



Reducing Environmental Degradation & Unsustainable  
Consumption Trends & Impacts On Nature & Society:  
*Research, Policy and Practice*

# Absolute REDUCTIONS

## *Factsheets 2014*



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## **About REDUCTIONS**

The overall objective of the REDUCTIONS\* project is to identify the potential for absolute resource and energy use reduction in production-consumption systems at all levels and to explore ways to realise this potential. The project has the ambition to generate knowledge-for-action and aims to propose science-based policies and strategies with a high potential to achieve substantial reductions. The detailed project objectives can be grouped under three separate headings reflecting the project's ambition to contribute to science, policy and practice:

### *i. Scientific objectives*

- Translate the need for reductions as established in sustainability research into numerical targets and timeframes.
- Contribute to the development of conceptual knowledge and methodologies for researching and understanding reductions, including expressing the need for reductions, identifying pathways towards reductions, and assessing the social implications of reductions.
- Integrate existing knowledge from technology studies, cultural studies, economics, anthropology, geography, psychology, sociology, and environmental studies to address complex issues like absolute reductions and systemic change.

### *ii. Policy objectives*

- Make the case for absolute reductions – beyond resource efficiency.
- Explore experiences gained so far by analysing existing programmes, projects and initiatives (case studies).
- Demonstrate the possibilities for reductions through scenarios on various scales and for various regions, and policy proposals on how to realise promising scenarios.
- Stimulate science-policy dialogue that can contribute towards joint learning on how to achieve reductions.

### *iii. Practice objectives*

- Contribute to reframing social progress in a resource-constrained world, emphasising the attainment of well-being, ecological sustainability and environmental justice as core tenets of development
- Establish the need for the restructuring of institutions to attain well-being, ecological sustainability and ecological justice.

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\* REDUCTIONS stands for: **Reducing Environmental Degradation & Unsustainable Consumption Trends & Impacts On Nature & Society**

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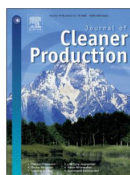
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## **CONTENTS**

- 1. Intentional Communities in Germany*
- 2. Reducing fertiliser use in Denmark*
- 3. Food Waste Prevention*
- 4. Sustainable levels of fish catch in Iceland*
- 5. More efficient use of aggregates in construction in the UK*

# Intentional Communities in Germany

## 1. Introduction and aim

Intentional Communities are perceived as a valid possibility to dematerialise individual lifestyles. As part of voluntary simplicity, Intentional Communities are built on the free choice (rather than economic necessity) to limit expenditures on consumer goods and services. Instead they aim to cultivate non-materialistic sources of satisfaction and meaning. Simplifying, self-provisioning and slowing down production as well as consumption processes are common characteristics of Intentional Communities. This fact sheet provides evidence about how far such communities contribute to absolute reductions of CO<sub>2</sub> emissions.

## 2. Description of the case

The cases described here summarise the comparison of three Intentional Communities in Germany with statistical data from German eco-friendly households and German average households.

Intentional communities are generally characterised as (1) consisting of at least five persons, (2) living together voluntarily and (3) sharing, at least in part, a common economy.

The communities chosen for the analysis are listed below:

(1) The Kommune Niederkaufungen was founded in 1986 and consists of about 60 adults and 20 children. One relevant point for the performance in the case study is the common pool of two vans and seven cars as well as nine season tickets for local public transport. Food is mainly produced organically within the community. The remaining foodstuff

is also organic and, as far as possible, locally or regionally produced.

(2) The LebensGut Pommritz was founded in 1993 and consists of about 20 adults and 15 Children. The explicit aim is to develop an optimal balance between local and global economic cycles. On the local level this means self-subsistent provision of food, energy and building materials as well as active contribution to the local health, culture, education and social systems.

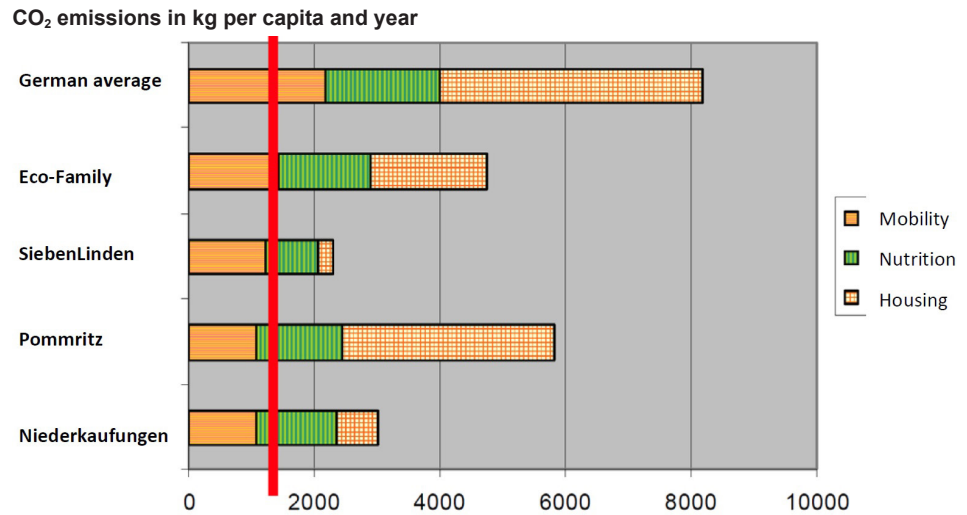
(3) SiebenLinden eco village was founded in 1997 and consists of about 140 inhabitants. The explicit aim is to implement sustainable lifestyles, taking into account ecological, cultural, economic and social issues. The community practices self-sufficient and sustainable consumption. Their special features are low energy and passive energy houses built with straw bales in combination with solar panels and ground heat to satisfy energy requirements.

The calculations presented here are based on material flow analysis and energy balance (eco-balances, life-cycle assessment). The focus of the analysis was on the consumption areas such as housing, food and mobility. Finally the environmental impact was quantified using greenhouse gas emissions as a central indicator.

## 3. Measured absolute reductions

The German Intentional Communities that were analysed show a remarkable reduction of CO<sub>2</sub> emissions per capita and year compared to average households. They are much closer to sustainability than the average German family, and two of them showed better results than families who

Figure 1



Source: Simon et al. 2004, p. 13.

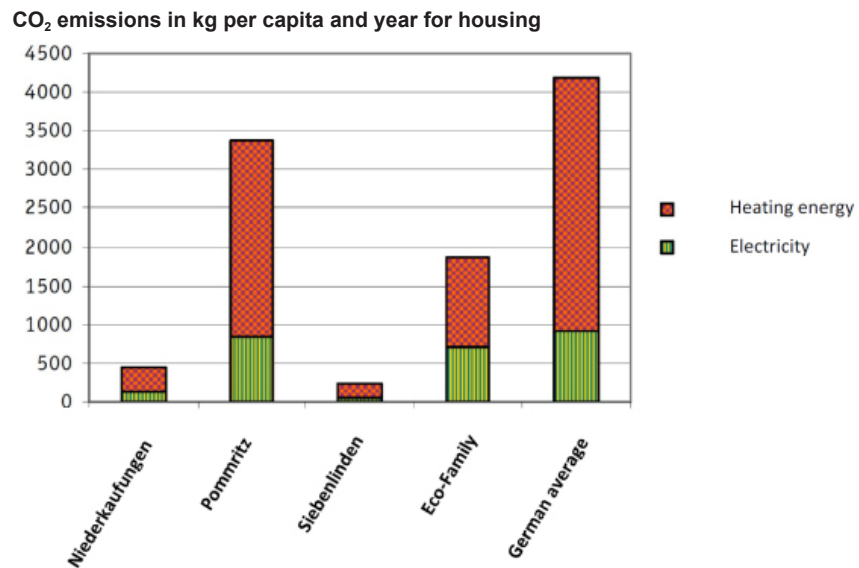
try to live in an environmentally friendly way. Compared to the German average, people living in the three analysed communities emit only half the average amount of CO<sub>2</sub> per year, some even less than one third.

#### a. Housing

Regarding housing, all three communities rank lower in terms of emission than the German average. However, there are tremendous differences in the level of reductions. The main influencing factor is

the building stock: Pommritz is a large old estate, whereas SiebenLinden has constantly optimised straw bale houses. A further factor is the self-production of energy based on renewable sources in SiebenLinden and Niederkaufungen optimised straw bale houses. A further factor is the self-production of energy based on renewable sources in SiebenLinden and Niederkaufungen.

Figure 2



Source: Simon et al. 2004, p. 15.

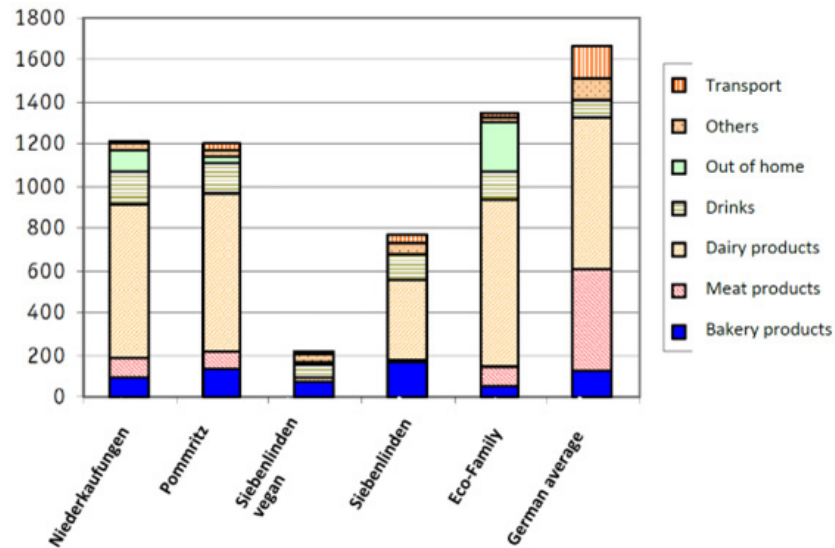
### b. Food

The impacts of food consumption differ a lot between the observed systems due to special preferences and local circumstances. All three communities rank lower in CO<sub>2</sub> emissions from food consumption than the German average and even ecologically oriented families. Sources of reduction here include reliance on local products (which reduces transport), integration of production

into the commune itself, a central kitchen (with energy optimized devices) etc. The most visible influence however is the lack of dairy products in the vegan diets of a subgroup of SiebenLinden inhabitants. However, with regards to food supply there is also a reduced environmental impact compared to people living in average households in Germany.

Figure 3

CO<sub>2</sub> emissions in kg per capita and year for food



Source: Simon et al. 2004, p. 17.

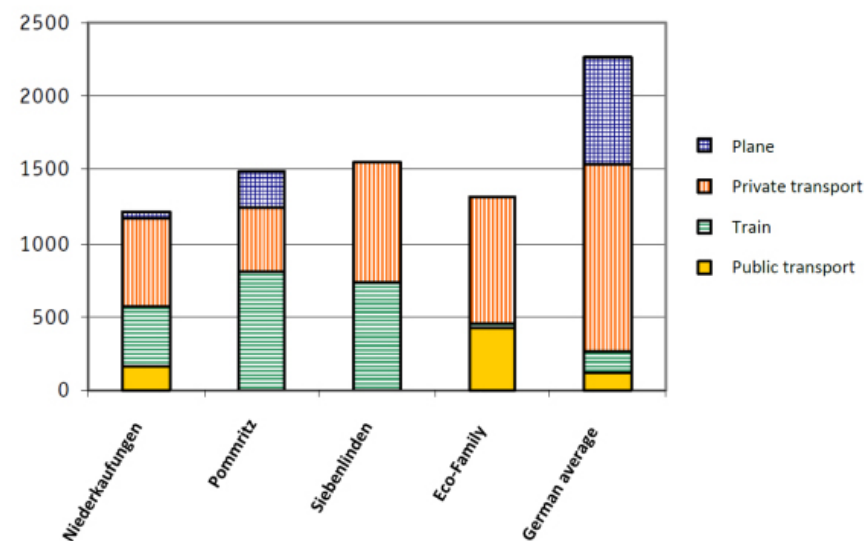
### c. Mobility

Despite the fact that mobility in general is not significantly lower in the communities, the total environmental impact is lower. The difference is due to a divergent modal split to realise mobility (a higher share of public transportation system, bicycles, etc.) and

the structural element: common use of cars and public transport tickets. Trains and other public transport account for about one half of journeys in each of the communities while this amount is only about one third in the eco-families and about 1/10 in the German average.

Figure 4

CO<sub>2</sub> emissions in kg per capita and year for mobility



Source: Simon et al. 2004, p. 19.



#### 4. Policy implications for waste reduction

The results from those Intentional Communities that were analysed indicate that, due to special personnel composition and factors like the integration of commercial undertakings (food production, small manufacturing) and common use of devices (automobiles, kitchen), there is a significantly lower impact on the environment when compared to the average household. Therefore these communities contribute significantly to a more sustainable society.

At least four structural elements are characteristic of Intentional Communities and their relationship to sustainability.

##### **Optimisation and resource sharing:**

Intentional Communities are more likely than individual households to assess the environmental impacts of equipment, such as cogeneration plants, cars, refrigerators. It is important to count the impacts from both the product's manufacturing and use phases. The environmental impact of its production may be significant, and the less the product is actually used (as, for instance, when a car spends most of its time parked at the driver's place of employment or home), the higher the proportion of the total impact from production. When an Intentional Community organises optimised use of equipment (for example, by shared access to a commonly used carpool), then there can be benefits with respect to the overall balance of production and use impact.

**Closing cycles:** Most of the radical sustainability conceptualisations take it for granted that a sustainable future can be achieved only if society is reorganised in

small, decentralised units. The assumption is that those small units will be more or less self-sufficient, with a good example of this being food production. When most of the food needed in a community is produced by that community itself, the consumers have the opportunity to set their own quality standards, to obey environmental principles, and to reuse waste from the system (for example, manure) in agriculture and gardening. The aim is to create production systems that are, to a high degree, independent from external resources, for example, by applying fertilisers produced on the farm itself, by minimising wastes, and by giving the consumer population control over production.

##### **Reliance on regional products:**

This element naturally follows on from the previous. More sustainable solutions are based on settlements in which most of the goods and services are produced from the land, labour, talent and capital of the local region. With reliance on regional products, transport expenses are lowered or avoided and more transparency can be achieved if participants within the production-consumption systems know each other and better coordinate their interests.

##### **Responsibility:**

Holding common property necessarily demands that people are more responsible with regards to everyday resource use, waste disposal and environmental conditions in that community. This holds especially true in the case of a common economy, which is a possibility but not a must for Intentional Communities. One result of a common economy is that people consciously reduce their wants so as not to burden the group.

#### 5. Transferability to other areas

Intentional Communities are a marginalised mode of living (in Germany far less than 1 per thousand of the population). However, more than 400 such communities exist in Europe. The Global Ecovillage Network also has chapters in Oceania and Asia, Africa, South America and North America.

They are well connected, share experience and thus constantly further develop sustainability practices. Through seminars and workshops the three Intentional Communities presented in this case study

spread their experiences and thus fulfill an important role in educating traditional municipalities and households on possible ways towards lifestyles within ecological limits. SiebenLinden, for example, and its ongoing practical experience in building straw bale houses also supports research on the further development of this building technique. In this sense Intentional Communities are living and learning centres for absolute reductions. A more structural uptake of best practice experiences for urban initiatives and development strategies can additionally increase the potential created in such communities.



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## 6. Other reflections and conclusion

Intentional Communities can develop a high potential to reduce impacts on the environment. Research confirms they are providing a positive contribution, even if they are not managing to stay within global limits. It is important to recognise that inhabitants of the communities do not have low living standards and cannot be classified as social outcasts. They have a significantly lower consumption that is not related to mobility,

or food supply (amount and quality), or other supply sectors. What makes the difference is the environmental impact of this consumption.

The case study revealed that, for example, those living in SiebenLinden have a carbon footprint that is a third of the size of the German average. In particular this is due to their vegan/vegetarian diet, car sharing, avoidance of aeroplane travel and good insulation of their houses.

**Authors:**

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Simon, K.-H.; Mativelle, A., Fuhr, D. et al. (2004). Ecological relevance of Intentional Communities (Gemeinschaftliche Lebens-und Wirtschaftsweisen und ihre Umweltrelevanz). University of Kassel.

Simon, K.-H. and H. Herring (2003). Intentional Communities and Environmental Sustainability. In: Christensen, K. and D. Levinson (eds) Encyclopedia of Community – From the Village to the Virtual World. Sage Publications. (Vol 2, p. 690-693).

Related website: <http://www.usf.uni-kassel.de/glww/ziele.htm>

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# Reducing fertiliser use in Denmark

## 1. Introduction

This case study focuses on the use of fertilisers in agriculture. Fertilisers are added to soils to improve the growth, yield and quality of crops. Fertilisers can be organic (e.g. manure) or inorganic (e.g. phosphate and synthetic fertilisers). 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.

Besides eutrophication, the diminishing reserves of phosphorus are also of concern in terms of global resources. As reserves of phosphorus are diminishing at a rapid rate, it is most likely that by 2050 all phosphate rock used in the European Union (EU) will come from Morocco, making all EU Member States very dependent on imports from Morocco.

This case study covers policies in Denmark, including the transposition of EU policies, over a period of time of almost 30 years from the 1980s to today.

## 2. Description of the case

The use of fertilisers in Danish agriculture has increased considerably since the Second World War. This is partly due to a 50% increase in crop land, but also a reduction of clover as animal feed. The energy crisis in the mid-1970s only could stop this trend for a short while as the price of oil rose drastically. The use of nitrogen fertilisers then continued to rise until the 1980s.

Methodologically this case has been analysed

following the DYNAMIX project framework. It uses a case study approach based on ex post evaluation of policy measures targeted at economy wide resource reduction. A specific emphasis in this framework is given to agricultural goods and biotic materials, fossil fuels, metals and construction material. 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. In addition, the policy mix's **efficiency** and **(social) sustainability** were evaluated. Efficiency of the policy mixes was assessed by 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). Social effects, however, were only assessed for EU countries, while environmental effects were assessed globally based on data availability. This fact sheet mainly reflects on the effectiveness.

## 3. Measured absolute reductions

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

So, **absolute decoupling between agricultural production and the apparent consumption of different types of fertilisers has occurred in Danish agriculture since 1991**. However, we cannot yet say that this has achieved a sustainable level.

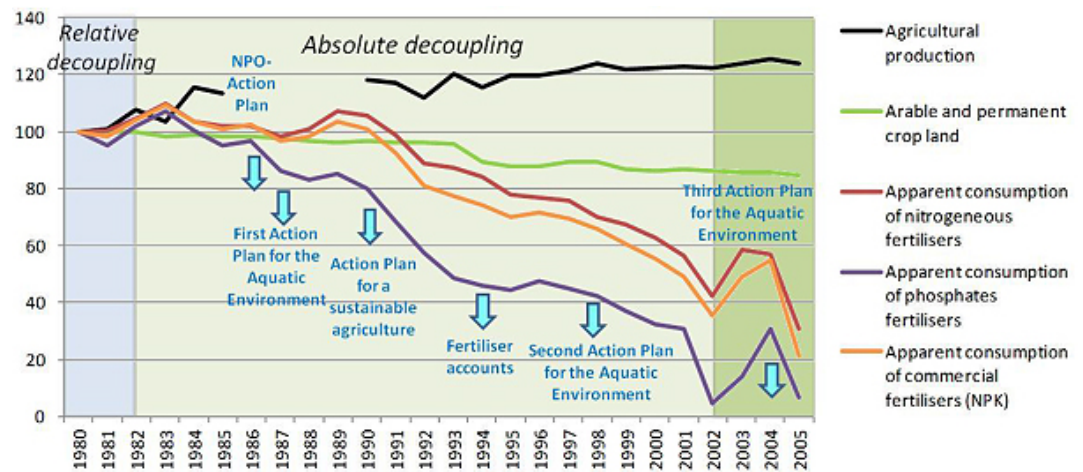
A target was set to reduce nitrogen leaching

by half from 1985 levels and this was met in 2003 (rather than 1993, the initial deadline). 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.

Figure 1

### Decoupling trends in agricultural use of fertilisers in Denmark

Agricultural production in relation to land and fertiliser use – Index 1980=100



Source: Tan and Mudgal 2013, p. 9

#### 4. Policy implications on reductions

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 on direct discharges from manure were accompanied with government subsidies for investments in animal manure storage capacity.

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. This helped guide the instruments and allowed the government to adjust policies according to progress and achievement of targets.

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. In 1987 the First Action Plan for the Aquatic Environment was adopted, and included targets to reduce phosphorus leaching from sewage treatment plants by 80% and nitrogen leaching (including fields) by 50% by 1993. 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 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 were 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 were introduced and targets were 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 which resulted in a 50% decrease in 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.

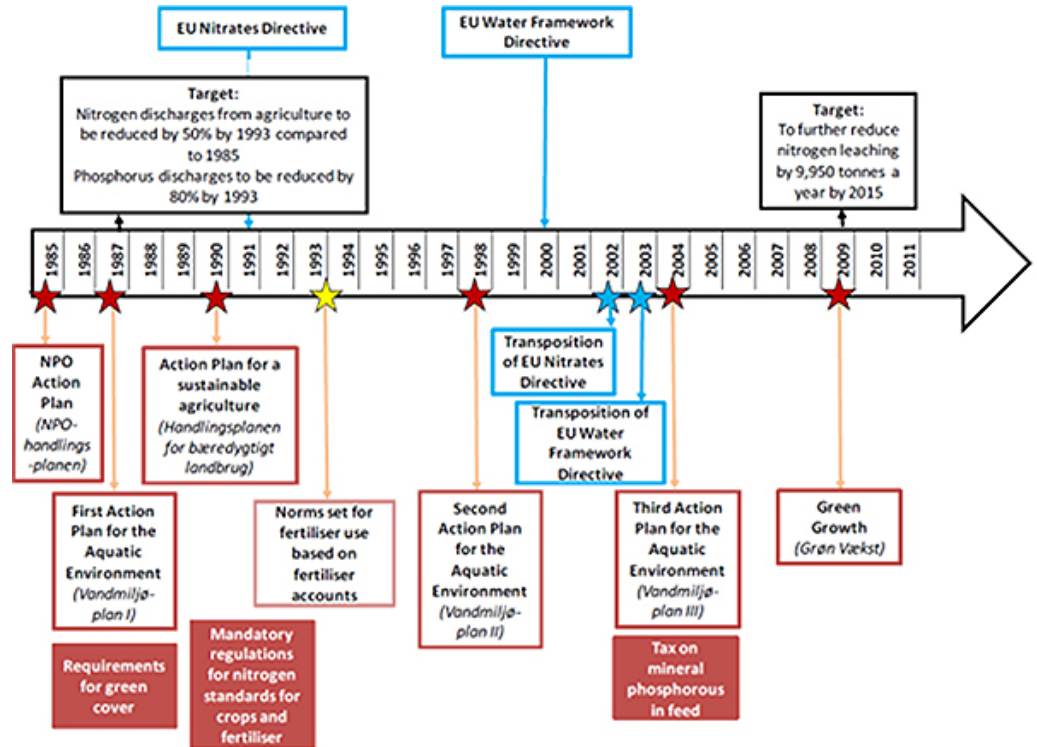
The 2004 Third Action Plan for the Aquatic Environment aimed to further reduce nitrogen and phosphorus leaching from agriculture. It included subsidies for establishing buffer zones between fields and water bodies to stop phosphorus leaching. It also introduced a mineral phosphorus tax on feed, with 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 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 in the discharge of nitrogen and phosphorus from 2010 to 2012. Nitrogen quotas were to come into force in 2012, but were delayed 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.

Figure 2

Implementation timeline of Danish fertiliser use policies, 1985-2011



Source: Simon et al. 2004, p. 15.

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## 5. Transferability to other areas

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.

The success of multiple strategies, objectives and policy instruments can be better ensured through constant monitoring

## 6. Other reflections and conclusion

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, such as regulatory, voluntary, economic and information based instruments that each addressed a specific contribution to the nutrient reduction targets. Also EU policies have contributed to setting stricter requirements in Danish policies.

In general, the implementation of Action Plans for the Aquatic Environment has been a success, even though this may have come at a price. According to the OECD the farm-level nitrogen quota has proved to be effective but costly. Farmers bear the greatest costs of implementing the policy measures to reduce the use of fertilisers and nutrient losses. The majority of government costs for implementing the various policy measures are subsidies and payments to farmers for environmental actions and compensation for losses. A minor part of the costs are administrative. Overall, the total annual cost of reducing nitrogen losses was slightly less

and enforcement, as well as adaptation of instruments according to their performance against targets.

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, that of using regulatory instruments that are supported by economic incentives and voluntary measures, could be transferred to other countries. However, a consistent monitoring system is fundamental for the policy to be successful.

than expected. However, in terms of cost efficiency the mid-term evaluation showed a doubling in costs, as cheap measures have not achieved the expected effect. The overall total annual cost for phosphorus reduction is higher than originally estimated and the tax on mineral phosphorus has not reached the expected impact.

Although the Danish case has shown a decoupling of fertiliser use and agricultural production, it seems that the nitrogen balance per hectare in agriculture is still relatively high compared to other EU or OECD countries. While the concentration of nitrogen and phosphorous in water bodies has generally been decreasing over the past 20 years, oxygen conditions in Danish waters have not improved. Instead, severe oxygen depletion in Danish waterways still occurs regularly. There is, therefore, a further need to improve fertiliser use and reduce leaching in order to achieve a sustainable level. A further influence is the 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.

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Mazza, L. D. Fedrigo-Fazio, S. Withana and A. Faria Lopez (2013). Evaluating existing policy mixes to identify solutions for EU resource efficiency – Summary report of 15 real world policy mixes - Project report. DYNAMIX project, FP7

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Related website: <http://dynamix-project.eu/results>

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# Food Waste Prevention

## 1. Introduction and aim

This case study focuses on the prevention of food waste along the value chain, with special focus on avoidable food losses in households. It describes resource reduction potentials based on empirical case studies in several European Union (EU) member states on national, regional and local levels. Through an exploration of the varying success of waste prevention policies it discusses policy implications and the potential for replication in other countries and sectors.

## 2. Description of the case

Every year about 1.2 billion tons of food waste, or roughly one third of the food produced in the world for human consumption, is generated. With about one billion people starving every day, this is not only a dire ethical situation but also a waste of resources from an environmental point of view. Environmentally, food waste leads to wasteful use of chemicals, such as fertilisers and pesticides; more fuel use for transportation; and more rotting food which creates more methane. Food loss and waste also amount to a major squandering of resources, including water, energy, labour and capital, as well as needlessly producing greenhouse gas emissions which contribute to global warming and climate change.

In Germany, for example, food products rank second in terms of highest resource use and environmental impact potential when the whole product life cycle is taken into account. It is estimated that the food sector is responsible for approximately 22% of the global warming potential in the EU.

For the United Kingdom, food waste has been identified as a priority waste stream for action as it accounts for almost half of all CO<sub>2</sub> emissions associated with waste. The International Resource Panel points to the potential savings in land use resulting from lower food consumption through the reduction of food wastage. The share of around one-third of edible food which is lost or wasted annually across the food supply chain corresponds to around 200 Million hectares (Mha) of cropland and other resources, such as nutrients (e.g. from fertiliser) and energy, which could be saved if the amount of food waste decreased. Apart from this, almost one billion more people could be fed if global food losses were at least halved by 2025. If food waste and losses were reduced to the lowest percentage achieved in any region across the food supply chain globally, 78 Mha of cropland and 12 Million tons (Mt) of fertiliser could be saved per year. These savings would even be high enough to compensate for the expected land use expansion that will be needed in 2050 to meet growing food demand (in the low range).

In developing countries food waste and losses occur mainly at the early stages of the food value chain and can be traced back to financial, managerial and technical constraints in harvesting techniques as well as storage and cooling facilities. Thus, a strengthening of the supply chain through the support of farmers as well as investments in infrastructure, transportation, and an expansion of the food and packaging industry could help to reduce the amount of food loss and waste. In contrast, in medium and high income countries food is wasted and lost mainly at later stages in the supply chain. Thus, in contrast to the situation in developing countries, the behaviour of consumers

plays a huge part in industrialised countries.

Unfortunately the data base for food waste generation is rather unreliable and figures differ significantly between different countries inter alia because of differences of sampling and aggregation protocols. This is because the waste statistics include different parts of the total food waste generated, for example many of the national reports only include data from a specific part of the hospitality sector. This also relates to the share of so-called avoidable food waste, excluding for example

parts of foods such as fruit skin, apple cores and meat bones.

For Germany a share of 35-40 kg out of 70-90 kg of food waste per inhabitant per year is estimated to be avoidable. Figures for food waste in the Netherlands indicate that about 105 kg per household per year are avoidable. The following table shows estimates for some Nordic countries, assuming that about 67% of the food waste is avoidable. When applying that same average rate for avoidable food waste for total food waste generation across

Table 1

**Best estimate of total food waste and avoidable food waste in Nordic countries**

Country	Total food waste (in tons/ year)	Avoidable food waste (in tons/ year)
Denmark	140.000	94.000
Finland	140.000	94.000
Norway	140.000	94.000
Sweden	260.000	174.000

Source: Marthinsen, J., Sundt, P., Kaysen, O., Kirkevaag, K. (2012). Prevention of food waste in restaurants, hotels, canteens and catering. Nordic Council of Ministers 2012.

the EU27, the total avoidable food waste in food service and catering would add up to 8.2 Million tonnes.

The food sector is one area where significant reductions in GHG emissions are possible, with food waste prevention having the

potential to reduce GHG emissions by 456 million tons by 2050 in the UK alone. Estimates for 2010 show that actions to address avoidable food waste could have reduced 17 million tons of CO<sub>2</sub>eq, which is equivalent to the emissions of 1 in 5 cars on UK roads.

### 3. Measured absolute reductions

A variety of initiatives and programmes have shown that the above mentioned amounts of food waste can actually be significantly reduced. Table 2 gives an overview on different measures in households, restaurants, and canteens, that have led to impressive immediate reductions.

Despite the huge potential for food waste reduction along the supply chain - from retailers and catering services to consumers - calculations on actual quantities and potential reductions are scarce. Food waste prevention initiatives are often locally organised and the results not extensively quantified. An exception to this is the UK, where the non-

governmental organisation WRAP already operates a number of initiatives and surveys in order to collect specific data for food waste prevention. The detection of the above mentioned potentials with regard to waste prevention forms the basis of the WRAP campaign 'Love Food Hate Waste', which was initiated in 2007 and aims to reduce the amount of food waste in private households. For this purpose, the programme cooperates with traders and manufacturers to support those developing individual campaigns. It also aims to gain the attention of individuals in order to increase their sensitivity towards the issue of food waste. One example of this is the way that British supermarket chains and major grocery chains introduced an improved labelling system for best-before



dates and installed packaging sizes which enable modern households to be more flexible in the purchase and consumption of groceries. At the same time, 'Love Food Hate Waste' supplies consumers with practical advice and incentives for using their groceries in the best possible way. This example shows that easily acquirable habits

of waste reduction can result in significant cost savings for consumers as well as reducing environmental impacts. These habits include preparing shopping lists, meal planning, freezing products that have a limited shelf life, appropriate product storage and the creative use of leftovers.

Table 2

**Prevention measures for the reduction of food waste**

Name	Description	Country	Results
Eurest restaurant food waste campaign	Measurement of food waste in restaurants	Sweden	Reduction of food waste by 25% per meal in participating restaurants
Decrease trade losses through waste reduction	Reduction of food and packaging waste in the food sector through reduced offers and optimised purchase	Finland	Reduction of waste by 25% (1,000 t)
Right portion size (Menu Dose Certa)	Menu Dose Certa is a part of the project "-100kg". It has been calculated that there is potentially 100kg of waste reduction per person. It is a challenge for restaurants to find out the right portion size, but it brings with it savings in waste fees and image improvements	Portugal	In urban regions, a reduction in food waste in restaurants of 48.5 kg EW/a per person could be achieved
Green Hospitality Award Scheme	The GHA scheme is an Irish environmental certification for the catering industry. The participants are certified according to international standards. Customers can collect information on sustainable restaurants and hotels on the emerging site www.greentravel.ie	Ireland	There are a high number of members. In 2009, 6,000 t of waste reduction was achieved
Love Food Hate Waste	Awareness campaign with the goal of highlighting the importance of reducing food waste. Consumers and households get practical advice on reducing food waste, which saves them money and protects the environment	UK	Since 2008, based on WRAP's estimations, more than 137,000 t of food waste have already been prevented
Love Food Champions	81 households met regularly within a period of 4 months and exchanged experiences about food waste	UK	The average food waste generation of 4.7 kg per week per capita could be more than halved during the project
"Throw away less" campaign	Courses on reducing food waste provided for the general public, combined with a consumer survey on perceptions of food waste focussing on potentials and measures in canteens.	Belgium	According to the study, 0.3 kg of waste are produced per plate in canteens. This was reduced by 40% in the pilot project.

Source: Marthinsen, J., Sundt, P., Kaysen, O., Kirkevaag, K. (2012). Prevention of food waste in restaurants, hotels, canteens and catering. Nordic Council of Ministers 2012.

Based on these and a whole range of other activities, the UK has managed to decrease food waste generation in households by 1.2 million tons between 2007 and 2010. This accounts for 45% of the total of 2.5 million tons waste reduction. 950,000 tons of this comes from avoidable food and drinks waste. In order to be able to document changes in consumer behaviour, WRAP additionally collected questionnaires giving information about the behaviour of private households with regards to three measures: checking household supplies before shopping, planning meals over several days

and preparing shopping lists before actual shopping. On this occasion, an increase by 3 to 5 percentage points in all three behaviour patterns could be registered until 2010. Moreover, the understanding of best-before dates was improved, which could also have contributed to the prevention of waste. In a consumer survey by the "Food and Drink Federation" with more than 1,000 respondents in the same year, more than half of the respondents reported that they were disposing of less groceries than the previous year.

#### 4. Policy implications for waste reduction

The case of food waste prevention highlights two points relevant to the development of policies for a global reduction of resource consumption: 1) the limitation of monetary incentives and 2) the necessity of systemic improvements alongside the whole value chain.

1) Estimates for the UK have shown that if clearly avoidable waste production were to be completely prevented then GBP12 billion could be saved. In the Netherlands consumers throw away an estimated EUR2.5 billion a year in edible food. This is some EUR340 per household or over EUR150 per person. These figures show that despite clear and significant economic incentives consumers still tend to over-shop, to buy more than they actually need (or would be healthy). This seemingly irrational behaviour appears to be partly motivated by ever-decreasing food prices caused by lower quality food and the externalisation of environmental costs. The small share of total consumption expenses for food and the permanent availability of groceries are mentioned as causes for a decreasing appreciation of groceries. Against this background the case of food waste and the missed opportunities for its prevention might allow one to draw the conclusion that economic incentives might not be sufficient to really reduce resource consumption and that the high hopes in market based instruments might be overestimated. It seems that the relationships between resources, needs and market prices seem to be significantly more complex – especially when it comes to

emotional issues like food.

2) It is not only households but also the food processing industry or retailers that should have incentives to minimise costly food losses. Here several studies identified a lack of coordination between actors in the supply chain as a contributing factor. Instead of focusing on information campaigns and only acting to raise awareness within the industry as so many countries do, in the UK the Waste and Resources Action Programme (WRAP) initiated the so-called ‘Courtauld Commitment’. This is a voluntary but binding agreement that obligates grocers, brand owners and producers to reduce the impact of the food industry on climate and the environment. More than 40 larger retailers, brand owners, manufacturers and producers joined during the first phase of the Courtauld Commitment. In total this represented 92% of food trade in the UK (the programme is divided into three integrative phases, with Phase 3 having started in 2013). The industry made a commitment, amongst other things, to avoid the increase of packaging waste generation completely until the end of 2008, and to achieve an absolute decrease until 2010. Since 2008, the average amount of packaging of every grocery purchased in Great Britain has decreased by approximately 4%, showing that there has been a clear reduction in food waste generation. In this case the clear identification of actors with actual influence on the value chain and the establishment of clear targets and a monitoring system seem to have been framework conditions that set incentives for real win-win eco-innovations alongside the value chain.

#### 5. Transferability to other areas

The case of food waste prevention in the UK seems to have high transferability, especially with regards to other regions. Of course differences in the culinary culture might influence the specific reduction potentials but it has been shown that the issue of

avoidable food waste generation seems to be present in all developed countries. A specific prerequisite seems to be a ban on the cheap disposal of untreated waste. In the UK, food waste prevention became a public concern shortly after the introduction of a waste disposal tax with especially high rates for food and other biogenic waste.

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## 6. Other reflections and conclusion

The issue of food waste prevention also raises the more general question of whether consumers alone can or should be held accountable for delivering on sustainable consumption. Resulting from the failure of global resource policies (e.g. the Kyoto Protocol, the Millennium Development Goals, etc.) there has been an increasing shift of responsibilities to private domains, with slogans urging us to “Buy greener products! Consume less! Eat smarter! Don’t waste food!” Environmental education specialists have been discussing methods for motivating people to act sustainably for decades. However, there are several dangers associated with linking this with the widespread impression of political failure to establish sustainable development.

In the course of this current “privatisation” of sustainability, the public debate increasingly

identifies areas of private action, as opposed to the domain of policy, as the key to solving environmental problems. The path to more sustainability is perceived as a reorientation of private action in terms of dealing with environmental goods, such as energy, water and raw materials. This assigns a political role to people in their private domains, which opposes the separation of private and public spheres in traditional and liberal systems. This is based on the premise that consumers make decisions according to their personal preferences, and not with any political intention. It is equally untrue that individuals do not have any responsibilities in environmental matters. But these responsibilities of private consumers refer to the political dimension of individual behaviour. Thus, the political power of individuals does not lie in their function as consumers, but in the engagement of individuals, groups and institutions for the ecological transformation of society.

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# Sustainable levels of fish catch in Iceland

## 1. Introduction

This case study focuses on fish as a renewable resource and the possibilities of policy to keep fishing within sustainability limits. The fisheries analysed are those of Iceland including all commercial stocks, such as herring, capelin, cod and redfish. 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.

## 2. Description of the case

During the first half of the twentieth century, Iceland, like other industrialised fishing countries, had a problem with overexploitation of its fish resources. This was a classic example of the tragedy of the commons, 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 in the 1960s. This was followed by a sharp drop in the demersal stock, with catch levels of capelin being seriously threatened by overfishing.

The area studied covers Iceland and, more specifically, the waters within its exclusive 200-mile economic zone. Iceland's exclusive fisheries zone has an area of 760,000 square kilometres, seven times the area of Iceland

itself. The cod and capelin stocks are found inside Icelandic waters. Other large stocks migrate in and out of Icelandic waters, including the Atlanto-Scandian herring and blue whiting stocks, while others are situated close to the 200-mile limit, such as the oceanic redfish stock. Icelandic vessels also fish in international waters, such as Atlanto-Scandian herring stock in the northeast Atlantic managed by the North East Atlantic Fisheries Commission, and the northern shrimp fisheries on the Flemish Cap in the northwest Atlantic, managed by the North Atlantic Fisheries Organisation. For these fisheries the total allowable catches (TACs) are set by the regional fisheries management organisations, but Iceland assigns its national quota to individual vessels.

Methodologically the case is analysed following the DYNAMIX project framework. It uses a case study approach based on ex post evaluation of policy measures targeted to economy wide resource reduction. A specific emphasis in this framework is given to agricultural goods and biotic materials, fossil fuels, metals and construction material. 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. In addition, the policy mix's **efficiency** and **(social) sustainability** were 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). Social effects, however, were only assessed for EU countries, while environmental effects were assessed globally based on data availability. This fact sheet mainly reflects on the effectiveness

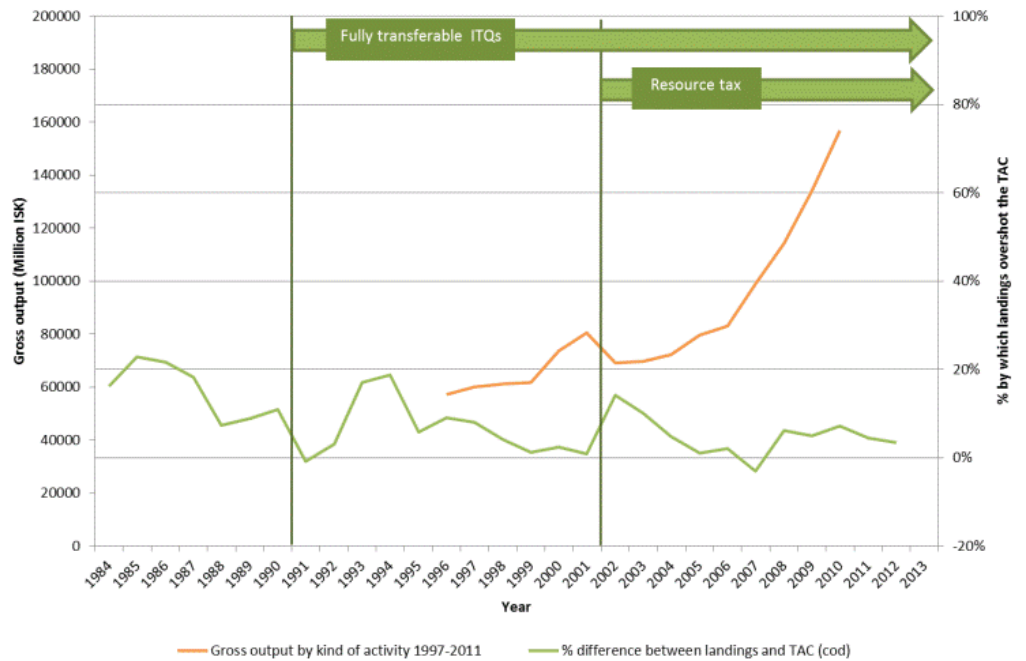
### 3. Measured absolute reductions

As fisheries are a renewable resource the overall 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. This would allow the population to continue to be productive indefinitely. The environmental problem in

the fisheries case, therefore, is exploitation that exceeds these sustainable levels. **The case study identified an absolute decoupling.** It is measured by the degree to which Icelandic landings of cod (one of the most fished species) exceed the Total Allowable Catch (TAC) set by the Icelandic government. The decoupling from GDP is measured in gross output, in millions of Icelandic Kroner, of the Icelandic fishing sector (as a whole). Figure 1 below 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%. It can therefore be concluded that decoupling has been achieved to a large degree (absolute decoupling within limits).

Figure 1

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



Source: Newman and Mazza 2013, p. 10.

### 4. Policy implications on reductions

The overexploitation of fish stocks was addressed by a policy mix. 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, i.e. catch limits on how much fish can be caught, can be employed as a fisheries management tool on their own. An ITQ is a tool that intrinsically requires the setting of a limit (in this case, the TACs). ITQs are a cap-and-trade mechanism, where 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, with Iceland being one of the first countries to try such a system.

There are numerous contextual elements which have influenced the introduction and development of the policy mix. The Icelandic economy has always been heavily dependent on fisheries. In fact, fisheries and sheep farming were the mainstays of the Icelandic economy in the past. For most of the twentieth century, Iceland's economic growth was led by the fisheries sector. Consequently, changes in the fish catch and export prices of marine products were the leading source of fluctuations in output growth. In addition to the export of fish products, many auxiliary companies have developed around the fishing industry, providing supporting services and products.

Prior to the introduction of the first limits on landings in 1975 (for herring only), the sector was barely regulated. Once it became known that fishing grounds were not inexhaustible, Iceland attempted to exclude foreign fleets from its waters. It declared an Exclusive Economic Zone EEZ of 12 nautical miles in 1958, increased to 50 miles in 1972, and extended to 200 miles in 1976. Soon after the extension of the EEZ to 200 miles, a special Fisheries Act was adopted by Parliament, giving powers to the Minister of Fisheries to restrict access to fishing grounds in Icelandic waters. Without establishing its jurisdiction Iceland would not have been able to assign any form of rights-based fisheries management system.

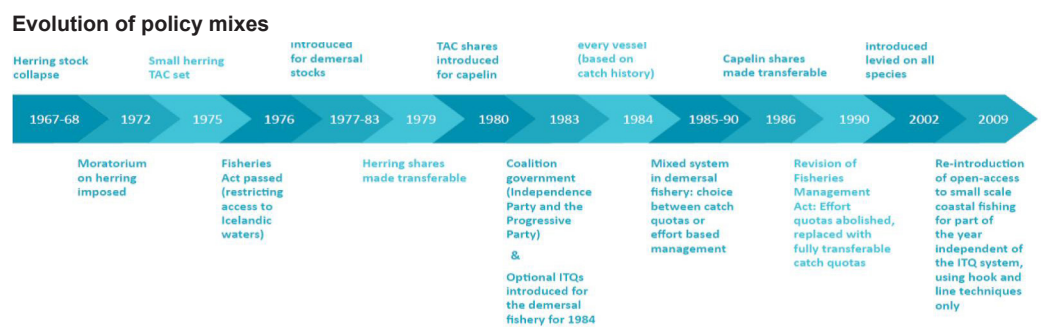
In 1983 this was followed by the partial introduction of catch quotas in the demersal fisheries. This is a well-established policy response in resource economics theory, though Iceland was one of the first countries to implement the system in practice.

The catch quota, however, came under pressure as opponents argued that it was unfair to give a public resource away for free to certain individuals and that the policy needed tweaking so that at least some of the profit derived from the exploitation of the resource (known as resource rent) could go to the Icelandic public. It was suggested therefore to capture the resource rent through a resource tax. This led to debate over the level at which to pitch such a tax from efficiency and equity points of view.

The policy mix has developed over time, in an ad hoc manner in the sense that the developments have not occurred as a result of a formal policy review cycle. In short, TACs and ITQs were introduced to the herring and other pelagic fisheries in the mid-seventies to early eighties. These were then gradually applied to the demersal stocks, and in 1990 TACs and ITQs were obligatory for all commercial fisheries. A resource tax was introduced in 2002. Together these elements now constitute the policy mix. The operational side of the policy mix has a formal cycle, in that TACs are set annually for the fish stocks for the year ahead.

Introducing property rights in fisheries was a major institutional reform, as was the introduction of a resource tax.

Figure 2



Source: Newman and Mazza 2013, p. 16



## 5. Transferability to other areas

The Icelandic example has provided numerous lessons for others attempting to overcome the tragedy of the commons in the fisheries sector. The most fundamental lesson would be that such a policy mix can be highly successful at rebuilding fish stocks. This has also been evidenced by similar schemes in other countries.

It became apparent from the Icelandic example that the gradual introduction of ITQs in the demersal fisheries (i.e. the mixed system) 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. Improving acceptance of the system was also the reason behind the initial (free) allocation of catch shares, which has since been criticised. Thus a balance needs to be struck between improving acceptance of such schemes and compromising on efficiency and effectiveness.

The Icelandic example also demonstrated that it was easier to introduce the policy mix to a sector of the fishing industry that was more homogeneous. In the herring fishery, vessels were similar in size and had recently experienced the collapse in the fishery, and

this is thought to have helped the sector to come to a consensus on property rights. In the cod fishery, there were important differences between fishing regions, and the fleet was more diverse in terms of size. Consequently it was more difficult to get agreement in these circumstances. This could be of interest to other administrations seeking to design and introduce a catch share system.

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 as well. In 2013, the European Commission proposed the introduction of mandatory tradable quotas (ITQs) for all Member States with the aim of reducing overcapacity in its proposal for the 2013 reform of the CFP, 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. A resource tax could also be introduced, but would need European Council unanimity in order to be introduced at the EU level. While there are no immediate plans to introduce such a tax on a regional level, individual states are free to establish national resource taxes, if they so wish.



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## 6. Other reflections and conclusion

The implementation of the policy mix in Iceland has achieved sustainable exploitation of fisheries resources and enabled the fishing sector to become highly profitable. It has therefore been successful in meeting the objectives of the Fisheries Management Act to promote the conservation of exploitable marine stocks. Recent reports confirm that the implementation of similar schemes worldwide ('catch shares') could halt and even reverse a widespread fishery collapse and thus help drive economic growth.

By contrast there have been social concerns throughout the development of the policy, and these remain. These relate to the initial allocation of quotas and the subsequent concentration of catch shares, with some parties arguing that this has been inequitable. There is disagreement over the importance of these concerns and the extent to which they are valid. Little research has been done, particularly in recent years, to analyse these

issues. However, the fact that such debates and concerns persist suggests that the policy mix has not been as successful in this regard. Nevertheless, the objective of the social element of the Fisheries Management Act was to promote stock conservation and efficient utilisation "thereby ensuring **stable employment and settlement** throughout Iceland". Incidentally, there is evidence to suggest that the policy mix has enabled fishing firms to remain stable while the rest of the Icelandic economy was in crisis (although there is a downward trend for employment in fisheries this is not due to low stocks or poor returns). In addition, there are indications that the policy mix has bolstered the economy of rural villages, thereby helping to slow or reverse the trend of outmigration from these villages to the capital city.

It should therefore be considered that the policy mix has had mixed results in terms of social sustainability. However, it is unlikely that certain social concerns outweigh the environmental, economic and social benefits.

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Related website: <http://dynamix-project.eu/results>

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# More efficient use of aggregates in construction in the UK

## 1. Introduction and aim

This case study considers the reduction of aggregates as basic material in the construction industry. The policy mix covers the United Kingdom (UK).

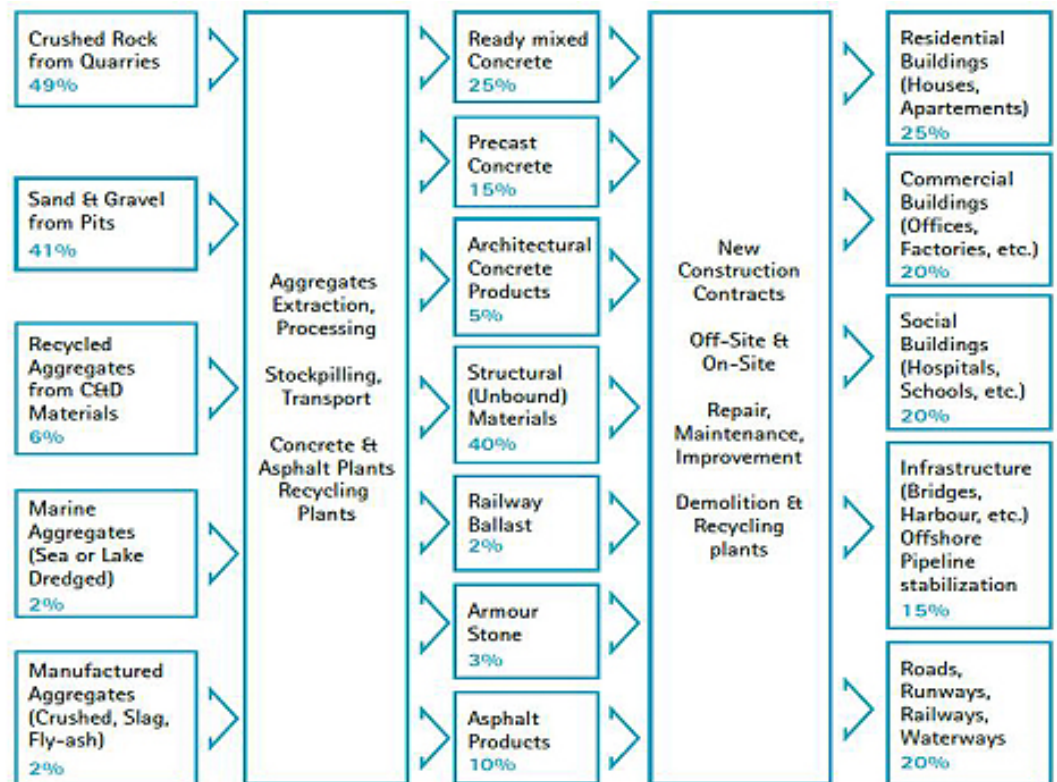
Aggregates as defined in this fact sheet are sand, gravel, crushed rock, and associated substances such as those that naturally

occur mixed with sand, gravel and crushed rock. They may be extracted from land or dredged from water ('primary aggregates'), produced as a by-product of other activities ('secondary aggregates'), or recycled from construction and demolition waste ('recycled aggregates').

In the EU, aggregates are used in the following ways:

Figure 1

Use of aggregates (EU data)



Source: Bicket and Salmons 2013, p. 12.

## 2. Description of the case

The case described here addresses the use of aggregates and their related environmental impacts in the UK during the extraction and disposal phases. The impacts of the extraction of aggregates show a wide range of impacts: noise, dust, traffic, are part of them, also contamination of ground water and surface water, as well as impacts on archaeology, heritage and wildlife. The impacts of disposal are: disamenity; contribution to global warming risks through the release of carbon dioxide and methane; damage from leachate; pollution and accidents associated with the

transportation of waste to landfill as well as road congestion, road wear and tear, and noise. The degree of environmental impacts varies across different aggregates.

The landmark policies for aggregates reduction – and thus the focus of this fact sheet – are the UK Landfill Tax, introduced in 1996 and the UK Aggregates Levy from 2002. Already before 1996, waste disposal management was subject to increasing UK legislation measures. However, they were insufficient so the insights about the environmental impacts of aggregates reach back to the research gained in the conception phase of these regulations.

Figure 2

### Overview of the potential environmental impacts of aggregates in the UK

Source	Transport	Dust	Noise	Blasting	Visual	Water	Wildlife	Heritage	Amenity	Restoration
Hard rock quarry	○	○	○	○	○	○	○	○	○	○
Sand and gravel quarry	○	○	○	n/a	○	○	○	○	○	○
Marine dredging	○	○	○	n/a	○	n/a	○	-	-	n/a
Recycling	○	○	○	n/a	○	n/a	-	-	-	○
Major impact	Noticeable Impact		Minor Impact			Insignificant Impact				
○	○		○			-				

Source: adopted from Bicket and Salmons 2013, p. 8.

The aim of the Landfill Tax was to: (i) internalise the environmental costs associated with landfill; (ii) minimise waste; (iii) promote recycling; and (iv) bring UK landfill costs in line with those of nearby countries. The aim of the Aggregates Levy was to ensure that the environmental impact of aggregates extraction was more fully reflected in prices, and to encourage a shift in demand away from primary aggregates towards alternatives such as recycled construction and demolition waste, and china clay waste. It was also anticipated that the Levy would encourage more efficient use of all aggregates, greater resource efficiency in the construction industry, and the development of a range of other alternatives including the use of waste glass and tyres in aggregate mixes. Until 2011, revenues generated by the Aggregates Levy were partially recycled into the Aggregates Levy

Sustainability Fund, whose aims included: reducing the environmental footprint of quarries and marine extraction; delivering more sustainable use of aggregates and transport thereof; and benefitting communities affected by aggregates extraction.

Methodologically the case is analysed following the DYNAMIX project framework. It uses a case study approach based on ex post evaluation of policy measures targeted at economy-wide resource reduction. This 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

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the social effects and environmental effects that are not covered in the key targets (e.g. local effects, toxicity, marine issues). Social effects, however, were only assessed for EU countries, while environmental effects were assessed globally based on data availability. This fact sheet mainly reflects on the effectiveness.

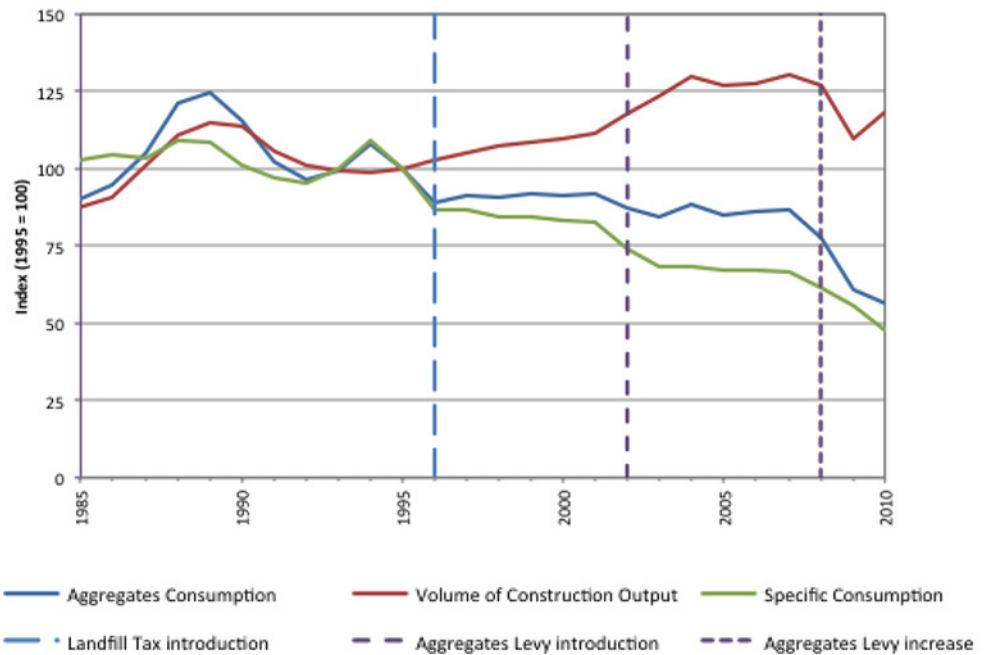
### 3. Measured absolute reductions

Before 1995 aggregates consumption and construction output was closely correlated. This changed with the introduction of the Landfill Tax in 1996. Analysis implies that absolute decoupling was achieved with an overall increase in construction output and an overall decrease in aggregates consumption over the period between 1995

and 2010. Figure 3 illustrates the trend in aggregates use against construction output in the UK compared to 1995 baseline levels. The vertical lines mark key relevant policy changes: the introduction of the Landfill Tax in 1996; the Aggregates Levy in 2002; increases in the Landfill Tax and Aggregates Levy in 2008; and another increase in the Landfill Tax in 2009.

Figure 3

**Policies and decoupling of aggregates consumption from construction output against a 1995 baseline**



Source: Bicket and Salmons 2013, p. 11. Based on: Idoine, N. E., T. Bide, and T. J. Brown. 2012. "United Kingdom Minerals Yearbook 2011", Nottingham, British Geological Survey

#### 4. Policy implications for waste reduction

The combination of instruments targeting both supply and disposal has contributed to the success of the policy mix. They provided “a signal to producers of the need to change production methods and practices”. The policy mix managed to better 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. To adopt the resource efficiency concepts, UK policy makers explicitly rooted their arguments in the Polluters Pay Principle and waste hierarchy of ‘reduce-reuse-recycle’.

The business sectors identified as having a key impact on the supply of aggregates included operators of quarry sites producing aggregates and importers of aggregates.

The Aggregates Levy was designed to target these, although it was anticipated that much of the financial burden of the levy would be passed on to purchasers of aggregates.

Some expected the Landfill Tax would increase fly-tipping to avoid the new charges associated with such a tax, but there is no strong evidence to support this. However, border leakage was observed as an unintended outcome of the Aggregates Levy; a high level of illegal trade was observed across the border between Northern Ireland, which was subject to the Aggregates Levy, and the Republic of Ireland, which was not. To address competitiveness concerns and to attempt to reduce the level of illegal trade, the Aggregates Levy Credit Scheme was introduced in Northern Ireland in 2004, giving aggregates operators a tax credit of 80% in return for signing an agreement to make environmental improvements on-site.

#### 5. Transferability to other areas

Drawing upon findings from the assessment of aggregates policy in the UK, the following recommendations have been made for countries considering the introduction of a tax on aggregates<sup>1</sup>:

- A tax on aggregates should be combined in a package with other policy instruments (such as permits or standards).
- The elasticity of demand for aggregates has to be considered, i.e. to what extent producers and consumers will be sensitive to price changes. Generally, due to their low cost relative to transport and overall construction costs, demand for aggregates is inelastic. The role of the tax in affecting the cross-price elasticity between primary and

recycled or secondary aggregates plays a vital role in encouraging the substitution of primary aggregates.

- Revenues should be recycled to correct market failures and further reduce external costs (e.g. through training in best practice methods to make extraction and transport more efficient and less disruptive). Recycling revenues is also likely to improve the public acceptability of a tax.
- Tax distortions across country borders need to be considered when setting the tax rate. Different tax rates for regions with borders may be necessary to discourage illegal trade activity which is otherwise costly to monitor and penalise.

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## 6. Other reflections and conclusion

The trend in absolute decoupling of aggregates consumption from construction output, observed in Figure 3, is consistent with the introduction of policy mix elements related to the Landfill Tax and the Aggregates Levy. The corresponding substitution of primary aggregates with secondary and recycled aggregates has contributed to a

reduction in the environmental externalities associated with the aggregates industry.

The Aggregates Levy acted as a stimulus towards environmental improvements, and the combination of the Aggregates Levy and the Landfill Tax are credited with giving a signal to producers of the need to change production methods and practices.

**Authors:**

This Fact Sheet is based on:

Bicket, M. and R. Salmons (2013). More efficient use of aggregates in the UK. Case Study conducted in the context of the DYNAMIX project, FP7

Mazza, L. D. Fedrigo-Fazio, S. Withana and A. Faria Lopez (2013). Evaluating existing policy mixes to identify solutions for EU resource efficiency – Summary report of 15 real world policy mixes - Project report. DYNAMIX project, FP7

Related website: <http://dynamix-project.eu/results>

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