The economic crisis and its consequences for the environment and environmental policy

Elina Berghäll and Adriaan Perrels

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Nordic Council of Ministers
Ved Stranden 18
DK-1061 København K
Phone (+45) 3396 0200
Fax (+45) 3396 0202

Nordic Council
Ved Stranden 18
DK-1061 København K
Phone (+45) 3396 0400
Fax (+45) 3311 1870

www.norden.org

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Content

Preface

The purpose of the project *The Economic Crisis and its Consequences for the Environment and Environmental Policy* is to provide a review of the effects of the crisis on environmental policy and on the environment in the Nordic countries, followed by an analysis of various possible policy interventions aimed at mitigating adverse effects.

This report contains a quick review of typical mechanisms and effects. It is based on a literature survey as well as on a quick scan of recent trends in key statistics regarding the economy and the environment in Nordic countries, in as far as data are readily available.

The assessment was carried out by two economic researchers of the Government Institute for Economic Research (VATT) in Helsinki, Elina Berghäll and Adriaan Perrels. The co-ordination on behalf of the Nordic Council of Ministers was carried out by Maria Vuorelma and Magnus Cederlöf of the Finnish Ministry of the Environment.

The theme is rather complex, whereas the situation of a still unfolding crisis limits the availability of the most relevant data. On the other hand, it was a very interesting study, from which easily various new research ideas could be derived, as well as a number of topics and suggestions for possible types of solutions for further follow-up regarding safeguarding of environmental policy goals.

Øyvind Lone, Chairman

The Working Group on Environment and Economy
under the Nordic Council of Ministers

Summary

Some Nordic countries were hit more severely by the economic crisis than others, owing to different economic structures and differences in monetary policies. Recovery has been rather hesitant. Considering the sources of the crisis changes in bank regulation, supervision and financial sector risk management procedures and techniques can be expected. From earlier crises can be inferred that banking crises can be especially severe and protracted. Crises usually also set in motion significant changes in the structure of the economy and its institutions, which constitute both risks and opportunities.

Green stimulus plans

Many countries, including most Nordic countries, allegedly have large shares of "green stimulus" in their stimulus packages, meaning that a good part of the extra investments is meant for environmental purposes, such as emission abatement and energy saving. However, there is no commonly accepted definition for "green investment", which makes comparison of packages tricky. Furthermore, many elements of these packages can entail indirect effects, which diminish the original environmental progress. Generally speaking any stimulus measure that promotes sustainable investment and operations which go beyond a baseline trend could be regarded as "green". More concretely, investments in energy efficiency, renewable energy (with some provisos), waste reduction and recycling, as well as various emission control technology could be termed "green". From an environmental point of view the sustenance of sufficient levels of environmental investments in the post-crisis years seems more important than the short term peak in efforts to mitigate the economic crisis. Careful selection and dosage of measures will help to ensure that recovery policies also promote sustainable transition.

Fiscal post-crisis changes

Outright green stimulus programmes will expire fairly soon, but for the medium to long term changes in fiscal policies may be expected, which can also offer opportunities for "greening" public finance policy. A common element for most if not all Nordic countries is a further shift towards so-called "ecological tax reform", i.e. taxing environmentally burdening activities more and taxing labour income less. Fiscal policy is expected to tighten considerably in all Nordic countries and elsewhere, as the crisis led to significant increases in public debt, whereas the ageing of the population adds further pressures. This creates possibilities to continue ecological tax reform

as well as to diminish or abolish environmentally harmful subsidies. Furthermore, in addition to emission trade other quasi market instruments and informational instruments may gain importance.

Immediate environmental effects

Most if not all crises tend to relieve the burden on the environment in the short term. This is also true for the current crisis. For example, greenhouse gas emissions in 2008 in Norway went down by about 2% and in Finland by about 10%, even though the reduction in Norway may be owing to other (technical) reasons. The substantial reduction of greenhouse gas emissions has approximately halved the price of emission permits in the European Emission Trade System (EU-ETS). This price drop in EU-ETS, together with diminished world coal prices, has incited electric power companies to use more coal, e.g. in Finland coal use rose by about 20% in 2009). As consequence a part of the sudden greenhouse gas emission reduction in 2008 will erode away in the following years, unless further policy measures are taken or precipitated.

Medium term environmental effects

The severity of the crisis in combination with structural change in heavy industries is expected to affect the medium term development pathway of greenhouse gas emissions, despite the erosion of emission reduction mentioned above. This means that the Nordic countries which are committed to the EU 20-20-20 for the year 2020 will probably experience a significant relief as regards the actual amount of emissions to be reduced. In turn this would mean some relief for abatement investment needs. Applying a crude downscaling of IEA projections for European energy investment needs between 2010 and 2020 to achieve long term emission reduction goals, the Nordic annual investment needs would be somewhat under 3 billion euro per year. Yet, the above mentioned easing of the 2020 emission reduction tasks implies a reduction of the annual investment need, e.g. by a few hundred million euro.

Long-term environmental effects

Long-term impacts could be profoundly adverse for the environment due to a severe slowdown in environmental investments and environmental research and development. In this respect a difference could be made between environmental issues for which policy implementation is already well established (such as is the case for acidification) and policies for which policy packages are still in various stages of development (e.g. in case of greenhouse gas emission reduction and the eutrophication of the Baltic Sea). Considering trends in various emissions the first mentioned type of environ-

mental policy areas (i.e. well established implementation) seems to be less affected by economic crises. On the other hand for the latter type of environmental themes the policies have often not yet succeeded in sufficient decoupling of the emission trends from economic development. This means that for not yet decoupled environmental effects the activity level of research, development and demonstration merits to be warranted by means of appropriate polices.

The above considerations are mainly based on the economic cycle and the expected low level of investment after a crisis in case of absence of policy interventions. In addition it should be added that crises are often followed by significant structural change, which can turn out to be either a blessing or conversely a worse burden for the environment, depending on public policies and business strategies ahead.

Green innovations in a globalising economy

All in all Asia's role in determining global economic growth and associated emissions and relative prices is likely to get ever more important. At the same time these countries constitute growing export opportunities for green products and services from Nordic countries. In this respect so-called leakage of emissions by replacement of emission intensive production from Nordic countries to high growth economies with less stringent environmental policies should be understood as part of the globalisation process. However, direct replacement of such production capacity is an exception, instead gradual displacement of production capacity in Nordic countries by newly invested capacity in growth markets is an issue. The challenge is to ensure that this new capacity embodies up-to-date clean technology, preferably based on Nordic innovations. It remains to be seen whether border adjustment taxes for countering emission leakage problems would be a useful supplementary instrument in this context. Its implementation would require still a multitude of research, regarding economic effects, generation of carbon footprint data, and international trade legislation and trade conflicts.

Promising green innovation potential in Nordic countries

In international comparisons Nordic countries generally rate high in terms of innovation efforts. In terms of eventual output (as compared to the sizeable input) there is still scope for improvement of the effectiveness, which may be particularly important when state budgets and credit markets tighten.

Thanks to the substantial and sustained innovation efforts (and thanks to fairly strict domestic environmental policies) Nordic countries have strong positions in a quite large portfolio of environmental technologies and services. For Nordic countries and their export potentials strong and/or promising green product and service areas are:

- Wind energy
- Hydropower
- Geothermal energy
- Biomass (incl. forest products)
- Biomass production (sustainable forestry/agriculture)
- Biomass use (incineration, gasification, refining)
- Energy saving technology
- in a selection of industrial applications
- in residential applications / buildings – optionally in combination with localised energy conversion / storage
- ICT solutions:
- Smart energy metering
- Monitoring and feedback
- Other measurement / monitoring systems
- Recycling
- Waste water treatment

Safeguarding continuity in green innovation and its market uptake

The upkeep of environmental research, development and demonstration is not a straightforward boosting of support of ongoing efforts, but should play into the structural changes in the global economy rather than resist them. Considering the limited size of domestic markets of each Nordic country separately, it might be worthwhile to consider to what extent environmental research, development and demonstration is pursued in common Nordic frameworks. Especially with respect to development and even more so demonstration joint efforts could enable significant positive scale effects. In due course the role of venture capital could be better exploited in development and demonstration projects.

In the nearby future investment levels in environmental technology, notably for abatement, can be expected to stay below original pre-crisis baseline expectations in case no action is taken which promotes continuation of environmental investment levels. In this respect it merits to mention that new technologies need actual applications, i.e. by means of demonstration projects, in order to get costs down over time. In other words better market prospects for innovations in the short run can help to precipitate the reduction of unit-costs of such technologies in the medium to long term. In that case it is however essential that the promotion policies stimulate the lowering of unit-costs.

Sustaining environmental policy in a budget constrained world

In order to ensure that environmental policy goals are achieved while structural change takes place and state budgets are tightened various policy instruments may need revision. In short the following adaptations could be considered: (1) tax reforms, with ever more stress on taxing consumption of (natural) resources and only limited (temporary) overall increase of tax rates, (2) abolishment or at least reduction of environmentally harmful subsidies, (3) other quasi-market incentive structures (tradable certificate systems; performance dependent "fee bates"), (4) radical improvement of market information via monitoring and feedback services, certified labelling, etc. and (5) combinations of the aforementioned options.

1. Introduction

The financial crisis has rapidly advanced from the US housing market to a full blown global economic crisis. Among the many implications it will have the implications for the environment and for environmental policy deserve attention. The commitments to climate policy and to sustainable development have become prominent policy issues, which need new reflection in the light of what the economic crisis may entail.

From an environmental point of view the economic crisis seems to bring both opportunities and threats. In the short run one may expect some temporary positive effects, notably in terms of emissions to air, as the diminished level of economic activity also comes along with a reduction in the consumption of fossil fuels. Yet, this period of reduced emission levels may be expected to last only a few years, after which emissions will start to grow again. If environmental investment efforts are slowed down due to the crisis, the resumption in growth of environmental burdens may even be significant.

This kind of concerns motivated many governments and specialists around the world to consider how economic stimulus packages could be made "green", i.e. promoting environmental protection and sustainable development. On the other hand these stimulus packages are supposed to have only a limited life span, whereas the economic conditions for both public and private investments probably imply a substantially reduced manoeuvring space for large efforts in various environmental policy areas. This prospect invites to consider what kind of policies could overcome these obstacles for envisaged increased environmental policy efforts.

The environmental policy challenges, most notably regarding climate change, have to be dealt with against a backdrop of other major changes, some of them precipitated by the economic crisis. There is for example the rising prominence of the G20 group, which indicates that the recovery from the crisis will entail more than just tightened policies in public finance and reregulation in the financial sector. A more profound reconsideration of the valuation of capital and resource productivity across sectors, alternative uses, and countries could emerge. To this set of challenges should be added the challenges (and opportunities) caused by the ageing of the population in Nordic and other OECD countries, which can further strain the financial sustainability of the public budget and of households" purchasing power.

The purpose of this project is to review the effects of the economic crisis on environmental policy and on the environment in the Nordic countries. If necessary and possible, country specific situations in the Nordic countries will be discussed. This report of the first phase is meant for a quick review of typical mechanisms and effects. It is based on a literature survey as well as on a quick scan of recent trends in key statistics regarding the economy

and the environment in Nordic countries, in as far as data have been readily available at the time of writing.

The report sets off in chapter 2 with describing how the crisis affected the economies of the Nordic countries, and to what extent these effects have been similar and dissimilar. It also reviews briefly the main factors behind the crisis, as some of the corrective measures may affect design or effectiveness of environmental policies. The chapter concludes with a review of earlier crises with the aim to identify commonalities. After having described initial effects and commonalities and differences of Nordic countries in chapter 2, chapter 3 handles recovery policies, their do's and don'ts, an overview of stimulus packages in various countries, as well as a discussion of the "greenness" of these packages, and of the likely manoeuvring space for ambitious environmental policies in the medium term given the expected fiscal implications of the crisis.

Whereas the chapters 2 and 3 discuss the economic impacts and public economic framework conditions for ambitious environmental policies, chapter 4 turns to an evaluation of the challenges and possibilities from an environmental point of view. Implications for achievement of medium term climate policy goals are discussed, whereas also other environmental effects are reviewed. Subsequently, long term prospects and the effects of likely structural changes are discussed with respect to the implications for the needs and obstacles of future environmental policy. Chapter 5 looks deeper into innovation and investment, as those are factors driving the concrete change of the economy into a greener one. The chapter looks at the options to ensure continuation and reinforcement of green innovation and investment efforts. Chapter 6 synthesizes the conclusions.

2. The economic crisis of 2008

2.1 GDP development in the Nordic countries

Up to 2007 the Nordic countries as a group tended to experience GDP growth rates similar to or somewhat above the average of the eleven Euro countries[1] (Euro_11 area; see figure 1). Since 2004 Iceland has experienced a more roller-coaster like GDP development. The dispersion of growth rates across Nordic countries grew in 2007 and 2008, seems to have grown even more in 2009, but is expected to narrow down in 2010. Since 2008 the Nordic countries – as a group – are not any more performing better than the Euro_11 area in terms of GDP growth rates. The differences in the drop in GDP growth rates in 2008 and 2009 across Nordic countries can be largely attributed to differences in economic structure, whereas also differences in exchange rate policy play a role. Iceland constitutes a special case due to its banking crisis, which heavily aggravates the effects of the global economic crisis.

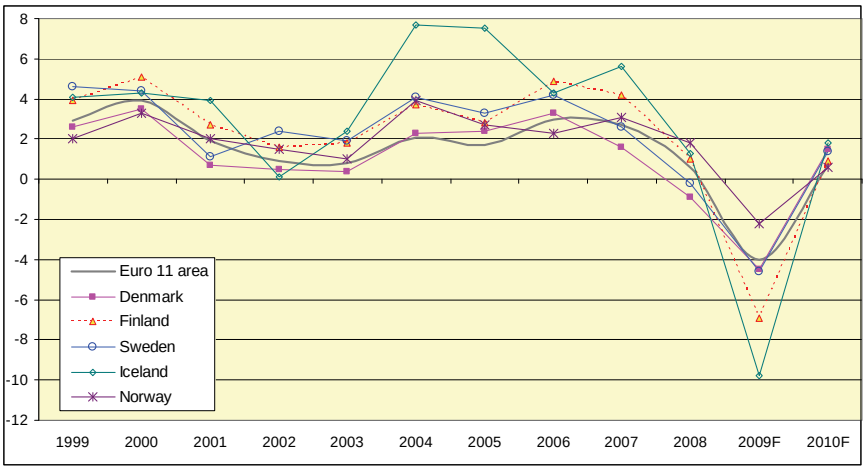

Figure 1. Observed GDP volume growth rates between 1999 and 2008 and forecasts of GDP volume growth rates for 2009(F) and 2010(F), in terms of %-change on previous year
(source: Eurostat – download 5-01-2010)

In order to follow more closely what is going on recent quarterly growth figures can be used (figure 2). However, these figures are also subject to larger risks of error, as various corrections may have not been accounted for adequately, given the short time since collection of the data. Also various unique events, not captured by seasonal adjustments, may cause quarterly data to be suggestive of even deeper slumps or quicker recoveries, which

[1] The Euro area has been extended in recent years (Slovenia, Slovakia and Cyprus joined).

may be momentarily accurate, but tell nothing about a trend. In October 2009, various indications of a rebound have already emerged, even though there are also warnings that these might be temporary effects attributable to public stimulus programmes. Various observers even warn of further or new declines. As figure 2 shows, most countries started to show signs of recovery in 2009, whereas the situation for Iceland is still more precarious. That is to say many countries at least see that their economies are not or hardly any more shrinking (i.e. growth rates approach zero). Yet, indeed it is too early to judge whether recovery has set in on a more solid basis.

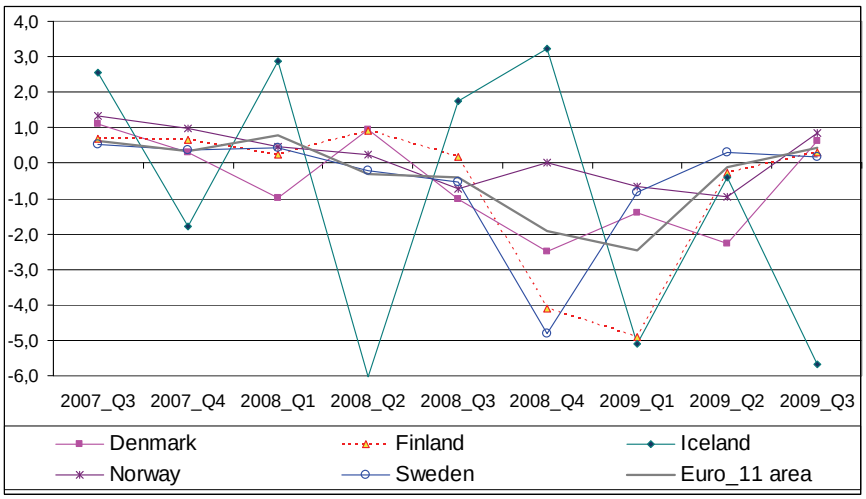

Figure 2. Quarterly GDP volume growth in % relative to the previous quarter
(source: OECD)

2.2 The crisis build-up

A phenomenon, called the Great Moderation, plays a role in the background. The Great Moderation refers to a significant decrease in volatility of GDP growth rates and other key indicators (inflation, interest) of OECD countries (CPB, 2009; van Ewijk and Teulings, 2009; Spehar, 2009) which took place in the past 20 ~ 25 years. There is still a debate going on about (the size of) the contribution of various factors, such as changes in monetary policies, labour market policies, etc. (e.g. Spehar, 2009).

The consequence of the Great Moderation was that overall predictability improved and thereby the idea that risk control, e.g. of credit strategies, investment portfolios and products, had greatly advanced. In fact the understanding and quantitative analysis of volatility on stock exchanges and of key indicators did improve remarkably over the past decades. On that basis new crediting structures emerged (notably securitization), which one way or another implied dissolution of the risks of credit products across an ever expanding global capital market (ECB, 2009, pp. 71/72). This development was especially strong in the US, as it was fuelled by a liberal monetary pol-

icy, which also meant that an ever larger part of banking activities were not any more subject to the (conventional) banking sector inspection systems and solvency guidelines.

In the years prior to the crises, 2002 – 2006, monetary policy was non-restrictive, especially in the USA, which led to low interest rates. Trade surpluses in China and various other countries needed investment opportunities, which the innovative American real estate financing sector was more than willing to offer. Current – or at least recent – monetary policy uses indicators such as inflation and output gap[2] to monitor whether overheating of the economy is occurring. Asset price rises are not regarded as inflation but a rise in value, which in turn helps to reduce the likelihood that positive output gaps occur. As a consequence in most OECD countries monetary authorities did not see (enough) reason to attenuate the boom timely, e.g. by raising interest rates.

The dissolution of risks through multi-step repackaging of risk portfolios effectively reduced the transparency of risk structures and sources. When also conventional banks around the world got more involved in the risk dissolution process (e.g. by buying packages of various kinds of derivatives) an unintended blueprint was made for globalising a US credit crisis more forcefully than otherwise would have been the case. Next to this methodological issue of risk management at bank level and macro-economic level, obviously the imbalances and rapid movements on global capital markets play an important role, in the sense that it provided ample "fuel" for creating large bubbles, which could grow to record sizes due to the absence of timely interventions by monetary authorities.

2.3 Differences between the Nordic countries[3]

Apart from monetary policy, recent economic trends have been similar in Nordic countries. Only the magnitudes vary greatly, although all are small open trade dependent economies. Albeit to a different degree, all Nordic countries have experienced economic downturns in 2008 and even more so in 2009. Public consumption and – only in 2008 – private consumption had still positive growth contributions. Investments, exports, imports, and household consumption declined, even though the latter component to a lesser extent. Unemployment rates are climbing, the worst being yet to come. Norway has survived rather well, despite a collapsing oil price, which later on recovered partly[4]. In contrast the economy of Iceland has plunged

[2] The *output gap* is defiend as the difference between the theoretically attainable output (i.e. maximum possible GDP), given the amount of installed production capacity and available labour force while assuming standard working times, and the achieved output (observed GDP).

[3] Cited economic figures in this section come from the Nordic Statistical Yearbook 2009, unless other references are indicated.

[4] Oil prices were at a record high level ($ 140/barrel) just before the collapse in autumn 2008. Prices recovered from under $ 40 to $ 80 per barrel during 2009. Since November 2009 prices vary between $70 and $80, which is another sign that global economic recovery is still hesitant.

deepest. Particularly, Finland, Denmark and Sweden have shifted to expansionary fiscal policy in the face of the rapidly worsening economic situation. Iceland's scope for public stimulus is virtually nonexistent under its new debt burden.

The differences between the Nordic countries regarding the timing and severity of the shocks and the policy responses can be mainly attributed to two aspects, being: (1) the differences in monetary frameworks, and (2) the differences in economic structure.

Countries in a monetary union (like the Euro area) and countries with a pegged currency may be confronted with exchange rates that may be not optimal for their economies. On the other hand the foreign currency risk and exchange competition effects are eliminated for trade between countries within a monetary union. For a small economy with a freely floating currency (e.g. like Sweden) ups and downs in the economy are – partly – cushioned by the corresponding appreciation and depreciation in the exchange rate.

Finland is in the euro area, this means that the cushioning potential of a floating exchange rate only applies in relation to key valuta outside the euro area (notably the US dollar), whereas it is not or barely linked to the state of the Finnish economy. The Danish crown is pegged to the euro[5] and therefore cushioning via depreciation is virtually non-existent. The Icelandic monetary policy is for the time being totally dominated by the recovery and settlements of its collapsed financial system. The Norwegian crown and the Swedish crown are freely floating. It should be noted that Sweden, even though no participant in ERM-II, is still subject to EU monetary stability guidelines (regarding public sector debt, balanced government budget, and inflation), as well as many other EU policy measures that somehow affect, if not constrain, macro-economic policy choices. For Norway, being not an EU Member state, and instead much more dependent on the markets for oil and natural gas, the situation is quite different (e.g. oil prices and dollar exchange rates affect Norway's monetary policy).

By and large it means that Sweden had the most manoeuvring space to have shocks of the crisis cushioned via (automatically occurring) depreciation, which made its currency cheaper in comparison to the euro in particular, and thereby its international compatitibe position relatively improved [6].

The Nordic countries have different economic structures, implying that some Nordic economies, notably the Finnish, got more exposed to dramatic drops in export demand (Figure 3). The crisis had the largest impact on the building sector, on sectors producing investment products (machinery), and on sectors for intermediate products (e.g. paper, steel, components). The latter category suffers primarily due to increased price competition, whereas the others suffered simply due to lack of demand.

[5] The ERM II (European Exchange Rate Mechanism vs. II). In fact only applying to the Danish crown (and the Euro).

[6] Also the Norwegian crown depreciated in 2008, but to a lesser extent. In 2009 both coins appreciated again, but that did by no means fully compensate the earlier depreciation.

In countries without cushioning effects of floating exchange rates companies are (even) keener on cutting cost, usually by (temporary) lay-offs, labour time reductions, freezing salaries, etc. In turn this threatens to reduce aggregate consumer demand, which in turn has a negative effect on companies only active on the domestic market. With some exceptions, such as car purchases, consumer demand sustained relatively well in Finland and Denmark. Thereby suggesting that households either reduced saving and/or have cut mainly on a few large expenses (durables, holidays).

In 2009, Finland was one of the worst performing countries in the euro zone and EU27. Exports of high-technology Finnish products have tumbled and industrial production has fallen faster than anywhere else in the 16-country euro zone. An explanation for this is that Finnish export contains a high share of investment goods (44% in 2008) and intermediate products (28% in 2008). The demand for investment goods has collapsed, whereas intermediate products are very sensitive to price competition. Unemployment in Finland may rise up to 10% (MLE 2009a).

Swedish firms have benefitted from a depreciating crown, which was helpful to keep up international cost competitiveness to some extent (Figure 3). The Swedish and Danish export bases are generally more diversified than in other Nordic countries. Nonetheless, also Sweden is suffering from the global investment slump as it affects the country's investment goods sector. Also the Swedish car industry has been suffering from the crisis.

The Danish economy is dominated by consumer goods production, as well as services, such as logistics. This structure has helped cushioning the crisis, since the demand for consumer necessities declines less than demand for durables or luxury goods. Yet, amidst deflation and durables consumption postponements, Denmark has been forced to keep interest rates above the interest level of the Euro area owing to its currency's peg to the euro. This has further decelerated economic activity.

Relative to other countries, Norway appears to have survived the crisis rather well. In addition to oil and related products (68%), Norway exports fish products and shipping services. When oil prices collapsed, Norway's sovereign wealth fund[7] served to buffer public finances and maintain Norway's high standard of living. By October 2009, inflation had declined from 3 % levels to about 2.5%, while unemployment is expected to peak at about 4.5% in June 2010. In 2008 exports declined, but since the summer of 2009 oil prices started to rise again. Domestic public and private consumption has rebounded and GDP growth is expected to resume in 2010 at the latest. Norway's central bank became the first in Europe to raise its interest rate in October 2009. (Barclays Capital, Euro Weekly, 30 October 2009).

In September-October 2008, Iceland plunged into a virtual state of bankruptcy. National output and income have declined strongly since the outbreak of the international banking crisis, among others because it caused a collapse of Icelandic banks. In the preceding years Icelandic banks were

[7] Its official name is: Government Pension Fund – Global.

walking a fine line in their rapid leverage financed expansion overseas. This risky strategy collided with the international banking crisis, eventually forcing the Icelandic state to turn to international monetary support, e.g. from the IMF. As a consequence the private sector credit crunch can by no means be compensated by a debt stricken Icelandic public sector. Inflation has been galloping despite declining housing costs. Despite the exchange rate collapse the global crisis has begun to take its toll on exports. More traditional natural resource oriented products have regained importance in the export mix, with fish (36%) and aluminium (42%) as principal export products in 2008. As a consequence of all this, Iceland is eyeing EU membership and joining of the euro zone to ensure future financial stability.

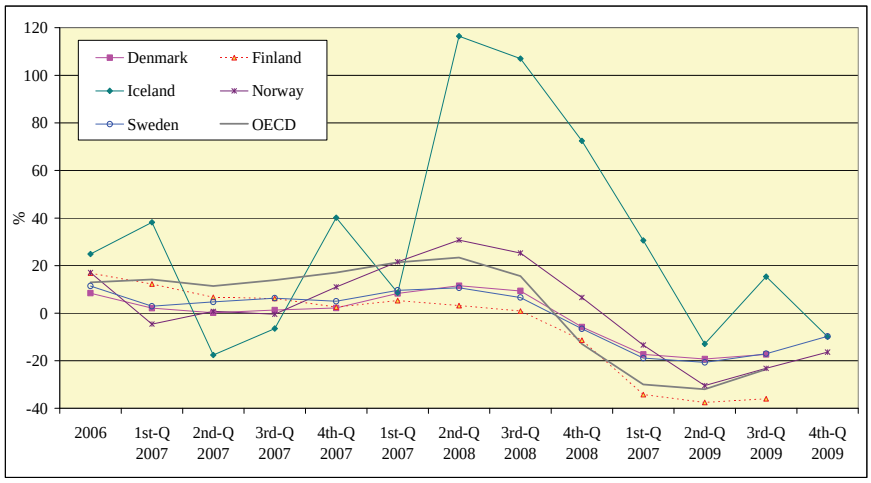

Figure 3. Development of export value by country in terms of %-change from the same quarter in the previous year
(source: OECD)

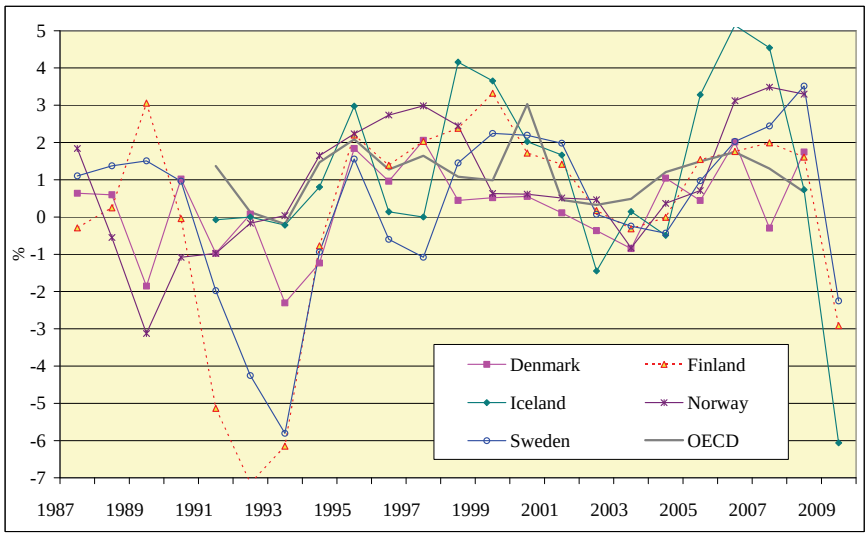

Figure 4. Changes in employment rates by country in terms of %-change from the previous year

2.4 Experiences during previous crises

The Great Depression of the 1930s

The current crisis represents a collapse comparable to the Great Depression of the 1930's. Though the depression spread via trade to the Nordic countries, the shares of foreign trade were low compared to the current decade. For instance in Finland, the depression of the 30's was mainly felt because it coincided with increased timber market competition from Russia. Large devaluations rapidly reversed output decline and strong growth resumed. For most countries, 1930's policies, such as increased protectionism aggravated the depression. Keynesian type public demand led growth policy was exercised successfully in the New Deal of President Roosevelt in the USA. In the later part of the thirties global recovery from the depression took off with public procurement led demand related to accelerating re-armament in response to the policies of Nazi Germany. The vast amount of destruction during World War II, also in various Nordic countries, was followed by a vast repair & recovery boom lasting until the early sixties.

The Banking Crisis of the early 1990s

Liberalisation and deregulation started in the 1980's. Though the motives for deregulation, at least in Finland, arose most of all from leakages in the system, the rise of supply side economics played a role. The era released accumulated pressures for trade and financial market liberalisation originating in Anglo-Saxon countries. The new doctrine was crystallised in the so-called Washington consensus, which characterised the government's role in sound growth policy. According to it, the government should abstain from unnecessary interference and confine policy measures to securing a stable and sound investment climate, notably through budget discipline and price stability, which paved the way for the great moderation (see section 2.2). In those days radical, such recommendations are now the routine in the EU, OECD and IMF. These tendencies turned prevailing attitudes against intervention in general, which together with beliefs in the efficiency of markets played an important role in the build-up of the current crisis (Berghäll et al., 2006). As indicated in section 2.2 some correction in those views seems to be on the rise, not so much amounting to a reversal of heavy handed intervention or steering, but rather further development of monitoring tools as support for eclectic preventive interventions (Spehar, 2009).

The Nordic banking crises of early 1990's resembled each other. Strong economic growth in the 1980's resulted in overheating. Gradual unbalanced deregulation of credit markets lead to a flood of foreign currency denominated debt, asset inflation and real estate and stock market bubbles. Investments and consumption rose rapidly, while budgets failed to accommodate with fiscal restraint. Liberalisation of the capital account has initiated major banking,

financial and economic crisis on several accounts in history, most recently in 1997 Asia and 1998 Russia. There are similarities with the recent crisis in Iceland, not to mention the current global crisis (Berghäll et al., 2006).

In almost all crisis situations, large devaluations have been the major immediate remedy imposed. Though they increase foreign debt servicing costs, they allow economies to turn around and export-led growth to gradually take off. Finland suffered perhaps the most, because its banking crisis coincided with the collapse of an important export market, that of the Soviet Union. During the depression of 1990 – 1993, Finland's GDP declined by 13% (9% in 1991 alone) and unemployment rose from 3.5% to 18% (Figure 4). Nokia Corporation emerged as the new engine of growth that pulled along an entire new high technology electronics industry, and accelerated Finland's average economic growth to second in the EU after Ireland (Berghäll et al., 2006). Similarly in Sweden Ericsson flourished. Yet, in Sweden the industrial basis of the growth was more diverse than in Finland.

Bursting of the dot.com bubble

All crises have involved significant inflows of so-called "hot money" that seeks high returns. After the Asian 1997 crisis, it fuelled the Dot.com bubble of high technology stocks. The ICT stock bubble represented a smaller crisis, but its build-up involved great technology belief, similar to crisis solution beliefs today. To R&D and other intangible inputs were attached increasing returns to scale and sky-high growth opportunities. This boom ended as the bubble burst in the spring of 2000 and stock prices plummeted throughout the world. Among the Nordic countries, Finland was the most affected with the largest bubble (Agerskov, 2009). Globally the crisis" impact was compounded by the 9/11 terrorist attack on the New York World Trade Centre. Subsequently, hot money was channelled to the US housing market.

2.5 Summary

Some Nordic countries were hit more severely by the economic crisis than others, owing to different economic structures and differences in monetary policies. Recovery has been rather hesitant. Considering the sources of the crisis changes in bank regulation, supervision and financial sector risk management procedures and techniques can be expected. From earlier crises can be inferred that banking crises can be especially severe and protracted. Crises usually also set in motion significant changes in the structure of the economy and its institutions, which constitute both risks and opportunities.

3. Recovery policies and public finance

3.1 Lessons about recovery from previous crises

According to Pisani-Ferry & van Pottelsberghe (2009), prior crises in Finland, Sweden, Japan and South Korea in the 1990's have taught important lessons that should be kept in mind when applying remedies today. First, there may be a permanent loss in output. Although growth may resume, the lost labour input from long-term unemployment implies a lower growth path (at least for the nearby future). This effect has been confirmed to apply to a wider group of crisis experiences and over a longer period (Cerra and Saxena, 2008; Reinhart and Rogoff, 2008 in Pisani-Ferry & van Pottelsberghe, 2009).

Second, the output loss can be minimised with appropriate policy. Sweden's swift measures in recapitalisation of viable banks and nationalization of insolvent ones enabled a timely and relatively smooth transformation of its economic structure, which accelerated productivity growth (for some time). In contrast, the growth miracle of post war Japan was stifled to a "lost decade" because the prolongation of the banking crisis decelerated necessary restructuring (Pisani-Ferry & van Pottelsberghe, 2009). Policy measures should be directed at activation, while avoiding measures introducing a permanent reduction in labour supply, such as early retirement schemes. Furthermore, stimulus packages should be "targeted, timely and temporary" and be scaled back when recovery takes off (OECD, 2009).

The packages should be education, innovation and generally growth oriented. Permanent labour supply cuts, such as early retirement schemes, should be avoided, and credit constrained innovative growth firms should be prioritized over large companies in mature industries, while R&D support should be countercyclical (Pisani-Ferry & van Pottelsberghe, 2009).

Edenhofer & Stern (2009), in their report to the G20 Spring meeting of 2009, recommend investment in energy efficiency, since its uptake is hampered by various market failures, including R&D for energy efficiency, while it does not crowd out private sector activity. The latter assertion may be only valid up to certain extent of stimulus, due to a large outflow of building workers into retirement without adequate replenishment by young workers (as is the case in Finland). The same authors (and others, e.g. UNEP, 2008) also recommend substantial green investments in energy and public transport infrastructure. For those options applies the same proviso as regards a "double dividend" of more growth and less emissions. Too much stimulus (from a macro-economic point of view) would incur (extra) inflation and a growing share of leaked stimulus to foreign suppliers and foreign workers. Further-

more, a sustainable transition of the economy is a strategic long-term process to which a so-called green stimulus may contribute, but the differences between objectives between transition and stimulus should be well understood.

Small innovative manufacturing firms often have suffered more from crises than larger firms, as it was harder for them to find alternatives for tightened credit facilities. These small innovative firms represent an important potential for growth and industrial renewal. According to Pisani-Ferry & van Pottelsberghe (2009), the procyclical nature of business R&D spending should be countered by public support. They emphasize the importance of not saving large hopelessly indebted companies at the expense of young innovative companies. Otherwise, creative destruction does not reallocate resources optimally (Pisani-Ferry & van Pottelsberghe, 2009). In practice however it may be difficult to discern – in advance – between a single bank failure and the collapse of the banking system. Furthermore, when successful in their innovation, small firms are often acquired by large ones, which in small countries are more likely to be foreign. This entails some risk that social returns to innovation spill abroad. On the other hand it may step up the inflow of direct foreign investment.

3.2 Stimulus types and their problems

Banking crises tend to linger longer than average recessions, as the loss of (value of) productive capital is accompanied by malfunctioning credit markets. For many countries policy options are limited as interest rates are already at an exceptionally low level (figure 5). Since the financial crisis affected virtually all countries in the world, there are few countries in the world that offer some engine of growth potential for export-led recovery in recession hit economies. China's demand may not suffice alone, though combined with the pull effect of other Asian growth economies, there might emanate some global impetus from Asia's growth.

The interest rate reduction in the Euro area and in Denmark, Sweden and Norway did not seem to provide much stimulus as such (at least not in the short term), but the cushioning effect of a (concomitant) depreciation of the Norwegian and Swedish crown helped export demand to some extent for those countries. For Finland and Denmark the absence of cushioning effects of depreciation made stimulus programmes more prominent and urgent. Demand stimulus occurs partly more or less automatically e.g. in connection with increased use of the social security system. In addition governments can decide to actively increase (or precipitate) public investments and fiscal measures. With the exception of Iceland Nordic countries are relatively well placed to exploit fiscal stimuli and enhance public investments, as they are among the few EU countries that entered the crisis in surplus and relatively low public debt (OECD, 2009b), but this may change rapidly as for example the Finnish Ministry of Finance showed recently (MOF, 2010).

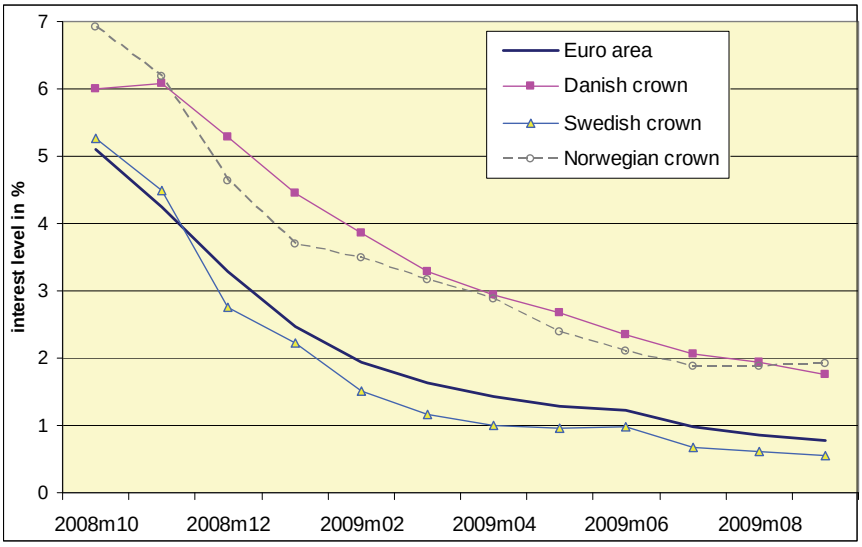

Figure 5. Three-months domestic market interest rates (in %)

The so-called leakage of domestic stimulus is usually large in small open economies owing to higher import shares. If (almost) all trade partners would do the same, the leakages would compensate each other. Yet, in practice there may be winners and losers in this respect. Leakage in Nordic countries hovers around the OECD average (OECD 2009b, p.115), albeit with Norway and Sweden leaking clearly more. Concerted action of stimulus may reduce severe imbalances in leakage. Accordingly, the international community has strived to coordinate economic stimulus packages that together would generate sufficient momentum for recovery to take off. Yet, at least European policy responses to the crisis have been nationally focused and mostly uncoordinated. Countering leakage by means of import substitution may be counterproductive, not only because it is likely to lead to counter measures of other countries, but just as well because it tends to distort the allocation of resources and may lead to significant long-term inefficiencies, when such policies are continued.

3.3 The size of stimuli packages

Discretionary fiscal measures have been introduced throughout the world. South-Korea, the US, Australia, Japan, Turkey, China, Brazil, Russia and Canada have introduced stimulus measures rising above 4% of GDP (OECD June 2009b).

Automatic stabilisers are generally forceful in Nordic countries, with Sweden and Denmark showing top OECD levels (OECD 2009, p.118). In addition, by March 2009 Denmark, Sweden and Finland had announced fiscal stimulus equal to 2.5% – 3.1% of GDP (OECD, 2009, p.110). In June 2009, these estimates had been revised to rise above 3 % of GDP for 2008–2010, as of 2008 GDP. Sweden's $2.7 billion stimulus package focuses on

"public infrastructure and investment in human capital, including job training, vocational workshops, and workplace restructuring; extension of social benefits to part-time workers (CRS, April 2009).

Tax measures comprise about 80% of Finland's stimulus package (situation in June 2009). Spending was targeted at the construction sector, transport, infrastructure and energy projects, business subsides and R&D, and labour policy and education.

In January 2009, Norway announced a package of $2.9bn or €2.2bn of "investment in construction, infrastructure, and renovation of state-owned buildings, tax breaks for companies." (CRS, April 2009). OECD is contradictory giving Norway a mere 0.8% of GDP stimulus package (OECD 2009, p.118), or slightly over 1% of GDP for 2008–2010, as of 2008 GDP. In contrast, Iceland differs from all with a spending cut of -9.4% of GDP (OECD 2009, p.118). Most stimulus packages focus on 2009 and fall rapidly in 2010, with the exception of at least Finland and Denmark.

Table 1. Fiscal Stimulus around the world

	Spending in 2009		Total size of stimulus	
Country	**USD amount (billion)**	**% share of 2008 GDP**	**amount (billion $)**	**% share of 2008 GDP**
Argentina	4.4	1.30 %	4.4	1.30 %
Australia	8.5	0.80 %	19.3	1.80 %
Brazil	5.1	0.30 %	8.6	0.50 %
Canada	23.2	1.50 %	43.6	2.80 %
China	90.1	2.10 %	204.3	4.80 %
France	20.5	0.70 %	20.5	0.70 %
Germany	55.8	1.50 %	130.4	3.40 %
India	6.5	0.50 %	6.5	0.50 %
Indonesia	6.7	1.30 %	12.5	2.50 %
Italy	4.7	0.20 %	7	0.30 %
Japan	66.1	1.40 %	104.4	2.20 %
Korea	13.7	1.40 %	26.1	2.70 %
Mexico	11.4	1.00 %	11.4	1.00 %
Russia	30	1.70 %	30	1.70 %
Saudi Arabia	17.6	3.30 %	49.6	9.40 %
South Africa	4	1.30 %	7.9	2.60 %
Spain	18.2	1.10 %	75.3	4.50 %
Turkey	0	0.00 %	0	0.00 %
UK	37.9	1.40 %	40.8	1.50 %
US	268	1.90 %	841.2	5.90 %
Denmark	0.4%[3] +automatic stabilisers[6]	0.8%[3] Budget deficit rise to 5%[6]		2.5 % [2]
Finland	mostly prior tax cuts[3] 1.7% Govt budget deficit 4.5%[5]	Govt budget deficit 1.7% [3] 5.8%[5]	Govt budget deficit 5.2%[5]	3.1 % [2]
Iceland	budget deficit[6] 12%			Surplus of 9.4 % [2]
Norway	+automatic stabilisers[6] 3%			0.8 %[2] 2010 n.a.
Sweden	+automatic stabilisers[6] 3%			0.8 %[2] 2010 n.a.

[1]For Argentina-US: Brookings Institute, 2009: Assessing the G-20 Economic Stimulus Plans: A Deeper Look. By Eswar Prasad and Isaac Sorkin, March 2009.
[2]OECD 2009, Interim Economic Outlook no.84, Chapter 3: The Effectiveness and Scope of Fiscal Stimulus, OECD, Paris, March 2009.
[3]European commission, European Economy 5/2009.
[4]European commission, European Economy 7/2009.
[5]Ministry of Finance, Finland
[6]Roubini Global Economics: 04 Global Economic Outlook, October 2009.
Please note that the table had to be composed from various sources, often with preliminary figures. For some countries data may have been revised.

3.4 Green Stimulus Programmes

The contents of green stimulus programmes

The economic crisis has also precipitated wide calls for eco-efficient recovery plans or "green stimulus". In the short-term there may be scope for stimulating depressed economies by bringing forward low-carbon and renewable energy investment expenditures. Green stimulus presents a case example of high estimated social returns. Factors offsetting increased costs of stimulus include accelerated technical change in low-carbon activities, employment of otherwise idle resources, and stimulating innovation and entrepreneurship, which engender future growth opportunities (Edenhofer & Stern, 2009). In as far as the concerned efforts are regarded as largely unavoidable, realisation during a slump may lower the cost of these policies thanks to suppressed prices of products and labour.

At the global level, the share of green in stimulus packages has been estimated at about 15% of a total of 3.1 trillion US dollar stimulus (UNEP, September 2009 and Robins at al., 2009). China (34–38% of about 590 billion US dollar) and the US (12 % of about $790bn) have introduced the largest green packages in volume terms (dollars), while South Korea has the highest share of green spending in its overall stimulus package (approx. 80% of about 38 billion US dollar). The EU also rates high (59% of about 39 billion US dollar) (source: HSBC February 2009). Among the larger European countries Italy's green stimulus effect seems to get more than outweighed by extra spending on new roads. The UK's small stimulus package also favours road building. Germany's and the US's stimulus packages are large, amounting to 0.5% of GDP, and predominantly green (i.e., 13% and 12% respectively according to UNEP, September 2009). Though fairly green (18.3% according to UNEP, September 2009), debt-ridden France can afford only about 0.1% of GDP stimulus package (ECOFYS, 2009b).

The share of "green" in stimulus packages varies in reports. Partly this has to do with timing differences, partly with how it is evaluated, partly because estimates of the effects of tax shifts to environmental taxes are not readily available. While large governments have dedicated over 180 billion US dollar to sustainable energy in the stimulus context, countries differ in the shares and lucidity of their instruments. According to UNEP, once credit constraints are eased, renewable energy projects are among the first to gain as steady producers of revenue from steadfast public services and infrastructure (UNEP et al., 2009). Yet, as will be further discussed in the next sections and in chapter 4, it will really depend on the environmental and fiscal policy context how expansionary this investment area will turn out to be.

By theme, energy efficiency (68%) clearly dominates the green parts of stimulus packages, followed by water (19%), renewable energies (9%) and finally other low carbon applications (5%). In terms of climate change combating stimulus the most relevant are low-carbon energy production, includ-

ing renewable sources along with nuclear power; energy efficiency & energy management; water, waste and pollution control; and carbon finance. Considerable scope remains in low-carbon electricity generation, i.e., renewables, CCS and others, as well as energy efficiency (HSBC February 2009, p.41).

HSCB expects the construction and capital goods sector to be the primary beneficiaries of green infrastructure expenditure, and the emphasis on a low-carbon recovery to intensify. A positive sign amidst the economic clouds is that firms in renewable energy technologies have continued to grow and employ. Moreover, the investment community has begun to perceive climate change as an important factor in risk assessments (HSBC, 2009).

Selection criteria and assessment of "greenness"

The Grantham Institute of the London School of Economics (2009) evaluated the potential of all kinds of green stimulus options with respect to "timeliness and short start up times, long-term social returns, positive lock-in effects, job-creation potential, focus on economic slack and the extent to which spending is temporary." According to this assessment system energy saving investments both in the building stock and in the industry tend to rate very well on practically all accounts. Also stimulus of renewable energy applications, e.g. through fuel switching, tends to rate quite well. It should be noted that the rating was made in the context of *temporary green stimulus* packages. For long term strategic plans economic and environmental efficiency ratings may look somewhat different again.

It should be noted that there does not exist a generally accepted standardised definition of green investments, and neither of green products and services (see also Strand and Toman, 2010)[8]. This makes it hard to compare packages and to interpret investment plan reviews in terms of "greenness" without getting arbitrary. Some options are rather clear and largely undisputed, such as solar electricity panels, wind turbines and many energy saving measures. Yet, biomass needs already much more scrutiny, e.g. with respect to system limits, to ensure that the option can be regarded as a substantial environmental improvement. Biomass is also an example of a solution of which the scale and location affect the environmental and economic rating, as local circumstances can be more or less conducive to such solutions. Similarly, the rating of transport solutions depends on the local population density, type of shipped goods, etc.

[8] The most thorough assessment of what green jobs and creation of green jobs constitutes was so far carried out by UNEP (2008). In that report "green jobs" are defined as: "*positions in agriculture, manufacturing, construction, installation, and maintenance, as well as scientific and technical, administrative, and service-related activities, that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect and restore ecosystems and biodiversity; reduce energy, materials, and water consumption through high-efficiency and avoidance strategies; de-carbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution*"

One may also wonder to what extent radical improvements in the environmental effects of heavy industry processes can be termed "green", when such sectors will remain almost inescapably resource intensive. This also ties in with concerns about "carbon leakage" and the "pollution haven hypothesis". These concerns refer to the effect pertaining that industries with high emission intensities may get ever more tempted to relocate to a country with less costly environmental policies, when environmental policies in the original production country continue to tighten. If innovations for heavy industries enable them to produce also in strict environmental policy environments, than such innovations may help to retain such industries and reduce "emission leakage" to countries where high emission activities can be continued. However, a good part of the growth prospects of these heavy industries coincides with the economic development phases of China, India, Brazil, and other emerging markets. So, the overriding reason to expand abroad and to – gradually – reduce in advanced economies is related to a very substantial demand pull. Retention through innovation may turn out to be merely postponement of reduction. In that case the stimulus of innovation should be considered right away in conjunction with technology export and transfer potentials, both in economic and environmental terms, and much less as an industrial retention strategy.

Country packages

The US plan fares well against the Grantham Institute criteria. It is the major stimulus package with significant support to renewable energy (29%). In addition the package includes energy efficiency in buildings (32%), low-carbon vehicles (5%), rail (9%), grids (11%), and wastewater treatment (14 %) (HSBC, February 2009, p.41).

China has responded surprisingly rapidly. Its stimulus package implies an earlier start-up of large construction investments and combines green investments with supporting policies regarding taxes on energy-intensive and polluting products (incl. fuels). China invests in railways, roads, public housing and rural infrastructure, such as grids and water infrastructure, as well as environmental improvement, and most in climate change themes. China has doubled its wind capacity every year since 2005, and is expected to become the world's largest wind power market in 2009. The government aims at raising the share of renewables to 15% by 2020, i.e., only 5% short of the EU target (HSBC February 2009, p.15, HS 28.10.2009).

South Korea comes 10th regarding global ranking of country's greenhouse gas emissions, while it enjoys developing country status in climate change negotiations despite a GDP/capita which approaches that of OECD (and Annex 1) countries like New Zealand and Greece. Nevertheless, South-Korea has introduced its own emission cap targets. The stimulus package involves energy conservation, recycling and clean energy development for an energy-saving economy, green transport networks and clean water sup-

plies, carbon reductions and water resource development, industrial and information infrastructures, quality of life improvements by means of green neighbourhoods and housing. About 38 % of Korea's package is directed at water and waste themes (HSBC, February 2009, OECD, June 2009).

EU stimulus packages are generally smaller due to the large automatic fiscal stabilisers that widen fiscal deficits in any case, but involve more significant climate components in the form of low carbon investment (41%) than in the US. Green stimulus in EU packages generally favour energy efficiency (68%) followed by green vehicles (whatever those may be) (HSBC February 2009). The EU promotes green products as a priority along energy efficiency, and plans to launch a European green cars initiative. (OECD, June 2009).

Stimulus packages in the Nordic countries

As for the Nordic countries, by February 2009 Denmark had not included any green stimulus. Norway complemented its stimulus package with a green component of NOK 1.6 billion (€183mln.), targeted at energy efficiency, the development of carbon capture technologies, and charging stations for electric vehicles, amongst other things (OECD, June 2009; HSBC February 2009). According to the OECD in August, 2009, Denmark, Finland and Sweden among other OECD countries are moving towards "green" taxation in the context of their economic recovery. For economic stimulus, Sweden had assigned as much as €10.8 billion, of which €3 billion to energy efficiency and €3 billion to low-carbon automobile R&D. Loan guarantees will be used to support more environmentally sound production systems.

Sweden has tied its stimulus package to its long term climate policy targets. To reach these targets, grid connections and wind power will be improved, and an annual investment of about €27.3 million will allocated to energy efficiency between 2010 and 2014, as well as other combinations of measures. Moreover, between 2009 and 2011, Sweden will invest about €363 million in climate related development assistance. Policies to adapt to climate change have been earmarked about €27.3 million for the years 2009–2011 (Regeringskansliet, March 2009, OECD, June 2009; HSBC February 2009).

Finland's stimulus package of €2 billion, launched in February 2009, includes green elements. A general shift in taxation of labour to environment and consumption, and eco-efficient energy sources are promoted as central elements in an ecological tax reform. A measure, which seems both environmentally and economically quite effective, is the introduction in 2008 of an emission dependent car purchase tax. In October 2009, the Finnish government announced a general target of reducing greenhouse gases by 80% (1990 level) by 2050. By 2020, Norway aims to reduce its emissions by 40 % (29 million tonnes), and Iceland by 15 % (3 million tonnes).

Green stimulus has enjoyed a central role at least in the packages of South-Korea, China, Germany, Sweden and the US. Output decline came to a halt in Sweden in the second quarter of 2009. Recent reports suggest that German and French economies resumed growth in the second quarter, albeit modestly. There are fears (ECB Monthly bulletin 2009/9) that this may be due to fiscally non-sustainable programmes such as the new car exchange premium in conjunction with an old car demolishment premium in Germany and similar programmes in various other EU countries. Nevertheless, among others the European Central Bank emphasised that such programmes should be operated cautiously (ECB Monthly bulletin 2009/9). An analysis of car renewal schemes indicates that the macro-effects are modestly positive, but temporary, while also some crowding out of other expenditures occurs. Furthermore precipitated stock renewal may be followed a phase of reduced demand, as people have been buying new cars or equipment earlier, but in the long run not more than in previous periods[9]. This kind of cyclical effects could also occur in some other stimulus packages. All in al the first empirical indications seem to provide support for the expectations that green stimulus helps, at least in the short run, but there are also founded concerns that their eventual economic and environmental effects might be very modest. In other words stimulus may have more lasting effects, if it coincides with other structural policy reforms (fiscal or otherwise).

3.5 Fiscal consequences of the crisis for policy design

In 2008 in Norway, Finland, Sweden and Denmark, the public budget still ran a surplus, whereas the consolidated government gross debt is well below the euro area average (figure 6). Only in Iceland the consolidated debt has been rising steeply. Yet, gross national saving rates have plummeted (fig. 7), which is only partly compensated by reduced need for investments. Indeed the Finnish Ministry of Finance (MOF, 2010) foresees the gross public debt to grow dramatically from approx. 34% in 2008 to approx. 48% of GDP in 2010. We therefore reiterate that the combination of shrunk asset values, tighter credit rules, higher public debts, and slowly recovering economies creates a context in which a tighter capital market and hence higher interest rates can be expected. In turn this makes investing, regardless of being green or not, more expensive for the public and private sector.

Even though Nordic countries have somewhat more fiscal manoeuvring space due their (initially) lower government debt (as share of GDP), this does not constitute a big difference compared to some Western European countries in terms of feasibility of climate policies. Furthermore, ageing of the population starts to increase expenditure pressures on the public budget. Assuming that there will be very little room for subsidy schemes on the one

[9] This would imply that at a larger time scale (e.g. 5 years or more) the net effect on emissions from the passenger car fleet is quite marginal.

hand and caution with respect to the raising of taxes, the need for very effective instruments probably will be stressed even more than today. Likely developments are (1) tax reforms, with ever more stress on taxing consumption of (natural) resources and only limited overall increase of tax rates, (2) abolishment or at least reduction of environmentally harmful subsidies, (3) other quasi-market incentive structures (tradable certificate systems; performance dependent "fee bates"), (4) radical improvement of market information and (5) combinations of the aforementioned options. This kind of expectations (or in some cases recommendations) can also be found elsewhere, e.g. UNEP (2008) and OECD (2009f).

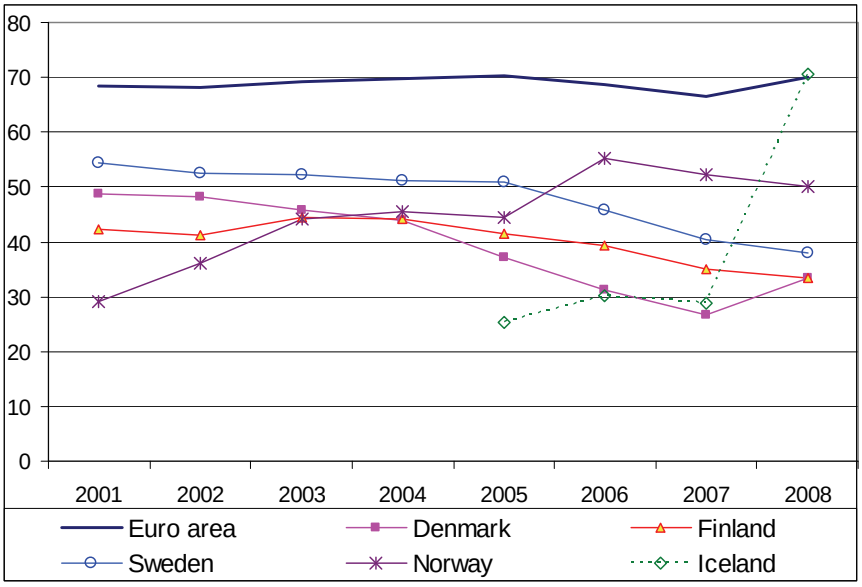

Figure 6. General consolidated government gross debt as %-share of GDP
(source: Eurostat)

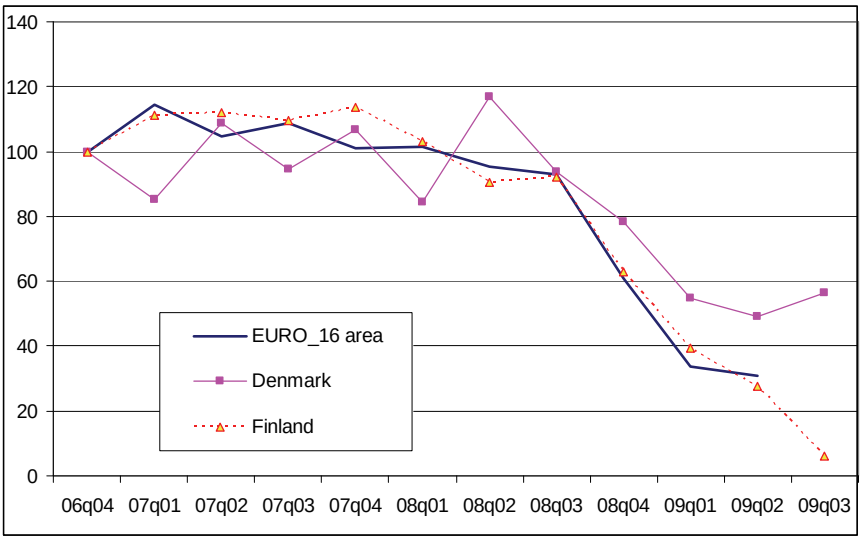

Figure 7. Gross quarterly savings for Denmark, Finland and EU-16 (2006_Q4 = 100)
Source: Eurostat.

Leaving aside Iceland for a moment, Finland, Denmark and Sweden will have to raise public sector revenues (or reduce expenditures) to gradually pay down the increased public debts to more sustainable levels. This process will put pressure on the development of purchasing power in these countries. For Iceland the public finance repair need is even appreciably larger. All in all both domestic markets and nearby export markets (at least of consumer products) can be expected to show rather modest growth rates for a good part of the next decade. Therefore, innovations that provide high cost effectiveness either for producers or consumers may be in high demand. Examples with a benign environmental potential are advancements in telemeetings, intelligent metering, and monitoring-feedback systems (see also sections 4.4 and 5.1).

Less growth in consumer markets will attenuate the resurgence of investments. Furthermore, both in the public and the private sector (new) capital can be expected to become more expensive for a good part of the upcoming decade[10] (e.g. Voigt and Moncada-Paternò-Castello, 2009). A possible consequence of this may be for example that greenhouse gas emission abatement solutions, that entail low up-front expenditures and reasonable payback times, will gain popularity. Energy saving efforts often fall into that category. In general, large, risky and costly options may be revised, whereas also some radical cost-efficient innovations, often originating in non-energy sectors, may succeed. Assuming that the economic recovery in China, India and other Asian countries continues to strengthen, fossil fuel prices will return to the high pre-2008 levels within the upcoming decade. This will make the market penetration of non-fossil fuel options, notably renewables, easier. On the other hand in conjunction with the credit crunch fossil fuel price rises may tempt governments to also reduce financial support for R&D on these energy sources.

On the positive side, environmental taxes offer prospective fiscal revenues from, e.g., carbon pricing that could help reduce the deficit at low, if any, welfare costs (OECD, 2009). From figures 8 and 9 can be inferred that also in Nordic countries there would still be space for more abundant fiscal exploitation of environmental taxation. Denmark has stepped up its environmental taxation from 2003 onwards (figure 8), whereas it has been high already for years in Denmark. For other Nordic countries there seems to be still space for "greening" the tax system. End-use energy taxation used to be high in Denmark, but possibly due to ongoing savings the taxable base diminished faster than rates went up (figure 9). Also in Sweden energy end-use taxation was tightened somewhat. In Norway and Finland energy end-use taxation doesn't seem to have bent consumption significantly, even though for some sub-groups effects have been reported. Possibly the recent

[10]. Existing capital lost a part of its value. A part of that loss is recovered, with variations by company, sector and country. It constitutes an inviting situation for takeovers by succesful newcomers (often from emerging economies) and relative winners.

energy tax changes in Finland start to have more effect, at least on households as well as small and medium sized companies.

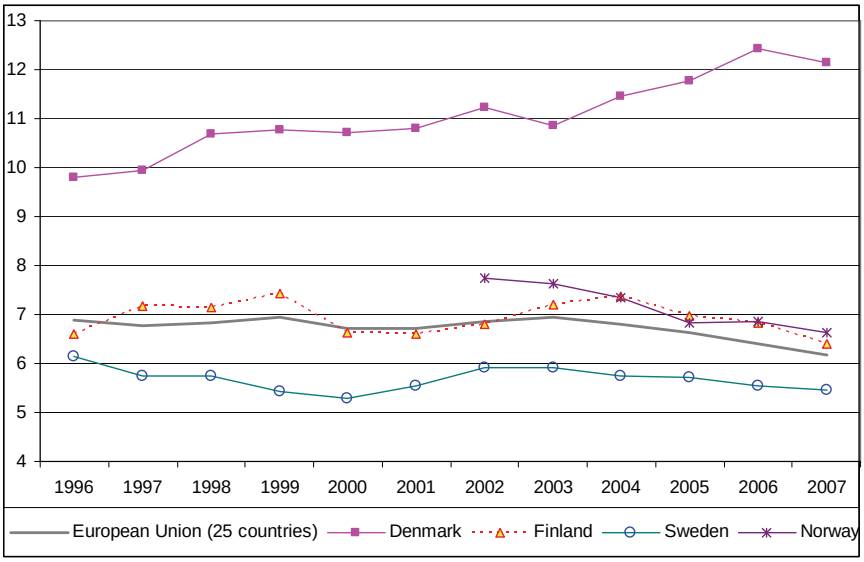

Figure 8. Environmental tax revenue as share of total tax revenue in Nordic countries and the entire EU 1996 – 2007

(source Eurostat)

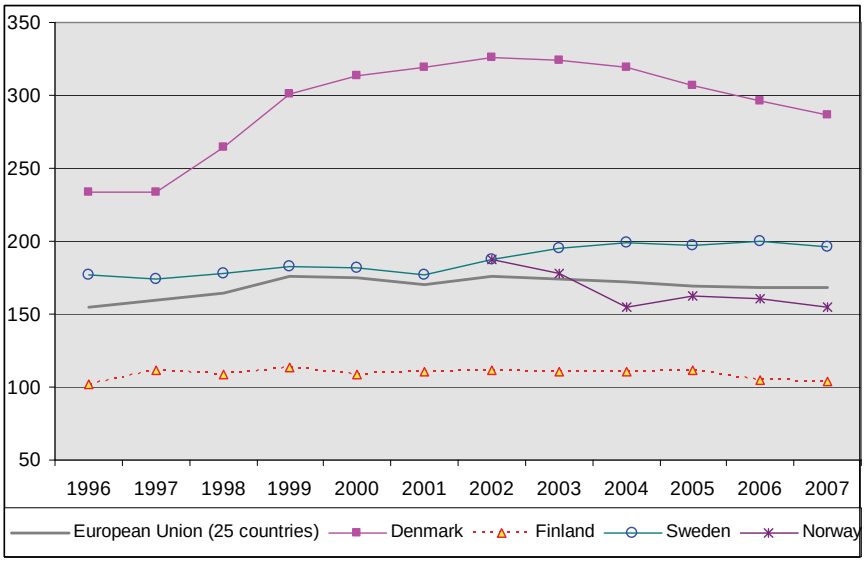

Figure 10. Energy tax index (gross energy tax revenue/final energy consumption) in Nordic countries 1996 – 2007

(Source Eurostat)

As regards the pricing of greenhouse gas emissions Denmark, Finland and Sweden take part in the European Emission Trade system (EU-ETS), whereas the Norwegian emission trade system is liaised to EU-ETS. Furthermore, Denmark, Finland, Norway and Sweden apply carbon taxes on fossil fuels, which however tend to involve exemptions for industries

(among others because of interaction with EU-ETS) and entail different degrees of revenue recycling. Iceland is considering the imposition of a carbon tax on fossil fuels[11]. Some revisions in the carbon taxation schemes of Nordic countries would make sense and are probably feasible, but major changes (e.g. regarding exemptions or much higher rate levels) might be unfeasible. However, reconsideration of environmentally harmful subsidy schemes (including tax rebates) may be both economically and environmentally more effective, among others due to side-benefits for the environment and/or public health.

There are discussions going on within the EU concerning a new carbon tax (and also for a carbon tariff, see below). As long as it concerns only fossil fuels and would leave a lot of leeway for national rate setting, there would change little for the Nordic EU member states. Expansion of such a tax beyond fossil fuels would entail significant methodological problems, as it would require assessment of the embodied CO_2 (e.g. Usva et al, 2009). Furthermore, for other products (than fuels) the effectiveness of such a tax can be questionable (Perrels, 2008b; Geller and Attali, 2005).

If international climate change negotiations fall short of EU targets, one suggested fallback measure has been to impose border charges, as is suggested by France for the EU. The idea is criticized by the OECD, among others due to its risks to elicit escalating trade disputes. On the other hand also in the USA this idea starts to arouse more interest, and it gets ever more widely studied (e.g. Cosbey, 2007; Ismer and Neuhoff 2007; van Asselt and Brewer, 2010; Kuik and Hofkes, 2010). Nevertheless, there would be still quite some obstacles ahead before an actual tax could be levied. For example, in order to prevent large scale litigation it would require a fairly accurate picture of the embodied emission content of the taxable import products. Yet, with ever more globalising supply chains that will get a cumbersome exercise (Hertwich and Peters, 2009; Usva et al, 2009).

3.6 Summary

Recovery policies, even when “green”, should be distinguished from long term policies aiming at a sustainable transition, inter alia creating a low-carbon society. The former type of policies focuses on *economic growth*, the latter on *structural change*. Careful selection and dosage of measures will help to ensure that recovery policies also promote sustainable transition. Many stimulus programmes were dubbed “green”. There is however no commonly agreed definition for “greenness” of public stimulus programmes. Generally speaking any stimulus measure that promotes sustainable investment and operations which go beyond a baseline trend could be regarded as “green”. More concretely, investments in energy efficiency, renewable energy (with some provisos), waste reduction and recycling, as

[11] Ends Europe Daily – 20/11/09.

well as various emission control technology could be termed “green”. Also the Nordic countries apply stimulus programmes with green elements, except Iceland which cannot afford a stimulus programme, due its domestic banking crisis.

Outright green stimulus programmes will expire fairly soon, but for the medium to long term changes in fiscal policies may be expected, which can also offer opportunities for “greening” public finance policy. A common element for most if not all Nordic countries is a further shift towards so-called “ecological tax reform”, i.e. taxing environmentally burdening activities more and taxing labour income less. Fiscal policy is expected to tighten considerably in all Nordic countries and elsewhere, as the crisis led to significant increases in public debt, whereas the ageing of the population adds further pressures. This creates possibilities to continue ecological tax reform as well as to diminish or abolish environmentally harmful subsidies. Furthermore, in addition to emission trade other quasi market instruments and informational instruments may gain importance.

4. The environment

4.1 Introduction

Remarkably enough there is very little material which deals explicitly with environmental impacts of economic crises. An exception is a fairly brief investigating article by Siddiqi (2000) on the environmental implications of the economic crisis in East Asia in the late nineties. Only the current crisis has spawned a fair amount of research and policy papers (so-called "grey literature") on the subject, mostly inspired by climate change and climate policy needs (e.g. Ecofys, 2009; Edenhofer and Stern, 2009; OECD/IEA, 2009; OECD, 2009f; Centraal Planbureau/Planbureau voor de Leefomgeving, 2009). The majority of these papers is forward looking and tends to be prescriptive. Some are based on model simulations, while others are merely of a lobbying nature. All in all this leaves us with scant literature with a retrospective analysis of what actually happened with the environment during and after an economic crisis.

However, if we cast the net wider a large amount of literature would become relevant, in which the relation between environmental quality and economic growth is analysed and discussed. This issue can be recast in the question what economic (long term) growth rate is also environmentally and socially sustainable (for a comprehensive overview see e.g. Neumayer, 2003; Pezzey and Toman, 2003 or more concise: Perrels, 2005). The concept can be broadened further by starting to reconsider the quality of economic growth (and welfare or well being). This would entail studies of sustainable consumption[12] (e.g. Jackson, 2006). The academic discourse has so far not led to a consensus, even though it seems now broadly recognised that during earlier stages of economic development the material and energy intensity (per unit of value) of an economy tends to go up, e.g. due the establishment of better infrastructure and rapid increases in the building and equipment stock.

Subsequently, at more advanced stages of economic development the relation between material and energy use on the one hand and economic growth on the other hand becomes weaker. Yet, up to now there is mixed (i.e. conflicting) evidence that beyond some level of GDP per capita the intensities would go down again. This – so far – contested hypothesis is usually referred to as the Environmental Kuznets curve (Andreoni and Levinson, 2001; Kearsley and Riddel, 2009). Furthermore, with the large progress of the globalisation of the economy, there seems to be a tendency that more resource intensive industries (re)focus their growth on emerging

[12] Please not that many of the earlier mentioned studies are essentially production oriented.

economies and to some extent on advanced economies with low population densities at the fringe of larger high income areas. The latter aspect is relevant for various Nordic countries, Canada and Australia. However, in this context Latin-America provides important (and competitive) opportunities as well. The overall effect of the internationalisation of product chains implies that it gets less meaningful to assess only the relation between GDP and energy, material and emissions, hence the rising interest in sustainable consumption. For the same reason there is arising a set of literature pointing at benefits of applying (also) consumption based emission accounting for country reports for the UNFCCC (Hertwich and Peters, 2009; Peters, 2008).

All in all the bottom-line is that at more advanced stages of economic growth there seems to be more leeway for trying to achieve an economy with low energy, material and emission intensities. Such an aim will however require particular policies, will come at some price (e.g. of gradually loosing some sectors) and may face extra set-backs due to climatic and/or geophysical conditions. This indicative information provides some clue as to the question what can be done when the recovery from the crisis sets in and is enhanced by policies. As regards the development of environmental indicators during and directly after a crisis we will resort to statistics ranging mostly from 1990~1995 to 2008~2009 and sometimes starting already earlier in 1970 or 1975.

4.2 Greenhouse gas emission levels

The economic crisis reduces industrial production and thereby industrial energy consumption and the consumption of raw materials. As a consequence also goods transport diminishes. Since households may experience income reductions or at least are less optimistic about their future income, the purchase of domestic appliances and other devices is stalling. All in all, notably electricity and transport fuel consumption will decline. Depending on the generation mix of electricity, the consequent reduction in greenhouse gas emissions can be substantial, e.g. Finnish greenhouse gas emissions have probably decreased by about 10% in 2008. Also in Norway, the emissions are estimated to diminish by about 2% in 2008. For other Nordic countries no information could be found for 2008 at the moment of writing.

The economic crisis will make it easier for EU countries to achieve their Kyoto targets (figure 10). An assessment of the evolution of GDP-emission elasticities enables us to make a projection about the likely achievement of the reduction targets (ignoring the acquisition of emission rights via CDM and JI). The GDP-emission elasticities vary considerably over time and between countries[13]. This means that the emission target relaxation effect of the crisis varies strongly across countries (the two lines in figure 10). Even

[13] This shows in due course the so far modest to moderate extent of decoupling achieved in most OECD countries.

before the crisis (2007) Sweden seemed to achieve its target with a rather high likelihood. Now it may even become a surplus country. Denmark and Finland, on the other hand, were in more challenging positions before the crisis (2007), with a shortfall looming in the absence of extra efforts or the use of flexible mechanisms. The effect of the crisis has made target achievement easier, in particular for Finland.

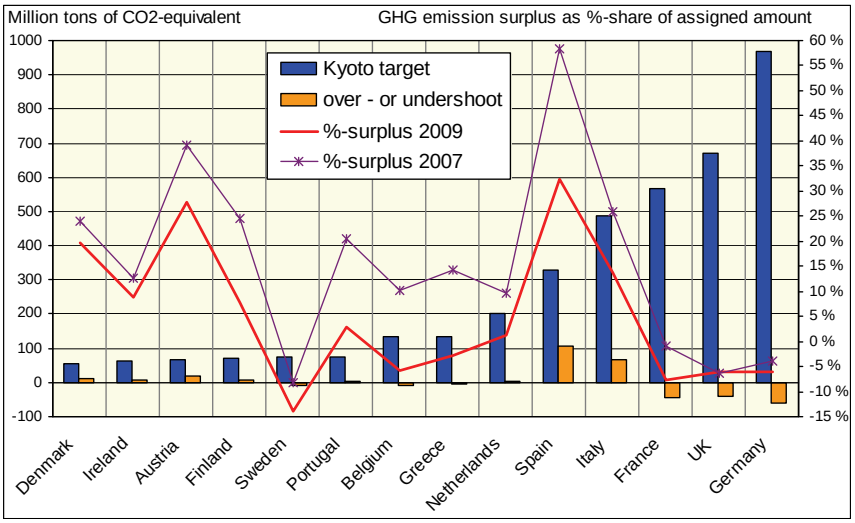

Figure 10. Assigned amounts and estimated over – or undershoot of national Kyoto targets based the situations in 2007 and 2009 respectively using GDP-emission elasticities and observed and expected GDP growth rates
The bars represent the total assigned amounts and the expected over- or undershoot per country for the 1st Kyoto commitment period (left scale). The lines link the estimated surplus (emissions above assigned amount) per country as % of the assigned amount, based on old (2007, pre-crisis) and new (2009) data (right scale).

Source: VATT / Eurostat

Thanks to closely monitored EU-ETS registries a quite reliable impression can be obtained of the changes in emission levels in the sectors participating in EU-ETS (electricity, district heat, oil refinery, industrial CHP, building materials, iron and steel, basic chemicals, paper; figure 11). The Finnish and Danish ETS sectors show remarkable reductions in CO_2 emission levels after a peak in 2006, whereas the Swedish EU-ETS sectors do not show a particular trend. The peak in 2006 can be related to the then ETS price collapse, which made coal an attractive energy source for fossil fuel power stations

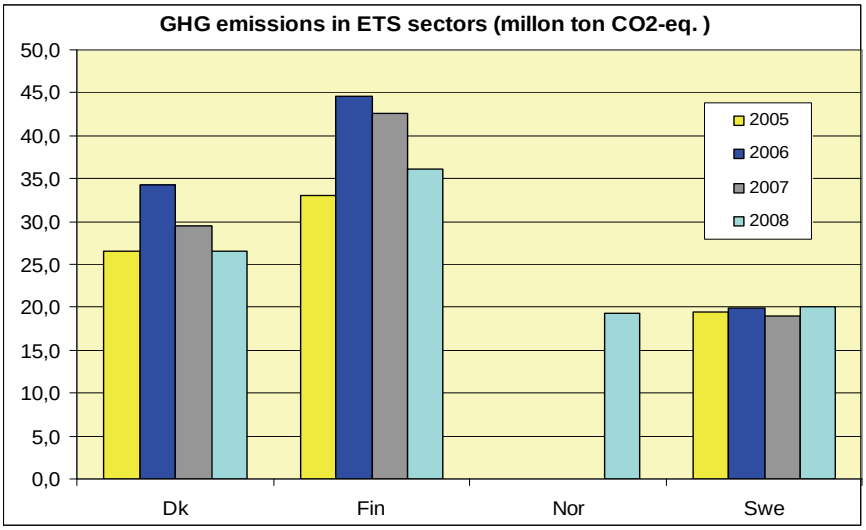

Figure 11. Carbon dioxide emission development from 2005 to 2008 in Nordic Countries for the industrial sectors in EU- ETS

Source: VATT / EEA (based on official registry)

Less pressure on the EU-ETS market due to reduced industrial output meant a drop in EU-ETS prices (figure 12). Fortunately, the prices stay at a level which has still some significance with respect to the choice between coal and natural gas for fossil fuel power stations. What will happen to the emission levels in EU-ETS is hard to say, because EU-ETS interacts with various markets, such power markets, natural gas and coal markets, and is also weather dependent (hydro reserves, temperatures) (figure 13). Furthermore, electricity companies (the dominant client group in EU-ETS) have different strategies, which may affect their responses to price changes differently. For example, the drop in coal prices and EU-ETS prices has incited power companies to swap from gas to coal (19 % more coal use in Finland as compared to 2008), also because hydro power was at normal and not abundant levels in the Nordpool area (Statistics Finland, 2009).

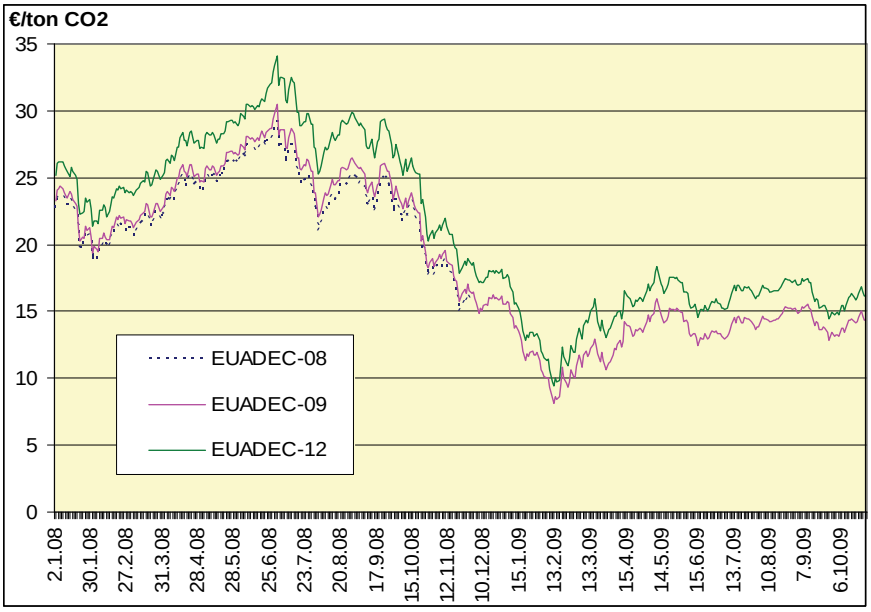

Figure 12. EU-ETS price development of emission rights to be surrendered in December 2008, December 2009, and December 2012 since the beginning of the second trading period (= 1st Kyoto period).

Source: Nordpool

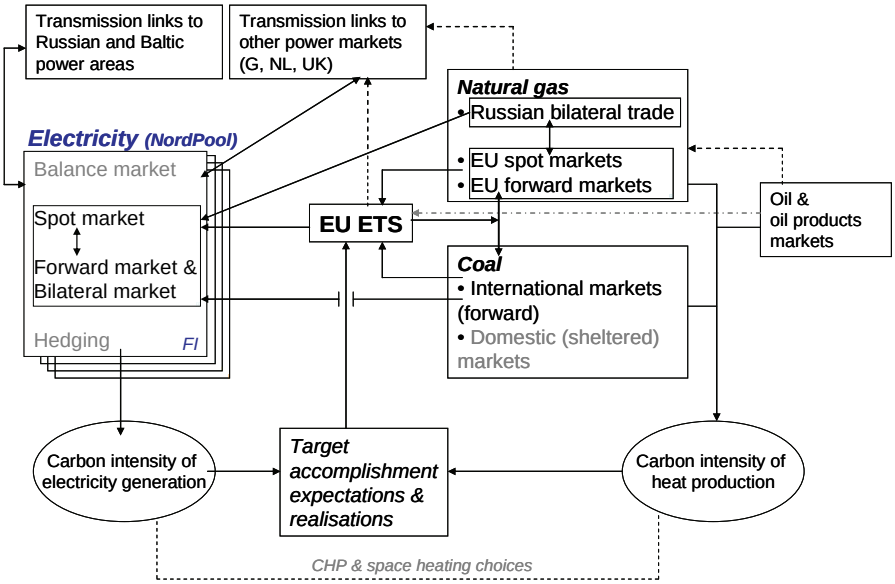

Figure 13. Direct and indirect linkages between electricity markets (Nordpool), fossil fuel markets and EU-ETS

(Source: adapted from Honkatukia et al, 2007)

4.3 Other environmental effects in the current crisis and before

Other emissions related to fossil fuel energy use and/or biomass use may have diminished as well. For example, in line with the reduction of industrial output, the volume of goods traffic declined as well. This would mean that the emission of small particles diminished to some extent. On the other hand, if households decide to use more own firewood to save on energy costs, emissions of small particles may rise significantly.

Various other emissions, related to eutrophication, are to a very large extent caused by agricultural production, even though energy and transport play a role as well. Due to the strong relation with the food chain, it can be expected that these emission levels have declined much less than energy use related greenhouse gas emissions. Traffic noise has probably declined as well, albeit marginally.

Figure 14 provides an overview of a compound indicator for acidifying emissions in four Nordic countries since 1995. For all countries steady decreases dominate with a few years with small hiccoughs in Finland (2003 and 2006), which are related to a significant upswing in coal use in power stations. In absolute terms Denmark is the largest emitter, while it has the smallest land surface area, thereby hinting at fairly high loads per km^2. The smaller crisis related to the bursting of the dot-com bubble is not noticeable in the data series.

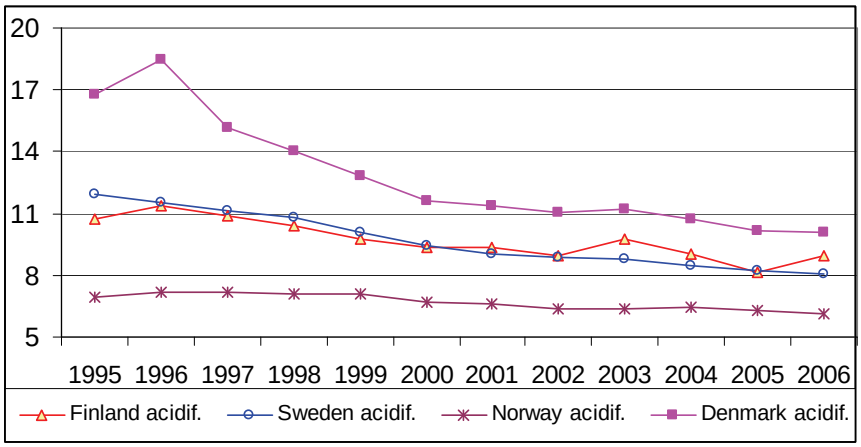

Figure 14 Acidifying emissions in the Nordic countries except Iceland (1000 tons of acidifying equivalents based on SO2, NOx and NH3 emissions).

Source Eurostat 2009

A further review of data by country and by main source of acidifying emission (SO_2, NO_x and NH_3) shows that for these emissions a decoupling from the development of GDP is by and large realised. Ammonia emissions (NH_3) seem to have diminished in most countries, albeit to varying extent. On the other hand emissions of nitrogen oxides (NO_x) and sulphur dioxide (SO_2) show fluctuations, but are usually barely lower in recent years as com-

pared to 1990. In Denmark these emissions show even a rising trend, notably after the year 2000. This is probably the combined result of a common Nordic electricity market, EU-ETS and other domestic energy policy decisions leading to an alternating level of attractiveness to use coal.

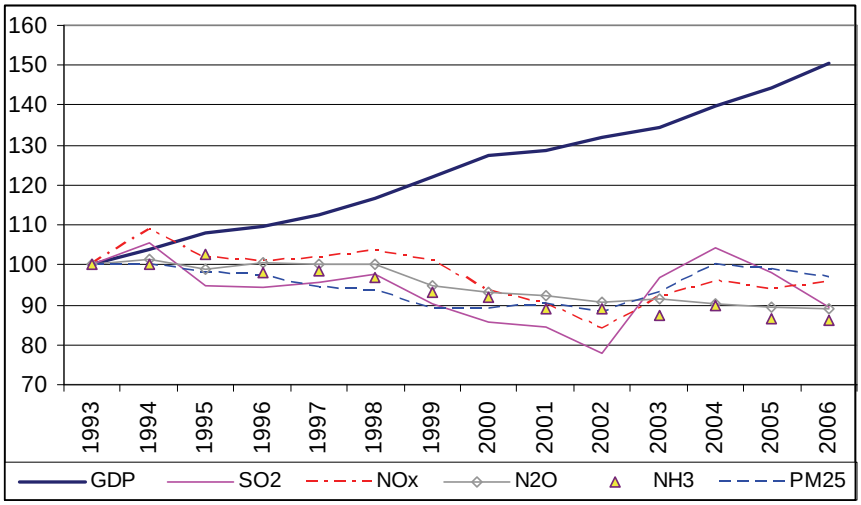

Figure 15. GDP and key emission indexes for Sweden 1993–2006 (1993 level = 100).

Source: Statistics Sweden

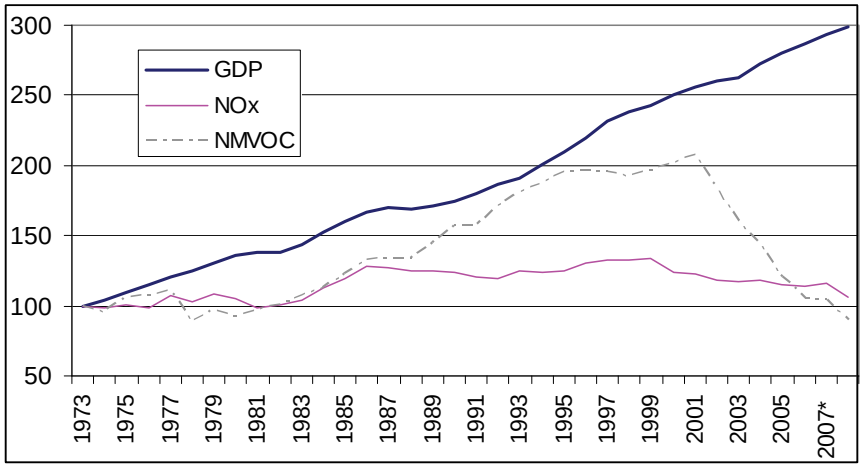

Figure 16. GDP and selected emission indexes for Norway 1973–2008 (1973 level = 100).

Source: Statistics Norway

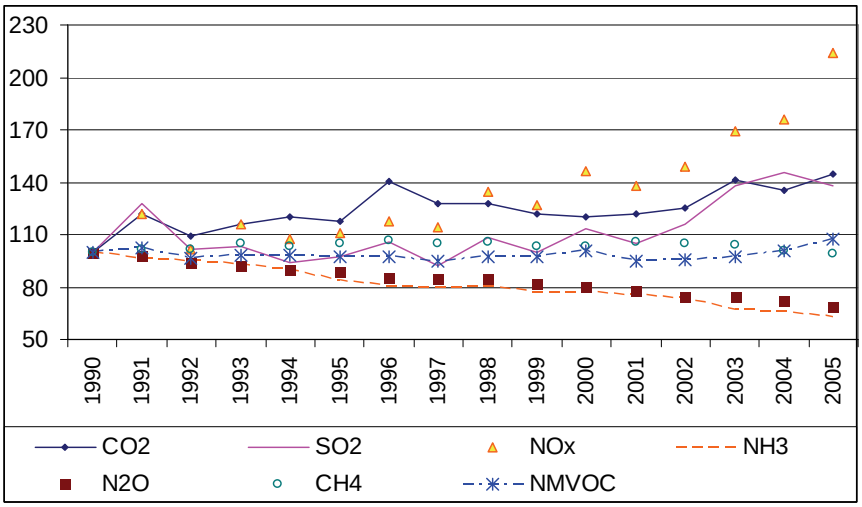

Figure 17. Selected emission indexes for Denmark 1990–2005 (1990 level = 100).

Source: Statistics Denmark

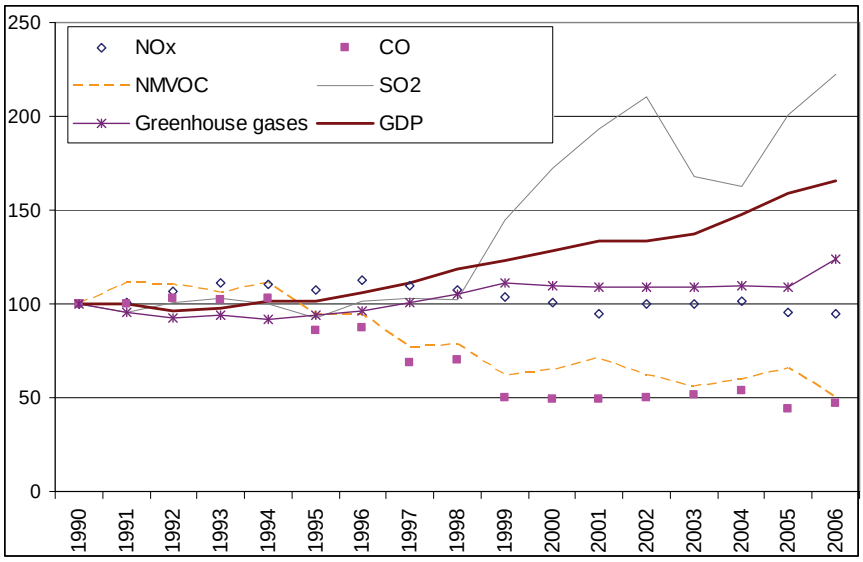

Figure 18. Selected emission indexes for Iceland 1990–2006 (1990 level = 100).

Source Statistics Iceland

Figures 19 and 20 summarise some other environmental effects. Nordic countries report quite different levels of urban waste per capita even though their purchasing power differences are not that big. Furthermore, there does not seem to be any clear decoupling between GDP and urban waste. In terms of a multi-year moving average both show an upward trend.

As regards trends and levels of energy intensity (in relation to GDP) the Nordic countries can be subdivided in three groupings, Scandinavia, Finland, and Iceland. The latter two have higher levels and show less (Finland) or no (Iceland) convergence towards the Nordic average. Please notice in this respect that end-use prices are in general lower in Iceland and Finland as compared to Sweden and Denmark. In Norway prices are low as well, but the intensity indicator seems low due to the high level of GDP.

Summarising, it seems that some degree of decoupling between energy end-use and GDP development is taking place, notably in Sweden and Denmark, but as yet no far reaching level of decoupling has been reached. The latter is necessary in the light of the long term greenhouse gas reduction targets.

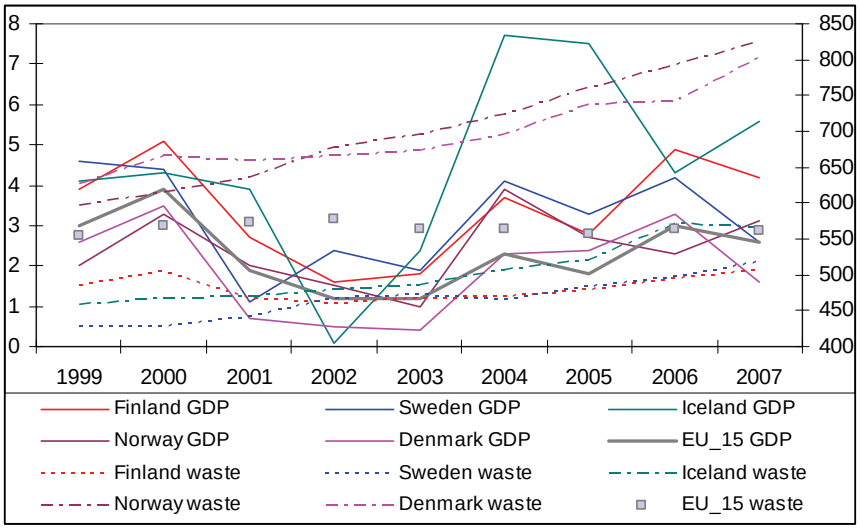

Figure 19. Development of urban waste per capita (in kg; right hand y-axis) and of GDP growth (in % per year; left hand axis) in the Nordic countries and the EU-15 area.

Source Eurostat

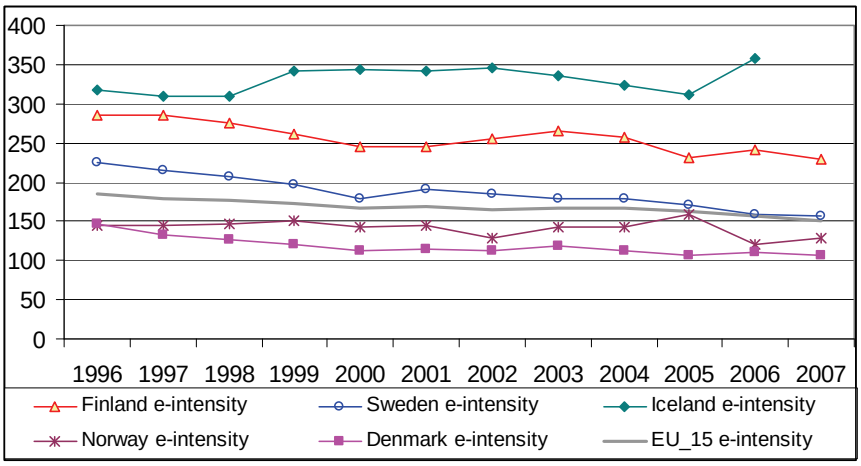

Figure 20. The energy intensity (in relation to GDP) of the Nordic countries and EU-15 (koe/1000 euro).

Source: Eurostat

All in all decoupling of greenhouse gas emissions from GDP development has still to make quite some progress, amongst others by increased decoupling of energy intensity from GDP. Furthermore, there are some hints with respect to possible unintended side effects of current climate policy arrangements on other environmental issues, such as acidifying emissions. Even the creation of urban waste, apart from its own problems, can be regarded as inefficient use of materials, which among others often (but not

always) contributes to higher greenhouse gas emissions. Furthermore, efficient material use and increased recycling provide also other environmental benefits and attenuate problems of various ever scarcer raw materials.

4.4 Long term effects

The long term effects of the crisis on the environment work via the renewal of the capital stock and to some extent via behavioural changes incited by the crises or by policy changes during and after the crisis. In addition a long term effect of bigger crisis is often structural change, which not only entails radical changes in the renewal of the capital stock, but usually also changes in institutions.

Dramatically changed perspectives

Prior to the economic crisis, energy consumption was expected to rise rapidly and precipitate climate change. According to the 2008 projections by the US department of energy (DOE), global energy consumption was expected to rise by 22 % between 2005 and 2015, of which 90 % was expected to come from fossil fuels – oil, coal, and natural gas. According to Suni, (Suhdanne 2009:2, p.36) the 2008 peak in crude oil prices resulted from long term expectations of oil scarcity.

Due to high oil and energy prices, as well as climate negotiations, many governments, energy firms and venture capitalists had announced plans to invest large amounts on developing alternative fuels, wind and solar power. Given the committed emission reductions up to 2020 the IEA World Energy Outlook 2009 (OECD/IEA, 2009) projects for the European Union[14] an investment need for abatement efforts of about 500 billion US dollar (at 2008 exchange rates). Translating this to the Nordic countries the aggregate additional effort level between 2010 and 2020 would be about 35~40 billion US dollar, that is somewhat less than 3 billion euro per year. However, according to Ecofys (2009a) the economic slump will make it significantly easier to achieve the 2020 targets in the overall EU-ETS system than originally planned. In absolute terms the needed reduction effort would diminish by approx. 250 megaton CO_2 equivalent annually, whereas the possibilities to buy attractively priced certified emission rights from CDM and JI projects remains (at least) the same. As a consequence the incentive to invest in abatement inside the EU-ETS sector reduces significantly. Furthermore, both EU-ETS and non-EU-ETS sectors are committed to targets for renewables and energy saving, which *on balance* seems to further reduce remaining abatement investment needs within EU-ETS sectors.

[14] In fact the overall scenario simulation is based on a 450 ppm target, but for the EU up to 2020 this is practically equaled to the 20-20-20 agreement.

As regards the electric power sector a reduced need for extra abatement investments does not equal a reduced need for investment in new (replacement) capacity. Both in Nordic countries and elsewhere older vintages of generation capacity will have to be replaced (ignoring life span expansion for the moment). Even if coal and natural gas prices recover in the next few years, the price of emission rights will probably remain for a longer time below 20 euro/ton CO_2-eq. (given the current commitments up to 2020). In turn this may affect the needed level of subsidies implied by feed-in tariffs, whereas also the interest to invest in carbon capture and sequestration may get tuned downward. All in all without extra policy efforts uncertainties regarding the competitiveness of renewable and low-emission options seem to grow.

Another consequence of the above pictured possible developments up to 2020 is that diminished efforts to promote innovative solutions inside the EU could affect the pace of technology transfer to non-Annex 1 countries, especially after 2020. This also points at the significance of keeping up R&D efforts with respect to abatement technology and solutions.

Economic growth and emissions

Projections for the next few years show mostly rather modest growth rates for most Western-European countries, varying between 0.5% and 2% for the next two years (European Commission 2009). Economic crises linked to bank crises also tend to last longer than the average crisis (IMF, 2009). As regards the Nordic countries Iceland may be expected to show stronger recovery, because the shock was very heavy to begin with, and even this has some provisos with respect to monetary and fiscal settlements.

Even though the relation between economic growth and emissions of greenhouse gases and other substances has tended to relax in recent years, i.e. a relative decoupling, most countries have not shown decisive decoupling of greenhouse gas emissions and economic growth (section 4.2; Ecofys 2009c). The past achievements of Germany and the UK are to a significant extent based on massive fuel switch from coal to natural gas and other fuels, replacement of outdated power stations, some renewables and refurbishment of a dilapidated building stock (the UK). When this so-called low hanging fruit is utilised the GDP-greenhouse gas emission elasticities may return to "normal" levels, unless emission abatement investments are stepped up. So far, of the EU countries (and the Nordic countries) Sweden may have gotten closest to structural decoupling.

In case of absence of further strengthening of climate policies at global and EU level the Nordic countries would probably match weak economic growth with approximately stable or slightly increasing emissions. Yet, the internal EU agreement for 2020 obliges member states to continue emission reduction after 2012. An uncertain factor remains the weather. A relatively

cold year can boost heating demand[15], whereas exceptionally abundant or scant precipitation in autumn and winter has a major impact on the use of fossil fuelled power stations in the Nordic electricity market (Gabrielsen, 2005; Bye et al 2006).

Weak economic growth in conjunction with restrained credit markets will imply postponement of investment in new energy conversion capacity. In the previous section the rising financial uncertainties of renewable energy capacity were highlighted. For these reasons as regards replacement investments there will be a rising interest to prolong the lifetime of older capital stock. This would mean that the GDP-emission elasticity decreases at a slower pace than in the pre-crisis situation. Even though prices of primary energy products (oil, coal, natural gas) have rebounded already to some extent due to resumption of growth in Asia, achievement of new price peaks will take probably take a bit more time, even though new peaks are definitely possible prior to 2020. Therefore, without further policies and with tighter credit, energy efficiency investments would also tend to slow down, and consequently once again the GDP-emission elasticity would decrease at an even lower pace than in the pre-crisis baseline.

There are however a few counter effects, thanks to which emissions might still diminish more than in a default – post-crisis – baseline. One effect is precipitated changes in economic structure and the other climate policy.

Economic and societal structure

As regards the Nordic countries the economic crisis seems to have hit relatively hard in the basic – energy intensive – industries, such as paper, steel[16], and chemicals. The growth perspectives of these industries are outside Western-Europe, predominantly in Asia and to a lesser extent also in Latin-America. The slump in demand exacerbates underutilisation problems and hence tends to precipitate closure of (economically) marginal capacity in Europe and North America. In this context should also be realised that the tighter credit markets will put more pressure on capital productivity and lower risks. This would mean that industries and services with less upfront cost for physical capital have an advantage over traditional capital-intensive industries. This again contributes to precipitated closure of economically marginal production capacity in heavy industry. The paper industry is already showing clear signs of such a development and the passenger car industry seems to follow suit. As a consequence the development of industrial energy consumption can be expected to be less ambitious or even result in a decrease. The new projections for electricity consumption in Finland (MLE, 2009b) are also based on this kind of insights. All in all it would also mean

[15] The ever more abounding air-to-air heat pumps can also be used as air-conditioners in case of higher summer temperatures. Depending on emerging habits this may ignite growing summer cooling demand.

[16] For other metals, low electricity cost may still be a sufficiently decisive factor to continue production in Nordic countries. Iceland may attract even new capacity, either from other Nordic countries and/or from elsewhere.

that emissions grow less than in the baseline referred to above. The changes described here are examples of the more hidden versions of (carbon) leakage phenomena mentioned on pages 30/31 and 40.

If countries wish to get less vulnerable to (external) shocks they can pursue various options. One is to get less dependent on too few export markets (geographical diversification) and less dependent on key import goods (e.g. oil and other energy carriers) by either more indigenous energy supply[17] and/or a more diverse energy supply portfolio. Another option is to diversify the economic structure, e.g. in terms of distribution over sectors and/or as regards size distribution of firms. These various types of diversification may be expected to occur at least to some extent in Nordic countries, if only because some large firms in traditional large sectors are diminishing their activities in Nordic countries. Furthermore, this trend may be to some extent promoted via innovation policies aimed at the development of sectors that are less prone to cost competition and emulation from upcoming economies in Asia. For example, sectors with high creativity and design contents. This may suit a credit constrained world, while being reconcilable with environmental policies regarding climate, eco-efficiency and overall sustainable development. In short, it would mean activities that have lower (or downright low) physical capital intensities, high or higher human/social capital intensities and require moderate to low energy and material throughput. Next to typical examples as design, art, furniture and music, such activities may include computer games, simulations and services (e.g. personalised monitoring and feedback services) and the transformation of the forest sector into a wood construction & design sector.

Structural changes also concerns demographics, i.e. age structure and household compositions, and spatial structure (land use and infrastructure). An ageing population may imply less upward pressure on emissions, but that is unsure. For example, active seniors may travel as much as people in the employable age. Furthermore, there are steadily more incentives installed to reduce early retirement. In all Nordic countries the living space per capita has continued and is expected to continue to rise. One reason for this is the reduction in average household size. In addition, affordable and spacious housing is a broadly shared wish in the population. Yet, its realisation has meant and often still means urban sprawl. In turn, urban sprawl tends to raise energy use and emission level per capita. If we wish to reduce urban sprawl, than land use policies, real estate taxation and infrastructure access pricing may have to be reconsidered. Hence these themes could be included in tax reforms which diminish the incentive to swap higher house prices for more transportation cost by moving to the urban fringe. Such policy needs caution, as there are many complications possible (Perrels, 2008a; Perrels, 2010). The cautions concern for example that new instruments such as congestion pricing should be accompanied by improvements in the public trans-

[17] Indirectly also (selective) energy saving can serve this purpose, i.e by saving particularly on imort fuels.

port system, well co-ordinated regional land-use and housing policies, and prevention of intercommunal competition for business (re)settlements within the region. Nevertheless, the London and Stockholm road pricing schemes show that adequate policy designs are possible (Santos and Fraser, 2006; Eliasson et al, 2009).

A more eco-efficient use of the built-environment would entail land use and transport policies (less urban sprawl, better access to public transport, promoting non-motorised modes), as well as energy policies (low energy housing, integrating distributed resources). At the spatial side fiscal incentive structures may have to be changed, possibly alongside increased investments and outlays for public transport (which would be difficult given the budget constraints). As regards the energy infrastructure the challenges have to do with realigning investments. Since energy supply is an increasing marginal cost industry it does not need continued support like public transport. Yet, the balance within the overall amount of investments between energy supply and energy demand (including energy saving, local storage/buffering, integrated solutions) needs some redressing from the supply to the demand side (e.g. Lechtenböhmer et al, 2007). So far, no truly satisfactory instrument portfolio has been found to promote such changes. In some cases change is promoted, but with instruments that may be not very efficient from an economic point of view. In other cases, economic efficiency prevails, but at the expense of the pace of change. Possibly, under certain conditions so-called white certificate systems may be a move in the right direction (Labanca and Perrels, 2008; Perrels 2008b).

Reconciling sustainability requirements

Just as structural changes will occur, policies will not be frozen. Therefore there will be still room for emission reduction thanks to new and reinforced policy measures. For a start, the EU 20-20-20 deal commits Denmark, Sweden and Finland to further actions as regards emission trade (EU-ETS), the emissions of non-ETS sectors and energy efficiency efforts. Depending on the eventual follow-up agreement of the Kyoto Protocol, the emission target of the internal EU deal may be further tightened, if next to Annex 1 countries also a substantial share of developing countries, including the large ones, would agree with some kind of commitment. As mentioned earlier the economic slump will make it significantly easier to achieve the 2020 targets in the EU (as a whole). This also points at the significance of keeping up R&D efforts with respect to abatement technology and solutions. Also sufficient options for demonstration projects is important in this respect, especially as credit will be tighter than earlier, proven technology will face lower risk premiums than innovations.

The need to maintain or rather raise fiscal revenues could be combined with a “greening” of the tax system and the abolishment or reform of envi-

ronmentally harmful subsidies. In this way a more straightforward framework can be created for abatement investments.

Another EU initiative which will affect eco-efficiency efforts in Nordic countries is the Communication on Green Public Procurement as part of the package of measures in the Sustainable Production and Consumption and Sustainable Industrial Policy Action Plan. Member States are obliged to put up a programme, which contains also quantitative guidelines and targets. It means that the public sector should set examples with respect to the eco-efficiency of its operations. A positive spin-off of this policy can be that it creates sufficiently safe markets for eco-efficient products (e.g. in the building sector), whereas it puts also a minimum demand level in the market, thereby enabling reductions of unit cost (e.g. Borg et al, 2006). Similarly the EU directive on product labelling will to some extent promote product development with more emphasis on eco-efficiency.

Also the Nordic countries will somehow have to reconcile a set of partly conflicting demands and challenges in their government policies. Without claiming to be exhaustive the following main factors can be mentioned:

- reducing national debts, while trying to safeguard purchasing power
- the ageing of the society and other demographics
- climate change mitigation efforts (domestic + international)
- climate change adaptation efforts (domestic + international)
- realigning the energy system (less vulnerable to international and domestic shocks; cleaner; more linkages with the demand side)
- agriculture, fisheries, forest sector and regional equity
- other environmental efforts:
  a) eutrophication and the Baltic Sea
  b) biodiversity

The first issue entails changes in fiscal policies as already mentioned earlier. It may also be expected that policy measures with limited direct budgetary burden (both for the public and the private sector) are favoured. In this respect new informational instruments that facilitate (almost) real time and tailored monitoring and feedback (i.e. smart metering, carbon footprinting, etc.) may be expected to gain ground. This kind of facilities also fit well in a broader process of sustainable transition and transition management (see below).

The ageing of society will create extra cost regarding care and basic income support. Even though future cohorts of pensioners will be on average wealthier, the cost for the public sector will nevertheless go up. Possibly also in this realm technical and social innovations may provide better solutions than the current strong emphasis on cost-efficiency. As regards the ageing of society and health cost, climate change and appropriate adaptation may have a significant effect on the care needs of elderly (Hassi and Rytkönen, 2005). Less very cold days diminishes mortality among the elderly.

On the other hand, an increased occurrence of slippery roads and sidewalks will raise health risks and hence costs for the elderly. Furthermore, the tendency that winters get less severe increases the risks of spreading of diseases from Western-Europe into the Nordic countries.

Domestic climate change efforts have already been discussed before. Yet, the success of a post-Kyoto deal depends also on the willingness of OECD countries, including Nordic countries, to provide financial support to technology transfer, capacity building and various adaptation measures to developing countries. One way or the other, this will entail a larger claim on national public budgets in Nordic countries[18]. This in turn however, interacts with the extent to which flexible mechanisms will be used or promoted by the governments in Nordic countries. More integrated approaches of mitigation and adaptation are also becoming more topical and will complicate climate policy implementation programmes. In the short run, however, this still requires abundant research.

For various reasons, security of supply has become a prominent issue in recent energy policy. There are political-economic reasons to become less dependent on fossil fuel imports. Furthermore, integrated climate policy scenario assessments often indicate that more localised production and/or integration of supply and demand technology (e.g. at building level) simultaneously contribute to emission reduction, lower outage vulnerability, and lower import dependency. The current energy systems, especially electricity and district heat, tend to be rather centralised, even though some tendency towards decentralisation is visible in Nordic countries, notably Denmark and Sweden. As such investment levels may not be the main problem in the energy sector, but the allocation of investments with respect to decentralised and integrated options could be (see also page 53 and Lechtenböhmer et al, 2007). If governments wish to see certain changes, e.g. because of its overall climate and sustainable development policies, incentives have to be put in place to achieve the new allocation of investments. In this case incentives could mean mainly changed regulation in the energy sector and not necessarily a lot of fiscal stimuli. Also with respect to this issue R&D efforts should be kept at certain levels.

With respect to sustainable development there are also some voices pledging for more fundamental reconsideration of the need and structure of economic growth (Jackson, 2005). This would mean that future growth of welfare consists less of growth of material wealth and more of immaterial welfare. So far this deliberation is largely academic or philosophic, even though politicians and high level officials have been referring to it occasionally. Nevertheless, this approach may contribute to solving the political dilemma of combining financial and ecological sustainability. Present day social-economic politics works with the implicit assumption that purchasing power grows for most citizens and should not (systematically) decline for

[18] The UNFCCC COP15 did agree on an international fund for financial support for adaptation in developing countries.

remaining groups. Since household consumption is eventually a large driver of environmental degradation, less emphasis on material wealth could be of great help to effectively promote a sustainable transition and to achieve long term climate policy targets. Among other things, this requires that the pace of innovation does not decelerate. These kind of broad based changes are often referred to as *sustainable transition*, around which a body of theory regarding transition management is emerging, see e.g. Fischer-Kowalski and Rotmans (2009), Bergmann et al (2008). For example in Sweden it is studied and experimented by the Stockholm Environment Institute (e.g. EPIGOV http://ecologic.eu/projekte/epigov/).

Interlink ages between global financial stability and environmental sustainability have been studied to some extent (Erdmann, 2009). This also links to discussions about global taxes of financial transactions[19]. Under certain conditions, such taxes have some capability to reduce volatility in financial markets (Kaiser et al, 2007), whereas the revenues could be used to invest in timely realisation of sustainable energy extraction or conversion capacity in developing countries and/or in climate change adaptation in those countries. The funding of these international commitments remains so far haphazard (cf. the flimsy deal on this issue in COP15). This kind of mechanism would make the funding more predictable and relieve the public finances of OECD countries. There should however, be more empirical assessment of the asserted volatility reducing effects of such schemes, before any serious discussion could sensibly start about some kind of global application. Furthermore, there are circulating also many other ideas with respect to international funding mitigation and adaptation efforts in developing countries.

4.5 Summary

The immediate effect of a serious economic crisis, such as the Nordic countries have been experiencing recently, is a reduction of most environmentally harmful emissions. The reduction depends on the structure of the economy and on the primary energy mix, notably with respect to electricity generation. The reduction in global energy demand caused a reduction in fossil fuel prices, whereas also prices of carbon emission rights in the European Emission Trade System (EU-ETS) decreased as a result of lowered projections of overall emissions in the near term future within that system. As a consequence the use of coal in electricity generation has started to increase, thereby partly offsetting the original reduction in greenhouse gas emissions. The Nordic countries that take part in EU-ETS are expected to fulfil their reduction obligations for the period 2008–2012 more easily, e.g. with re-

[19] These are often referred to as "Tobin tax', even Tobin's original idea only refers to one option amongst many.

duced or not any need to buy emission rights from other EU countries or from CDM and JI projects.

In as far as available data allow the drawing of conclusions it seems that other emissions (such as related to acidification and eutrophication) show less sensitivity to the economic crisis. This is partly attributable to activities such as food production of which the physical volumes depend much less on economic cycles. Another reason is the extent to which various emissions are regulated by well established policy frameworks, which are well internalised in business decision making and production technology.

The long term objective of environmental policies, embodied by sustainable transition, is so-called *decoupling* of emissions from economic development, i.e. emissions can decrease or stay low irrespective economic growth rates. Some of the emission trends, e.g. acidifying emissions outside the agricultural sector, suggest a quite far reaching decoupling from GDP developments. On the other hand carbon dioxide emissions, some emissions from agriculture, and urban waste volumes show as yet no clear signs of decisive decoupling from GDP developments.

The depth of the crisis may turn out to be large enough to even ease the efforts needed for the combined so-called EU 20/20/20 targets for 2020. In conjunction with expected tightening of public finances and capital markets in general this easing effect could result in a slowdown of a sustainable transition in the Nordic countries as well in Europe overall, unless environmental policies and the greening of the fiscal policies are emphasized sufficiently.

5. Environmental innovation and structural change

5.1 Nordic leadership in green technologies

Nordic countries have strong positions in a fairly broadly selection of environmental technologies (Nordic Globalisation Barometer 2009). Denmark enjoys the largest eco-industry in terms of share of GDP, while in Finland this cluster expanded by 54 % in the period 1999–2004. Sweden and Denmark perform high in pollution abatement, waste water treatment and solid waste management & recycling industries. In 2004, the main Nordic eco-industry export fields were other environmental equipment, air pollution control, and water pollution control.

Yet, when it comes to future prospects and innovative strength of the Nordic countries both favourable and less favourable aspects are identified (Nordic Globalisation Barometer 2009; Nordic Innovation Monitor 2009). Summarising, one could say that overall Nordic countries rate often quite high in terms of input (expenditures, human resources, ICT infrastructure) for R&D and innovation, but show mixed and partly even rather modest ratings when it comes to result and commercialisation oriented indicators (coherent and strategic accumulation of knowledge, entrepreneurship and expansion, venture capital).

Eco industries have been defined as “activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. That includes technologies, products and services that reduce environmental risk and minimize pollution and resources.” (The European Commission and the OECD in Nordic Globalization Barometer 2009, p.45).

- Principal international environmental challenges are:
- mitigation of and adaptation to climate change
- deterioration of bio-diversity
- eutrophication
- exhaustion and/or pollution of sweet water sources
- urban air quality
- spread of new alien chemicals in all kinds of eco-systems
- acidification (soil, forests, oceans)
- large scale erosion of (fertile) soil

For the Nordic countries themselves the challenges 1–3 and 5–7 are of direct importance, with climate change and eutrophication (the Baltic Sea) proba-

bly having the highest priority. However, via the globalisation of the world economy and spatial reorientation of economic sectors (see section 4.4 page 49/50) the same and the other problems (no. 4, 8) aggravate in particular in developing countries. In as far as restructuring is inevitable it would need to be accompanied by a transfer of green technology to minimise the negative environmental effects.

From the perspective of technological innovation and export potential the above mentioned issues are at quite different stages of development. As regards climate mitigation (involving energy saving, renewable energy, carbon capture & storage, nuclear power, sustainable forestry and agriculture, soil management, sustainable transport, material flow management and recycling, and behavioural change) there is a lot of potential for innovations and the Nordic countries have strong positions in various sub-fields (see below). Biodiversity is still very much in a stage of basic research, whereas proposed measures have often to do with land use planning and much less with technological innovations. On the other hand the technology and governance solutions to contain eutrophication are well known and hence application and export of these do not so much depend on innovation as on strong political support at a national and at the level of all Baltic Sea states together. There will be also domestic and international market options for Nordic countries regarding urban air quality (e.g. monitoring systems and clean incineration and boiler technology). Also with respect to the detection and assessment of new alien chemicals as well as with respect to finding safer alternatives there are good possibilities for Nordic countries. Also the presence of the European Environment Agency (EEA) in Copenhagen and the European Chemical Agency (ECHA) in Helsinki should be of help in profiling the region as being in the forefront of green technology development.

For many of the mentioned application areas Nordic countries have to compete with industries from other countries (notably Western-Europe, North-America, and Japan), which means that a continued strong R&D effort will be necessary to keep up with competitors. Furthermore, for many industries successful export of innovations will only abound after some stage of "proven technology" has been achieved. To this end domestic demonstration projects can be great assistance because capital providers tend to have a systematically more cautious assessment of the cost-effectiveness of new technologies than the technology providers and technology specialists (Dixon, 1998). Considering the increased caution among capital providers in and after the current crisis this demonstration aspect probably even gains importance.

Notwithstanding the various provisos mentioned above the Nordic countries (or rather varying subset of them depending on the sector) seem to have strong positions in the following applications areas[20] (with special reference to climate mitigation):

[20] Based on the Nordic Globalisation and Innovation monitors (Norden, 2009a, Norden 2009b).

- Wind energy
- Hydropower
- Geothermal energy
- Biomass (incl. forest products)
    a) Biomass production (sustainable forestry/agriculture)
    b) Biomass use (incineration, gasification, refining)
- Energy saving technology
    a) in a selection of industrial applications
    b) In residential applications / buildings – optionally in combination with localised energy conversion / storage
- ICT solutions:
    a) Smart energy metering etc.
    b) Monitoring and feedback …
    c) Other measurement / monitoring systems
- Recycling
- Waste water treatment

The above mentioned areas would need continued support for their R&D efforts and for demonstration projects. In some cases the support does not have to take the form of subsidies, but could also be promoted – among others – via green public procurement (Borg et al, 2006), so-called greening of the tax system, white certificate systems and performance standards[21]. It may also be added that the above listed application areas do *not necessarily* imply that Nordic countries have a strong position across the board. Good example of this is the building sector, where for example the Passive House concept has been strongly developed and promoted in Germany and Austria (Schnieders and Hermelink, 2006; http://www.passiv.de/index.html), even though the original idea was put forward together by a German (W. Feist) and a *Swedish* expert (B. Adamson). Another example may be found in the use of biomass. In terms of technology Nordic countries do have a truly strong position, but on the other hand for various options there are risks involved in case of overseas expansion of the technology due to wider sustainability requirements with respect to growing the biomass.

5.2 Trends in Private Venture Capital

Prior to the financial crisis, investments in clean energy grew at a record-breaking rate. In 2008, new investment in renewable energies continued to grow in the first half of the year. Investment fell by 8 % in North America and rose by 2 % in Europe. As a result, investment in 2008 grew to $155 billion worldwide, which is still four times the expenditure in 2004, but the

[21] It is fair to say that from an economic point of view performance standards are usually a less preferable option, but in some cases, when the eventual product is complex and/or split incentives play a role, they may be the only reasonable solution.

general pace of investment decelerated from 50 % growth rates to a stagnating 5 % in 2008. Initial indications for 2009 suggest that with the exception of some "green-shoots of recovery" in the latter half of the year, the total will fall far short from prior levels (UNEP et al., 2009). The decline in venture capital and private equity investment into renewables continued in the 1st quarter of 2009 (VBR, 2009).

On average, Nordic countries have attracted more venture capital than their share of European GDP, but recently they appear more vulnerable to volatility. The Nordic economies" share in venture capital dropped more drastically than that of Europe as a whole in the first half of 2008, hence the lower rating of this feature in recent economic monitors (section 5.1; Nordic Globalization Barometer 2009).

In 2008, the Norwegian NorSun AS, manufacturer of mono-crystalline silicon ingots and wafers, raised $87 million in the first quarter of 2009. The Finnish Silecs Oy raised $7.7 million in the same period to develop chemicals and coating materials for the semiconductor industry with a focus on solar cells and LED light applications. Otherwise, Nordic companies were not mentioned among the largest VC deals. Two Denmark based solar power companies received early-stage VC funding in the same period (VBR, 2009).

In comparison to many other sectors, sustainable energy sectors sustained the share price collapses of the latest economic crisis relatively well. Nevertheless stock market investments in clean energy tumbled by 51 % in 2008. The global volume of mergers and acquisitions in clean energy fell by 16 % (UNEP et al., 2009).

In 2008 at a global scale wind power received most investment, while solar power came second before biofuels. Energy efficiency, both at the supply and the demand side, came next (UNEP et al., 2009). As a result of the financial crisis, early stage investment shows the most dramatic collapse in solar energy. Wind, biomass, energy efficiency, advanced materials, green transportation, environmental services have also fallen significantly. Other renewables (incl. wave/tidal, hydro, clean coal, micro generation and geothermal) and energy storage are rather ambiguous so far (VBR, 2009). Most late stage venture capital disappeared in the first quarter of 2009, with the exception of solar power. Strong declining trends from 3rd quarter of 2008 could be observed for other renewables, energy efficiency and wind (VBR, 2009). Nevertheless, in the first quarter of 2009, solar ($38 million), energy efficiency ($10 million), energy storage ($13 million), advanced metals & technologies ($11 million), and biofuels ($12 million) enjoyed most venture capital investment (VBR, 2009).

5.3 Research and innovation performance and investment trends

Notwithstanding the more mixed picture regarding environmental technology and innovation presented in section 5.1, the Nordic countries rate quite well in overall R&D and innovation performance in comparison with many OECD countries. The amount of expenditures for research and development expressed as percentage share of GDP lies above the OECD average and well above the EU_27 average, except for Norway (Statistics Finland, situation in 2007). Sweden, Finland and Denmark belong to the EU_27 top five as regards the number of patents per capita, whereas inclusion of Japan, the USA and Canada would not alter that rating (Statistics Finland, situation in 2007). It also seems that total public funding for research has not been going down since 2008, though some levelling off might be visible (Statistics Finland).

Specific information regarding environmental investments is not easily available. Furthermore, in practice it is not easy to identify those environmental investments that are integrated in the purchases of new equipment, infrastructure or real estate. Such acquisitions have to fulfil all kinds of interacting criteria, which affect the eventual price. We give here one example of Finnish investments in emission abatement technology and clean technology (figure 21). The series show some remarkable features. Investments in emission abatement show sensitivity to economic cycles, albeit with approx. 2 years delay (e.g. the collapse of 1991/1992 and the dot.com bubble burst in 2001). Emission abatement is as such not a productive investment[22] and often takes the form of an add-on or modification of an existing installation. In case of an economic downturn a part of the installations liable for (not yet installed) abatement technology will be idling and consequently abatement investments are postponed or cancelled.

In contrast to abatement efforts the investments in clean production technology don't seem to have a straightforward relation with economic up- and downturns, presumably because in both situations there are promoting forces (e.g. attempts for radical renewal) and discouraging forces (e.g. cost minimisation) at work. No doubt a part of the expansionary investments will be postponed or cancelled, but a good part of the replacement investments will be continued, even though there will be attempts to cut costs (e.g. by relaxing environmental performance of the new equipment). During the period 2003–2006 the investments in clean production technology stayed surprisingly low. Probably this has to do with structural changes in the heavy industry, but it would require a close investigation of various statistics to clarify the reasons.

[22] Environmental policy can create a market environment in which it becomes productive, if less clean options become subject to extra costs (e.g. due to taxation) and leakage to foreign countries is not a serious problem. Yet, even under those circumstances investments in actual production capacity have usually much higher pay-back times.

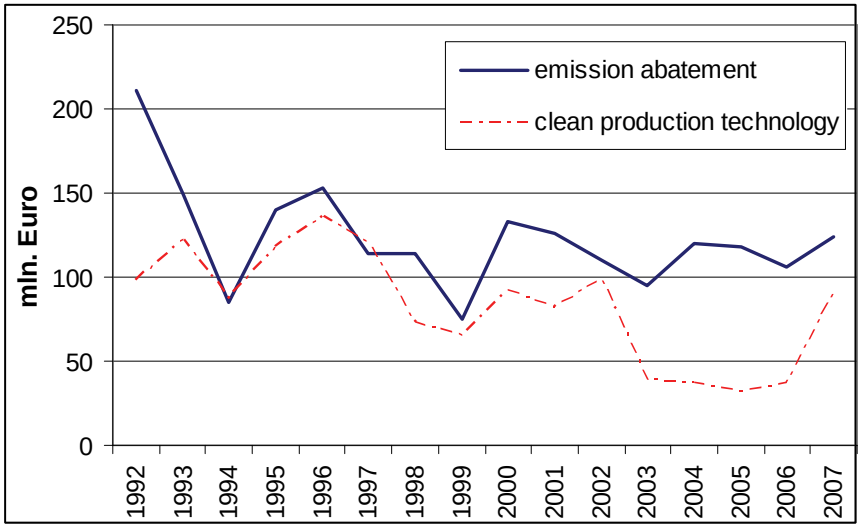

Figure 21. Investments by industries in emission abatement and clean production technology in Finland

Overall investments (gross fixed capital formation) in Nordic countries (figure 22) followed the same cycle as for the EU_15 average in the past decade. Iceland is an exception due to its strong expansion during the last decade. However the Swedish and Finnish levels (expressed as percentage share of GDP) tend to be lower than the EU_15 average, probably owing to the structural change which implies a shift in emphasis to less capital intensive activities. The difference with the EU_15 average is diminishing over time, which suggests that the structural change has been progressing significantly. The effect of structural change probably also explains why Danish investment levels are approximately equal to the EU_15 average, as that country has not been experiencing such a shift. Norway on the other hand does have a rather capital intensive industry as well, but the high level of GDP (related to a high capital-output ratio in its energy industry) tends to lower the investments expressed as share of GDP. Variations in oil- and gas prices will therefore affect the development of the investment share, both directly via the denominator effect of GDP and indirectly due to an increase or decrease of the attractiveness of investments resulting from the oil- gas price changes.

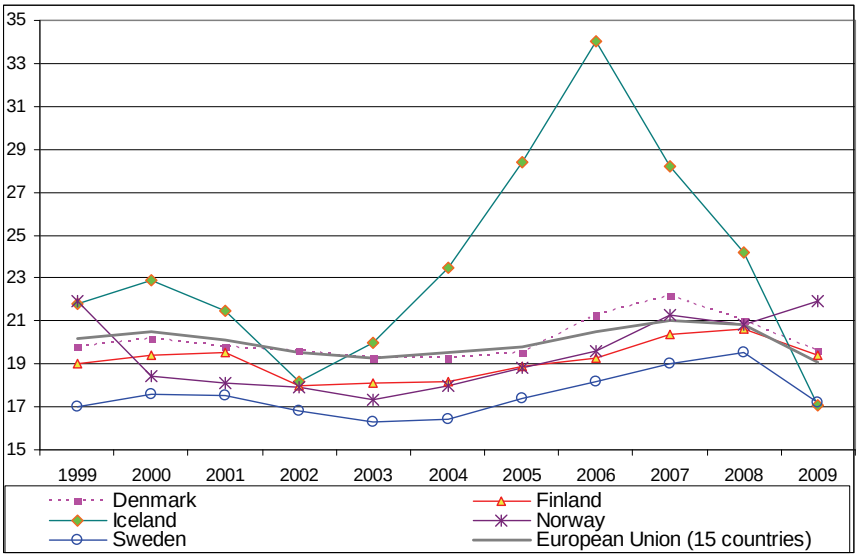

Figure 22. Evolution of gross fixed capital formation as %-share of GDP (volume, market prices) in Nordic countries and the EU_15 average (1999–2008; projection for 2009).

Source: Eurostat

As regards public investments (figure 23)[23] all Nordic countries, except Denmark, have consistently higher levels than the EU_15 average. After 2004 Finland has been converging towards the EU_15 average. The lower Danish level may have to do with the more compact size of the country. It should be realised that there can be differences across countries in the degree of public sector involvement regarding funding and exploiting infrastructure due to privatisation and public-private partnerships. As a result public investments in different countries not necessarily cover the same sectors or activities.

[23] Please realise that the investments depicted in figure 23 are a part of the total investments shown in figure 22.

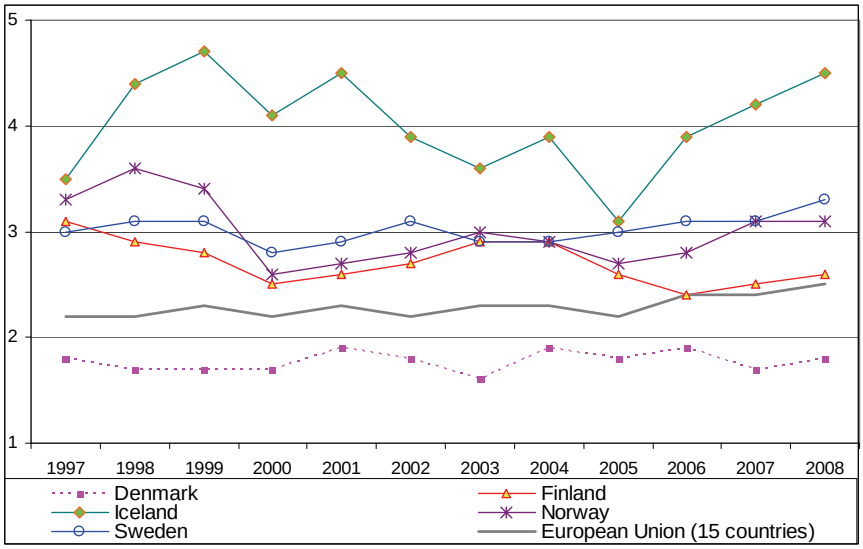

Figure 23. Evolution of gross fixed capital formation of the public sector as %-share of GDP (volume, market prices) in Nordic countries and the EU_15 average (1997–2008).

Source: Eurostat

On the basis of earlier experience and economic theory (see chapters 2 and 3) as well as from the observed substantial reductions in the order books of the investment goods industry we know that investments in equipment and buildings will be appreciably lower in the next few years. As illustrated above, this can be expected to affect the environmental investment levels, notably regarding emission abatement. As regards investments in clean production technology the prospects may be more mixed. All in all this hints at a situation in which the public sector may wish to promote the continuation of environmental investment levels in order to safeguard achievement of original environmental policy targets.

In as far as reduced production levels ease also the achievement of medium term targets (e.g. with the respect to the EU 20-20-20 deal, see also section 4.4) a modest lowering in investment levels may not be so alarming. Yet, stagnation in investments may spill over to stagnation in willingness to invest in environmental research and development. In turn that would risk locking the world into a higher emissions trajectory for quite some time to come (OECD/IEA, May 2009). Furthermore, economic growth and also growth of greenhouse gas emissions and of other pollution is still strong in many Asian countries and to a milder extent in Latin-America. If Nordic countries would lower their environmental research and development efforts, that would also threaten to reduce export potential later on. All in all in terms of a medium to long term perspective there are both environmental and economic reasons to sustain a sufficiently high level of environmental technology and service innovations. This practice should also include sufficient space for demonstration projects as these are essential to drive down unit cost and convince foreign buyers. It remains to be seen to what extent

demonstration projects would need public support and to what extent more venture capital could be incited to these endeavours.

Considering the limited size of domestic markets of each Nordic country separately, it might be worthwhile to consider to what extent environmental research, development and demonstration is pursued in common frameworks. As regards research this is happening already to a considerable extent, but regarding the subsequent steps, being development and a fortiori demonstration, there may be space for more cooperation, even though competitive considerations and EU regulations can have limiting effects.

The difference in observed and expected developments of emission abatement investments versus clean production technology investments could also be taken into consideration in an intensified innovation and investment promotion policy. After all a larger uptake of clean production technology, e.g. very advanced forms of energy saving, may help to reduce required emission abatement investments over time.

The above indicated reasons for public promotion of environmental research and development and investments can also be explained in terms of different market failures. One market failure in research and development arises from the fact that the private sector invests only as much as it estimates to gain in terms of private returns, i.e., profits from the investment. Potential social returns to other firms, sectors, science, etc., have often been estimated to rise much higher. Since these benefits cannot be captured by the firm, they are ignored in investment calculations.

Another frequently mentioned motivation for public support results from financial market imperfections that concern especially young innovative firms that cannot secure sufficient venture capital. Another funding related market failure concerns the strong risk mark-ups given to new technologies, with inherently shorter experience curves. The funding party has no interest in the future reductions of the unit-cost of the new technology resulting from expanding its experience curve. Therefore demonstration support is an essential third leg in environmental research development policy. The challenge is to apply a form of demonstration support which still gives a strong incentive to continue efficiency improvements (i.e. lowering the unit-costs). Similarly, support should gradually diminish as the new technology gets economically more efficient (IEA, 2000).

5.4 The impacts of green stimulus on technological progress

The public sector can stimulate the economy with R&D both by direct support as well as by public procurement. Market place originated motives are referred to as demand-pull effects, while scientific advances refer to technology push effects in R&D investment. Demand driven R&D investment may sometimes be more effective in delivering innovations. Joint Nordic

projects that procure new technologies may be ideal when there is little to choose from on the global green technology market.

Ideal public policies have been found to correct the environmental externality and address the knowledge market failure for innovation in general, not just in environmental innovation. Excessive focus on environmental R&D may substitute other R&D with an important social opportunity cost (Pizer and Popp, 2007). Moreover, there may arise problems, such as that a public agency (instead of the market) is "picking the winners". This links to questions to what extent innovation policy needs to be guided by input (resource allocation) or output (goals). On the other hand, when considering for example the sluggish development of alternative clean propulsion systems for road transport (electric, hybrid, hydrogen, etc.), it seems (or seemed) that no obvious preferred option was unfolding in the market[24] and consequently public frameworks were necessary.

Technological progress is at the core of climate change mitigation and environmental protection in general. Yet, its role is complex and sometimes misleading in macroeconomic model simulations[25], e.g. resulting in too optimistic or too pessimistic projections of employment effects. On the other hand empirical econometric exercises may fail to respond to some of the important questions (Pizer and Popp, 2007, p.22), when the inherent historic assumptions become invalid and/or produce results that conflict with macroeconomic model simulations. Many underscore the opportunities presented by the economic crisis. It can change the course of economic growth to a more sustainable and innovative, technologically progressive and dynamic tomorrow. Regrettably at this stage – experiencing high uncertainties and possible bifurcations – economics seems predominantly only capable of providing qualitative guidance regarding (green) innovation policy, even though quantitative exercises may help to identify or confirm some do's and don'ts.

Past experiences suggest that companies bold enough to invest in R&D and innovation during downturns are more likely to gain the competitive edge in upswings. Otherwise, there is no uniform response to the crisis by sector, region or size class. Thus firm-specific factors appear to determine crisis impacts of the corporate R&D level. At the same time it is important that stimulus packages are intelligent beyond short-run stabilization, and are supportive of innovation in high potential (small) companies for long-term regeneration and creativity to emerge from the destruction. While infrastructure investment and other direct economic stimulus, combined with seed capital and start-up support to entrepreneurs is nothing new, Voigt and Moncada-Paterò-Castello (2009) argue for their reinforcement.

[24] Admittedly there were fundamental uncertainties, but the disjoint operations of the car industry and the oil industry did not help either.

[25] There are various competing theories about the influence of technical progress and innovation efforts on economic development (for an overview see e.g. Grübler et al, 2002).

5.5 Globalisation and the scope of green investments

If relatively clean Nordic industries migrate to so-called pollution havens, the risk of emissions growth at the global level is real. This issue was also discussed in section 3.3 and section 4.4. However, according to Copeland & Taylor (2004, p. 50), there is little empirical evidence suggesting that more stringent regulation in the North has raised costs to the point of pushing pollution intensive industries to pollution havens. Also a recent study by Kearsley and Riddel (2009) indicates that there is no clear evidence of outspoken shifts of production.

To these above mentioned findings could however be commented, that carbon leakage, or more general emission leakage, is integrated in the globalisation process, as also pointed at in section 4.4. In other words it is anyhow unlikely to find proof of the pollution haven hypothesis in its pure form. Strict environmental policies in some richer countries may precipitate structural change and international reallocation of production, but are seldom, if ever, the main reason for such changes.

Norway, Iceland and Finland, the Nordic countries with the lowest population densities, the smallest populations and fringe locations regarding the main markets of Europe, have still economic strategies in which natural resource exploitation (i.e. mining, quarrying, forestry, fisheries) plays a relatively significant role. For the medium term Norway can probably trust quite safely that oil and gas will remain remunerating export commodities, but for the truly long term this may be quite different. The global targets to reduce if not abolish the use of hydrocarbons by 2050 very much points in that direction. For Iceland and Finland, even though for quite different reasons the assessment of the strategic position of natural resource use in the economic strategy is more acute. In the background also the effect of carbon (and other emission) leakage can play a role in this case. From this strategic option emanate various questions with respect to climate policy and innovation strategy.

Very advanced clean natural resource exploitation technology and management could constitute an export possibility in the longer run, whereas it might assist in finding solutions in conflicts of interest often linked to large scale natural resource exploitation. Last but not least such advanced technologies and management approaches will help to reduce emissions considerably. This also underscores the significance of the question what is regarded as “green technology”. Dramatic reduction in the polluting loads of heavy industries and natural resource exploitation can have global significance if the technology transfer is sufficiently quick and effective. On the other hand if Nordic countries would choose this strategic option there is also the issue of financial sustainability. Initially it would require massive public support in research, development and demonstration, whereas there is a risk that the benefits of the resulting innovations will mainly spill abroad, if local companies are unable to commercialise these successfully.

As indicated earlier the assessment of country emissions on the basis of final consumption (Peters, 2008) may be a means to develop new instruments to support the sustainable transition. It can open up to new allocation methods that could account for particularities of e.g. Nordic countries. Such a consumption based reporting would also assist the establishment of accurate border adjustment emission taxes. Furthermore, as leakage is embedded in evolving new patterns of international trade and global supply chains final consumption oriented information can assist in mobilising the consumer in conjunction with retail and linked supply chains to lower emissions (Usva et al, 2009; Perrels et al, 2009). In due course this could promote globally the growth of voluntary emission trade, which may give new impetus to green innovations e.g. in the food chain.

5.6 Summary

As regards climate mitigation there is a lot of potential for innovations and the Nordic countries have strong positions in various sub-fields. The technology and governance solutions to contain eutrophication are well known and hence application and export of these do not so much depend on innovation as on strong political support. There will be also domestic and international market options for Nordic countries regarding urban air quality.

In particular the following applications areas seem very important and promising for Nordic countries (with special reference to climate mitigation): wind energy, hydropower, geothermal, biomass (incl. forest products), energy saving technology, ICT solutions, recycling, and waste water treatment. These areas would need continued support for their R&D efforts and for demonstration projects. In quite some cases the support does not have to take the form of subsidies, but could be promoted – among others – via green public procurement, so-called greening of the tax system, white certificate systems and performance standards. Considering the limited size of domestic markets of each Nordic country separately, it might be worthwhile to consider to what extent environmental research, development and demonstration is pursued in common Nordic frameworks. Especially with respect to development and even more so demonstration there could be significant positive scale effects. In due course the role of venture capital could be better exploited in development and demonstration projects.

In contrast to abatement efforts the investments in clean production technology don't seem to have a straightforward relation with economic up- and downturns. In both economic phases there are promoting forces (e.g. attempts for radical renewal) and discouraging forces (e.g. cost minimisation) at work. All in all investment levels in environmental technology in the nearby future, notably for abatement, can be expected to stay below original pre-crisis baseline expectations in case no action is taken which somehow promotes continuation of environmental investment levels. In this respect it

merits to mention that new technologies need actual applications in order to get costs down over time. In other words better market prospects for innovations in the short run can help to precipitate the reduction of unit-costs of such technologies in the medium to long term. In that case it is however essential that the promotion policies stimulate the lowering of unit-costs.

Outright leakage of emissions, due to relocation of industries from Nordic countries to places with less stringent environmental policies, seems to be rather unlikely. However, implicit leakage as part of globalisation, in which new investments flow mainly to principal economic growth areas, is probably taking place.

In addition to the typical sustainable transition strategies that focus on radical reduction of natural resource use, it could be worthwhile to consider that most Nordic countries have fringe locations regarding the main markets of Europe, whereas they have significant natural resource surpluses. Therefore strategies that include very advanced clean natural resource exploitation and management constitute an export possibility in the longer run, whereas it might assist in finding solutions in conflicts of interest often linked to large scale natural resource exploitation.

6. Conclusions

The economic crisis

Some Nordic countries were hit more severely by the economic crisis than others, owing to different economic structures and differences in monetary policies. Recovery has been rather hesitant. Considering the sources of the crisis changes in bank regulation, supervision and financial sector risk management procedures and techniques can be expected. From earlier crises can be inferred that banking crises can be especially severe and protracted. Crises usually also set in motion significant changes in the structure of the economy and its institutions, which constitute both risks and opportunities.

Green stimulus plans

Many countries, including most Nordic countries, allegedly have large shares of "green stimulus" in their stimulus packages, meaning that a good part of the extra investments is meant for environmental purposes, such as emission abatement and energy saving. However, there is no commonly accepted definition for "green investment", which makes comparison of packages tricky. Furthermore, many elements of these packages can entail indirect effects, which diminish the original environmental progress. Generally speaking any stimulus measure that promotes sustainable investment and operations which go beyond a baseline trend could be regarded as "green". More concretely, investments in energy efficiency, renewable energy (with some provisos), waste reduction and recycling, as well as various emission control technology could be termed "green". From an environmental point of view the sustenance of sufficient levels of environmental investments in the post-crisis years seems more important than the short term peak in efforts to mitigate the economic crisis. Careful selection and dosage of measures will help to ensure that recovery policies also promote sustainable transition.

Fiscal post-crisis changes

Outright green stimulus programmes will expire fairly soon, but for the medium to long term changes in fiscal policies may be expected, which can also offer opportunities for "greening" public finance policy. A common element for most if not all Nordic countries is a further shift towards so-called "ecological tax reform", i.e. taxing environmentally burdening activities more and taxing labour income less. Fiscal policy is expected to tighten considerably in all Nordic countries and elsewhere, as the crisis led to sig-

nificant increases in public debt, whereas the ageing of the population adds further pressures. This creates possibilities to continue ecological tax reform as well as to diminish or abolish environmentally harmful subsidies. Furthermore, in addition to emission trade other quasi market instruments and informational instruments may gain importance.

Immediate environmental effects

Most if not all crises tend to relieve the burden on the environment in the short term. This is also true for the current crisis. For example, greenhouse gas emissions in 2008 in Norway went down by about 2% and in Finland by about 10%, even though the reduction in Norway may be owing to other (technical) reasons. The substantial reduction of greenhouse gas emissions has approximately halved the price of emission permits in the European Emission Trade System (EU-ETS). This price drop in EU-ETS, together with diminished world coal prices, has incited electric power companies to use more coal, e.g. in Finland coal use rose by about 20% in 2009). As consequence a part of the sudden greenhouse gas emission reduction in 2008 will erode away in the following years, unless further policy measures are taken or precipitated.

Medium term environmental effects

The severity of the crisis in combination with structural change in heavy industries is expected to affect the medium term development pathway of greenhouse gas emissions, despite the erosion of emission reduction mentioned above. This means that the Nordic countries which are committed to the EU 20-20-20 for the year 2020 will probably experience a significant relief as regards the actual amount of emissions to be reduced. In turn this would mean some relief for abatement investment needs. Applying a crude downscaling of IEA projections for European energy investment needs between 2010 and 2020 to achieve long term emission reduction goals, the Nordic annual investment needs would be somewhat under 3 billion euro per year. Yet, the above mentioned easing of the 2020 emission reduction tasks implies a reduction of the annual investment need, e.g. by a few hundred million euro.

Long-term environmental effects

Long-term impacts could be profoundly adverse for the environment due to a severe slowdown in environmental investments and environmental research and development. In this respect a difference could be made between environmental issues for which policy implementation is already well established (such as is the case for acidification) and policies for which policy packages are still in various stages of development (e.g. in case of green-

house gas emission reduction and the eutrophication of the Baltic Sea). Considering trends in various emissions the first mentioned type of environmental policy areas (i.e. well established implementation) seems to be less affected by economic crises. On the other hand for the latter type of environmental themes the policies have often not yet succeeded in sufficient decoupling of the emission trends from economic development. This means that for not yet decoupled environmental effects the activity level of research, development and demonstration merits to be warranted by means of appropriate polices.

The above considerations are mainly based on the economic cycle and the expected low level of investment after a crisis in case of absence of policy interventions. In addition it should be added that crises are often followed by significant structural change, which can turn out to be either a blessing or conversely a worse burden for the environment, depending on public policies and business strategies ahead.

Green innovations in a globalising economy

All in all Asia's role in determining global economic growth and associated emissions and relative prices is likely to get ever more important. At the same time these countries constitute growing export opportunities for green products and services from Nordic countries. In this respect so-called leakage of emissions by replacement of emission intensive production from Nordic countries to high growth economies with less stringent environmental policies should be understood as part of the globalisation process. However, direct replacement of such production capacity is an exception, instead gradual discplacement of production capacity in Nordic countries by newly invested capacity in growth markets is an issue. The challenge is to ensure that this new capacity embodies up-to-date clean technology, preferably based on Nordic innovations. It remains to be seen whether border adjustment taxes for countering emission leakage problems would be a useful supplementary instrument in this context. Its implementation would require still a multitude of research, regarding economic effects, generation of carbon footprint data, and international trade legislation and trade conflicts

Promising green innovation potential in Nordic countries

In international comparisons Nordic countries generally rate high in terms of innovation efforts. In terms of eventual output (as compared to the sizeable input) there is still scope for improvement of the effectiveness, which may be particularly important when state budgets and credit markets tighten.

Thanks to the substantial and sustained innovation efforts (and thanks to fairly strict domestic environmental policies) Nordic countries have strong positions in a quite large portfolio of environmental technologies and ser-

vices. For Nordic countries and their export potentials strong and/or promising green product and service areas are:

- Wind energy
- Hydropower
- Geothermal energy
- Biomass (incl. forest products)
  a) Biomass production (sustainable forestry/agriculture)
  b) Biomass use (incineration, gasification, refining)
- Energy saving technology
  a) in a selection of industrial applications
  b) in residential applications / buildings – optionally in combination with localised energy conversion / storage
- ICT solutions:
  a) Smart energy metering
  b) Monitoring and feedback
  c) Other measurement / monitoring systems
- Recycling
- Waste water treatment

Safeguarding continuity in green innovation and its market uptake

The upkeep of environmental research, development and demonstration is not a straightforward boosting of support of ongoing efforts, but should play into the structural changes in the global economy rather than resist them. Considering the limited size of domestic markets of each Nordic country separately, it might be worthwhile to consider to what extent environmental research, development and demonstration is pursued in common Nordic frameworks. Especially with respect to development and even more so demonstration joint efforts could enable significant positive scale effects. In due course the role of venture capital could be better exploited in development and demonstration projects.

In the nearby future investment levels in environmental technology, notably for abatement, can be expected to stay below original pre-crisis baseline expectations in case no action is taken which promotes continuation of environmental investment levels. In this respect it merits to mention that new technologies need actual applications, i.e. by means of demonstration projects, in order to get costs down over time. In other words better market prospects for innovations in the short run can help to precipitate the reduction of unit-costs of such technologies in the medium to long term. In that case it is however essential that the promotion policies stimulate the lowering of unit-costs.

Sustaining environmental policy in a budget constrained world

In order to ensure that environmental policy goals are achieved while structural change takes place and state budgets are tightened various policy instruments may need revision. In short the following adaptations could be considered: (1) tax reforms, with ever more stress on taxing consumption of (natural) resources and only limited (temporary) overall increase of tax rates, (2) abolishment or at least reduction of environmentally harmful subsidies, (3) other quasi-market incentive structures (tradable certificate systems; performance dependent "fee bates"), (4) radical improvement of market information via monitoring and feedback services, certified labelling, etc. and (5) combinations of the aforementioned options.

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Glossary of terms

Aggregate demand:
Sum of all demand in an economy, i.e., the expenditure on consumer goods and services, investment, and net exports (total exports minus total imports).

Air pollutant:
Any substance in air, either natural or artificial, that in high concentrations could harm humans, plants or animals. Pollutants may be in the form of solid particles, liquid droplets, gases or a combination thereof. Generally, they fall into two main groups: (1) those emitted directly from identifiable sources and (2) those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric constituents, with or without photoactivation. Exclusive of pollen, fog and dust, which are of natural origin, about 100 contaminants have been identified. Air pollutants are often grouped in categories for ease in classification, such as solids, sulfur compounds, volatile organic chemicals, particulate matter, nitrogen compounds, oxygen compounds, halogen compounds, radioactive compound and odors.

Ancillary benefits:
The secondary or supplementary benefits accompany a prime benefit, and accrue from the same performance from which the prime benefit accrues.

Annex I countries:
Mostly countries which have ratified the Kyoto Protocol and have therefore committed to reduce their emission levels of greenhouse gasses to targets that are mainly set below their 1990 levels. They include Australia. Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, United States of America. Annex II countries are a sub-group of the Annex I countries, consisting of developed countries which pay for costs of developing countries, which in turn are not required to reduce emission levels unless developed countries supply enough funding and technology.

Appreciation / depreciation of currency:
Currency appreciation / depreciation refers to an increase in / a loss of value of a country's currency with respect to one or more foreign reference currencies, respectively.

Assigned amount units (AAU):
One of the three measurements for measuring defined by the Kyoto Protocol as criteria for annex 1 countries to achieve emission reduction targets. The other two mechanisms are Emission Reduction Units (ERU) and Certified Emission Reductions (CER). AAU is an cap and trade mechanism, and the latter two mechanisms deal with actual project based reduction. It defines the total volume of green house gases (GHGs) in units of one tonne CO_2e – that each Annex B country is allowed to emit during the first phase of the Kyoto Protocol.

Automatic stabilizers:
In macroeconomics automatic stabilisers work as a tool to dampen fluctuations in real GDP without any explicit policy action by the government. They are measures built into the governments budget that cause spending to increase and tax revenues to decrease when the economy goes into a slump.

Clean Development Mechanism (CDM):
A mechanism of the Kyoto Protocol for reducing emissions through implementing projects in developing countries. More specifically it allows Annex 1 countries to make emissions reductions overseas in non-Annex 1 countries and count those reductions towards their own legal commitments to the Kyoto Protocol. This method results in the issuing of tradable Certified Emissions Reductions (CERs).

Crisis:
An unstable situation of extreme danger or difficulty; a crucial stage or turning point in the course of something;

Currency peg:
A fixed exchange rate, sometimes called a pegged exchange rate, is a type of exchange rate regime wherein a currency's value is matched to the value of another single currency or to a basket of other currencies, or to another measure of value, such as gold.

Depression:
Considered a rare and extreme form of recession, a depression is characterized by its length, and by abnormal increases in unemployment, falls in the availability of credit, shrinking output and investment, numerous bankruptcies, reduced amounts of trade and commerce, as well as highly volatile relative currency value fluctuations, mostly devaluations. Price deflation, financial crisis and bank failures are also common elements of a depression. There is no widely agreed definition for a depression, though some have been proposed. Generally, periods labeled depressions are marked by a substantial and sustained shortfall of the ability to purchase goods relative to the amount that could be produced using current resources and technology (po-

tential output). Another proposed definition of depression includes two general rules: 1) a decline in real GDP exceeding 10%, or 2) a recession lasting 2 or more years.

Eco-efficiency:
Optimal use of materials and energy in order to minimize economic costs (or maximize economic output), while minimizing environmental impacts in terms of resource use, waste and pollution. It includes therefore thedispersion of toxic materials, recyclability, use of renewable resources, durability of products, and service intensity of goods and services.

GDP-emissions elasticity:
The ratio of the percent change in GDP to the percent change in emissions. It is a tool for measuring the responsiveness of emissions to economic growth and vice versa, and progress made in their disconnecting them.

European Union Emission Trading System (EU ETS):
Launched in 2005 the cap and trade scheme is designed to help achieve Kyoto Protocol commitments. The European Commission puts a cap on each country's emissions and issues a certain amount of allowances – measured in tons of carbon dioxide – and governments subsequently allocate credits / allowances to firms. Companies that do not have sufficient allowances to cover their emissions can buy more through the Emissions Trading Scheme (ETS). Companies with surplus allowances can sell them. Allowances can also be brought into the system from outside the EU through UN systems set up under Kyoto – for example Clean Development Mechanism (CDM).

Free-riding:
People who think the common cause will stand/fall regardless of their contribution (or do not care) and therefore do not contribute in the hope of riding free if the cause succeeds.

Greenhouse gases (GHGs):
Gases that trap the heat of the sun in the Earth´s atmosphere. Water vapor and carbon dioxide are the primary greenhouse gases. Carbon dioxide (CO2) accounts for approximately 380 of every one million molecules (380 parts per million (ppm)). Methane (CH4) accounts for only 1.8 ppm, but its total impact on the current greenhouse effect is one third of that of carbon dioxide. Nitrous Oxide (N20) accounts for only about 300 parts per billion (ppb) of the atmosphere but has about 300 times the effect of C02, molecule for molecule, over its century-long lifespan in the atmosphere. Hydrofluorocarbons (HFCs) and chlorofluorcarbons (CFCs): These account for approximately 1 ppm. Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF6) are present in trace amounts.

Gross fixed capital formation:
A common measure of the level of public and private investment combined. It summarizes the total amount of capital invested in buildings, engineering construction and machinery and equipment. Includes imports of used machinery and equipment, which constitute additions to domestic capital stock, and transfer costs on the sale of existing fixed assets (i.e. real estate commissions). Comprises three broad categories: residential structures, non-residential structures and machinery and equipment. Government fixed capital formation includes spending on non-military defense buildings and equipment.

Intergovernmental Panel on Climate Change (IPCC):
Established by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) to assess scientific, technological and socio-economic information relevant to the understanding of climate change, its potential impacts and options for adaptation and mitigation.

Instrumental efficiency:
A criterion that focuses on the instrument, i.e., policy measure and medium used for implementation. When the instrument is efficient, it produces the best possible outcome relative to other means.

Joint Implementation (JI):
Under this method, industrialized countries can contribute to their greenhouse gas emission reductions targets by investing in emissions reduction projects in other industrialized (Annex I) countries and receive credits called Emission Reduction Units (ERUs). This is advantageous if mitigation costs are lower than those for national action. Joint Implementation (JI) is defined in Article 6 of the Kyoto Protocol.

The Kyoto Protocol:
The first ever international treaty to set legally binding emissions reduction targets on developed countries that have ratified the Protocol. Developed (known as Annex 1) countries agreed to targets that will reduce their overall emissions of six greenhouse gases by 5.2 per cent below 1990 levels over the five-year period 2008–2012. The targets vary from country to country, but the Protocol has an overall 5% reduction target.

Leakage (economic context):
Leakage describes an unwanted loss, or leak, of something which escapes e.g. through a regulatory system. The impact of public demand stimulus measures on aggregate output is lessened by its partial diversion to import demand, i.e., trade leakage abroad, as well as savings. Similarly R&D support granted to firms may partly be used to finance other ends or indirectly substitute private financing that would have otherwise taken place. Leakage

is also present in emission reduction policies or activities, when they result in a rise in emissions elsewhere.

Low hanging fruit:
Easily obtained gains; what can be obtained by readily available means.

Pollution haven hypothesis:
The hypothesis argues that pollution intensive, i.e. dirty industries migrate from developed economies with strict environmental regulations to the developing world with lax/ weak or poorly enforced environmental regulations.

Recession:
A business cycle contraction, a general slowdown in economic activity over a period of time. Generally production or output as measured by Gross Domestic Product (GDP), employment, investment spending, capacity utilization, household incomes, business profits and inflation fall, and bankruptcies and unemployment rises.

Portfolio risk:
The risk that is related to a portfolio or grouping of assets, a collection of investments all owned by the same individual or organization. An optimal portfolio secures the investor the highest possible return for a given level of risk, or the least possible risk for a given level of return.

Venture (risk) capital:
Money and resources made available to startup firms and small businesses with exceptional growth potential. Most venture capital money comes from an organized group of wealthy investors, which also often provide managerial and technical expertise. Venture capitalists seek higher rates of return (generally 25 percent or more) than typically gained from traditional investments.

Feed-in tariff:
A policy that sets a fixed guaranteed price at which power producers can sell renewable power into the electric power network. Some policies provide a fixed tariff while others provide fixed premium added to market or cost related tariffs.

Bioenergy:
Renewable energy produced from organic matter. The conversion of the complex carbohydrates in organic matter to energy. E.g., biogas is a combustible gas, typically 50 to 60 percent methane, derived from decomposing biological waste.

Biofuels:
Fuels – such as ethanol and biodiesel – that are made from biomass.

Biomass:
Renewable organic matter including agricultural crops and residue, wood and wood waste, animal waste, aquatic plants and organic components of municipal and industrial wastes. Biomass power and heat is generated from solid biomass such as wastes from forest products, agriculture, municipalities or industrial sources.

Carbon capture and storage (CCS):
The process by which carbon dioxide is captured from the combustion of fossil fuels and permanently stored to prevent its release into the atmosphere.

Combined heat and power.
The cogeneration of useful heat and electrical power in a single process.

Geothermal power and heat:
Heat energy emitted from within the Earth, usually in the form of hot water or steam, which can be used to produce electricity or direct heat for buildings, industry and agriculture.

Hydro power plant:
A plant that produces electrical power from moving water.

Volatile organic compound (VOC):
An organic compound that participates in atmospheric photochemical reactions, except those designated by EPA as having negligible photochemical reactivity.

Coal:
Coal is classified into four main types: lignite, subbituminous, bituminous and anthracite. Lignite has the lowest energy content with 25–35% carbon. Subbituminous coal contains 35–45% carbon. Bituminous coal, the most abundant type contains 45–86% carbon. Anthracite, which contains 86–97% carbon, is very rare.

Clean coal technology:
Any technology to reduce pollutants associated with the burning of coal that was not in widespread use prior to the US Clean Air Act Amendments of 1990. Originally, “clean coal” referred to any number of techniques to reduce the negative effects of burning coal. Up until recently, this has meant reducing sulphur dioxide and other particulates that contribute to acid rain, as well as removing minerals and impurities which reduce the efficiency of

combustion. Now, with increased concern about climate change, the term is more often used to describe a process that greatly reduces carbon dioxide emissions. The most commonly referred to method is carbon capture and sequestration (CCS), in which the CO2 from coal is isolated before being emitted into the atmosphere and is disposed of in a way that prevents its escape. While there are several ways to capture CO2 from coal, in the U.S. the most promising way is via coal gasification. This process converts the coal into a gas by heating it with steam, air or oxygen, producing hydrogen, which is used as fuel, and CO2, which can be captured. The CO2 is then transported as a gas or liquid via pipelines to sequestration sites. Options for storage include declining oil fields, saline aquifers, unmineable coal seams, and even the ocean.

Energy storage:
Energy storage media are matter that store some form of energy that can be drawn upon at a later time to perform some useful operation. A device that stores energy is sometimes called an accumulator. All forms of energy are either potential energy (eg. chemical, gravitational or electrical energy) or kinetic energy (eg. thermal energy). A wind up clock stores potential energy (in this case mechanical, in the spring tension), a battery stores readily convertible chemical energy to keep a clock chip in a computer running (electrically) even when the computer is turned off, and a hydroelectric dam stores power in a reservoir as gravitational potential energy. Ice storage tanks store ice (thermal energy) at night to meet peak demand for cooling. Fossil fuels such as coal and gasoline store ancient energy from sunlight. Even food (which is made by the same process as was fossil fuel) is a form of energy stored in chemical form.

Abbreviations:
IEA: International Energy Agency – a subsidiary organization to the OECD
OECD: Organisation of Economic Co-operation and Development; the member countries are mostly developed wealthy countries (most EU countries, USA, Canada, Australia, Japan) plus a few newly developed countries (e.g. South Korea, Mexico)

UNFCCC:
The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty signed at the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro in 1992. The treaty addresses emissions of greenhouse gases in order to combat global warming, and in 1997, was amended to include the Kyoto Protocol. Parties to UNFCCC are classified as: Annex I countries (industrialized countries and economies in transition), Annex II countries (developed countries which pay for costs of developing countries), Developing countries.

UNEP:
The United Nations Environment Programme (UNEP) is an international organization established in 1972 to catalyse and coordinate activities to increase scientific understanding of environmental change and develop environmental management tools.

Units:
- Million – mn. – 10^6
- Billion – bn. – 10^9
- Trillion – 10^{12}
- Mega = million
- Giga = billion
- Tera = trillion
- KOE = kilos of oil equivalents

CO_2_eq. = CO_2-equivalent: CO2e (carbon dioxide equivalent). Under the Protocol, this is the universal unit of measurement used to indicate the global warming potential of each of the six greenhouse gases, expressed in terms of the global warming potential of one unit of carbon dioxide.

British Thermal Unit (Btu). A unit of heat energy required to raise the temperature of one pound of water one degree Fahrenheit at sea level.

Kilowatt hour (kWh): A measure of electricity, measured as one kilowatt (1,000 watts) of power expended for one hour. One kWh is equivalent to 3,412 Btu.

Sammanfattning

Vissa nordiska länder drabbades hårdare än andra av den ekonomiska krisen på grund av skillnader i de ekonomiska strukturerna och penningpolitik. Återhämtningen efter krisen har varit långsam. Med tanke på orsakerna till krisen är förändringar i regleringen och övervakningen av bankernas verksamhet att vänta liksom även förändringar i riskhanteringsmetoderna inom den ekonomiska sektorn. Av erfarenhet vet man att bankkriser kan vara speciellt svåra och utdragna. Den här typen av kriser brukar också sätta igång stora förändringar inom den ekonomiska strukturerna och dess institutioner vilket medför både risker och möjligheter.

Gröna stimulansplaner

Många länder, även de flesta nordiska länder påstås ha en betydande andel gröna stimulansåtgärder i sina ekonomiska stimulanspaket vilket innebär att en stor del av de extra investeringarna är avsedd för miljöbefrämjande åtgärder såsom utsläppsminskning och energibesparing. Eftersom det inte finns någon gemensamt fastställd definition av'gröna investingar" är det knepigt att jämföra de här paketen. Dessutom kan många av elementen i de här paketen ge upphov till indirekta följder som kan hålla tillbaka de ursprungliga miljöframstegen. Egentligen kan vilken stimulansåtgärd som helst som främjar hållbar utveckling och verksamhet bortom vad som är standardmässigt, anses "grön". Mer konkret kan investeringar i energieffektivitet, förnyelsebar energi med vissa villkor, avfallsminskning och återvinning samt olika typer av teknik med vars hjälp man kontrollerar utsläppsnivåer klassas som "gröna". Ur miljösynpunkt är det dock viktigare att en tillräckligt hög nivå på miljöinvesteringar bibehålls under åren som följer efter krisen än kortvariga satsningar för att motverka den ekonomiska krisen. En hållbar övergång främjas också av att återhämtningsåtgärderna väljs noga och tas i rätt mängd.

Skatteförändringar efter krisen

Direkta gröna stimulansprogram kommer rätt snart att höra till historien men på mellanlång och lång sikt kommer skattepolitiken troligen att förändras vilket kan erbjuda möjligheter för en grönare finanspolitik. Ett gemensamt element för de flesta nordiska länderna, om inte rent av allihop, är att beskattningen fortsättningsvis kommer att genomgå en s.k. ekologisk reform som innebär att aktiviteter som belastar miljön beskattas mer medan arbete beskattas mindre. Skattepolitiken kommer att stramas åt hårt i samtliga nordiska länder liksom på övrigt håll i världen eftersom krisen har lett till att

statsskulden ökat och den åldrande befolkningen innebär förändringar i förhållandet mellan statens inkomster och utgifter. Det här skapar möjligheter att fortsätta den ekologiska skattereformen och minska eller avskaffa subventioner som skadar miljön. Utöver utsläppshandeln kan övriga informationsinstrument och kvasimarknadsinstrument bli allt viktigare.

Omedelbara miljöeffekter

Så gott som alla kriser tenderar att minska miljöbelastningen på kort sikt och det här gäller även den här krisen. Utsläppen av växthusgaser minskade med t.ex. 2% i Norge under 2008 och 10% i Finland trots att minskningen i Norge kan ha berott på andra tekniska orsaker. Den avsevärda minskningen av växthusgaser har halverat priset på utsläppstillstånd i EU:s system för utsläppshandel (EU-ETS). Den här prissänkningen i EU-ETS, i kombination med lägre världsmarknadpriser på kol har fått elproduktionsbolagen att använda mer kol. I Finland till exempel ökade användningen av kol med 20% under 2009. Om inga åtgärder vidtas för att begränsa utsläppen av växthusgaser kommer minskningen under 2008 bli delvis betydelselös under de följande åren.

Miljöeffekter på mellanlång sikt

Krisens allvar i kombination med strukturella förändringar inom tung industri förväntas påverka utvecklingen av växthusgasutsläppen inom några år trots att den ovannämnda utsläppsminskningen delvis eroderas.

Det här betyder att de nordiska länder som förbundit sig till EU:s 20-20-20 avtal fram till år 2020 förmodligen kommer att se att mängden utsläpp som skall minskas är mindre än förväntat. Det här i sin tur innebär att behovet av begränsningsinvesteringar minskar i någon mån. En hård sänkning av IEA:s prognos av hur stora investeringar som behövs inom europeisk energiproduktion mellan 2010 och 2020 skulle innebära de årliga nordiska investeringsbehoven vara strax under 3 miljarder per år. Lättnaderna i den ovannämnda planerade utsläppsminskningen fram till 2020 skulle dock resultera i minskade årliga investeringar på uppskattningsvis några hundra miljoner euro.

Miljöeffekter på lång sikt

Långtidseffekterna skulle kunna bli mycket negativa för miljön till följd av betydligt färre investeringar samt mindre forskning och utveckling inom miljöteknik. I det här avseendet finns det skillnader mellan sådana miljöfrågor som redan har ett väletablerat regelverk vilket är fallet för t.ex. försurning, och sådana miljöfrågor för vilka normerna fortfarande håller på att fastställas som t.ex. utsläppsminskning av växthusgaser och övergödningen av Östersjön. Då man analyserar mönstret för olika typer av utsläpp förefaller miljöfrågorna av den första typen att vara mindre påverkade av ekono-

miska kriser. För den andra typen av miljöfrågor har politiken och normerna ännu inte lyckats skilja åt utsläppsmönster och ekonomisk utveckling tillräckligt väl. Det här betyder att forsknings-, utvecklings- och förevisningsaktivitet gällande miljöeffekter som ännu inte har skiljts åt från ekonomisk tillväxt bör säkerställas av lämpliga strategier.

Ovanstående slutsatser grundar sig huvudsakligen på den ekonomiska cykeln och den förväntade låga investeringsnivån som som följer efter en kris då policyåtgärder saknas. Tilläggas bör att kriser ofta åtföljs av omfattande strukturförändringar vilket kan visa sig vara antingen en välsignelse eller en börda för miljön beroende på kommande offentliga politiska- och affärsstrategier.

Gröna innovationer i en global ekonomi

Sammanfattningsvis kan man säga att Asien kommer att spela en allt viktigare roll i den globala ekonomiska tillväxten och även utsläppstillväxten och då relativa priser bestäms. Samtidigt utgör dessa länder en växande potentiell exportmarknad för gröna produkter och tjänster från de nordiska länderna. I det här avseendet skall det s.k. utsläppsläckaget som sker genom att den utsläppsintensiva produktionen förflyttas från Norden till tillväxtekonomier med mindre strikta miljölagar förstås som en del av globaliseringsprocesen. Att den här typen av produktionskapacitet ersätts direkt är ett undantag. Därför gäller den egentliga frågan den gradvis avtagande produktionskapaciteten i de nordiska länderna samtidigt som nya investeringar görs på tillväxtmarknaderna. Utmaningen ligger i att säkerställa de den här nya kapaciteten också omfattar den senaste miljöteknologin och att den helst är baserad på nordiska innovationer. Det återstår att se om gränsjusteringsskatter som införs för att motverka problemen med utsläppsläckage kunde vara ett användbart tilläggsinstrument i det här sammanhanget. Införandet av justeringsskatter skulle fortfarande kräva en hel del forskning om ekonomiska effekter, uppgifter om koldioxidfotavtryck, internationell handelslagstiftning och handelskonflikter.

Lovande grön innovationspotential i Norden

I internationella jämförelser hamnar de nordiska länderna högt upp listan över innovationsforskning. Då det gäller resultat i relation till satsningar kan effektiviteten ytterligare förbättras vilket kan bli speciellt viktigt då statsbudgeterna och lånemarknaderna starmas åt. Tack vare betydande och fortlöpande innovationsforskning samt rätt strikt miljöpolitik har de nordiska länderna en stark ställning i ett ganska brett utbud av miljötjänster och miljöteknik med lovande exportpotential:

- Vindkraft
- Vattenkraft
- Jordvärme
- Biomassa (skogsprodukter ingår)
    a) Produktion av biomassa (hållbart jord- och skogsbruk)
    b) Utnyttjande av biomassa (förbränning, omvandling till gas, förädling)
- Energisparande teknologi
    a) Inom en mängd industriella applikationer
    b) För byggnadsbranschen och bostadshus-möjligen I combination med local energikonversion eller-lagring
- IKT lösningar:
    a) Smart energimätning
    b) Övervakning och feedback
    c) Andra mätnings- och övervakningssystem
- Återvinning
- Avfallsvattenrening

Säkerställning av fortlöpande grön innovationsforskning och dess marknadsmottagning

Att upprätthålla miljöforskning, -utveckling och -demonstration innebär inte enbart direkt stimulans, utan denna borde påverka den globala ekonomins strukturförändringar snarare än motarbeta dem. Eftersom de enskilda marknaderna för varje nordiskt land är små är det värt att överväga i vilken utsträckning miljöforskning, -utveckling och -demonstration skulle kunna genomföras gemensamt inom en nordisk referensram. Gemensamma ansträngningar i synnerhet i fråga om utveckling och förevisning av innovationer skulle kunna få till stånd positiva skaleffekter. I sinom tid kunde riskkapital utnyttjas bättre i utvecklings- och förevisningsprojekt.

Inom den överskådliga framtiden kan investeringarna i miljöteknologi, framför allt i utsläppsminskning, förväntas sjunka under basnivån innan krisen ifall inga åtgärder vidtas för att främja investering i miljöteknik. I det här avseendet är det värt att nämna att ny teknologi kräver konkreta tillämpningsområden, t.ex. demonstrationsprojekt för att sänka kostnaderna under en längre tidsperiod. Med andra ord kan bättre marknadsutsikter för innovationer på kort sikt minska de långsiktiga enhetskostnaderna för den här typen av teknologi. I så fall är det det dock väsentligt att den främjande policyn också leder till en sänkning av enhetskostnaderna.

Hållbar miljöpolitik i en värld med budgetbegränsningar

För att säkra att de fastställda miljömålen uppnås medan strukturförändringar äger rum och statsbudgeter stramas åt kan en mängd olika intstrument i miljöarbetet kräva revidering. I korthet kunde följande åtgärder övervägas:

(1) skattereformer med tyngdpunkten på beskattning av utnyttjande av (natur)resurser och endast en begränsad (tillfällig) höjning av allmänna skattesatser, (2) avskaffande av eller åtminstone minskade miljöfarliga subventioner, (3) andra kvasimarknadsstrukturer avsedda att fungera som sporrar (t.ex. reultatbaserade feebate-system och utbytbara certifieringssystem) (4) radikala förbättringar av information om marknaden genom övervakning och feedbacktjänster, certifieringsstämplar etc. och (5) kombinationer av samtliga ovannämnda alternativ.

Yhteenveto

Talouskriisin vaikutukset Pohjoismaissa ovat vaihdelleet talouksien rakenteiden ja harjoitettujen politiikkojen mukaan. Elpyminen on ollut epäröivää. Talouskriisin syyt huomioon ottaen, pankkivalvonnassa, -säätelyssä ja rahoitusmarkkinoiden riskien hallinnassa on odotettavissa muutoksia. Aikaisemmat kriisit ovat osoittaneet pankkikriisilähtöiset kriisit poikkeuksellisen pitkiksi ja vaikeiksi. Yleensä kriisit merkitsevät myös merkittäviä rakennemuutoksia taloudessa ja sen instituutioissa, mikä luo niin riskejä kuin mahdollisuuksia.

Vihreä elvytys

Useimmat Pohjoismaat, monien muiden maiden joukossa, ovat väittäneet soveltaneensa merkittäviltä osin ns. “vihreää elvytystä”. Yleispätevän vihreän elvytyksen määritelmän puuttuessa elvytyspakettien vertailu on kuitenkin vaikeaa, varsinkin kun pakettien monista ulottuvuuksista voi aiheutua ympäristökehitykselle haitallisia epäsuoria vaikutuksia. Yleisesti ottaen, mitä tahansa elvytystä, joka edistää kestävän kehityksen mukaista investointi- ja muuta toimintaa, voidaan pitää “vihreänä”. Konkreettisemmin ilmaistuna, investoinnit energiatehokkuuteen, uusiutuvaan energiaan (joillakin varauksin), päästöjen vähentämiseen sekä jätteiden kierrätykseen (kuten erilaisiin päästökontrolliteknologioihin) voidaan määrittää “vihreiksi”. Vihreän elvytyksen määrää tärkeämpää on kuitenkin ympäristöinvestointien ylläpito talouskriisin jälkeisinä vuosina. Elvytysmenetelmien huolellinen valinta ja annostelu edistävät siirtymistä kestävämpään kehitykseen.

Finanssipolitiikkamahdollisuudet talouskriisin jälkeen

Vihreä elvytys on pian ohi, mutta keski- ja pitkällä aikavälillä finanssipolitiikka tarjoaa vihertymismahdollisuuksia. Pohjoismaissa näyttää olevan yleinen trendi siirtyä kohti ekologisempaa verojärjestelmää, jossa ympäristöä rasittavien toimintojen verotusta nostetaan muiden verojen, esim. ansiotuloverojen kustannuksella. Valtion velkaantuminen ja väestön ikääntyminen kiristävät valtion budjetteja, tarjoten samalla mahdollisuuksia jatkaa ekologista veroreformia, esim. vähentämällä tai poistamalla ympäristölle haitallisia tukiaisia. Päästökaupan myötä kasvaa myös muiden markkinamekanismia hyödyntävien menetelmien ja tietovälineiden merkitys.

Välittömät ympäristövaikutukset

Kuten nykyinenkin kriisi, useimmat talouskriisit alentavat ympäristökuormitusta lyhyellä aikavälillä. Esimerkiksi vuonna 2008 kasvihuonekaasupäästöt

laskivat 2 % Norjassa ja 10 % Suomessa, tosin Norjan lasku saattoi johtua muista (teknisistä) syistä. Erityistoimenpiteiden puuttuessa on kuitenkin suuri riski, että osa myönteisestä kehityksestä katoaa tulevina vuosina. Talouskasvun pudotus on keskimäärin puolittanut EU:n päästökaupan (EU-ETS) piirissä olevien päästöoikeuksien hinnat. Samalla tärkeiden energialähteiden, kuten hiilen maailmanmarkkinahinta on pudonnut. Näiden seurauksena sähkövoimayhtiöt ovat lisänneet hiilin käyttöään, esimerkiksi 20 % Suomessa vuonna 2009.

Keskipitkän aikavälin ympäristövaikutukset

Kaikesta huolimatta, talouskriisin syvyys yhdistettynä raskaan teollisuuden rakennemuutoksiin voi alentaa keskipitkän aikavälin kasvihuonekaasupäästöjen kasvua pysyvästi. Siten EU:n 20-20-20 tavoitteeseen vuoteen 2020 mennessä sitoutuneet Pohjoismaat tulevat todennäköisesti nauttimaan huomattavasta huojennuksesta päästövähennystarpeissaan. Samalla päästöjä hillitsevien investointien tarve alenee. Arvioimalla IEA:n (International Energy Agency) Euroopan energiainvestointitarve-ennusteita vuosille 2010 – 2020 pitkän aikavälin päästövähennystavoitteiden saavuttamiseksi karkeasti alakanttiin, on Pohjoismaiden vuosittainen investointitarve vähän alle 3 miljardia euroa vuodessa, johon ym. talouskriisin päästöaleneminen merkitsee muutamien satojen miljoonien eurojen vuosittaista helpotusta.

Pitkän aikavälin ympäristövaikutukset

Talouskriisi ei ole juurikaan vaikuttanut sellaisiin päästöihin, joita säätelee vakiintunut politiikka. Esim. happamoituminen ja rikkidioksidin päästöt on käytännössä irrotettu talouskasvusta. Sen sijaan päästöt, joiden säätelyä vasta kehitetään näyttävät olevan herkempiä talouskasvun muutoksille. Näin on asian laita esim. kasvihuonekaasupäästöjen ja Itämeren rehevöitymisen osalta. Näillä alueilla T&K ja innovaatioiden toimivuuden esittelyprojektit edellyttävät erityishuomiota ja pitkän aikavälin ympäristöhaitat voivat olla syvällekäyviä.

Yllämainitut odotukset pohjautuvat etupäässä talouden kausivaihtelun ja talouskriisin jälkeen odotettavissa olevan alhaisen investointitason vaikutuksiin, sillä oletuksella ettei erityisiin politiikkatoimenpiteisiin ryhdytä. Talouskriiseihin liittyy usein myös merkittävää talouden rakennemuutosta, jonka ympäristöseuraamuksiin vaikuttaa alan erityispiirteiden lisäksi harjoitettu politiikka ja yritysstrategiat.

Vihreät innovaatiot globalisoituvassa taloudessa

Aasian rooli globaalin talouskasvun ja niihin liittyvien päästöjen ja suhteellisten hintojen määrittäjänä on todennäköisesti vain kasvamassa. Samalla Aasian maat tarjoavat kasvavia vientimahdollisuuksia Pohjoismaisille

ekoinnovaatioille. Päästöintensiivisen tuotannon siirtyminen nopean talouskasvun ja vähemmän tiukkojen ympäristörajoitteiden maihin, eli ns. päästövuoto tulisi nähdä osana globalisaatioprosessia. Suorien siirtojen sijaan, Pohjoismaiseen tuotantokapasiteettiin kohdistuu vähittäistä korvautumista uusinvestoinneilla kasvumarkkinoilla. Pohjoismaisen politiikan haasteena on varmistaa, että kasvumarkkinoille nouseva tuotantokapasiteetti on tasoltaan viimeisintä puhdasta teknologiaa, joka mieluiten perustuu Pohjoismaisiin innovaatioihin. Jää nähtäväksi voiko EU:n rajoille asetettavilla veroilla hillitä kasvihuonekaasupäästöjä maailmanlaajuisesti. Ainakin se edellyttäisi runsaasti taloudellisten vaikutusten tutkimusta, hiilijalanjälki tilastojen tuottamista, sekä kansainvälisen kauppalainsäädännön selvitystä erityisesti kauppakonfliktien suhteen ennen sellaisen instrumentin käyttöönottoa.

Pohjoismaissa on lupaavaa vihreää innovaatiopotentiaalia

Innovaatiopanostusten kansainvälisissä vertailuissa Pohjoismaat tyypillisesti menestyvät hyvin. Innovaatioiden kaupallisessa menestyksessä on sen sijaan runsaasti parantamisen varaa, minkä suhteen vaatimukset voivat kasvaa yksityisen ja julkisen rahoituksen saatavuuden kiristyttyä. Aikaisempien panostusten koko ja laatu on yhdessä yleisesti ottaen tiukan Pohjoismaisen ympäristöpolitiikan kanssa tuottanut suhteellisen vahvan vientipotentiaalia omaavan tuotevalikoiman ympäristöteknologiaa ja -palveluita seuraavilla alueilla:

- Tuulivoima,
- vesivoima,
- maalämpö,
- biomassa (ml. metsätuotteet):
    a) biomassan valmistus (kestävä maa- ja metsätalous),
    b) biomassan käyttö (jätteen poltto, kaasuunnus, jalostus),
- energian säästöteknologia,
    a) teolliset sovellukset,
    b) asuin- ja asuinrakennussovellukset – yhdistettynä parhaimmillaan paikallisiin energianmuunto- tai -säilöntäjärjestelmiin,
- tieto- ja kommunikaatioteknologia (ICT):
    a) älykkäät energiamittarit,
    b) muut mittaus-, seuranta- ja palautejärjestelmät,
- kierrätys, sekä
- jätevesien käsittely.

Vihreän innovoinnin jatkuvuus ja innovaatioiden kaupallistaminen

Laskevat lähitulevaisuudessa alle talouskriisiä edeltävien odotusten erityisesti päästövähennysteknologioiden osalta. Ottaen huomioon yksittäisten

Pohjoismaiden markkinoiden pienuuden, erityisesti kehitys-, kokeilu- ja esittelyvaiheet voisivat hyötyä Pohjoismaisen yhteistyön tarjoamista skaalaeduista. Yksikkökustannusten laskua edeltävät tyypillisesti useat sovelluskokeilut ja markkinointiyritykset. Ympäristötutkimus ja -kehitys, sekä innovaatioiden toteuttamiskelpoisuutta esittelevien projektien tuen jatkuvuuden turvaaminen tarjoaa mahdollisuuksia tiivistää Pohjoismaista yhteistyötä, mikä puolestaan voi lisätä yksityisten sijoittaen kiinnostusta ja riskipääomarahoitusmahdollisuuksia.

Ympäristöpolitiikan jatkuvuus budjettirajoitteiden vallitessa

Talouksien rakennemuutosten ja kiristyneiden budjettirajoitteiden vallitessa, ympäristöpolitiikan tavoitteiden saavuttaminen edellyttää politiikkainstrumenttien uudelleentarkastelua. On syytä harkita (1) luonnonvarojen kulutusverouudistuksia ilman keskimääräisiä veronkorotuksia; (2) ympäristölle haitallisten tukiaisten poistoa tai alennusta; (3) muita markkinamekanismia hyödyntäviä menetelmiä, kuten vaihdettavia sertifikaatteja tai suoritukseen perustuvia maksualennuksia; (4) radikaaleja parannuksia markkinatietoon uudenlaisilla seuranta- ja palautejärjestelmillä, sertifikaatti leimoilla, jne.; sekä (5) edellisten yhdistelmiä.

Annex 1

Stepwise description of a bank crisis starting in real estate

A crisis in the real estate market, implying substantial drops in prices of real estate, reverberates through the economy due to several reasons:

- sellers of real estate that planned to use the revenue of the sales as part funding for new acquisition (of which the price may have been agreed already) suddenly need extra credit, whereas the underlying value of their new acquisition dropped under the agreed price; this implies more expensive credit (due to higher risks) and hence less remaining purchasing power, some of these sellers will end up in bankruptcy or financial remediation
- real estate owners with mortgaged property can experience that the underlying value diminished below the mortgage volume; in that case banks will demand additional collateral, in turn this may spur a spiralling amount of forced sales if no other sources of collateral are available; as a consequence prices of real estate will drop even more
- small entrepreneurs often use real estate as a collateral for starting up or expanding their business, a drop in the value of their real estate curtails the funding potential and may thereby smother business expansion or even continuation of the business (this business funding effect was also typically reported in the current crisis)
- when the aforementioned effects have achieved some scale banks are forced to tighten credit policies in general and this starts to affect all kinds of business operations, in particular also trade
- the effects mentioned under 3 and 4 will affect economic growth, simply because a growing number of business start-ups and extensions gets cancelled, whereas also orders – even in existing trade relations – get cancelled; in other words economic activity starts to slow down instead of getting busier; at this stage the crisis also internationalises and share prices start to drop (significantly)
- when the crisis has arrived at stage 5 employment effects start to play a bigger role and thereby consumer demand, the number of laid-off people increases and – depending on the social security systems – consumer expenditure will tend to decrease or at least stagnate, for a start with respect to durables; as a consequence the crisis will start to spread further through the economy and also more internationally, whereas further drops in share prices are likely

- some counter movements should start to get visible, among others because more than only real estate prices may start to decrease, especially of products from short term fixed capacity systems (e.g. energy), also share prices of basically sound companies will drop and may become attractive for those that can still afford to buy; there occur also changes in demand structures causing some sectors to win (e.g. in Nordic countries: domestic tourist services vs. abroad); whether these counter movements start to catch up enough to stop the (worsening of the) crisis depends on the severity of the crisis and the concomitant loss in trust and on public stimulus policies
- the added element in the crisis of 2010 is a faltering banking system at an internatial scale, which is attributable to the un-transparent risk dissolution structure that emerged; this meant that when the crisis proceeded, banks could no longer adequately assess the risks of other banks, and as consequence even all kinds of fairly routine bank services became more difficult to sustain at levels needed for a normal business environment. This in turn has decelerated the economy much more briskly (causing the effects mentioned under 4 to 6 to swell to new proportions and develop surprisingly quickly)
- as a result, national governments and central banks had to step in to safeguard the banking system. Nevertheless various banks and financial service organisations went bankrupt; even though in Nordic countries this has only been a very big issue in Iceland, it nevertheless also affects these economies e.g. because of generally changing trends in public finance conditions, and hence public policies in Europe, with significant ramifications for environmental policy.