. As such, the consumption-based perspective of the Carbon Footprint complements the production-based or territorial-based accounting approach such as those taken by national greenhouse gas inventories for reporting under the Kyoto Protocol.

The Carbon Footprint has the ability to track the impacts of international supply chains, spanning multiple sectors in multiple countries, but also has various associated weaknesses. For example, by looking at GHGs only, the Carbon Footprint is not able to track the full palette of human demands on the environment (e.g., resource depletion). It should be noted that, in calculating the Carbon Footprint, this does not yet answer the question whether there is a carbon concentration or climate change problem or not. Deriving a maximum 'allowable' amount of GHG emissions (a "Carbon Footprint threshold") would be needed once a 'sustainability threshold' for global warming has been agreed.

Water Footprint

The Water Footprint is an indicator of water use that looks at both direct and indirect water use of a consumer or producer. The Water Footprint of an individual, community or business is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community or produced by the business (Hoekstra and Chapagain 2008). Water use is measured in terms of water volumes consumed (evaporated or incorporated into the product) and polluted per unit of time. The Water Footprint is a geographically explicit indicator, not only showing volumes of water use and pollution, but also the locations (with nation-level resolution).

Water Footprints can be calculated for a particular product, for any well-defined group of consumers (e.g. an individual, family, village, city, province, state, or nation) or producers (e.g. a public organization, private enterprise, or economic sector).

Three key water components are tracked in the Water Footprint calculation: the blue Water Footprint refers to consumption of blue water resources (surface and ground water); the green Water Footprint refers to consumption of green water resources (rainwater stored in the soil as soil moisture); and the grey Water Footprint refers to pollution and is defined as the volume of freshwater that is required to assimilate the load of pollutants based on existing ambient water quality standards (Hoekstra et al. 2009).

Whilst the Water Footprint used in the OPEN:EU project has the benefits of not focusing purely upon blue water usage (typical of other water indicators), it is not a measure of the severity of the local environmental impact of water consumption and pollution. The local environmental impact of a certain amount of water consumption and pollution depends on the vulnerability of the local water system as well as on the number of water consumers and polluters that make use of the same system. In other words, unlike the Ecological and Carbon Footprint, the Water Footprint carries with it no global threshold in environmental services and thus cannot easily be benchmarked.

The Footprint Family

By bringing together the three selected indicators, the Footprint Family offers a complementary assessment of human pressure on the planet from a consumer-based angle. The Ecological Footprint focuses on the aggregate demand that resource consumption places on the planet's ecological assets; thus recognizing the existence of limits to our growth and trying to measure them. The Carbon Footprint focuses on the total amount of GHGs released due to resource-consumption activities; by complementing the production-based accounting approach taken by national GHG inventories, the Carbon Footprint provides a better understanding of humans' contribution to GHG emissions. Finally, the Water Footprint focuses on the human appropriation of natural capital in terms of fresh water volumes required for human consumption; it is primarily intended to illustrate the hidden links between consumption activities and water use.

A partial overlap exists between the Ecological and the Carbon Footprint as human-induced CO_2 emissions are tracked by both methodologies. However, both methodologies go beyond the sole CO_2 investigation as the Carbon Footprint also tracks the release of additional GHGs (usually CO_2, CH_4, N_2O, HFC, PFC, and SF_6) and the Ecological Footprint expands its area of investigation by looking at human demand for food, fibers, wood products, etc.

There is also a partial overlap between the Ecological and Water Footprints since water is tracked by both methodologies. But while direct and indirect freshwater requirements are clearly tracked by the Water Footprint indicator, the water issue is only indirectly tracked by the Ecological Footprint, which is able to provide limited information to back up water policies. The direct Ecological Footprint of a given quantity of water cannot be calculated in the same manner as a quantity of crop or wood product, though it is possible to measure the Ecological Footprint embedded in the provisioning of water (Lenzen et al. 2003). The combined use of both Ecological and Water Footprint indicators provided by

the Footprint Family is deemed to be the best approach to develop a multi-criteria decision making process and arrive at optimal decisions. There is a degree of double-counting due to these overlaps, but each of the Footprints represents an individual assessment with a focus upon differing pressures upon the ecosphere.

The Ecological, Carbon and Water Footprint are characterized by a wide spatial coverage and scale of applicability: they can all be applied to single products, cities, regions, nations and up to the whole planet. In terms of time coverage, the Ecological Footprint was found to be the most comprehensive as it covers a 1961-2007 time period, while values exist for the year 2001 and an averaged 1997-2001 period only, for the Carbon[4] and Water Footprint, respectively.

The Footprint Family of indicators can provide a key element of a multidisciplinary sustainability assessment and it also emphasizes the strengths and tries to dissipate the weaknesses of each indicator. A full sustainability assessment would require additional indicators covering environmental issues not covered by the Footprint Family (e.g., toxicity, soil quality and land degradation, nuclear wastes, etc.) as well as economic and social indicators. A more comprehensive analysis of the Footprint Family of indicators is available in Galli et al 2011 and Knoblauch and Neubauer 2010.

[4] More extensive time series Carbon Footprint results are available for some nations such as the UK – see Wiedmann et al., 2008.

2. Capabilities of the EUREAPA tool

EUREAPA Tool Functions

The Footprint Family's three indicators were brought together under an input-output ecological-economic modelling system (Weinzettel et al. 2011) to allow direct comparison of the indicators. Environmentally Extended Input-output (EEIO) models have been used for decades for the analysis of environmental impacts caused by human activities in complex economic systems (Minx et al. 2009). The strength of this approach is that it addresses production and consumption processes and their underlying technical, social and behavioural drivers simultaneously (Barrett et al. 2011). The method allocates environmental pressures associated with production and the supply chain processes to groups of final products by means of inter-industry economic transactions. Utilizing a multi-regional framework significantly adds to the depth of the analysis, tracking international trade and the environmental repercussions (Wiedmann, Lenzen et al. 2007; Peters and Hertwich 2009). The model created as a result of this project is referred to as an Environmentally Extended Multi-Region Input-Output model; an EE-MRIO.

The Footprint Family and the EE-MRIO have considerable application to policy makers when attempting to influence both consumption patterns and production processes. However, ensuring that this model is made accessible and relevant to a policy audience can be a very difficult undertaking. Nevertheless, it is important that the benefits from methodological advancements are made available to policy makers so that research can be used most effectively to support decision making and communication.

The EUREAPA tool was created to address these challenges and make the complex data in the EE-MRIO more accessible and relevant. It has been designed as a user interface to allow policy makers and civil society to rapidly identify the important messages resulting from the EE-MRIO modelling and to support the identification and evaluation of potential policy interventions.

The EUREAPA tool has been developed as a result of an extensive process of user engagement and has two principal functions: viewing data and creating scenarios. The viewing data function allows users to analyse the wealth of data held within the EE- MRIO model from a range of perspectives helping them to understand the causes of environmental pressure and identify priorities for policy intervention. The scenario function allows users to make changes to production and consumption and explore the effect of these changes on the Footprint Family. Both functions are described in more detail below.

Viewing data

At its greatest level of detail, the EE-MRIO model can take the emissions associated with 57 consumption sectors for 113 regions, and show the contribution that each other sector in every other country makes towards this impact. For example, the quantity of emissions from 'bovine cattle production' in Brazil that contributes to the UK's consumption of 'leather products' can be determined. The challenges presented in developing the EUREAPA tool are not only how to present this vast amount of data in an

understandable way for a policy audience but also how to draw out interesting findings to allow users to make informed policy decisions.

The complex array of data provided by the EE-MRIO can be viewed from a range of perspectives to allow users to rapidly identify important messages and identify priorities for action. The perspectives have been selected following extensive user engagement to ensure that communication of results is as effective and relevant as possible. The perspectives allow users to view data in detail for one country or to compare the performance of several countries; they are described in more detail in *Table 1* below.

Table 1: *EUREAPA data perspectives*

Perspective	**Relevance**
View impact of all 45[5] regions together	Allows users to compare their country of interest to other countries' performance. Identify best practice for consumption and production.
View impact of one country in detail	Allows users to compare the contribution of different consumption activities to each footprint for their country of interest to identify hotspots and priorities for intervention.
View results for consumption impacts[6]	Allows users to compare impacts occurring in their own country with impacts that arise as a result of activities in their country.
View impacts of consumption from household, government, or 'other[7]' sources	Allows users to identify the relative importance of household or government expenditure and target policy interventions appropriately.
View results for three top level footprint indicators	Allows users to assess indicators together and assess trade-offs between indicators.
View more detailed indicator breakdowns – for example for carbon footprint – CO_2, CH_4, N_2O, F-gases.	Allows users to assess the nature of impacts in more detail.
View impacts broken down into the high level 'basket' of sectors or products e.g. manufacturing or food[8]	Allows users to identify the consumption or production activities that contribute most to the footprint and prioritise effort in these

[5] Part of the process of simplifying the model for a policy audience involved aggregating to 45 regions from 113. The EUREAPA tool is designed for assessing and exploring issues concerning the EU; a selection of other countries/regions has been included for comparison. A full list of the 45 countries/regions presented in the EUREAPA tool is provided in Appendix I.

[6] Consumption impact is the lifecycle impact associated with the goods and services consumed within the country of interest.

[7] Capital and margin exports.

[8] A full list of the 62 products presented in the EUREAPA tool is provided in Appendix II.

	areas.
View a more detailed breakdown of impacts by consumption category	Allows users to delve deeper into the drivers of impact and identify product groups that contribute most significantly to the footprint and prioritise effort in these areas.

Figure 1 Screenshot of the EUREAPA tool showing Austria's Ecological Footprint per capita broken down by product basket

This allows users to interact with the data within the EE-MRIO at differing levels of disaggregation to maximise its application to policy development.

Creating scenarios

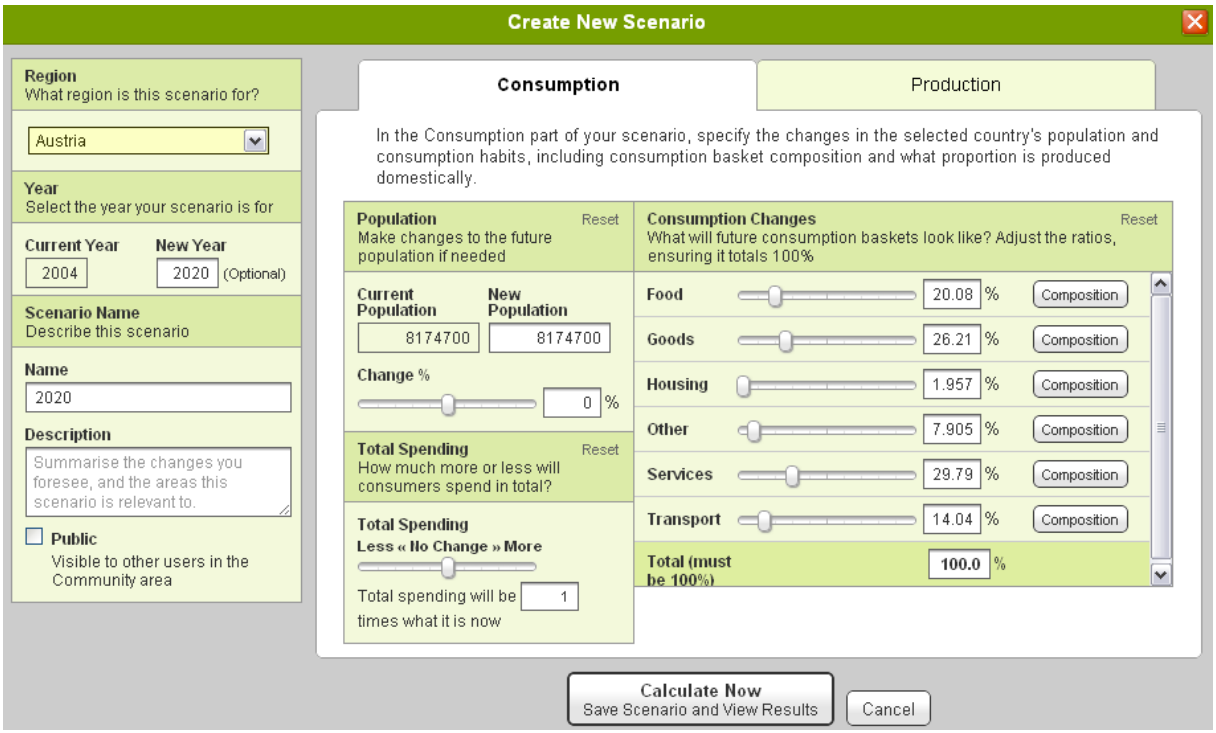
EUREAPA also allows users to create scenarios to explore how potential changes in consumption and production might affect the Footprint Family in the future. The scenario variables within EUREAPA describe future environmental change based on the understanding that environmental impact is driven by population, affluence and technology (Ehrlich and Holdren 1971). As a result, the variables in EUREAPA affect both

the direct intensity of production and the household demand for products and are described in more detail in *Table 2*.

Table 2: *EUREAPA Scenario Variables*

Variable	**Description**
Population	Users can change the number of residents in their country of interest.
Spending (affluence – total output)	Users can increase overall spending in high level scenarios or increase spending on a particular basket of goods and services.
Basket of spend (affluence - composition of household consumption)	Users can move expenditure consumption categories to model the effect of changing expenditure patterns.
Production efficiency (technology)	Users can change the efficiency of all production sectors in a particular country or change sector efficiency individually. This can be done separately for each footprint indicator.
Energy mix (technology)	Users can change the source of energy used by each sector, including the electricity sector, to model changes in the national energy mix.

Figure 2 Screenshot of the EUREAPA tool's Scenario function showing how changes can be made to the consumption patterns of Austrian citizens



Scenarios can be created for any year or series of years that the user specifies to provide maximum flexibility. Users can make changes to consumption and production in their own country or in any of the 45 regions presented in the tool. There are two principal processes for creating scenarios:

- Using the tool to ascertain the changes to consumption and production that result in the reduction in footprint required, then identifying the policy interventions that would bring about these changes.

- Establishing how a particular policy or strategy might change consumption and production, then using the tool to quantify the effect of these changes on the footprint indicators.

The tool's scenario function has been designed to allow users to change variables directly and independently. Users must identify evidence to support any changes they make; the model does not contain any assumptions or forecasts of potential future changes. When using tools to create scenarios and support decision making it is important that the connection between model variables and impact indicators is transparent (Boulanger and Bréchet 2005). This reduces uncertainty about a model's quantities, structure and its pertinence, improving confidence in the tool's outputs. It also encourages a more interdisciplinary approach to scenario development allowing a number of different stakeholders to contribute to changes made to model variables.

Saving and sharing scenarios

The scenario function has been developed to allow users to save their scenarios, making them available to view and upload by other users of the tool. The saved scenario can be viewed or edited and re-saved as a new scenario. It is hoped that this will improve the transfer of knowledge and best practice between tool users. More broadly, it is also hoped that by showing consequences of choices rather than predicting most likely outcomes, EUREAPA's interactive scenario function will provide a basis for users to change their minds about what is desirable for the future and alter their views on possibilities for change (Robinson 2003, 845).

What EUREAPA cannot do

The modelling taking place in the OPEN:EU project can help policy makers in understanding the broader implications of policy decisions for the long term sustainability of Europe. However, as OPEN:EU is specifically examining the impact of different assumptions and policy settings on the Footprint Family of indicators, and is doing so by making use of an input-output model (with no market or general equilibrium modelling), it will not provide sector-specific outputs such as projections of changes in prices, nor will it provide macro-economic outputs such as estimates of economic costs associated with certain policy settings.[9] More detailed information on how the EE-MRIO model and the

[9] EUREAPA contains baseline data on the economy, greenhouse gas emissions, ecological footprints and water footprints for every EU Member State and 16 other countries and regions of the world. At the heart of EUREAPA is an environmentally extended multi-region input-output model which combines tables from national economic accounts and trade statistics with data from environmental and footprint accounts. The extensive data system models the flow of goods and services between 45 countries and regions covering the global economy for 57 individual sectors over the period of a year. The sectors cover a range from agricultural and manufacturing industries to transport, recreational, health and financial services. Supplemented with detailed carbon, ecological and water footprint data for hundreds of individual materials and products, EUREAPA can account for the full supply chain impacts associated with the food people eat,

EUREAPA tool were developed is available in Weinzettel et al 2011 and Owen et al 2011, respectively.

the clothes they buy, the products they consume or the way they travel. This allows the user to look at the impacts of consumption activities in the context of lifestyles or national differences. It is important to note that a number of impacts of the policies investigated during the scenario development exercise cannot be quantified by the EUREAPA tool.

3. Using the EUREAPA tool to support policy-making throughout the policy cycle

One of the key objectives of the EUREAPA tool is to assist policy-makers in identifying appropriate policy interventions that will help the EU in the transition to a One Plant Economy by 2050. The EUREAPA tool combines data from national economic accounts and trade statistics with data from environmental and footprint accounts and can account for the full supply chain impacts associated with various consumption activities. The tool's benchmarking, analytical and visualisation facilities allow policy-makers to easily access and manipulate this vast amount of information; this enables them to better understand the impacts of consumption activities in the context of lifestyles, to consider national differences in environmental impacts, to identify which goods or services cause the most environmental impact ('hotspots') and to help prioritise policy intervention efforts. The tool's scenario editor can be used to compare different policy options, justify policy intervention, or assess the likely impact of proposed policies, strategies or investment decisions, thus enabling more informed decision making.

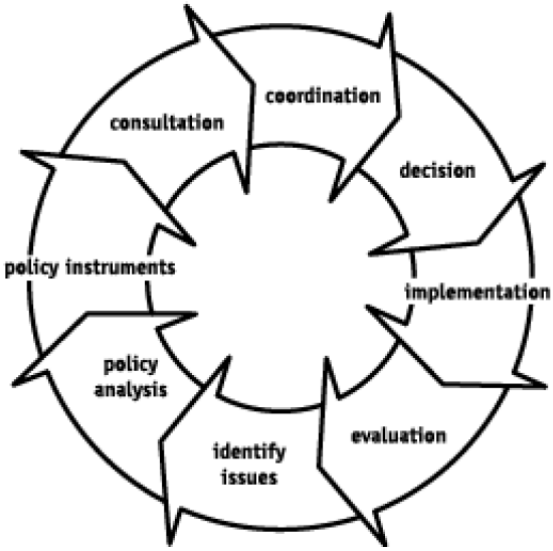
The EUREAPA tool can therefore assist in linking environmental impacts with driving forces (e.g. population growth, consumption and production patterns) and associated pressures (e.g. intensive agriculture, climate change, etc.), in order to better understand future trends and the potential effect of policies. Such an approach is consistent with the DPSIR (Drivers, pressures, status, impact and responses) analysis framework (Kristensen 2004; EEA 2003), which helps address functional relationships between nature and human well-being, as well as identify and measure driving forces behind environmental impacts.

This section of the report highlights those stages of the policy-making cycle to which the EUREAPA tool could be of particular relevance. Chapter 4 provides specific insights into which environmentally related policies the EUREAPA tool could be applied to.

Introduction to the policy cycle

There is no single, straight-forward definition of a standardised process for developing policy. However, policy development can be seen as an iterative process, and described by a 'policy cycle'. According to this view, the development of a policy moves through a cycle of stages, from issue identification (e.g. of a problem that needs to be addressed through policy) through to evaluation (e.g. of a policy's effectiveness). The cycle can be divided into different intermediate stages such as planning, implementation, monitoring, etc. There are different versions of the policy cycle depending on the emphasis needed and the complexity of the issue at hand. A textbook example by Bridgman and Davis (2004) is shown in Figure 3 below, where the policy process is depicted as a cycle consisting of 8 stages.

Figure 3 The policy cycle – an example



Source: Bridgman and Davis, 2004

It can be argued that a policy cycle is an artificial structure that may not fully reflect the complexity of policy development – for instance, policy stages may not be sequential, they can overlap, or consist of more or less intermediate steps. De Smedt (2008) notes that changes in policy and policy implementation are rarely the result of a linear process, but rather the result of iterative interactions 'where a strategic problem setting is linked to a plausible solution meeting the test of political consensus'.

However, while implications of oversimplification should clearly be taken into account, the policy cycle can be a powerful tool for policy analysis. By breaking down policy development into clear, distinguishable stages, it can make the decision making process more understandable, allowing for useful comparisons and analyses of distinct stages, and helping to identify weaknesses and opportunities in each step of the policy making process.

The Economics of Ecosystems and Biodiversity (TEEB) report for policy makers (TEEB 2011) underlines that, in the context of a policy cycle, indicators can help develop and communicate an understanding of the relationship between drivers and effects. For instance, the TEEB report stresses that biodiversity and ecosystem service indicators (such as the footprint) can be useful at different stages of the policy cycle, such as: problem recognition (e.g. endangered habitats and loss of ecosystem services); identification of solutions (e.g. favourable conservation status and necessary management activities); assessing and identifying linkages between policy options (e.g. investment in protected areas, green infrastructure); the implementation process (e.g. reforming subsidies, payment for ecosystem services); and ongoing monitoring and evaluation (e.g. status and trends).

The policy cycle approach can therefore help identify in which stages the Footprint indicators and the EUREAPA tool can be particularly useful, and what type of support they can provide to each step of policy development.

In the context of the OPEN:EU project, the policy cycle has been broken down into 10 phases, building on the TEEB approach - see Figure 4 below:

Figure 4 The policy cycle in OPEN:EU

Source: Adapted from TEEB (2011)

The use of EUREAPA in the policy cycle

By providing information based on the footprint indicators, the EUREAPA tool can inform policy makers, civil society organisations (CSOs) and scientists across several **different phases** of the policy cycle. The decision making process can potentially benefit from EUREAPA's **two main functions**: 'Viewing data' and 'Creating scenarios'.

Through these functions and the use of the Footprint Family of indicators, the EUREAPA tool can help policy development by providing information on the current environmental impacts of a policy/measure. Furthermore, its scenario function allows users to investigate the effect that different policies might have in the future. The scenarios are built on a number of variables affecting future environmental change, such as population, affluence and technology. These variables can be changed and tailored to different needs and assumptions, for instance by adopting different GDP and population growth rates or looking at various timeframes. This allows users to both forecast (i.e. estimate what will happen to the Footprint Family indicators, up to a specific year, if the variables change) and backcast (i.e. understand what policy changes are required to achieve a prescribed end-point, up to a specific year). This in turn can inform the evaluation and/or prioritisation of different policy interventions.

The EUREAPA tool can therefore be used to both assess a policy ex-ante or ex-post implementation and at different phases of the policy cycle. The potential use of the tool in each of the ten stages is as follows:

Stage 1 - **Problem recognition**: In this stage of the policy cycle, a particular issue is identified by stakeholders and/or political actors as being a 'problem' on which action needs to be taken. The EUREAPA tool can help to provide useful information on the type and size of impact and the correct signals as to which issues need to be addressed most urgently (e.g. providing

information on the key environmental impacts from food consumption).

Stage 2 - **Agenda setting:** After acknowledging the problem, policy-makers decide when and who will deal with it and what steps should be taken to address it. Here, the EUREAPA tool can identify footprint 'hot-spots,' which can help policy-makers prioritise between different options under consideration (e.g. within the food sector, identify meat as having the biggest impact and thus as an area to prioritise).

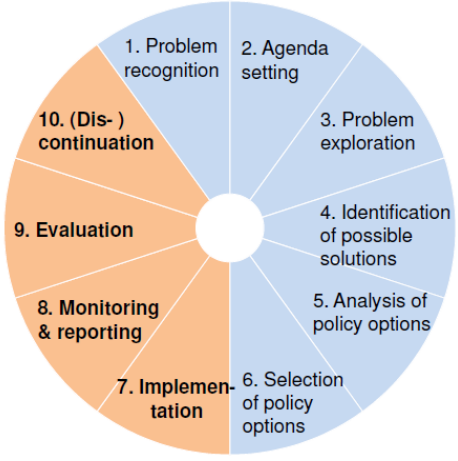
Stage 3 - Problem exploration: At this stage in the policy cycle, the problem is defined – e.g. in relation to size and impact. Assumptions and public opinion can play a critical role in this process. The EUREAPA tool can help improve understanding of the problem, enable comparisons across countries, identify best practices and provide arguments to raise awareness about the problem among stakeholders and the general public (e.g. the EUREAPA tool can help identify which countries have a lower food footprint, and/or what measures others are taking, which could provide good examples to learn from).

Stage 4 - Identification of possible solutions: At this stage in the policy cycle, possible solutions (policy options, actions etc.) are identified. The EUREAPA tool can be used to set up different scenarios based on these options (e.g. by setting up a scenario where food consumption decreases, or detailed scenarios where only meat consumption decreases, etc.).

Stage 5 - Analysis of policy options: In this stage, different solutions that have been identified are assessed (regulations, standards, plans, programmes, etc.) with different content, aims, instruments, strategies, responsibilities, funds, etc. The scenario function of the EUREAPA tool can be used to investigate the impact that the different policies and strategies might have in the future (e.g. by investigating the impacts on the footprint of the options/scenarios defined in stage 4).

Stage 6 - Selection of policy options: At this stage in the policy cycle, policy-makers choose between the different alternative options. The results obtained in stage 5 can help in the understanding of which option will have the lowest environmental impacts. For instance, the EUREAPA tool allows the users to change the food consumption profile (as a result of a proposed policy) and calculate how this affects the environmental impact. This will help policy-makers assess the relative effects of different policy approaches and help prioritise among them.

Stage 7 - Implementation: In this stage of the policy cycle, administrations implement what has been decided by the policy-makers. There is no particular role of the EUREAPA tool at this stage.



Stage 8 - Monitoring and reporting: Administrations monitor actions and report back to policy-makers. In a future generation of the EUREAPA

tool, the Footprint Family might among the indicators to be monitored at this stage.

Stage 9 - Evaluation: At this stage in the policy cycle, the effectiveness of the policy measure is assessed. In a future generation of the EUREAPA tool, the effectiveness of the measure could be evaluated.

Stage 10 - (Dis-)continuation: At this stage, policy-makers decide whether or not a policy measure should be continued. The EUREAPA tool can be used to influence this decision, in light of the estimated environmental impacts of the policy measure.

4. Insights into the use of the EUREAPA tool and the Footprint Family of indicators in selected policy areas

The potential of the EUREAPA tool for informing decision-making across a range of policy areas with significant implications for the environment and sustainability has been analysed in order to clarify where the use of the tool could be of added value. The selected policy areas broadly reflect the policy areas identified as key components of the framework for delivering the Flagship Initiative for a resource-efficient Europe under the Europe 2020 strategy (EC 2011) (hereafter referred to as the Resource Efficiency Flagship Initiative). According to the Resource Efficiency Flagship Initiative, in order 'to achieve a resource-efficient Europe, we need to make technological improvements, a significant transition in energy, industrial, agricultural and transport systems, and changes in behaviour as producers and consumers' (EC 2011).

The Resource Efficiency Flagship Initiative also recognises the need to develop more harmonised and transparent ways of measuring environmental impacts, for further analytical work to fully capture the impact of resource use on ecosystems, enterprises, the economy and society as a whole, and for appropriate indicators to monitor and measure progress on resource efficiency covering issues such as the availability of natural resources, their location, how efficiently they are used, waste generation and recycling rates, impacts on the environment and biodiversity (EC 2011).

The section below examines how the EUREAPA tool can be used to address some of these outstanding analytical gaps, collect data on the lifecycle impacts of various activities, and contribute to the development of future policies in the following policy areas:

- Agriculture
- Biodiversity and fisheries
- Climate change and energy
- Raw materials
- Regional development - cohesion policy
- Sustainable consumption and production
- Transport
- Water

Agriculture

Relevant policies/instruments and targets

Agriculture currently accounts for approximately half of the land area of the EU-27, and the cultivation needed to achieve its primary purpose – the production of materials for food, fibre and fuel – has impacts on the functioning of natural systems and the availability of natural resources (IEEP 2011). The **Common Agriculture Policy** (CAP)

exerts an important influence on agricultural land management in the EU. A series of successive reforms of the CAP have introduced important mechanisms that contribute to integrating environmental considerations in EU agricultural policies**.** Certain measures within the CAP, most notably the agri-environment measure within Axis 2 of Rural Development policy, have explicit environmental objectives. Other Axis 2 measures such as those concerned with supporting management within Less Favoured Areas (LFA) and Natura 2000 sites can indirectly support environmentally favourable management on farms. Other CAP measures, such as decoupled direct payments under Pillar One of the CAP in many cases support the continuation of farming which is essential for undertaking specific management to provide public goods. Linking direct payments to standards of Good Agricultural and Environmental Condition (GAEC) can further contribute to providing basic levels of public goods. Furthermore, measures applied under Article 68 of Council Regulation 73/2009 may support specific types of farming important for environmental protection or certain agricultural activities with environmental benefits (IEEP et al. 2011 - Forthcoming). Until 2008, there was no earmarking of funds under the CAP for specific environmental actions. The 2008 CAP Health Check introduced the concept of earmarking funds to 'new challenges' and has been the first step towards more focused environmental action in agricultural policy, although there are significant differences between Member States on the allocation of these funds (von Homeyer et al. 2011). In addition to the CAP, dedicated funding for a range of public goods exists at a smaller scale administered through the LIFE+ programme, the Structural Funds, and national measures in Member States.

Agriculture is an area where considerable transformation is needed to modernise policy approaches and mechanisms to reflect a resource constrained world (Fedrigo-Fazio et al. 2011). The **next major reform of the CAP** is due in 2013 and will fit in with the next EU Multi-annual Financial Perspective from 2014–2020. In November 2010, the Commission presented outline proposals (EC 2010c) for a significant reform of the CAP and a stakeholder consultation on the proposals was launched. Detailed legislative proposals are due to be launched in autumn 2011.

As noted in the Resource Efficiency Flagship Initiative, upcoming proposals to reform the CAP should help align this area with the requirements of a resource-efficient, low-carbon economy (EC 2011). The ongoing review of the EU budget and the imminent discussions on the next Multi-annual Financial Perspective are prompting a much wider debate about what the future purpose and priorities of the Commission's spending should be (IEEP 2011). Given that the CAP accounts for a large proportion of the EU budget, the current system of providing all farmers with direct income support payments and the purpose and efficiency of such payments is under increasing scrutiny. It is becoming clear that a fairly significant reform of the CAP will occur in 2013. This reform will need to take into account expected trends in international policy drivers including *inter alia* higher, unstable commodity prices, higher input costs, more variable climatic conditions, rising demand for land for biofuel and biomass crops, increasing policy focus on ecosystem services/resource protection, and rising national food security concerns. Although the direction of these drivers is relatively certain, uncertainty remains over the likely magnitude of change, especially in the long-term (IEEP 2011).

Extent to which the EUREAPA tool can inform policy decisions in this policy area

The consumption-based perspective of the EUREAPA tool could be useful for policy makers in the **problem recognition** stage of the policy cycle by providing information

on the type and size of the impact of food consumption at the level of 'livestock', at lower levels within such a category (e.g. poultry, pigs, and other), or, for example, with regard to a number of different grains, rice, fruits, vegetables, oil crops, etc. The tool could also be used in the **agenda-setting** stage in helping to identify footprint 'hot-spots' which can be prioritised for action, for example identifying the consumption of meat and dairy products as having the most significant environmental impact and thus as a priority area for action. The tool could be used in the **problem exploration** stage of the policy cycle, by helping to improve understanding of the type and size of the problem, enable comparisons across countries, identify best practices and raise awareness among stakeholders and the wider public. For example, cross-country comparisons can be used to identify countries with a lower footprint associated with food consumption that may offer examples of good practices for policy-makers to draw on.

The scenario function of the EUREAPA tool could be used to model increases in yield (which would result in a reduction in footprint per unit of crop produced) and a change in the energy mix of agriculture associated with different policy options and thus could be useful in the **identification of possible solutions,** the analysis of **different policy options** and the **selection of policy options** based on associated impacts.

Biodiversity and fisheries

Relevant policies/instruments and targets

While pressures on biodiversity have grown in recent years, there has also been an increasing awareness of its intrinsic value and of the benefits related to ecosystem services, such as the provision of biomass and biological resources (e.g. diversity of pollinators for food provision), the capacity of environmental media such as water, air and soil to function as emission absorbers (e.g. atmospheric cleansing capacity of forests) and the value of protected areas for recreation and ecotourism. A number of developments seeking to integrate the socio-economic value of these services into decision-making have taken place, not least due to some of the emerging insights from initiatives such as 'The Economics of Ecosystems and Biodiversity' (TEEB) and there has been renewed political interest in conserving biodiversity (Fedrigo-Fazio et al 2011). The Resource Efficiency Flagship Initiative notes the importance of using resources more efficiently in order to 'protect valuable ecological assets, the services they provide and the quality of life for present and future generations' (EC 2011).

Despite efforts, the EU has missed its target to halt the loss of biodiversity in the EU by 2010 and to restore habitats and natural systems. Key factors that precluded the achievement of the target include inadequate implementation of biodiversity measures, policy gaps, knowledge and data gaps (such as the scarcity of biodiversity monitoring and ecosystem services indicators), inadequate integration of biodiversity concerns in other policies, insufficient funding, and issues concerning equity of biodiversity conservation actions at the EU and global levels (EC 2010a).

At the international level, a new global **Strategic Plan for biodiversity** was adopted at the 10th meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD) in Nagoya Japan in October 2010. The Plan includes a vision that by 2050 'biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people'. To

implement this vision, the Plan sets out 20 headline targets under five strategic goals to be achieved by 2020.

In May 2011, the Commission presented the EU's new **Biodiversity Strategy to 2020** (EC 2011c). The Strategy reflects the increasing shift in focus from the conservation of biodiversity and nature conservation for its sole intrinsic value to its conservation and restoration for its economic values and importance for human well-being. The Strategy is expected to contribute to the EU's strategic objectives outlined in the Europe 2020 Strategy, including a more resource-efficient, climate-resilient and low-carbon economy. The Strategy sets out six targets which are broken down into a set of 20 actions and 36 measures.

Recent developments in EU biodiversity policy, the latest CBD COP meeting and the attention to the results of the high-profile TEEB study, have increased the importance of ecosystem valuations and fuelled the demand for reliable biodiversity and ecosystem services related indicators. It is also increasingly evident that a major failure of existing biodiversity policy instruments was related to the lack of appropriate indicators, milestones and baselines against which progress could be assessed (Herkenrath et al. 2010). While measuring all aspects of biodiversity is no doubt a complex task, an increasing number of indicators have emerged over the past few years to communicate trends in biodiversity and ecosystem health to policy-makers, including the Biodiversity Information System for Europe (BISE) and the EU 2010 Biodiversity Baseline (IEEP et al. 2011 – Forthcoming). More work is needed to help policy-makers better understand the links between biodiversity loss and the efficient use of natural resources, with ecosystem services operating as a partial link between the two. The role of biodiversity in ensuring the diversification of goods and services provided by ecosystems could form a central part of the discussions on resource efficiency (Fedrigo-Fazio 2011).

Fishing remains one of the most significant factors influencing the state of the European marine environment. The overexploitation of marine fisheries remains a major problem and has led to a situation where 26 per cent of fish stocks are below safe biological limits (Sissenwine 2010). Despite an apparent improvement in the current state of fish stocks, there is also pressure to greatly reduce levels of by-catch, eliminate the discarding of non-target fishing species, and avoid the damage to habitats which currently arises from several types of fishing gear, in particular dredging and beam trawling (Lutchman et al. 2009). Another critical issue arises from intensive aquaculture production which involves emissions of pollutants, releases of non-indigenous species or genetically modified fish and new pathogens, noise pollution, water abstraction, and places pressure on wild fish stocks (IEEP 2011). Such activities have an impact on the state of marine resources and have implications for the resource efficiency agenda.

The pressure to manage fisheries sustainably and responsibly and to consider fisheries management in the broader marine context is however growing. The EU **Common Fisheries Policy (CFP)** will be reformed in 2012. As noted in the Resource Efficiency Flagship Initiative, upcoming proposals to reform the CFP in the context of the next EU budget should help to align this area with the requirements of a resource-efficient, low-carbon economy (EC 2011). A Green Paper published in April 2009 (EC 2009) launched a stakeholder consultation process on the future of the CFP. Further integration of environmental principles in the CFP post-2012 are expected, including the adoption of more long-term management plans and measures to ensure that fish stocks are fished to their maximum sustainable yield (MSY) by 2015. The reform of the CFP is also likely to

have significant implications on the future of the European Fisheries Fund (EFF) which is a key implementing instrument of the CFP and sets the framework for the provision of public financial aid to the fisheries sector (IEEP 2011).

Extent to which the EUREAPA tool can inform policy decisions in this policy area

Extending biodiversity assessments to account for the role of human pressures on ecosystems and biodiversity is becoming a shared approach within the CBD. The Ecological Footprint is useful in this context as it can be one of the measures of human pressure on ecosystems and the long time series of Ecological Footprint data can provide a way to measure how this pressure has changed over time (Galli et al. 2011). The Ecological Footprint could be suitable to help address monitoring and evaluation requirements under the CFP. As it is an aggregated indicator, the Ecological Footprint can add to the bigger picture but may not be suitable to inform policy makers concerning a specific resource (e.g. a particular type of fish stocks). The current fishing ground calculation of the Ecological Footprint and biocapacity trends are not able to show overfishing and fish stock depletion and additional research is required to improve this before the Ecological Footprint can be used to inform the CFP. (Galli et al. 2011).

The consumption-based perspective of the EUREAPA tool can help identify environmental pressures associated with specific product categories (e.g. timber products) including those imported into the EU and how changes in the production or consumption of specific product categories within the EU or a specific Member State would affect environmental pressures. The EUREAPA tool only allows for country wide analysis, therefore, in its current form, it cannot be used to link the pressures to specific ecosystems or habitats. Additional research is required to determine whether such relationships could be established from a quantitative point of view and whether the outcomes can be strong enough to be significant to inform policies. Nonetheless, the EUREAPA tool can be useful in helping to mainstream biodiversity and fisheries related issues in other policies, such as climate change policies, agriculture, or broader economic and land planning policies, by informing the initial stages of the policy cycle with regard to the environmental impacts of different policy options under consideration. EUREAPA could also be a useful communication tool, helping to raise the awareness of problems in relation to the protection of biodiversity and fisheries among stakeholders and the general public.

Climate change and energy

Relevant policies/instruments and targets

In the area of climate change, the EU has commitments at both a multilateral and the EU level. At the multilateral level, the EU is a party to the United Nations Framework Convention on Climate Change (UNFCCC), which has the ultimate objective of achieving stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (UN 1992: 4). The EU is also committed to an overall emission reduction of 8% on 1990 levels by 2012 under the **Kyoto Protocol**.

Consistent with the ultimate objective of the UNFCCC, the EU has long supported the objective of limiting temperature increases to below 2°C. The EU has a long-term target of reducing emissions by up to 80-95% by 2050 as a way of helping to ensure this objective is met (EC 2011f: 3).

As interim steps towards meeting these objectives, the EU has set a number of headline medium term commitments known as **the '20-20-20' targets**: 20% reduction in greenhouse gas emissions from 1990 levels by 2020, 20% of energy consumption to come from renewable sources by 2020 and a 20% improvement in energy efficiency by 2020. These targets are set out in the EU Climate and Energy Package and became law in 2009.

The emissions target to achieve at least a 20% reduction in greenhouse gas emissions below 1990 levels by 2020 is legally binding via the strengthened EU ETS Directive (Directive 2003/87/EC) and the Effort Sharing Decision (Decision 406/2009/EC). Based on current measures and projections, the EU is on track to achieve the 20% target by 2020 (EC 2011f: 3). The EU has also been considering increasing its target from 20% to 30% within the framework of an ambitious and comprehensive global agreement, and the European Parliament has recognized that increasing the target would be 'in the interest of the future economic growth of the European Union' (EP 2011).

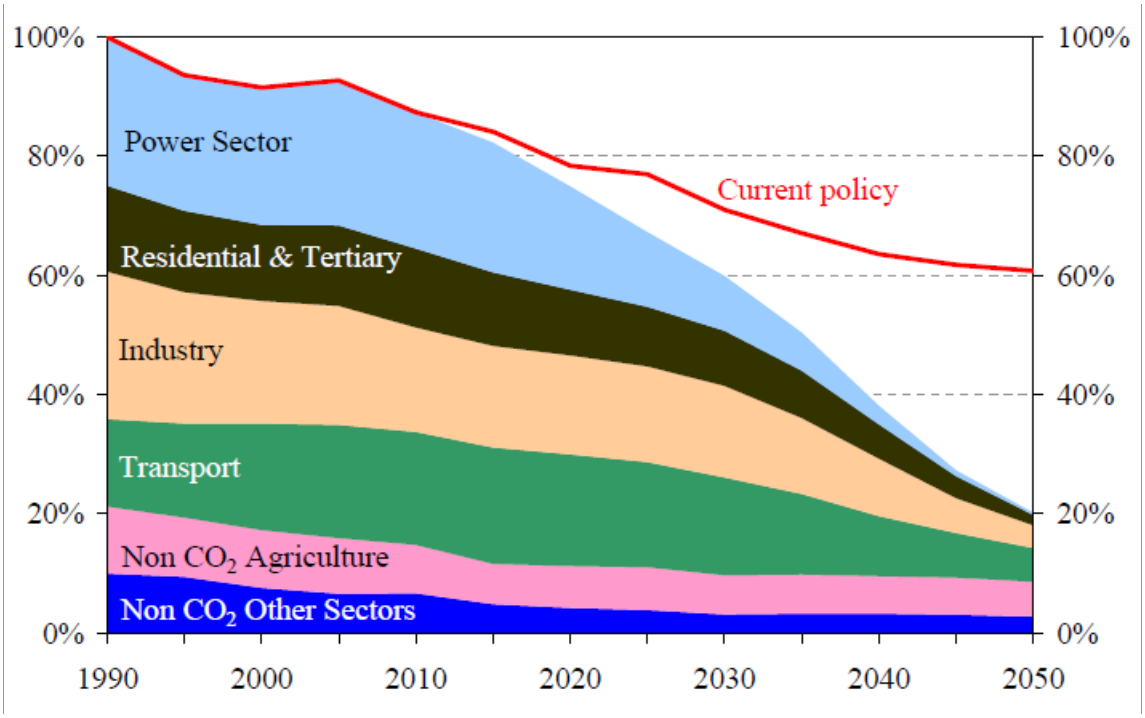
The Renewable Energy Directive (RED) (Directive 2009/28/EC) sets out the EU's commitments to increase the share of energy coming from renewable sources to 20% by 2020, including a 10% increase in the consumption of renewable energy for transport purposes. The RED contains legally binding national renewable energy targets of the final energy consumptions for the Member States, differentiated by Member State[10]. All Member States have now submitted National Renewable Energy Action Plans outlining their plans to achieve their targets and based on current projections, the 20% target will be achieved by no later than 2020.

By contrast, the 20% energy efficiency improvement target is not legally binding at present, and current Commission estimates show the EU is only likely to achieve half of its target of reducing its estimated energy consumption for 2020 by 20% (EC 2011g). In June 2011 the European Commission proposed a new Energy Efficiency Directive to strengthen the requirements on Member States to increase their efforts including a proposal to establish energy savings schemes in all Member States to help achieve the 2020 target (EC 2011h). Other legislation related to energy efficiency is already under development, such as the reform of the Energy labelling Directive, expected to result in new rules for energy labelling of the equipments and in an extension of the scope to all energy related products.

In its **'Roadmap for moving to a low carbon economy in 2050'**, also released in March 2011, the Commission has set out steps to achieve the EU objective of reducing greenhouse gas emissions by 80-95% by 2050 compared to 1990 levels. The Roadmap outlines the required range of emissions reductions for 2030 and 2050 for the major economic sectors. Importantly, the share of low-carbon technologies in the electricity mix (renewables, fossil fuels with carbon capture and storage, and nuclear) will need to increase from 45% today to nearly 100% in 2050 if the overall emissions goals are to be achieved. This is because electrification also plays a major role for the decarbonisation of the transport sector and in the built environment. In the latter, emissions could be reduced by around 90% by 2050 through energy efficiency and switching to renewable electricity for heating. Figure 5 below provides an overview of the emissions reduction pathways modelled by the Commission for the Roadmap.

[10] The 10% transport target is uniform across Member States.

Figure 5 EU GHG emissions towards an 80% domestic reduction (100%=1990 levels)



Source: Roadmap for moving to a low carbon economy in 2050, COM (2011) 112 final

As a part of the Europe 2020 strategy for smart, sustainable and inclusive growth, the Roadmap for moving to a competitive low-carbon economy in 2050 is contributing to the Resource Efficiency Flagship Initiative intended to put the EU on course to using resources in a sustainable way.

Extent to which the EUREAPA tool can inform policy decisions in this area

The usefulness of the EUREAPA tool in the context of the EU's international greenhouse gas mitigation commitments is primarily in providing a complementary 'consumption-based' perspective to the production-based or territorial-based accounting approach taken by national greenhouse gas inventories for reporting under the Kyoto Protocol. As discussed in Section 2, the Carbon Footprint relates to consumption of goods and services by households, governments, and other 'final demand' categories such as capital investment and trade, and estimates the emissions associated with the life cycle of these products. The tool could be used in **consultation and or communicating with consumers** on issues relating to – for example - individual responsibility for addressing global climate change. It is important to note that the tool cannot help project whether the EU will meet its climate mitigation objectives.

If further developed, a subsequent release of the EUREAPA tool could potentially allow policy makers to identify the countries or regions in which the most greenhouse gas emissions are caused to be released as a result of the EU's consumption of goods and services – for example, by looking into the level of emissions in a group such as 'non-Annex 1 countries', or specific trading partners such as Brazil, China or Russia. A policy maker could also explore how changes in the production and/or consumption of specific product categories (e.g. timber products) within the EU or a specific Member State would affect the level of emissions in key trading partners from which those products are

supplied[11]. The consumption-based perspective could be particularly useful for policy makers in **problem exploration and agenda-setting** exercises – for example, in identifying which product categories imported into the EU are most responsible for causing greenhouse gas emissions in developing countries and raising the profile of this issue by utilising the numerical outputs of the EUREAPA tool. If the tool were developed to show what proportion of the EU's consumption emissions stem from the 'non-Annex 1 countries' group, it could help illustrate where carbon leakage might occur.

In the energy policy area, the EUREAPA tool can help policy makers in the **exploration stage** of the policy cycle. For example, to explore the impact of policy options that affects the consumption and production of energy products on the Footprint Family of indicators. In the **scenario function** of the EUREAPA tool, users can change the source of energy used by each sector, including the electricity sector, to model changes in the national energy mix. Users can also change the basket of spend on energy products over time. In using the tool, the policy maker may wish to explore the level of reduction in the consumption of non-renewable energy products (e.g. oil, coal, gas) that would be required in different sectors in order to achieve a specific targeted reduction in pressure on one or more of the Footprint Family of indicators. Alternatively, the policy maker may have a particular policy in mind (e.g. X% reduction in fossil fuel consumption in road transport due to a policy to increase the consumption of sustainable biofuels) and wish to explore what the impact of this would be on the Footprint Family of indicators.

Energy efficiency changes in a sector can be modelled as a reduction in the consumption of energy products. This can be done by changing the basket of spend on energy products (e.g. oil, coal, gas) in the scenario function of the EUREAPA tool. The policy maker can therefore explore how an improvement in energy efficiency, defined as a reduction in spending on energy products (as defined by the user), would impact on the Footprint Family of indicators. This might include exploring the impact of a specific energy efficiency improvement in a certain sector.

Raw materials

Relevant policies/instruments and targets

Measures to tackle the challenges in commodity markets and on raw materials are among those identified in the Resource Efficiency Flagship Initiative as necessary to help ensure coherence between the EU's raw materials and external policies, and to promote extraction, recycling, research, innovation and substitution inside the EU (EC 2011).

In 2008, the European Commission published its **Raw Materials Initiative** (RMI) (CEC 2008b) as a first step towards developing a more coherent EU strategy on raw materials to ensure access to key raw materials and to address the EU's vulnerability related to its reliance on imports of these raw materials. The RMI focuses on key raw materials, particularly construction minerals, 'high-tech' metals and secondary raw materials. It is based on three pillars: fair access to non-energy raw materials from international markets; fostering sustainable supply of raw materials from EU sources; and boosting resource efficiency through increased recycling and lower resource consumption. It also

[11] Note, however, that since the MRIO model is currently based on historical (2004) data, it would not possible to forecast global emissions levels over time due to consumption/production changes in the EU. Thus, using the hypothetical example of timber consumption, the tool would not be able to take into account changes in data since 2004, nor forward estimates of deforestation or reforestation rates in the trading partner.

identifies potential provisions in the Ecodesign Directive to incorporate criteria for resource-efficient products, which have yet to be taken up, as well as the more robust integration of natural resource-related impacts into preparatory studies and implementing measures. The RMI points out that the EU is particularly dependent on imports of 'high-tech' metals, such as cobalt, platinum and titanium which play a critical role in high value manufacturing and electronics products, including energy efficient and innovative green technologies such as lithium-ion batteries, photovoltaic, fuel cells, electric vehicles and catalysts, and seawater desalination equipment. Thus, access to these materials is necessary for developing products in a future low-carbon, resource efficient economy. Moreover, as noted in the Resource Efficiency Flagship Initiative, 'By reducing reliance on increasingly scarce fuels and materials, boosting resource efficiency can also improve the security of Europe's supply of raw materials and make the EU's economy more resilient to future increases in global energy and commodity prices' (EC 2011).

In February 2011, the Commission published a follow-up Communication on '**Tackling the challenges in commodity markets and on raw materials'** (EC 2011b). This Communication updates the original RMI and maintains the three pillars of the Initiative with some variations on priorities, notably highlighting more strongly the need to increase recycling of some critical raw materials. The Communication makes links to the Resource Efficiency Flagship Initiative and lists a number of measures to improve waste legislation implementation and enforcement. The Communication also provides a link to Ecodesign by stating a proposition to undertake an analysis of the feasibility of developing ecodesign instruments. The second pillar of the Initiative focuses on sustainable supply within the EU, and the Commission has prepared guidelines to clarify rules on mining in protected natural areas (EC 2010). On global access to materials, activities since 2008 have created more of a focus on the integration of raw materials issues in EU development and trade policies and 'raw materials diplomacy'. The Communication was extended to cover elements relating to the better management of commodity markets which are seen as having important impacts on the prices of materials (of metals, but also of food). Focusing particularly on energy, agriculture and security of food supply, and raw materials, the Communication explains some linkages between commodity and financial markets and sets out reasons for the better regulation of financial markets, thus highlighting the increasing political insecurity of unstable access, supply, and pricing of key raw materials (beyond the 'critical' raw materials of the original RMI, extending to oil and food) (IEEP 2011).

Extent to which the EUREAPA tool can inform policy decisions in this policy area

The EUREAPA tool could be useful in the **problem recognition** stage by providing information on the size and impact of the consumption and production of different raw materials. The tool could also be useful in the **agenda setting** stage by helping to identify those raw materials with the largest footprint, thus helping policy-makers to prioritise between different areas of action. The tool could also be used in the **problem exploration** stage by helping to improve understanding of the environmental consequences of different raw materials and consumption patterns, allowing comparisons across different countries and against benchmarks. The tool could also help to raise awareness among the public on these issues and thus help to inform public opinion on the issue. This would feed into the problem exploration stage but also the **policy development** stage as the scenario function of the EUREAPA tool can help to quantify the effect of changing production and consumption patterns. The EUREAPA tool could be

used to help develop policies and activities addressing the demand-side of the RMI where absolute quantitative reductions of resource use in addition to the current focus on resource efficiency (and acquisition) are needed, by helping to raise awareness of the environmental impacts related to the consumption of different raw materials and identifying priorities for action.

The RMI (and the Innovation Partnership) focuses primarily on ensuring continuing access and supply of raw materials to Europe, rather than on their more efficient use and increased recycling or the need to reduce resource consumption. Nonetheless, the recycling activities relate to both product policy (particularly the Ecodesign Directive) and waste policies (especially the 'Recycling Directives') so a future version of the EUREAPA tool could be used in the **monitoring, reporting and evaluation stage** by helping to measure progress in the RMI and support the stronger shift from virgin to secondary raw materials made through recycling and resource efficiency.

Regional development – Cohesion Policy

Relevant policies/instruments and targets

EU Cohesion Policy has a key role to play in supporting the shift towards a low-carbon, resource-efficient economy, in particular in the new EU Member States as renewable energy, energy efficiency and cogeneration investments as well as clean urban transport and public transport are eligible for European funding. The principal purpose of the **Structural Funds** (ERDF and ESF) is to promote the economic and social development of disadvantaged regions, sectors and social groups within the EU. The **Cohesion Fund** is intended to strengthen economic and social cohesion within the Community through the provision of EU finance to programmes and projects in the poorest Member States, specifically in the fields of environmental protection and transport infrastructure. The total budget of the Structural Funds and the Cohesion Fund for the 2007-2013 programming period is €347 billion (IEEP 2011).

In September 2007 the Commission launched a public consultation on the **future of the EU cohesion policy**, addressing in particular how it can be adapted to new challenges facing Europe. In November 2010, the Commission published the 5th Report on economic, social and territorial cohesion which provides a comprehensive assessment of the economic, social and territorial situation and trends (including environmental sustainability) and assesses the contribution and impact of the EU's Cohesion Policy to these trends (EC 2010b). The report outlines proposals and options for the future Cohesion Policy. Proposals are made regarding strengthening the strategic planning framework and the thematic concentration of funding in line with the objectives and targets of the Europe 2020 Strategy, strengthening the system of conditionality and incentives, which could make funding conditional on achievements in certain policy areas including environmental protection, improving the performance and quality of spending through better evaluation, strengthening partnership and good governance, and reinforcing the third dimension of the future Cohesion Policy - territorial cohesion (IEEP 2011).

Shortly after the publication of the Resource Efficiency Flagship Initiative, the Commission published a separate, complementary Communication outlining how EU Regional Policy contributes to the EU's strategic objective for sustainable growth (EC 2011d). The Communication calls for national, regional and local actors to reallocate

available funds under the current Operational Programmes to boost 'green' investments by investing more in sustainable growth (e.g. in low carbon economy by stepping up investments in energy efficiency in buildings, renewable energy and clean transport systems; in ecosystem services by focusing activities on measures such as preserving natural capital, promoting risk prevention and climate adaptation and enhancing green infrastructures and eco-innovation) and investing better in sustainable growth (e.g. through the integration of sustainability concerns throughout the entire project lifecycle, strengthening the use of green public procurement and environmental indicators for monitoring and evaluation, screening Operational Programmes for their climate resilience and steering investments towards the most resource efficient options, and improving the participation of environmental authorities and actors in the decision-making process). It remains to be seen whether any of these 'green' practices will be brought forward in legislative proposals on the post-2013 EU funds Regulations due in autumn 2011 (IEEP 2011).

Extent to which the EUREAPA tool can inform policy decisions in this policy area

A future version of the EUREAPA tool could be developed to help in the **selection of projects funded under the Structural and Cohesion Funds**. For example, the EUREAPA tool could be developed into some form of ex-ante carbon screening tool to assess GHG emissions under different investment scenarios, thus enabling managing authorities to identify key emission savings and investments which lead to a decrease in CO_2 emissions.

There is currently no consistent EU-wide **monitoring and reporting system** in place to measure the environmental impact of EU spending programmes. The EUREAPA tool could be helpful in this context as it can be used to model the effects of an increase in 'government' or 'capital' spend and/or quantify the change in footprint as a result of the change in consumption or production brought about by a particular EU spending programme.

Sustainable consumption and production

Relevant policies/instruments and targets

There are a number of EU policy instruments that seek to promote more sustainable patterns of consumption and production. This includes a 2003 Commission Communication on Integrated Product Policy (IPP) (CEC 2003) which introduced lifecycle thinking for consumption and production processes and advocated a mix of policy instruments to tackle environmental impacts in an effective and cost-efficient way. A number of laws, policies and guidance documents aimed at improving the efficiency of the use of natural resources and reducing environmental impacts throughout a product's lifecycle have also been introduced. These are supported by measures which aim to improve awareness and understanding of the impacts of products and funding to promote eco-innovation. Specific instruments include the ecodesign (EuP) Directive, the energy labelling Directive, the energy star Regulation, the ecolabel Regulation, Eco-management and audit systems (EMAS) and promotion of green public procurement (IEEP 2011).

In July 2008, the Commission presented a **Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan** (SCP/SIP Action Plan) (EC 2008) as part of a package of measures on sustainable consumption, production and industry. The Action Plan seeks to provide an integrated policy framework for eco-efficient products,

cleaner and leaner production, and contributing towards consumption and production efforts internationally. The Action Plan does not contain any targets *per se* but was accompanied by a series of legislative and non-legislative measures:

- Proposal for the extension of the Eco-Design of Energy-Using Products Directive.
- Proposal for the revision of the Eco-Label Regulation.
- Proposal for the revision of the EMAS Regulation.
- Communication on green public procurement (GPP).

The Action Plan was followed by a proposal for the revision of the energy labelling Directive and a proposal for a Regulation creating an environmental technology verification scheme.

Although the SCP/SIP Action Plan included a section entitled 'boosting resource efficiency', the content on natural resources was limited and reiterated the objectives set out in the 2005 Natural Resources Thematic Strategy (CEC 2005) of creating tools to monitor, benchmark and promote resource efficiency, taking account of the lifecycle perspective and including requirements of trade rules. The Action Plan proposed that 'detailed material-based analysis and targets' be addressed at a later stage, based on environmental significance and on access to natural resources. However no substantial work in this regard has been presented publicly to date (Fedrigo-Fazio et al. 2011) and the EU's consumption of natural resources and its ecological footprint are hardly addressed in the Action Plan (Withana et al. 2010). The SCP/SIP Action Plan is due for revision in 2012.

Revisions to various EU legislative measures that were envisaged in the Action Plan have now been adopted. Directive 2009/125/EC establishing a framework for the setting of **eco-design requirements for energy related products** expands the scope of the original Directive from energy-using products (EuP) to cover all energy related products. The Directive not only covers the energy use of products but also includes provisions relating to resources aspects, such as water consumption in the use phase, the quantities of a given material incorporated in the product or a requirement for minimum quantities of recycled material. The Directive defines conditions and criteria for setting requirements regarding environmentally relevant product characteristics. Subsequent implementing measures are adopted which establish the eco-design requirements the products must fulfil in order to be placed on the market and/or put into service. To date, implementing measures that have been adopted for different products have been limited to highly problematic substances such as mercury, and to water efficiency and durability on a total of three products (Fedrigo-Fazio et al. 2011).

The revised **Ecolabel Regulation** No 66/2010 lays down rules for the establishment and revision of criteria to be used to award the EU Ecolabel covering the whole lifecycle of products, including resource use, generation of waste, the substitution of hazardous substances and other aspects relevant for sustainable management and use of resources. In early May 2011, the Commission issued a draft working plan for the EU Ecolabel for 2011-2015 which contains various actions, targets and deadlines for expanding the scheme in line with the Ecolabel Regulation. The revised **Energy-Labelling Directive** 2010/30/EU extends the scope of the earlier Directive from 'white goods' household appliances to energy-related products which have a significant direct or indirect impact

on energy consumption and, where relevant, on other essential resources during their use. This extension in scope links this Directive to the Ecodesign Directive. The Directive requires *inter alia* that information relating to the consumption of electric energy, other forms of energy and where relevant other essential resources during use, is brought to the attention of end-users by means of a fiche and a label.

The revised **EMAS Regulation** No 1221/2009 introduced the following mandatory key-performance indicators for companies to report on: Energy Efficiency; Material Efficiency; Water; Waste; Biodiversity; and Emissions. The **GPP Communication** sets out a process for setting common GPP criteria at European level to promote goods that reduce negative environmental impacts, *inter alia* resource use.

Extent to which the EUREAPA tool can inform policy decisions in this policy area

The EUREAPA tool will be very useful in informing policy in relation to sustainable consumption and production as it links information on the consumption of products and services with various forms of pressure due to production both within the EU and worldwide. The EUREAPA tool could be useful in the **problem recognition** stage by providing information and the correct signals as to which specific consumption and production areas are problems which need to be addressed. The tool could also be useful in the **agenda setting** stage as results by industrial sectors and/or consumption categories can be used to further identify the main footprint 'hot spots' and trends in unsustainable consumption patterns, thus helping policy-makers to prioritise between different areas of action. The tool could also be used in the **problem exploration** stage by helping to improve understanding of the environmental consequences of different production and consumption patterns and different consumer life-styles, comparing the impact to benchmarks and impacts in other countries. The tool could form the basis for new, innovative ways of communicating and creating awareness among the public on these issues and thus help to inform public opinion on the issue. This would feed into the problem exploration stage but also the **policy development** stages as the EUREAPA tool can help to quantify the effect of changing production and consumption simultaneously and can also compare the relative effect of consumption and production policy.

Transport

Relevant policies/instruments and targets

The transport sector continues to be a source of significant environmental pressure in the EU. Emissions from transport are a major source of the EU's greenhouse gas (GHG) emissions (representing roughly one third of emissions from sectors not covered by the EU Emission Trading System (ETS) in the EU-27) (EEA 2010) and exacerbate problems around poor air quality[12]. A large number of people are also exposed to transport noise levels that affect the quality of their life and health; road traffic is the dominant source of exposure to transport noise (EEA 2010a). The construction and existence of transport infrastructure also has implications for biodiversity, fragmentation of landscapes and ecosystems, and the use of raw materials. The transport sector poses major challenges for the EU objective of establishing a low carbon, resource efficient economy not only as

[12] despite some reductions in air pollutants, road transport continues to be a significant contributor to NOX emissions, particulate matter (PM10, PM2.5), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOC) emissions

a significant and growing source of GHG emissions but also as the principal consumer of oil-based fuels on which it is almost wholly dependent[13].

Over the years, the EU has adopted a number of measures which seek to promote sustainable mobility and integrate environmental considerations in transport policies. With the increased prominence of climate change policy in the EU and the need to address GHG emissions across all sectors, emissions from the transport sector have become an increasingly important element of the EU's climate change and energy policy. Measures adopted in this area include 'Euro' emission standards for certain cars, vans, lorries and buses; measures encouraging public procurement of energy efficient and low polluting vehicles; measures to promote the use of sustainable biofuels in transport; car labelling; binding legislation to reduce lifecycle GHG emissions from transport fuels, reduce average CO_2 emissions from new passenger cars and light-commercial vehicles, include aviation in the EU ETS, and the adoption of the 10 per cent renewable energy target for the transport sector to be met by each Member State by 2020. These attempts to integrate environmental issues in transport initiatives have had mixed results in practice. The key achievement has been the reduction of emissions from individual vehicles through the progressive tightening of emission standards and fuel quality standards. However, improvements in vehicle efficiency have not yet produced corresponding reductions in total CO_2 emissions as a result of the continuing growth in traffic and congestion (IEEP 2011).

The Commission has also issued a series of strategy documents relating to sustainable transport. The most recent being the '**Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system'** presented in March 2011 (EC 2011a). The Roadmap outlines a number of initiatives as part of an overall strategy to 'increase mobility, remove major barriers in key areas and fuel growth and employment' while reducing GHG emissions by 60 per cent by 2050. The roadmap sets ten goals for a competitive, resource efficient transport system which include *inter alia*:

- Halving the use of 'conventionally-fuelled' cars in urban transport by 2030; phasing them out in cities by 2050; achieving essentially CO_2-free city logistics in major urban centres by 2030;
- For 30% of road freight over 300 km to be shifted to other modes such as rail or waterborne transport by 2030, and more than 50% by 2050;
- By 2050, to complete a European high-speed rail network and triple the length of the existing high-speed rail network by 2030;
- By 2020, to establish the framework for a European multimodal transport information, management and payment system; and
- Move towards full application of 'user pays' and 'polluter pays' principles and private sector engagement to eliminate distortions, generate revenues and ensure financing for future transport investments.

[13] Transport within the EU is heavily dependent on imported oil and oil products which account for more than 96 per cent of the sector's energy needs (EC 2011e)

Achieving these goals require *inter alia*: early deployment of new technologies (e.g. on vehicle efficiency and cleaner energy use through new fuels and propulsion systems); promotion of more sustainable behaviour (e.g. through better information on all modes of transport, pricing schemes and efficient public transport services); development of adequate infrastructure (e.g. ensuring EU-funded transport infrastructure takes energy efficiency needs and climate change challenges into account, climate resilience of infrastructure, refuelling/recharging stations for clean vehicles); and restructuring transport charges and taxes to 'get the prices right', avoid distortions, and internalise externalities such as noise, air pollution and congestion. The need to get prices right in the transport sector is reiterated in the Resource Efficiency Flagship Initiative which states that 'policy measures to improve resource efficiency and overall economic competitiveness must place greater emphasis on 'getting prices right' and making them transparent to consumers, for instance in transport, energy and water usage, so that prices reflect the full costs of resource use to society (e.g. in terms of environment and health) and do not create perverse incentives' (EC 2011).

Extent to which the EUREAPA tool can inform policy decisions in this policy area

The problems related to the transport sector are already well recognised and transport has already been identified as a footprint hotspot. Thus the role of the EUREAPA tool in this area could be in the further **elaboration of the problem** by evaluating the full supply chain impacts associated with different modes of transport, comparing these impacts to certain benchmarks and across different countries. The tool could also be useful in communicating these impacts to the wider public and helping to increase consumer awareness of the impacts of the way they travel.

The EUREAPA tool's scenario editor could be useful in the **identification and development of possible** policy options, actions etc., in line with the objectives set out in the Transport Roadmap. As noted above, restructuring transport charges and taxes to 'get the prices right', avoid distortions, and internalise externalities such as noise, air pollution and congestion are among the actions set out in the Transport Roadmap and reiterated in the Resource Efficiency Flagship Initiative. The EUREAPA tool can play a role in this regard in terms of highlighting the supply chain impacts associated with different modes of transport and help in the process of integrating and reflecting the costs of these impacts in final prices, thus supporting the incorporation of 'externalities' in planning and decision-making in the transport sector. The EUREAPA tool could also be useful in the **analysis of different options** to take forward the Transport Roadmap in terms of their impacts in the future and could help in the **prioritisation and final selection among these different options**. The process of taking forward the Transport Roadmap will need to be steered by a set of clear targets and a reliable set of indicators covering the different areas in which transport systems need to see their performance improve (e.g. reducing GHG emissions, measuring smart mobility). A future version of the EUREAPA tool could be developed for use in the **monitoring, reporting and evaluation** stage of the Transport Roadmap, providing information on progress in relation to identified indicators.

Water

Relevant policies/instruments and targets

Freshwater is a key limiting resource in the EU; consumption pressures on water resources are ubiquitous. As a whole, Europe abstracts a relatively small proportion of its

renewable freshwater resources (13%), and water consumption has stabilized (EEA 2009). However, localized scarcity arises in all regions (especially the south) due to an imbalance between abstraction and availability. In the future, climate change will most likely exacerbate these problems (EEA 2009).

In the last twenty years, there has been an increase in political attention toward harmonizing sustainable water management strategies across the EU and protecting water resources from further pollution. The **Water Framework Directive (WFD)** (Directive 2000/60/EC) is Europe's basin-based approach to achieving 'good status' of all EU water bodies by 2015 (European Union 2010). The WFD requires that Member States produce an analysis for each river basin within their territory by 2004 and a management plan covering the period 2009-2015. Both the analysis and the plan are to be revised in 2013 and 2015 respectively and every six years thereafter.

There exists a suite of European policies concerned with the consumption and quality of both fresh and marine water resources; some of them are listed below:

- the Groundwater Directive 2006/118/EC requires reaching good chemical status for groundwater and seeks to identify and reverse pollution trends
- the Drinking Water Directive 98/83/EC is intended to protect human health by assuring the suitability of drinking water
- the Urban Waste Water Directive 91/271/EEC is concerned with the management of urban waste
- the Bathing Water Directive 2006/7/EC regulates the use of water bodies for bathing
- the Water Scarcity and Drought Commission COM 2007 provides guidelines for addressing sporadic drought and medium- or long-term water scarcity; it deals with, amongst other issues, water pricing and water allocation
- the Industrial Emission Directive 2010/75/EU establishes a permit procedure for industrial activities with a major pollution potential
- the Nitrate Directive 91/646/EEC, a key instrument of the WFD, aims at protecting waters against pollution caused by nitrates from agricultural activities
- the REACH regulation deals specifically with chemicals

A new European water policy is in the making for 2020: ''the Blueprint to Safeguard Europe's Water''. The Blueprint will identify gaps in current legislation and constitute the response to the challenges encountered in achieving current EU policy objectives.

Extent to which the EUREAPA tool can inform policy decisions in this policy area

The EUREAPA tool allows decision makers to explore the Water Footprint associated with the agricultural, fisheries and forestry sectors (which together account for over 85% of water consumption) and the industrial sector. By tracking human pressure from the consumption of global freshwater resources, it can be helpful in **identifying the policies and actions** that could prevent and mitigate water scarcity and move towards a water-efficient and water-saving economy. In the tool, the Water Footprint is available at the sector level, for aggregated baskets of goods, but not at product level. It may allow the user, as a first step, to appreciate the significance of each sector on the consumption of water resources and may also hint towards issues which require attention. Hence, the

EUREAPA tool may be very useful in the **problem recognition** and **problem exploration** stages. Comparing the Water Footprint across countries can reveal how water-intensive countries' consumption patterns are relative to one another. The user must note that the values for domestic and imported water consumption cannot be disaggregated for consumption values but they can be for production values. Consequently the tool can help identify sectors with a high water saving potential which can be directly addressed by developing regulations or requirements specific to the sector. By comparing the Water Footprint associated with total national production and data on national water capacity, the Water Footprint can function as an early warning indicator. These comparisons will assist in targeting the sectors or products which require action and hence will be useful in the **agenda setting** stage. They can also be suggestive of **possible solutions** and actions that would potentially diminish stress on water resources. The tool is particularly designed for the purpose of comparing the impacts of different policy options and will be useful in the **analysis of policy options** and **selection of policy options** stages. The EUREAPA tool can be used to compare the effect of changes in the efficiency of water use in production or consumption patterns on the Water Footprint. The Communication "**Addressing the challenge of water scarcity and droughts**" (COM (2007) 414 final) identified seven policy options[14] to address and mitigate the challenge posed by water scarcity and drought within the EU. The EUREAPA tool could be used to explore these policy options.

Decision making can also benefit from the tool in terms of its potential to **communicate the issue to the public**. For example, when presented with the Water Footprint associated with meat production, consumers may more readily recognize the impact of meat production and perhaps be more inclined to reduce their meat consumption in favor of other less water intensive goods. In turn this may help promote more responsible behaviours and facilitate the acceptance of new policies - for example, the decision to establish higher prices for water intensive products to reflect their "true"cost (i.e. which includes the cost associated with water).

The policies and measures mentioned above whose objectives affect trends in water use/consumption can gain from the use of the tool. The following provides some examples of where the tool will be of relevance:

- in the analysis required by the WFD in the review of the impact of human activity on water;
- to define objectives of the WFD management plan, objectives which aim, amongst others, at ensuring a balance between groundwater abstraction and replenishment (and ensure a balance between consumption and resources in general);
- to develop efficient water pricing policies and allocation schemes (these measures are included in the Water scarcity and drought Commission COM 2007); and
- to define requirements and increase water use efficiency in the production sectors.

[14] Putting the right price tag on water; allocating water and water-related funding more efficiently; improving drought risk management; considering additional water supply infrastructures; fostering water efficient technologies and practices; fostering the emergence of a water-saving culture in Europe; improving knowledge and data collection.
Source: http://ec.europa.eu/environment/water/quantity/eu_action.htm#2007_com

Prescriptions on quantitative management are, to all practical extents, absent from the WFD and daughter directives. Water quantity remains nonetheless a chief concern for Member States and the EUREAPA tool can assist decision making regarding consumption, use, and allocation of this resource. The EUREAPA tool will be useful when dealing with water from a quantitative perspective. The Water Footprint refers not only to the volume, but also to the sort of water: green, blue, grey. Therefore, the tool may also be helpful in assisting policy efforts that deal with water quality issues. As mentioned above, the implementation of economic instruments is a key area that will require a more demand-orientated management process and where the tool could be an added value in getting the water prices right.

The trade and consumption data included in the tool represent an average of 10 years (1996-2005). This data is not updated regularly and consequently users will not be able to calculate the Water Footprint on the basis of current data or to look at historic consumption data and identify trends in water consumption. The tool is therefore not suitable to reflect short-term changes and will not be useful during the **monitoring and reporting** or **evaluation** stages. It may be that future versions of the tool, with updated data, could be helpful in these stages as well as during the **(dis)continuation** stage. Moreover, water policy in the EU approaches water management through focusing on river basins. Because the tool reports impacts on a national or EU level, using and integrating outputs may not be so straightforward for river basin managers.

5. How to use EUREAPA: A practical example

This section demonstrates how a user might use the EUREAPA tool to investigate and find possible solutions for a particular policy challenge. By way of example, the steps below illustrate how a policy maker could use EUREAPA to explore different approaches for the UK to reduce emissions associated with food consumption by 30% by 2020.[15] It is important to note that data depicted in the following screens is for indication only and does not show the actual changes brought about by this scenario.

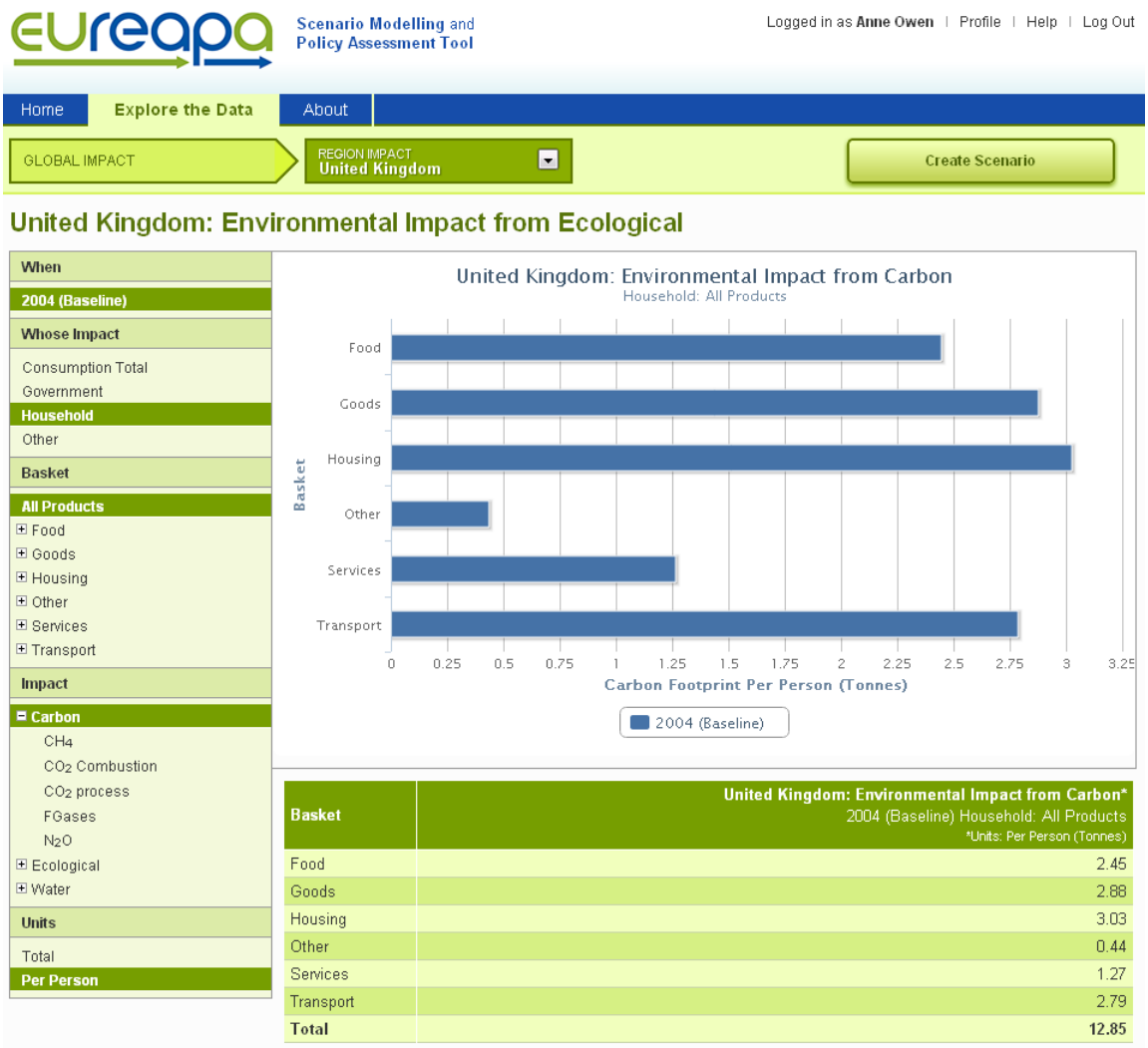
What policies would be effective at reducing the UK's Carbon Footprint for food?

[15] Note: Several design features of the tool, such as labeling and headings, are still under development and the appearance of the screens depicted in this report may change by the time it is released for public use.

Step 1: Examining the UK's Carbon Footprint

Figure 6 below shows the Carbon Footprint of consumption in the UK in tonnes of CO_2-equivalents, broken down across a basket of six areas of consumption, based on 2004 baseline data. This figure tells us that the food sector in the UK is responsible for 2.54 tonnes of CO_2-e per person and would be aiming for this to be 1.72 in 2020, for a 30% reduction.

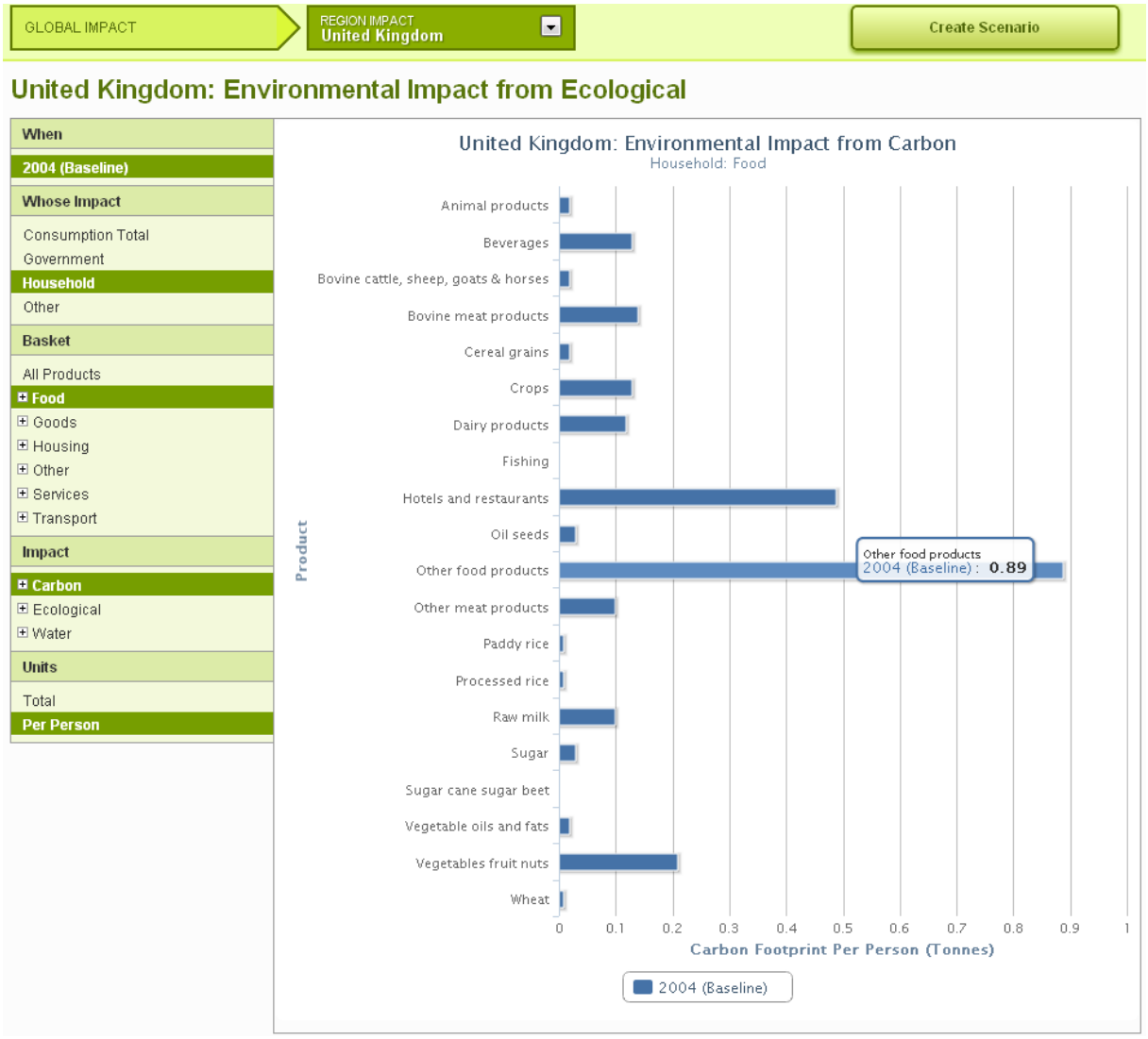
Figure 6 The UK's Carbon Footprint



Basket	United Kingdom: Environmental Impact from Carbon* 2004 (Baseline) Household: All Products *Units: Per Person (Tonnes)
Food	2.45
Goods	2.88
Housing	3.03
Other	0.44
Services	1.27
Transport	2.79
Total	**12.85**

Figure 7 below presents the UK's Carbon Footprint related to food across a basket of 20 different products. Ignoring the impact of processed food ('other food products') and catered food ('hotels and restaurants'), bovine meat products are among the top contributors to the Carbon Footprint.

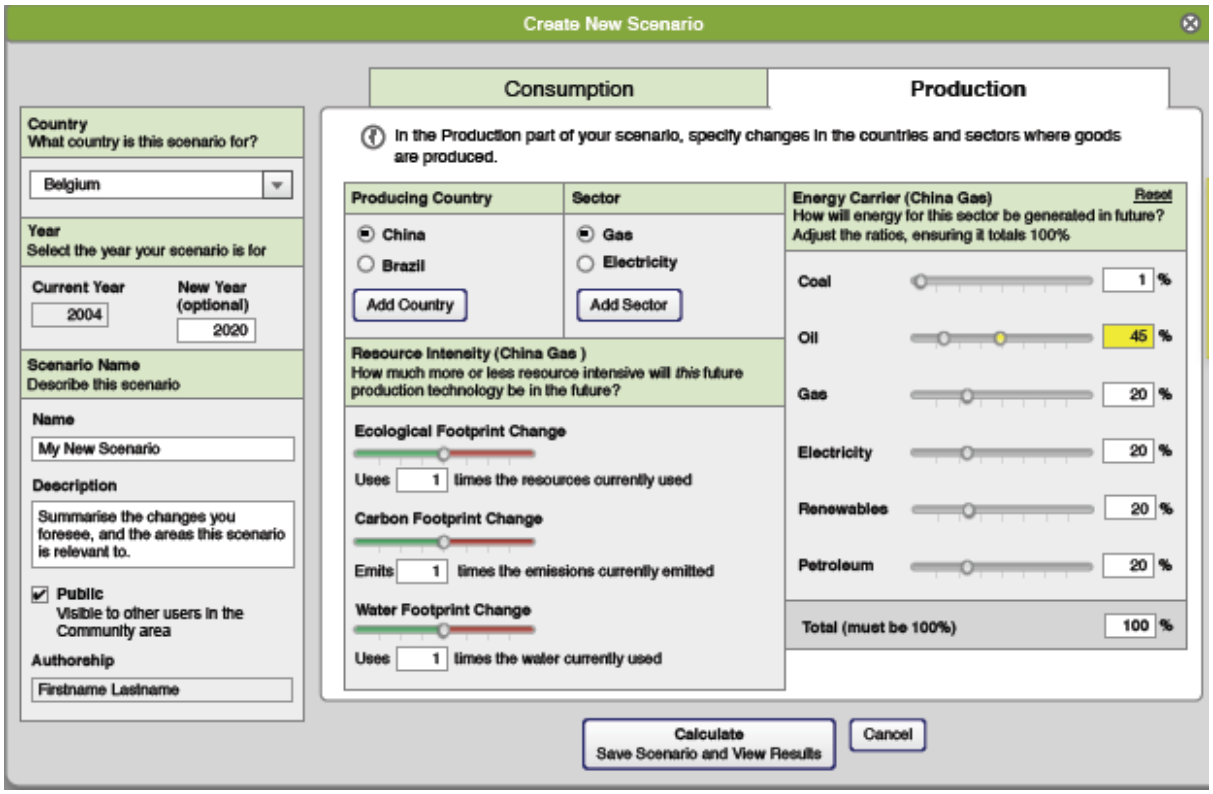
Figure 7 Breakdown of UK Carbon Footprint related to food



Step 2: Exploring changes in the energy efficiency of UK meat production

Here we investigate the effect of the UK's 'meat production' industry becoming 20% more efficient and using a cleaner mix of energy in its factories to see whether this will reduce the UK's total Carbon Footprint related to food consumption. To do this, we create a production scenario which allows us to change the efficiency of industry and the energy used. In EUREAPA's scenario editor, after selecting the UK and the sector 'bovine meat products', we would adjust the Carbon Footprint Change slide to 0.8 to represent a 20% reduction in energy use. We can also change the type of energy used by this sector to increase the proportion of renewables used by this sector.

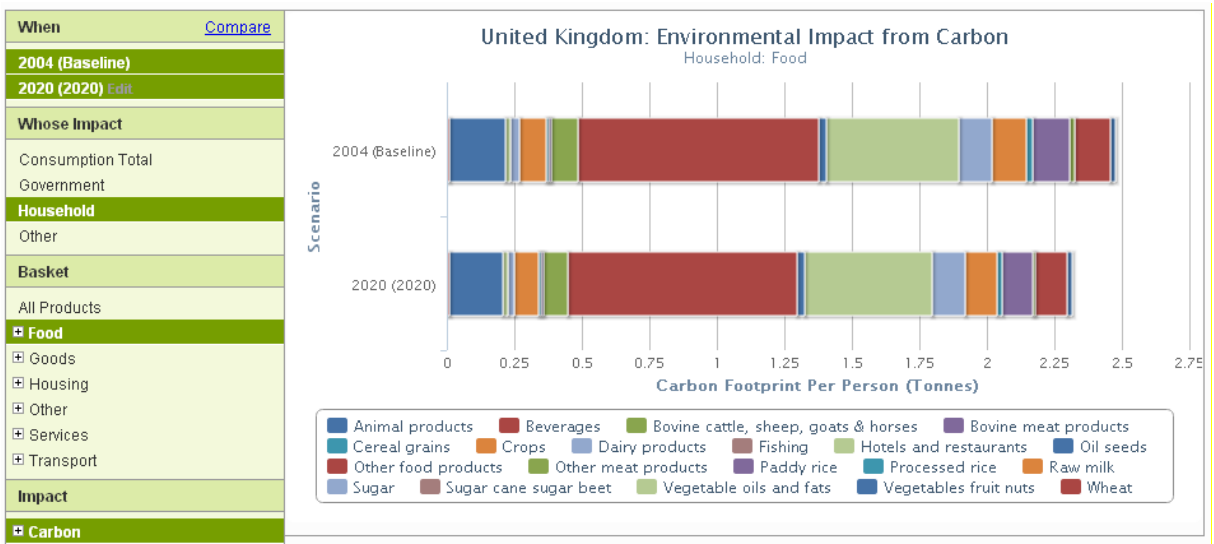
Figure 8 Creating a UK food production scenario[16]



[16] At the time of writing, this part of the web application has not yet been implemented. This figure shows a screen shot of what it will look like, but does not depict the correct variable changes.

In a comparison of baseline data for 2004 with our production change scenario for 2020, Figure 9 below shows that making the UK's meat production greener has not yet reduced emissions by the desired 30%.

Figure 9 UK food production scenario

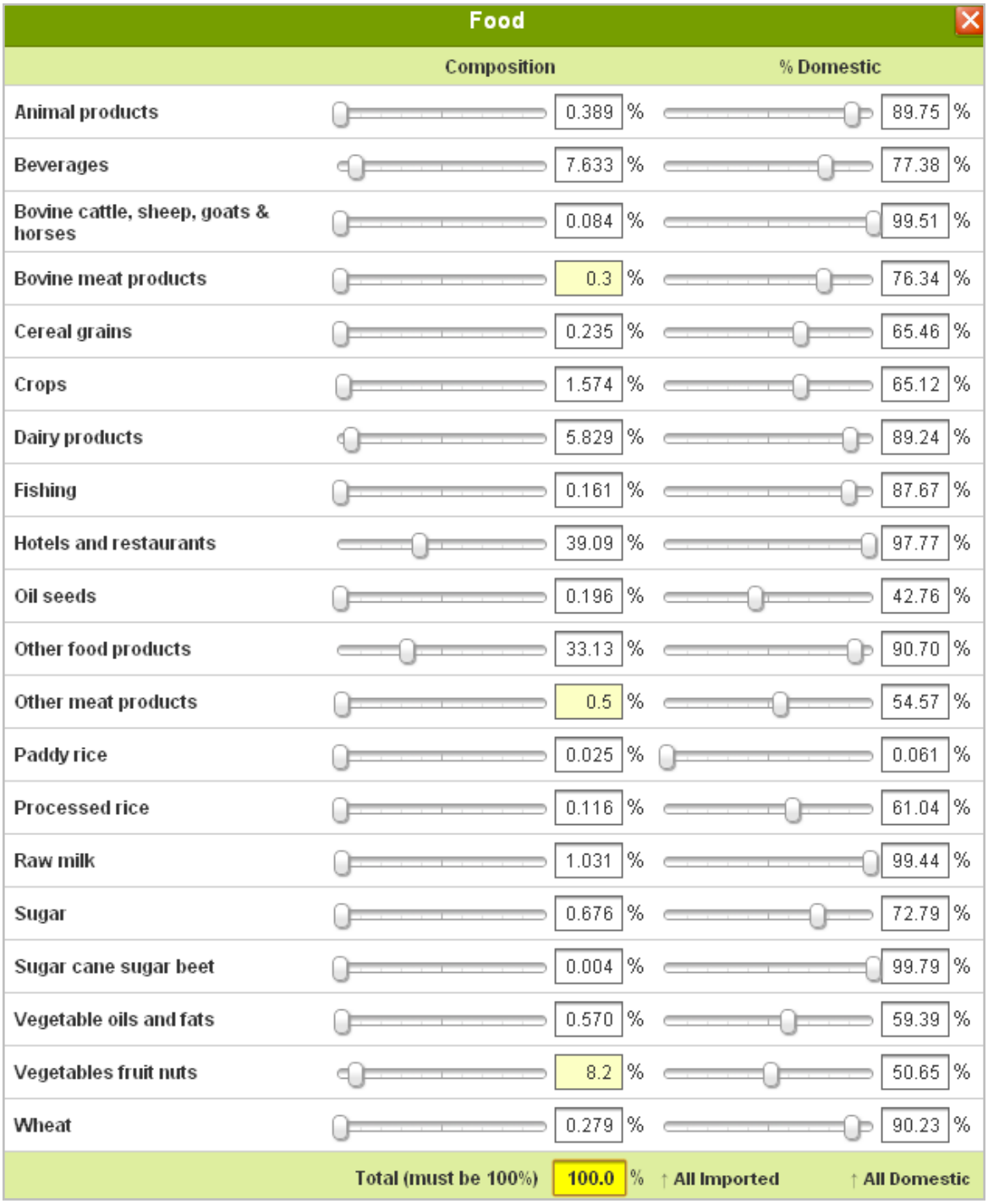


Product	United Kingdom: Environmental Impact from Carbon* 2004 (Baseline) Household: Food *Units: Per Person (Tonnes)	United Kingdom: Environmental Impact from Carbon* 2020 (2020) Household: Food *Units: Per Person (Tonnes)
Animal products	0.02	0.02
Beverages	0.13	0.12
Bovine cattle, sheep, goats & horses	0.02	0.01
Bovine meat products	0.14	0.11

Step 3: Exploring changes in the intensity of UK meat consumption

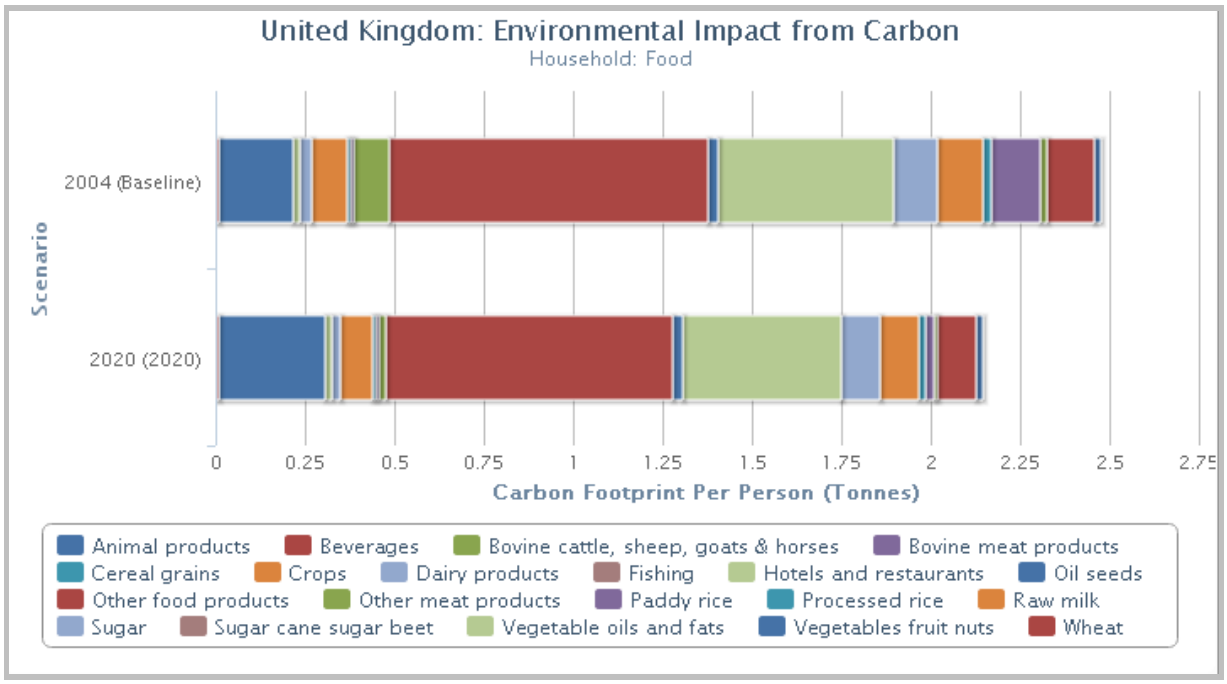
We will now add a consumption change to our future scenario. Here we investigate the impacts of a low meat diet in the UK. We change the future composition of the UK food consumption basket such that 'Bovine meat products' consumption decreases from 1.6% of total expenditure on food in 2004 to 0.3% in 2020, and 'Other meat products' from 2.5% to 0.5%.

Figure 10 Adding consumption change to UK food scenario



In a comparison of 2004 and 2020, Figure 11 below shows that the reduction in impact from our changes in consumption is still not quite large enough to reach the goal of 1.72 tonnes CO_2-e associated with food consumption by 2020.

Figure 11 UK food scenario, including production and consumption changes



This suggests that perhaps the UK needs to consider the production sectors in countries which are involved in the supply chain of its food.

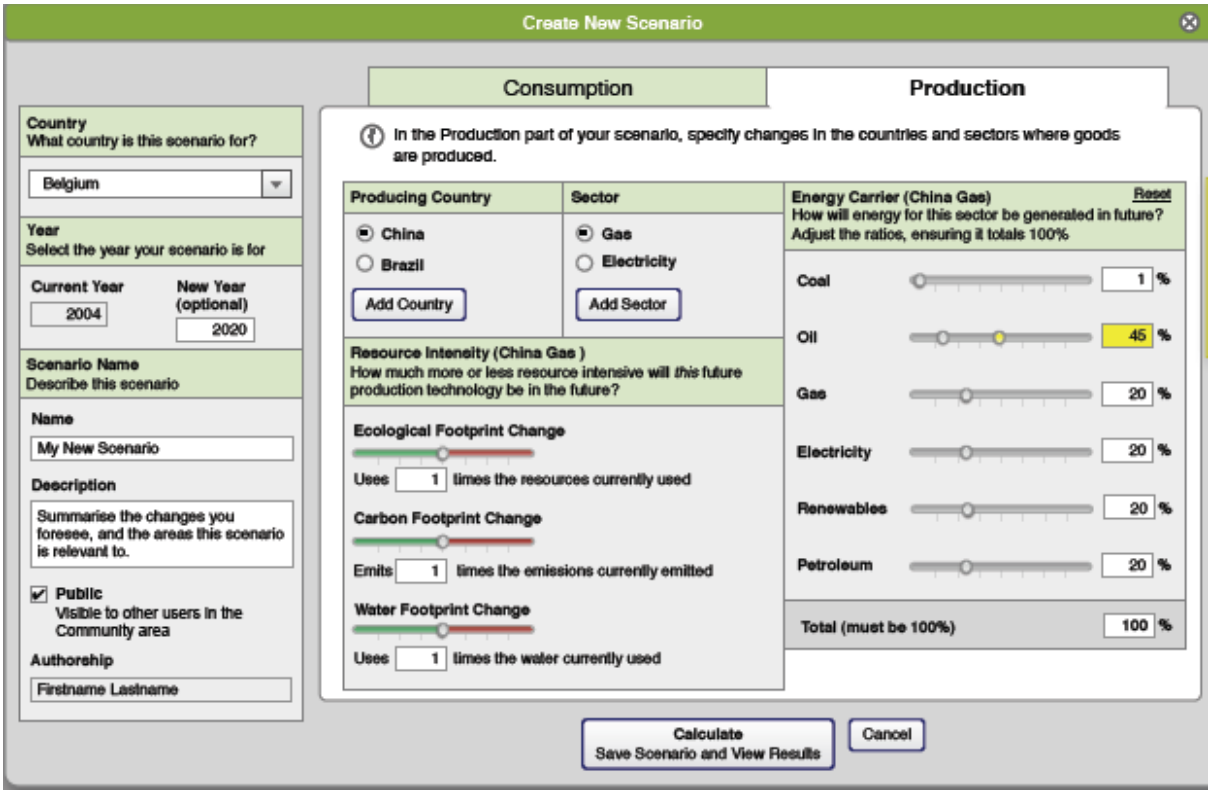
Step 4: Exploring the supply chain impacts of the UK's food consumption

The UK sources much of its food from abroad. When considering how to reduce the UK's food footprint by 30% by 2020, we may also want to consider the effect that changing production efficiencies in other countries has on our Carbon Footprint. Investigation into the supply chain emissions associated with meat products[17] show the largest contributing sector is not domestic factories producing hamburgers. Rather it is cattle farms in Brazil.

Step 5: Exploring the effects of a reduction in the carbon impact from Brazilian farms on the UK's Carbon Footprint

In this step, we target the carbon emissions occurring in Brazilian farms, and apply the same approach as in the UK to reduce emissions. For Brazil's 'Bovine cattle, sheep and goats' sector, we adjust the energy sources such that future use of gas is reduced from 8% to 0%, non-renewable electricity is reduced from 34% to 17% and renewable electricity is increased from 0% to 17%.

Figure 12 Editing UK food scenario to include reduction in impacts from Brazilian cattle farms[18]



[17] Using sources additional to the EUREAPA tool.

[18] At the time of writing, this part of the web application has not yet been implemented. This figure shows a screen shot of what it will look like, but does not depict the correct variable changes.

Figure 13 below shows that we have now reduced the impact of the UK's food consumption by 30%.

Figure 13 Final UK food scenario depicting successful 30% reduction in emissions associated with food consumption by 2020

Product	United Kingdom: Environmental Impact from Carbon* 2004 (Baseline) Household: Food *Units: Per Person (Tonnes)	United Kingdom: Environmental Impact from Carbon* 2020 (2020) Household: Food *Units: Per Person (Tonnes)
Animal products	0.02	0.02
Beverages	0.13	0.09
Bovine cattle, sheep, goats & horses	0.02	0.01
Bovine meat products	0.14	0.02
Cereal grains	0.02	0.01
Crops	0.13	0.09
Dairy products	0.12	0.09
Fishing	0.00	0.00
Hotels and restaurants	0.49	0.35
Oil seeds	0.03	0.02
Other food products	0.89	0.64
Other meat products	0.10	0.01
Paddy rice	0.01	0.01
Processed rice	0.01	0.01
Raw milk	0.10	0.07
Sugar	0.03	0.02
Sugar cane sugar beet	0.00	0.00
Vegetable oils and fats	0.02	0.01
Vegetables fruit nuts	0.21	0.24
Wheat	0.01	0.01
Total	**2.45**	**1.72**

6. Opportunities for expanding the Footprint Family of indicators and for further development of EUREAPA

There are a few important limitations to the Footprint Family of indicators and the EUREAPA tool that are important to recognise. The section below also indicates opportunities for improving on the Footprint Family and EUREAPA that could be carried out in a future research effort.

Limitations and potential improvements to the Footprint Family

The goal of the OPEN:EU project is to monitor progress towards a One Planet Economy – an economy that respects all environmental limits and is socially and financially sustainable, enabling people and nature to thrive – specifically for use by EU decision makers. The Footprint Family concept was designed as a consumer-based suite of indicators to identify such progressions. Unfortunately, the Footprint Family as it is currently defined is not able to fully address all social and financial aspects, and is also limited in its capability to track environmental impacts.

In order to overcome this inability to consider social and financial implications, it was suggested (OPEN:EU 2010) to make qualitative links between the Footprint Family and a wider range of socio-economic indicators that are more comprehensively able to address the issues of income and consumption, material well-being, access to education, income distribution, health conditions and health expectancy, personal activity (including work and unemployment), physical and financial insecurity, political voice and governance, and social connections and relationships (Stiglitz et al. 2009). Establishing these linkages would ensure that better monitoring of human-induced environmental pressures is undertaken and that the potential implications for a country's economy and residents' well-being are understood more comprehensively.

The secondary limitation introduced above refers to the current Footprint Family's inability to adequately address all environmental issues, this includes issues such as ecosystems' eutrophication due to nitrogen deposition, soil quality and land degradation due to intensive agricultural practices, release of toxic compounds, depletion of non-renewable resources and issues related to nuclear energy and nuclear waste. The Footprint Family could therefore benefit from the inclusion of additional, potentially footprint-style, indicators; this would enable a better system to assess the environmental impacts of production and consumption activities and assess trade-offs. Such indicators could include the 'nuclear' (Stoeglehner et al. 2005; Wada 2010) and 'nitrogen'[19] footprints. Undertaking this process is not so straightforward since the methodologies for these indicators are not at the same high level or standardization and robustness as the Ecological, Carbon and Water Footprints are. Indeed, substantial research is required before it will be possible to expand the Footprint Family to include these additional metrics. In order to track production and consumption of non-renewable materials, such as metal ores and other minerals, a 'material footprint' could be developed based upon the material flow accounting discussed by Giljum et al (2011). Using this sort of analysis

[19] see http://www.n-print.org/

would allow for the pressures on the lithosphere to be tracked, by comparing the use of mineral resources with the Earth's regenerative capacity for those resources.

As has been highlighted above, there are some overlaps between the indicators currently included in the Footprint Family. This is particularly so for the Carbon and Ecological Footprint, where the carbon component of the Ecological Footprint (known as carbon uptake land) has an overlap with the Carbon Footprint, despite the differences in methodological approaches (Galli et al. 2011). It can be argued that there is the possibility to better correlate the Ecological Footprint and Carbon Footprint by removing the 'carbon uptake land' from the Ecological Footprint methodology. On the other hand, there is debate as to whether it might be more useful to strengthen the Ecological Footprint indicator by including additional GHGs instead of focusing purely upon CO2. This, as well as a variety of additional merits and drawbacks of the Ecological Footprint, has been discussed in detail in Kitzes et al (2009).

Limitations and potential improvements to the EUREAPA tool

Several features of EUREAPA could be refined within the current system in which it operates. There are also some features that we could be added to EUREAPA, which would require significant additions to and re-working of the current system. These are listed in more detail below.

Refinement of the current system

User experience

There is a minimum level of support in interpreting the results and functions of the tool. This could be enhanced to provide more support for users.

The tool does not currently 'carry over' settings between different operations, which means that users must re-enter some data if they are, for example, creating the same production scenario for two countries. This could be amended to reduce the repeat work for users.

Graphics

The users are currently limited to viewing results in bar charts. If they want to view results in more sophisticated formats they must download data and manipulate it externally to the tool. More graph types and display functions could be added.

Users are not currently able to export graphs as images – they must create the image using data downloaded from the tool.

Scenarios

Users cannot group countries and make bulk changes (e.g. making a change that applies across the EU-27). This could be implemented in a future version of the tool.

Community

The 'community' section of the tool that allows people to view scenarios created by other users, share links and rate and comment on scenarios, has not yet been implemented. These functions would provide a substantial improvement to the tool, encouraging networking and discussions. Users are able to save changes to a scenario and download the settings to send to other users external to the tool.

Addition to the current system

Additional Indicators

Additional environmental extensions could be added to the MRIO, which could generate new indicators in the tool. These are summarised in the table below:

Table 3 Possible new indicators for EUREAPA

Indicator	**Comment**
Material use	This has been proposed at a number of stakeholder workshops. Data may be available through SERI materials flow project or NAMEA tables (for EU). Ideally it should be broken down into biotic and abiotic.
Land use	This has been proposed at a number of stakeholder workshops.
Employment	If an appropriate source can be found
Acidification	From NAMEA tables for EU
Trophospheric ozone forming precursors	From NAMEA tables for EU

New data

The current trade model that underpins the MRIO and EUREAPA uses data from 2004. It would be desirable to update this trade model with more recent data once it becomes available. The GTAP 7 model is currently being updated and it is anticipated that GTAP 8 will be available within a year. The MRIO and EUREAPA's 'calculation engine' have been designed to be flexible and accept different data sources but will need some development work to implement this. The front end of EUREAPA, which displays results and allows users to create scenarios would require additional work to amend data display and scenario editing.

Conclusions

Having a clear understanding of the effects of policies (or the lack of policy) on the environment is crucial to making responsible decisions. The use of the policy cycle approach breaks down the policy development process into discrete stages, each of which needs information, data and judgement to ensure that the right choices among policy options are made.

The EUREAPA tool can be used by different user groups at different stages in the policy cycle and for different purposes. The tool is most helpful in the first half of the policy cycle, as it allows users to assess the environmental impacts of current issues; it can estimate future impacts through the use of general and detailed scenarios, and provides information useful for prioritising policy options.

The tool cannot project whether the EU will meet its various policy objectives; rather it is a means of preliminarily testing how effective certain policy options might be in achieving them. Users can explore the changes that would be needed to reach a certain target and draw conclusions about the focus and severity (i.e. in which sector, at which rate?) of policies needed. Or users can come to the tool with an existing policy option to assess whether it is strong enough to reach targets in the desired time frame. EUREAPA can also indicate which, perhaps unforeseen, tradeoffs a certain policy approach might have on one or the other footprint indicator. In this way the tool illustrates the interdependence of all issues related to environment and resource use and can help mainstream these issues into other policy areas. By tracking environmental pressure associated with human consumption patterns, the EUREAPA tool can help policy makers ensure that resource prices reflect the full environmental costs of resource use and can provide a basis for making the costs and prices transparent to consumers.

In its current design, the tool is less suitable for later stages of the cycle, e.g. for assessing the performance of the policies implemented. However, if further developed, with updated data, it could also be turned into a useful tool in the monitoring, reporting and evaluation stages of the policy cycle.

Table 4 below summarises the key policy challenges in each of the policy areas discussed above that the EUREAPA tool can help inform and Table 5 presents the key functions of the EUREAPA tool as they apply to the policy cycle.

Table 4 Key policy challenges that EUREAPA can help inform

Policy area	Main policy targets or upcoming reforms	Key policy challenges that the EUREAPA tool can help inform
Agriculture	Common Agriculture Policy reform in 2013	Higher, unstable commodity prices, higher input costs, more variable climatic conditions (impact on yield), rising demand for land for biofuel and biomass crops, increasing policy focus on ecosystem services/resource protection, and rising national food security concerns (population growth)
Biodiversity and fisheries	EU Biodiversity Strategy to 2020; Common Fisheries Policy reform in 2012	Mainstreaming biodiversity and fisheries related issues in other policies
Climate change and energy	Roadmap for moving to a low-carbon economy in 2050; The '20-20-20' targets	Continued reduction in GHG emissions, significant increase in share of low-carbon technologies in the electricity mix, energy efficiency in transport sector
Raw materials	Raw Material Initiative	More efficient use and increased recycling, lower resource consumption
Regional development – Cohesion policy	EU cohesion policy, new programming period after 2013	Renewable energy, energy efficiency, clean urban transport and public transport in new EU Member States
Sustainable consumption and production	SCP/SIP Action Plan revision in 2012	Energy efficiency, material efficiency, water, waste, biodiversity, and emissions
Transport	Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system	Promotion of more sustainable behaviour, restructuring transport charges and taxes to 'get the prices right', reduction in GHG emissions, impact on biodiversity, landscape fragmentation, raw materials use, dependence on oil-based fuels
Water	Water Framework Directive; Blueprint to Safeguard Europe's Water, expected in 2020	Moving towards a water-efficient, water-saving economy to avoid problems around localized scarcity and drought due to an imbalance between water abstraction and availability

Table 5 Key function of the EUREAPA tool as applied to the policy cycle

Stages in the policy cycle	Functions of the EUREAPA tool	
1. Problem recognition **2. Agenda setting** **3. Problem exploration**	Identify how the consumption of certain products in certain sectors impacts the Footprint Family.	Viewing Data
	Measure the environmental impact of certain consumer lifestyles.	
	Quantify the full supply chain impacts of consuming certain products or consumption within certain sectors.	
	Appreciate the significance of each sector on each of the three footprint indicators.	
	Locate footprint 'hot-spots' – either in terms of the most footprint-intensive products and sectors, or countries in which the most negative impacts are originating or resulting – and highlight priority areas for action.	
	Compare country performance and identify best practices.	
	Communicate numerical outputs of the tool to inform public opinion.	
4. Identification of possible solutions **5. Analysis of policy options** **6. Selection of policy options**	Explore the impacts of increases in efficiency.	Creating scenarios
	Explore how changes in EU production and consumption in specific production categories affects environmental pressures both domestically and for trading partners.	
7. Implementation **8. Monitoring and reporting** **9. Evaluation** **10. (Dis-)continuation**	*Measure progress*	*Future EUREAPA*
	Support stronger shifts, continued effort	
	Explore environmental impact of EU spending programmes (Cohesion Policy)	

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Appendix I: List of countries and regions presented in the EUREAPA tool

Table 6 EU-27 and other countries presented in the EUREAPA tool

Austria	Germany	Netherlands	Australia	Russian Federation
Belgium	Greece	Poland	Brazil	South Africa
Bulgaria	Hungary	Portugal	Canada	South Korea
Cyprus	Ireland	Romania	China	Switzerland
Czech Republic	Italy	Slovak Republic	India	Taiwan
Denmark	Latvia	Slovenia	Indonesia	Turkey
Estonia	Lithuania	Spain	Japan	United States
Finland	Luxembourg	Sweden	Mexico	Annex Countries (I, II or B)
France	Malta	United Kingdom	Norway	Rest of the World

Total: 45 countries/regions

Appendix II:
List of products presented in the EUREAPA tool

Table 7 Products presented in the EUREAPA tool

Basket	Product
Housing	Coal and coal burning
	Electricity
	Gas and gas burning
	Gas manufacture, distribution and manufactured gas burning
	Oil and oil burning
	Petroleum coal products and burning
	Rent and mortgages
	Water
Transport	Air transport
	Motor vehicles and parts
	Other transportation
	Petrol products and combustion
	Transport equipment
	Vehicle maintenance
	Water transport
Food	Animal products
	Beverages
	Bovine cattle, sheep, goats & horses
	Bovine meat products
	Cereal grains
	Crops
	Dairy products
	Fishing
	Hotels and restaurants
	Oil seeds
	Other food products
	Other meat products
	Paddy rice
	Processed rice
	Raw milk
	Sugar
	Sugar cane and sugar beet
	Vegetable oils and fats
	Vegetables fruit nuts
	Wheat
Goods	Cement, plaster, lime, gravel and concrete
	Chemical rubber plastic products
	Electronic equipment
	Ferrous metals

	Forestry
	Leather products
	Metal products
	Minerals
	Non ferrous metals
	Other machinery and equipment
	Other manufacturing
	Paper products, publishing and media
	Plant-based fibers
	Repairs of goods
	Textiles
	Tobacco products
	Wearing apparel
	Wood products
	Wool silk-worm cocoons
Services	Business services
	Communication
	Financial services
	Hotel services
	Insurance
	Recreational and other services
Other	Construction
	Public Administration Defense Education Health

Total: 62 products