



OPEN: EU Scenario Storylines Report:

Scenarios for a One Planet
Economy in Europe



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PROJECT REPORT

JULY 2011

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7th Framework Programme for Research and Technological Development

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement N° 227065. The contents of this report are the sole responsibility of the One Planet Economy Network and can in no way be taken to reflect the views of the European Union.

Acknowledgements

We are grateful to the participants from the September 2010 Scenarios workshop who have provided us with feedback on drafts of the scenario narratives and their policy settings. Their input to the process was of great value and we have taken their subsequent feedback into consideration in further developing these storylines. We would in particular like to thank Chris Baker (independent consultant), Samuela Bassi (IEEP), Gemma Cranston (Global Footprint Network), Willy De Backer (Greening Europe Forum), Jean-Roger Drèze (Federal Department for Health and Environment, Belgium), Rosa Groezinger (Centre on Sustainable Consumption and Production), Martin Kemp (Centre for Alternative Technology), Doris Knoblauch (Ecologic Institute, Berlin), R. Andreas Kraemer (Ecologic Institute, Berlin), Marc Luyckx Ghisi (Business Solutions Europa), Leonardo Mazza (IEEP), Katy Roelich (SEI), Kristian Skånberg (TCO), David Watson (European Topic Centre on SCP) for their thorough feedback on this report. Without their effort, the completion of the project would not have been possible.

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Abbreviations

BAP	Biomass Action Plan
CAP	Common Agricultural Policy
CCS	Carbon Dioxide Capture and Storage
CF	Carbon Footprint
CFP	Common Fisheries Policy
CIP	Competitiveness and Innovation Framework Programme
CSD	Commission on Sustainable Development
DG	Directorate General
DWD	Drinking Water Directive
EC	European Commission
EET	Emissions Embodied in Trade
EF	Ecological Footprint
EFTA	European Free Trade Association
ETAP	Environmental Technologies Action Plan
ETS	Emission Trading System
EU SDS	European Sustainable Development Strategy
FAP	EU Forest Action Plan
GDP	Gross Domestic Product
GEI	Green Economy Initiative
GFN	Global Footprint Network
GHG	Greenhouse Gases
GPP	Green Public Procurement
IEEP	Institute for European and Environmental Policy
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual Property Rights
MRIO	Multi-regional input-output model
MS	EU Member State
NGO	Non-governmental organisation
OPEN:EU	One Planet Economy Network: Europe
PCB	Polychlorinated Biphenyl
SCP	Sustainable Consumption and Production
SDS	Sustainable Development Strategy
UNEP	United Nations Environment Programme
WEEE	Waste Electrical and Electronic Equipment
WF	Water Footprint
WFN	Water Footprint Network
WWF	World Wide Fund For Nature

Executive Summary

A set of future scenarios were developed as part of the OPEN:EU project to help support policy makers in thinking about the policy effort needed to transform Europe into a One Planet Economy¹ by 2050. This report provides an overview of the methodology that was used by the project team in the development of the scenarios, and an illustration of how life would be in 2050 in each of the scenarios. It places this scenario exercise in the context of the EU's overarching plan for smart, sustainable and inclusive growth over the coming decades as well as in the perspective of other existing scenario exercises that address similar themes.

There are four narratives that provide alternative, albeit not necessarily ideal, visions of the transition toward a One Planet Economy in Europe by 2050. They present both an illustration of life in Europe in 2050 and the policy settings that are necessary to support the transition to this common end point under different assumptions about the future. The scenarios were developed via a back-casting exercise on the basis of stakeholder input provided during a two-day workshop in September 2010.

Scenario 1, "**Clever and Caring**", assumes rapid technological change combined with a high level of preparedness to move away from materialism and the traditional focus on economic growth. This enables a relatively painless shift to a high-tech, but more caring, collaborative and sustainable society. In this world, Europeans recognise that sustainable lifestyles are paramount to the continued function of global ecosystems and the livelihood of future generations. Competition has largely been replaced by cooperation. Planned obsolescence of technology has been replaced by planned durability and reuse. The European health and education systems reflect holistic social values. Social innovation² flourishes at the neighbourhood, city and regional levels due to robust participatory governance and ample time availability for personal activities. Nearly 95% of farms in the EU are organic or permaculture-based. The financial system is radically different and has broadened its focus from the short-term and profit-driven models of lending to include social and environmental considerations. Energy infrastructure is largely decentralised and flexible.

Scenario 2, "**Fast Forward**", assumes the economic growth focus of today will continue to be a driving force. The transformation to a One Planet Economy has to be spurred on more aggressively by policies designed to maximise the potential of technological innovation to improve resource efficiency, to constrain overall consumption and to deal with global distributional issues. Without a "green tech revolution" and strong political action, Europe would have been unlikely to stay within the limits of a One Planet Economy, and there would have been a high risk of social and economic instability at global and regional levels. About 70-80% of Europeans live in a highly modern city in high-tech accommodation located in close proximity to work and personal, social and community services. Improvements in energy efficiency have helped drive the decoupling of energy use from economic growth between 2011 and 2050 beyond current trends (in transport, for example, there has been a large-scale reduction on the dependency on

¹ A One Planet Economy is an economy that respects all environmental limits and is socially and financially sustainable, enabling people and nature to thrive.

² A social innovation is a novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals (Phills, et al., 2008, p. 36).

fossil fuels). While energy demand in Europe has increased compared to 2011, by 2050 there is almost full decarbonisation of the power sector and a large scale switch to renewable electricity in the heat and transport sectors). Competition has catalysed a transformation of the global economy into one centred on low-impact growth and development, operating under a system of global production zoning.

Scenario 3, "**Breaking Point**", combines slow technological change and an enduring growth focus in people's mindset about development. The prices of high-impact goods and services have reached levels that are unaffordable for many people in society. Society is strongly divided by a large social gap between those who can and those who cannot afford an affluent lifestyle. This world is characterised by greater inequality and tension and it is more prone to conflict, which is exacerbated by political and resource-related uncertainty shocks and vicious competition for resources. These shocks eventually force this unwilling world to decrease its consumption levels and institute severe policies in order to meet the One Planet Economy goal by 2050. Since only limited gains in resource efficiency are possible through technological solutions, the emphasis has been on changing consumption behaviour. There has been a renewed shift to a more labour-intensive economy with greater food production within the EU for internal consumption, driven by the high prices of energy and other inputs and the fierce competition in world markets for increasingly scarce raw materials. Both imported and domestically produced goods are expensive. Prices for services are also generally high, and nearly every aspect of European life is heavily regulated to control demand and force conservation and efficiency measures.

Scenario 4, "**Slow Motion**", illustrates a more equitable transformation, with the vast majority of people embracing a "back to basics" and "doing more with less" lifestyle. Technological innovation does not play as great a role in enabling the shift to a One Planet Economy as in Scenarios 1 and 2. Instead, Europeans quickly learn to make the most of today's available technologies, to collaborate more, and to share limited resources more effectively. In this world, most Europeans have embraced frugality, simplicity and sustainability as core lifestyle choices. Average working hours are roughly half as long as they were in 2011. The average European walks, rides a bike or uses state of the art public transport rather than private road vehicles. The EU's economy is reflective of "greened" societal values and has become famous for its Beyond-GDP approach. In business, cooperation and knowledge sharing are more important drivers than competition, resulting in a more limited amount of innovation and growth but a more stable, albeit more insular, economy. Demand for imported goods is low due to large-scale de-materialism and self-sufficiency and due to high trade barriers or tariffs for products and services with high environmental and social harm. Notwithstanding this "ethical" trade policy, Europe actively engages with the global community to promote peace, fair trade, and eliminate trade barriers for technologies that maximise resource and energy use efficiencies.

Table 1 summarises the defining characteristics of the four scenarios.

Table 1 Defining characteristics of the OPEN:EU scenarios

	Clever and Caring	Fast Forward	Breaking Point	Slow Motion
Key assumptions	<ul style="list-style-type: none"> • Quality-driven mindset towards development • Dynamic technological innovation 	<ul style="list-style-type: none"> • Quantity-driven mindset towards development • Dynamic technological innovation 	<ul style="list-style-type: none"> • Quantity-driven mindset towards development • Technological stagnation 	<ul style="list-style-type: none"> • Quality-driven mindset towards development • Technological stagnation
Key features	<ul style="list-style-type: none"> • People have voluntarily become more socially responsible and environmentally aware in their lifestyles and act less selfishly • Planned obsolescence of technology has been replaced by planned durability and reuse • Energy infrastructure is largely decentralised and flexible. • Competition has largely been replaced by cooperation 	<ul style="list-style-type: none"> • Aggressive policies to stay within the boundaries of a OPE despite ongoing growth focus and to deal with global distributional issues • Global production zoning • Mix of regulation, taxation and innovation delivered massive efficiency gains, decarbonisation of power sector and shift to renewable electricity use for transport and heating 	<ul style="list-style-type: none"> • European society is strongly divided, a large gap exists between rich and poor • The costs of new technologies did not fall rapidly enough and new technologies were not deployed quickly enough to avoid energy shortages • Scarcity of resources leads to global resource conflicts • Shareholder profits dominate over stakeholder values • Nearly every aspect of life is eventually regulated by the state to address spiralling consumption 	<ul style="list-style-type: none"> • Prices are strong drivers towards resource efficiency and sufficiency • Collaboration and knowledge sharing are more important forces than competition in business • Dynamic social innovation increases human capabilities, welfare and environmental sustainability • Culture of repair and reuse, reinforcing a strong circular economy • Holistic approach to education: self-awareness, environmental awareness, spiritual and community values play a key part

Main policy interventions

- **Economy:** Environmental pricing reform
- **Labour:** guaranteed minimum "living" wage; mandated phased-in limits on maximum paid weekly working hours
- **Resources:** footprint tax, advanced labelling, household waste measures
- **Energy:** advanced fossil-fuel power plants are successfully deployed along with a large-scale roll-out of renewables; strong carbon pricing and energy efficiency schemes
- **Trade:** Extra-EU investment in low carbon development; global benefit-maximising trade policies aimed at high impact trade sectors; GMO food import ban

- **Economy:** focus on spurring strong competition for eco-innovation
- **Labour:** guaranteed minimum "living" wage across the EU
- **Resources:** Personal resource and emissions allowances , footprint tax
- **Energy:** Carbon pricing, smart metering, ban on conventional vehicles
- **Trade:** preferential trade with countries with the lowest footprint intensity

- **Economy:** shift in the tax burden from labour to resources
- **Welfare:** strong measures to control population growth
- **Labour:** Progressive income taxation to curtail excessive demand and provide funds for R&D investment.
- **Resources:** Personal resource and emissions allowances , footprint tax, meat tax; strong measures to foster "reduce, reuse, recycle"
- **Energy:** highest carbon prices of all scenarios and aggressive "at the pump" petrol taxes
- **Trade:** strong restrictions

- **Economy:** transition to a beyond-GDP model, helped by OPE indicators
- **Labour:** guaranteed minimum "living" wage; limits on weekly working hours; 2 years of community service
- **Resources:** footprint tax, advanced labelling, household waste measures
- **Energy:** carbon tax replaces cap and trade; phase out of inefficient appliances
- **Agriculture:** Measures to achieve 95% organic farming / permaculture production
- **Trade:** fuel import policy, GMO food import ban

Ultimately, the aim of the scenarios is to help policy makers understand what kind of effort is necessary to achieve the transformation towards a One Planet Economy and encourage them to take decisions that will deliver on this goal. Even though the future is inherently unpredictable, scenarios can provide a frame for creative discussion about how the major developments needed toward a One Planet Economy might take place and what their implications are for policy makers. The scenarios also aim to engage other stakeholders such as producers and consumers by helping them to imagine different futures and their potential role within these.

Following stakeholder feedback on the outputs of the scenario workshop, effort was taken to elaborate four distinct future scenarios, which all reach the One Planet Economy goal, but do so in different ways. The value in presenting differentiated scenarios is enhanced exchange and dialogue, hopefully leading to action by policy makers in guiding Europe's future.

The associated policy settings presented for each scenario are not intended to be comprehensive, but rather to outline indicative policies for each given scenario in light of the drivers at play. Thus, while all scenarios will deploy demand side measures, for example, these measures will be featured in greater detail in scenarios 2 and especially 3, which must work harder to suppress demand with available technology.

Following the qualitative development of the four scenario narratives and their associated policy settings, the scenarios are being modelled and analysed within the EUREAPA tool to quantify the potential impacts on the Footprint Family of indicators. The results of this quantification and modelling exercise will be presented in a separate report by the Stockholm Environment Institute (SEI).

1. Introduction

The OPEN:EU project³ centres on the goal of transitioning Europe to a One Planet Economy⁴ by 2050 and understanding what it would take to make this transformation. Firstly, the aim is to support policy makers in their thinking about what kind of effort is necessary and how effective different policy settings are likely to be in transforming Europe into a One Planet Economy. Secondly, the 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 toward the goal of a One Planet Economy. 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.

The problem to be addressed is quite clear: in a business-as-usual scenario, the world as a whole would need 2.5 planets to sustain the environmental impact associated with the consumption and production of goods and services in the EU today (Moore et al., in press). Understanding how to tackle this problem is less clear. The policy interventions needed over the next 40 years to arrive at a One Planet Economy depend on multiple interrelated factors influencing consumption and production patterns in Europe. For example, where consumption is concerned, there is considerable uncertainty and complexity due to the nexus between economic development, human behaviour, technology and governance – all of these factors influence consumption patterns, which are also strongly linked to cultural and social identity.

This report shows how the OPEN:EU project addressed these uncertainties through the development and analysis of different hypothetical but plausible future scenarios, characterising the future and its shifting variables through structured, but imaginative thinking. The OPEN:EU scenarios were created based on a participatory process involving stakeholders of the OPEN:EU project in September 2010.

Section 2 of this report describes the purpose, methodology and process of scenario development undertaken for the OPEN:EU project. Section 3 contains the detailed storylines and policy measures of the four scenarios. Section 4 explores the link between the OPEN:EU scenarios and other existing related scenarios and overarching policy strategies.

³ <http://www.oneplaneteconomy.network.org/>

⁴ A One Planet Economy is an economy that respects all environmental limits and is socially and financially sustainable, enabling people and nature to thrive.

2. Scenario Development

What are scenarios?

Scenarios can be defined as 'plausible and often simplified descriptions of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces and relationships' (Millennium Ecosystem Assessment 2005). Thus, a scenario consists of the end-state (an image of the future or a vision) and of the path by which this is reached.

Storylines are the qualitative and descriptive component of such scenarios. They reflect the assumptions about drivers of change and describe the consequences or outcomes of a scenario. Scenario storylines aim to open our eyes to different ways of perceiving the world. It is important to note that scenarios are not meant to be predictions and that 'they do not seek truth' (Rounsevell and Metzger 2010). They 'explore the possible, not just the probable, and challenge their users to think beyond conventional wisdom' (UNEP and IISD 2007, 5).

Developing scenarios

A range of methods are available for producing scenarios (see for example Van Notten, et al. 2003; Börjeson et al. 2006; Bishop et al. 2007). In order to understand the reasoning behind developing the OPEN:EU scenarios, it is essential to understand the difference between backcasting and forecasting.

Backcasting versus forecasting

Scenarios can either be created as "forecasts", describing how alternative futures might develop from current conditions and driving forces (*What if...?*), or as "backcasts", which start with an image of the future and aim to find plausible development pathways for getting there (*How could...?*). Rather than focusing on current trends and conditions, backcasting takes as its starting point a desirable resolution to the problem at hand. This approach is typically applied to complex long-term issues, involving various aspects of society and its environment, when there is a need for a major change (i.e. the target seems unreachable if current trends continue), and when the time horizon is long enough to allow considerable scope for deliberate action (Dreborg 1996). The process of developing a descriptive image of the future can also be helpful in broadening the perspectives of the participants involved in the scenario building exercise by helping them to envisage the end goal and beginning to imagine the implications of achieving it, i.e. the concept of a One Planet Economy (or more broadly, sustainability).

Why create scenarios for a One Planet Economy in Europe?

The aim of the One Planet Economy Network is to help transform Europe to a One Planet Economy by 2050. Given the long timeframe (up to the year 2050), the wide range of factors and the complex interrelationships between these factors, often involving feedback loops, the degree of uncertainty in any attempt to predict future outcomes would be very high.

To try to address this uncertainty and complexity we have developed scenarios that describe different ways in which consumption and production patterns in Europe might change towards 2050. The ultimate aim of the scenarios is to provide better policy support and to stimulate engagement in the process of change. Specific objectives are to:

- help policy makers understand the changing patterns of consumption and production and the reasoning behind such changes;
- show a wide range of measures which can help deliver a One Planet Economy, even under difficult circumstances (e.g. stagnant slow-down in technological innovation combined with an ongoing growth-driven mindset);
- identify key branching points where policy interventions could be particularly influential in determining the future development of consumption and production patterns;
- help policy makers understand the relative importance of different policy measures for reaching a One Planet Economy; and
- raise awareness, stimulate discussion and foster creative thinking (challenging the conventional wisdom and encouraging policy makers to think outside the box).

This scenario exercise also serves to test the robustness of currently discussed policy approaches in meeting the One Planet Economy goal. By examining a range of plausible futures involving different assumptions, we can begin to identify which kinds of policy interventions are most likely to help achieve a One Planet Economy in the EU and start to quantify the potential effects of these interventions (via the modelling of scenarios using the EUREAPA tool).

Scenario Development Methodology in the OPEN:EU project

The OPEN:EU scenarios were developed following a well-established methodology produced by UNEP (UNEP, IISD 2007). This methodology has a strong focus on participation, which helps to:

- Access local or specialised knowledge;
- Gather varied perspectives and avoid developer bias;
- Create buy-in so people are more likely to use the results; and
- Actively engage the target audience.

The OPEN:EU scenario framework was developed with stakeholders at a two-day workshop in Brussels in September 2010. It involved selecting drivers with critical uncertainties and then using these drivers to develop a scenario framework.

The process was divided into three stages:

1. Clarifying the purpose and structure of the scenario exercise

Careful planning in the early stages of scenario development is essential to ensure the quality of any scenario exercise. This stage of work included clarification of why we are building the scenarios, the issues to be addressed (i.e. future development of consumption and production patterns in Europe) and defining the vision for the scenarios (i.e. a One Planet Economy in Europe by 2050).

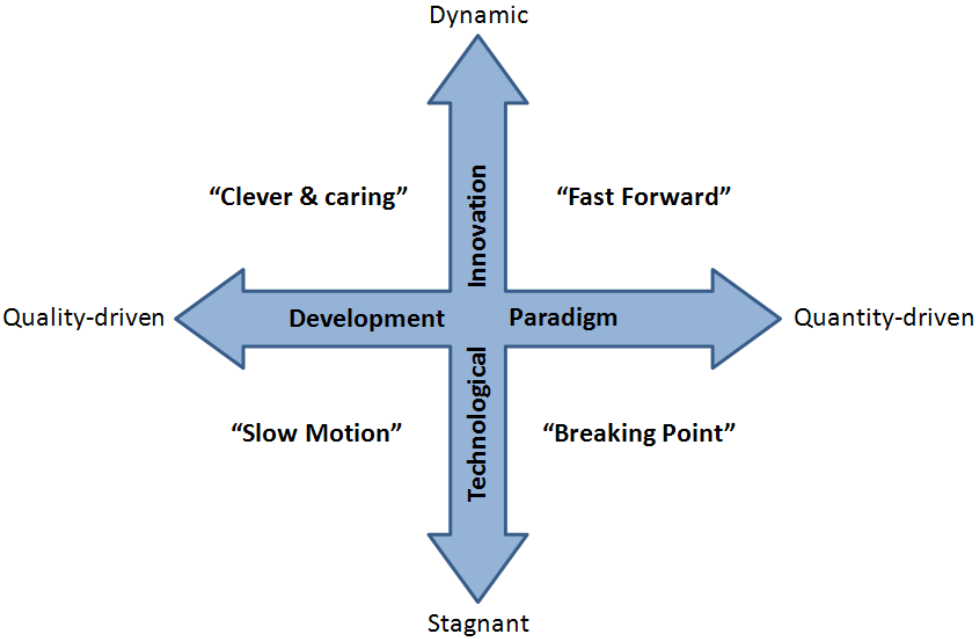
2. Laying the foundation for the scenarios – creating a scenario framework

The future development of consumption and production patterns in Europe depends on the interaction of many different driving forces. Stakeholder input is essential at this stage to making sure the foundations of the scenarios take into account as many perspectives as possible. Expert stakeholders participating in the OPEN:EU scenario development workshop were asked to work in groups to identify potential trends and dynamics in drivers, as well as uncertainties associated with the trends and drivers that are especially important in determining how the future evolves, but whose future development is highly unpredictable. From an initially large number of driving forces, participants agreed on two that they considered as being the most “critical uncertainties” in determining how the future development of consumption and production in Europe evolves – these are:

- a) **The momentum of technological innovation:** ranging from dynamic to stagnant. For example, advances in electricity generation technologies could either be more or less rapid, with implications for the cost and availability of alternative options in the future and the ease of reducing the EU’s carbon footprint to that of a One Planet Economy.
- b) **The motivating mindset behind the economic development paradigm:** ranging from quality-of-life-driven to growth-driven. For example, the individual could see maximising income growth as more or less important compared with other non-financial forms of utility, with implications for the consumption of material goods and the ease of reducing the EU’s impact across the Footprint Family.

These two uncertainties were chosen by the participants as being the two driving forces behind the scenario framework. The OPEN:EU scenario framework plots the two uncertainties on two axes to create a matrix of four unique scenario quadrants, representing four sets of conditions within which consumption and production patterns in Europe could develop to 2050. This framework is presented in Figure 1 below.

Figure 1 The OPEN:EU Scenario Framework



Each scenario proposes one possible way in which the uncertainty surrounding a) the momentum of innovation and b) the motivating mindset behind the development paradigm in Europe could resolve over the course of time to 2050. Based on each scenario’s assumptions of how these drivers will evolve and how their evolution will influence the environmental impact of consumption and production in Europe over the next 40 years, a set of policies – or a policy mix – was developed for each scenario, representing the steps that may be necessary to bring Europe to a One Planet Economy under these conditions.

3. Developing the narratives and policy settings

The third stage involves imagining life in Europe in 2050 for each of the four different futures created by the scenario framework. To do this, we developed a detailed, qualitative description of each scenario “world”, presenting a plausible picture of how our current world could evolve into the future under each of the four sets of assumptions about how the two critical uncertainties will evolve. These storylines focus mainly on describing what life could look and feel like in 2050 and are presented in Section 3.

None of these future worlds will come about without active participation and without policy interventions to help steer future developments in desired directions. We therefore developed a policy mix for each scenario to describe the policy path that would lead to each particular version of the future. This involved reviewing a wide range of relevant EU policy, strategy and related scenario documents to gather a range of ideas for specific policy settings that could be applied to the scenarios. The spectrum of policy areas considered included: broad economic policies; welfare, labour and income taxation; education, media and culture; consumption and waste; industrial policy; agriculture and land use; water resources; energy and transport; and trade and geopolitics.

A particularly challenging aspect of this exercise is to be sure that the different policy settings (type of policy and strength of application) for each of the scenarios are logical and consistent, both in themselves and with respect to their sister scenarios. While the

policy settings would ideally be *plausible*, it is not important for them to be *probable*. The aim was to define policy pathways to a level of detail that will allow us to model them in the EUREAPA tool and thereby check the consistency of the qualitative scenarios and whether the envisioned policy pathways could in fact bring us back within the limits of the planet's regenerative capacity. Given the constraints of this exercise, it was not possible to undertake the type of detailed analysis that would be required to define the hypothetical policy pathways to a high level of precision. However, the experimental exercise can still yield valuable insight into the inherent synergies and tradeoffs between the issues and their policy responses.

4. Modelling the scenarios

The qualitative part of the scenario development is followed by an iterative modelling exercise to model effect of the policy measures for the four scenarios. For the modelling, a new software tool, called EUREAPA, was developed, which for the first time brings together three footprint indicators (the Ecological Footprint, the Water Footprint and the Carbon Footprint). The EUREAPA tool was used to quantify the change in the Footprint indicators as a result of the changes to consumption and production brought about by each scenario's policy mix.

Testing the policy interventions with the model will help to determine the feasibility, effectiveness and robustness of particular policies (including combinations of policies) in reaching the One Planet Economy goal across the range of scenarios.

As stated earlier, there is an iterative process between Step 3 and Step 4. The nature of the scenario development exercise is such that it is impossible to know at the outset if the individual scenarios and combined policy settings will be effective at reaching the end goal (a One Planet Economy in 2050). It may be necessary to reconsider certain assumptions and policy settings within one or more of the scenarios if the modelling exercise reveals that it is impossible to reach a One Planet Economy on the basis of the initial settings. This report does not include the results of the modelling exercise, which is being conducted in July 2011.

3. One Planet Economy scenario storylines

This section presents the four scenario storylines for a One Planet Economy in Europe in 2050 – Scenario 1: Clever & Caring, Scenario 2: Fast Forward, Scenario 3: Breaking Point, and Scenario 4: Slow Motion. Each of the scenario narratives is accompanied by the mix of policy measures that would be necessary to bring about a One Planet Economy in this future. The policies included for each of the scenarios are not intended to be a definitive list – simply to highlight the differences between the worlds.

Scenario 1 – Clever & Caring

DRIVERS:

Quality-driven mindset towards development & technological innovation

ASSUMPTIONS:

The following assumptions about society help to form a picture of what life would be like for Europeans in 2050. These assumptions also inform the consideration of the policy measures needed in this Scenario to reach the One Planet Economy goal:

- Quality of life (e.g. health and vitality, holistic education, social interactions, comfort, spirituality) is prized over economic growth and increasing output (GDP).
- Social values move from being largely materialistic (extrinsic) to socially conscientious (intrinsic).
- People have voluntarily become more socially responsible and environmentally aware in their lifestyles and act less selfishly (i.e. because of these shifts, driving changes in consumer behaviour is not as heavily dependent on policy measures in this scenario compared with scenarios 2 and 3).
- Society values an equitable, collaborative and enabling approach rather than relying on a controlling and competitive approach.
- Society is highly dynamic and innovative, characterised by strong and successful research and innovation activities at all levels and a large number of scientific and social entrepreneurs throughout the EU.
- Technological innovation aimed at minimising environmental impacts of production and consumption enables more rapid change at lower costs than in scenarios 3 and 4.
- Many businesses prioritise social good before profit and are able to prosper because this aligns with the expectations of consumers.

LIFE IN EUROPE IN 2050

In this future, Europeans have recognised that sustainable lifestyles are paramount for the continued functioning of global ecosystems and the livelihood of future generations. As these lifestyles aim to deliver maximum quality of life rather than monetary or material wealth, there has been a dramatic reduction in resource consumption compared to the year 2011. People highly value immaterial goods—free time, family life, personal development and quality interpersonal relationships, for example. Innovative forms of

housing reflect greater societal value for community. Most Europeans live in energy, water and resource efficient housing, with a smaller housing floor area per person compared to 2011, but with more common space areas (both in form of common public space in buildings, e.g. shared kitchens and laundry rooms, and in form of more common public space in cities, e.g. parks and green urban areas) and state-of-the-art green architecture.

Social innovation flourishes at the neighbourhood, city and regional levels due to robust participatory governance and ample time for personal activities. Indeed, flexible working arrangements and fewer working hours allow citizens to enjoy more leisure time and meet their needs in less materialistic ways. Great value is placed on caring-giving, voluntary work, community-based collaboration and on non-monetary rewards. Little or no involuntary unemployment exists, with the average European working about half the number of hours per week in conventional paid work compared to 2011 (i.e. an average of 20 hrs/week, as opposed to 40 hrs/week), spending more time on voluntary community-based work. A defining characteristic is clearly defined maximum and minimum incomes, including a maximum relative gap between the lowest and highest earned incomes. Much less disparity exists between the wealthiest and the poorest, as Europeans regard poverty as unacceptable. Long distance and air travel for business meetings or exotic weekend breaks are rare due to reliable and wide-spread video conference systems as well as virtual travel solutions for cultural learning.

Strong, cooperative global relationships are of the utmost importance. A strong awareness and acceptance of shared international values prevails around the world. Cross-border collaboration is the norm, for example, in balancing renewable energy across Europe. Investment in less economically developed nations is very high, with the aim of reducing poverty while at the same time ensuring "zero carbon growth" through heavy investments in carbon neutral energy infrastructure via technology transfer.

The financial system is radically different. Lenders have broadened their focus to include the valuation of social and environmental considerations. Investors and trading houses have shifted away from short-term trading and risky, volatile speculative investment to longer term investments in a sustainable future. The banking sector has become much more diverse in terms of the objectives and nature of institutions and forms of lending and borrowing. Micro-finance, co-operatives and community ownership support a significant portion of investment.

Competition has largely been replaced by cooperation and planned obsolescence by planned durability and reuse. Business models and strategies on innovation align business with environmental and social objectives. Hence, businesses employ measures of success and production systems that are geared towards delivering the highest overall (social, environmental and economic) value, rather than just financial return. Technological breakthroughs have achieved a market transformation to a closed-loop economy where resources stay in circulation for as long as possible. Materials are tracked as they pass through the economy. Products are designed for easy separation and reuse of materials. All efforts are made to develop zero-waste, resource-efficient and dematerialised products in order to lighten and to reduce the resource content of the consumption and production patterns. Only when it is not possible to do this is the material discarded, also in a sustainable way.

Energy infrastructure is largely decentralised, flexible and collaborative. Electricity is generated almost exclusively from renewable sources. The optimisation of networks across countries in the EU allows for a high utilisation of both large-scale renewable energy sources (e.g. solar in the south and hydro and wind in the north), and small-scale on-site generation (e.g. homes, businesses, farms), making large scale centralised power plants as we know them today much less prevalent.

The rate of cost reduction and uptake of emerging technologies on both the supply side and the demand side is high, improving the efficiency of the renewable energy supply and reducing energy consumption.

The vast majority of personal passenger automobiles are electric, powered by the fully renewable grid or from local generation sources. Cars are leased from the manufacturer who has incentives to upgrade the transport fleet with the most energy efficient vehicles. All vehicles not powered by electricity are powered by sustainable biofuels or hydrogen. Old cars are fully recyclable. The transformation of the car, the commercial transport fleets and the mass transport infrastructure to support low carbon or electric operation has significantly reduced carbon emissions from transport, and the rapid pace of technology development has meant that the costs of transport are still affordable by most. Air travel is less common for casual purposes, as most Europeans have slowed down their pace of life and follow the slogan "the journey is the reward". Energy use in the airline industry has improved dramatically, as airplanes have been redesigned to become lighter, experience less drag and therefore need smaller engines that burn less fuel, such as the Flying Wing Design. Smaller aircrafts, primarily used for goods shipments, are completely solar powered or equipped with solar co-generation engines in the case of short distance intra-EU passenger flights.

The European health and education systems reflect holistic social values. The health system is diverse and pro-active, rather than reactive, placing a high value on prevention. The holistic view on health ensures that human wellbeing is a prime consideration in all aspects of life, such as the design of the built environment, of transport systems, food systems, and education. The 2050 diet is guided by mindful eating practices, which deliver health and pleasure, while at the same time reducing overall food consumption and amounts of food waste. School children understand the impact of food choices on the surrounding environment and choose to adopt vegetarian and low animal product consumption. The education system is broader based and holistic, aimed at teaching the whole student and not just academic and vocational skills, with a strong emphasis on infant and early education. It encourages self-awareness and compassion. The system provides citizens incentives to be adaptive and continue learning throughout their lives.

Nearly 95% of the farms in the EU are organic or permaculture-based farms. Since radical CAP reform in 2014, the environmental impact of the agricultural system diminished significantly. Inputs of fertilisers and pesticides have been substantially reduced. Food supply chains are generally short, except for in regions with a shortage of agricultural land. This dramatically reduces the need for transportation of food products over long distances and cuts the associated carbon impact. A strong farmer-citizen link and "intelligent cohabitation" paradigm ensures that food is supplied by community-supported agriculture and is mainly distributed through co-operatives and farmers' markets, but not at the expense of preserving natural ecosystems. In order to avoid competition between the preservation of natural ecosystems and the development of

agricultural activities, CAP payments for organic production favour multi-story indoor organic farming facilities powered by renewable energy and utilising sustainable techniques. These facilities allow for more efficient year-round supplies of fresh, organic and locally grown food. Additionally, CAP payments for ecosystem services also favour ecosystem preservation and land stewardship. Demand for animal-based products is low. Consequently, in many areas, farmland formerly used for animal fodder or for grazing has been returned to nature and has resulted in the restoration of the natural functions and services of the ecosystem and increased biodiversity.

EUROPE'S POLICY MIX TO A ONE PLANET ECONOMY BY 2050

Broad economic policies

- **New tools for measuring progress.** With social good and quality of life valued over profit making, Europe has made a concerted effort to move beyond GDP. The use of One Planet Economy environmental indicators for monitoring development progress was established by 2015. Corporate accounting requirements have ensured that businesses make visible and account for not just financial value, but also the environmental and social performance of the company (i.e. triple bottom line reporting is mandatory, with penalties for noncompliance).
- **Environmental pricing reform.** An EU-wide initiative to coordinate price signals resulted in increased prices for energy, raw materials and materials with high environmental impacts, both per unit of use and in total amount.
- **Financial market reform.** Lending and investment regulations and incentives were introduced in 2015 to reward longer term sustainable investments and discourage risky and speculative non-sustainable investments. These included, for example, requiring the use of One Planet Economy indicators in investment decisions, and fostering and rewarding lending diversification in the banking sector.
- **Monetary policy reform.** European monetary policy is more closely aligned with the objectives of the One Planet Economy including, for example, through a reform of the European Central Bank's mandate and close oversight of the impact of financial sector trends on achievement of sustainability goals.
- **Intellectual property rights (IPR) policy.** Increased collaboration under this scenario and the desire to move away from an IPR system that rewards incremental advances in innovation, has led to the renegotiation of the WTO TRIPS agreement (trade-related aspects of intellectual property rights). The length of time IP is protected has been reduced and protections for environmental technologies are purchased through an EU Buy-Out Policy in order to provide maximum public benefit around the globe.

Welfare, labour, and income taxation

- **Wages & income.** In 2015, an EU-wide directive required Member States to adopt a guaranteed minimum "living" wage, which included an annual local adjustment with the goal of normalising wages across the EU over time. In addition, a progressively higher marginal taxation on income earned in excess of the guaranteed "living wage" was implemented, beginning in 2015. This effectively limited the maximum difference between lowest and highest earned incomes. The "living" wage coincided with a major overhaul of the EU Working Time Directive (2003/88/EC), which, beginning also in 2015, mandated phased-in limits on maximum paid weekly working hours (or maximum annual total, spread over a year to allow flexibility).

- **More flexible working arrangements for employees.** The EU Working Time Directive was also amended to permit flexibility in working hours and working arrangements. Beginning in 2012, a new model allowed for job sharing, school term shifts, extended care leave and sabbaticals.
- **Tax allowances for employee training.** Generous tax breaks and grants to employers were instated early on (2015-2025) for employee training and development programs which resulted in increased employee hiring.

Education, health, media, and culture

- **Education reform.** Europe's education system was radically reformed early on (by 2015), shifting focus from the training of purely academic and vocational skills to also include cultural and environmental education to promote behaviours and attitudes necessary for achieving a One Planet Economy.
- **Special education measures: urban farming.** Beginning 2012, all European children were taught organic farming methods – including skills which could be applied in the urban environment. Additionally, a food supply chain education initiative taught the impact of food choices on the surrounding environment and encouraged the adoption of vegetarian and low animal product consumption, discouraged consumption of processed foods, and emphasised the importance of consuming local and healthy foods.
- **Health system reform.** There was early investment in the expansion of preventative, proactive, and holistic medicine, including increased funding for research and education.
- **Media policy.** Restrictions on advertising, especially advertising aimed at children. Media campaigns promote healthy and harmonious living, such as "Leave no child inside⁵" which encourages enjoyment and appreciation for the outdoors and nature as well as enhancement of health and community. These campaigns are coupled with enhanced funding through, e.g. CAP for environmental services, including land stewardship and preservation.

Consumption and waste

- **Advanced labelling.** Labelling and pricing of resources, goods and services has taken into account the environmental and social harm caused during extraction, production and use including impacts on biodiversity, ecosystem services, air and water quality, and scarcity of finite resources. Advanced labelling requires product and components to be electronically labelled with their material component to permit more effective stripping and recycling of individual materials or parts.
- **Footprint tax.** Under this progressive taxation scheme, a tax was introduced to discourage production and consumption of high-impact products. The higher the product's or service's Ecological, Carbon and/or Water Footprint, the higher the tax applied to it (up to 75% surplus on the market price in 2050).
- **Household waste measures.** The EU recommended that all Member States encourage municipalities to reduce waste collection services to a biweekly instead of a weekly scheme and to offer door-to-door recycling collection on a weekly basis.

⁵ This example slogan is derived from an actual campaign by the state of Connecticut, U.S.A. called "No Child Left Inside[®]" which aims to "introduce children to the wonder of nature-for their own health and well-being, for the future of environmental conservation, and for the preservation of the beauty, character, and communities (of the state)."

Industrial policy

- **Measures to improve the resource-efficiency of production processes.** Resource efficiency improvements are driven by various measures, for example through the early strengthening and widening of the Eco-Design Directive to include industrial inputs beyond energy and by strengthening public procurement regulations across EU Member States. Regulations on efficiency are promoted in tandem with increased efforts on recycling to ensure that recycling does not become an end in itself.
- **Recycled content manufacturing regulation.** Industry and the manufacturing sectors were required to use a minimum of 20% recycled material in products by 2020 (increased to 50% by 2040). The regulation applied also to products manufactured outside of the EU at facilities under ownership or control by EU companies. In addition, an advanced “Take back” law was applied to nearly all commercial products sold.
- **Expansion of extended producer responsibility (EPR) obligation beyond Waste Electrical and Electronic Equipment (WEEE) directive 2002/96/EC.**⁶ The list of applicable priority products under WEEE was expanded to include all products composed of 50% or greater plastic, 50% or greater metals, as well as all products containing any mercury, batteries, all medical products, and all carpeting.

Water resources

- **Full cost recovery water pricing.** (Pricing covers financial, resource and environmental costs). Under the EU Water Pricing Directive, Member States are required to ensure full cost recovery water pricing in household, agricultural, and industrial (including mining) sectors. Under a stepwise increase between 2015 and 2050, average water pricing for public water/wastewater services in non-water scarce EU regions is 5 €/m³; in water scarce regions, it is in the order of 8 €/m³.
- **Water pricing and removal of water-related energy subsidies.** Existing water pricing subsidies for industries and agriculture were reduced, eliminated and refocused on water efficiency R&D (reduced by up to 50% by 2030; 100% by 2050).
- **Measurement of water intensive products.** A water intensity labelling scheme was introduced (for non-food goods) to raise consumer awareness and support retailer pressure on the supply chain to provide less water-intensive products. The labelling includes a measurement of both water and carbon footprints of products, to prevent negative trade-offs.

Energy and transport

- **Market reforms.** Implemented very early on (from 2012) to provide a level playing field for investment in demand side management, on-site generation and smart grid infrastructure.
- **Renewable energy and fossil-fuel power plants incorporating CCS/CCR.** On the supply side, society was not prepared to accept any new conventional coal-fired power stations, and none are built from 2011 onwards. In addition to the decentralisation of the energy supply infrastructure, the rapid uptake of large scale renewable energy technologies is enabled by the combination of rapid technological innovation and targeted measures. The replacement of existing

⁶ See, e.g., “Priority products and materials report” at <http://www.unep.org/resourcepanel/>

fossil fuel plant is also made possible with a limited contribution (less than 10% of the mix) from advanced fossil-fuel plants incorporating carbon capture and storage (CCS) and carbon capture and reuse (CCR) - available from 2020 onwards.

- **Nuclear Power Independence.** As electricity is generated almost entirely from renewable energy sources, nuclear power plants were phased-out across the EU and also constitute less than 5% of primary energy production in 2050. Construction of new plants was banned in 2012 with funding provided to countries heavily dependent upon nuclear energy to facilitate rapid transition to renewables.
- **Carbon pricing.** Despite the inclusion of carbon pricing, in this scenario the carbon price signal is the lowest compared with other scenarios because of the combination of lower demand and rapid technological innovation (e.g. it peaks at around 30 EUR/tonne by 2020). The carbon price signal is supported by targeted measures on both the supply side (e.g. feed-in tariffs) and demand side (e.g. white certificate schemes).
- **Energy efficiency schemes.** On the demand side, implementation of energy efficiency "white certificates" schemes across the EU by 2015, placing an obligation on utilities to help their customers reduce energy consumption, were highly effective at incentivising the uptake of opportunities, without the need for more draconian measures.

Agriculture and land use

- **Radical CAP Reform.**⁷ Phase-out of direct payments by 2018; all market measures abolished (CAP export subsidies, import tariffs, quotas).
- **Environmental service/benefit CAP payments phased-in by 2018.** The income lost through a progressive phase out of direct payments has been in large part compensated by the progressive phase in of Payment for Ecosystem Service (PES) schemes underpinned by EU CAP payments, favouring small and medium sized farms of large agricultural holdings. Rural development measures focus on reducing agricultural impact on carbon, water and ecological footprints through forestry and land management innovation and preservation of pastoral and natural landscapes through stewardship aid.
- **Organic farming/permaculture measures to achieve nearly 100% organic or permaculture production in the EU.** Organic farming assistance subsidies (independent of CAP payments) for multi-story indoor organic farming facilities powered by renewable energy and utilising sustainable techniques will start with 400 EUR/ha in 2012 and then be reduced to 300 EUR/ha in 2020 and 200 EUR/ha in 2030, 100 EUR/ha in 2040. All other organic or permaculture farms receive 60% payment, as a measure to balance organic production with competing land use goals of preserving natural ecosystems.

Trade and geopolitics

- **Extra-EU investment in low carbon development.** Very aggressive investment early on (2015-2025) via robust funding mechanisms in low carbon development and decarbonisation in emerging economies and developing countries has ensured that a great majority of developing countries could move directly to cleaner technology, avoiding the environmentally most harmful stages of development and industrialisation.

⁷ In this scenario, the architecture of the CAP is conceptually in-line with Option 3 of the CAP Towards 2020 EC Com.

- **Global benefit-maximising trade policies aimed at high impact trade sectors.** EU trade policy highly focused on reducing the impact on the footprint indicators of the traded sectors with the greatest impact. This would logically include: (1) chemical, rubber, and plastic products; (2) electronic equipment; and (3) machinery and equipment⁸. Policies, often highly altruistic, were targeted especially at trading partners producing these products (China, the United States, and the Russian Federation) to maximise the rate and impact of reduction caused by these sectors. Specific trade strategies included bilateral deals with China aimed at **transferring technology and skill sharing**, and **making capital investments** in both China and the Russian Federation. Efforts were especially focused on **decoupling China's economic growth from energy consumption as a mechanism to most effectively reduce the impact on the Carbon Footprint and the Ecological Footprint**.
- **Sustainable furniture.** Under all the scenarios, imports of manufactured furniture must be certified by the Forest Stewardship Council (FSC) and/or a credible equivalent and must comply with existing EU illegal timber legislation requiring Chain of Custody (COC) certification.
- **GMO food import ban.** The phased-in import ban on GMO food products was very aggressive under this scenario, with a very short schedule beginning in 2014 and reaching a complete ban by 2018. These measures in the EU resulted in a global reduction in GMOs, which has enhanced biodiversity of crops and food security.

⁸ These product sectors, very generally, have the greatest impact on the three footprint indicators, based on a generalised multiregional input-output (MRIO) analysis of the 2004 GTAP 7 database. This is not to say that these product sectors, when viewing the footprint indicators individually, would necessarily have the highest impact upon a specific footprint indicator.

Scenario 2 – Fast Forward

DRIVERS:

Quantity-driven mindset towards development & technological innovation

ASSUMPTIONS:

The following assumptions about society help to form a picture of what life would be like for Europeans in 2050. These assumptions also inform the consideration of the policy measures needed in this Scenario to reach the One Planet Economy goal:

- Growth-oriented thinking shapes economic decision-making in the EU (focus is on GDP growth, increasing production and consumption of goods and services over the quality of life aspects that are a feature of scenarios 1 and 4).
- Global resource shortages and significantly higher prices for non-renewable energy sources and materials drive creativity and innovation.
- Accelerated technological innovation is needed even more than in scenario 1 to achieve the necessary improvements in resource and energy efficiency by 2050.
- Efficiency improvements alone have not brought about a One Planet Economy and the necessary decoupling of economic growth and resource use from environmental degradation. Thus, compared with scenario 1, more aggressive policy measures and ambitious solutions are needed to drive the change required to stay within the limits of One Planet Economy.

LIFE IN EUROPE IN 2050

Global stability, with an adequate distribution of power, is the cornerstone of this future. Stability enabled the creation of a global sustainable development framework. European demand for “green” goods and services during the first half of the century resulted in strong competition among trading partners for access to the European market. Consequently, countries producing goods and services with the lowest impact on the Footprint family of indicators are favoured trading partners. The most successful firms—many of which are European—are those offering eco-innovations, which enable consumption and drive the economy, but which result in minimal environmental impact. Indeed, Europe’s technologies often out-innovate the competition, resulting in significant “in-house” reductions and a “green tech revolution.”

Competition has catalysed a transformation of the global economy into one centred on low-impact growth and development. The economic structure is characterised by a system of global production zoning in which manufacturing and service companies with synergistic production processes are clustered in specific regions. Industrial collaboration in the area of environmental and resource management is rising, as firms seek to maximise their economic performance by saving resources. As a by-product, the negative environmental impacts of production are minimised and zero-waste production processes, recycling and re-use has been optimised in many industrial clusters. Waste products from one industry are used as inputs in neighbouring industries as often as possible. The production motive is still largely shaped by shareholder profits,

but regulations require businesses to measure changes in their social and environmental performance.

About 70-80% of Europeans live in high-tech accommodations located in close proximity to work and personal, social and community services. The education system reflects the global mindset of Europe and is highly internationalised, focusing on technology and adaptability.

Compared to scenarios 1 and 4, most Europeans voluntarily spend more time working in order to enable additional consumption. Consumers value products and services based on their resource efficiency, as social status is now linked to sustainable living. They also demand high quality products; as a result, high quality, longer-lasting products are more profitable and dominate the market. By producing and selling more high quality products than today, companies are able to add more value while not increasing their resource inputs and this value is shared with workers in the form of higher wages. Economic growth is hence achieved without a growth in resource use and its related environmental impacts.

Government policy is required to drive further changes in behaviour due to the higher growth and demand in this scenario compared with Scenario 1. Policies involve price signals such as the taxation of consumption of environmentally-harmful products and services rather than direct regulation. Consumers have provided early adopter markets for the new, developing technologies and consumer products. Ultimately this mix of regulation, taxation and advances in technology has delivered a net reduction in consumption for society overall.

Improvements in energy efficiency have continued to contribute to a relative decoupling of energy use from economic growth in Europe between 2011 and 2050, although overall energy demand has increased. Compared with Scenario 1, the focus in this Scenario is more on policies that encourage business models such as Energy Performance Contracting/Energy Services Companies, and less on forcing utilities to meet obligations. Smart metering is rolled out across the EU by 2020, enabling remote load control, but only with the customer's consent.

On the supply side, emissions reductions are achieved via numerous cost-effective low-carbon technologies such as large-scale off-shore wind and solar parks, widespread heat recuperation, and utilisation of local smart grids. However, centralised power generation is more of a feature than in Scenario 1, due to the higher level of demand for electricity and stronger economic growth focus. Ultimately, ambitious trans-continental projects such as Desertec (generating electricity from solar power plants in North Africa) are needed to enable the full decarbonisation of Europe's energy supply to keep emissions in check.

Mobility is revolutionised, using less resources and energy. As oil and gas became very expensive and shortages in supply a regular phenomenon during the first quarter of the century, motor and alternative fuel technologies quickly advanced. From 2030, bans are enforced on conventional road vehicles. Most airplanes have been redesigned to become lighter, experience less drag and therefore need smaller engines that burn less fuel. Cars run with electricity made from renewable energy sources. Long distance travel, overall, is less necessary due to the maximum use of videoconferencing technologies.

With a large global population and ongoing focus on income growth and consumption, there is intense pressure on land for food production and human inhabitation. Advances in agriculture have relieved some of this pressure with new technologies, such as multi-storey greenhouses, which substantially contributed to increased global agricultural yields. Significant advances and efficiency improvements in industrial agriculture has also resulted in highly efficient use of land, which enabled a conversion of former agricultural land back to resilient and diverse areas which increased biodiversity and enhanced ecosystem services. Efficiencies gained through industrial agriculture have also enabled an increase in organic agriculture in the EU to 75% by 2050, compared to 4.1% in 2010.

EUROPE'S POLICY MIX TO A ONE PLANET ECONOMY BY 2050

Broad economic policies

- **Economic reform.** In the interest of supporting eco-innovation, the market was further liberalised, strong competition among firms across the economy was spurred and supporting policy incentives were provided. This includes strong re-investment of funds generated through taxes and emissions allowance auctions in R&D and enhanced collaborative implementation of the Environmental Technologies Action Plan (ETAP) and Competitiveness and Innovation Framework Programme (CIP) and other programmes which foster eco-innovation
- **Monetary policy.** In this Scenario, the ECB policy concerning its key interest rates remained unchanged, as the focus in this world is growth-oriented.
- **Corporate accounting.** New regulations have required businesses to measure their social and environmental performance additional to financial profits.
- **Innovation tax breaks.** Tax-incentives encouraged businesses to renovate their buildings to improve energy efficiency and to take up on-site renewable generation options (see also Energy and Transport below).
- **Technology Procurement.** Governments gear up procurement policies to offer substantial incentives to innovators to compete to bring forward and to deliver innovative, viable solutions which can achieve large environmental yields quickly (e.g. buildings, food and drink, recycling and waste water industries, private transport).

Education, media, and culture

- **Education reform.** The education system was internationalized, with less focus on national boundaries/divisions in order to prepare for the global zoning of production, which was planned for 2020. New incentives helped the education system to become more flexible and to encourage creativity required to support greater innovation and technological advancement, with a strong focus also on adaptability skills.
- **Special education initiatives: food choice coaching.** Important initiatives include food supply chain education to reduce demand for meat and animal products.
- **Media policy.** Increased use of green consumerism marketing and advertising campaigns.

Consumption and waste

- **Personal carbon and emissions allowances (PCEA) scheme.** Introduced in 2015, every person was given an annual carbon allowance card with a credit of 3000 kg CO₂ which was required to purchase petrol, diesel, traditional electricity (i.e., electricity with CO₂ emissions), gas, coal, heating oil or a flight to go on holiday. Allowances can be bought and sold. The size of the annual allowance was progressively reduced down to 2500 kg in 2025, and even further following the ban on conventional passenger cars, and the increasing shift to renewable energy for electricity and heat generation.
- **Footprint Tax.** The footprint tax was ramped up more aggressively than in Scenario 1, reaching up to 85% of the value of a product in 2050. Because of the introduction of the personal carbon allowance (see above), the carbon component of the footprint tax was eventually phased out.
- **Advanced Eco-labelling scheme.** Advanced labelling regulation was implemented which provided better energy/environmental performance information and covered more products to further facilitate "Smarter Consumption".
- **Reduction of waste collection services.** In 2015, municipalities were required to reduce waste collection to a bi-weekly service and restricted private companies from offering more frequent services. Further measures were needed due to the stronger demand in this scenario, resulting in the introduction of an aggressive tax on non-recyclable waste by weight.
- **Required door-to-door recycling collection.** In 2015, all EU municipalities were required to offer door-to-door recycling collection on a weekly basis (apartment buildings excluded), resulting in an immediate additional decrease of unsorted waste generation. The share of non-biodegradable municipal waste recycled in the EU increased from around 25% in 2011 to around 50% by 2020 and over 75% by 2050.

Industrial policy

- **Resource pricing measures.** Global constraints on the availability of raw material and energy inputs became one of the most important features of this world. Policies were imposed to set the direction for market innovation and competition. The raw material inputs with the highest environmental impact were identified and were subjected to an internationally-agreed minimum tax rate of 10% on the value of materials produced at the primary production point, starting in 2020. This tax rate reached 30% by 2040 and included imports of fossil fuels.
- **Environmental accounting measures.** Industrial codes have incentivised companies to include environmental factors in their financial accounting and to transfer costs to the price of the end product. Rule of Supply Chain Optimisation to minimise resource inputs (e.g. Benchmarking scheme in the industries with required efficiency improvements of 10% every 5 years).
- **Product phase-outs.** Inefficient products were gradually phased out through the introduction of progressive minimum standards as new innovative products become available.
- **Recycled content manufacturing & purchasing regulations.** Industry and manufacturing sectors were required to use a minimum of 20% recycled material in products by 2020 (increased to 50% by 2040). The regulation applied also to products manufactured outside of the EU at facilities under ownership or control

by EU companies. Beginning in 2020, a wholesaler and retailer purchasing obligation mandated that products must contain a minimum of 20% recycled materials (increased to 50% by 2040).

Water resources

- **Full cost recovery water pricing** (financial, resource and environmental costs). Under the EU Water Pricing Directive, Member States are required to ensure full cost recovery water pricing in household, agricultural, and industrial (including mining) sectors. Under a stepwise increase between 2015 and 2050, average water pricing for public water/wastewater services in non-water scarce EU regions is 6 EUR/m³; in water scarce regions, it is of 9 EUR/m³.
- **Water sanitation & sewage systems.** Mandatory replacement of municipal water sanitation and sewage systems with eco-sanitation systems (ca 2020).
- **Water conservation campaigns.** Water awareness campaigns in e.g. schools, especially in water scarce regions. EU wide media campaigns have heavily promoted consumption of less water intense products.

Energy and transport

- **Carbon pricing.** In this Scenario, the carbon price reached a higher level than in Scenario 1 (e.g. reaching 40 EUR/tonne by 2020), driven by the stronger demand for energy and the greater emphasis on the role of the EU ETS as the primary policy measure for decarbonisation. This price signal was sufficient to deploy large-scale renewable energy technologies and some advanced fossil-fuel powered plant incorporating CCS/CCR and a limited contribution from nuclear power (together, CCS and nuclear make up no more than 20% of the mix by 2050). Compared with Scenario 1, centralised power generation continued to play a greater role in this Scenario.
- **Electricity imports.** Because of the higher demand compared with Scenario 1, the decarbonisation of the EU energy sector did not happen as quickly as was needed - despite the carbon price signal. Around 2030, the EU was forced to introduce a strategy to import around 15% of its electricity needs from North Africa/the Middle East (the MENA region) via a direct current (DC) link similar to that proposed in the Desertec project in 2011.
- **Smart metering** was rolled out across the EU by 2020, enabling remote control of both household and business consumption and electric vehicle charging by utilities to optimise the utilisation of renewable resources at different times of the day. This only occurred on a voluntary basis.
- **Incentives for building renovations and household energy efficiency measures.** Legislative reforms made it easier for tenants to recover the costs of building renovations aimed at increasing efficiency from owners. Strong rebates provided for household investments in energy efficient appliances.
- **R&D incentives.** Significant public funds were made available to help support the new business models aimed at replacing old technologies with new. For example, a massive cash prize was offered for a technological solution for addressing emissions from air travel, resulting in cost-effective solar-powered aircraft.
- **Electro-mobility became the norm by 2030.** R&D support encouraged vehicle producers to invest heavily in innovation in the decade up to 2020, followed by price signals to force the mass roll-out of electric vehicles from 2020-2030. In 2030, bans were enforced on conventional road vehicles.

Agriculture and land use

- **Major CAP Reform.**⁹ Direct payments more equitably distributed among EU Member States, but significantly lower overall and only where the crop/animal product meets a carbon intensity performance standard. Significantly greater relaxation of trade barriers. Additional environmental service/benefit payment phased in by 2018.
- **Organic farming measures to achieve 75% organic production in the EU.** By regulation the share of organic farming increased significantly, but less aggressively than in scenarios 1 and 4, by 2.2% every year (from 2007 baseline of 4.1% in the EU 27) to 28.6% in 2020 and up to 75% in 2050.

Trade and geopolitics

- **Extra-EU investment in low carbon development.** Large-scale investment early on (2015-2025) via robust funding mechanisms (akin to an enhanced Global Environment Facility (GEF)) in low carbon development and decarbonisation in emerging economies and developing countries had a major effect on decoupling economic growth from consumption of natural resources . A global governance structure has provided the framework through which private and public funds were mobilised, rather than at national level.
- **Zoning of global production.** The EU introduced a policy of preferential trade with countries with the lowest footprint intensity for each product group. Combined with the technological efficiency breakthroughs, Europe's own manufacturing sector realised a "green tech revolution" enabling EU manufacturers to compete with cheaper, less green products from outside the EU.
- **Sustainable fish & fish products policy.** Measures were taken to restrict imports of certain species or from countries with unsustainable fishing practices, including quotas and import bans of certain species, and a requirement that all imports of certain species contain certified sustainable fisheries eco-labelling (Measures coupled with generous sustainable fisheries foreign aid).

⁹ In this scenario, the architecture of the CAP is conceptually in-line with Option 2 of the CAP Towards 2020 EC Com.

Scenario 3 – Breaking Point

DRIVERS:

Quantity-driven mindset towards development & technological stagnation

ASSUMPTIONS:

The following assumptions about society help to form a picture of what life would be like for Europeans in 2050. These assumptions also inform the consideration of the policy measures needed in this Scenario to reach the One Planet Economy goal:

- Technology existing in 2011 continues to spread through industry, energy delivery, housing etc., but with little new innovation after 2011 compared with Scenarios 1 and 2. This results in improvements in carbon efficiency of production (amount of carbon released per unit of output) of about 1-2% per year up to 2020, with no further improvement beyond that date.
- Despite strong measures to invest in R&D, these measures do not result in as much innovation as in Scenarios 1 and 2.
- The rest of the world improves the efficiency of production to catch up with EU levels of efficiency, but not beyond.
- Due to stagnation in the rate of technological innovation, most of the reductions in per capita resource use and carbon emissions must come through changes in consumer behaviour – either through reduced consumption resulting from higher prices, or smarter less-resource intensive consumption.
- The EU must take strong measures to limit population growth both in Europe, but more importantly in the rest of the world in the face of increasing demand at a time when technological innovation is stagnant and global shortages (e.g. of fossil fuels and agricultural land) are pushing up prices. In some European countries, life expectancy stagnates; in others it falls.

LIFE IN EUROPE IN 2050

The global struggle for increasingly scarce energy and raw materials resources needed to meet spiralling demand is the dominant theme of life in this world.

Eventually, uncertainty shocks¹⁰ force the people of this unwilling world to decrease their consumption levels – this is done by the imposition of draconian government measures. These shocks, which became more frequent in the first quarter of the century, halted investment and resulted in a series of deep recessions. Also becoming more intense with decreasing resilience to their effects, these shocks inflated inequality in an already tense and conflict-prone world. Trade barriers are becoming the norm again as countries fight to protect the resources they have. The industrialised and emerging countries of today fight to protect their large tracts of land in developing countries which they bought to secure resources and food production. Armed conflicts have become more numerous and international cooperation is limited to securing resources rather than promoting global sustainability.

¹⁰ For example, an uncertainty shock might involve an unanticipated global military conflict, which results in the energy needed for transportation systems to move food around the EU, or provide heating during winter months not being available for a long period of time.

In this future, European society is strongly divided and work-obsessed. There is a large social gap between the very few who can still afford affluent lifestyles and the masses that have been forced to significantly reduce their overall levels of material consumption. The impact of increasing prices for materials, products and services means that people have not seen significant increases in real wages for the last four decades. To compensate, people work long hours and many are unable to take even short holidays. The average age of retirement has increased significantly.

Many Europeans are employed in service industries, since manufacturing and primary industries are increasingly constrained by resource shortages. Aside from agriculture, sectors such as education, financial services, media, marketing, restaurants, hotels, and caring professions are major employers. A shift in taxation from labour to resources favours employment in the agriculture and services, although some manufacturing remains, especially for high-quality goods. A large pool of low skilled immigrant labour supports, but does not dominate, the agricultural sector. Women working at home or in occupations that were previously not counted as part of the official labour market are now included in the workforce due to the expansion of the boundaries of the economy to include traditionally non-GDP contributing care-giving professions. Education and knowledge services have become some of the most important sources of EU export earnings, being one of the few industries that can deliver GDP growth with minimal environmental degradation and result in a “greening” of the economy. Those Europeans who can afford it, receive a high quality, but extremely tailored education, which is highly focused on vocational training to produce a superior skilled service workforce.

Energy prices are high. Since 2025, the availability of fossil fuels has been strongly constrained by surging demand in the powerhouse economies of China, India, Brazil and other rapidly developing economies with large populations such as Indonesia and Nigeria. In Europe, like many countries around the world, alternative technologies were not deployed quickly enough to avoid energy shortages, resulting in numerous energy shocks. It is not until these supply-induced shocks impact on the quality of life of average people that meaningful demand-side policies are implemented. Energy and fossil fuels are taxed heavily – both via the highest carbon prices of all scenarios and aggressive “at the pump” petrol taxes. These act as strong drivers to spread the use of the best technological solutions existing in 2011, but also push up prices which many consumers cannot afford to pay.

Energy rationing becomes the norm. The rich, however, can afford to pay the upfront capital investments required to save energy (in their homes through efficiency renovations and by purchasing “best practice” products, and vehicles that run on biofuels). Many of the poor cannot afford to pay the up-front costs of these goods and must use their energy ration sparingly. Due to high electricity prices, many poor opt to sell portions of their rations to the wealthy, as they cannot afford to pay to consume their entire ration. As a back stop to control consumption, smart metering technology is increasingly used to cut off customers from non-critical electricity use, along with civil and criminal penalties for exceeding rations.

Electricity production is high along the coastlines of Northern Europe, where offshore wind energy has proliferated, but in other regions there are limited alternatives to replace fossil plant on a large scale (e.g. CCS never becomes viable). Solar energy is the main renewable energy source in Southern Europe, although it remains expensive.

Nuclear power is an important part of the energy mix in Europe, particularly in regions with few alternatives. Europe has to import significant amounts of energy from beyond its borders than in scenario 2. Because of the lack of innovation in electric vehicles and powerful agricultural lobby, liquid biofuels have to play a much more significant role (including EU production and imports from developing countries) as does the use of public transport and bicycles instead of cars. Biofuels, however, are heavily regulated and the use of first generation biofuels is significantly restricted to avoid impacting further on food prices and climate change through rainforest destruction.

There is a strong emphasis on European food production. A respectable percentage of this production is organic, but most production utilises conventional intensive farming practices so that more food can be produced per acre, while at the same time using less water, nutrient, and fertilizer input as possible. Food which cannot be produced domestically is largely imported from tracts of EU-owned land located in poor countries or from countries with which the EU has bilateral trade deals that require trading partners to implement population control measures. As a result of a global trend in intensive farming expansion, monocultures are spreading across the world, and there is a significant loss in biodiversity.

Industry is more labour intensive and less resource and energy intensive, due to continuously rising resource prices and shortages of critical materials for high-tech industries and renewable energy technologies. Existing technology is utilised to its fullest, thanks to a concerted effort by business to create a closed loop economy. Despite massive R&D investments, resource efficiency could not be improved significantly beyond the gains achieved through existing technology due to a lack of successful innovation. As a result of the resource constraints in this world, companies are forced to focus on the production of low impact goods and services with high added value but low material intensity. Competition among firms remains fierce and the pursuit of shareholder profits dominates over stakeholder values.

Prices for goods and services are generally high, especially for those products with a high impact on the Footprint family of indicators. Despite the few who are able to consume at today's level of intensity, excessive resource consumption and energy use is increasingly no longer seen as socially acceptable by the majority of people. Consumption for these people is characterised by a preference for goods and services with low resource intensities and which are highly recyclable because they are much more affordable. Quality is thus actively demanded and marketing places emphasis on durability, service, and green/sustainable credentials as selling points. Super resource-efficient high tech goods become status symbols, as does the consumption of knowledge and education, and in particular leisure activities, and social networks, all of which require spare time, an ever scarcer commodity.

Nearly every aspect of life is heavily regulated by the state. Because of the slow pace of lifestyle changes in the early years of this scenario, the adoption of sustainable lifestyles needs to be continually reinforced by government policy in the later years leading up to 2050. In 2050, Europeans are forced to adopt "green" lifestyle habits– for example, via bans on non-essential individual long distance travel. By this stage, air travel has long been too expensive for the majority of people. The state controls or heavily influences all available channels of education, media and marketing to spread this message to continually reinforce its adoption and mould perceptions of "sustainability." Civil society also plays a role in selling the message of green lifestyles as a means to

achieving “green” growth. Excessive resource consumption and energy use is no longer seen as socially acceptable.

Most Europeans live in densely populated urban areas in compact, efficient living quarters. Most households are comprised of three or less family members. Living quarters are modest, energy efficient, and contain smart meters which enable utilities to control load and the state to monitor use, enforce rations, or cut off electricity if necessary. Recycling and waste reduction measures are high, as households pay high taxes on land filling waste and are heavily penalised when per capita waste quotas are exceeded. Most travel, when possible, is done by high quality public transport (including an extended network of high-speed trains) and non-motorised transport. Where car use is unavoidable, car pooling is wide-spread because of congestion charges in inner city areas and unaffordable petrol prices and rationing. Because of soaring prices, and eventually due to the ban on non-essential air travel, Europeans rediscover the beauty of their own and neighbouring countries. Guided bike tours and other non-motorised forms of tourism are very popular.

Europeans have not seen significant improvements in their health. While no concerted effort is made to improve public health, dietary changes that have increased vegetarianism, and increased levels of cycling and walking have delivered some health benefits. In terms of food, European citizens eat less meat and dairy (due in part to high prices) and spend money on a smaller amount of higher quality food. The wealthy can still afford the high prices of meat, fish and other animal products. Overall, however, life expectancy has stagnated due in part to increasing working hours.

EUROPE’S POLICY MIX TO A ONE PLANET ECONOMY BY 2050

Broad economic policies

- **Economic reform.** With growth in GDP as a high societal priority in this scenario, significant economic reform measures were not pursued other than measures aimed at increasing competition among firms (market liberalisation, deregulation, privatisation and other measures to prevent anti-competitive practices). Instead, policies in this scenario leaned heavily on measures to compensate for the lag in technological innovation. One major change, however, has been a shift in the tax burden from labour to resources. This both protects increasingly scarce resources but also allows for cheap labour to produce labour intensive rather than resource intensive products and services.
- **R&D investment policy.** Building on policy recommendations existing in 2011, the EU mandated (effective 2015) that Member States invest in R&D the equivalent of 10% GDP each year and increase total R&D energy subsidies at a rate of 8% every 5 years.
- **Coordination of innovation-technology agencies.** A coordination framework was established early on to enhance EU-Member State collaboration in implementing the Environmental Technologies Action Plan (ETAP), the Competitiveness and Innovation Framework Programme (CIP) and other programmes fostering eco-innovation. Eco-innovation was focused on “low hanging fruit” sectors where large environmental improvements could be made quickly (i.e., buildings, food and drink, recycling and waste water industries, private transport). Funding of ETAP and CIP was doubled to spur innovation.

- **Cash prizes.** Cash prizes to reward technological solutions in this scenario are more aimed towards stimulating innovation in the utilisation of existing technologies compared with supporting the breakthroughs achieved in Scenario 2.
- **Technology diffusion tax breaks** Tax-incentives for rapidly improving the rate of diffusion of low energy technology developed by 2011 throughout the economy to increase the energy efficiency of buildings and encouraging uptake of on-site renewable generation options were also key in this scenario. The effects of these were short lived, however, as once all the pre-2011 technology had diffused through industrial and municipal infrastructure few new gains were to be made.

Welfare, labour, and income taxation

- **Wages & income.** Unlike Scenario 1, no minimum “living” wage was established, which kept businesses competitive and provided strong economic growth connected to labour intensive production of higher quality goods and services.
- **EU Working Time Directive.** To allow employers greater flexibility (in hiring and firing staff, making use of casual, seasonal and immigrant labour), there were no further restrictions placed on working hour limits beyond what existed in 2011 and worker protection laws were wound back. In a phased-in approach beginning in 2015, the retirement age was gradually raised to 73 by 2030. This caused considerable conflict and social tension across the EU.
- **Women at Work measures.** To increase individual contribution to the economy, generous tax breaks and grants were provided to employers to increase participation of women in the workforce (through direct hiring and professional development and mentoring programs), especially in the information and communication technologies (ITC), computing, media and marketing sectors.
- **Economising care-giving services.** In this scenario, there has been a shift away from manufacturing toward services, except for critical goods manufacturing remains in Europe or in EU-owned land in poor countries. Beginning in 2015, to transform traditionally unpaid forms of care-giving work into GDP-contributing economic sectors, new regulations required recipients of “free” childcare services to report the fair market value (FMV) of these services as income, with the only exemption being services provided by members of the immediate family (i.e., parents, siblings or others that live in the family unit) or alternatively, that all non-exempt childcare service providers are paid market wages for their services. These policies encouraged placement of children under professional care and increased economic activity related to this sector.
- **Demographics.** Beginning in 2012, one of the measures taken to control population growth was to phase-out child benefits for multi-children families. By 2020, benefits were only provided for up to a maximum of 2 children. As the economy in general has become more labour intensive, immigration policies were relaxed in order to attract low skilled labour, especially for the agriculture sector. This further adds to social tension in the EU. Bilateral trade deals require trading partners to implement population control measures.

Education, health, media, and culture

- **Education reform.** Europe’s education system was completely reformed by 2020 to focus on education and knowledge based service careers. By 2030, education was largely privatised to allow export of education as a service. This resulted in higher costs of education, further adding to the social tensions of this Scenario.

- **Special education measures: lifestyle and food-choice coaching.** By 2020, free lifestyle coaching was provided to citizens to encourage behaviour change to a more sustainable lifestyle. By 2015, large-scale and long-term food education initiatives to teach the impact of food choices on the surrounding environment to and good nutrition, encouraging adoption of vegetarian and low animal product consumption, with a strong focus on elimination of meat from the diet.
- **State media policy.** By 2020, most media outlets were tightly controlled by the government and used to try to manage behaviour change, selling the "cool to play within the limits" and "green means growth" messages.
- **Health choices.** In 2015, voluntary and assisted suicide became legal in all EU countries.

Consumption and waste

- **Personal carbon and emissions allowances (PCEA) scheme.** As in Scenario 2, this scheme was introduced in 2015, with every person given an annual carbon allowance card with a credit of 3000 kg CO₂. The size of the cap was reduced more aggressively compared with Scenario 2, reaching 1500 kg by 2025. In this Scenario, the rich typically purchase allowances from the poor to help fund their more lavish lifestyles, resulting in many poorer people being forced to all but curtail their use of air travel and other high-carbon intensive goods and services.
- **Footprint Tax.** Introduced in 2015, the Footprint Tax in this scenario was significantly higher than in other Scenarios. By 2050, over 100% of a product or service's value was taxed. Unlike the other Scenarios, the "triple incidence" of the footprint tax, the personal carbon cap and the EU ETS was seen as being necessary to curb carbon-intensive consumption in this Scenario.
- **Advanced Eco-labelling scheme.** Advanced labelling regulation was implemented which provided better energy/environmental performance information and covered more products to further facilitate "Smarter Consumption."
- **Meat Tax.** A tax on meat was introduced in 2015 (100% surplus on the market price) and rose to 200% in 2040. Only the rich were able to afford to eat meat regularly.
- **Reduction of waste collection services.** Compared with other scenarios, the obligations on municipalities to reduce waste collection needed to be even tougher (due to stronger demand), and an even more aggressive tax on municipal waste by weight was introduced (beginning with a 50% surplus on municipal waste fees and increasing to 100% by 2040).
- **Required door-to-door recycling collection.** In 2015, municipalities were required to offer door-to-door recycling collection on a weekly basis (apartment buildings excluded), and heavy penalties were introduced for non-compliance, resulting in an immediate additional decrease of waste generation.
- **Tax benefits for repair and reconditioning services.** The new business of repairing and reconditioning electronic goods was encouraged via tax benefits. As a result, people keep electronics longer and the intensity of their consumption is thereby reduced.

Industrial policy

- **Raw material taxation.** Compared with Scenario 2, competition for scarce resources is an even greater feature of this world. Because of the lower level of global cooperation and the re-emergence of trade barriers, it was not possible to negotiate a harmonised approach to raw material taxation. Instead, raw materials are taxed within the EU and a similar tax is imposed on imported products and raw materials, with this tax needing to be ramped up more aggressively than in Scenario 2, reaching 40% by 2040.
- **Environmental accounting measures.** Industrial codes have forced companies to include environmental factors in their financial accounting and to transfer costs to the price of the end product. Rule of Supply Chain Optimization to minimize resource inputs (e.g. Benchmarking scheme in the industries with required efficiency improvements of 10% every 5 years).
- **Product bans.** Harder measures were needed in the second half of the time period to “ban” the most inefficient products from the market to account for higher growth. These were coupled with product efficiency initiatives, such as a “top runner programme”, in which all products in a specific category are regularly tested and the most efficient model becomes the new baseline.
- **Expansion of extended producer responsibility (EPR) obligation beyond Waste Electrical and Electronic Equipment (WEEE) directive 2002/96/EC.**¹¹ The list of applicable priority products under WEEE was expanded to include all products composed of 25% or greater plastic, 25% or greater metals, as well as all products containing any mercury, batteries, all medical products, and all carpeting.

Water resources

- **Full cost recovery water pricing.** (Financial, resource and environmental costs). Under the EU Water Pricing Directive, Member States are required to ensure full cost recovery water pricing in household, agricultural, and industrial (including mining) sectors. Under a stepwise increase between 2015 and 2050, average water pricing for public water/wastewater services in non-water scarce EU regions is 8 EUR/m³; in water scarce regions, it is of 11 EUR/m³.
- **Water pricing and removal of water-related energy subsidies.** Existing water pricing subsidies for industries and agriculture were eliminated and refocused on water efficiency R&D (up to 50% by 2030; 100% by 2050). Energy subsidies for pumping, treating and distributing water were also removed.
- **Measurement of water intensive products.** A water intensity labelling scheme was introduced (for non-food goods) to raise consumer awareness and support retailer pressure on the supply chain to provide less water-intensive products. The labelling includes a measurement of both water and carbon footprints of products, to prevent negative trade-offs. This was coupled with a quota that slowly phased out the production of low-value, water intensive goods.
- **Greywater use measures.** Obligatory grey water reuse for low quality purposes (toilet flushing, etc.) to increase grey water reuse by 5% every 10 years until 2050.

¹¹ See, e.g. “Priority products and materials report” at <http://www.unep.org/resourcepanel>.

Energy and transport

- **Power station efficiency standards.** Extremely tough efficiency improvement standards were enforced on existing coal and gas-fired power stations from 2015 onwards, partly because of fear that new technologies would not fall in cost as rapidly.
- **Fossil fuel taxes.** Most substantial increase in fuel taxes “at the pump” to drive vehicle efficiency improvements, stimulate sustainable biofuels uptake and reduce consumption since the breakthroughs in electric mobility and other technologies was not as successful in this Scenario. These types of measures were applied to the entire transport sector (e.g. the aviation sector was forced to use biofuels, significantly increasing its costs). Individual transport (via road, air etc) becomes unaffordable for many people.
- **Carbon pricing.** Despite the efficiency standards imposed on power stations, carbon prices spiked rapidly (e.g. reaching towards 100 EUR /tonne by 2020) due to the lower pace of technological innovation on key technologies including large-scale renewable energy (e.g. CSP) plant and advanced fossil fuel plant incorporating CCS. Expensive nuclear power has the greatest role in this Scenario, adding to social tension in many countries. The high energy prices cause an affordability crisis for many consumers. From 2020 to 2030 a softening of emissions credit import restrictions was implemented under the EU ETS to try to push down carbon prices to soften impact on European industry and households. The worsening trade and geopolitical relationship with the rest of the world (see below) made this approach rather ineffective. Energy and emissions-intensive goods and services remained expensive throughout the period.
- **Energy retrofit subsidies.** Massive government subsidisation of energy efficient building retrofits and strong enforcement of building retrofitting standards were introduced from 2030 onwards after a series of devastating energy shocks to address the lack of technological solutions on the supply side (and hence drive emissions reductions via lowering demand).

Agriculture and land use

- **Major CAP Reform.**¹² Direct payments have become more equitably distributed among Member States, but significantly lower overall and only where the crop/animal product meets a carbon intensity performance standard. There was some elimination of market intervention measures and trade barriers, but not to the same extent as Scenario 2. Additional environmental service/benefit payment was phased in by 2018.
- **Organic farming measures to achieve 50% organic production in the EU and extra-EU controlled lands.** By regulation the share of organic farming increased significantly, but less aggressively than in all other scenarios, by 2.2% every year (from 2007 baseline of 4.1% in the EU 27) to 28.6% in 2020 and up to 50% in 2050. To meet the 50%, the EU purchased land located outside of the EU 27, mainly in developing countries, for the purpose of organic farming and other food production.

¹² In this scenario, the architecture of the CAP is conceptually in-line with Option 2 of the CAP Towards 2020 EC Com.

Trade and geopolitics

- **Trade policy to control consumption impact of imports.** Trade has been limited with countries with no population control measures. Moreover, trade is restricted, through caps and quotas and high tariffs, with respect to the most harmful product sectors on the footprint indicators (e.g. (1) chemical, rubber, and plastic products; (2) electronic equipment; and (3) machinery and equipment). Bi- and multi-lateral negotiations are most aggressive towards trading partners who produce these products (China, the United States, and the Russian Federation) to maximise the rate and impact of reduction caused by these and other sectors. Partners who refuse to lower impacts are replaced by willing trading partners.
- **Carbon tax.** A tax was imposed on the carbon content of all fuel imports (coal, oil and gas), with the level pegged to the carbon price of the EU ETS. The tax thus reached 100 EUR/tonne (of upstream emissions) by 2020. It then fell as a result of measures to drive improvements in energy efficiency on both the supply and demand side, and the availability of alternative fuels (e.g. due to large-scale biofuel production) improved.
- **Sustainable fish and fish products policy.** Measures were taken to restrict imports of certain species or from countries with unsustainable fishing practices. This included an import ban and quotas for certain species and a requirement that all imports of certain species be certified as sustainably sourced.

Scenario 4 – Slow Motion

DRIVERS:

Quality-driven mindset towards development & technological stagnation

ASSUMPTIONS:

The following assumptions about society help to form a picture of what life would be like for Europeans in 2050. These assumptions also inform the consideration of the policy measures needed in this Scenario to reach the One Planet Economy goal:

- Quality of life is prized over economic growth and increasing income.
- Prices act as a strong driver towards resource efficiency and sufficiency.
- Values have become less materialistic. Companies and consumers are driven by a quality and community development-orientation instead of profit maximisation.
- Technological innovation in the efficiency of resource and energy use and in the development of alternative energy sources is limited.
- Due to the stagnation in technological innovation and changing societal expectations, collaboration and knowledge sharing have become more important forces than competition in the business world.
- Social innovation¹³ is highly dynamic and proves successful in increasing human capabilities, welfare and environmental sustainability.

LIFE IN EUROPE IN 2050

Most Europeans have embraced frugality, simplicity and sustainability as key elements of their lifestyle. Most Europeans live in cities in socially innovative modes of housing such as co-housing communities, urban co-ops and communes. Urban sprawl has thus declined. Some self-sufficient communities have moved back to the countryside, and many people have developed the green areas of the cities for cultivation. In general, social status across society is gained from immaterial goods such as education, culture and social networks. The education system takes a holistic approach to learning, in which self-awareness, environmental awareness, spiritual and community values play a key part.

The EU's economy is reflective of its values and has become famous for its Beyond GDP approach, which is also being promoted in the rest of the world. When people do make purchases, prices for goods and services are comparatively higher than 40 years ago, as they now reflect the true costs of social and environmental externalities. Most people prefer to share or lease many durable goods that were previously individually owned. Further, roughly half of Europe's population shuns consumerism altogether and adopted the more extreme **lifestyle of voluntary simplicity—LOVOS**. These large groups form strong local communities and are often completely self-sufficient. Due to the large segment of LOVOS, energy and resource use has declined dramatically over the past 40 years despite lagging technological advancements.

¹³ A social innovation is a novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals (Phills, et al., 2008, p. 36).

Average wage-based working hours are roughly half as long as they were in 2011, since a large segment of the population has significantly reduced its demand for goods and services. In terms of social values, work and money are less important, whilst building social relations and participating in community activities are high priorities. The reduction in working hours has also contributed to a significant reduction in resource use, as Europeans earn, produce, and consume less. Income disparity is also smaller than in 2011, with much less deviation between the wealthiest and the poorest. Every EU citizen spends at least two years of life (not necessarily consecutively) in compulsory paid community service (in hospitals, kindergartens, retirement homes, etc). This fosters the strength of communities and the non-profit and non-governmental sector.

Cooperation and knowledge sharing are more important than competition in business strategies. Firms are expected to maximise community values by their shareholders, who come from a broader societal base than in 2011, are more risk averse, and do not expect very high return on investments. Moreover, there are an increasing number of employee-owned companies. Using technologies that were available in 2011, networks of industries help to decarbonise the economy. Following the early example of the industrial ecosystem in the Danish industrial zone of Kalundborg¹⁴, different firms work together by exchanging materials and energy for mutual benefit, on the basis that by-products from one business can be used as low-cost inputs to the others (the “zero-waste” production loop). The use of best available technologies is being maximised, largely driven by the high prices for all kinds of materials, including energy. Over the course of a product’s lifetime, it is likely to be transferred from the original purchaser to numerous owners or hirers through shared ownership, reuse schemes and hire or lease shops. Products are designed to use fewer scarce resources, to last longer, and – if they cannot be reused - are easily recyclable.

The average European walks, rides a bike or uses excellent public transport. Getting around in Europe, especially in the cities, is easy, thanks to well-connected networks of light rail lines and buses powered by renewable energy sources, bicycle lanes as well as safe and well designed footpaths. Cars are very expensive to use and individual ownership is shunned by most people, while public transport is strongly subsidised. Car sharing is widespread, but in general there are far fewer cars on the road in Europe compared to 2011. Electricity is largely generated from renewable technologies that were available in 2011. Significant reductions in consumption result from lifestyle changes, the removal of inefficient products from the market and industrial remodelling as described above. This strong demand side effect, combined with the increased utilisation of decentralised energy production, make it possible to shut down most centralised power generation facilities by 2050. The utilisation of local renewable energy resources for small-scale production of electricity, heat and cooling is widespread (be this via wind, solar, bioenergy, geothermal etc).

The policy frameworks governing the agricultural sector as well as consumer demand have created strong incentives for organic farming and permaculture systems. Even though the land area used for agriculture has steadily increased over the

¹⁴ In Kalundborg, an industrial ecosystem was established which involves inter alia an oil refinery, a glyproc factory, a pharmaceutical firm, a fish farm, a coal-fired electrical power station and the municipality of Kalundborg. Steam and various raw materials such as sulfur, fly ash and sludge are exchanged in a very elaborate industrial ecosystem. Participating firms benefit economically from reduced costs for waste disposal, improved efficiencies of resource use and improved environmental performance.

past 40 years, overall environmental impact (measured by the Footprint family of indicators) is low, due to the substantial decline in resource inputs for farming and the dramatic decrease in meat and animal product consumption. There has been a gradual move from conventional agriculture and (industrial) livestock operation towards plant-based, labour-intensive and organic agriculture. The share of organic farming is nearly 95%. Thanks to the spread of permaculture systems, wastes are turned into resources, productivity and yields are high, and natural environments have been restored. GMO crops are no longer used or consumed in the EU. GMO crop import bans have resulted in a significant global reduction in the use of GMOs, which in turn has enhanced crop biodiversity and food security.

At the international level, global, peaceful agreements ensure convergence of emissions and on the sustainable and equitable use of resources. A new international consensus was reached to ensure that international trade would contribute to a global One Planet Economy. The regime is built on three guiding principles: (1) trade based on environmental competitive advantage; (2) fair trade; (3) localisation¹⁵. No trade barriers exist for best available technologies in terms of resource and energy efficiency. As a result of large-scale dematerialisation, the EU was able to diminish its overall dependence on imports of goods and services to become more self-contained.

EUROPE'S POLICY MIX TO A ONE PLANET ECONOMY BY 2050

Broad economic policies

- **Economic reform.** Given the strong societal drive to shift into a quality-driven development paradigm, EU economic policy transitioned to a Beyond GDP model. This was aided by the early adoption (2012) of sustainability indicators for monitoring economic progress. To support this, Europe embarked on a broad policy of ensuring that the true social and environmental costs of producing and consuming all goods and services are reflected in prices.
- **Monetary policy reform.** European monetary policy is strongly aligned with the objectives of the One Planet Economy. The European Central Bank and the National Banks took on a role designed to steer the European economy towards a path consistent with the One Planet economy goals.
- **R&D investment policy.** As in scenario 3, great emphasis was placed on efforts to compensate for the lag in technological innovation. Building on policy recommendations existing in 2011, the EU mandated (effective 2015) that Member States invest in R&D the equivalent of 8% GDP each year and increase total R&D energy subsidies at a rate of 7% every 5 years – percentages that are slightly lower than in scenario 3.
- **Coordination of innovation-technology agencies.** A coordination framework was established early on to enhance EU-Member State collaboration under the Environmental Technologies Action Plan (ETAP), the Competitiveness and Innovation Framework Programme (CIP) and other programmes fostering eco-innovation. Eco-innovation was focused on “low hanging fruit” sectors where large

¹⁵ Economic localisation actively favours more local production and investment whenever it is reasonable and conveniently possible. With a focus on co-operation for the best, rather than competition for the cheapest, localisation aims to rebuild sustainable national and local economies worldwide. Depending on the size of the country, “local” can both refer to a country, which may aim for increased self-reliance within its own borders, or to a grouping of smaller, neighbouring countries. For a more detailed account of localisation, see for example Woodin and Lucas (2004).

environmental improvements could be made quickly (i.e. buildings, food, recycling and waste water industries, private transport). In this scenario ETAP and CIP are funded through public and private investment in R&D.

- **Relinquishment of IP protections.** Due to technological stagnation, collaboration and the sharing of intellectual property has become necessary and culturally accepted. Public buy-outs effectively removed IPR barriers to the wide diffusion of best available technologies. The EU Technology Altruist Prize – a non-cash prize – was created to reward technological innovations which were released into the public domain for the benefit of society with no IPR protections.

Welfare, labour, and income taxation

- **Wages & income.** In 2015, an EU-wide directive required Member States to adopt a guaranteed minimum “living” wage, which included an annual local adjustment with the goal of normalising wages across the EU over time. Annual adjustments were also made to coincide with phased-in limits on weekly working hours (by 2040, maximum working hours was capped at 20 hours per week). This policy also included a requirement that all EU citizens perform 2 years of community service, at minimum “living” wage. In addition, a progressively higher marginal taxation on income earned in excess of the guaranteed “living wage” was implemented, also beginning in 2015. The end result in this scenario is that wages are much more normalised across the EU, with much less disparity between rich and poor.
- **Tax allowances for employee training.** Generous tax breaks and grants to employers were instated early on (2015-2025) for employee training and development programs which resulted in increased employee hiring. Allowances are favour in the information and communication technologies (ICT) sectors to foster eco-innovation.

Education, media, and culture

- **Education reform.** Europe’s education system was radically reformed early on (by 2015), shifting focus from the training of purely academic and vocational skills to an education of the whole student.
- **Special education measures.** Beginning in 2012, all European children were taught organic farming methods and permaculture techniques, which could be applied in the urban environment as well as in rural community living. Additionally, a food supply chain education initiative taught the impact of food choices on the surround environment and encouraged the adoption of vegetarian and low animal product consumption with a strong focus on consumption of local foods.
- **Health system reform.** There was early investment in the expansion of preventative, proactive, and holistic medicine, with strong influence from traditional knowledge and ancient health systems.
- **Media policy.** Use of media for awareness-raising campaigns—to inform and reinforce social ideals of sustainability: pressure against very high personal incomes, emphasis on sparing resource use, fair trade and organic products.

Consumption and waste

- **Footprint Tax.** In this Scenario, the Footprint Tax (reflecting the Ecological, Carbon and Water footprint of the product or service), needed to be higher than in Scenario 1, due to the lower level of technological innovation. The tax reached up to 85% of the product's value in 2050. As a result, the consumption of electronic goods, for example, is very low in this scenario. There is a wide culture of repair and reuse, reinforcing a strong closed loop economy.
- **Advanced labelling.** Labelling and pricing of resources, goods and services has taken into account the environmental and social harm caused during extraction, production and use, including impacts on biodiversity, ecosystem services, air and water quality, and scarcity of finite resources.
- **Household waste measures.** As in Scenario 1, the EU required that Member States encourage municipalities to reduce waste collection services to a biweekly instead of a weekly scheme and to offer door-to-door recycling collection on a weekly basis. This reduction in services resulted in an immediate 20% reduction in the amount of household waste generated and had a longer-term effect of fostering a culture of zero waste households.

Industrial policy

- **Raw material taxation.** Similar to Scenario 2, an international agreement made it possible to harmonise the taxation of raw material inputs with the highest environmental impact. The shift in focus towards the Beyond GDP model in this Scenario meant that the tax rate did not have to reach as high a level (reaching 20% by 2040).
- **Carbon taxes.** In this Scenario, the general trend away from the emphasis on markets and private sector competition results in a carbon tax system being introduced to replace the EU ETS as the main carbon policy instrument. In addition to the carbon footprint tax imposed on products and services (described above), carbon taxes were imposed on many industrial sectors at the point source of emissions from 2020 onwards to drive efficiency improvements and the diffusion of alternative technologies where available.
- **Recycled content purchasing regulation.** Beginning in 2020, a wholesaler and retailer purchasing obligation mandated that products must contain a minimum of 20% recycled materials (increased to 50% by 2040).

Water resources

- **Full cost recovery water pricing.** (Financial, resource and environmental costs). Under the EU Water Pricing Directive, Member States are required to ensure full cost recovery water pricing in household, agricultural, and industrial (including mining) sectors. Under a stepwise increase between 2015 and 2050, average water pricing for public water/wastewater services in non-water scarce EU regions is 7 EUR/m³; in water scarce regions, it is of 10 EUR/m³.
- **Water pricing and shift of water-related energy subsidies to R&D.** Agriculture and industry voluntarily redirected water pricing and energy subsidies to R&D.
- **Scarcity & drought bands and quotas.** Imposed during the summer season and during any other times of water scarcity and drought in water scarce regions to reduce average per capita water consumption to 300 m³/ year. An additional ban on water cooling restricted power generation in Southern Europe and England to dry cooling only.

Energy and transport

- **Tax breaks** were offered early on to incentivise building retrofits and the adoption of small-scale on-site renewable generation options.
- **Phase out of inefficient appliances.** The adoption of frugal lifestyles and energy conservation played a major role in this scenario – energy policy measures were generally designed to reinforce these trends. The worst-performing energy using appliances were rapidly taken out of the market early on (e.g. from 2015 onwards via the combination of consumer choice and Member State regulation).
- **Carbon tax replaces cap and trade.** The EU ETS was increasingly seen as being part of the “old way” (free-market and competition-based model). After 2020 it was decided that other measures were to become the focus of the EU’s climate policy, including a carbon tax system imposed on heavy industry and electricity generation. The carbon tax was set at a relatively strong level (e.g. 40 EUR/tonne CO₂-e) in 2020 and was combined with other policies such as efficiency standards.
- **Efficiency standards for power generation.** No new coal fired power plants were permitted from 2012, and emissions standards were introduced to force existing plants to improve their efficiency in countries with high levels of thermal generation such as Germany, Poland and the Czech Republic.
- **Phase out of coal.** Coal was eventually phased out altogether by 2040 – largely made possible by the significant reduction in demand from the dematerialisation of European lifestyles and the shift away from heavy industrial production. Decentralised electricity generation utilising local renewable energy resources and technology already available in 2011 played a major role in enabling this shift.
- **Energy efficient building retrofits.** Buildings renovations were supported initially by obligations on utilities, which become more community-owned and focused on energy-services provision. Because of the changing trends there was less need for mandatory retrofitting compared with scenario 3.
- **Transport emission standards.** Transport emissions were largely reduced by the significant reduction in demand. Tough emissions standards were imposed early on, but took longer to achieve than in Scenarios 1 and 2. The electric mobility revolution did not happen, but rather there was a greater emphasis on efficiency improvements, sustainable biofuels and a major change in the way society views transportation (for example, a greater reliance on sharing of transport assets, high utilisation of public transport and limited long distance or leisure travel).

Agriculture and land use

- **Radical CAP Reform.**¹⁶ Phase-out of direct payments by 2018; some market measures abolished (CAP export subsidies). Market intervention measures and trade barriers resulted in the internalization of social and environmental externalities of agricultural imports.
- **Environmental service/benefit CAP payments phased in by 2018.** Rural development measures focus on reducing agricultural impact on carbon, water and ecological footprints through forestry and land management innovation and preservation of pastoral and natural landscapes through stewardship aid.

¹⁶ In this scenario, the architecture of the CAP is conceptually in-line with Option 3 of the CAP Towards 2020 EC Com.

- **Organic farming/permaculture measures to achieve nearly 100% organic or permaculture production in the EU.** Organic farming assistance subsidies (independent of CAP payments) were introduced in 2012 with 400 EUR/ha and were then reduced to 300 EUR/ha in 2020 and 200 EUR/ha in 2030, 100 EUR/ha in 2040.

Trade and geopolitics

- **International cooperation on carbon-intensive fuel taxation.** As is the case on the taxation of raw materials, the successful international cooperation that is characteristic of this scenario enables a harmonised approach to the taxation of carbon-intensive fuels, with the tax rate gradually being ramped up to reduce the global consumption of these fuels (coal, oil and gas).
- **Agriculture.** In this Scenario, certain import barriers (tariffs) for fair trade and organic agricultural products have been lowered compared to 2011. Foreign aid has been directed to producers supplying such products (e.g. through the EU SFA programme). However, an internationally-agreed ban has been imposed on commodities with unacceptably high impacts on footprint indicators (e.g. palm oil) and which are not certified to be sustainably sourced. With particular emphasis placed on social welfare, trade agreements have been amended to require strict compliance with worker rights codes (e.g. Ethical Trading Initiative (ETI)).
- **GMO Food Import Ban.** Next to Scenario 1, measures to restrict GMO (food and organisms) products are most extreme in this scenario. An internationally-agreed ban on the trade of GMO products was phased in from 2014 to 2024, such that GMOs were no longer used or consumed in the EU by 2024 and led to a significant global reduction in the use of GMOs, which has enhanced biodiversity of crops and food security. A provision in the ban has allowed the import of GMO in extreme circumstances where food security is in jeopardy.
- **Trade policies which improve efficiency and result in reduced demand for the most harmful products and product sectors.** Available technology was transferred to trading partners and shared as way of maximising efficiency gains, and reducing the impact of the most harmful product sectors (e.g. (1) chemical, rubber, and plastic products; (2) electronic equipment; and (3) machinery and equipment). Trade policies were coupled with education and media campaigns to reduce demand for harmful products, along with international pressure on countries producing these products to institute regulatory reform that resulted in reduced impact on the footprint indicators.

4. Link to current policy initiatives and other scenarios

The activities of the OPEN:EU project are very timely. Project results are being produced as policy-makers are defining the steps needed to meet the sustainable growth goals recently established in the Europe 2020 strategy. At an international level, there is a renewed focus on “green economy” in the run-up to the United Nations Conference on Sustainable Development in 2012 (or Rio+20). This section connects the OPEN:EU project and its scenario development exercise to related European and international policy initiatives and other existing scenarios focused on long term sustainability.

European and global initiatives on resource efficiency and green economy

Europe 2020 – A strategy for smart, sustainable and inclusive growth

With the adoption of the Europe 2020 strategy, the EU has launched a new strategy for stronger economic governance over the coming decade and beyond. Europe 2020 provides a framework for the EU to mobilise all of its instruments and policies and for Member States to take coordinated action on creating smart, sustainable and inclusive growth. Seven flagship initiatives organised under the three banners of smart, sustainable and inclusive growth are the “new engines” that Europe has identified for boosting growth and jobs. Under smart growth are the flagship initiatives for *Digital agenda for Europe, Innovation Union, and Youth on the move*; under sustainable growth are *Resource efficient Europe* and *An industrial policy for the globalisation era*; and under inclusive growth, are *An agenda for new skills and jobs* and *European platform against poverty*. EU and national authorities are to coordinate their efforts within these initiatives to ensure that they are mutually reinforcing.

Of particular interest for the work being undertaken in the OPEN:EU project is the flagship initiative for a resource-efficient Europe. This initiative provides a long-term framework for actions in numerous policy areas, supporting policy agendas for climate change, energy, transport, industry, raw materials, agriculture, fisheries, biodiversity and regional development. In carrying out this scenario exercise, the OPEN:EU project has made a modest first attempt to begin connecting several of the core issues identified in this flagship initiative.

A resource-efficient Europe - Flagship Initiative under the Europe 2020 Strategy

In recognition of the fact that natural resources underpin our economy and our quality of life and that continuing our current patterns of resource use is not an option, the resource-efficient Europe flagship initiative aims to decouple economic growth from resource use and its environmental impact. In doing so, the initiative will support a shift towards a resource-efficient, low-carbon economy to achieve sustainable growth. The OPEN:EU project shares these objectives, along with the explicit goal of achieving a shift of a particular magnitude within a specific timeframe – namely, a One Planet Economy in Europe by 2050.

The EU sees increasing resource efficiency as key to securing growth and jobs for Europe. The European Commission has outlined that it will be necessary to develop new products

and services and find new ways to reduce inputs, minimise waste, improve management of resource stocks, change consumption patterns, optimise production processes, management and business methods, and improve logistics. 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. The OPEN:EU scenarios begin to explore precisely these types of changes and the associated policy effort needed to bring them about.

With the help of the EUREAPA tool, we will be able to measure the impact of the policy interventions outlined in the scenario storylines on the Footprint Family of indicators.¹⁷ In effect, scenarios will thus provide an opportunity for a first test run of the EUREAPA tool's ability to evaluate the impact of a specific kind of policy effort. Future users of the tool will be able to do so themselves, applying the tool to test whatever policy interventions they wish to define.

The Commission has identified the need for a vision of where Europe should be in 2050 and a long-term policy framework that can provide a clear path for businesses and investors:

"It is important to sharpen the focus on the action that has to be taken in the next ten years to put Europe on the right track and to speed up the transition." (European Commission 2011, 2)

In the OPEN:EU scenario exercise we have started to outline the key elements of a number of different long-term policy paths for the EU to get to a One Planet Economy by 2050. The scenarios take into account the considerable uncertainty facing policy makers today, and try to demonstrate that the quality of life in the world we "arrive in" in 2050 will vary depending on the path we take to get there.

The approach to building a resource-efficient Europe must be "complex and interlocking" (ibid., 4). Policy measures need to be mutually supportive and we need an overview of the synergies and tradeoffs between different priorities, areas and policies. Initiating this kind of an overview has also been the task of the OPEN:EU scenario exercise and is something the EUREAPA tool is specifically designed to support.

The resource-efficient Europe flagship initiative will make use of roadmaps and scenarios to build its long-term framework. A series of roadmaps are being developed in order to ensure that the actions we take now are in fact well coordinated and that concrete actions already decided for 2020 pave the way towards longer term goals for 2050. These roadmaps include the Low-carbon economy 2050 roadmap, the Roadmap for a resource-efficient Europe, and the Energy Roadmap 2050. The Commission will focus its analysis in the resource efficiency roadmap on three approaches – namely: resource prices, costs, and subsidies; resource-by-resource, for example where resources come from and how supplies might change; and sectoral studies – and Commissioner Potočník has indicated that he "attaches more importance to behaviour-changing policies such as green taxes rather than 'reactive' policies that punish polluters" (ENDS Europe 2010).

In order to build up the knowledge base for this initiative and ensure that analysis is based on common assumptions and a shared vision, the European Commission will

¹⁷ This analysis will follow as a subsequent report in the OPEN:EU project.

present joint modelling scenarios up to 2050 on climate, energy, and transport policies. The Commission has already found that modelling is particularly complex due to the fact that resource efficiency requires action in a wide range of areas. Most existing models focus on specific policy areas (e.g. energy and transport) and cannot capture fully the impact of resource use on ecosystems, enterprises, economy and society, or the interdependence of policy measures. The Commission is therefore working to improve its ability to estimate economy-wide impacts and to model in other areas relevant to resource efficiency, such as agriculture, industry and environment.

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.¹⁸

UNEP's Green Economy Initiative

The United Nations Environment Programme's (UNEP) Green Economy Initiative (GEI) also shares some similarities with the objectives of OPEN:EU, scaled up to the global level (UNEP, 2009, 2011). The GEI was launched in 2008 to make the economic, social and environmental case for supporting a global plan for transitioning to a green economy. GEI focuses on making shifts in investment and consumption to "environmentally enhancing goods and services"¹⁹ and it defines a green economy in essentially the same way as the OPEN:EU project has defined a One Planet Economy:

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

"A green economy is one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities."²⁰

The OECD has also worked with a similar understanding in their development of a Green Growth Strategy, which will "elaborate specific tools and recommendations to help governments to identify the policies that can help achieve the most efficient shift to greener growth" (OECD 2010).

¹⁸ 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, 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.

¹⁹ UNEP, 2009: 2.

²⁰ UNEP, 2011: 2.

The Green Economy Coalition

The Green Economy Coalition is another group with aims very similar to those of the One Planet Economy Network. It is a coalition of organisations from environment, development, trade union, consumer and business sectors, North and South, which are committed to the common cause of accelerating a transition to a new green economy. It aims to provide a platform for debate, organise and share knowledge, identify priority issues and strategic opportunities, build consensus on them, and communicate policy messages to key audiences. Part 3 of the Coalition's "core script" (preceded by Part 1 on a Shared Analysis and Part 2 on "Glimpses of the Future" showcasing current initiatives that work and represent examples of tomorrow's world) will include a Transition Roadmap. This will suggest a "roadmap" of economic policies, critical activities, and other enabling conditions that will accelerate progress towards GEC's vision for "a resilient economy that provides a better quality of life for all within the ecological limits of one planet" (Green Economy Coalition 2011, 1).

Related existing scenarios

Over the last few decades scenarios have been used with increasing frequency to support the policy making process and to aid in planning for the future, especially in the context of environmental issues. In the early 1970s, Shell pioneered the use of scenario thinking in corporate strategy, helping decision-makers anticipate and prepare for possible future events and optimising the ability to turn challenges into chances. Since then, scenario thinking has been taken up as a useful tool for many other strategic decision making contexts – for example, regarding the environment. Some of the most widely known environmental scenarios include exploratory (or forecasting) scenarios on climate and greenhouse gas emissions (IPCC), ecosystems (MEA), and land use change (EEA PRELUDE). In recent years, an increasing number of scenarios have traded the exploratory approach for a backcasting approach in order to focus options for meeting the challenge of transitioning to social, economic, and environmental sustainability. The following is a selection of scenarios most relevant to the OPEN:EU scenarios.

WBCSD Vision 2050: The new agenda for business

In 2009, the World Business Council for Sustainable Development (WBCSD) engaged 29 of its member companies in developing a vision of a world "on-track toward sustainability" by 2050 and outlined a pathway for achieving this. The objective of the Vision 2050 project was to challenge companies to rethink and envision opportunities that put sustainability at the centre and also to invite governments to consider which policies are needed to organise society and give market incentives to move toward sustainability. The leading questions that drove the exercise were:

What does a sustainable world look like? How can we realise it? What are the roles businesses can play in ensuring more rapid progress toward what world?

The result was a pathway that features many fundamental changes that are not only necessary, but also feasible and offer many business opportunities. The "new agenda for business leaders" is based on a shift from thinking of climate change and resource constraints as environmental problems to understanding them as economic ones related

to the sharing of opportunity and costs. Vision 2050 recognises that business must lead this transformation, in parallel with governments, “by doing what business does best: cost-effectively creating solutions that people need and want” (WBCSD 2010, iv).

In collaboration with the Global Footprint Network, the project calculated the Ecological Footprint of the Vision 2050 pathway against business-as-usual and showed how 9 billion people can live well within the limits of the planet (WBCSD 2010, 35).

Vision 2050 is not intended to be a blueprint, but rather a platform for dialogue and asking questions – especially the question foremost in many business leaders’ minds: *How do we get there?* It is an attempt to help leaders to avoid repeating mistakes of the past by making decisions in isolation that result in unintended consequences for people and the environment, and to instead make decisions that deliver the best possible outcomes for human development in the coming decades.

The scenario storylines developed in OPEN:EU are similar in that they are primarily intended to provide a frame for discussion and better understanding about different pathways for reaching a One Planet Economy and a means of testing the EUREAPA tool. They do not prescribe specific policy recommendations as such.

The Planet in 2050: Lund Discourse of the Future

In October 2008, The Planet in 2050, an interdisciplinary Fast Track Initiative of the International Geosphere-Biosphere Programme, gathered a diverse group of stakeholders to participate in a workshop in Lund, Sweden to describe desirable futures for Earth in the year 2050 and to explore pathways to move from the present situation toward those futures. The resulting picture has been summarised as follows:

"In 2050, the billions of people living on Earth have found a way to manage the planetary system effectively. Everyone has access to adequate food, shelter, and clean water. Human health is no longer considered outside of the health of the ecosystems in which people live. Ecological awareness is an integral part of education. People respond effectively to social and environmental hazards, and societies care for the most vulnerable amongst them. The economy, too, has shifted. Carbon dioxide management is under control, and energy efficiency is the norm. The remaining rainforests have been preserved. Coral reefs are recovering. Fish stocks are thriving."²¹

After describing this future, the Planet in 2050 group had to grapple with a few sincere questions:

Is any of this really possible? How can our complex social and economic systems interact with a complex planetary system undergoing rapid change to create a future we all want?

Recognising that their vision for 2050 was extremely ambitious, the group identified specific concerted action and change needed along five pathways: governance, the global economy, knowledge and education, creativity, and value and belief systems. Perhaps the most interesting similarities between this exercise and the OPEN:EU exercise is the

²¹ See <http://www.routledge.com/books/details/9780415590006>.

characteristics of the global economy pathway. Underpinning this pathway is a new development model based clearly on the goal of development not as economic development but as improvement in human well-being in line with sustainable development (Jäger 2009, 18). This model focuses on sufficiency of material consumption, whereby consumers consider their needs rather than their wants. The new economic system values all of the diverse kinds of capital and wealth (social, human, cultural, biological, social, infrastructural and physical) as the core assets of society. As a result, measures of improvement in human well-being and environmental and social sustainability have replaced GDP as a measurement of progress and the indicators used to track progress in development have expanded to include qualitative and quantitative measures of all types of capital.

A few other key similarities with OPEN:EU scenarios appear in the governance, knowledge and education, and creativity pathways. The governance pathway stresses a shift away from adversarial systems to consensus-building ones. Transformations in the educational system ensure a balance of building values and developing every person's intellectual, emotional, social, physical, artistic, creative and spiritual potentials. In the creativity pathway, attention to inner well-being helps redefine notions of success away from material wealth toward a more inclusive approach of fulfilment related to spiritual and moral values as well.

IN-STREAM

IN:STREAM is another FP7 funded project also involving partners from the OPEN:EU project, which is currently examining more closely the role of sustainability indicators in shifting away from a purely GDP-focused measure of progress. The objective of the project is to support the move away from policy decisions on the basis alone of economic mainstream indicators like GDP and advise policy makers on which indicators would provide additional information for their policy decisions and how to use them. To this end, the IN-STREAM consortium is conducting valuations of ecosystem services and of health effects of emission reductions, in effect diversifying the kinds of capital we can measure. Researchers in IN-STREAM are also modelling the impact of environmental policy on business competitiveness, highlighting the synergies and trade-offs implicit in Europe's pursuit of economic growth and environmental sustainability.

Images of the Future City: Time and Space for Sustainable Development

This major backcasting study carried out by the Royal Institute of Technology in Stockholm, Sweden over the last several years presents images of a future where Stockholm citizens in 2050 have sustainable energy use (here defined as a 60% reduction per capita over a 50-year period, in line with Sweden's vision for no net emissions of GHG to the atmosphere by 2050). The leading question for the study was:

How can a combination of spatial city planning and changed use of time be an effective tool for strategy development towards a transition to a low-energy city, where total energy use by its citizens is sustainable?

The result is six images of the future created by the crossing of three different versions of change in urban structure (the space dimension) with two versions of people's life tempo (the time dimension). Added to this is the consideration of technological development to produce images that illustrate how combinations of planning, behavioural change and technological development could lead to sustainable energy use in Stockholm.

The study takes a households perspective rather than a sector perspective so that all energy use is allocated to individuals' activities. The future images are thus able to provide details on a variety of aspects of a future sustainable city, including travel, housing, eating, time use, consumption and urban form. The authors note that the main justification for doing a study of this kind is that it can connect short-term and long-term targets, identify potential conflicts between measures to achieve targets, and display consequences of actually achieving set targets.

Global Environment Outlook – 4 (GEO-4)

Chapter 9 of the United Nations Environment Programme's (UNEP) Fourth Global Environment Outlook (GEO-4) is entitled "The Future Today" and presents four scenarios up to the year 2050, using narrative storylines and quantitative data to explore different policy approaches and societal choices at both global and regional levels. Unlike the WBCSD Vision 2050 project and the Planet in 2050: Lund Discourse of the Future, which define a desirable vision of the future as their endpoints, these are exploratory scenarios which look at how current social, economic and environmental trends may unfold along divergent development paths in the future, and what this might mean for the environment, development and human well-being.

Previous scenario exercises have shown that narratives and modelling complement each other to enrich futures analysis. The GEO-4 narratives were modelled using a suite of advanced global and regional models to ensure that the quantitative and qualitative components of the scenarios complement and reinforce each other. The OPEN:EU scenarios exercise has been conducted on a much smaller scale and without presenting quantitative data analysis in the scenarios themselves. However, the consistency of the scenarios will be tested by using the EUREAPA tool (and the underlying multi-regional input-output model) to quantify the effect that changes to consumption and production brought about by policy intervention in each of the four scenarios have on the Footprint Family of indicators.

The GEO-4 scenarios – entitled Markets First, Policy First, Security First and Sustainability First – are defined at both the global and regional scales, including a section with specific focus on Europe. Europe is not a leading economic power in any of the GEO-4 scenarios, but it has the potential to positively influence other nations, especially through sustainable development technology and environmental management. Europe is always at risk of dependence on foreign sources of natural resources. A key uncertainty is how future migration of the young population will affect Europe's ability to develop new technology. The scenarios suggest a future policy focus on R&D and education programmes to keep young professionals from leaving Europe and help develop new technologies to mitigate environmental impacts.

Articulated again by these scenarios is the diversity and multiplicity of tradeoffs and opportunities for synergy that these issues of sustainability present and the resulting need for decision-makers to meet this complexity with adaptive, innovative approaches.

GEO-5

UNEP's fifth GEO report will be published in 2012 and Chapter 9 of this report will again be dedicated to "Scenarios and Transformative Change" (UNEP 2010). In stakeholder consultations, GEO's key audiences indicated stronger interest in solutions formulated around a 'backcast' rather than a 'classical' scenario approaching involving the development of alternative projections, as was done in GEO-3 and GEO-4 before. GEO-5

will thus use backcasting to map out possible pathways (combinations of options) to a desired outcome – or “challenge scenario”. The pathways must be consistent with long-term (2050) sustainability goals and targets that have been agreed upon in multilateral environmental agreements and within the critical environmental limits identified by science. Conceptually, this is a similar approach to that undertaken for the development of the OPEN:EU scenario narratives.

Common messages

Each of these scenario exercises are slightly different – some define one desirable vision of the future and a pathway to get there (Vision 2050, The Planet in 2050), others present several possible paths to a future goal (Images of the Future City, OPEN:EU), and still others define no specific end-point, but rather look at the range of possible ways current trends could unfold in the future (GEO-4). The common message emerging from all of these, however, is that the resources and services we depend on are highly interconnected and require that we undertake policy solutions that are similarly interconnected and mutually supportive. This also means that we must ensure that short-term policy decisions are consistent with long-term goals and outcomes, a particular concern also of the EU’s flagship initiative for a resource-efficient Europe. Furthermore, these scenarios also demonstrate that behaviour change and social innovation are as important as technical and commercial innovation in our transition to a sustainable economy. As emphasised by The Planet in 2050 Lund Discourse, a social dialogue on our collective future and responsibility to the planet also plays an important role in this respect.

Putting society on any one of these potential paths to sustainability will require a set of tools for measuring our progress and helping us to course correct. The OPEN:EU project’s integration of the Footprint Family of indicators and the creation of the EUREAPA tool, as well as the work being carried out in the IN-STREAM project on new indicator approaches, provide early contributions that can be built on going forward.

5. Conclusions

Prior to conducting the quantitative stage of the analysis, it is difficult to draw concrete conclusions about how effective the different scenario storylines are likely to be in reaching a One Planet Economy. The modelling of the scenarios using the EUREAPA tool will take place in July 2011, with the results of this exercise feeding into the final report. At this stage, however, a number of initial messages can be drawn from the qualitative stage of the scenario development exercise, with further refinement of these being possible post quantification.

There are likely to be different pathways for getting to a sustainable future, which have quite different implications for society. The scenario storylines highlight that the nexus between the rate of technological innovation and the preparedness of society to move beyond a GDP-growth focus can produce quite different “worlds”. For example, life in Scenario 3 is a world characterised by resource shortages, high prices and social tension. In this world, life is likely to be far less pleasant for the majority of Europeans for whom today’s consumption patterns are unaffordable.

Some scenarios may be more stable than others. For example, Scenario 2 describes a world in which comprehensive government policy is needed to maintain the delicate balance between growing demand driven by the ongoing growth-focus of society on the one hand, and the need to reach a One Planet Economy on the other. Rapid technological change is assumed to enable this balancing act. There are many risks in this world that could tip society into the type of conflict more characteristic of Scenario 3. For example, the technological change may be less rapid than expected, tensions could emerge between government, business and society, or an unanticipated shock, such as war or natural disaster could take place.

The issues must be considered in an integrated way. The scenarios highlight the challenges in developing consistent policy strategies to put Europe on a path towards a One Planet Economy. This is due to the complexity of the issues and the interrelationships between the factors that influence patterns of consumption and production. For example, the greater importation of low-impact goods from “environmentally competitive” countries (envisaged in Scenario 2) would necessitate an educational revolution to create adequate opportunities to find employment in new, high-tech, innovative industries.

Tradeoffs are likely to be involved. The scenarios highlight that the transition to a One Planet Economy is likely to involve trade-offs. For example, the rapid shift to electro-mobility (envisaged in Scenarios 1 and 2) would create an additional burden for the transformation of Europe’s electricity supply to avoid simply shifting the carbon impact from one sector to another. In Scenario 2, this increase in demand is exacerbated by the strong growth-focus, and may require significant imports of electricity from beyond Europe’s borders.

Behavioural change and social innovation is likely to be needed alongside technological innovation and policies aimed at industrial transformation. The scenarios highlight that behavioural changes resulting in lower consumption of high-impact goods and services can ease the pressure on the supply side and the role of technology. The changes in behaviour can either be shared evenly across society, leading

to greater harmony (as in Scenario 4), or forced via high prices and draconian measures, leading to greater tension (as in Scenario 3). Government action to encourage behavioural change is likely to be needed in all scenarios, but the nature of this action is likely to be quite different.

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7th Framework Programme for Research and Technological Development.
The research leading to these results has received funding from the
European Community's Seventh Framework Programme (FP7/2007-2013)
under grant agreement N° 227065.

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