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USING ENVIRONMENTAL TAX REFORM TO SUPPORT SUSTAINABLE DEVELOPMENT IN TRANSITION ECONOMIES:

the case of the Czech Republic

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MATISSE Methods and Tools for Integrated Sustainability Assessment

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MATISSE (Methods and Tools for Integrated Sustainability Assessment) aims to achieve a step-wise advance in the science and application of Integrated Sustainability Assessment (ISA) of EU policies. In order to reach this objective the core activity of the MATISSE project is to improve the tools available for conducting Integrated Sustainability Assessments.

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Preface

About the MATISSE project

The MATISSE (Methods and Tools for Integrated Sustainability Assessment) project is funded by the European Commission, DG Research, within the 6th Framework Programme. The project is interested in the role that Integrated Sustainability Assessment (ISA) could play in the process of developing and implementing policies capable of addressing persistent problems of unsustainable development and supporting transitions to a more sustainable future in Europe. The core activity of MATISSE is to develop, test and demonstrate new and improved methods and tools for conducting ISA.

This work is carried out through developing and applying a conceptual framework for ISA, looking at the linkages to other sustainability assessment processes, linking existing tools to make them more useable for ISA, developing new tools to address transitions to sustainable development and applying the new and improved tools within an ISA process through a series of case studies.

The extent to which the case studies are carrying out a complete ISA for their area of focus varies between attempts to cover all phases of an ISA process to partial implementation of the process. Equally, different case studies are oriented to developing and testing tools and approaches to some, but not all, of the methodological challenges of ISA. The case studies are complementary, however, and the set of cases offers the opportunity to address a wide range of methodological challenges and to explore linkages between cases. An evaluation of practical experiences with ISA implementation in the case studies will provide guidance on the further improvement of methods and tools. Results will also contribute to more informed policy advice.

What is ISA?

Within the MATISSE project, Integrated Sustainability Assessment (ISA) has been defined as a cyclical, participatory process of scoping, envisioning, experimenting, and learning through which a shared interpretation of sustainability for a specific context is developed and applied in an integrated manner, in order to explore solutions to persistent problems of unsustainable development. ISA is conceptualised as a complement to other forms of sustainability assessment, such as Sustainability Impact Assessment, Integrated Assessment and Regulatory Impact Assessment. Whereas these other forms of assessment fulfil the pragmatic need for *ex ante* screening of incremental sectoral policies that are developed within the prevailing policy regime, ISA is conceptualised as a support to longer-term and more strategic policy processes, where the objective is to explore persistent problems of unsustainable development that have a systemic pathology and possible solutions to these. ISA is therefore oriented toward supporting the development of cross-sectoral policies that specifically address sustainable development and at exploring enabling policy regimes and institutional arrangements.

MATISSE Working Papers

Matisse Working Papers are interim reports of project activities that are published in order to illustrate ongoing work and some provisional conclusions, as well as providing the opportunity for discussion of the approaches taken by the project and interim results. This discussion should be both within the project and between project members and the broader scientific and policy communities. Readers are encouraged to contact the authors to discuss the content of MATISSE Working Papers.

Jill Jäger and Paul Weaver

Editors of the MATISSE Working Paper Series

Table of Contents

List of Tables

List of Figures

USING ENVIRONMENTAL TAX REFORM TO SUPPORT SUSTAINABLE DEVELOPMENT IN TRANSITION ECONOMIES: the case of the Czech Republic

1 Introduction

This paper summarises the analysis undertaken within the MATISSE project on the role that environmental tax reform[1] (ETR) could play in future sustainable development in the EU and the Czech Republic in particular, and points debated in discussions with key Czech stakeholders.

Overview of MATISSE

The MATISSE project aims to advance Integrated Sustainability Assessment (ISA) of EU policies. A core activity of MATISSE is to improve the tools available for conducting Integrated Sustainability Assessments. Case studies provide the real-world contexts within which the ISA methodology and tools can be assessed.

Overview of this case study

The case study for which the work reported in this paper is undertaken focuses on the role of sustainable environmental technology within the context of the transition of national economies. The case study has focused in particular on the Czech Republic and the process to date has involved several meetings with stakeholders in the country.

Initially work and discussions focused on providing stakeholders with information (previously lacking) on underlying trends and on using broadly based scenarios to reveal indicative impacts that technology might be able to achieve. As a result of this stage and the direction of focus given by stakeholders in early workshops held during 2006 and 2007 a second iteration was undertaken to look at the potential impacts of ETR.

Overview of this paper

On 6 November 2007 a workshop with stakeholders from the Czech Republic discussed the possible role of ETR within the sustainable development of the country. This paper summarises the analysis that was presented at the meeting and the points raised during debate.

Section 2 provides a brief summary of the underlying context of the discussions of ETR, including the underlying trends in indicators such as economic growth, demands on energy and other resources, as well as the underlying attitudes of key groups in society. Section 3 reviews the role of ETR in current scenarios and goes on to set out a development vision for the EU and the Czech Republic. Section 4 analyses the results of the scenarios developed to assess different aspects of the development vision, drawing out potential tensions and other issues that might arise (intentionally or otherwise) for future sustainable development. Section 5 reviews the response of stakeholders to the analysis that was presented to them, and concludes with suggestions for how the debate could be taken forward in MATISSE or by others.

[1] We use the term environmental tax reform to mean shifting the burden of taxes from conventional taxes, such as the ones levied on labour and capital, to those on environmentally related activities, such as taxes levied on resource use, in particular energy, or pollution.

2 The Context for Future Sustainable Development

2.1. Underlying Trends

The context for this case study is provided by the underlying trends within the MATISSE baseline scenario. This scenario in turn was based on the scenario published by the European Environment Agency (EEA) in the European Environmental Outlook of 2005. The economic, energy and emissions forecasts for the EEA scenario were in turn those published by DG TREN[2] in "Energy and Transport: Trends to 2030". However, there have been a number of significant changes that have occurred since the development of the economic and associated forecasts for DG TREN and so it was agreed to reflect these in the MATISSE baseline scenario. In particular, the price of oil was much higher than was assumed in the EEA scenario, and it is likely to remain at relatively high rates for some time, and the EU Emissions Trading Scheme (ETS) had been introduced into the MATISSE baseline scenario.

Trends for the EU25 – baseline scenario

Overall, economic growth in the EU25 averages 2-2½ percent p.a over the baseline period, with the rate slowing over the long term (2015-30). Growth is stronger in the EU10[3], with growth averaging 4 percent p.a over the short term (2005-10) before slowing to 3 percent p.a over the long term. Population in both the EU10 and EU15 falls over the baseline period with the result that GDP per capita in the EU25 grows by an average of just under 2½-2¾ percent p.a over the period. With stronger GDP growth and a stronger fall in population, the EU10 sees much stronger per capita growth (3½-4 percent p.a.).

The growth in GDP, GDP per capita and employment support growth in real personal disposable income per capita of 3½ percent p.a, with stronger growth among the EU10. Although the growth in per capita incomes is stronger in the EU10 than in the EU15, the absolute gap between the highest and lowest average household incomes continues to widen (although it represents a smaller multiple of the lowest income group). This pattern of continuing, but slowing, growth in income differentials is seen in both the EU10 and the EU15, with a much sharper slowdown in the former.

Demand for energy among the EU25 rises by around 0.3 percent p.a to 2020, but then remains little changed to 2030. In line with the economic performance, growth in the demand for energy is stronger among the EU10 economies than in the EU15. Energy demand in some of the EU10 rises by 2½-3 percent p.a in the short term (to 2015) compared to growth of around 1 percent p.a in many of the EU15. Growth in energy demand slows over the long term in most of the EU10, and decreases very marginally across the EU15 as a whole. The rate of growth in energy demand is slower than the growth in GDP meaning a relative decoupling of economic growth and energy demand.

In the EU25, the *emission of GHGs* rises by ¼ percent p.a in the short term to 2010 before falling by ¼ percent p.a to 2020 and by more than ½ percent p.a over 2020-2030. While the profile of emissions in the EU15 is similar to that of the EU25 as a whole (it accounts for 80-85 percent of EU25 emissions), GHG emissions from the EU10 continue to rise to 2020, by more than ½ percent p.a., falling over the long term by ¼-½ percent p.a. This reflects both the stronger growth of these economies and the working through of the 'beneficial' effects of economic restructuring, with the closure of inefficient plant and the underlying structural change away from heavy manufacturing towards services that have occurred more strongly in the preceding period. Despite the stronger growth in emissions among the EU10, their collective share of total emissions from the EU25 does not alter greatly, rising from around 16¼ percent in 2000 to 17½ percent in 2030. The emissions intensity of economic activity in

[2] European Commission Directorate-General for Energy and Transport. It is responsible for managing the financial support programmes for the trans-European networks, technological development and innovation.

[3] The EU15 comprises Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, Netherlands, Austria, Portugal, Finland, Sweden and the UK. The EU10 comprises the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia.

the EU25 falls at a constant rate over the whole scenario horizon; with the EU10 experiencing a faster fall.

In summary the review found that for the EU as a whole the greatest pressures for sustainability come from the social and environmental dimensions, and the pressures are more severe in the EU10.

Underlying trends in the Czech Republic

The underlying trends within the Czech Republic are similar to those of the EU10 as a whole, namely with the greatest pressure for sustainable economic development being felt within the environmental spheres, particularly with regard to energy and other resource use, and in the social sphere, in particular with the potential spatial distribution of growth within the country.

Regarding *economic growth*, the short-term picture for the Czech Republic is not particularly favourable, with GDP growth of 2½ percent p.a over 2005-20. The population in the Czech Republic falls, as it does elsewhere in the EU10, which helps boost growth in GDP per capita. However, the relative level of GDP per capita at best keeps in line with that of the EU25 as a whole, though worsens against some of the other countries in the EU10. The baseline scenario is for GDP growth in the Czech Republic to weaken.

Employment growth, however, is relatively strong throughout the period to 2030, with growth exceeding the average for the EU25 as a whole and the EU10.

The differential in the levels of wealth within the Czech Republic increases in the baseline scenario. Overall, levels of GVA (gross value-added) per capita rise in sub-national areas, but growth is stronger in those regions that already have the greatest level of wealth, and that of the capital city region in particular.

The *use of energy* grows throughout the period to 2030. Growth is at a faster rate than for the EU25 but at a slower rate than for the EU10 as a whole (in line with slower economic growth). In the long term (post 2020) growth in energy use weakens to around ¼ percent p.a from ¾ percent p.a in the previous decade. Throughout the period to 2030 the growth in energy use is weaker than the growth in GDP with the result that the economy is becoming less energy intensive.

Energy use by industry rises gently through the period though the strongest growth in energy use in the long term is from services. Household demand rises strongly in the short term, but growth then slows in the long term.

As a result of the changing pattern of energy use, *GHG emissions* fall from 2010, with the rate of decline increasing in the long term. The decline in emissions commences earlier than it does in a number of the other EU10 counties. The rate of decline in the Czech Republic is quicker than for the EU15 as a whole.

2.2. Key Issues of Material Use

MATISSE has also been testing ISA for the issue of material use and dematerialisation through the work of Workpackage 5[4]. This work has also focused in particular detail on the Czech Republic and so has been able to provide important input to the debates with stakeholders.

Current and past trends

The work undertaken within WP5.1 analysed current and past trends and patterns in material and resource use in the Czech Republic as compared to Germany and the EU-15 over the period 1992 – 2000[5]. This was done by focusing on two types of material flow indicators: the DMI (direct material

[4] See http://www.matisse-project.net/projectcomm/index.php?id=833 for more information on the work of Workpackage 5.

[5] A more detailed description of the work and the results can be found in MATISSE Working Paper 13, available at http://www.matisse-project.net/projectcomm/index.php?id=831

input, consisting of domestic extraction used and imports) and the TMR (total material requirement, consisting of the DMI in addition to the unused domestic extraction and the indirect flows associated with imports). Both sets of indicators were analysed in terms of their different material/resource categories (agricultural, fossil, construction and industrial minerals, and metal materials/resources) as well as in relation to GDP, thus comparing material and resource intensities between countries.

In terms of *material and resource intensity* (DMI/GDP, TMR/GDP) there are still considerable differences between the Czech Republic on the one hand, and Germany and the EU-15 on the other hand. Although the levels of material and resource intensity have been decreasing by around 20 percent and 26 percent respectively in the Czech Republic between 1991 and 2000, they are still around four times higher than in Germany or the EU-15. This is partly due to the much lower levels of GDP per capita in the Czech Republic compared to Germany and the EU-15.

When comparing the material and resource use at the aggregate level, it was found that the levels of DMI and TMR per capita are similar for the Czech Republic and Germany, with a mean of 23 and 24 tonnes per capita for the DMI and 74 and 74 tonnes per capita for the TMR respectively. However, there are important differences in the composition of the indicators for both countries. Although the use of fossil fuels has been decreasing over the period examined, the Czech Republic showed a consistently higher use of fossils than both Germany and the EU-15, both in terms of DMI and TMR. This is mainly due to the comparatively higher dependency of the Czech economy on coal. Per capita values of construction minerals, on the other hand, were found to be lower in the Czech Republic than in Germany and the EU-15. Yet given the anticipated increase in investments in transport infrastructure and buildings[67] construction minerals might be expected to increase considerably in the Czech Republic in the future, thus possibly approaching German levels, where significant investments in construction activities in the Eastern part of Germany were undertaken after reunification. Differences were also notable when comparing the TMR of metals. At the beginning of the 1990s the TMR metals with around 3 tonnes per capita was considerably lower than in the EU-15 (8 tonnes per capita) and Germany (13 tonnes per capita). However, this changed markedly over the period considered, with the Czech Republic surpassing the levels of the EU-15 in the mid 1990s reaching around 10 tonnes per capita in 2000. There is thus a strong tendency for convergence between the Czech Republic, the EU-15 and Germany, also with regard to the share of the direct input of metals in TMR.

Overall the analysis of past and current trends of material and resource use in the Czech Republic has significant implications with regard to future development. First, it highlights the importance of fossil materials in both TMR and DMI. Although these have followed a steadily decreasing trend, they still remain at a rather high level. Policy should thus enhance the trend towards decreasing levels of fossil materials. Second, although the DMI of construction materials is still at a lower level than in Germany and the EU-15, one might expect increases in the per capita level of construction given current investment plans in buildings and infrastructure. There will thus be a need for greater material and resource efficiency in construction. Finally the comparison of the TMR for metals has shown an increasing trend in the Czech Republic again pointing to the need to increase resource efficiency in metal based industries.

The work within WP5.2 focused on energy consumption and carbon emissions in the Czech Republic. Direct and up-stream energy requirements and carbon emissions related to the production system in the Czech Republic were calculated for 1999 and 2003 using the input-output technique, described, e.g., in Hannon et al. (1983), Miller et al. (1985) and Machado et al. (2001). Direct energy requirements and carbon emissions refer to flows, which are directly needed/emitted during production of commodities for final demand. Apart from this, there are up-stream energy and carbon

[6] Czech Government (CZ Gov), 2005. Economic Growth Strategy of the Czech Republic (approved by the Government of the Czech Republic in November 2005)

[7] Ministry of Transport of the Czech Republic (MoT), 2006. Transportation Policy of the Czech Republic for 2005 – 2013 (approved by the Government of the Czech Republic in July 2005)

flows. They take place when producing infrastructure and/or semi-manufactured products, which are then used to produce commodities for final demand. This production can take place abroad or domestically, in other sectors. Total energy and carbon flows (i.e. sum of their direct and up-stream parts) indicate total energy inputs and carbon emissions mobilized during the whole production process of a commodity. To identify the most environmentally-damaging commodities, it is useful to take into account total energy and carbon flows related to commodities production, as environmental pressures are associated with both direct and up-stream material/energy/emission flows.

The basic analytical tool employed for the calculation was a symmetric input-output table. Moreover, a structural decomposition analysis was carried out to enable changes in energy consumption/carbon emissions to be attributed to their drivers: changes in final demand and changes in technology. Calculated energy requirements and carbon emissions were linked to domestic final demand of commodities, as well as to their exports and imports.

Results revealed that total energy requirements and carbon emissions related to all commodities consumption for final demand were growing in the Czech Republic between 1999 and 2003. In the case of energy, this growth was rather driven by final demand abroad (exports), while in the case of carbon emissions, this growth was rather driven by domestic final demand. This suggests that more carbon intensive fossil fuels were used for production of commodities for domestic final demand in 2003 compared to 1999, while less carbon intensive fossil fuels were used for production of exports. It further showed that the Czech Republic rather exerted pressure on the environment abroad than other economies exerted pressure on its environment (positive balance of total energy requirements and carbon emissions related imports and exports).

Analysis revealed that the most environmentally-damaging commodities with respect to related total energy and carbon flows include construction work, basic metals, chemical products, food and beverages, machinery, motor vehicles, real estate services and fabricated metal products. From these, the analysis further focused on basic metals and fabricated metal products (metal commodities). It showed that both energy requirements and carbon emissions related to final demand of metal commodities reduced between 1999 and 2003. This positive trend was mostly driven by consumption abroad, as metal commodities as defined above largely include semi-manufactured products, which are only rarely used for domestic final demand. In spite of this reduction, the contribution of metal commodities to the total energy and carbon flows was profoundly higher in both years relative to these sectors' shares in total value added. It therefore seems that focusing on this commodity group is a very efficient way to decrease total energy requirements and carbon emissions of the economy.

Structural decomposition analysis showed that changes in technology lowered the energy requirements and carbon emissions both in the case of all commodities and the metal commodities. Final demand also slightly lowered the energy requirements and carbon emissions down in the case of metal commodities, which allowed for a decrease in these flows. Final demand, however, strongly pushed the energy requirements and carbon emissions up, more than outweighing the technological gains in the case of all commodities, which led to an increase in these flows. In order to decrease overall energy requirements and carbon emissions in the coming years the influence of technological change has to be strengthened by additional investments in less energy/carbon intensive technologies and by production of less energy/carbon intensive commodities, or the growth of overall final demand has to be abated, or both of these must be combined.

2.3. Initial Views of Stakeholders

An initial workshop with stakeholders from the Czech Republic was held, which was designed to identify the long term sustainability problem and challenge(s), develop a sustainability vision for the Czech Republic, and to consider development pathways by which the vision may be reached Key challenges identified included growth of consumption, a lack of consensus building, and short termism. When thinking of how stakeholders wished the Czech republic to look by 2030 views expressed included paying the whole cost of current activities, balancing over and under-consumption, lowering imports and exports of non renewable raw materials and decentralising the location of 'good

jobs' (i.e. essentially balancing development in rural and urban areas). Initial thoughts on the possible strategic measures that could bring about the vision included needing to invest more in R&D and innovation, improving physical and social infrastructure, changing behaviour and attitudes, ecological tax reform and improving monitoring systems and indicator sets.

The second workshop discussed the results of the analysis undertaken in the first ISA cycle, that looked at the impact of increasing R&D in environmental technology. The stakeholders suggested that the results on Direct Material Input in the agriculture sector were interesting, because while the results suggested that the DMI increases, the possible effects of overall EU agricultural policy and biofuels policy had not been taken into account. Furthermore, a shift to less intensive agriculture in the Czech Republic could reduce income differences between rural and urban areas, which was an important part of the sustainability vision developed in the first stakeholder workshop in Prague. Another observation from the second workshop was the need for some indicators for quality of life. That is, there is a need for new measures of progress instead of economic growth. The results of the modelling also stimulated discussion on the need for system-level changes rather than small adjustments to current practices. A number of other important indicators were proposed, especially in connection with industrial sectors. Finally the second workshop suggested that modelling of a scenario of ETR would not only reflect an important topic of current political debate but could produce results closer to the elements of the sustainability vision developed in the first workshop.

3 A Vision for Environmental Tax Reform

3.1. Role of ETR in Existing Studies and Scenarios

The use of fiscal measures to alter behaviour away from environmentally damaging behaviour is already well-established, as recent summaries show[8]. However, while the imposition of environmental taxes may be well established, what is less widespread is the practice of ETR, whereby the revenues generated are offset by reductions in taxes raised elsewhere.

To date the focus of implementing environmental taxes has been most common in the areas of energy and transport followed by waste and water. While taxes are applied in some countries in other areas (such as pesticides and fertilisers, packaging, resources, and chemical waste) the practice is more limited.

References to ETR have been made within policy statements (though not all) although there is little detail given. For example, the OECD Environmental Strategy for the First Decade of the 21st Century was intended to provide clear direction for environmentally-sustainable policies in OECD countries. The strategy was intended to be implemented by 2010. It saw a strong role for the use of environmental taxes and associated methods to internalise the full cost of actions and to create incentives for innovation but did not give specific examples of where or how such measures might be applied in the future. Perhaps reflecting this, ETR is not a theme that is included in most existing scenarios, even those that are focused primarily on the issue of resource use.

Resource use scenarios

Key existing resource-use scenarios include the 'Aachen Scenario', the European Environment Agency Scenarios for Waste and Material Flows[9] and Resource Use Scenarios for Europe in 2020 developed within the MOSUS project (Modelling Opportunities And Limits For Restructuring Europe Towards Sustainability).

In the *Aachen scenario* it is assumed (based on case study evidence) that a 20 percent reduction in material and energy costs of manufacturing, construction and public administration can be achieved by spending the equivalent of one year's savings in material costs on consultancy (one-third) and new capital equipment (two-thirds). The drivers behind the scenario are clear: improved technical processes based on a better understanding of the use of materials in the production process and its associated costs. The impact is assumed to occur given the current fiscal environment. A general move to environmental taxation may help reinforce the information campaigns, and lead to a greater likelihood of the outcome coming about, or to a greater reduction in material use being achieved.

The *EEA scenario* report's conclusions on the strategic response to the unsustainable trends included the need for better integration of environment- and resource-related considerations in sectoral and other policy areas. It found it unlikely that resource use can be reduced by technological improvements alone. Current lifestyles and consumption patterns may have to be critically reviewed, and price signals will be an effective tool for improving resource efficiency and influencing consumption patterns. It may also be necessary to reduce subsidies that sustain practices with negative environmental impacts. Analysis supporting the report included waste and material flow projections. However, there was no explicit role given to the possible future use of ETR or the impact that it might have. However, the EEA's position makes clear reference to the need to use price as a mechanism to change behaviour, although no illustrations of where such policies might be adopted are given.

[8] See for example, EEA (2006), Using the market for cost-effective environmental policy: market based instruments in Europe, Luxembourg: Office for Official Publications of the European Communities, EEA (2000), Environmental taxes: recent developments in tools for integration, Copenhagen

[9] Sustainable use and management of natural resources, EEA Report No 9/2005

Three main scenarios were developed in *MOSUS* (baseline, weak sustainability - reflecting policy goals and measures derived from key EC strategic documents, high sustainability). In developing the scenarios all national/EU documents were first screened, which showed that while high levels of resource use, waste and emissions were identified as a major obstacle to environmentally sustainable development, the problem was being addressed by tackling a specific aspect (eg reducing CO2 emissions) rather that taking resource use as a whole. The project noted that while quantitative reduction targets have been set (at the EU level) for outputs of economic activity, namely waste and emissions to air, no targets have been set for inputs to production (other than energy). The focus of the scenarios was on domestic extraction of resources. In the weak sustainability scenario ETR in the area of energy taxes was one of the possible policy instruments that could be deployed to bring the outcome about. In the high sustainability scenario ETR in the area of energy could be supplemented by material inputs tax or the introduction of material input permits. Other possible policy measures mentioned included production quotas for material-intensive products and the prohibition of particular materials with high environmental burden.

Conclusions

A selected review of resource use strategies and scenarios shows that environmental taxes and other fiscal measures are increasingly being seen to play roles in future environmental strategies. At the same time, however, there is little by way of detail of the precise role they will have, be it the type of policies, or the base on which they will be targeted. That said, this omission is perhaps not surprising given the precise nature and purpose of the strategy documents themselves.

There is greater visionary thinking in some of the modelling work that is not directly connected to the strategy documents.

Generally, thinking of future fiscal reform is related to

- energy (emission trading schemes, refocusing transport-related taxes)
- use of non-renewable resources (eg material inputs tax)
- waste generation (eg landfill tax)
- dissipative use of chemicals (especially in agriculture)

3.2. ISA Development Pathway

The general development pathway examined in the first iteration of this ISA case study in the MATISSE project was that private companies in the new member states in particular seek to raise their competitive position through a focus on increasing spending on investment in equipment, skills and research. In modernising the production processes firms not only take on board technologies that are currently available but also adopt the organisational structures of more ‘mature’ economies.

This was not specific in its formulation and lacked a policy focus. Nevertheless, it did provide stakeholders with vital information with which to engage with the issues and to suggest a particular direction to take.

The following narrative was developed, informed by discussions with stakeholders in the Czech Republic and the existing scenarios involving this policy area discussed above.

General EU context: ETR in the area of energy

The combined pressures of global competition and domestic political pressures result in firms implementing measures to improve their current resource use using currently available technologies. Countries actively embrace ETR in the area of energy use, using additional revenues from taxes on energy to reduce taxes on employment and to fund R&D activities and other programmes related to resource use. As a result the so-called ‘Aachen scenario’ outcome, whereby material and energy costs of key sectors are reduced by 20 percent, comes about by 2015.

These events reinforce the drive for technical progress through R&D and, in the case of the EU10, in the speed of their transition in the technological and organisational structures to those of more 'mature' economies. At the same time, pilot programmes on resource productivity in pioneering countries are watched by other countries and adopted in case of successful performance, thus contributing to sustain the "maturation" of the economy.

Pathway for the Czech Republic: they are keen to go further, to apply ETR to more areas than energy

The Czech Republic actively embraces environmental tax reform as a means to limit the potential environmental impact of future economic growth. It is keen to achieve more far-reaching efficiencies in resource use and for efficiencies to be improved in more areas of the economy than are envisaged in the 'Aachen scenario'. Its desire for more active policies in this area result from the wish to encourage competitive businesses and environmental responsibility, but also from a belief that more far-reaching ETR will, in time, become the norm within the EU and that by being at the forefront of the movement, it will achieve longer term benefits for the economy.

Specifically, it wishes to reduce demand for non-renewable raw materials, from wherever these may be sourced, and in the use of commodities that have high environmental costs either resulting from their use or from their manufacture. Therefore, in addition to implementing taxes on energy in an attempt to reduce demand and promote the uptake of energy-efficient production techniques, the Czech Republic also introduces a materials input tax on the use of certain raw materials and a materials tax on the use of key manufactured commodities by certain sectors that are environmentally damaging (where the environmental burden relates to more than the sourcing of its material inputs or the (potentially) high use of energy in its manufacture). The issues relating to the introduction of ETR to areas other than energy are expanded on in more detail below.

3.3. Issues Relating to the Introduction of ETR for Non-Energy Commodities

Potential commodities that could merit the application of a materials levy include mineral aggregates, metals, non-metallic mineral products, wood and paper. There are issues with each regarding imposing some form of environmental tax on them.

Mineral aggregates

Mineral aggregates make up a considerable proportion of the mass of materials used in an economy both through direct extraction and also through indirect extraction (spoil). Reducing the use of these materials will have a significant impact on the material intensity of economies. The intention of a levy would be raise the cost of (non-recycled) mineral aggregates which are used by sectors such as construction. There is likely to be little potential to switch demand to imported aggregates as a result of the levy due to the relative importance of transport costs. Currently, volumes of imported aggregates are low. However, the introduction of an import duty on material aggregates at a similar rate will remove the potential adverse competitive effects on domestic producers of mineral aggregates. The international competitive position of the domestic aggregates industry could be maintained by a rebate of the levy on exports. The levy could be applied as a flat rate (the UK has set a levy of £1.6 per tonne in 2002, which will rise to £1.95 per tonne from 2008) or as an ad valorem levy (some countries apply a levy at a rate of around 1-4 percent).

Metals

A key issue with the use of metals is the associated indirect flows from the mining of the metal ore used in the manufacture of basic metals (eg iron, steel). The concern is greater for the precious metals, where the relative magnitude of the indirect flows and environmental implications of processing is greater.

New policies are not focused on primary metal refining, on the grounds of detrimental competitive impacts, but are instead aimed at improving the efficient use of metals within the economy (and so eventually the demand for metal refining). A levy could therefore be placed on the price of basic metals used in industry, regardless of whether the commodity is imported or produced domestically. If the levy were implemented as an ad valorum tax, it would take account of the fact that taken over the whole lifecycle the use of precious metals tends to be more environmentally damaging.

Wood and paper

The key issue which any levy should seek to address is the inefficient use of commodities such as print paper and packaging rather than the use of biomass resources per se (the trends in the demand for biomass will be increasing given renewable energy policies etc, and demand for biomass for some packaging makes more environmental sense than non-biomass alternatives). In this respect the key issue may be better addressed through the processed materials, such as paper and packaging.

Paper and packaging

There is increasing concern in society over the over-packaging of products. However, packaging represents only a small proportion of the overall use of paper and so, if the concerns on use of primary fibres are to be fully addressed, any levy would also need to apply to other forms of paper (eg printing and household uses of paper). There will be a need to design any policy so that the substitution of plastic-based packaging for paper-based packaging is avoided. Societal concern may act to restrain any substitution, though the scale of this effect will no doubt depend on the scale of levy imposed.

Chemicals use by agriculture

There is increasing consumer concern over the effects of the dissipative use of pesticides and fertilisers by the agriculture sector in particular. A levy could be imposed aimed at reducing their use, although it may not be the most effective policy to bring about a change in practices. However, the structure of any levy would need to differentiate between chemicals given their different environmental impacts in order to gain acceptance. The agricultural sector is already subject to considerable change due to the process of CAP reform (moving from subsidies based on production towards subsidies based on hectares cultivated) and this may have an impact on the use of chemicals by the sector. Promotion of agri-environmental schemes would be an alternative approach to reduce the use of chemicals by the sector.

4 Scenario Analysis

4.1. Overview of the Scenarios

The impact of the proposed development pathway has been modelled through a series of sequential scenarios, each of which examined the effects of a particular driver for change in the context of other changes that have been modelled.

In summary these scenarios involve

- the widespread introduction of a revenue-neutral carbon levy on energy throughout the EU25
- increases in business R&D (stimulated by the increased cost of energy)
- improved material efficiency

In addition, further scenarios are being developed that consider the potential impact of subsequently extending the base of environmental tax reform to include construction aggregates and mineral ores[10].

The scenario analysis has used E3ME, a multinational dynamic model of EU25, key features of which include

- being elaborated at a European rather than at a national level, with the national economies being treated as regions of Europe;
- dealing with energy, the environment, population and the economy in one consistent and integrated modelling framework;
- designed specifically to address issues of central importance for economic, energy and environmental policy at the European level;
- analysing long-term structural change in energy demand and supply and in the economy.

For a description of the E3ME model and its underlying assumptions the reader is referred to the model website[11] and online manual[12].

4.2. Scenario 1: Introducing a Carbon Levy and Reducing Taxes on Labour

Key assumptions

A levy is introduced from 2008 as a flat rate charge on the carbon content of fuels. The levy is set at 200 euros per tonne of carbon (55 euros per tonne of CO_2). The current price value of the levy is maintained to 2030. Therefore the value of the levy in real terms reduces over time. The effective increase in the price of energy resulting from the levy therefore depends on the carbon content of each fuel. The levy is applied at the same rate to all countries within the EU25, all fuels and fuel users (households, power generation sector, manufacturing, transport and services).

The purpose of the levy is twofold: to raise the price of energy and thereby encourage improved efficiency in its use, and to encourage users to switch to less carbon-intensive sources of energy.

The levy is assumed to be revenue-neutral for each country, with the revenues raised matched by an offsetting reduction on social security payments by employers. The scale of the reduction in rates of social security payments varies across the EU25 depending on the scale of the revenues generated (itself dependent on the energy mix of the economy) and levels of employment etc.

[10] These scenarios are being further developed as part of supporting the work of WP5.2 and will be discussed in a supporting paper in due course.

[11] www.e3me.com

[12] www.camecon-e3memanual.com/cgi-bin/EPW_CGI

The method by which revenue-neutrality comes about can have an important impact on the outcome, as we discuss later.

Overview of results

Table 4.1 shows the impact of the scenario on a number of key macroeconomic indicators of sustainable development, compared to the baseline projections. Results are shown for the EU, EU15, EU10 and the Czech Republic[13].

TABLE 4.1: IMPACT OF CARBON LEVY ON KEY MACROECONOMIC INDICATORS

	% difference from baseline			
	2010	2015	2020	2030
GDP				
EU25	0.1	0.1	0.2	0.4
EU15	0.0	0.1	0.2	0.3
EU10	0.5	0.8	1.0	1.2
Czech Republic	0.7	0.7	0.9	1.3
Employment				
EU25	0.1	0.4	0.4	0.6
EU15	0.1	0.4	0.4	0.6
EU10	0.3	0.5	0.7	0.9
Czech Republic	0.3	0.7	0.8	1.1
Energy Use				
EU25	-3.1	-6.7	-9.4	-14.2
EU15	-2.8	-6.2	-9.2	-13.9
EU10	-4.8	-9.3	-10.9	-15.9
Czech Republic	-6.7	-8.9	-10.8	-14.4
GHG Emissions				
EU25	-3.7	-8.3	-10.7	-17.0
EU15	-3.0	-7.1	-10.1	-16.5
EU10	-7.6	-14.8	-13.7	-19.6
Czech Republic	-10.1	-14.2	-17.4	-24.1

The impact of the levy and revenue recycling is to raise GDP in the EU25, though the overall impact is relatively small (by 2030 GDP is around ½ percent higher than in the baseline scenario). The impact is greater within the EU10 than in the EU15. While the outcome for the aggregate areas is positive, some

[13] Results for all scenarios are available for the each country within the EU25. Results for the Czech Republic are highlighted in this report as this country was the focus of detailed stakeholder consultation.

countries see a negative impact from the policy, including Greece, the UK, Estonia and Latvia, although the scale of the impact is relatively small. Further, the negative impact is often only realised towards the end of the period being considered, 2030.

The overall impact on employment is again positive, though as with the impact on GDP it is relatively small in scale (½ percent, 1.2m people in EU25 by 2030), and the largest relative impact is within the EU10. All countries (with the exception of Cyprus and Malta) see positive employment effects.

For the EU25 as a whole, a positive employment impact occurs in all the main sectors of the economy, with the strongest increases in the short term (to 2010) in manufacturing, while in the long term the consumer-related services including distribution, hotels & catering and transport & communications have equally strong employment impact (1 percent of baseline employment by 2030). The impact on value-added (as against industry output) is strongest in manufacturing and the consumer service sector (1½ percent in 2030).

The overall demand for energy in EU25 is almost 10 percent lower in 2020 and 15 percent lower in 2030. The reductions are slightly stronger in the EU10 than the EU15.

In the baseline scenario energy demand in the EU25 rise, and the reductions in energy use brought about by the policies in this scenario are sufficient to result in overall energy demand in the EU25 falling from around 2010. Despite the reduction in demand in the EU10 overall energy use continues to rise through to 2030, though the rate of increase is reduced to 0.1 percent p.a in the long term.

The impact of the carbon levy is to lower GHG emissions by around 17 percent by 2030. GHG emissions already fell in the baseline scenario, with the result that in the ETR scenario emissions in 2030 are some 20-25 percent lower than in 2000.

Revenue recycling

The effect of recycling the revenue raised by the levy is notable. Without it, the carbon levy has a small negative effect on GDP. For the EU25 as a whole GDP is around ½ percent lower in 2030 than in the baseline scenario (compared with ½ percent higher with revenue recycling) and employment 0.2 percent, 450,000 jobs lower (compared with 0.6 percent higher with revenue-recycling).

The economic impact from recycling the revenues is largest (in terms of proportionate increases) in distribution, hotel & catering, finance & business services, and transport & communications. These include sectors where household demand is important (and so will benefit disproportionately from increases in spending associated with increased employment in the economy) and those where employment cost comprise a relatively high proportion of total costs.

Clearly, as the effect of recycling the revenues from the levy is to raise output, employment and incomes, the level of energy use and associated GHG emissions will also be higher than if there was no recycling of the revenues.

Results in more detail for the Czech Republic

Table 4.2 shows the impact of the scenario on value-added by broad sector in the Czech Republic.

Industry value-added is around 1½ percent higher in 2020 and 2030, with the largest relative impact occurring in manufacturing and financial & business services (FBS) (2½-2¾ percent in the long term). The relative competitive impact of the increase in energy prices and reduced labour costs, and subsequent industry-level responses to these, vary by sector. However, most manufacturing sectors see higher levels of value-added in the scenario.

The impact on employment is broadly similar to that of value-added. Employment is 0.8 percent higher by 2020 (and just over 1 percent, 73,000 in 2030), with increases in all broad sectors, including agriculture. The relative increase in employment is largest in manufacturing, with mechanical engineering and food processing seeing some of the largest gains.

TABLE 4.2: IMPACT OF CARBON LEVY ON GVA IN THE CZECH REPUBLIC

	% difference from baseline projection			
	2010	2015	2020	2030
Agriculture	0.2	0.6	1	1.5
Mining etc	-1.5	0.4	1.1	1.6
Manufacturing	1.1	2.4	3.1	2.7
Utilities	63.2	39.7	-23.1	-16.6
Construction	-0.2	0.5	1.5	2.2
Dist., hotel & cater	0.2	0.5	0.8	1
Transp.& Comms	0	0.3	0.8	1.3
Fin. & Bus Services	0.1	0.8	1.9	2.6
Government & Other services	0.3	0.5	0.7	0.8
TOTAL	0.7	1.3	1.3	1.5

The impact of the levy is to reduce greatly the generation capacity provided by gas-fired stations and increase greatly the capacity using biomass as a fuel source. This is one factor supporting the increased activity in the agriculture sector. In the long run there is an overall reduction in generation, in line with the reduction in overall demand for energy. This tends to impact more on the biomass-fuelled generation than other sources and so counteracts the previous increases in demand for this source of generation.

Table 4.3 summarises the impact of the carbon levy on energy use. In the scenario energy use in 2030 is almost 15 percent lower than in the baseline scenario. As a result total energy use falls in the long term. The largest relative impact on energy use occurs among the production sector (particularly the energy-intensive sectors including non-metalic mineral products, food processing, paper and iron & steel) and transport. Household demand is lowered by around 10-15 percent as is the demand from services.

TABLE 4.3: IMPACT OF CARBON LEVY ON ENERGY USE IN THE CZECH REPUBLIC

	% difference from baseline scenario			
	2010	2015	2020	2030
Power generation own use and trans.	-5.9	-1	-0.9	-0.8
Other energy own use & transmission	-0.4	-0.8	-0.9	-0.4
Production	-20.4	-30.6	-32	-33.4
Transport	-1.5	-6.2	-12.4	-24.9
Households	-2.2	-6.9	-10.1	-13.8
Other final use	-7.8	-11.9	-12.7	-12.2
TOTAL	-6.7	-8.9	-10.8	-14.4

As a result GHG emissions are some 25 percent lower in 2030 than in the baseline scenario and around 40 percent lower than in 2000.

The impact of recycling the revenues raised by the levy in the Czech Republic are similar to those described above for the EU as a whole; a positive impact on output, employment, incomes and energy use. However, the scale of the impact is comparatively large in the CZ. Overall, output and employment is 1¼-1½ percent higher by 2030 when the revenues are recycled. The effect of the recycling of the revenues through reduced employers' social security contributions adversely affects the prospects for some sectors, depending on the relative importance of labour costs to the sector nationally compared to the sector in other countries, and the relative reduction in labour costs that can be achieved (which depend on the revenues received through the levy). Basic metals and electronics are two of the sectors that are affected[14]. The relative impact on both output and employment is greater in FBS than it is in manufacturing. This reflects that labour costs make up a larger proportion of overall costs in the FBS sector.

The additional economic activity resulting from the revenue recycling leads to a ½ percent increase in energy demand by 2030. The additional energy use comes disproportionately from the household sector. Domestic use of energy is 1½ percent higher by 2030 with revenue recycling than without it as a result of the additional employment and incomes associated with it.

The introduction of the carbon levy reduces the level of resource use in the Czech Republic by around 1¼ percent in the short term and by a smaller amount (½ percent in the long term). The reduction comes entirely from the imports of commodities (and their associated indirect flows), and primarily the imports of fuels. However, imports of other commodities are also lower than in the baseline scenario as a result of the change in sectoral growth prospects. The results show a slight increase in direct extraction used, with small increases in agriculture and other mining in the long term.[15]

TABLE 4.4: IMPACT OF CARBON LEVY ON RESOURCE USE IN THE CZECH REPUBLIC

	% difference from baseline scenario	
	2015	2030
DEU	0.1	0.3
Imports	-4.9	-2.4
UDE	0.1	0.2
Indirect Flows	-1.8	-0.6
Total	-1.2	-0.6

[14] These are examples where the relative international competitive position of a sector is altered by the fact that the levy revenues allow the labour costs to be reduced by different amounts in different countries.

[15] The impact on direct extraction is more optimistic that we would expect in practice as there is no impact on domestic output of coal and gas in response to the policy. These are commodities in E3ME with the least well-specified behavioural equations, particularly for the EU10 countries. This has resulted in some instances in the equations determining domestic output being 'fixed' up in order to get the model to solve, and in some extreme cases, including for the Czech Republic, this has meant having to remove the sensitivity of output to changes in, say, price or demand. In the case of the impact on the carbon levy scenario the impact is probably to overstate the level of output of the energy extraction industries domestically and at the same time to overstate the reduction in imports (as demand for energy products does respond to changes in price etc).

Issues for sustainable development debate

The scenario identifies a number of potential tensions between the different pillars of sustainable development (environmental, social, economic and institutional) for the Czech Republic.

- The introduction of a carbon levy has a significant impact on energy use and associated emissions. The impact on economic growth and jobs is relatively small (compared to the impact on energy use and emissions) and depends crucially on if, and how revenues are recycled. The material requirement of the economy is greatly reduced, though this is due almost entirely to the impact on energy products. The impact from changes in economic production is small in comparison.
- Revenue-recycling through reduced employer's social security contributions can adversely affect the relative competitive position of sectors compared to other countries even where all countries in the EU are implementing a similar policy.
- The costs and benefits of the policy vary between sectors, which in turn has implications for the distribution of growth, both spatially and between different groups in society. There is some additional support for the agriculture sector in the scenario that bolsters the prospects for the more rural areas (through the increase use of biomass as a fuel). There are also additional 'entry-level' jobs created and additional jobs in manufacturing, but the largest employment boost is in financial & business services which tend to be focused around city regions.
- There is a potential that the policy focus of the scenario does not gain widespread acceptance among the population, rather than businesses. Households face higher energy costs but are not directly compensated (eg through reduced employees social security contributions). Although there is the potential for households to benefit through the expected increase in employment and incomes these are not seen as directly and there is likely to be a lag in their being realised.

4.3. Scenario 2: Increasing Research & Development

Assumptions

It is assumed in this scenario that an indirect effect of introducing a carbon levy is that businesses raise the level of R&D that they undertake. This would be in an attempt to lower their own costs by improving their processes, as well as to improve the energy-efficiency characteristics of the products they produce. These products could be consumer durables (eg domestic appliances, vehicles) or plant and machinery used by other firms.

In the scenario it is assumed that business R&D rises to achieve stated national targets as a proportion of GDP in the short term (eg by 2010) and then remain at that rate. For the EU as a whole it means that business R&D spending would represent around 2½ percent of GDP. As a result, R&D is some 40 percent higher than in the baseline scenario in both 2020 and 2030.

The characteristics of the addition R&D activity varies by country, both in the scale of the additional spending (which depends on the national target set and the gap this represents on current levels of expenditure) and the sectors expected to undertake the R&D (although the major R&D-intensive sectors are similar in each country).

For the EU25 as a whole the sectors undertaking most of the additional R&D include electronics, motor vehicles, chemicals and pharmaceuticals and professional services (within which the R&D sector is classified).

Overview of results

Table 4.5 shows the impact of the scenario on a number of key macroeconomic indicators of sustainable development, compared to Scenario 1, the carbon levy scenario.

TABLE 4.5: IMPACT OF HIGHER LEVELS OF R&D ON KEY MACROECONOMIC INDICATORS

	% difference from Scenario 1			
	2010	2015	2020	2030
GDP				
EU25	2.4	2.5	2.2	2.4
EU15	2.3	2.4	2.1	2.3
EU10	4.4	3.8	3.7	5.3
Czech Republic	4.8	5.9	5.0	4.7
Employment				
EU25	0.7	1.0	0.9	1.1
EU15	0.7	1.0	0.8	0.9
EU10	1.0	1.1	1.1	2.2
Czech Republic	1.8	1.8	1.5	1.9
Energy Use				
EU25	-10.4	-9.9	-10.1	-9.3
EU15	-11.2	-10.1	-10.4	-9.6
EU10	-5.4	-8.4	-8.1	-7.5
Czech Republic	-3.6	-5.0	-5.8	-6.6
GHG Emissions				
EU25	-10.2	-11.4	-11.7	-10.5
EU15	-11.0	-11.9	-12.7	-11.5
EU10	-5.4	-8.6	-7.0	-6.0
Czech Republic	-4.7	-6.4	-7.2	-7.9

The overall impact of the additional R&D is to raise GDP in EU25 by 2½ percent by 2030. The largest relative impact is in the EU10, where GDP is around 5-5½ percent higher. Among the countries to see the largest impact are the Netherlands, Germany and Ireland, which, with the exception of Germany, are countries with the largest proportionate increase in R&D expenditure.

Overall, the largest impact is seen in manufacturing, where value-added in 2030 is some 5½-6 percent higher. However, output in financial & business services (this is the sector in which R&D activities are classified) and transport & communications is also around 3 percent higher. The transport sector benefits from the reduction in costs that come from the improvement in vehicles, and communications (particularly telecommunications) is among the sectors to exploit the products from R&D activities.

The employment impact amounts to 1 percent (some 2.7m jobs) by 2030. Most of these net additional jobs are created in the EU15, though just under 1m are created in EU10 by 2030. The largest proportionate increase is among FBS (3¼ percent by 2030), followed by manufacturing (2¼ percent) and transport & communications (1¼ percent). Given the relative impact in output by sector, this illustrates the relatively high levels of productivity in manufacturing compared to FBS.

There is a relatively quick impact on energy use, with energy use in the EU25 10 percent lower by 2010 as a result of the addition R&D. The relative scale of the impact remains at around this rate to 2030. The relative impact is greater among the EU15. Emissions of GHGs are reduced as a result of the lower energy use. The distribution of the impact across the EU25 is generally in line with the impact on energy use[16].

Results in more detail for CZ

In the scenario, business R&D in the Czech Republic rises to 2½ percent of GDP compared with a level of spending in 2003 of just over 1½ percent.

The additional R&D is undertaken by those sectors that are already undertaking the bulk of R&D in the country, predominantly motor vehicles and professional services.

Table 4.6 shows the impact of the scenario on value-added by broad sector in the Czech Republic.

TABLE 4.6: IMPACT OF HIGHER LEVELS OF R&D ON GVA IN THE CZECH REPUBLIC

	% difference Scenario 1			
	2010	2015	2020	2030
Agriculture	2.3	2.8	2.3	2.1
Mining etc	-0.5	-0.4	-0.8	-1.3
Manufacturing	16.4	17.4	14.4	13.4
Utilities	-1.8	-14.2	-12.8	-10.5
Construction	2.6	3.4	2.4	1.7
Dist., hotel & cater	4.4	4.8	3.6	2.6
Transp.& Comms	3.1	5.3	4.6	4.5
Fin. & Bus Services	6.8	10.1	8.8	7.6
Government & Other services	0.9	1.4	1.1	1.3
TOTAL	7.9	8.3	6.9	5.9

The impact of the additional R&D activity in the Czech Republic is to raise output (value-added) by 6 percent in the long term. The largest impact is in manufacturing, with output almost 15 percent higher. In contrast, the increases in FBS and the more leisure-related services (including retailing, hotels & catering) are 7-10 percent and 2½-5 percent respectively.

Within manufacturing the greatest increases are in pharmaceuticals, chemicals, textiles, metal goods, motor vehicles and electrical and instrument engineering, though these are not always the sectors that have seen the largest proportionate increases in R&D spending. For example, although the increase in R&D by pharmaceuticals is relatively small, there is a comparatively large impact on output from the sector. Motor vehicles is one sector where a large increase in output has required a large increase in R&D. The relative impact on a sector domestically will depend on the relative behaviour of sectors in other countries. For example, if business R&D in, say, motor vehicles rises in all countries, then the domestic sector will see its relative competitive position deteriorate if it does not also increase its investment.

In the scenario employment in the Czech Republic is around 2 percent higher in 2030 than in the absence of the additional R&D activity. Manufacturing employment is around 3½ percent higher in

[16] The impact depends on the particular mix of fuels used in each economy.

the long term, although the relative impact on employment in FBS is greater. Employment in the sector is around 4 percent higher than it otherwise would be.

Table 4.7 shows the impact of the scenario on energy demand. In the scenario energy use is 6-7 percent lower by 2030 than in Scenario 1, resulting in a similar proportionate reduction in GHG emissions.

The largest reductions are made by the major manufacturing sectors, such as the iron & steel and ore extraction industries, where energy use is some 20-25 percent lower by 2030 despite increases in output. As these industries are energy intensive they therefore benefit most from improvements in energy efficiency of machinery and improvements in their own processes. Other manufacturing sectors see their energy needs lower by 10-15 percent. Household energy use is around 8 percent lower by 2030 and that by road transport more than 15 percent lower. This is sufficient to result in a reduction of energy use by road transport in absolute terms after 2020.

TABLE 4.7: IMPACT OF HIGHER R&D ON ENERGY USE IN THE CZECH REPUBLIC

	% difference from Scenario 1			
	2010	2015	2020	2030
Power generation own use and transm.	-1.6	-0.2	0.1	0.1
Other energy own use & transmission	0.1	0.1	0.2	0.1
Production	-8.3	-12.6	-14.7	-15.9
Transport	-5.7	-11	-13.4	-16
Households	-4.3	-7.2	-7.9	-8.6
Other final use	-2.9	-3.9	-4.4	-4.2
TOTAL	-3.6	-5	-5.8	-6.6

Improvements in the efficiency of the national vehicle fleet are assumed to be influenced by R&D activities by the motor vehicles industry in the EU as a whole, and not just that of the national industry. There are, therefore, important spillover effects from national R&D programmes for the EU as a whole.

Table 4.8 shows the impact of higher R&D activity on resource use in the Czech Republic on various key indicators. Overall resource use is higher as a result of the economic consequences of higher R&D. The strongest increase is in imported goods, and those that have a relatively high level of indict resource flow associated with them. There is a small increase in domestic extraction of agriculture and other mining in the scenario. Although resource use is higher in the scenario than in the baseline, the material intensity of the economy is in fact lower. Both the total material requirement (TMR) and domestic material input (DMI) intensity of GVA is lowered (eg TMR per GVA is 10 in 2030 in the scenario compared to 10.3 in Scenario 1).

TABLE 4.8: IMPACT OF HIGHER R&D ON RESOURCE USE IN THE CZECH REPUBLIC

	% difference from Scenario 1	
	2015	2030
DEU	1.0	1.1
Imports	2.5	1.8
UDE	0.5	0.4
Indirect Flows	9.0	5.2
Total	3.5	2.5

Issues for the sustainable development debate

The scenario identifies a number of issues regarding sustainable development for the Czech Republic.

- The impact on economic growth is positive, particularly in manufacturing which is the sector of the economy where underlying employment prospects are weakest.
- Energy use (and GHG emissions) is reduced, particularly among the key energy users including heavy engineering and road transport.
- The reductions in energy use are the result of 'technological' solutions rather than a change in behaviour.
- There is a favourable effect on measures of the material intensity of the economy, but this is not due to a reduction in the overall use of materials but rather that the increase in resource use is slower than the increase in GDP. Direct extraction is higher, as are imports of semi-manufactured commodities as a result of the increase in activity in the economy. Importantly, the impact on indirect flows associated with the imports could be proportionately larger than the increase in imports.
- As higher R&D does not necessarily lower material use there is still a need to deliver resource efficiency through other means if the absolute level of resource use is to be reduced.
- There are important tensions relating to the capacity of the economy to provide the conditions needed to deliver the scenario. These include whether there are sufficient skilled researchers, whether existing manufacturing sites are suitable to adapt to new processes or whether instead new facilities on 'green field site' developments would be needed, or whether the result of the move to higher skilled production might lead to clustering of activities (around the central city region as the likely source of qualified workers).

4.4. Scenario 3: Raising Resource Use Efficiency

Assumptions

The earlier scenarios have shown that while a focus on raising the cost of energy, or on improving the energy efficiency of production can have a favourable impact on the material intensity of an economy (on some measures) it does so in a limited way. This is typically either by reducing the extraction/use of energy products (coal, oil) or by focusing additional growth on the less resource-intensive parts of the economy. There is little impact on the more general resource use and requirements of the economy.

In this third scenario it is assumed that an additional indirect benefit from the introduction of the carbon levy, and the focus this gives to using the energy resource effectively, is that it focuses attention on the efficient use of all resources. The result is that a variant on the so called 'Aachen scenario' is brought about. Manufacturing and construction achieve a 20 percent reduction in material input costs through the widespread implementation of currently known technologies and best practices[17]. These savings are achieved in the decade from 2005 to 2015 (ie 2.2 percent p.a.). Thereafter it is assumed that the focus to make additional (ie above trend) improvements continues but to a lesser degree (savings of 0.5 percent p.a.). It is assumed that the savings are achieved through the more effective decision making on future advice and capital equipment rather than by firms spending more on advice or investment over and above that in the baseline scenario. It is therefore about making 'smarter' choices in investment decisions.

Overview of results

Table 4.9 shows the impact of the scenario on a number of key macroeconomic indicators of sustainable development, compared to the results from the enhanced R&D scenario discussed above.

In this scenario GDP in the EU25 is lower than in the absence of the stronger resource efficiency trends, by around 3 percent by 2015 (the year in which the main additional resource savings are achieved) and by around 2¼ percent in the long term. In the short term, the impact is mainly felt in the EU15, the economies that will be supplying most of the manufactured inputs for which demand is being reduced as a consequence of the improvements in resource efficiency.

There are important differences in the impact that the scenario has on different indicators of economic output. While the impact on GDP is negative (and that on industry output is more adverse), there is a positive impact on value-added.

There are conflicting influences. Manufacturers face reduced demand for their products (as a result of improved efficiency by others). However, manufacturers also face lower costs as a result of the more efficient use of inputs. This offers firms a range of options to trade off the lower costs against increased profit margins or lowering the price to stimulate sales. The extent to which firms are able to maintain prices (and so increase profit rates) varies greatly across industries, and is determined by the estimated parameters in E3ME. For example, monopolistic sectors, such as power generation are more likely to be able to pass on any cost increases to customers.

The impact on GDP varies greatly by country. The countries seeing the largest increases include Ireland, Germany and Finland, countries which are major suppliers of manufactured inputs. Many countries in the EU10 see a positive GDP impact.

As a result of the lower levels of economic output (as against value-added) in the EU25 in the scenario, the use of energy is lowered by 5-6 percent from 2015. The greatest impact is in the energy-intensive sectors of metal manufacture, where output is greatly reduced.

[17] The Aachen scenario assumes similar savings are also achieved by the public administration sector.

TABLE 4.9: IMPACT OF RESOURCE EFFICIENCY SCENARIO ON KEY MACROECONOMIC INDICATORS

	% difference from Scenario 2			
	2010	2015	2020	2030
GDP				
EU25	-1.9	-3.1	-2.1	-2.2
EU15	-1.9	-3.2	-2.2	-2.2
EU10	-0.6	-1.0	-1.3	-2.2
Czech Republic	0.0	1.7	2.9	1.6
Employment				
EU25	-1.3	-2.2	-2.1	-3.0
EU15	-1.2	-2.1	-2.1	-2.9
EU10	-1.8	-2.7	-2.4	-3.4
Czech Republic	-2.6	-3.9	-3.6	-5.2
Energy Use				
EU25	-2.8	-5.3	-4.5	-6.0
EU15	-2.9	-5.6	-4.8	-6.1
EU10	-1.9	-3.1	-2.7	-5.4
Czech Republic	-1.2	-2.1	-2.6	-3.1
GHG Emissions				
EU25	-3.3	-6.3	-5.5	-7.3
EU15	-3.5	-6.7	-6.0	-7.5
EU10	-2.5	-4.0	-3.1	-6.8
Czech Republic	-1.7	-2.5	-2.7	-3.3

The effect of the reduced energy use is to lower GHG emissions by a similar amount, 7 percent by 2030.

The effect of improved material efficiency across the EU25 is to greatly reduce the level of direct extraction. By 2030 the level of extraction is some 20-25 percent lower than under no improvement in efficiency trends, with the greatest savings being made in other (non-energy) mining, which includes ores and aggregates. Levels of extraction from agriculture are also lower as a result of the more efficient use of the products in food processing etc.

Comparison with other analyses of the 'Aachen scenario'

Other modelling has considered the impact that the 'Aachen scenario' could have for the German economy under three alternative frameworks[18]:

- Imperfect markets where dematerialisation takes place within current wage and price formulation structures
- Wage competition – where productivity gains achieved through resource efficiency do not lead to higher wages
- Price competition – where productivity gains are passed on to consumers in the form of lower prices, while wage-setting behaviour is in the same as the imperfect markets scenario.

The analysis was undertaken using INFORGE, an inter-industry model of the German economy and considered the impact occurring over 2004-15.

The analysis conducted showed that, although GDP was higher in all three scenarios than it would have been in the absence of the material efficiency gains, it was only in the second framework, where labour costs did not respond to improvements in resource efficiency (lower cost base) where there was a positive employment impact.

The largest loss of jobs was under the imperfect markets framework. This is the framework which most closely represents the situation in E3ME, where reductions in costs of production arising from the need for fewer resources can be shared to varying degrees between increasing profits to the firm and increasing wages for those employed.

There are some important differences between this earlier analysis and the scenario modelled for MATISSE.

In the MATISSE scenario firms are assumed to be able to make the transition in behaviour without the need to spend any of the financial savings on advice or additional investment. Therefore, the direct demand shock to the economy is greater. Were it to require some of the savings that are being made in input costs from improved resource efficiency to be spent in additional investment, then this would increase the economic and associated impacts. A fair proportion of the spending would be focused on the relatively labour-intensive consultancy sector, and there is also the strong likelihood that this input would be sourced domestically. Also, the transition is assumed to occur throughout the EU and so the relative competitiveness effect on sectors nationally are unclear. Were the impact only to occur in a single country, then it would be expected to improve its relative competitive position (and so trade performance) unambiguously. Also, if all countries are reducing their demand for manufactured inputs then sectors face reduced demand for their exports as well as reduced domestic demand.

Results in more detail for CZ

Table 4.10 shows the impact of the scenario on value-added by broad sector in the Czech Republic.

The impact of the stronger trends in resource efficiency means that GDP in the Czech Republic is some 1½ percent higher in 2030. As for the EU25 as a whole, the impact on value-added is more positive than for GDP, while the impact on industry output is negative.

The impact of the scenario on output is more 'pronounced' in the Czech Republic than it is for the EU as a whole (as it generally is for most countries individually). The scenario changes the relative international competitive position of industries. As in the scenario manufacturing in all countries improves its resource intensity by 20 percent, the relative impact on costs is greater for those sectors in

[18] Impulses for Growth and Employment through Profitable Savings in Material Resources, Fischer, Lichtblau, Meyer and Sceheelhaase

countries which are relatively inefficient (where manufactured inputs currently comprise a relatively high level of overall costs).

The greatest increase in value-added is for manufacturing despite a fall in industry output[19]. Some sectors within manufacturing see output, as well as value-added, rise. These include basic metals and electronics.

TABLE 4.10: IMPACT OF IMPROVED MATERIAL EFFICIENCY ON GVA IN THE CZECH REPUBLIC

	% difference from Scenario 2			
	2010	2015	2020	2030
Agriculture	3.4	7.8	9.7	13.5
Mining etc	3.8	7.6	8.9	10.4
Manufacturing	-0.6	29.5	35.5	32.4
Utilities	2.2	-9.1	-7.8	-5
Construction	36.2	92.9	126.8	166.4
Dist., hotel & cater	-0.5	0.9	2.7	3.8
Transp.& Comms	-1.5	-2.8	-2.1	-2.9
Fin. & Bus Services	-2.9	-4.7	-4.2	-7.3
Government & Other services	1.5	3.2	4.1	4.2
TOTAL	1.4	13.5	17.1	17.3

Although not directly affected in the scenario, output (value-added) is lower in FBS on account on the lower levels of activity going on elsewhere in the economy. Distribution, hotels & catering benefit from the lower prices of goods, and the effective boost this gives to consumer spending.

The impact that increasing resource efficiency has on employment is similar in pattern and scale to the impact on output. Overall, employment is some 4 percent lower by 2015 and 5¼ percent by 2030. Manufacturing employment is 10 percent lower in 2015 (165,000) while manufacturing in FBS is 3½-4 percent (28,000) lower.

The impact that improvements in resource efficiency have on energy use are shown in Table 4.11. They reflect the impact on output by sector. Overall, energy use is some 2 percent lower in 2015 and 3 percent in 2030 as a result of the sectoral changes. Energy use by manufacturing is some 12½ percent lower while that of services is 3 percent lower.

GHG emissions are correspondingly 2½ percent lower in 2015 and 2½ percent in 2030.

[19] The impact on construction is, we feel implausible, given the fall in overall output. It is likely to result from poorly specified parameters linking demand to changes in prices. The sector is one where material inputs comprise a very high proportion of overall costs. The cost savings implied in the scenario are also substantial, and of a scale not seen in the data available to estimate model parameters. The result of

TABLE 4.11: IMPACT OF IMPROVED MATERIAL EFFICIENCY ON ENERGY USE IN THE CZECH REPUBLIC

% difference from Scenario 2

	2010	2015	2020	2030
Power generation own use and transm.	-0.7	0	0.1	0.1
Other energy own use & transmission	0	-0.1	-0.1	0
Production	-3.3	-8.1	-10.4	-12.6
Transport	-2.3	-4.2	-4.5	-5.2
Households	-0.3	-1.4	-2.3	-2.8
Other final use	-1.1	-2.3	-2.8	-2.9
TOTAL	-1.2	-2.1	-2.6	-3.1

Impact on resource use

The scenario is intended primarily to improve the level of resource use. Table 4.12 summarises the impact on key indicators of resource use[20]. The scenario produces a significant reduction in the resource intensity of output.

TABLE 4.12: IMPACT OF HIGHER R&D ON RESOURCE USE IN THE CZECH REPUBLIC

% difference from Scenario 2

	2015	2030
DEU	-2.6	-5.1
Imports	-9.6	-5.0
UDE	-1.1	-1.4
Indirect Flows	-24.0	-19.8
Total	-9.8	-9.5

There is a reduction in the direct extraction of resources of 5 percent by 2030, through reduced agricultural output and a steadily increasing reduction in extraction of other (non-energy) mined resources throughout the scenario period. The level of imported resources is lowered, by around 10 percent by 2015, though the impact of the scenario falls thereafter to end at around 5 percent of imports by 2030. Imports of all major categories of products are reduced, but the largest relative effects are among other (non-energy) mining products, although this accounts for a relatively small

[20] The projections of material use which are summarised in Table 4.10 have been made outside of the formal E3ME model by using E3ME projections for the value (in constant prices) of industry output and imports of commodities to project detailed data on material inputs constructed by the Wuppertal Institute. The projections in the scenarios run assume no change in the material intensity of the value of output (in the case of direct extraction) or imports of particular commodities.

amount of the overall magnitude of change. The impact is dominated by the impact of imported (non-primary) products, particularly chemicals, basic metals and non-metallic mineral products.

Issues for sustainable development debate

A number of potential tensions arise for sustainable development from the analysis presented above.

- The economic impact of widespread resource efficiency can vary depending on the precise indicator that is being considered. Improving resource efficiency does not necessarily lead to stronger economic activity (and employment) by improving the competitive position of sectors when similar policies are being pursued in other countries. However, some industries can gain. Also not increasing resource efficiency would be detrimental to competitiveness in the event that other countries pursue policies to promote resource efficiency.
- Improvements in (non-energy) resource efficiency can lead to lower energy use (and GHG emissions) as result of the impact it has on economic output. There are thus synergies between dematerialisation and climate change mitigation.
- The effect is a significant reduction in material intensity of output, both with a reduction in direct extraction and in the level of imports. The impact on indirect flows associated with the imports can be much greater than the reduction in direct imports.
- It can be questioned whether businesses would focus on total resource use as a result of significant increases in the cost on one resource input (energy). If it did, then there is also a question as to whether it would need additional spending by firms to bring it about or whether this could be achieved by more focused choices over future spending plans (as we have assumed in this scenario). If it does require some of the savings that are being made in input costs from improved resource efficiency to be spent in additional investment, then this will increase the economic and associated impacts (GVA, employment, resource use).
- The economic impact will be less favourable in an economy which has a strong focus on component manufacturing activities. This could limit the social acceptance of pursuing such a policy.
- There might be a tension in the manner by which the cost reductions achieved in certain sectors are shared between improvements in company profits and with the workers through higher wages.
- The scale of the impact on material use reduces over time. The effect for those commodities whose importance is already expected to reduce over time anyway is to bring forward the time when efficiencies are achieved.

4.5. Summary of Scenarios

Table 4.13 summarises the impact of the scenarios on the Czech Republic in terms of several 'headline' indicators of sustainable development.

Together, the measures result in a higher level of economic output, though slightly lower employment and reduced levels of energy demand, GHG emissions and resource use.

However, there are important issues, and potential tensions for sustainable development raised by each of the scenarios considered.

TABLE 4.13: SUMMARY OF SCENARIO IMPACTS: CZECH REPUBLIC

% of baseline in 2020

	Carbon levy	Increased R&D	Material efficiency	Total
GDP	0.9	5.1	3.1	9.0
GVA	1.5	7.0	18.6	27.0
Employment	0.8	1.5	-3.6	-1.3
Energy use	-10.8	-5.2	-2.2	-18.2
GHG emissions	-17.4	-5.9	-2.1	-25.4
Resource use (TMR)	-1.2	3.4	-10.0	-7.8

5 Response of Stakeholders in the Czech Republic

The scenario analysis outlined in the Section 4 formed the basis of discussions with stakeholders in the Czech Republic. The goal was to integrate their knowledge and to ensure the legitimacy, policy relevance and credibility of the ISA case study. The workshop "Czech Republic On The Road Towards Sustainability" took place in Prague, on November 6th, 2007 with a focus on MATISSE results with respect to the Czech Republic and especially the ETR-scenario work. Beside the project team, 14 participants took part in the workshop and 10 of these completed the main questionnaire that was handed out at the end of the workshop and provides insights into learning experiences.

The workshop in November 2007 was the third workshop with Czech stakeholders held within the MATISSE project. The first workshop (April 2006) was attended by stakeholders from Czech Ministries and Agencies, non-governmental organisations and academia. It developed elements of a sustainability vision for the Czech Republic. The second workshop (September 2006) was poorly attended but served to discuss the results of the first set of scenario calculations (experimenting phase of the ISA).

In general, the November 2007 workshop generated a much wider response than previous MATISSE workshops in Prague – probably also due to the fact that it was promoted in the ETR community of the Czech Republic. One of the participants also stressed that "especially in the Czech Republic the situation [regarding ETR] is of serious concern, as first measures in the direction of an ETR are being taken since January 2007 (only regarding energy)."

Figures 5.1 and 5.2 and table 5.1 show the self-evaluation of the stakeholders participating in the November 2007 workshop regarding organisational background, their organisation's goals *vis-a-vis* a sustainable development of the Czech Republic and the importance of sustainability to their **organisation.**

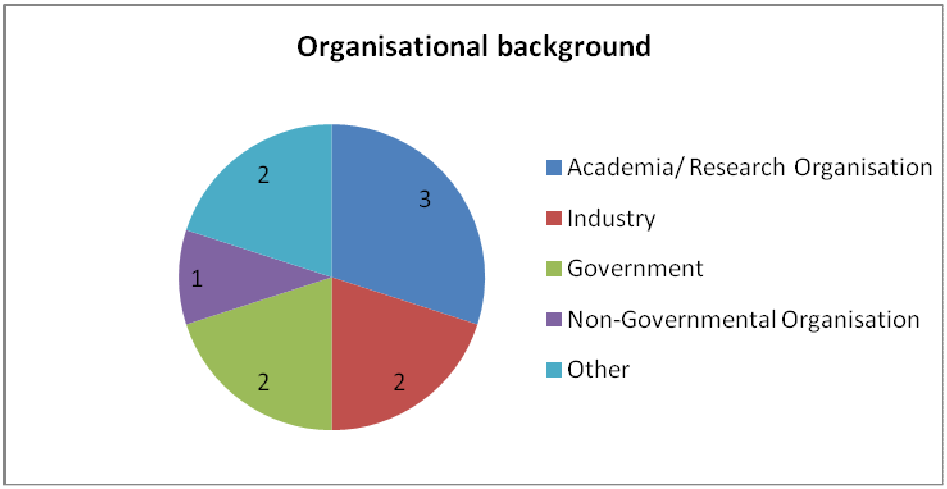

Figure 5.1. Which of the following best describes the organisation you work for?

The organisational background of the participants covered a wide range, with only a slight tendency towards people from academia/research. For about one third of the participants sustainability considerations play a very important role in their organisation's decision making. For a further third of the participants they play an important role and for the remaining third they play no role.

Table 5.1. Answers to "What are your/your organisation's goals vis-à-vis a sustainable development of the Czech Republic?"	
information on sustainable development / consulting	3
promote sustainable consumption and production	2
sustainability assessment	1
environmental sustainability	2
energy savings in buildings	1

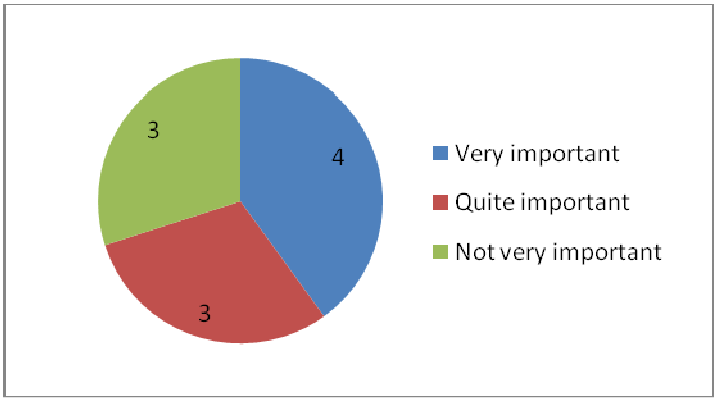

Figure 5.2. How important are considerations of 'sustainability' to your organisation's goals and decision-making?

5.1. Ranking of visions' elements

At the beginning of the workshop the views of stakeholders on the Czech vision for sustainability and the key challenges in achieving it were gathered through questionnaires (see appendix). This exercise took place before any material had been presented or discussions held and again at the end of the workshop in order to elicit whether learning had taken place.

The participants were asked to rank seven elements of the sustainability vision according to

(a) how important they seem to them and

(b) how challenging they thought it would be to achieve them .

For this exercise, the sustainability vision (derived from the April 2006 workshop) was split up into seven elements – each of which had to be ranked from 1 to 5 according to importance and influence. Table 5.2 shows the scale used when ranking the elements of the vision.

Table 5.2: Scale used for ranking elements of the vision according to importance and challenge		
Scale	**Importance**	**Challenge**
1	*essential*	*almost unachievable*
2	*very important*	*very challenging*
3	*quite important*	*quite challenging*
4	*rather unimportant*	*rather easy to achieve*
5	*not important at all*	*no problem to achieve*

The seven elements that had to be ranked were:

1. stable economic growth
2. achieving a similar standard of living as that experienced in most other countries in the EU
3. healthy, productive, educated and qualified workforce
4. good jobs located in areas other than just the major cities ('fair' regional distribution of benefits of growth)
5. distinct cultural heritage is maintained
6. full environmental and social cost of activities will be paid and the environmental burden of activities will not be shifted to others
7. achieving a level of material and resource use that is close to the sustainable level

Fourteen participants filled in this questionnaire. The second questionnaire which was handed over at the end of the workshop included the elements of the sustainability vision again. At that time, the participants were not asked to rank them, but they were asked, if their opinion regarding importance and challenge changed in the course of the workshop.

In the following the results concerning the ranking of the vision's elements are shortly described.

Importance

"*A healthy, productive, educated and qualified workforce*" was seen as the most important element. All participants except one ranked it as essential or very important. Interestingly, two participants stated at the end of the workshop that they would now evaluate it at less important (Table 5.3), for none it became more important.

This element is followed by "*full environmental and social cost of activities will be paid and the environmental burden of activities will not be shifted to others*" (ten out of 14 ranked it as essential or very important).

Also "*stable economic growth*" and "*achieving a level of material and resource use that is close to the sustainable level"* were highly ranked (8/9 persons ranked it as essential or important).

The elements "*Good jobs located in areas other than just the major cities ('fair' regional distribution of benefits of growth)*" and "*achieving a similar standard of living as that experienced in most other countries in the EU*" were mainly ranked as very or quite important, but after the workshop were not ranked any longer as essential. The latter is even evaluated as less important by three participants after the workshop.

The element that was ranked as least important is "*distinct cultural heritage is maintained*" (median of 2.5). 4 persons ranked this element as rather unimportant or not important at all.

In total three elements were ranked as "not important at all" once - which is due to one participant. (S)He ranked a stable elements "economic growth", "achieving a similar standard of living" and the "cultural heritage" as not important at all.

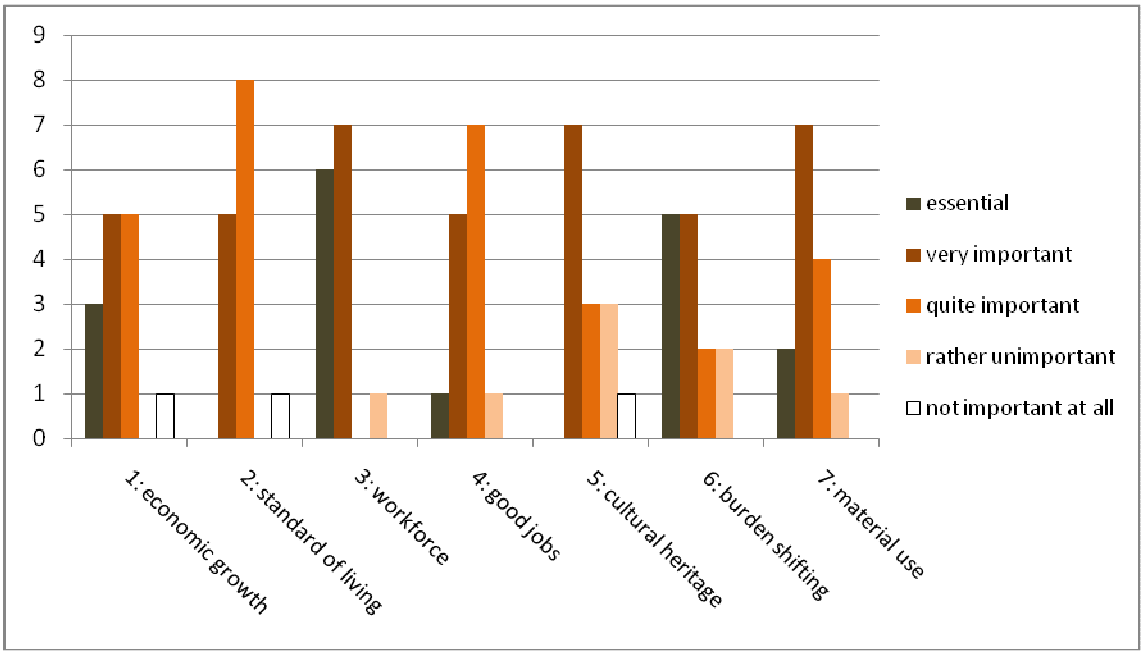

Figure 5.3: Results of the importance ranking exercise. The horizontal axis gives the numbers of the elements given above and truncated version of the element (full length in the text above). The vertical axis states the number of persons.

Challenge

The element which seems by far most difficult to achieve according to the workshop's participants is a reduction of burden shifting, i.e. "*full environmental and social cost of activities will be paid and the environmental burden of activities will not be shifted to others*". Twelve out of 14 persons rated this element as almost unachievable or very challenging (modal 1; median 1.25). Additionally, two participants even stated that the workshop made them feel that this element is more difficult to achieve (Table 5.3). Interestingly this is also the only element which was ranked as "no problem to achieve" by one participant.

10 out of 14 rated the element of the vision "*achieving a level of material and resource use that is close to the sustainable level*", as almost unachievable or very challenging. Also in this case, three participants rated this element as more difficult to achieve after the workshop.

These two most challenging elements are also rated as one of the most important elements – which shows a certain doubt of the workshop's participants that the sustainable vision can be achieved.

The most important element "*good jobs located in areas other than just the major cities ('fair' regional distribution of benefits of growth)*", was only ranked as unachievable by two persons. All other participants (13) ranked it as very or quite challenging.

"*Achieving a similar standard of living as that experienced in most other countries in the EU*" and a "*healthy, productive, educated and qualified workforce*" are also mainly very or quite challenging according to the participants.

The least challenging elements are "*stable economic growth*" and the *maintenance of a distinct cultural heritage* – although still in the range of "quite challenging". The first one was even thought easier to achieve after the workshop than before.

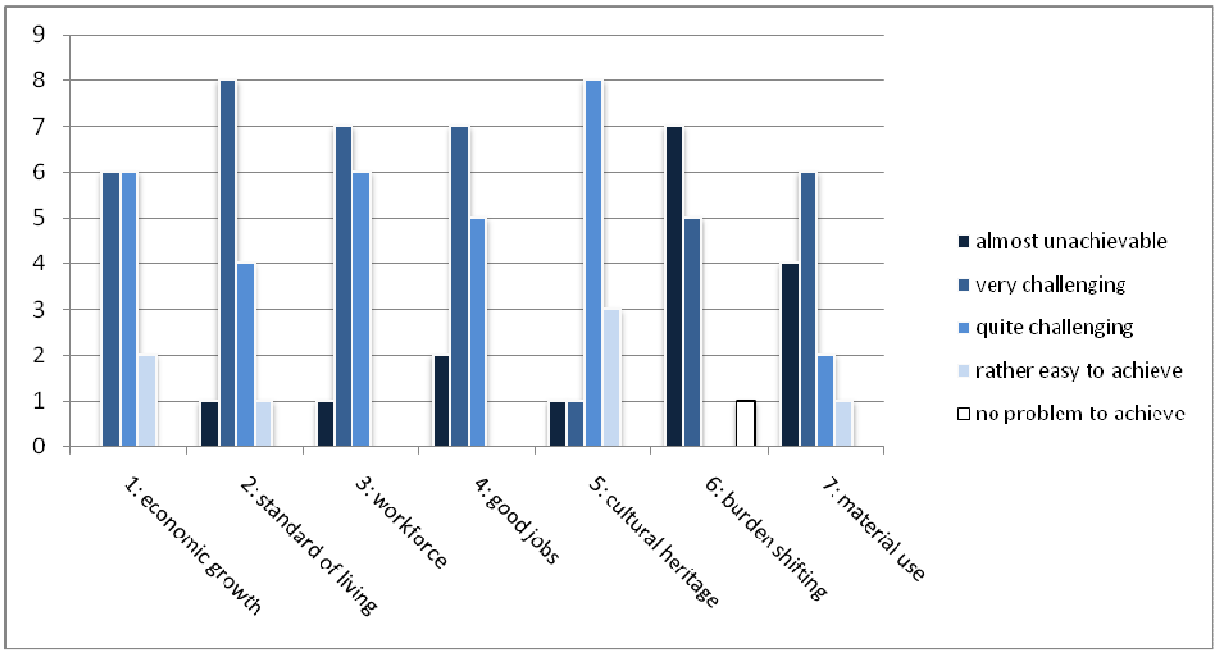

Figure 5.4: Results of the ranking exercise according to "challenge to achieve". The horizontal axis gives the numbers of the elements given above and truncated version of the element (full length in the text above). The vertical axis states the number of persons.

Table 5.3: Change of opinion regarding importance / challenge of vision's elements

	more important	less important	more challenging	less challenging
1: economic growth	1	2	0	2
2: standard of living	1	3	1	2
3: workforce	2	0	1	0
4: good jobs	1	1	0	1
5: cultural heritage	1	1	0	1
6: burden shifting	1	1	2	1
7: material use	1	1	3	0

4.1. Discussion at workshop and further insights from the questionnaire

The discussion at the stakeholder workshop started with a moderated part, in which it was up to the participants to raise issues arising from the results of the MATISSE research that seemed most interesting to them. Then other tensions (see above) that had been raised by the research but not addressed in the discussion previously were discussed.

At the end of the workshop the participants were asked to fill in a second questionnaire (see Appendix 2), which – besides the questions on changes of opinion (see above) – included some statements out of (internal) working papers and assumptions made within MATISSE. The stakeholders were asked to

indicate how much they agree or disagree by ticking the corresponding boxes. Due to the fact that some stakeholders had to leave early, only ten persons filled in this questionnaire. An overview of the results is given in Table 5.3.

In the following the discussion at the workshop and the findings from the questionnaire are summarized under related topics.

As an introductory question in the questionnaire the chances of new member states to initiate a transition towards sustainability were addressed. The tendency shows that stakeholders rather disagree with the statement that "*new member states have better chances to initiate a transition towards sustainability*". However, most stakeholders neither agreed nor disagreed.

ETR and Policies

The issue of ETR was raised in the previous workshop (September 2006) as being of major interest for the Czech stakeholders. Following this stakeholder event the issue was taken up in the MATISSE work. The basis for the modelling work was laid in an internal MATISSE paper[21]. This paper included on the one hand the Czech sustainability vision, which was developed at the first stakeholder workshop and assessed in the 2007 workshop using the questions on importance/challenge discussed above; in addition the paper described key assumptions for the modelling work, which were also addressed at the workshop:

The stakeholders were asked if they agree with the statement that "*An Ecological Tax Reform (ETR) in the CZR would reinforce the drive for technical progress through R&D and, in the case of the EU10, the speed of the transition in technological and organisational structures to those of most other EU countries.*", which derives from the internal background paper on the 2nd iteration of ISA[22]. The majority of the stakeholders agreed with the first part of this statement ("An Ecological Tax Reform (ETR) in the CZR would reinforce the drive for technical progress through R&D"), but were unsure if this would also "speed the transition in technological and organisational structures to those of most other EU countries" (three agreed, four neither agreed, nor disagreed).

The internal background paper also includes the following vision on the introduction of an ETR in the Czech Republic: "The Czech Republic actively embraces ETR as a means to limit the potential environmental impact of future economic growth. It is keen to achieve more far-reaching efficiencies in resource use and for efficiencies to be improved in more areas of the economy than are envisaged in the 'Aachen scenario'. Its desire for more active policies in this area result from the desire to encourage competitive businesses and environmental responsibility, but also from a belief that more far-reaching environmental tax reform will, in time, become the norm within the EU and being at the forefront of the movement will achieve longer term benefits for the economy."

The questionnaire included two parts of this assumption to be evaluated by the stakeholders: "*ETR will become the norm within the EU*." and "*The CZR can achieve longer term economic benefits by being at the forefront of this development*". Half of the stakeholders agreed with the assumption that ETR will become the norm within the EU, the other half neither agreed nor disagreed, except one stakeholder who disagreed. The answers to the second part were more heterogeneous. One participant strongly agreed that the CZR can achieve longer term economical benefits by being at the forefront of this development, two agreed. The majority was unsure (neither agreed nor disagreed). One participant strongly disagreed.

The open part of the questionnaire included a question regarding appropriate policies for the Czech Republic to foster sustainable development. None of the participants answered with ETR, but the discussed issues were all named: i.e. energy, transport, agriculture, R&D. One mentioned that

[21] Sustainable Development Visions and Pathways. Developed for the Second Round of ISA Case Study on Sustainable Environmental Technology, Transition of National Economies. Version 2.

[22] ibid

integrated (cross-sectoral) sustainability policies would be most appropriate, one mentioned "financial" policies.

During the discussion one participant mentioned that *"on the one hand the progress made on implementing ETR in the EU is not very big, but the call for ETR in many EU policies is getting louder, e.g. in the Green Paper on market-based instruments. It is necessary to establish a platform to make market-based instruments more efficient."* He distinguished two streams on the EU level in order to tackle the energy issue:

a) a tax on diesel and maybe also other fuels (there is general agreement that this should be raised);

b) a parliament proposal directive on road pricing and taxation on vehicles (seems to be agreement on how to proceed);

In contrast to policy measures, it was also asked what role individuals can play "to make the Czech Republic's development more sustainable". There is a clear tendency towards the opinion that individuals play an important role ("crucial", "significant", "key"). Only one participant stated that individuals can only play a small role. Nevertheless, the role of individuals is seen as supplementary to policies, as those participants stressing their role also mentioned diverse policy measures.

ETR trade-offs

Several trade-offs are usually discussed in the context of ETR. Stakeholders at the MATISSE workshop agreed that there is no ideal ETR case/set-up, therefore science should be used in order to show what impacts can be expected.

The following issues were discussed during the stakeholder meeting:

- **adverse social impacts**: The argument was put forward that retired persons and people without income (unemployed, parents staying at home) would be exposed to relatively larger impacts. Mitigation strategies to reduce the adverse social impacts have to be considered, e.g. the introduction of a compensation scheme (either as lower labour taxes or direct monetary compensation). This might oppose the fact that ETR should be revenue neutral.
- **erosion of tax basis:** When introducing ETR, public finances may not be stable. Tax revenues might be lost or uncertain as the tax base is eroded (as production/ consumption is reduced).
- **obstacles to technology change**: The taxation of energy products and electricity is based on the Directive 2003/96/EC, which therefore is the basis for energy related ETR-measures. It was mentioned by one of the experts that this directive does not differentiate the input (fuels) for electricity generation, a fact which is not optimal regarding the environmental goal. Other possibilities would be to introduce an input tax or charges on specific pollutants (which would probably mean too many), or to introduce subsidies for "desired" technologies (which raises the question of how to fund them?). Therefore it would be important to test different hypotheses to find out which kind of R&D scheme could enhance technology progress as much as possible.

Furthermore, trade-offs between efficiency increases of the industry versus negative impacts on household level were named.

Regional aspects of sustainable development

A special emphasis of an ETR has to be placed on ensuring that all regions profit from such taxation changes. The ETR can not be a sustainable solution, if only the main cities benefit from it. There are no hard numbers in MATISSE to support this assumption but the sectoral outcomes, trends etc. of the model show rather a regional divergence, unless particular policies are introduced to spread growth

more widely and it can be assumed that different Czech regions will be affected to a different extent from the measures taken in the context of an ETR.

The question of a "fair" regional distribution of benefits from growth was also regarded as an essential element of the Czech sustainability vision – and also major difficulties to achieve it were seen by most stakeholders.

Therefore this topic was raised explicitly in the discussion in order to get the experts' and stakeholders' attitudes towards these questions. Moreover the open part of the questionnaire included questions regarding appropriate policies for the Czech Republic

- to reverse rural to urban migration;
- to keep urban sprawl within sustainable limits; and
- to make agriculture sustainable.

There was no clear agreement among the stakeholders whether this regional divergence is negative or not. One participant stated that "this is definitely a negative outcome". Others replied that it depends on what is done with free resources and that it depends whether one focuses only on financial benefits, or environmental ones as well. The latter will occur somewhere else than in the big cities. It is necessary to tackle non-monetary benefits as well and then look at the net total benefits.

The stakeholders argued that also the question of how to aggregate benefits has to be taken into account. "Welfare", for example, would be a wider indicator than GDP and would cover more possible impacts of ETR. Using another measure of progress would be a paradigm change – away from a focus on GDP as the only measure of progress. If indicators would include issues like health, social capital, etc. rather than only material assets, possibly different conclusions would be drawn. The MATISSE team also asked the stakeholders whether there is a policy framework in the Czech Republic that tries to even the progress between different regions (in Great Britain there are, for example, regional development agencies that have specific targets set in order to avoid too large differences in GDP). Stakeholders felt that the current practice of tax distribution rather promotes big cities. Many policies (transport, tax distribution) result in the fact that smaller communities have worse conditions. Tax income is seven times higher in Prague than in small municipalities. Small areas do not get enough tax revenues, they need more instruments. One of the stakeholders stated that only the region around Prague is growing in GDP, all other regions show decreasing GDP.

On the other hand it was stated that regional differences could also be a statistical construct, because GDP is attributed to headquarters in Prague, although there are regional production sites. Moreover the cost-of-living index in Prague is higher: as people pay more for everything, a higher GDP is logical.

It was also argued that it is necessary to think of the impacts of ETR and other policy measures also on the micro level. There is a need to generate new options also for those who currently have few alternatives. E.g. some regions in the Czech Republic will never have natural gas; therefore some other remedy for existing structures has to be found.

The answers to the open part of the questionnaire supported the issues raised during the discussion. Tax policies (better distribution), and non-financial factors such as health, education, environmental, and local strategies were named as appropriate policies to reverse rural to urban migration in the Czech Republic. In order to limit urban sprawl, spatial planning and more restrictive measures, such as land use policy with clear rules, or regulation were named.

The question concerning appropriate policies to make agriculture in the Czech Republic sustainable raised very diverse answers such as environmental or spatial planning, financial strategy, food security, water management, organic farming, a price/tax reform, or the removal of subsidies.

Energy, material use and carbon

The aim of achieving a level of material and resource use that is close to the sustainability level was ranked by most participants as at least very important (if not essential), and at the same time as one of the most difficult to achieve. Due to the presentations from other MATISSE work packages, which specifically discussed the issue of material and energy use, this topic also played a major role in the discussion. Several issues around this topic were also included in the questionnaire in order to have them evaluated by the stakeholders.

The following ones derive from the MATISSE Working Paper 13 (van de Sand, et al., 2007) and research carried out in the MATISSE case study on resource and energy use in the Czech Republic.

Van de Sand et al. (2007) stated in their paper that it "*can be expected that future changes in the structure of the economy will continue to lead to higher GDP per capita in the Czech Republic and thus decreasing levels of material and resource intensity"*. There was quite strong agreement on this statement: seven and eight stakeholders, respectively, agreed with the first and second part of this statement, none disagreed.

WP 5.2 in MATISSE furthermore concludes that "the most environmentally-damaging commodity groups from the viewpoint of energy consumption and carbon emissions – i.e. commodity groups, which final demand is associated with highest total primary energy requirements and carbon emissions – were as follows in 1999 and 2003: some energy carriers (coal /CPA 10/, electricity /CPA 40.1/, coke /CPA 23/ and gas /40.3/), construction work (CPA 45), basic metals (CPA 27), chemicals and chemical products (CPA 24), food products and beverages (CPA 15), machinery (CPA 29) and motor vehicles (CPA 34). This implies that *energy and carbon policies should aim at final demand of these commodities, as through its reduction we can get highest gains in decreasing the energy consumption and carbon emissions in the Czech Republic*". Half of the participants strongly agreed with this statement, which is the highest rate of strong agreement. Nevertheless, four stakeholders who responded to this question were undecided. Two others (strongly) disagreed.

The discussion at the workshop also raised possible side-effects of policies to reduce energy and material requirements. Stakeholders raised the issue that technological improvement and taxation are often in conflict with each other. For example, there are some modern progressive technological methods for burning coal (i.e. new boilers in households). Although they are more expensive, they become more and more popular in the Czech Republic. It was stated that after the introduction of higher taxation on coal, people would maybe stop buying these modern appliances as they would be afraid that it would not pay off due to higher coal prices. In this case the high taxation of C-rich fuels would have a negative impact on the results of the tax reform on the adoption of environmental technology. There was no agreement among the stakeholders as how to avoid this. Some stated that the relative burden of technologies should be taken into account and that also the best new technology can be worse than old technologies using other fuels. An assessment of relative burdens would be needed.

The discussion on material and energy usage seems to have contributed to a more differentiated view on this topic among stakeholders. Three of them regarded the element of achieving a "sustainable" level of material and energy use as more challenging after the workshop, which might also derive from the fact that the topic was central to the discussion.

Burden shifting

The work of WP 5.2 MATISSE reveals that "the Czech Republic rather exerts pressure on the environment abroad than other economies exert pressure on its environment". .

The topic of burden shifting had already been raised within the first stakeholder meetings and was included in the questionnaire and also discussed during the workshop.

There was very strong agreement on the statement in the questionnaire that "*the CZR should not exert bigger pressure on the environment abroad by its consumption than other countries exert on the Czech*

environment". Eight participants out of ten (strongly) agreed with this statement. Only one participant was undecided, one disagreed. This outcome is also backed by the fact that the element of burden shifting was ranked as one of the most important ones.

Nevertheless, discussions during the workshop revealed that Czech people on the one hand probably do not know about this situation and on the other hand that people in the Czech Republic probably also would not care. The latter comment was backed by the fact that there is a possibility to change the energy supplier e.g. to buy green electricity, but only a negligible number of citizens chose this opportunity voluntarily. The only real drivers currently seem to be relative prices. This situation probably also led the stakeholders to rank the element of burden shifting as the one which is most difficult to achieve.

Biofuels

There is an increasing discussion about competing demands on agricultural land. Due to a carbon tax on fossil fuels, biomass becomes increasingly interesting. The competition in land use for biofuels versus food could be another barrier to technological change. This issue was raised in the discussion (concerning tensions) and in the questionnaire as well.

The stakeholders' statements underlined the contested status of biofuels. The current increase in the price for butter was named as one reason for an increasing debate in the Czech Republic. An OECD study was cited to show the discussion on the international level about whether it is worth producing biofuels. And the discussion in relation to the 10 percent aim (biofuels directive) of the EC was brought forward. One stakeholder used the proverb "The way to hell is paved with good intentions!" in relation to the biofuels topic.

One stakeholder stated that the introduction of biofuels will not help to reduce CO_2 emission to the extent expected either. Although CO_2 goals are not the problem for the Czech Republic at the moment, it was clear that this could be a problem in the future or that allowances could be sold, if the CZR would be more energy efficient and more profit could be made. At the moment, air pollution is rather the driver for policies at regional level, not CO_2.

It was also mentioned that it is necessary to state which effects are the most wanted ones, i.e. the composition of benefits. Biofuels are very energy intensive to produce and have high particulate emissions. External costs should be used to compare impacts and then the political level should decide which effect should be prioritised. Biomass used for burning also has some impacts on air pollution. It is necessary to also include the question of where the biomass is burned and which technology is used. Modern technology for biomass burning would be better than burning gas. Therefore it really depends on the technology, it should not just be said that biomass should be supported or not.

Transport-related statements dominated the last part of the questionnaire. The answers to this section were quite heterogeneous, although in its tendency it supports the discussion during the workshop.

Six participants (strongly) agreed with the statement that "*Biofuels do not offer a sustainable solution for the Czech Republic´s transport problems due to global competition between food and non-food crops (and between energy and material use of non-food biomass)*". Three persons were indifferent, only one disagreed.

A similar statement was given before in a questionnaire to European stakeholders in the transport sector (Whitmarsh et al., 2007). For the questionnaire in the Czech Republic the statement was negated and "due to global competition between food and non-food crops (and between energy and material use of non-food biomass)" was added. On the European scale about 40 percent agreed, 40 percent disagreed with the statement "*Biofuels offer a sustainable solution for Europe´s transport problems"*. Only one person strongly disagreed, the rest was indifferent. These results are to some extent in contrast with the results for the Czech level. A possible reason for that can be seen in the amendment of possible negative effects of biofuels (competition between food and non-food crops) and the fact that the discussion before was quite negative, while the issue was not discussed during the workshop on the European scale.

Czech stakeholders also rather agreed with the quite general statement that "*there is a role for hydrogen technologies within Czech's transport system*". About the same rate of agreement was given to the statement that "*widespread use of hydrogen-based transport in the Czech Republic will bring environmental benefits*". Nevertheless, in both cases about 50 percent were indifferent; one person disagreed with both statements.

Time aspect

Another interesting aspect that was raised during the discussion with stakeholders is the question in how far time plays a role when thinking about ways to move the Czech Republic towards sustainability. Time can play different roles in this respect:

When speaking about policies, long-term goals and short term policies are needed to deal with sustainability questions. For example, if the goal is to have passive houses (i.e. houses with little or no need heating demand) for everyone (in order to overcome the discussion on heating technologies), short and medium term policies are needed to enter this path. This approach requires consideration of another (longer) time horizon, but also follows the discussion at the earlier MATISSE stakeholder workshop in Prague, where the topic of making a more qualitative change was raised and where it was mentioned that the sole ambition to have a GDP-growth might not lead to a sustainable solution or make people happier. It was suggested that the question of a paradigm shift is getting more and more important in the EU (Beyond-GDP workshop of the EC) and would also be an ideal topic for an ISA at the EU-level.

The time aspect also has to be taken into account when it comes to the question of how fast certain policies will take effect. With regard to the results presented, one stakeholder raised objections against the presented impacts of economic instruments. He argued that taxes will have an impact the next day – transformations are usually much smoother. One needs also to take into account possible changes on the supply side: e.g. good refrigerators were not available in the CZR 10 years ago, now changes can be seen.

Moreover the time aspect was mentioned in regard to the fact that time will maybe sort out some problems. E.g. brown coal in the Czech Republic is already limited. After 2012 the most important producer will probably close down. Therefore the problem is probably limited to 2020. Nevertheless the intervening time period is important for taking decisions and preparing the path.

It was also mentioned that besides models, which are good for learning especially in the field of politics, the issue of subjective judgements or value judgements by stakeholders (e.g. value of carbon) will become more and more important in the future. In this respect, ISA seems a promising tool, as it includes several steps in order to address these issues. The policy community and scientists should be included in scoping stage at the beginning of an ISA. The problem at hand and the issues to be addressed are defined together. Moreover the vision and corresponding pathways are described in collaboration with the policy community and the public. The experimenting stage can take various approaches, and use models, data, other analysis, etc. Based on the outcome, learning and evaluation should help to find the "optimal" solution for the problem; ISA is also a process to link science and policy.

Table 5.4 Number of persons choosing the according answers to question 4 in section B of the 2nd questionnaire. (Please indicate how much you agree or disagree with the following statements by ticking one box on each row):

	Agree strongly	Agree	Neither agree nor disagree	Disagree	Disagree strongly	No answer
a. New member states have better chances to initiate a transition towards sustainability.	1	1	4	3	1	0
b. An Ecological Tax Reform (ETR) in the CZR would reinforce the drive for technical progress through R&D and	0	7	1	1	0	1
• speed the transition in technological and organisational structures to those of most other EU countries.	0	3	4	1	0	2
c. ETR will become the norm within the EU.	0	5	3	1	0	1
• The CZR can achieve longer term economical benefits by being at the forefront of this development.	1	2	5	0	1	1
d. Future changes in the structure of the economy will continue to lead to higher GDP per capita in the CZR and	0	7	2	0	0	1
• thus decreasing levels of material and resource intensity.	0	8	1	0	0	1
e. The trend of carbon emissions in the CZR follows a sustainable trajectory.	1	1	5	3	0	0
f. Energy and carbon policies in the CR should aim at the commodities that are most environmentally-damaging, i.e. energy carriers, construction work, etc.	5	0	2	1	1	1
g. The CZR should not exert bigger pressure on the environment abroad by its consumption than other countries exert on the Czech environment.	3	5	1	1	0	0
h. Biofuels do not offer a sustainable solution for the Czech Republic´s transport problems due to global competition between food and non-food crops (and between energy and material use of non-food biomass).	2	4	3	1	0	0
i. There is a role for hydrogen technologies within Czech's transport system.	1	4	4	1	0	0
j. Widespread use of hydrogen-based transport in the Czech Republic will bring environmental benefits.	0	5	4	1	0	0

4.2. Conclusion

It can be concluded that the views of the workshop were broadly in agreement with the findings of the scenario analysis, as no substantial issue was raised by the stakeholders that had not been considered in the MATISSE case study and no substantial disagreement with findings or assumptions was articulated. The stakeholder workshop therefore was an important event to back-up the work of this case study and also raised some issues to be considered in the finalising work.

The appraisal of the sustainability vision used within MATISSE for the Czech Republic demonstrated the importance of its constituent elements, but some of the further assumptions from the internal

MATISSE working papers were regarded with greater ambivalence. ETR is not seen as the final solution to many of the current problems in the Czech Republic and not seen as a means to speed the transition towards the structures of the old EU-member states. Moreover, the uncertainties regarding the status of ETR were reflected by the answers to the questionnaire.

In general, the discussion on ETR-related topics as well as the outcomes of the questionnaires showed that stakeholders have a differentiated opinion on this issue. They are aware of benefits of this measure, but also about possible pitfalls. The (very positive) assumptions on ETR made within MATISSE for the second ISA-iteration are not shared generally.

The fact that burden shifting was seen throughout as very important, but on the other hand as the most difficult to achieve (even regarded as more difficult after the workshop by two participants), reflects the opinion of the stakeholders that "people" do not know, and if they know, then "do not care".

Referring back to the question, to what extent stakeholders have changed their views towards the elements of the sustainability vision, it is possible to observe that learning took place during the workshop. Stakeholders stated several changes in their opinion, mainly regarding "burden shifting" and "material use" (both in their tendency more challenging) and "economic growth" and "standard of living" (both in their tendency less important and less challenging). Actually, the discussion on alternative measurements of welfare could have supported this change of opinion regarding the latter elements, which often are seen as the main indicators of economic development.

6 Issues for Further Study

The scenarios developed showed in broad terms that the impact of the polices was to reinforce underlying trends in the economy, for example, accelerating change from manufacturing to service employment base, increasing the demand for skilled labour, requiring firms to move up the 'value-added' chain to remain competitive.

The next steps for the ISA for ETR would be to develop potential ETR policies in more detail (e.g., considering potential revenue-recycling mechanisms and other policies to mitigate potential impact on vulnerable groups) and to consider the extent to which current strategies in related policy areas would be sufficient to accommodate the changes that ETR could bring about. Related policy areas would include education/skills, business support polices and regional policy.

In MATISSE we will make an initial assessment of the implications of the scenarios for regional policy for the Czech Republic, but it is hoped that the issues for wider policy will be considered more fully as part of subsequent analysis undertaken in the Czech Republic on ETR.

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8 Appendix

Questionnaire 1

Stakeholder Consultation Workshop "Czech Republic On The Road Towards Sustainability"

Please rank the elements of the Czech vision listed below according to
1) how important they seem to you.
2) how challenging you think it would be to achieve them.

	Importance	**Challenge**
Scale	*1: essential* *2: very important* *3: quite important* *4: rather unimportant* *5: not important at all*	*1: almost unachievable* *2: very challenging* *3: quite challenging* *4: rather easy to achieve* *5: no problem to achieve*
stable economic growth		
achieving a similar standard of living as that experienced in most other countries in the EU		
healthy, productive, educated and qualified workforce		
good jobs located in areas other than just the major cities ('fair' regional distribution of benefits of growth)		
distinct cultural heritage is maintained		
full environmental and social cost of activities will be paid and the environmental burden of activities will not be shifted to others		
achieving a level of material and resource use that is close to the sustainable level		

Prag, November 6th, 2007

Questionnaire 2

MATISSE Stakeholder Questionnaire – Visions for a Sustainable Czech Republic

Introduction

This short questionnaire is intended to elicit stakeholders' views on visions for a sustainable Czech Republic (CR). The information gathered via this questionnaire will be summarized and discussed within the MATISSE project to verify the legitimacy, policy relevance and credibility of the ISA case study on the Czech Republic. ISA is a stakeholder-centred process, which values stakeholders' unique expertise and concerns. Therefore, your views are crucial.

All information gathered is **completely confidential**. Key findings from this survey will be circulated to all workshop participants following the workshop and will be integrated in the further MATISSE work.

Section A Your role and interests in a sustainable Czech Republic

1. Which of the following best describes the organisation you work for:

Academia/ Research Organisation ☐
Industry ☐
Government ☐
Non-Governmental Organisation ☐
Other: _____

2. What are your/ your organisation's goals vis a vis a sustainable development of the Czech Republic?

3. How important are considerations of 'sustainability' to your organisation's goals and decision-making?

Very important ☐
Quite important ☐
Not very important ☐
Not at all important ☐

Section B Your views about a sustainable Czech Republic (CR)

4. Please indicate how much you agree or disagree with the following statements by **ticking one box on each row**:

	Agree strongly	Agree	Neither agree nor disagree	Disagree	Disagree strongly
a. New member states have better chances to initiate a transition towards sustainability.	☐	☐	☐	☐	☐
b. An Ecological Tax Reform (ETR) in the CR would reinforce the drive for technical progress through R&D and • speed the transition in technological and organisational structures to those of most other EU countries.	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
c. ETR will become the norm within the EU. • The CR can achieve longer term economical benefits by being at the forefront of this development.	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
d. Future changes in the structure of the economy will continue to lead to higher GDP per capita in the CR and • thus decreasing levels of material and resource intensity.	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
e. The trend of carbon emissions in the CR follows a sustainable trajectory.	☐	☐	☐	☐	☐
f. Energy and carbon policies in the CR should aim at the commodities that are most environmentally-damaging, i.e. energy carriers, construction work, etc.	☐	☐	☐	☐	☐
g. The CR should not exert bigger pressure on the environment abroad by its consumption than other countries exert on the Czech environment.	☐	☐	☐	☐	☐
h. Biofuels do not offer a sustainable solution for the Czech Republic´s transport problems due to global competition between food and non-food crops (and between energy and material use of non-food biomass).	☐	☐	☐	☐	☐
i. There is a role for hydrogen technologies within Czech's transport system.	☐	☐	☐	☐	☐
j. Widespread use of hydrogen-based transport in the Czech Republic will bring environmental benefits.	☐	☐	☐	☐	☐

5. Did your appraisal of importance and challenge regarding the elements of the Czech vision change due to the workshop? **please make a cross (x) in the respective box**

Importance	*more important*	*no change*	*less important*
a. stable economic growth	☐	☐	☐
b. achieving a similar standard of living as that experienced in most other countries in the EU	☐	☐	☐
c. healthy, productive, educated and qualified workforce	☐	☐	☐
d. good jobs located in areas other than just the major cities ('fair' regional distribution of benefits of growth)	☐	☐	☐
e. distinct cultural heritage is maintained	☐	☐	☐
f. full environmental and social cost of activities will be paid and the environmental burden of activities not be shifted to others	☐	☐	☐
g. achieving a level of material and resource use that is close to the sustainable level	☐	☐	☐

Challenge	*more challenging*	*no change*	*less challenging*
a. stable economic growth	☐	☐	☐
b. achieving a similar standard of living as that experienced in most other countries in the EU	☐	☐	☐
c. healthy, productive, educated and qualified workforce	☐	☐	☐
d. good jobs located in areas other than just the major cities ('fair' regional distribution of benefits of growth)	☐	☐	☐
e. distinct cultural heritage is maintained	☐	☐	☐
f. full environmental and social cost of activities will be paid and the environmental burden of activities not be shifted to others	☐	☐	☐
g. achieving a level of material and resource use that is close to the sustainable level	☐	☐	☐

6. What policies are most appropriate to foster a sustainable development in the Czech Republic?

7. What role can individuals play to make the Czech Republic's development more sustainable?

8. What policies are most appropriate to reverse rural to urban migration in the Czech Republic?

9. What policies are most appropriate to keep urban sprawl within sustainable limits?

10. What policies are most appropriate to make agriculture sustainable in the Czech Republic?

11. Has the discussion this morning changed your view on the importance of the elements of the development vision or on the challenges of achieving them? If yes, in which ways?

12. Please feel free to add any further comments (also on the other side of this page, if you wish) – **in Czech** if preferred.

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