DYNAMIX

Decoupling growth from resource use and environmental impacts

Evaluating existing policy mixes to identify solutions for EU resource efficiency



Summary report of 15 real world policy mix evaluations

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DYNAMIX PROJECT PARTNERS

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1 Introduction

The objective of the EU-funded DYNAMIX project is to identify policy pathways to EU absolute decoupling of economic performance and wellbeing from resource use and its related environmental impacts. DYNAMIX focuses on the EU by addressing the impacts of EU resource use within the EU and globally, to be implemented at EU level. Given the EU's intense trade relations with the rest of the world, EU consumption and production patterns have substantial impacts on and are impacted by other world regions in manifold ways, including impacts of imported goods and resources/products (along their lifecycles and supply nets). Thus, within data availability limitations, all impacts and resource flows resulting from final EU consumption of goods and services aim to be considered within DYNAMIX.

Similarly, non-EU countries' environmental legislation also determines to what extent resources or products exported to the EU burden the environment in the exporting country. Given the high complexity in the project, policy developments and other relevant trends occurring outside the EU (and not related to EU consumption) will be acknowledged where possible, but are not considered in detail within DYNAMIX.

The project's focus on absolute decoupling places the assessment at a very aggregate level. In order to investigate whether economy-wide decoupling occurs, we have to consider a multitude of biotic and abiotic resources having an impact on various elements of the global ecosystem across the entire value and supply nets, from extraction to disposal, and within a number of economic sectors and consumption fields. Even though some consumption fields and sectors clearly involve higher resource use than others – notably food, mobility and housing – virtually any activity, good or service directly or indirectly depends on resource use. A meaningful assessment of whether absolute decoupling is achieved at the level of an entire economy thus needs to take into account all types of resources and the interconnections and competition that exist between resource systems. Even though a policy strategy to reduce overall resource use and its impacts will have to encompass sector- or resource-specific measures, a focus on these alone would risk shifting problems to other sectors or regions, or trading one type of environmental impact for another. Here, one crucial side-effect is the indirect rebound effect that occurs when income saved through efficiency gains is spent on other resource-consuming goods and services.

DYNAMIX follows EU strategic documents, namely the Thematic Strategy on Sustainable Use of Natural Resources and the Roadmap for a Resource-Efficient Europe, in taking a broad approach to resources. Hence, in line with the approach chosen in the DYNAMIX project, in the selection of potential case studies for ex-post evaluation the resources considered ranged from abiotic resources, including minerals, metals, and fossil fuels; biotic resources, including timber, fish, agricultural products and all other types of biomass, to environmental media and the ecosystem services linked to them: land, water, air, soil, biodiversity and flow resources such as wind, geothermal, tidal and solar energy.

2 Case study identification and selection

2.1 Identification

In order to inform the development of scenarios, a total of 15 case studies were undertaken in the DYNAMIX project. Given the breadth of resources which could have been covered, as well as the multiplicity of policy mixes potentially available, the selection of the case studies was an important step in the development of the project as a whole. For this reason, we started with an initial screening process to provide a long list of policy mixes, primarily scanning online documents from international bodies such as the United Nations (particularly, but not restricted to, its Environment Programme and related International Resource Panel), the Organisation for Economic Cooperation and Development (OECD), and resource/issue specific bodies such as the International Energy Agency, especially for identification of third country examples. EU country examples were identified by additionally scanning online EU institution (including the European Environment Agency) and Member State documents, as well as those of research institutes, administrative agencies, industry federations, environmental NGOs, and other relevant sources of policy analysis.

The initial broader screening exercise included output-focused policy mixes (i.e. outputs or impacts of human activity, particularly to environmental media of air, land and water) as it was thought that some valuable lessons could be learned which could be transferred to a resource (input) based approach (the focus within DYNAMIX). Given the historical approach taken to environmental policy, i.e. reducing environmental impacts, the study team came across considerable experience in policy addressing outputs. In addition, some resources have already been addressed via an input focus (such as water and energy consumption), and these were screened for potential relevance in application to other resources.

Initially, the following broader resource categories were discussed within the context of the project's 'common approach':

- Minerals and metals
- Biomass
- Biodiversity and ecosystem services
- Air
- Water
- Soil
- Energy – fossil fuels
- Energy – renewable flow resources
- Land area (space)

Given the breadth of resources for potential consideration in the project, we chose to focus primarily on those resources having the most significant environmental impacts – a list narrower than the one above.

The team decided to broadly follow the list of products with considerable environmental impacts in the UNEP International Resource Panel's report *Priority products and materials: assessing the environmental impacts of consumption and production*[1], which gave the following insights into lifecycle studies analysed for the different categories:

- **Agricultural goods and biotic materials**: Studies converge on their importance. Particularly impact-based studies further highlight the relative importance of animal products, for which indirectly a large proportion of the world's crops have to be produced, with e.g. high land use as a consequence.
- **Fossil fuels**: Studies converge on their importance. They come out as important and even dominant. Fossil fuel combustion is the most important source of most emissions-related impact categories, and plastics are important in terms of impacts among materials.
- **Metals**: Although many metals have high impacts per kg compared to other materials, in view of the comparative size of their flows, only iron, steel and aluminium enter the priority lists.
- The studies do not agree regarding the issue of **construction materials**. They show up as important in studies using mass-based indicators such as Domestic Material Consumption (DMC), but not in all studies that also include a measure for impact per kg material.

Details of potential case studies were entered into a spread sheet, with comparable data provided on each, for the ensuing selection process.

2.2 Selection

Based on the long list of cases identified in the screening process, a short list of 15 cases was identified for further evaluation. Given the small number of case studies to be undertaken, the intention was to try to cover a wide range of less-studied resources, while also providing more than one case study on similar resources, to **compare and contrast** approaches. This, however, obviously could not be done for all the resources.

The case studies were selected on the basis of the following criteria:

- Type of resources: inputs/outputs
- Objective of policy mix: absolute/relative reduction of use of resource use, reduce outputs (wastes/emissions) or impacts (historically impacts on environmental media)
- Orientation of policy mix: mix led by regulatory, economic or information tools/approach
- Level of focus: economy-wide, sectoral, specific products
- Geographic coverage: North, South, East, West EU and non-EU countries
- Success and failure: to learn from both outcomes/effects of policy mixes
- Timeline/age of policy mix: more recent may mean less assessment
- Data availability: an element of analysis already undertaken on the policy mix
- Potential replicability / transferability to EU level/other EU countries/region

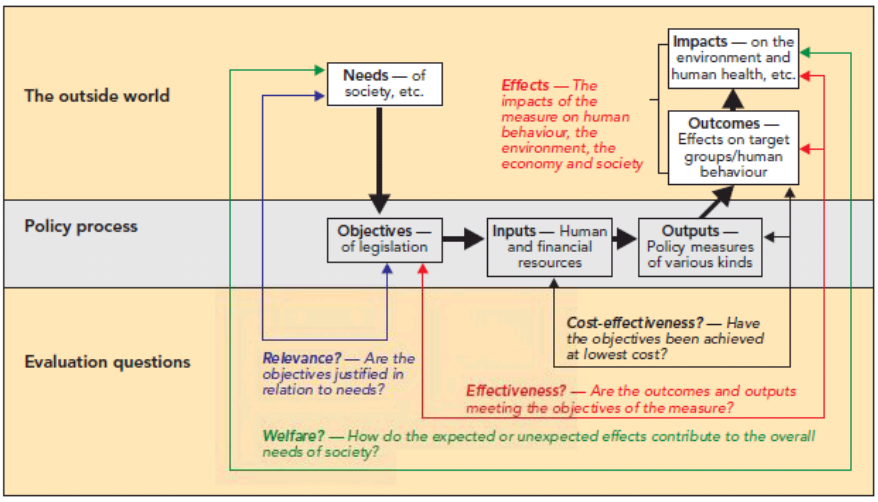
3 Case study evaluation

Once the case studies for evaluation were selected, an in-depth evaluation was undertaken based on a common assessment template. The evaluation of the identified policy mixes usually distinguished between the ***effect*** of the policy mix, i.e. the results of a measure that can be attributed to its implementation (which implies a causal link between the policy action and its intended impacts on human behaviour and the environment) and its ***effectiveness***, i.e. whether or not the intended objectives and targets have been achieved[2].

In addition, the policy mix's ***efficiency*** and ***(social) sustainability*** was evaluated. Efficiency of the policy mixes was assessed comparing the achieved level of resource and impact decoupling with the monetary (or other) resources applied to achieve the outcome. Sustainability of the policy mixes was assessed by evaluating the social effects and environmental effects not covered in the key targets (e.g. local effects, toxicity, marine issues). To reduce complexity, social effects were only assessed for EU countries, contrary to the environmental effects which were also assessed globally (as much as data allow).

Figure 1 below provides an illustration of a policy evaluation framework and includes a number of broader evaluation questions including those related to the 'effect' and 'effectiveness' of a policy / policy mix. The figure distinguishes between inputs (resources dedicated to the design and implementation of the measure, e.g. staff, financial resources, administrative structures), outputs (tangible results of the measure), outcomes (the response of target groups to the outputs) and impacts (effect of the changes in behaviour on the environment, human health etc.).

Figure 1: Policy evaluation framework



Source: EEA. 2001. Reporting on Environmental Measures – Are we being effective?, Environmental issue report No. 25, EEA, Copenhagen

4 Case studies

4.1 Policy mixes targeted at renewable resources

4.1.1 Sustainable use of forests and wood in Finland

Issue: The case study focuses on forests and the different uses of wood as a resource: pulp and paper, wood products and bioenergy. As wood is a renewable resource, the main issue is ensuring that forests are managed sustainably and that EU wood consumption does not lead to deforestation, degradation of ecosystems and loss of biodiversity in the EU and globally.

This case study focused on the policies that were put in place to enhance and secure the sustainable supply of wood. Forests provide many ecosystems services other than the provision of wood, but these other functions are not the focus of this study.

Nature of the policy mix: As wood is an internationally traded commodity, the EU demand of wood is partly supplied by imports from other countries. This case study therefore considers wood produced in the EU as well as imported from countries outside the EU, covering policies at three levels: international sustainable forestry management and wood trade; EU forestry policies; and Finnish forestry policies. Although the policies address different issues at different stages in the product chain and at different levels of governance, they are systemically interlinked. The policies that are considered to form the policy mix in this case study are those that directly or indirectly ensure that wood biomass is produced and harvested sustainably.

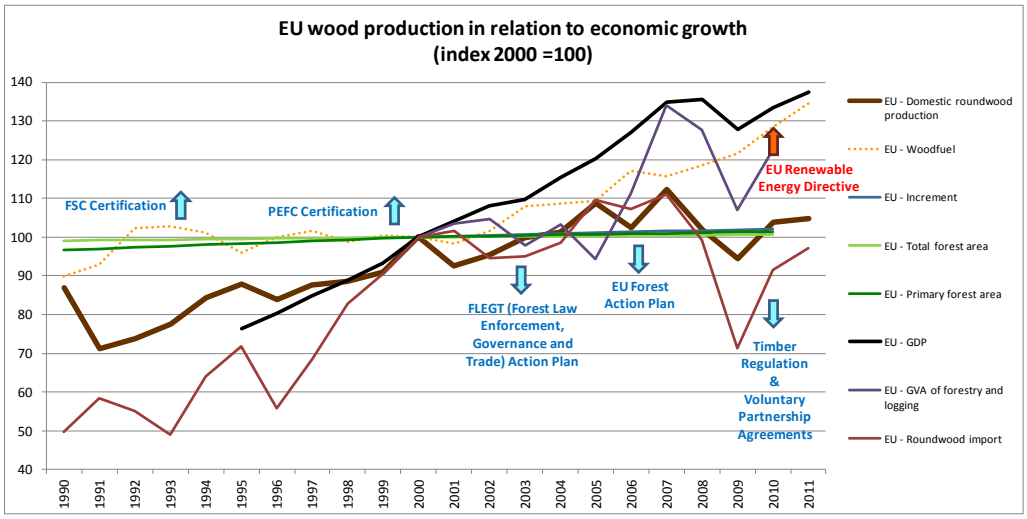
Lessons on decoupling

Type of decoupling: The annual increment of growing stock (and also the net carbon sink) in Finnish forests has been greater than the removals.

Decoupling achieved: Decoupling was not achieved as the forestry industry's economic output is still linked to wood removals, both domestically and abroad (and, over recent years, increasingly abroad). In addition, forest biodiversity, both domestically and internationally has continued to decline, suggesting that the contrary of decoupling might have occurred: further intensification of forestry practices (increase in overall wood production mostly through import of wood whose production all in all respected lower standards than those set domestically) without added value in terms of increased economic output over the period studied. It appears that renewable energy targets and increased wood fuel production might be linked to this intensification. While Finland is a net exporter of wood products, the increase in wood consumption and production is largely based on imports. This could mean that the more sustainable management of forests in Finland has been achieved by increasing imports. Furthermore Finland imports most of its round wood from Russia and it is estimated that this represented about half the imported illegal wood in the EU in 2006[3].

More specifically, trends at EU and national level show that in the EU over the past two decades, total wood removals[1] (i.e. round wood) have increased together with a slight increase in both total and primary forest area and increment. This would indicate that forests in the EU are generally managed sustainably. The gross value added of the forestry industry however seems still to be linked to wood removals. From 1990-2000 round wood imports to the EU doubled to satisfy demand. While domestic wood fuel production appears stable in the same time period, since the turn of the millennium it has followed GDP. Renewable energy and climate change policies in the EU and Member States are believed to have driven the increase in wood fuel production in the EU.

Figure 2 Forest and wood production trends in the EU



Source: FAOstat and Eurostat.

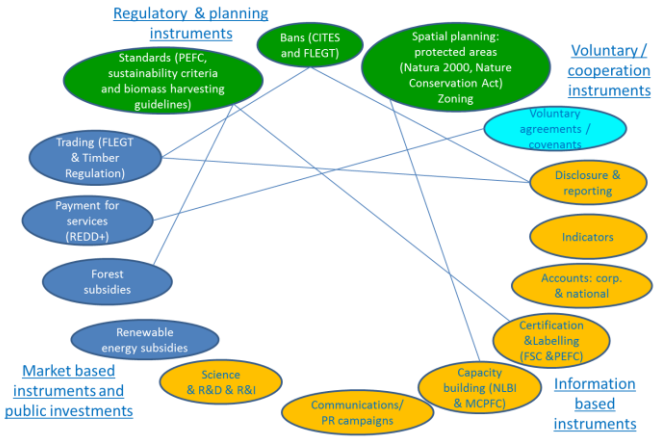
Instrument mix

Objective of policy mix: Ensure that the demand for wood can be provided within resource limits through sustainable forest management. The main policies and associated instruments of the policy mix are primarily national and EU regulatory instruments. These include the National Forest Act (regulation and guidelines for good forest management and silviculture), National Act for Financing of Sustainable Forestry (subsidies for certain silvicultural procedures based on forest management plans), National Forest Programme 2010 (policy strategy and targets), National Strategic Programme for the Forest Sector (funding for innovation projects), and National Forest Programme 2015 (policy strategy and targets). At EU level, there is the Forest Law Enforcement, Governance and Trade (FLEGT) (voluntary agreements) and a licensing scheme to control trade of timber products exported to the EU, and the EU Timber Regulation (regulation and information requirements). Certification schemes are also included, notably the Forestry Stewardship Council (FSC) (voluntary

[1] Wood removals include wood that is harvested as well as felled by natural causes (e.g. wind storms) and removed from the forest. Wood fellings include wood removals, but also include wood that is felled and left in the forest.

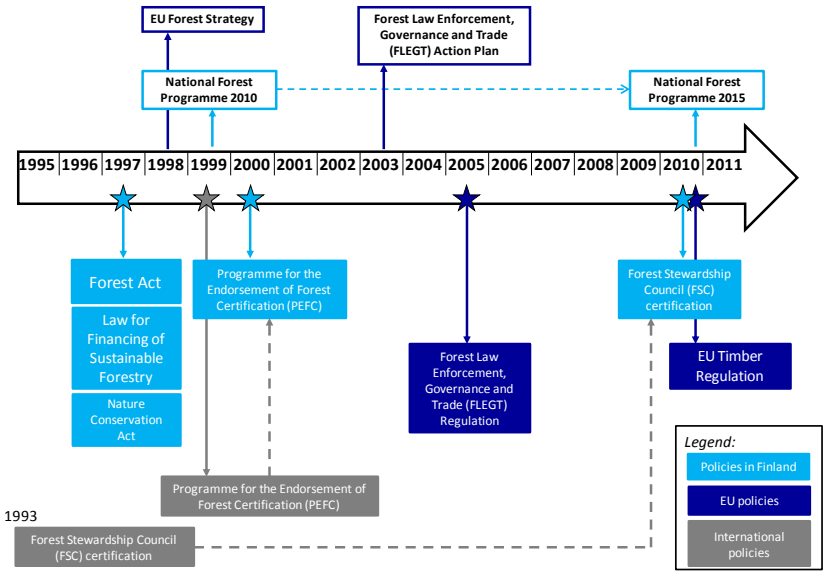
standards, certification and labelling) and the Programme for the Endorsement of Forest Certification (PEFC) schemes (voluntary certification and labelling).

Figure 3: Instruments in Finland's sustainable wood policy mix



Source: Own compilation

Figure 4 Evolution of the policy mix



Source: Own compilation

Instrument impact on decoupling – Key messages

The objectives of the policy mix were to implement sustainable forestry management by reducing deforestation and forest degradation. While the status of forests globally and locally have improved, deforestation of primary forests and severe degradation of forests and their ecosystem services continues to occur, so the impact objective has not yet been achieved. However, it is remarkable that voluntary forestry certification schemes have managed to cover almost 10 % of the world's forest areas in just 20 years. In order for forest certification schemes to expand and work properly government institutions, monitoring and law enforcement must be strengthened particularly in developing countries. [4,5]

In Finland, the annual increment of forest growing stock (and the net carbon sink) has been greater than removals for almost 40 years. Although this can be seen as an example of absolute *resource* decoupling within resource limits, habitat degradation and in particular biodiversity loss still continues in Finland, hence *impact* decoupling has not yet occurred. Wood imports have been growing in Finland in the years before the economic crisis. This is mainly due to the lower prices of wood in relation to costs of domestic production, but also the availability on the domestic market of certain timber grades.[6]

Implications for EU resource efficiency

The lessons learnt from the development of Finnish forestry policy are useful for the EU and other policy areas. Some of the characteristics of these are high private ownership of natural resources, the use of a consensus-based approach, and emphasis on the recreational and cultural benefits of natural resources. These all contribute to general support for protecting natural resources and high compliance with policies. Compensating landowners and wood producers for their efforts to support sustainable forest management measures that would otherwise not be profitable is a principle that already seems to be included in the EU Common Agricultural Policy. Forest management plans and professional support provided locally seem to be good policy instruments that could be transferred to other areas in the EU. Finally, clear standards and guidelines for sustainable wood removal and long term targets would also be needed when developing policies to achieve decoupling.

Also, when introducing policies to achieve a sustainable management of specific renewable resources, the EU should also take steps to ensure that the sustainable yields domestically are not leading to unsustainable practices outside the EU which it indirectly encourages through the import of unsustainably harvested resources abroad.

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4.1.2 Sustainable levels of fish catch in Iceland

Issue: As fish are a renewable resource, the goal is to exploit stocks at levels that obtain the maximum yield whilst still maintaining the population size at the point of maximum growth rate by harvesting the individuals that would normally be added to the population, allowing the population to continue to reproduce indefinitely.

During the first half of the twentieth century, Iceland, like other industrialised fishing countries, had the problem of overexploitation of its fish resources. This is a classic example of the tragedy of the commons,[7] whereby the resource is shared by numerous individuals each seeking to maximise their yield, despite the fact that depletion of the common resource is contrary to the group's long term best interests. In Iceland there were numerous international and domestic fishers competing for shares in the resource, resulting in excessive fishing capital and effort compared to the reproductive capacity of the fish stocks. This overexploitation resulted in the serious decline of fisheries resources, including total collapse of the herring stock.[8] This was followed by a sharp drop in the demersal[2] stock and catch levels and capelin was seriously threatened with overfishing.[9]

Nature of the policy mix: The policy mix aimed to address overexploitation of fish stocks, to ensure that fishing remained within sustainable levels. The policy mix contains three instruments: total allowable catches TACs for all commercially exploited species; individual tradable quotas (ITQs) for the same species; and a resource tax. TACs and quotas, i.e. catch limits on how much fish can be caught, can be employed as a fisheries management tool on their own. An ITQ, on the other hand, is a tool that intrinsically requires TACs and quotas to be established. ITQs are a cap-and-trade mechanism, and the TAC constitutes the cap on fishing opportunities. Therefore it could be stated that TACs are the primary instrument, and ITQs are an enhancing instrument. The introduction of ITQs was a pioneering step in fisheries management globally: Iceland was one of the first countries to try such a system.

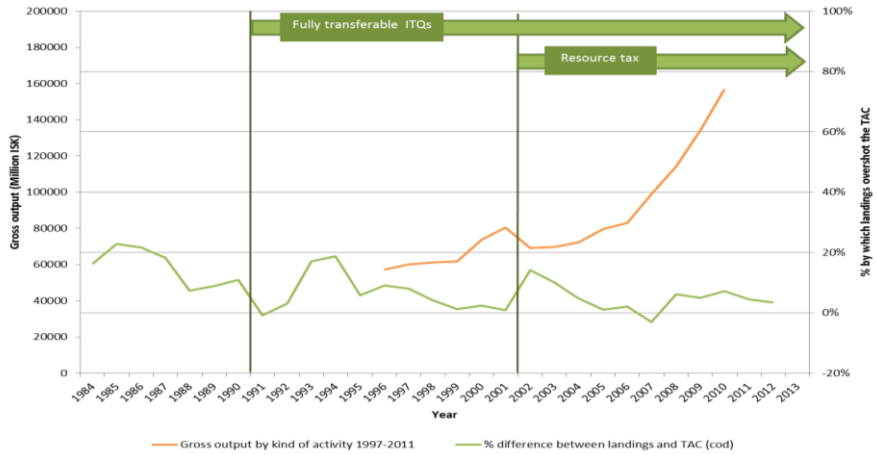
Lessons on decoupling

Type of decoupling: Decoupling between economic output from the fish stocks in the sector from overexploitation of the fish stocks (i.e. beyond the total allowable catch set according to the maximum sustainable yields (MSY).

Decoupling achieved: Absolute decoupling (within limits). Figure 5 presents an indicator the overexploitation of fisheries resources alongside an indicator of economic performance. The former is a measure of the degree to which Icelandic landings of cod (one of the most fished species) exceed the TAC set by the Icelandic government. The latter is the gross output of the fishing sector as a whole. The figure shows that the economic performance of the sector has grown steadily and very significantly over the period. At the same time, overexploitation of the fisheries resource has shown an overall downward trend, stabilising over the past decade at fewer than 10 per cent.

[2] Demersal fish live and feed on or near the bottom of seas or lakes, living on sea floors and lake beds, which usually consist of mud, sand, gravel or rocks. In coastal waters they are found on or near the continental shelf, and in deep waters they are found on or near the continental slope or along the continental rise.

Figure 5 Performance of the policy mix in relation to gross output of fishing activity



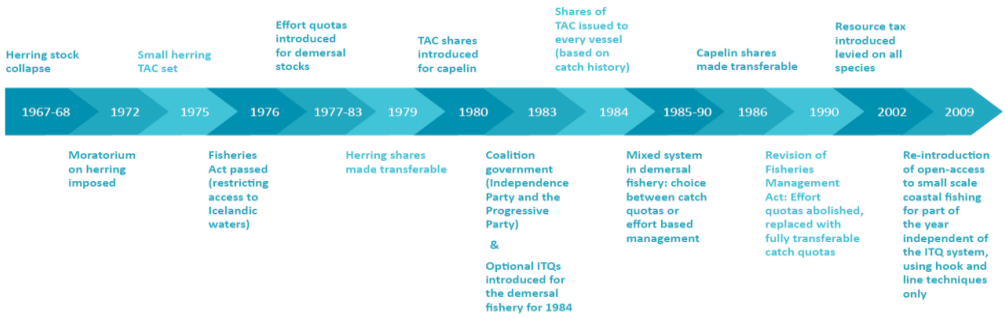
Source: Author's compilation based on Statistics Iceland for economic data and from Icelandic Marine Resources Institute for cod stocks

Instrument mix

Objective of policy mix: The policy mix itself does not have a stated objective as such, although the objective of the Fisheries Management Act is "to promote [exploitable marine stocks'] conservation and efficient utilisation, thereby ensuring stable employment and settlement throughout Iceland". The policy mix has developed over time in an ad hoc manner in that developments have not occurred as a result of a formal policy review cycle. TACs and ITQs were introduced to the herring and other pelagic fisheries in the mid-1970s to early 1980s, and these were gradually applied to demersal stocks. In 1990 TACs and ITQs were obligatory for all commercial fisheries. A resource tax was introduced in 2002. Other supporting measures were introduced to address specific issues. One consequence of the ITQ system was that it incentivised high-grading, as the quota price can be high compared to the landed value of the fish. It created an incentive to discard less valuable grades. A ban on the practice of discarding[10] was introduced to counter this. Technical measures, such as gear restrictions and area closures were introduced to protect juvenile fish, spawning areas, vulnerable marine ecosystems, and to reduce discards of unwanted species.

Evolution of the policy mix: Figure 6 below illustrates this.

Figure 6: Evolution of the policy mix



Source: Author's compilation

Instrument impact on decoupling – Key messages

The policy mix has achieved sustainable exploitation of fisheries resources and enabled the fishing sector to become highly profitable. At least as much as the policy mix aimed to improve environmental sustainability, it aimed to maximise the profitability of the exploitation of the resource. Before the introduction of the ITQ system, profitability of the fisheries sector was poor.[11,12] and the effect of the system was an increase in its efficiency by reducing fishing effort and fishing capital, rebuilding fish stocks, raising the quality of the landed catch and improving coordination between supply of landings and market demand.[13]

Since the introduction of the ITQ system steady improvements in the state of fish stocks have been seen: herring stocks have risen steadily since collapse in the late 1960s, and cod stocks have more slowly begun to rise. Also, the percentage of the fish stock removed each year by fishing (i.e. fishing mortality) has declined significantly since the early 2000s and is presently at a historical low. Some argue that the stock could have been rebuilt quicker, had the mixed system which included effort restrictions as well as ITQs not continued from 1985 to 1990, and had small vessels not been subject to various exemptions from the system until 2004.[14,15]

Implications for EU resource efficiency

The EU Common Fisheries Policy (CFP) already includes TACs for a large number of stocks. In principle a system of transferable quotas could be applied at the EU level. A resource tax could also be introduced, but would need European Council unanimity. In 2013, the European Commission proposed the introduction of mandatory tradable quotas (ITQs) for all Member State, but this was very unpopular and rejected early on in negotiations. In Iceland's case, the ITQs also proved unpopular at the beginning, but these eventually yielded excellent results. In any case, Member States are free to establish tradable quotas, as some do, including Denmark and the UK, and resource taxes also.

It also became apparent from the Icelandic example that the gradual introduction of ITQs in the demersal fisheries was less effective than the much more direct and complete introduction of ITQs in the pelagic fishery. However, the rationale behind having a mixed system was to improve acceptability of the scheme, and such concerns should be taken into consideration when designing a catch share scheme.

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4.1.3 More efficient use of aggregates in the UK

Issue: Environmental impacts related to the extraction of aggregates include noise, dust, traffic, visual impacts, blasting, contamination of ground water and surface water, loss of amenity, impacts on archaeology, heritage and wildlife.[16,17] The degree of impacts on the environment varies across different aggregates.

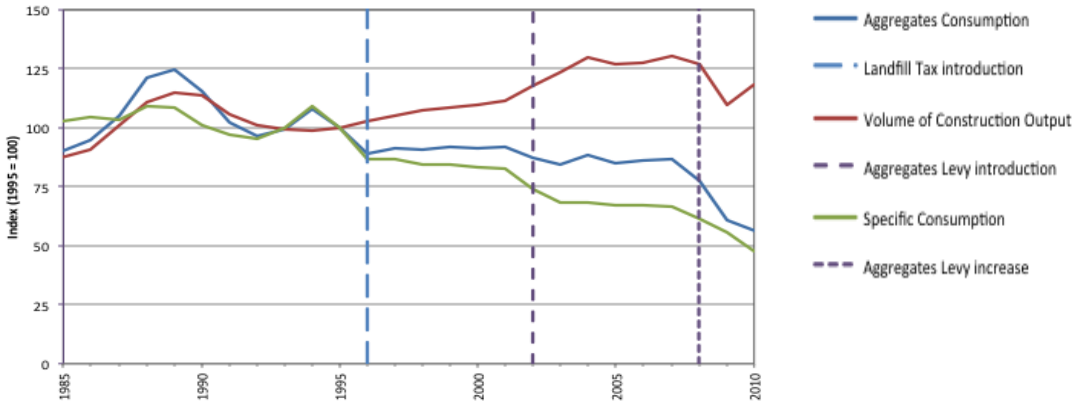
Nature of the policy mix: The policy mix aimed to internalise externalities of aggregates production, as well as those related to landfilling. Through revenue recycling, funding was allocated to research and development of alternative uses of recycled aggregates.

Lessons on decoupling

Type of decoupling: Absolute decoupling

Decoupling achieved: While aggregates consumption and construction output was closely correlated before 1995 (before the introduction of the Landfill Tax), analysis implies that absolute decoupling was achieved with an overall increase in construction output and an overall decrease in aggregates consumption over the 1995-2010 period – see Figure 7.

Figure 7: UK aggregates consumption and construction output against a 1995 baseline



Source: Idoine, N. E., T. Bide, and T. J. Brown. 2012. United Kingdom Minerals Yearbook 2011, Nottingham, British Geological Survey.

Instrument mix

Objective of policy mix: The objective was to internalise externalities associated with the disposal of waste in landfills and with the supply of aggregates, as well as to encourage the use of alternative materials.

Evolution: The landfill tax was introduced in late 1996. In 1995, Landfill Tax Credit Scheme (LTCS) was announced for landfill operators paying for remediation of closed landfill sites, research and other environmental improvements. Following a review in 1998, changes were announced to make the tax more environmentally effective including an increase in the standard rate, although the lower rate for inert waste (relevant to aggregates) did not change. Inert wastes used in the restoration of landfill sites and quarries were exempted from late 1999. In 2003 the LTCS was reformed, and funding directed towards other activities.

Proposals for a levy on aggregates extraction were announced in 1997. A number of studies were commissioned and voluntary proposals as an alternative to a tax were presented by the national quarrying sector trade body. An aggregates levy was announced in 2000, and introduced in early 2002. Secondary aggregates from building and maintenance of highways and waterways are exempt from the levy. In early 2008 the levy was increased and further exemptions were announced, and a further rise took place in early 2009. The Sustainability Fund (revenue recycling) was discontinued in March 2011. An expected increase in the levy in early 2011 was delayed and the levy is to remain at its current level until 2013-2014.

Instrument impact on decoupling

A combination of instruments targeted at both supply and disposal have contributed to the success of the policy mix - the policy mix of the Aggregates Levy, Landfill Tax and the Sustainability Fund provided "a signal to producers of the need to change production methods and practices".[18] Similarly, one might also attribute changes and technical improvements in construction practices to the success of the policy mix.

Decoupling has reduced environmental externalities - the absolute decoupling of aggregates consumption from construction output and the corresponding substitution of primary aggregates with secondary and recycled aggregates contributed to a reduction in environmental externalities associated with the aggregates industry.

Implications for EU resource efficiency

Drawing on its assessment of aggregates policy in the UK, the EEA recommended that other EU countries considering the introduction of a tax on aggregates should: combine the tax in a package with other policy instruments (i.e. permits or standards); consider the elasticity of demand for aggregates (due to their low cost relative to transport and overall construction costs, demand for aggregates is generally inelastic); recognise and exploit the potential of recycling revenues to improve the public acceptability of a tax; and consider tax distortions across country borders when setting the tax rate.[19]

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4.1.4 A sound material cycle society in Japan

Issue: An expected increasing dependency of high-tech industries (the major exporters of Japan) on imports of raw materials, including critical metals, encouraged the Japanese government to take initiatives in order to foster a 'Sound Material Cycle (SMC) Society'[20], aiming to ensure efficiency in resource use and recycling of waste products to create a circular economy.

Nature of the policy mix: This policy mix is adapted from the broader 'SMC Society' policy mix, with a particular focus here on critical metals. The SMC Society objectives of higher resource productivity and secondary material use, are added to via an added focus on security of supply of critical metals.

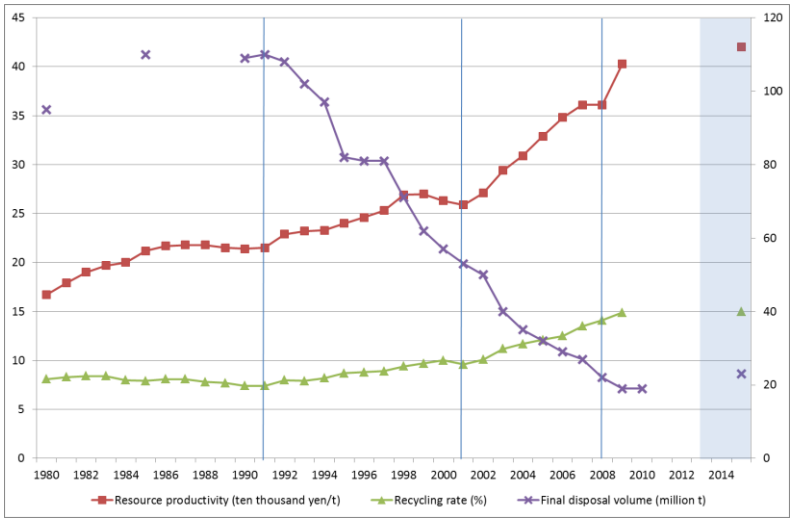
Lessons on decoupling

Type of decoupling: Decoupling of domestic material use from economic growth from 2008 onwards as a result of the policy mix, taking into account the results already achieved. Additionally, decoupling between economic growth and the use of critical metals is sought, but the specific initiaves taken are too recent to discern whether these were successful or not.

Decoupling achieved: Absolute decoupling of material use (but not of critical metals). Japan achieved absolute decoupling of material use from GDP from 2001 onwards as a result of the policy mix. Resource productivity (GDP/kg natural resources) is 1 of the headline indicators used to monitor progress of the policy mix, and this has been increasing steadily. The evolution of this indicator points to relative decoupling, since GDP growth is faster than resource use and this ratio increases over time. As the natural resource input growth rate is negative every year since 2001, absolute decoupling in material use has been achieved.

Critical metals decoupling is not yet clear as there are no specific indicators for these resources, and the measures taken are recent (2009 onwards). However, many projects are taking place to develop cost-efficient recycling technologies of critical metals and the amount of appliances containing metals collected for recycling have been increasing.

Figure 8: Evaluation of the main indicators envisioned in the 2003 SMC Plan



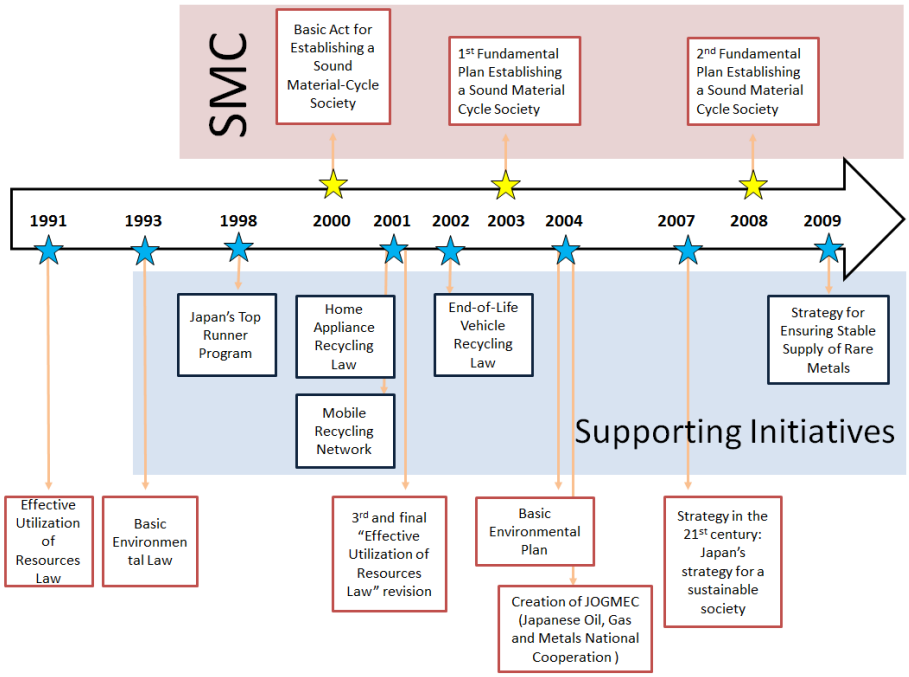
Source: Data collected from Environmental Statistics 2012 of the Japanese Ministry of Environment (http://www.env.go.jp/doc/toukei/contents/index.html)

Instrument mix

Objective of policy mix: The aim of the policy mix is to create a closed-loop society in materials usage. No clear policy targets were designed into the first Fundamental Plan on the SMC Society. After an official review of the Plan, these were introduced in 2008 with the 2nd Plan of the SMC Society. It established 3 indicators with targets to 2015: resource productivity (GDP/Direct Material Input) to achieve a certain number of Yen/tonne; the cyclical use rate of materials between 14-15 %; and a final waste disposal amount limit.[21] Critical metals were specifically addressed in the 2009 Strategy for Ensuring Stable Supplies of Rare Metals with 4 aims: 1) ensuring supply of metals for industries dependent on their provision, 2) ensuring recycling of rare scrap metals, 3) developing alternative materials, and 4) fostering stocking of some rare metals.

Evolution of the policy mix: Figure 9 below sets out the conceptualisation and evolution of this policy mix, as identified through the DYNAMIX project. The instruments used include the policy instruments of the SMC Plan (the 3 indicators, labelling, awareness campaigns and environmental liability), the Effective Utilization of Resources Law (fines, codes of conduct and quotas), and the initiatives such as the Home Appliances Recycling Law or the Mobile Recycling Network (investment), to name a few, but with a great emphasis in relation to critical metals on subsidies for R&D and awareness campaigns.

Figure 9: Evolution of the Japanese Sound Material Cycle Society policy mix



Source: Own compilation based on Japanese Ministry of the Environment (2010): Establishing a sound material-cycle society - Milestone toward a sound material-cycle society through changes in business and life styles

Instrument impact on decoupling – Key messages

A clear vision is needed in order to achieve decoupling results on waste of materials – Japan was able to engage all of society (consumers, businesses and governments) in the transition towards an SMC society due to a clear vision established in 2000 of what the SMC Society should be. In this vision, responsibilities were set out for consumers, businesses and government, enabling projects to be carried out that shifted the behaviour of consumers, in particular. After setting this vision, a continuous evolution of policy (2003, 2008 and many projects after) was essential to implement the SMC Society.

Usage and promotion of the key economic sectors creating employment and business opportunities - The SMC Society, including for example recycling and disposal sites, market grew due to increased demand of scarce raw materials.[22] Efforts (namely subsidies) concentrated on giving businesses opportunity to invest in R&D (a major sector in the Japanese economy) to develop cost-efficient technologies to recycle materials and critical metals.

Setting indicators and targets help to get a broad overview of the implementation status – The success of decoupling is apparent thanks to the 3 indicators included in the 2003 SMC Plan. Their evolution is crucial to decide on policy of material waste management. In contrast, the critical metals management strategy does not have hard indicators, and success appears to be more modest.

Implications for EU resource efficiency

Japan and the European Union alike are forerunners when it comes to recycling. However, the EU still lags behind Japan in recycling critical metals. Both regions are very dependent on critical metals in their production processes. Japan's practice of high investments, R&D and working with industry to develop better methods is an element EU Member States should consider in their policy design.

The EU will have to continue to build a vision and engage businesses and consumers. Efforts are also needed in identifying how best to target tools at key economic sectors, as Japan did when concentrating efforts on R&D. There is also scope for the EU to take up certain indicators and targets beyond the already proposed and under development through the Resource Efficient Europe Roadmap. In particular, targets and indicators on cyclical material use and on final waste disposal volume (which were already proposed in the 5th Environmental Action Programme but deleted), would be interesting to explore.[23]

Sources and references:

Bio Intelligence Service (BIOIS) (2010): Preparatory Study for the Review of the Thematic Strategy on the Sustainable Use of Natural Resources

Government of Japan (2008): Fundamental Plan Establishing a Sound Material Cycle Society

Japanese Ministry of the Environment (2008): The World in Transition and Japan's Efforts to Establish a Sound Material-Cycle Society

Oko institut (2011): Study on Rare Earths and Their Recycling

4.2 Policy mixes targeted at land

4.2.1 Conserving rural land in England

Issue: This case study looks at the set of policies which govern the use of rural land for built development in England in a context of increasing pressure on rural land for built development. Prior to the policy mix there was a significant share of rural land being taken for built development; strong trends of rural outmigration and concerns that the agricultural sector was suffering; and indications of urban sprawl and ribbon development.

Nature of the policy mix: To oversee land use developments and ensure that rural land is used efficiently and sustainably, a set of policies, primarily in the area of land use planning, have been introduced. The need to protect the countryside and rural areas from built development is to ensure the on-going protection and enhancement of natural resources and environmental services they provide.

Lessons on decoupling

Type of decoupling: Relative decoupling between new dwellings and rural land take was achieved: although the rate of decline has slowed, rural land continues to be taken for built development. The policy mix has probably contributed to a significant share of new built development occurring without impinging on rural land as evidenced by the number of new dwellings built and the amount of built development carried out on brownfield sites as opposed to on greenfield sites. In terms of decoupling the *impacts* of built development on the environmental services rural land provides, very limited decoupling has occurred if at all, as evidenced by the changing rural landscape since the 1950s and subsequent deteriorating biodiversity and heritage value of the English countryside.[24]

Decoupling achieved: The share of land allocated to different land uses in the UK has remained relatively stable in the last 50 years. Since the introduction of the policy mix, the rate of rural land take for built development has declined. The average annual rate of rural land take for built development from 1927-1939 was approximately 25,000 ha which declined to 15,700 ha for the period 1945-1975 and further still to 5,000 ha in 2009.[25] See Figure 10.

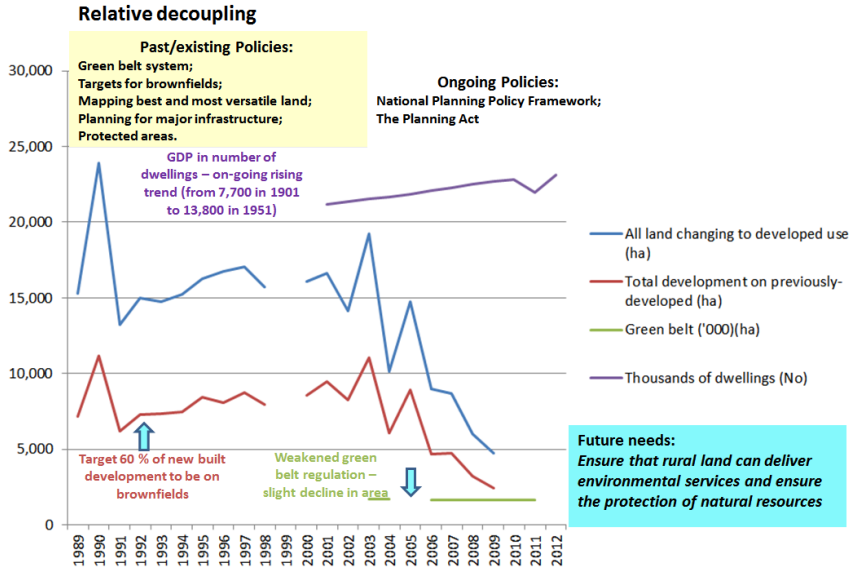
Instrument mix

Objective of policy mix: Control urban sprawl, reduce rural land take, stimulate agricultural production, and encourage the reuse of previously developed land for new dwellings and to increase the density of dwellings in developed areas.

The principal instrument within this policy mix is spatial planning as all policy instruments within the policy mix are a form of spatial planning. These are the 1949 National Parks and Access to the Countryside Act 1949 (includes conservation designation for National Parks, Areas of Outstanding Natural Beauty and Heritage Coasts), the 1955 green belt system; the 1996 'Best and most versatile land' distinction (to inform land use planning decisions with regards to rural land to ensure that the most fertile land is used for agriculture rather than built development); and the 2008 Planning Act (for major infrastructure planning). In the 1990s, targets were also developed for the reuse of brownfield sites.

Two additional instrument types have been included as influencing land planning policy but not consisting of the key components: property rights and quotas. Indeed, the target to prioritise the redevelopment of previously developed land over built development on non-developed land is primarily a planning instrument, however it could also be perceived as a quota.

Figure 10: Policies and instruments on UK land use and their decoupling results



Source: Author's compilation (data sourced from Land Use Change Statistics, 2012; DCLG, 2011; DCLG, 2013)

The identification of brownfield sites to be given priority for re-development over new development on greenfield sites was a key element in the success. In addition, the mapping of best and most versatile land to identify land with the potential for high yields to ensure that this land is used for agriculture is intended to provide a rationalised assessment of the economic and environmental benefits of land use in planning decisions.

Evolution of the policy mix: is set out in Figure 11 below.

Figure 11: Evolution of the UK land use policy mix

Source: Author's compilation

Instrument impact on decoupling – Key messages

The identified policy mix sought to decouple built development from rural land use. **The principal policy instruments aimed to control built development and facilitate the containment of urban areas, densification of already developed areas and the protection of designated conservation sites.** It also sought to strengthen the rural economy by prioritising agricultural production as the principal source of rural income in a bid to mitigate rural out-migration and meet growing demand for food and fuel. Agricultural production has increased over this time and the reversal of rural out-migration indicates that the policy mix was successful in strengthening rural vitality.

The policy mix has been relatively successful in limiting urban sprawl; however, the implications of later trends of urban out-migration, the declining area of green belt land, and degradation of the rural landscape over the past 50 years (with loss of native woodland species and habitats, loss of boundary features, and a decline in the number of designated conservation sites) should not be overlooked. The on-going rural land take for built development, although small, indicates that as a relatively finite resource, this trend is not environmentally sustainable, particularly when coupled with evidence of landscape degradation.

Implications for EU resource efficiency

There has been definite success in slowing down the rate of rural land take for built development over the course of the past century. While the policy mix has been relatively successful in limiting urban sprawl; implications of later trends of urban out-migration and the declining area of green belt land should not be overlooked.

The designation of conservation sites is commonplace across the EU as is support for agricultural production. Together these policies already offer a degree of protection for rural land from built development at an EU level. The controlled land planning approach to contain urban sprawl does offer certain benefits as discussed in the evaluation; however, it is a contentious issue with debate as to how much it might restrict construction development and investment growth. Due to these reservations, and in the current economic climate, it is questionable how much weight this approach would carry at an EU level.

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Bibby, P. 2009. Land use change in Britain. Land Use Policy 26 (S), S2:S13. http://bis.gov.uk/assets/foresight/docs/land-use/jlup/03_land_use_change_in_britain.pdf

Gallent, N., Juntti, M., Kidd, S. and Shaw, D. 2008. Introduction to Rural Planning. Routledge; Oxon (UK).

4.2.2 Reducing land sealing in Germany

Issue: Land is a limited resource and under pressure from increasing demands for agricultural and forestry products as well as land requirements for settlements and infrastructure. The sustainable use of land is key to the provision of ecosystem services, be it regulation of water quality, availability of water resources, provision of food or storage of carbon in soils. Hence, land is a key resource that needs to be protected. An important driver that reduces the usability of land is urbanization and the increase of settlement areas, often referred to as "land take"[26] or the increase of settlement areas/ artificial surfaces over time, usually at the expense of rural areas.[27]

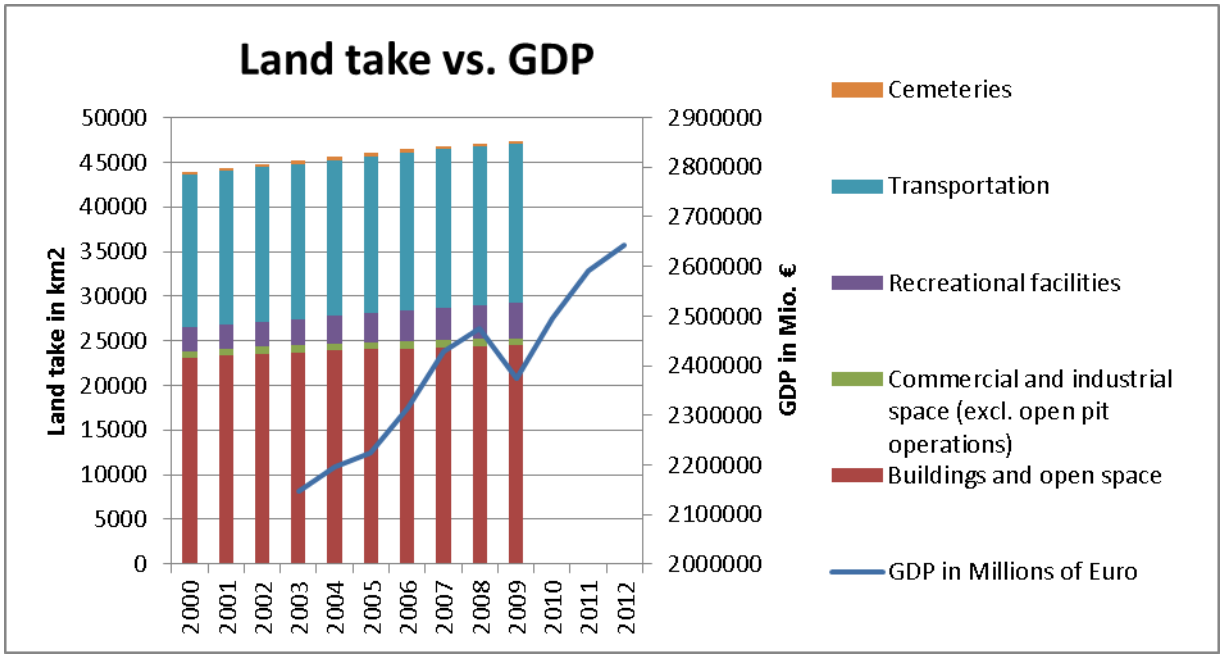
Nature of the policy mix: The policy mix aims to achieve a reduction in additional land take in Germany. It focuses on the policies in place at the federal level, and gives illustrative examples from the national, regional and municipal levels.

Lessons on decoupling

Type of decoupling: The decoupling to be achieved in this context is that between economic activity (GDP growth) and further land take in particular through the increase in settlements and traffic areas.

Decoupling achieved: The comparison between the economic development expressed as GDP and the development of land take show that trends for both have (steadily) increased over the last 10 years, as illustrated in Figure 12 below.

Figure 12: Trends in land take and GDP in Germany, 2000-2009



Source: Statistisches Bundesamt. 2010. FS 3 Land- und Forstwirtschaft, Fischerei, R. 5.1 *Bodenfläche nach Art der tatsächlichen Nutzung 2009*, Wiesbaden (accessed on 23.07.2013 at http://www.umweltbundesamt-daten-zur-umwelt.de/umweltdaten/public/document/downloadImage.do?ident=21306)

The decoupling achieved is therefore relative at best and one could argue that economic development and land take are still coupled to a certain extent. While additional land take per day has been slowing down (from more than 120 ha per day in 1993 to 81 ha a day in 2011), the actual overall land take is increasing and remains on a high level. It is therefore increasingly unlikely that the "30 hectare goal" (see below) will be achieved.

In 2006 the amount of sealed surface per capita in Germany amounted to 249 m² which is about 10 % above the EU average.[28] In 2011, each day, 81 ha were lost to settlement and traffic areas.[29] Approximately 43-50% of them were sealed surfaces.[30]

Instrument mix

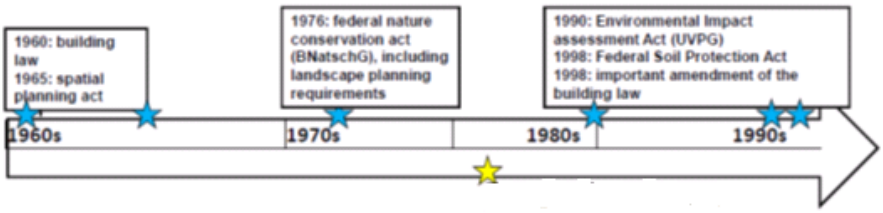
Objective of policy mix: The policy mix aims to achieve a reduction in additional land-take in Germany. A national target, to restrict daily new land take to 30 hectare per day by 2020 was set by the government in 2002 within the national Strategy for Sustainable Development.

The policy mix studied in this case study corresponds to the set of policies to reduce additional land take in place in Germany between 1976 and today. The policies in place fall into a set of different categories:

1. Regulatory and planning instruments: The spatial planning act provides the framework for spatial order and planning at the Federal level. The federal states make this framework operational through a federal state planning. Each federal state consists of several planning regions, which work out regional plans with guidelines on the regional planning structure.
2. Strategies: Since 2002 the Federal Government has a "30 hectare goal" by 2020, meaning that land take in Germany should be reduced to 30 ha per day by 2020. The goal is a non-binding political intention.
3. Voluntary/cooperation instruments: Also considered very useful, but only available in a few regions are building area cadastrals which provide an overview of available building potentials.
4. Information-based instruments: Handbooks, guidelines, manuals for different target groups have been published to increase knowledge about the environmental and economic impacts of land take and tools and instruments to support land saving. Several regions have also created web based information and communication tools.
5. Economic/fiscal instruments: Land certificates (tradable planning permits) are in a pilot phase.
6. Research: Many research activities address the challenge of reducing land take, providing input for the further development of informative instruments, planning tools, communication tools, markets based instruments and overall concepts.

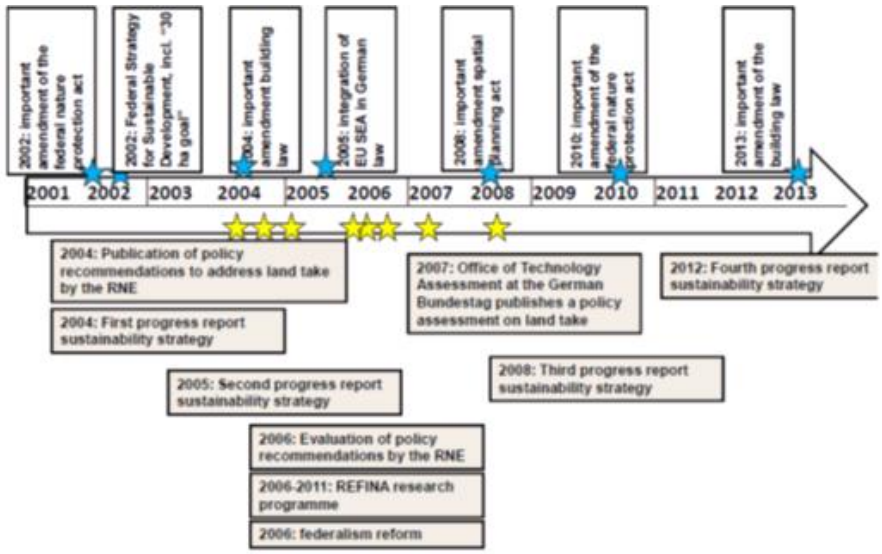
Evolution of the policy mix: Figure 13 and Figure 14 below illustrate the evolution of the policy mix. As many instruments date back to the 1960s and 1970s two Figures have been prepared to show the main steps in the policy evolutions. The text boxes/events above the arrow are mandatory planning/ regulatory instruments (with the exception of the sustainability strategy that had an important impact but is not mandatory). Those below the arrow are context information e.g. about the governments in place, establishment of research programs, publications of policy recommendations etc. Each "event" is marked with a star.

Figure 13: Evolution of the German land take policy mix, 1960s-1990s



Source: Author's compilation

Figure 14: Evolution of the German land take policy mix, 2000-2013



Source: Author's compilation

Instrument impact on decoupling – Key messages

All categories of policy instruments can be considered as almost equally important in the policy mix, with regulatory/ planning instruments and cooperation instruments having the strongest impact. Research activities were an exception, having a comparably lower impact but influencing the development of instruments in all other categories.

Implications for EU resource efficiency

Most studies suggest that with the current policy mix or only slight modifications of single instruments a fundamental change to reverse land take cannot be achieved. It is therefore necessary to adapt the policy mix. Worth pointing out is that Germany has some particular instruments, that only few countries have experiences with, such as its complex system of landscape planning, the impact mitigation regulation ("Eingriffsregelung") or more recently with trading certificates for land or Circular Flow Land Use Management that has been first tested in Germany and now transferred to Italy, Austria, Poland, Slovakia and the Czech Republic.

These instruments are particularly suitable and potentially interesting for other countries and EU regions that face similar challenges to Germany (land take, densely populated areas, demographic change etc.). However, the complex spatial and landscape planning system is difficult to transfer as it is very complex and formalised and tailored to the German federal system.[31] It may therefore only be transferable to a limited extent, especially with its specific distribution of competences across different levels. This is not to say, however, that it may not be possible to progressively put similar tools and instruments in place in other EU Member States, adapting it to the institutional context where there is political will to do so. It is however also clear that introducing an adapted version of the German system primarily makes sense in countries where there is the administrative capacity to manage and enforce such a complex system. Where relatively effective spatial planning systems are already in place, some of the tools and instruments used or tested in Germany could still help further increase their efficiency and effectiveness.

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Statistisches Bundesamt. 2010. FS 3 Land- und Forstwirtschaft, Fischerei, R. 5.1 Bodenfläche nach Art der tatsächlichen Nutzung 2009, Wiesbaden (accessed on 23.07.2013 at http://www.umweltbundesamt-daten-zur-umwelt.de/umweltdaten/public/document/downloadImage.do?ident=21306)

4.3 Policy mixes targeted at environmental media

4.3.1 Reducing transport CO_2 emissions in Spain

Issue: The environmental issues associated with transport include: air pollution (including CO, CO_2, NO_X, lead, particulate matter, and volatile organic compounds); climate change (predominantly from CO_2); and nature, landscape and urban effects (e.g. the impacts of extending transport infrastructure on soil and biodiversity). There are also upstream and downstream impacts such as those associated with the extraction and transportation of fuel for the transport sector, and the disposal of disused transport stock.[32] The contribution of the transport sector in Spain to national CO_2 emissions is amongst the highest in Europe. Emissions from transport account for roughly one third of CO_2 emissions in Spain.

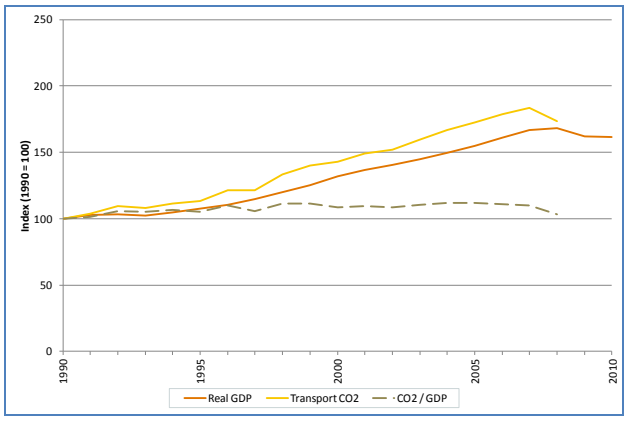
Nature of the policy mix: The policy mix examined in this case study comprises policies from the Spanish 2005-2007 Action Plan on Energy Saving and Efficiency, 'Plan de Acción de la Estrategia de Ahorro y Eficiencia Energética en España' approved by the Council of Ministers in Spain in July 2005. The case study focuses on the freight and passenger transport sector in Spain, examining the extent of decoupling of CO2 emissions from the transport sector from economic growth, and the policies put in place that have contributed to decoupling efforts.

Lessons on decoupling

Type of decoupling: None achieved.

Decoupling achieved: From 1990-1998, CO_2 emissions grew at a slightly faster rate than GDP, with the emissions intensity index rising to around 110 by 1998. For the next ten years, emissions grew at the same rate as GDP, with emissions intensity remaining (approximately) constant. That is, there is no evidence of any relative decoupling over this period. In 2008 (the last year for which transportation emissions data is available) there was a sharp decline in emissions while GDP continued to rise, with a corresponding reduction in emissions intensity. However, this is most likely an artefact of how the GDP time series is constructed rather than evidence of any absolute decoupling. See Figure 15 below.

Figure 15: Domestic transport CO_2 emissions versus GDP



Source: Author's compilation

An evaluation of the environmental impact of the 2005-7 Action Plan suggests that it did result in a reduction in CO_2 emissions from the transportation sector, amounting to around 8.5-9.0mt CO_2 in the final year. However, this was not sufficient to induce decoupling.

Instrument mix

Objective of policy mix: The 2005 Action Plan was implemented as the first of two action plans in the 2004-2012 Spanish Energy Efficiency Strategy, which proposed an overall 87.9 million oil equivalent tonne saving through transport policies, amounting to a total goal of 238 million tonnes of CO_2 avoided. The 2005-7 Action Plan set out "priority measures to start a process applying pressure to all sectors, so as to reduce growth rates in consumption and in energy intensity indicators".[33]

The Action Plan was heavily reliant on strategic plans, required from regional and local governments and individual companies. These included urban mobility plans, transport plans in enterprises and activity centres, management of transport infrastructure, and management of road transport and aircraft fleets.

Instrument impact on decoupling – Key messages

No clear decoupling – relative or absolute – could be concluded from the analysis. It appears that there was too heavy a reliance on strategic documents and management plans, and other instruments, notably market-based instruments, were not introduced.

Implications for EU resource efficiency

Given the dominance of information and education campaign measures in the 2005-7 Action Plan policy mix, there is little challenge to the transferability of these instruments. In the case of the Action Plan's measures to increase the use of rail transport, the quality and extent of the existing rail infrastructure in the transfer country in question would be a key factor. With regard to financial measures to incentivise the updating of the road transport fleet and stock of private vehicles, vehicle registration and ownership taxes vary greatly across Europe, and in many cases are already complex. The transferability of financial incentives for renovating the road transport fleet and stock of private vehicles is therefore more strongly dependent on the transfer country in question and its existing vehicle taxation system.[34]

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4.3.2 A fossil fuel-free energy system by 2050 in Denmark

Issue: Increasing levels of fossil fuel use globally has led to significant emissions of greenhouse gases, resulting in faster and more extreme evidence of climate change around the world. In Denmark, in the period since systematic national records began in 1873 to the present, it has had increases in average temperature of 1.5 °C, in precipitation of 15 %, and more powerful storms and hurricanes have been observed.

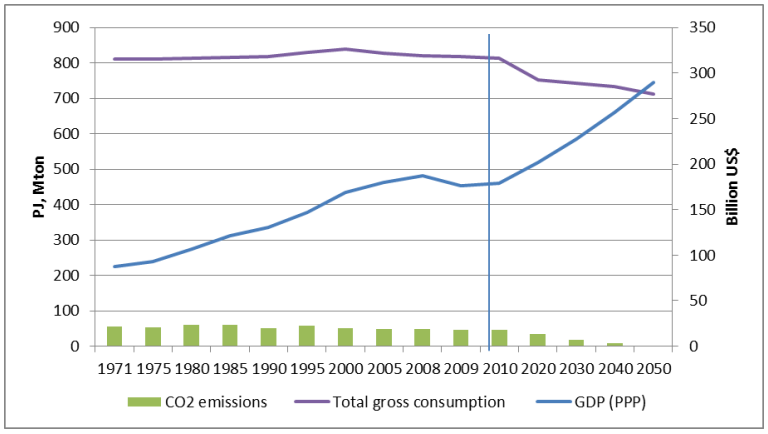
Nature of the policy mix: Denmark's 2011 energy strategy *Our Future Energy* further developed an existing objective of achieving a fossil-fuel-free energy system by 2050. This was followed by a cross-party government agreement in 2012 which set out medium-term initiatives to 2020 instrumental to reach the targets set for 2050.

Lessons on decoupling

Type of decoupling: According to the IEA[3], "Denmark is one of the most efficient users of energy compared with the other OECD countries. Since 1990, energy consumption has remained more or less constant; the Danish economy has grown by 35 %, while CO_2 emissions have reduced by 7.2 %." In terms of fossil fuel use, the decline is more recent: after annual increases between 1990 - 2011, it declined sharply thereafter.

What decoupling has been achieved: Relative decoupling of energy consumption from GDP has occurred since the 1970s, with stronger relative decoupling in later years. Between the 1970s and 2000, both CO_2 emissions and total gross energy consumption (TGEC) were constant while GDP increased. From 2000 to 2010, both CO_2 emissions and TGEC reduced slightly while GDP increased (with a dip since 2008, presumably due to the economic crisis). To 2050, CO_2 emissions are forecasted to reduce to nil and TGEC will reduce more considerably than previously, while GDP will continue to rise (see Figure 16).

Figure 16 Danish GDP, CO_2 emissions and total gross energy consumption, 1971-2050, past trends and projections



Source: IEA (2012), Statistics Denmark, Authors' computation on data by the Danish Energy Agency. GDP growth based on OECD Economic Outlook average rate for the period 2010-2014, taking into account the 2020 targets set in the 2012 Energy Agreement

[3] International Energy Agency

Instrument mix

Objective of policy mix: *Our Future Energy* has two over-arching objectives: independency from fossil fuels and drastic curbing of CO_2 emissions from the energy sector by 2050. These translate into the following objectives:

- By 2050 energy and transport sectors should rely 100 % on renewable energy.
- By 2035 electricity and heat production should rely 100 % on renewable energy.
- By 2020, Danish greenhouse gas emissions should be reduced by 40 % compared to 1990.
- By 2020, 50 % of electricity consumed in Denmark should be generated by wind power.

Also, the 2012 Energy Agreement contains various measures and initiatives which will:

- Increase the share of renewable energy in final energy consumption to more than 35 % by 2020.
- Increase the share of domestic electricity consumption produced by wind turbines to 50 % by 2020.
- Reduce greenhouse gas emissions by 34 % by 2020 compared to 1990.[4]

Evolution of the policy mix: Denmark's policy efforts on energy date back to the 1970s, following the oil crises in that decade. In the late 1970s it introduced energy taxes, followed by a CO_2 tax on household and industry energy consumption in 1992. All these taxes were restructured and gradually increased from 1993, and a further reform took place in 1996.[5] Below are highlights of developments over the years, as these have been extensive.

The objective of Denmark's 2005 Energy Saving Action Plan was to reduce total energy consumption (excluding transport) corresponding to an average of 1.15 % per year.[35] In 2007, an amendment to the Plan raised this target to 1.4 %. In the same year, the Government launched the energy strategy *A Visionary Danish Energy Policy 2025*, detailing cost-effective measures to meet objectives on security of supply, environmental impact and competitiveness. The measures combined regulation and market mechanisms. This was followed in 2008 by an Energy Agreement[36] between the Government and most other national political parties. The Agreement promoted energy efficiency, renewable energy sources and increased research effort in energy technologies. The 2009 Promotion of Renewable Energy Act[37] significantly transposed the Energy Agreement into national law. Also in 2009 a broader agreement - the Agreement on Green Growth[38] - was signed and it prompted the expansion of the agriculture sector's role as an energy provider (through biomass and biogas).

EU Directives have also had a direct influence on renewable energy policy. The Renewable Energy Directive 2009/28/EC[39] required Member States to produce national renewable energy action plans (NREAPs) setting out how the EU target (20 % overall target for renewables and 10 % share of renewables in the transport sector by 2020) would be met.

[4] From an as-yet unpublished report produced by IEEP for DG Environment providing an EU summary of Member State activities and results on resource efficiency in 2011-2012.

[5] From an as-yet unpublished report produced by IEEP for DG Environment providing an EU summary of Member State activities and results on resource efficiency in 2011-2012.

Denmark's NREAP[40] is more ambitious, with a 30 % share of renewables by 2020, and 21.9 % already in 2010.

Our Future Energy is a comprehensive, multi-faceted plan covering many sectors and relies on many tools, while not cancelling existing policy measures such as energy and CO_2 taxes. It is structured in three tracks: short, medium and long term actions. Given the uncertainty of long-term perspectives, the tools shift gradually from concrete market instruments, standardisation and regulation to activities such as earmarking funding for future actions, planning and research.

Lesson/insight: Although *Our Energy Future* is a recent strategy, it builds upon decades of strategies, policies and instruments relating to energy and climate dating back to the 1970s. Denmark is recognised as one of the more progressive countries in using taxation instruments for environmental benefit. Nonetheless, *Our Energy Future* extends beyond traditional instruments to promote significant transition in energy production and consumption.

Three key lessons to extract from this case study are:

- The importance of **cross-party political support** for strategy objectives and the means of achieving them. Denmark has done this for many years, and on broader variety of topics than energy and climate. Such agreement provides political stability should a government change, as happened in Denmark in 2011. Similarly **sectoral support** is an important element of Denmark's approach. This ensures that different industrial, manufacturing and commercial sectors, as well as households, can see the contributions made by others thereby making their contributions more appealing.[6]
- *Our Energy Future* is an ambitious strategy, based on transformation of energy production and consumption. One of its anticipated strengths is its balance between **pragmatism and flexibility** through the three-track approach: focus first on what can be done immediately, while paving the way for the transition by kicking-off long-term processes, while maintaining flexibility to cope with uncertainty.
- The need for such ambitious and transformative strategies to include **financing plans and mechanisms**. The 2012 Energy Agreement identified how much money is needed in 2020, and proposes how this will be met. Three elements are outlined: energy company tariffs, Public Service Obligations (PSOs), and a security of supply tax. Savings in final energy consumption have also been estimated, and funds have also been earmarked for different elements of the Energy Agreement.

Instrument impact on decoupling

The use of strategies, policies and instruments since the 1970s has already led to reductions in total primary energy consumption and in CO_2 emissions. Taxes have been a key instrument, and other measures helped to drive transformation by producers and consumers.

Key message: Considered use of a mix of instruments to provide incentives and disincentives for certain activities are key to achieving political objectives.

Denmark's ambitious energy strategy contains a number of clearly communicated objectives for the mid-long term.

[6] From an as-yet unpublished report produced by IEEP for DG Environment providing an EU summary of Member State activities and results on resource efficiency in 2011-2012.

Key message: Set political objectives that include clearly defined and communicated targets.

The 2012 Energy Agreement, the overarching implementation vehicle for *Our Future Energy,* is based upon cross-party political and wide-ranging sectoral support.

Key message: Get political buy-in from as many actors as possible, including other political parties, to ensure longer-term political stability of the strategy objectives.

Implications for EU resource efficiency

Denmark's level of ambition is exceptional and depends on how high climate change mitigation and independency of fossil fuel ranks on the political agenda of EU Member States, and on how much this is likely to be sustained in the coming decades. Denmark has a record of successful energy policies that have already put its economy on an absolute decoupling path. It already has a flexible international electricity transmission network that can accommodate peaks in renewable electricity generation, and it has a strong commitment to R&D and innovation in energy technology that has already placed it at the frontier of the renewable energy sector, particularly in the case of offshore wind generation. These preconditions are hard to come by simultaneously in any other EU country, with the possible exception of other Scandinavian countries. On the other hand, some ideas, if backed by sustained political will can be transferred to other countries: the support for renewables, the shift away from fossil fuels in the transport sector, and energy efficiency in buildings are a few examples of transferable policy initiatives.

Key message: Political ambition and sustained political will can provide the support needed to transform the EU energy system to one that is more based on renewables and drives more energy efficient behaviour in producers and consumers.

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4.3.3 Reducing fossil fuels use in Sweden

Issue: Increasing levels of fossil fuel use globally has led to significant emissions of greenhouse gases, resulting in faster and more extreme evidence of climate change around the world. In Sweden, forecasts highlight increased precipitation, flooding, risks of landslides, stronger winds, storm felling of forests, and water shortages in the South-East of the country.

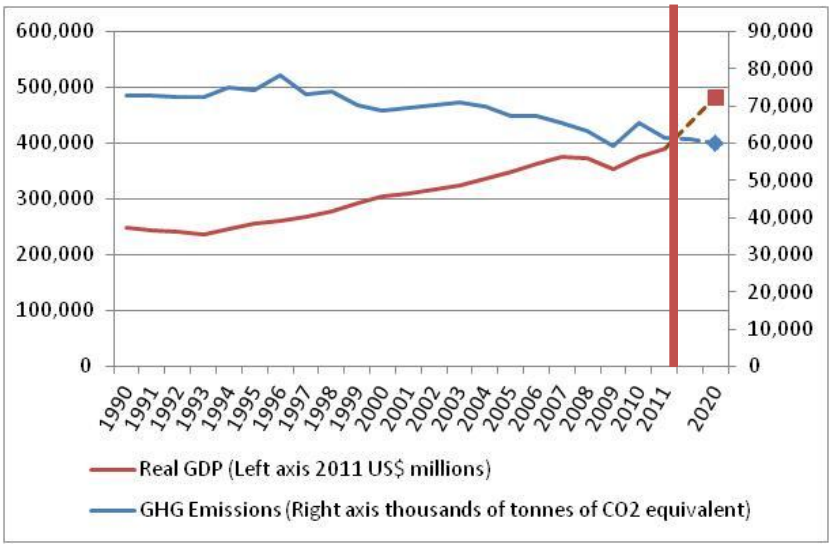
Nature of the policy mix: In 2009, the Swedish government introduced *An Integrated Climate and Energy Policy* aiming to achieve carbon and energy efficiency and the reduction of environmental impacts from related emissions. Based on a mix of primarily regulatory and market instruments, the strategy addresses the supply and demand side of energy. It also includes voluntary agreements and information/awareness-raising activities.

Lessons on decoupling

Type of decoupling: A mixed picture, leading to generalised relative decoupling. This is made up of absolute decoupling of GHG emissions from GDP between 1996-2007 and 2010-2011, and relative decoupling from 1993-1996. GHG emissions appear to have grown beyond GDP growth from 2007-2010. In future, a consequence of existing and additional measures in the *Integrated Climate and Energy Policy* and estimates of future GDP performance highlight that an absolute decoupling trend should continue to 2020, while a forecast of emissions to 2050 shows that these will continue to fall.

What decoupling has been achieved: Since 1990, Sweden has decreased its CO_2 emissions annually by 0.5 % on average, and emissions from fuel combustion were 9.8 % lower in 2010 than in 1990. Carbon intensity was also reduced by 40.5 % in 2010 compared to 1990. Between 1990 and 2011 Sweden's total GHG emissions declined by 15%, and the average 2008–2011 emissions were already 12.6 % lower than in 1990 (see Figure 17).

Figure 17: Sweden: historical and projected real GDP and GHG emissions



Source: Author's elaboration from Eurostat on 1990-2010 GHG emissions; EEA (2012) on 2010-2020 GHG emissions, Eurostat on 1990-2010 Real GDP; EU (2012) on 2010-2020 GDP projections

Instrument mix

Objective of policy mix: *An Integrated Climate and Energy Policy* aims to increase energy efficiency and reduce environmental impacts from emissions using a complex mix of economic (taxes, cap and trade) and regulatory instruments addressing supply and demand. The policy includes targets to 2020, set at EU and national level:

- A 17% decrease in emissions of sectors outside the EU Emissions Trading System (ETS) between 2005 and 2020. Extra to this, a national target is set of 40% reduction relative to 1992 in GHG emissions for specific sectors (transport, housing, waste facilities, agriculture, forestry, aquaculture and some parts of industry).
- An increase in the share of energy from renewable energy sources from 40% in 2005 to 49% in 2020.
- At least 50% of energy will be from renewable sources.
- A 20% reduction in energy intensity by 2020 relative to 2008.

Evolution of the policy mix: Sweden's efforts in energy date back to the 1920s, when it introduced a petrol and diesel tax in 1924, followed by an electricity tax in the 1950s, an oils and coal tax in 1957, a liquid petroleum gas (LPG) tax in 1964 and a natural gas tax in 1985. The level of energy tax has changed over time, varies between different fuels and includes various forms of exemptions. The energy tax system was reformed in 1991 to base it on taxes on carbon (see below) and on energy on fuels (not connected to the carbon content). A sulphur tax was also introduced in 1991. A 2009 climate policy resolution restructured the energy tax to base it on the energy content of the fossil fuel, with different levels according to consumer type.

In relation to carbon, in 1991 a carbon tax was introduced. With the introduction of the EU ETS in 2005, sectors covered by the ETS are exempted from the tax, to avoid double taxation. In 2006, a CO_2-based vehicle tax was introduced, and since 2011, the tax was extended to light-duty vehicles, buses and motor caravans.

Carbon and energy efficiency are addressed through an electricity certificate system introduced in 2003. Under this system, electricity producers (and some users) are required to purchase certificates equivalent to a certain proportion (quota) of their sales (or use). Producers of electricity from renewable energy sources receive an electricity certificate for every megawatt-hour of electricity produced. In 2010, the system was amended leading to increased quotas to meet the share of 50 % renewable energy by 2020.

Regulatory tools are also in use: The building regulation standards for energy efficiency used in Sweden since the 1960s underwent a major change in 2006 and tightening of the requirements for electrically heated buildings came into effect in 2009 and further in 2012. The fluorinated greenhouse gases (F-gases) regulation applied in Sweden following the EU Regulation (No 842/2006) on Certain Fluorinated Greenhouse Gases.

Lesson/insight:

- Sweden has used many overlapping instruments and goals in its national policy mix.[41] Both the energy tax on fossil fuels and the CO_2 tax raise revenues and both, directly or indirectly, target carbon emissions. A complex system of exemptions complicates the picture. As a consequence, the differentiated CO_2 taxation across fuels and sectors lowers the cost-effectiveness of the instrument because emission abatements are made in sectors (and for fossil fuels) where tax rates are the highest and not necessarily where marginal abatement costs are the lowest.

- The electricity certificate system raises two questions. First, whether there is a need to support specific carbon-free technologies beyond the incentives generated by carbon pricing. Second, whether this is the optimal instrument for support. The main argument in favour of the certificate system is that it is market-based.

Instrument impact on decoupling

The use of several policy instruments makes it difficult to assess the impact of each instrument. However, the carbon tax is considered to have caused emission reductions mainly in the residential sector (district heating mostly) and has mitigated the trend increase in emissions in transport. Its impact on industry is probably small as this sector benefits from large exemptions.

Key message: Multiple instruments can be used to address different users of a resource, designed for flexibility to adapt to changing situations in consumption and production activity. Taxes are a strong driver for behaviour change.

There are important connections between the different instruments used by Sweden on climate and energy policies, substantiating the policy mix. In particular, the flexibility in linking the energy tax, the CO_2 tax and the EU ETS to meet Kyoto Protocol targets and then EU and national targets.

Key message: Flexibility in instrument design and in being able to link to other instruments can help prevent overlap or gaps in the coverage of key target sectors.

Implications for EU resource efficiency

Sweden's use of strategies, policies and instruments has helped it to achieve at least some of the EU 2020 climate and energy targets long before that date. None of the instruments it uses are peculiar to Sweden, so they can be applied in other EU Member States. It has benefited from more ambitious political objectives than those set at EU level, and particularly from its long-standing use of taxation to achieve those objectives. Energy and carbon taxes have reduced and are likely to keep on reducing national GHG emissions. Nonetheless, some indicators seem to point out the relative inefficiency of the policy mix. Improvements could be made by making the carbon price more uniform across sectors, by limiting the interaction between different instruments (especially between the carbon and the energy tax), and by limiting the overlap between targets (e.g. renewables versus energy efficiency).

Key message: Strong evidence exists of actual practice in absolute decoupling in climate and energy policy, which could be used by all EU Member States.

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4.3.4 Reducing fertiliser use in Denmark

Issue: Direct discharges of manure and excessive or inappropriate use of fertiliser leads to leaching of nutrients to aquatic environments and can cause eutrophication or nutrient enrichment and algal blooms, which in turn leads to hypoxia (oxygen depletion) in water bodies, extensive fish death and ultimately loss of biodiversity. Throughout the 1980s, hypoxia seemed to occur more often and to more coastal areas around Denmark than before.[42] Also, as reserves of phosphorus are diminishing at a rapid rate, it is most likely that by 2050 all phosphate rock used in the EU will come from Morocco, making all EU Member States very dependent on imports from Morocco.

Nature of the policy mix: Since the 1980s a mix of national strategies, policies, and instruments have been implemented with an overall aim to improve the quality of the aquatic environment in Denmark. The strategies and policies also address issues not related to agriculture or fertiliser use. Regulatory instruments (e.g. bans, limits and requirements) form the primary instruments. Bans of direct discharges from manure were accompanied with government subsidies for investments in animal manure storage capacity.

Lessons on decoupling

Type of decoupling: Absolute decoupling between agricultural production and the apparent consumption of different types of fertilisers has occurred since 1991 (see Figure 18). Despite signs of absolute decoupling of fertiliser use in Danish agriculture, we cannot yet say that this has achieved a sustainable level.

What decoupling has been achieved: The use of commercial nitrogen fertiliser in Denmark has dropped from 394,000 tonnes (t) N in 1990 to 203,900 t N in 2011. The use of nitrogen in manure has dropped from 244,000 to 226,000 t N in the same period. Overall the nutrient balance has decreased from 397,000 t N in 1990 to 211,400 t N in 2011 - a reduction of 45%.

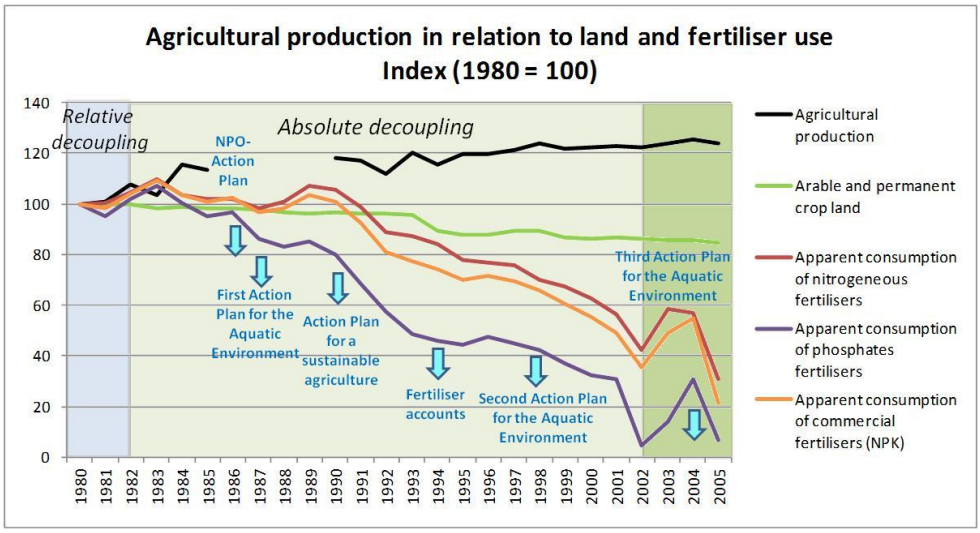
The target of reducing nitrogen leaching by half from 1985 levels was met in 2003 (rather than 1993, the initial deadline)[43]. Despite this absolute decoupling, average nitrogen surpluses in Denmark (76 kg N/ha in 2009) still remain above the EU average (49 kg N/ha in 2008). Phosphorous surpluses are now closer to EU averages.

Despite reductions in nutrient use and leaching, oxygen conditions in Danish waters have not improved.[44] This is thought to be due to still relatively high intensity of nutrients used per hectare in agriculture compared with other OECD countries[45], but also due to increasing temperatures caused by climate change. With temperatures set to increase further, the state of Danish waters will continue to degrade if the flow of nutrients is not further reduced.

Instrument mix

Objective of policy mix: A wide range of policy instruments were introduced to reduce fertiliser use and nutrient losses in agriculture in Denmark. The instruments were implemented through various actions plans. For each of the Action Plans a clear target (i.e. quantitative objective to be achieved by a certain time period) was set and the estimated contribution of the various initiatives was also provided.

Figure 18: Decoupling trends in agricultural use of fertilisers in Denmark



Source: OECD Environmental Data. Compendium 2008. Agriculture.

Evolution: In the 1980s awareness of the poor state of Denmark's aquatic environment led to the NPO (Nutrients-Phosphorus-Oxygen) Action Plan in 1985, which focused on direct pollution from farms and fields[46]. The 1987 First Action Plan for the Aquatic Environment included targets on reductions of phosphorus leaching from sewage treatment plants by 80 % and on nitrogen leaching (including fields) of 50 % by 1993[47]. In 1991, when it was clear that the nitrogen leaching reduction target could not be achieved, the policy was strengthened with an Action Plan for Sustainable Development in Agriculture.

Since 1993/94, farmers have been required to produce accounts to track fertiliser use[48] as a means of regulating fertiliser use and management; these efforts were strengthened in 1998 with the passing of the Danish Regulation on agricultural use of fertilisers and plant cover. In order to achieve policy targets, other requirements on farmers where increased in the Second Action Plan for the Aquatic Environment. Stricter requirements were implemented for the use of nitrogen fertilisers, requirements for low nitrogen feed introduced, targets set for increasing the area of forests, organic agriculture and wetlands. In 2000 a mid-term assessment of the Aquatic Plans revealed that the leaching of nitrogen had decreased by about a third. This was achieved by better use of manure as a fertiliser resulting in a 50% decrease of commercial nitrogen fertiliser. Limits on livestock density were also introduced to balance livestock manure production and the area of adjoining farmland on which it is applied[49].

The 2004 Third Action Plan for the Aquatic Environment aimed to further reduce nitrogen and phosphorus leaching from agriculture, and it included subsidies for establishing buffer zones between fields and water bodies to stop phosphorus leaching. It also introduced a mineral phosphorus tax on feed, with tax revenues returning to the agricultural sector through a reduction in land taxes. Since 2005 farmers have had to comply with the Danish regulatory measures as a condition for benefiting from EU Common Agricultural Policy support.

The 2009 Green Growth Plan[50] provided funding to ensure better conditions for the country's nature and environment while allowing agriculture to develop. Among its targets and measures are further reductions of the discharge of nitrogen and phosphorus from 2010 to 2012. Nitrogen quotas were to come into force in 2012, but were delayed still in 2013 as an

independent committee considered acceptable options for this. The plan also stipulates that 50 % of farm animal manure must be used to produce biogas in 2020 and that, with time, all farm animal manure must be used as a source of renewable energy.

Lesson/insight:

For each of the Action Plans clear targets (i.e. quantitative objectives to be achieved by a certain time period) were set and the estimated contribution of the various initiatives was also provided. This helped guide the instruments and allowed the government to adjust policies according to progress and achievement of targets.

Instrument impact on decoupling

The introduction of various policy measures with clear reduction targets for nutrient losses together with constant monitoring, enforcement and follow up appears to be a good approach for decoupling. The policy mix applied a wide range of instruments, e.g. regulatory, voluntary, economic and information based that each addressed a specific contribution to the nutrient reduction targets.

Key message: The success of multiple strategies, objectives and policy instruments can be better ensured through constant monitoring and enforcement, and adaptation of instruments according to performance against targets.

Implications for EU resource efficiency

EU Member States have taken different approaches to reducing agricultural fertiliser use. Although there are considerable variations in rules, regulations and application standards, the general approach to setting clear targets, using regulatory instruments that are supported by economic incentives and voluntary measures could be transferred to other countries. A consistent monitoring system is however fundamental for the policy to be successful.

Key message: More effective implementation of EU action on water quality and links to the Common Agricultural Policy can be made through consistent monitoring of performance and use of instruments.

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4.3.5 Reducing phthalate and PVC use in Denmark

Issue: Polyvinyl chloride (PVC) is a petroleum-based material (thereby having significant environmental impacts in its manufacture), which is also made of a number of additives with negative health and environmental impacts. Phthalates are a group of substances primarily used as plasticisers in PVC, and suspected to be endocrine-disrupting substances. They are liberated during the lifetime of the products and might be the cause of health issues in young girls and new-born boys. The end-of-life of PVC products may also cause environmental and health problems, as incinerating a product containing chlorine can liberate organic compounds containing chlorine to the environment due to incomplete combustion. These compounds are persistent environmental pollutants and can cause several health issues.

Nature of the policy mix: Denmark's policies on phthalates and PVC are primarily due to health concerns. Since phthalates are released from products made of PVC, the policy approach has focused on those products that could represent a risk of harm to people. Lack of specific studies and the difficulty of extrapolating results to humans led to an adoption of the precautionary principle: a policy restricting the use of some components was set in view of the risk of possible harm to consumers.

Lessons on decoupling

Type of decoupling: Reduction in consumption of phthalates and PVC was the general target for this policy mix, with a target of 50% reduction in consumption of certain phthalates by 2010, and the banning of some phthalates in childcare products.

What decoupling has been achieved: Absolute decoupling of phthalate and PVC consumption to GDP appears to have occurred, at least to 2008 before Denmark's GDP decreased largely due to the global economic crisis. However, as statistical data cannot be collected on products containing phthalates, or which ones, this result is based on extrapolations and is therefore not to be considered scientifically robust. Although no graph is provided showing such results, this can be induced by Denmark's annually increasing GDP from the period 1999 to 2008, compared to a 40-44 % reduction in PVC consumption and a roughly halving of phthalates consumption from 1999-2011.

Instrument mix

Objective of policy mix: In 1999 the Danish Ministry of Environment adopted an *Action plan for reducing and eliminating the use of phthalates in soft plastics* and a *Strategy for the PVC Area*. These strategies combine different policy tools to restrict the use of phthalates and to support the development of substitutes. It also established an objective of reducing the consumption of certain phthalates by 50% by 2010.

Evolution of the policy mix: In 1991, the Danish government and the industry developed and Agreement on the reduction of use of PVC. Within that agreement, the DMoE and the PVC industry committed to identify the problems associated with the use of PVC, to establish objectives for action and to define the strategy for dealing with these problems. Since 1996, the DMoE has issued a number of GPP guidance documents to include criteria for avoiding products containing PVC. The 1999 *Action plan for reducing and eliminating the use of phthalates in soft plastics* considered a number of policy options, recognising the limitations of action only at the national level. EU level action was required and Denmark made efforts

(which continue today) to get the European Commission to set out an EU response. Nonetheless, the action plan included a number of policy instruments:

- Phthalates restriction/avoidance in Danish and EU level standardisation;
- A tax on phthalates in selected product groups: a charge aiming to contribute to the reduction of soft PVC in products and to provide incentives for the use of other plasticisers than phthalates;
- Subsidies: a grant scheme for the development of substitutes;
- Green public procurement: linking to work delivered through a more comprehensive GPP programme;
- Ecolabelling: introducing PVC bans or restrictions into EU Ecolabel and Nordic Swan product criteria.

The 1999 *Strategy for the PVC area* was established by Danish Environment Protection Agency and the industry and contained a number of policy instruments: a tax on PVC products and on phthalates and a ban on the use of problematic stabilisers. The tax introduced in 1999 originally applied to all PVC foils for food stuffs was introduced, and in 2000 it was extended to all PVC products and all phthalates. Also in 1999, a ban was introduced on the sale, use or import of all phthalates for childcare products intended for children up to 3 years old. In 2012 the Danish Government proposed a ban on the use of 4 further phthalates in products for indoor use and products that can come into direct contact with the skin or mucous membranes. However, this ban has been postponed due to the discovery of the extent of the wide use of these phthalates and therefore the difficulty in effecting the ban.

Lesson/insight:

- **Bans and taxes form the main policy instruments of the policy mix.** They have directly affected manufacturers since their entry into force, and were expected to have a direct influence on consumption of phthalates in Denmark. Both instruments aim to encourage manufacturers to substitute phthalates with other products. Complementary instruments have been introduced to help develop and spread alternatives in the market such as funding for R&D, GPP and voluntary agreements.
- Denmark's engagement with industry while developing its strategies, its use of agreements, and its persistence in arguing for EU-level action has recently resulted in industry agreeing to support an EU-wide ban of the four phthalates, to prepare guidelines to help consumers to better avoid products containing phthalates, and to develop options for labelling of products not containing the phthalates.

Instrument impact on decoupling

PVC consumption has decreased in Denmark and so has phthalates consumption. As the ban of phthalates does not affect all phthalates, it could be that the banned substances have been substituted by alternative phthalates after the policy mix was applied.

Key message: Policy mixes can help to 'disturb' business as usual by forcing innovation in a more specific direction, and to identify potentially more effective instruments and action.

Implications for EU resource efficiency

Denmark's actions on phthalates remains more ambitious than action subsequently taken at EU level, where a 2005 Directive[51] restricted (but did not ban) the use of phthalates in toys

and childcare articles. In 2011, the Danish Ministry of Environment proposed to the European Commission an EU-wide ban on all types of phthalates in all indoor products in contact with consumers. Such an absolute ban at EU level is legally possible, provided that valid plasticiser alternatives are developed and available. In that case, the objective of reducing phthalate consumption would be reachable both at EU and Danish levels.

Key message: Problematic substances such as phthalates can be eliminated or their consumption severely reduced at EU level, learning from Member State actions.

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4.3.6 Increasing industrial energy efficiency in Portugal

Issue: In 2010 energy consumption in Portuguese industry was 18% higher than the EU average, while energy consumption in manufacturing was 28% higher than the EU average.[52] This has led to high emissions from industry which accounts for 13% of national greenhouse gas (GHG) emissions, 37% of sulphur oxides (SO_x), 22% of nitrogen oxides (NO_x) and 1% of ammonia (NH_3) emissions (2010, calculations based on Eurostat data).

Nature of the policy mix: The policy mix is to a large extent the result of national implementation of Directive 2006/32/EC on energy end-use efficiency and energy services ("Energy Services Directive").[53] It is set out in the Portuguese National Energy Efficiency Action Plan (PNAEE) published in 2008 and revised in 2011. This case study examines two programmes in the Action Plan which relate to industry - Industry Efficiency System and the Energy Efficiency Fund which include a mix of regulatory and economic instruments.

Lessons on decoupling

Type of decoupling: While final energy consumption in Portuguese industry dropped by 14% from 2000 to 2010, energy use in industry per unit of value added slightly increased over the same period. Thus, energy use has not been decoupled but rather the reduction in energy use is explained by a drop in industrial production. However, electricity consumed in the production of 1 Euro of added value decreased by 28% on average for the manufacturing industry as a whole from 2000-2011. This reduction indicates that electricity use has been decoupled from production in the manufacturing industry. At the same time, there has been a shift in fuel use in industry which has contributed to a decline in emissions of GHGs, NO_x, and in particular SO_x. Although GHG and NO_x emissions have declined at approximately the same rate as value added, decoupling is evident in the reduction in SO_x emissions.

Decoupling achieved: The effect of the policy mix is difficult to estimate, partly because the mix was recently implemented and partly because it coincided with an economic crisis. Thus it is hard to say if the policy mix enables decoupling. Final energy consumption of the industry sector has been reduced since the introduction of the policy mix. There are indications that the energy savings to a large extent reflect the economic crisis. There are also indications that the energy efficiency gains compared to 2000 are significantly lower than the EU average. Furthermore, the deadline for meeting targets for reduced energy consumption is 2016 and experts have different views as to whether or not they will be met.[54]

Instrument mix

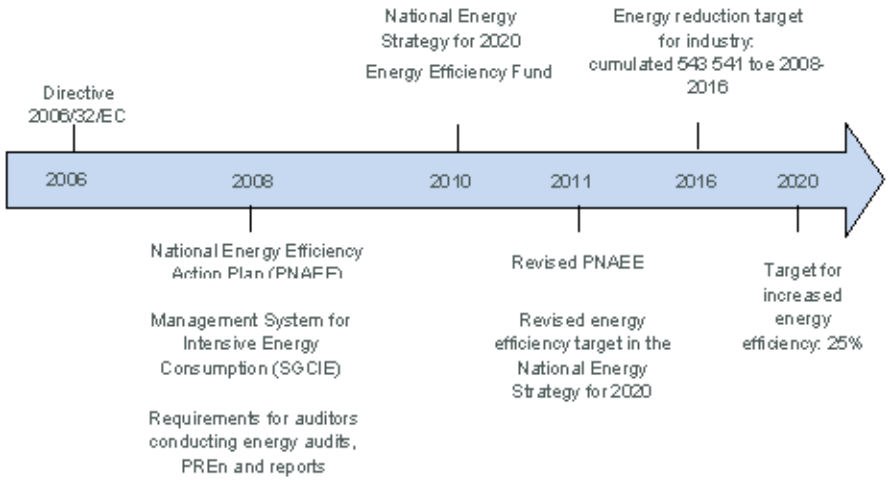
Objective of policy mix: The PNAEE from 2008 aimed to increase energy efficiency by 9.8% of total final energy consumption by 2015, with 30% of projected energy savings to be achieved by industry. The PNAEE was revised in 2011 and the energy savings target was raised from 1.8 Mtoe in 2015 to 2.2 Mtoe in 2016, with 24% of the projected energy savings to be achieved by industry.[55] Additional objectives are to increase coherence of energy efficiency policies, address all sectors and aggregate existing measures.

This case study focuses on two programmes in the PNAEE relevant to industry. The Industry Efficiency System introduced the Intensive Energy Consumption Management System (SGCIE) which includes: energy audits; Energy Consumption Rationalisation Plans (PREn);

requirements on education; Rationalisation Agreement for Energy Consumption (ARCE); penalties for non-compliance; exemptions from excise duties; subsidies for energy audits and investments in energy management and monitoring equipment. The Energy Efficiency Fund (EEF) was set up in 2010 to encourage behavioural changes, raise awareness, and support energy efficiency projects.

Evolution of the policy mix: is set out in Figure 19 below.

Figure 19: Evolution of the Portuguese industrial energy efficiency policy mix



Source: Own compilation

Instrument impact on decoupling – Key messages

Coupling regulatory instruments with economic instruments increases the effectiveness of the policy mix - Regulatory instruments coupled with a set of economic instruments connected to the fulfilment of certain conditions (e.g. exemptions from excise duties for facilities with an ARCE and subsidies for energy audits and investments granted to facilities with a PREn, financial penalties are applied for non-compliance with targets set in the ARCE). These economic instruments provide financial incentives to comply with the regulatory instruments, thereby complementing and strengthening these instruments.

Increased level of knowledge due to provision in regulatory instruments can help identify potential for resource efficiency gains - The obligation to carry out energy audits and develop PREns helped facility operators to identify and assess energy efficiency measures that had not yet been realised even though these measures could potentially decrease costs.

Reporting requirements and gradual strengthening of targets over time helps to maintain a long-term perspective - By the end of each PREn period (6-8 years depending on total energy consumption of the facility), facility operators must reduce their target indicators by 4% if their reference energy consumption is over 500 toe/year and by 6% if their reference energy consumption is above 1,000 toe/year.[56] This encourages operators to consider mid- and long-term energy efficiency measures rather than only focus on short-term solutions.

Implications for EU resource efficiency

The combination of energy audits and energy consumption rationalisation plans could be transferred to the EU level. The active involvement required from facility operators can result in better understanding and awareness of the importance of energy efficiency. This, in turn, would increase the acceptance of requirements to reduce energy use or increase energy efficiency. However, the inflexible targets of 4% and 6% reductions are probably only justified in countries where the initial energy efficiency is low. In countries with high energy efficiency, such as Denmark, the cost of a 4% or 6% increase in energy efficiency at an individual production facility could be exceedingly high and a more flexible approach considered.

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4.4 Policy mixes for waste prevention

4.4.1 Reducing municipal waste at the local level in Slovakia

Issue: Landfilling of waste is the least preferable waste management method due to loss of resources and environmental degradation. Landfilling can result in soil and water contamination, dispersion of hazardous/toxic substances in the environment, greenhouse gas emissions, risk of explosions, landscape degradation, etc. In addition, resource scarcity and depletion demands that materials be collected for recycling and composting, to be used as secondary raw materials, before energy be generated from waste. In Palárikovo municipality, the closure of the old municipal landfill due to stricter national legislation provided the driver for changing the municipality's approach to municipal waste management.

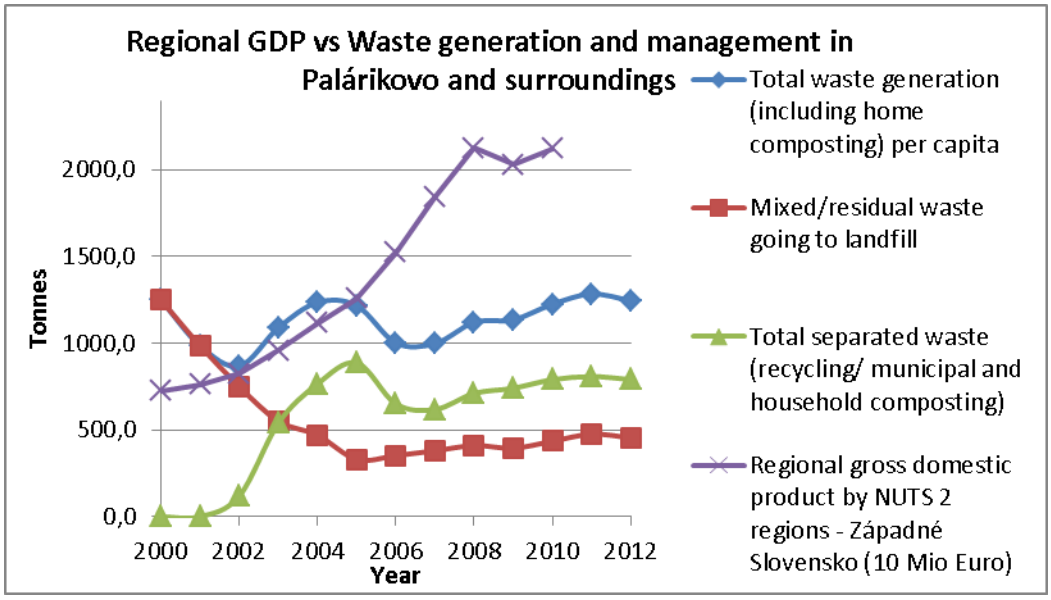
Nature of the policy mix: Palárikovo municipality's strategy is often referred as a "Zero Waste" strategy. In principle, "zero waste" approaches maximise recycling, minimise waste, reduce consumption and ensure that products are made to be reused, repaired or recycled.[57] As Palárikovo's approach was driven by economic rather than environmental needs, it discourages practices that would help in reusing or even in preventing waste. The approach taken was intuitive rather than evidence-based, aiming to increase recycling and composting levels and to reduce waste going to landfills.

Lessons on decoupling

Type of decoupling: Relative decoupling appears to have occurred in waste *generation* as this level has remained steady, between 1,000-1,250 t / year since 2000. Nonetheless, there has been a decrease in waste going to landfill (around 64 % reduction since 1999) and of recycled and composted waste (around 64 % of total generated waste in 2012). The GDP of the region (Západné Slovensko) shows a positive trend since 2000, with a dip in 2008 due to the global financial crisis.

What decoupling has been achieved: Since 1999, when first policy instruments were introduced, the municipality achieved a reduction of landfilled waste from 1,300 tonnes (t) in 1999 to 445 t in 2012, with a minimum of 330 t in 2005. This reflects a 64 % reduction of waste going to landfill compared to 1999. In 2013, 37 % of waste is landfilled, 40 % is composted (through municipal or household composting) and 23 % is recycled. In addition, through recycling activities, 45 million Mega joules of energy and 27,000 t of greenhouse gases were saved in 2011.

Figure 20: Palárikovo policies and instruments and their actual and projected performance towards decoupling



Source: Authors' computation based on data provided by Palàrikovo Municipality (2013)

Instrument mix

Objective of policy mix: The initial objective of the policy mix was to make savings on the municipal budget, given that continuing to landfill most/all of the municipal waste would cost more due to the closure of the old municipal landfill.

Evolution: Development of the policy mix appears to have occurred in a random way, e.g. some instruments were introduced before a political objective was set. In 1999, the Municipality began promoting home composting, but without any clear data or objective. In the same year the Municipality assessed possible alternatives to landfilling through a cost efficiency analysis which identified that a possible solution would be to implement an integrated waste management system to enable waste collection and recycling. In 2000, the first activities related to waste collection were initiated. With major support from the environmental organisation, Friends of the Earth (FoE) Slovakia, a public awareness-raising campaign promoting biodegradable municipal waste sorting and domestic composting was launched. In 2002, the first waste management facilities were opened and glass, paper and plastic packaging (PET bottles and beverage cartons) began to be collected; home composters were also sold at a subsidised rate. In 2003, a differentiated fee for municipal waste management was introduced (a lump sum fee). The first monitoring activity was undertaken in 2004, in order to get funding from the national Recycling Fund. A 2005 audit by FoE Slovakia convinced the Municipality to also introduce door to door collection for plastic, paper, beverage cartons and glass. 2006 saw the introduction of a pay-as-you-throw (PAYT) scheme, the extension of materials collected for recycling and the construction of municipality composting plants.

Lesson/insight:

- The importance of **raising public awareness** on their role in the process: The public awareness-raising campaign was conducted in such a way that people felt emotionally attached to the programme and proud to collaborate. A high level of acceptance achieved: from 0 to 99 % involvement in seven years, and there are many recent cases of people requesting that the Municipality introduce separation of further materials/products. It may be that the small size of the village helped to ensure the success of the initiative as it is easier to feel part of a collective activity.
- **The need for coherence in the objectives and implementing instruments:** Palárikovo Municipality is highly dependent on the national Recycling Fund to fund its activities. The Recycling Fund is driven by the need to achieve targets for materials collected for recycling, hence municipalities are encouraged to produce waste (to be able to recycle it). This has resulted in a partial climb up the waste hierarchy - from landfilling to recycling and composting, but many reuse and prevention opportunities are lost.

Instrument impact on decoupling

The level of Palárikovo's waste being landfilled began to decrease significantly even before charges were introduced, when a public awareness-raising campaign was delivered and home composting was encouraged. Levels of recycling/composting increased with the introduction of waste charging, and increased again with changes (increases) to the charge.

Key message: Public engagement in changing behaviour benefits from communications campaigns, before changes to charging structures.

Implications for EU resource efficiency

The success achieved in Palárikovo has already served as an example to the rest of Slovakia in implementing similar waste management systems. The transferability of such a system is possible in areas that are geographically and socially similar to Palárikovo, i.e. rural areas with lower economic activity, lower levels of education and environmental awareness, and typically far from achieving EU 2020 goals on landfilling and recycling/composting. An important factor to consider is the small size of the municipality and the limited number of inhabitants, which made it easier to introduce door-to-door collection and to emotionally engage the inhabitants through the awareness-raising campaign.

Key message: Sharing good practice domestically and EU-wide can help lower-performing countries make more effective improvements to performance.

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4.4.2 Preventing food waste in the UK

Issue: According to 2008-2010 data, the UK is the second largest producer of household food waste in the EU and the largest producer of wholesale/retail and food service/restaurant food waste.[58] Thus huge amounts of land, water, energy and other resources used in food production are misused (and lost) and unnecessary costs incurred. 2010 figures estimate the total avoidable household food and drink waste within the UK to be 4.4 million tonnes per year, equivalent to 17 million tonnes of CO_2 emissions.[59] In addition, at least 40% of food waste produced in Britain is disposed in landfill.[60] Decomposition of this waste results in the production of methane, a very potent greenhouse gas contributing to climate change.

Nature of the policy mix: The policy mix consists of a number of different instruments including EU legislation and strategies, instruments at the national (UK), country (Wales, Scotland, England and Northern Ireland) and local levels. It follows the principles of the waste hierarchy such that waste prevention is the highest priority, followed by re-use, recycling, other recovery and disposal.

Lessons on decoupling

Type of decoupling: Not clear as data available is not sufficient to draw conclusions.

Decoupling achieved: Available data indicates an initial growth in the amount of food waste which peaked in 2009 at 15,700,000 tonnes. In contrast, GDP decreased between 2007 and 2009. Thereafter, the amount of total food waste starts to decrease while GDP increases. Although figures suggest a link between GDP and food waste, available data is not (yet) robust enough to draw conclusions. It also needs to be proven if there is a trend that in economically difficult times more food is wasted (as suggested by available data), which seems unlikely at least for people with low income.

At the overall UK level, between 2006/2007 and 2010, 1.1 million tonnes of food waste was prevented.[61] At the country level, in England, there has been an 18 % reduction in food waste collected by local authorities in the same time period. This reduction has taken place despite growth in household numbers.[62] At the local level, implementation of a “Love Food Hate Waste” campaign by Worcestershire County Council led to 15 % less avoidable household food waste being collected.[63] Significant environmental results have also been credited to the Landfill Allowance Trading Scheme (LATS) - 32% less BMW was landfilled in 2009 than in 2001/2002.[64] In 2011/12, local authorities landfilled 52% less BMW and collectively sent 59% less BMW to landfill than in 2001/02.[65]

Instrument mix

Objective of policy mix: The overall objective is to reduce the amount of food and drink waste produced and subsequently reduce food waste which ends up in landfills. This can be viewed as a sub-objective of wider UK waste policy goals which seek to reduce the amount and types of waste (including but not only food waste) ending up in landfills to meet the EU Landfill Directive targets, address the top of the waste hierarchy, and support the move towards a circular economy.

Evolution: The management of (food) waste in the UK has been transformed in the last 15 years. It began with the Landfill Tax introduced in 1996 and has moved progressively up the agenda since 2007 in large part due to the publication of detailed reports by the Waste and Resource Action Programme (WRAP) as well as more recently rising up the EU and international agenda. The scope of targeted actors has also broadened to not only include waste-based organisations but also food-based organisations and consumers.[66] There are also a number of continuous changes with new targets set under voluntary agreements over time and increased annual tonnage rates under the Landfill Tax.

Instrument impact on decoupling

Mix of market-based, regulatory and information-based instruments key to success - A key consideration in the success of the policy mix is the existence of an underlying market-based instrument (the Landfill Tax), parallel regulations and the support of numerous complementary information-based instruments and voluntary agreements. The development of voluntary agreements to complement the findings of the informational campaigns is a further step which underlines the policy mix's success.

Gradual expansion of target group increases effectiveness of policy mix - While the instruments initially targeted a limited number of sectors, they have expanded to address food waste prevention and minimisation in hospitals, schools, households, different actors along the supply chain, restaurants and the tourism sector. This broader target group have enabled the instruments to achieve a much greater impact than was possible at their inception.

Importance of monitoring and assessment to identify limitations of instruments – Following a 2012 review by Defra, the LATS was deemed to no longer be an effective policy tool and is being phased out (to be completed in late 2013).[67] This indicates the value of monitoring and conducting impact assessments to enable informed evaluations of policy instruments on a regular basis. While the Landfill Tax remains a key instrument for waste in general, it has limitations in the area of food waste. Since food waste is more likely to be weighed at the point of disposal than at the point of collection, there is a lack of incentive for individual food waste producers to reduce the quantity of food waste produced. This could potentially be addressed by the introduction of 'pay as you throw' schemes.

Implications for EU resource efficiency

The case indicates the important role EU waste legislation has had in shaping national policy. EU waste policy has significant potential to impact the treatment of food waste once it has been generated and ensure that (1) no or minimal amounts are deposited in landfills and (2) the use of anaerobic digestion is increased as the preferable treatment method. While guidance and information documents are useful at an EU level to provide an indication of the overall situation in the EU, national/local campaigns targeting the specific context and drivers of food waste in a given country are more likely to have a high impact as the UK case shows**.**

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4.4.3 Reducing plastic bag use in Ireland and the UK

Issue: Single-use plastic carrier bags, usually made of high-density polyethylene (HDPE), are a major source of litter. On land, conventional plastic carrier bags can last as litter for two years or longer before disintegrating. Plastic carrier bags can contaminate soil and waterways, and be ingested by animals. Of particular concern are problems in the marine environment. Apart from litter, the environmental impact of plastic carrier bags is dominated by extraction of materials and production phases. In addition, littered plastic carrier bags have economic costs for industries such as fishing and tourism and for municipalities responsible for clean-up operations.

Nature of the policy mix*:* This case study focuses on the use of taxes, voluntary targets, initiatives and awareness raising campaigns in the UK and Ireland.

In Ireland a levy was introduced in March 2002 on the purchase of plastic carrier bags in supermarkets, petrol stations and shops. The levy level was raised in 2007. Proceeds from the levy are paid into an environment fund, which is used for financing recycling centres and other environmental activities. Retailers failing to implement the levy are liable to a fine and/or to imprisonment.

In the UK voluntary agreements are in place between the government and retailers to reduce the harmful environmental impact of single-use carrier bags. In addition, charges are being introduced at the country level, in 2011 in Wales and in early 2013 in Northern Ireland. A charge will be introduced in Scotland in late 2014 and in England in late 2015. Several towns and cities in the UK have also banned plastic shopping bags, e.g. Modbury and Chesham.

Lessons on decoupling

Type of decoupling: The experience from Ireland and the UK show that taxes or levies on plastic bags have been successful in reducing consumption. The apparent success of these policies could have been amplified by the general drop in purchasing power due to the 2008 financial and economic crisis; however the tax in Ireland was successful even in a time of relatively robust economic growth (2002-2007). There was also a decrease in plastic bags as a percentage of the national litter composition from 0.32 % in 2008 to 0.24 % in 2009.[68] In the UK, the overall number of carrier bags reduced by 26 % in 2008 and by 48 % in 2009. In 2010, the decreasing trend stopped and the use of thin plastic bags increased by 5 % compared to May 2009.[69] In terms of progress at country level, in Wales, use of plastic bags fell by 22 % (compared to 2010) following the introduction of the charge in late 2011.

Decoupling achieved: In Ireland, within five months of introduction, a 90 % reduction was achieved.[70] The number of bags used per person dropped from 328 in 2002 to 21 within the year. However, there was subsequently a gradual increase in plastic bag usage to 30 bags per person/year in 2006 (a time of strong growth in incomes). The plastic bag levy was thus increased which resulted in a decrease to 26 bags per person in 2008 and 18 bags per person in 2010. The share of plastic bags in litter pollution has fallen from 5 % in 2001 to 0.25% in 2010.[71]

In the UK, statistics show that in May 2006, 870 million thin bags were used in participating supermarkets. In May 2009, this number was 452 million and 475 million in May 2010. This is a reduction of around 45 % compared to 2006. Research on the Welsh situation published

nine months after the introduction of the charge shows that people who took their own bags on their last supermarket trip increased from 61 % to 82 % six months after the fee came into force. Also, the use of bags also fell by 22 % (compared to 2010) and the distribution of free carrier bags fell by up to 96 % in some retail outlets. Meanwhile, use increased in England by 7.5% and in Northern Ireland by 8.1%.

Instrument mix

Objective of policy mix: The main objective is to reduce litter by reducing the number of units consumed.

Evolution of the policy mix: In Ireland the levy was introduced in early 2002, and its level was raised in mid- 2007. The aim of the increased rate was to keep the number of plastic bags per person to 21 or fewer. In 2011, a provision was made in national legislation which sets a ceiling for the levy and enables the levy to be amended once in any financial year. There are currently no plans to increase the plastic bag tax further.

In the UK, before 2008, there were only voluntary agreements between the environment ministry and leading supermarket and department store chains to reduce the use of plastic carrier bags. Initial agreements included reduction targets, while a 2010 agreement continued with the idea of further reductions, but did not set concrete targets. The agreements were mainly aimed at simple plastic carrier bags that customers get for free in supermarkets. There are no penalties involved. The 2008 Climate Change Act provided conditions to allow the introduction of a general charge for plastic carrier bags. This led to the introduction of subsequent charges at the country level:

- In late 2011, Wales introduced a charge on single-use plastic carrier bags given out in supermarkets and other shops. There are some exemptions for small paper or plastic bags used to package items such as loose food, seeds and plants.
- In early 2013, Northern Ireland introduced a charge for single use carrier bags in shops and over the internet. Revenue from the charge is used to fund environmental programmes and activities. Certain services, like shoe repair and launderettes are not subject to the levy as are certain bags, exempted on grounds of hygiene and food safety.
- In late 2014, Scotland will introduce a charge to apply to carrier bags generally, not only on plastic bags given the environmental impacts of other bags.
- In autumn 2015, England will introduce a charge on plastic bags given in supermarkets and larger retail stores. Proceeds from the charge will be donated to charities. The use of biodegradable shopping bags will be encouraged by exempting those bags which meet a yet-to-be developed manufacturing standard.

Instrument impact on decoupling

Importance of review and revisions to policy instruments – The experience in Ireland indicates a “short, sharp shock” upon introduction of the plastic bag tax (the steep drop seen in 2002). However after this initial period, consumption began to creep back up and necessitated a further increase in the tax. This experience highlights the need to keep the policy instrument under review and adjust it as necessary to better achieve policy objectives.

Importance of engaging with retailers and the public - Public awareness-raising is crucial to any approach addressing consumers, to highlight the damage caused by thin bags, the cost of addressing environmental damage caused, and to promote the use of reusable bags. Collaboration with the retail sector is also essential in this regard.

Charges can result in positively changed behaviours - Consumption levies are expected to yield higher reductions in the number of plastic carrier bags used and littered than supply-side weight-based taxes. Governments can enhance the environmental benefit of such levies by ring-fencing funds for litter clean-up activities, recycling and other environmental projects.

Keep in mind potential impacts on other areas – The tax on single-use carrier bags is likely to result in an increase in the use of multiple-use plastic carrier bags and smaller increases in the use of other carrier bags such as paper and cotton, and bin liners for domestic waste. However the overall effect is expected to be positive on all indicators, including energy use, greenhouse gas emissions and especially for litter.

Implications for EU resource efficiency

The most effective approach may be to combine a waste prevention target at EU level with pricing measures at national level that would make it obligatory for shops to charge for plastic carrier bags. Such an approach would combine the political commitment and monitoring of an EU target with the flexibility and efficiency of pricing measures which are most appropriately implemented at national level. Awareness raising campaigns prior to the introduction of a policy are important, to ensure that the objective of the measure is well understood by consumers and to highlight the availability of more sustainable alternatives.

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