Chapter 3

Sustainable development: Climate change and fisheries policies

Sustainable development is a key theme in policy making in Norway. Although it owes a considerable part of its wealth to the carbon-based economy, Norway gives priority to the objectives embodied in the OECD Green Growth Strategy and sees itself as a pioneer in some areas. The sustainable development strategy, an integral part of the documentation for the 2008 budget, spelt out the key principles that were intended to guide policymaking and a set of quantitative indicators that are intended to give an indication of progress. Its focus on preserving natural capital and the precautionary principle can indeed be seen to be reflected in Norway's policy aims on climate change and on fisheries, two otherwise rather different problems. Another principle is the use of cost-efficient means to achieve these policy objectives. In many ways Norway has pioneered the use of such measures, introducing a CO_2 tax early on and adopting individual quotas in fisheries. But in other ways policy prevents them from playing their full role, exempting significant sectors from the CO_2 tax and now from the emission trading system, and restricting the tradability of quotas in fishing. This chapter explores these issues, noting that some potential conflicts between sustainable development objectives could be given fuller recognition, and that Norway can and should follow through more strongly the logic of its pioneering use of economic incentives to further sustainability goals.

The pursuit of sustainable development is an explicit part of the government's programme; the guiding principles were set out as part of the 2008 budget. It embodies the key aims of the OECD's green growth strategy both in trying to improve the environmental sustainability of economic development in Norway and in making a contribution, through supporting the development of new energy-related technologies, to green growth elsewhere and particularly in developing countries. This chapter is not a full analysis of the consequences of this policy which, in principle, has ramifications in a wide array of economic policies. Instead, after a brief outline of some key aspects of the sustainable development framework in Norway, the chapter covers two particular issues: climate change and fisheries.

Climate change and fisheries are in a sense almost polar opposites: the emissions from Norway's small population contribute little to global warming, though of course all countries large and small will need to act in order to reduce the problem. But Norway's economy is highly dependent on the petroleum industry, whose exports are obviously heavily implicated. On the other hand, the fishing industry, important in the past, is now of only marginal importance in the Norwegian economy; but, and by contrast, Norway has one of the largest fishing fleets in the world and the eleventh largest catch by weight (the 3rd largest among individual OECD countries after the USA and Japan). As the analysis below shows, in both areas other countries indeed have something to learn from Norway, even if Norway's policies are not always designed to be as effective as they could be and sometimes cause higher economic losses than might be necessary to achieve their objectives.

Sustainable development in Norwegian economic policy

The principles set out in the 2008 budget are probably the most explicit and highly developed incorporation of sustainable development considerations into declared economic policy aims in any OECD country (Box 3.1). This is a quite unusual arrangement in OECD countries. Another facet of sustainable development policy that seems unique is that in 2007 the Norwegian authorities invited a "Peer Review" of the programme by experts from abroad (admittedly they were largely Swedish civil servants); some of whose recommendations were taken account of in the 2008 budget (Docent *et al.*, 2007).

The premise of sustainable development is that public policy should pursue the overarching goal of evaluating measures in terms of a variety of long-term impacts that cannot be easily synthesised. Since the ministry of finance is generally the most powerful ministry, giving it responsibility for overseeing the sustainable development strategy is a good way to give the strategy a high priority in policy formation. Nevertheless, sustainable development will have the priority that policy statements imply, only if the internal organisation of the ministry in turn gives it such priority. A system of output-oriented budgetary management in the ministry (indeed in all ministries) might make it easier to change priorities in this way in addition to improving efficiency generally, as noted in the

Box 3.1. **Priorities and principles in the Strategy for Sustainable Development**

The government has identified seven priority areas in its strategy:

- International co-operation to promote sustainable development and combat poverty.
- Climate change, the ozone layer and long-range air pollution.
- Biodiversity and cultural heritage.
- Natural resources.
- Hazardous chemicals.
- Sustainable economic and social development.
- Sami perspectives on environmental and natural resource management.

And five principles against which to judge policy action:

- Equitable distribution.
- International solidarity.
- The precautionary principle.
- The polluter pays principle.
- Joint efforts (i.*e* by the whole population).

previous chapter. The Peer Review (Docent *et al.*, 2007) suggested that it might be more effective to locate the finance ministry unit responsible for sustainable development in the budget department of the ministry rather than in the economic department, on the grounds that there is a more direct link with concrete policy measures and expenditure; however, it noted that there were arguments that justified the current choice. According to the Peer Review, unless the budgetary process "*starts* with the goals and ambitions formulated in [the sustainable development strategy]" these goals will not be pursued to the degree that programme implies.

Currently, the annual budgetary process does not start with a full review of sustainable development, rather a report on progress forms part of the background documentation, being prepared after all key decisions have been taken. Although regular analytical work in the ministries can still influence policy, there is a risk that such routine reports eventually focus more on "box-ticking" than developing arguments for policy change. Since priorities and problems in this area change only slowly, and also because most related policies tend to be slow-acting and need stability, an annual in-depth review would indeed be unnecessary. But to maintain the strategic priority implicit in its place in the 2008 budget it would be a good idea to follow the recommendation of the Peer Review at least periodically, with a report that explicitly sets out to match specific policies against results obtained and deriving consequent policy changes where necessary. There is an opportunity for this in 2011, when the strategy for sustainable development is to be revised (revisions are due every 4 years).

Indicators for sustainable development

Norway has been officially investigating alternative measures of sustainable national income for some time. In fact, as the Peer Review pointed out, Norway has been a driver internationally in the OECD and other bodies to develop analytically coherent and internationally accepted indicators. A commission was appointed in 2004 to decide on a

set of indicators. In its report (Ministry of Finance, 2004) the commission chose 16 indicators intended to complement standard economic data with a view to indicating whether a broad definition of national wealth (*i.e.* that which could be passed on to future generations) was being maintained. Public consultations were also involved and in the end a set of 18 indicators was chosen, grouped under a number of key headings (Box 3.2). The European Commission uses about 30 indicators of a similar type (the "Level 2" indicators, see EU, 2009a).[1]

Box 3.2. **Norwegian indicators for sustainable development**

International co-operation for sustainable development and combating poverty:

- Norwegian official development assistance, in NOK and as percentage of gross national income.
- Imports from least developed countries and from all developing countries.

Climate, ozone and long distance transport of air pollution:

- Norwegian emissions of greenhouse gases compared with the Kyoto Protocol target.
- Emissions of NO_x, NH_3, SO_2 and NMVOCs.

Biodiversity and cultural heritage:

- Bird population index – population trends for breeding bird species in terrestrial ecosystems.
- Proportion of inland water bodies classified as "clearly not at risk".
- Proportion of coastal waters classified as "clearly not at risk".
- Trend in standards of maintenance of protected buildings.

Natural resources:

- Energy use per unit of GDP.
- Size of spawning stock of Northeast Arctic cod and Norwegian spring-spawning herring, compared with the precautionary reference points.
- Irreversible losses of biologically productive areas.

Hazardous chemicals:

- Potential exposure to hazardous substances.

Sustainable economic and social development:

- Net national income per capita by sources of income.
- Trends in income distribution.
- Generational accounts: need to tighten public sector finances as a share of GDP.
- Population by highest level of educational attainment.
- Disability pensioners and long-term unemployed persons as a percentage of the population.
- Life expectancy at birth.

Source: See Brunvoll *et al.* (2008).

These indicators are used in the annual report on progress on sustainable development for the budget. As a relatively new procedure, its practical impact on policy has yet to be established, and a "some indicators are better than no indicators" approach is

a reasonable way to start. The current set is a mixture of outcomes, inputs and risks, which may not always be appropriately dimensioned. No compact set of indicators can capture the subtleties (and imprecision) of the concept of sustainable development; sensible guidelines to future revisions to the set of indicators can be found in Alfsen and Moe (2008), suggesting that they should focus on total wealth, including both wealth which can be given monetary value and other forms. The existing indicators were developed in this framework but, nevertheless, there are some dangers in taking some of them too seriously as policy targets. For example:

- Development assistance expenditure is a classic case of using an input indicator because the appropriate output indicator – which would be development progress due to Norwegian assistance – is difficult to measure.
- Energy use *per se* may, on the one hand, be irrelevant once account is taken of the problems it generates (greenhouse gas and other emissions, loss of habitat) but, on the other hand, *if* it is relevant, why should it be per unit of GDP and not overall use?

This is not to say that input indicators have no value, but that targeting them may be pointless unless at least some information is available on results obtained.

The priority area "Sami perspectives on environmental and natural resource management" was singled out by the Peer Review as a potential source of fragmentation, since in principle these perspectives would already be relevant under all the other headings. The Peer review suggested that it be dropped as a specific priority, but it has been retained. This perhaps reflects how difficult it can be to avoid equating socially (or politically) *desirable* with socially *sustainable*. A related area where there is a clear social (or at least political) preference, and which could arguably be related to some form of sustainability, is regional policy. In fact the political importance of maintaining population in certain areas that would not be economically viable, without public intervention of some sort, has a significant influence on many policies from education and health to transport and climate change. Taking account of this in the sustainable development indicators might not improve policy making but it might make parts of it more transparent. As Alfsen and Moe (2008) note, none of the key indicators should be reduced below critical levels – implying that critical levels should be defined for each of the indicators including regional factors. Furthermore, it also follows that a fall in any individual indicator is not necessarily undesirable if it is not critical and is compensated by an improvement elsewhere, but what

Box 3.3. **Recommendations on the sustainable development strategy**

- While maintaining a variety of indicators for their heuristic or public consciousness role, be clear on which are outcome indicators which can be targeted and those which are input or intermediate indicators, such as development assistance expenditure or import volume, which should not be targeted *per se*.
- Establish ways in which trade-offs and conflicts between different indicators can be assessed and managed.
- If Sustainable Development, or Green Growth, is to be a genuine over-arching goal, ensure that the budgetary and policymaking process does, at least periodically, start with an assessment of Sustainable Development needs.
- Apply the tools of Regulatory Impact Analysis and Public Expenditure efficiency assessment to Sustainable Development policy.

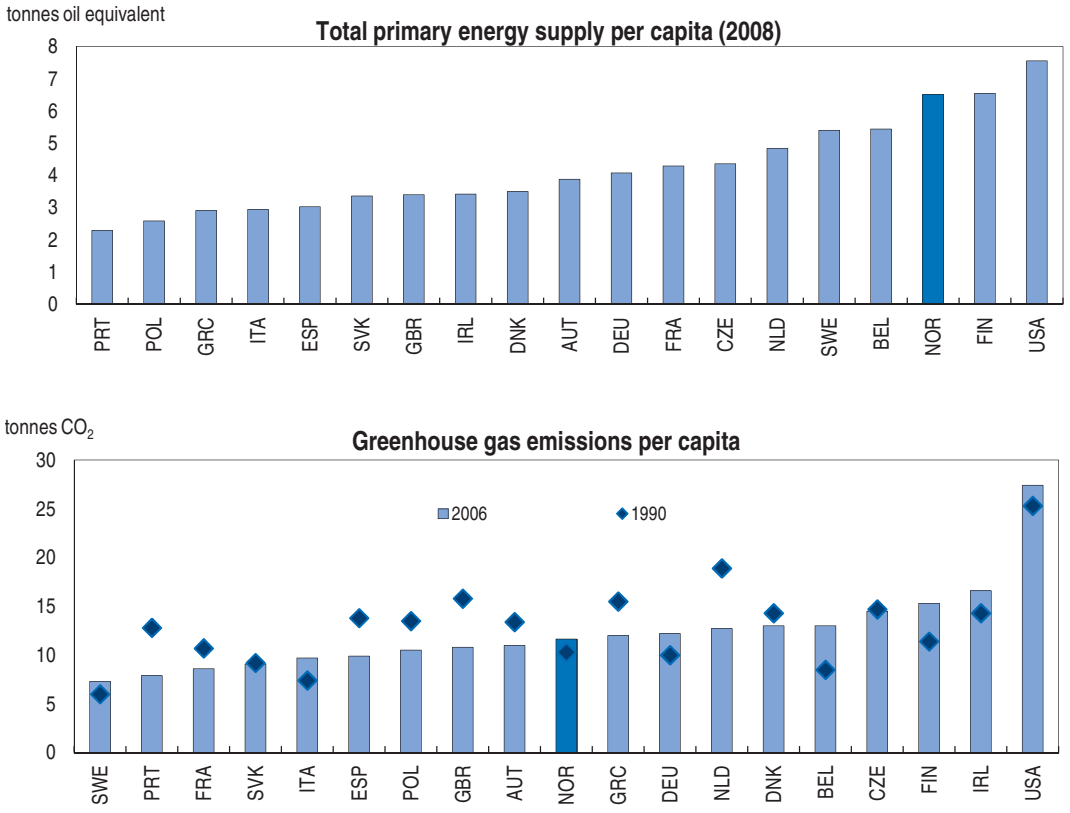
is the trade-off between different indicators? This is another area that deserves attention if the sustainable development indicators are to be taken seriously as a check on policy.

Climate change

Norway is energy-intensive with relatively high per capita greenhouse gas emissions

The case of climate change policy in Norway is interesting because, as a small country, its own carbon or greenhouse gas (GHG) "footprint", at least if derived from the consumption activities of Norwegians, is quite small by global standards. On the other hand, its economy is highly dependent on the petroleum industry so it exports products which will inevitably generate a considerable amount of greenhouse gases. Norway is a relatively energy-intensive country. In terms of per capita greenhouse gas emissions, it stands out somewhat less but still appears by no means a "clean" country, compared with Sweden, for example or even Denmark which has no hydro power (Figure 3.1, Figure 3.2). The high energy intensity is due both to the abundance of hydroelectric energy, and to the petroleum sector. The main emissions associated with petroleum of course occur in countries to which Norway supplies energy, but the extraction and supply of oil and gas is a major emitter in Norway, and increases in these emissions are the main reason why Norway's *domestic* emissions in 2008-12 will far exceed its target[2] under the Kyoto Protocol. "Fugitive emissions" such as flaring account for over 10% of GHG emissions from the energy sector. The importance of the petroleum sector also means that one of the main

Figure 3.1. **Total primary energy supply and GHG emissions per capita, Norway and selected countries**



Source: IEA (2009) for (Panel A) and European Environmental Agency (Panel B).

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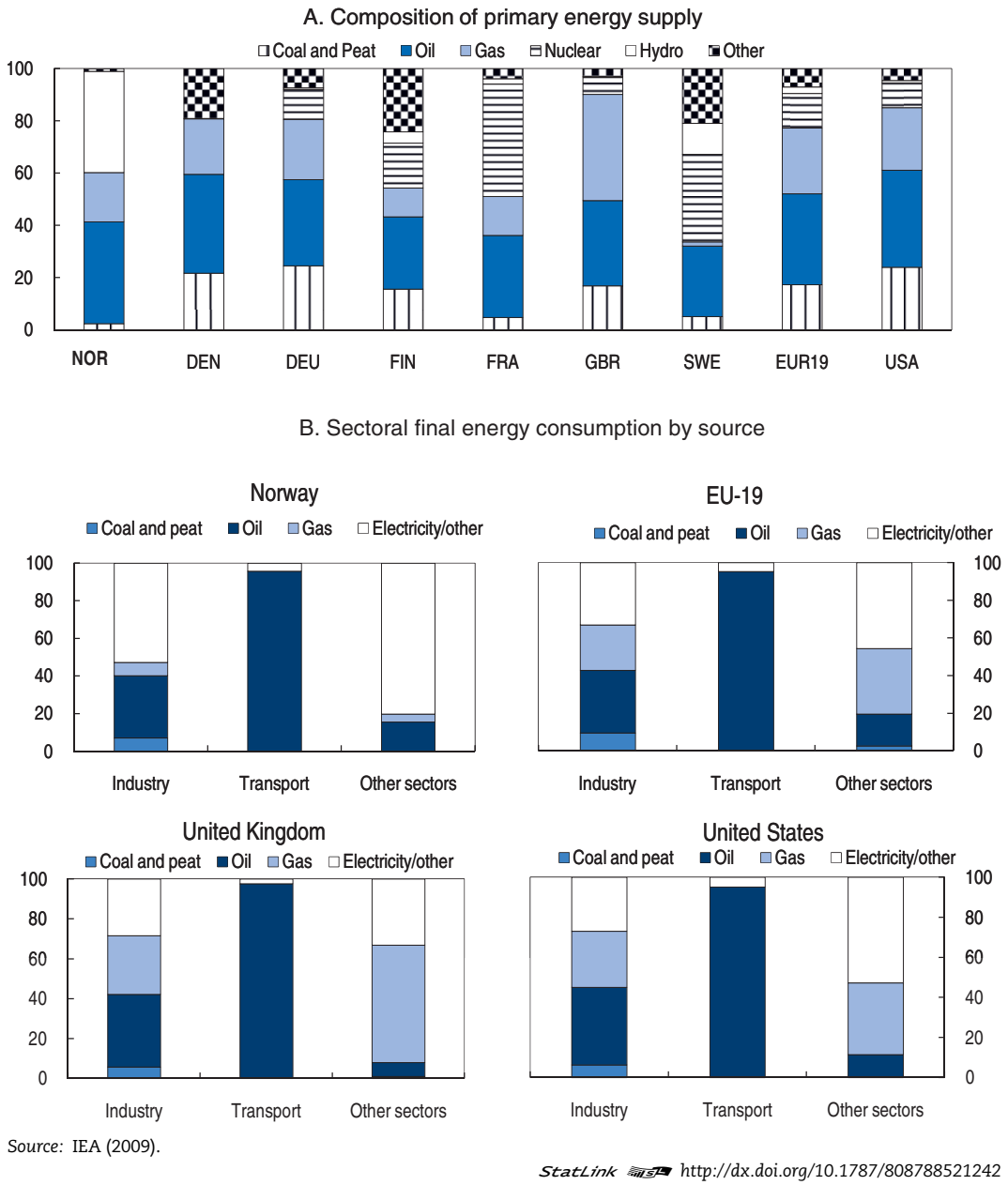
Figure 3.2. **Energy by source**

% of total, 2008



Source: IEA (2009).

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ways in which Norway will lose economically from a successful curb on global GHG emissions is through a terms of trade loss as the price of hydrocarbons would be significantly lower than otherwise.

Cheap hydroelectric energy has been important in developing certain specific industries, especially aluminium and metal alloys. In most cases raw materials other than energy have to be imported and production sites are remote so transport costs for the product are high. So, despite cheap energy, many plants in these industries are not particularly profitable and have been supported through labour subsidies or other regional policy tools. However, they are also significant emitters of CO_2, not because of the energy

consumed but because of emissions due to the chemical processes involved. Even though their emissions have not been subject to CO_2/GHG taxes, as discussed below, their GHG emissions have declined significantly over the past 20 years, unlike that in most other categories. Aside from those in the petroleum sector, it is emissions associated with transport that have risen particularly strongly as rising incomes lead to more travel and more emission-intensive modes of travel. Contrary to the process industries, emissions by much of the transport sector (with the notable exceptions of international air travel and shipping) have been subject to the CO_2 tax, at relatively high rates.

Norway is an enthusiastic supporter of international action on climate change

Norway has a record of activism in trying to develop international action on climate change. It was an enthusiastic supporter of the 1992 UN Framework Convention on Climate Change and was one of the first countries to introduce a CO_2 tax, in 1991. It also supported the development of the Kyoto Protocol to the convention, ratifying it in 2002 at the same time as European Union countries. Since then, its domestic emissions have risen further, but Norway has announced that through purchasing offsets that reduce emissions in other countries it aims to effectively reduce its emissions by 10% relative to the Kyoto target (Box 3.4).

Box 3.4. **Key climate change policy targets**

		Norway's GHG emissions (thousand tonnes CO_2 equivalent) (as % 1990 level)	Memo: Annex 1 countries emissions (as % of 1990 level)
1991	United Nations Framework Convention on Climate Change. Annex 1 parties agreed to work to reduce GHG emissions, recognising that "the return *by the end of this decade* to earlier levels of anthropogenic [GHG emissions] … would contribute to modifying [long term emission trends]" (emphasis added)	47 686 (*96.0*)	(97.7) (excluding former CMEA: 99.8)
1997	Kyoto Protocol. Norway committed to average GHG emissions (on a net basis, *i.e.* after adjusting for use of flexible mechanisms such as emission trading and the CDM) in 2008-12 no more than 1% above the 1990 level.	52 647 (*105.9*)	(93.2) (excluding former CMEA: 106.6)
2008	Norway committed to over-fulfil the Kyoto commitment by limiting its net emissions (after adjusting for use of Kyoto mechanisms) to 91% of the 1990 level. Norway announces a target for 2020 of net emissions at 70% of the 1990 level and zero net emissions by 2050. The target date for "carbon neutrality" is to be brought forward from 2050 to 2030 if enough other countries adopt similar ambitious targets.	53 848 (*108.4*)	(97.0, 2007 data) (excluding former CMEA: 111.0)
2009	The re-elected government announces that, in the context of an ambitious agreement at the Copenhagen climate change conference, it would reduce the target for net emissions in 2020 to 60% of their 1990 level.		

Data: Statistics Norway, UNFCCC.

At the same time as declaring, in early 2008, that it would "over-fulfil" its Kyoto target, Norway announced emissions targets for dates further in the future. By 2020 it aims to have reduced net emissions by 30% compared with 2012 and that by 2050 it would reach "carbon neutrality", *i.e.* that its net emissions (of all greenhouse gases, not just CO_2) would be zero. By "net" emissions is meant Norway's contribution to global emissions, *i.e.* actual domestic emissions less offsetting reductions abroad achieved through mechanisms such as trading under the Kyoto Protocol or the Clean Development Mechanism. Prior to the Copenhagen conference the government announced that it would aim for a lower target, 60% of 1990 emissions, if this contributed to an ambitious global agreement. As is the case for its Kyoto period target, Norway intends to use emissions reductions abroad as credits to offset domestic emission that will still be positive in 2050. The government has not yet set any specific objective for domestic emissions, though it currently estimates that they could be reduced by some 15-17 million tonnes CO_2-equivalent in 2020 relative to a baseline which projects an increase of some 9 million tonnes over 1990 levels. With this implied level of domestic emissions, reaching the 30% target in 2020 would require 7-9 million tonnes of offsets, 14-18% of 1990 emissions. The government has a study under way, in its "Klimakur" programme, intended to calculate the marginal costs of various kinds of action with a view to using this as an input to policy formation.

Norway's contribution to global mitigation efforts

One of the aims of Norwegian policy in announcing ambitious emissions objectives for the future is an attempt to lead by example, to encourage other countries to adopt serious programmes for emission reduction. It does this even though such objectives could be costly to meet with essentially no benefit for Norway from its own action unless other countries do indeed follow the lead. In fact, even if other countries do take sufficient action to avoid significant climate change, there may still be little benefit for Norway. This is because the costs to Norway of the direct effects of climate change are not clear (indirect repercussions, through migration for example, could be important, independently of these directs effects). It is true that the loss of the Gulf Stream would be catastrophic but estimates of the likelihood of this have diminished in recent years. Some parts of Norway are vulnerable to sea level rise also, but these are not too large, although they include important populated areas. A significant rise in average temperatures would obviously change the way of life if it reduced snow cover a lot, but this might bring benefits as well as costs. As everywhere, the risk of extreme weather events would rise too. Overall, given the significant costs of obtaining a carbon-neutral economy (even if they are not particularly large set against Norway's current and expected future wealth, although Norway would suffer significant terms of trade losses – unlike most OECD countries), Norway's objectives for its climate change policy have to be seen as some combination of pure altruism and a strong precautionary approach. Both of these are consistent with the policy approach embodied in Norway's agenda for sustainable development. But they both also require an enduring political commitment since, while the overall economic costs are not large, decisions that affect particular sectors quite significantly have to be made at some point.

A small country's influence in climate change policy developments may not be very large, although such things are obviously hard to measure. Norway's influence is enhanced by its reputation for fairness and transparency in other areas, but also no doubt because its status as a major oil exporter raises its profile – and enhances its credibility given its material self-interest in maximising petroleum revenues. Recent OECD work suggests that

only large coalitions of countries could get sufficient return on joint emission reduction actions to make the formation of a coalition worthwhile and even then it would obviously be still subject to free rider problems without any mechanism to enforce compliance (OECD, 2009a). But Norway may be having some impact by building influence in successively larger coalitions. Firstly, the Nordic countries themselves often have a similar outlook on environmental issues and are sensitive to each others' policies.[3] Secondly, three of these countries are in the European Union and can exert influence over time on the objectives adopted by the Union.

Another way Norway works to build its influence is through measures in developing countries. First by making it clear that it believes that richer countries should provide finance for "capacity building" measures and also by participating in Clean Development Mechanism (CDM) projects that both provide Norway with offsets and frequently provide the target country with technological transfer. Under the CDM, countries subject to emission ceilings under the Kyoto Protocol indirectly finance projects in countries without emissions ceilings (but which are parties to the Protocol); the finance is provided by purchasing credits that represent the amount by which the project reduces GHG emissions below what they would otherwise have been. These reductions then count, for Kyoto purposes, as if they were reductions in the purchaser's own emissions. Recently Norway has helped to launch a United Nations programme aiming to Reduce Emissions from Deforestation and land Degradation, the REDD programme, in developing countries. Such action is not eligible for consideration under the CDM. A significant part of Norway's contribution to the REDD programme involves helping to set up procedures whereby actions to reduce the emissions caused by deforestation and degradation could be verified and certified so that they could count towards global action in a similar way to CDM projects. Deforestation and land degradation in developing countries are important sources of GHG emissions and developing techniques that could give landowners and others a market incentive to avoid them would be a significant step. Norway's proposal on REDD recognises that the key issue is to overcome the major problems in monitoring, reporting and verification for such projects.

Both game theory and simple geopolitics would suggest that in practice it is difficult for Norway to pursue its agenda for global action on climate change independently of other issues. From fish to finance, Norwegian economic policy is to a greater or lesser extent constrained by developments in neighbouring countries, notably Russia and the European Union. One of the key differences between fisheries policy, discussed later in this chapter, and climate policy is that Norwegian actions on fisheries have a direct effect on specific countries, whereas this is not true for GHG emissions policy. This actually simplifies the analysis of policy for climate change: Norway can essentially influence other countries only by example or persuasion, not by any kind of potential sanctions.

One way in which Norway could use its reputation, but within its existing policy, to improve sustainability is in improving the system of verification of additionality in "offset" actions taken in countries that have not committed themselves to an emissions ceiling. Additionality is important because, if offset projects serve only to help reduce emissions that would have been eliminated anyway, or if they are replaced by emission increases elsewhere, they can severely undermine the objective of reducing global emissions. The use of the CDM by Norway and other countries is subject to its inherent weaknesses related to the difficulty of ensuring that emissions reduction associated with a particular project

really do represent cuts in overall emissions below what they would have been, as well as potential perverse incentive effects (OECD, 2009a: Section 4.3).

The manner in which the GHG-neutrality target is defined is an interesting example of leading by example. Norway's policy commits it to GHG-neutrality by the year 2050, already a potentially costly objective. In addition, if a good number of other countries also commit themselves to ambitious policies, Norway will bring forward its own target to 2030. In fact, if many significant emitters of GHG really did put themselves on a path leading to GHG-neutrality by 2050, the marginal benefit of Norway doing so, and of doing it earlier, would be diminished; furthermore, while Norway could use purchases of emission reductions abroad to achieve unilateral GHG-neutrality, this would be much more expensive if many countries are doing the same thing, as considerably lower net domestic emissions would be required. Thus, under the circumstances in which the 2030 target would be adopted, it would be both substantially more costly and less necessary. As an announcement device, provided it is credible, it is therefore quite powerful.

However, to be credible it has to be feasible. As Box 3.4 shows, Norway's declarations have increased in ambition through time, as its actual emissions have risen. This is not far out of line with the overall group of Annex 1 countries, once the former centrally planned economies (whose emissions dropped radically once their highly inefficient heavy industries were closed down) are removed from the comparison.[4] Emissions have at least stabilised in recent years and did fall as the recession took hold. And overall emissions intensity – the quantity of emissions per unit of GDP – has fallen by over one third since 1990. Rising domestic emissions are perfectly consistent with meeting the Kyoto target (because a high-abatement cost country such as Norway would be expected to use mechanisms that allow it to promote emission reductions in other countries). But the apparent inability to cut domestic emissions significantly so far, despite good intentions, is a reminder that politically difficult choices are involved; furthermore, viewed from abroad, it may weaken the leadership effect of Norway's ambitious targets on effect on other countries. It is therefore important for Norway to adopt efficient domestic measures early, lest excessive costs lead to public resistance to the further measures necessary to meet even the current targets.

Policies to reduce emissions

Norway employs a wide range of measures to reduce emissions (Box 3.5). As far as their impact on emissions up to about 2003 is concerned, they are dominated by two very different measures: the CO_2 tax and the voluntary agreement with the aluminium industry (Table 3.1). It should be noted that the CO_2 tax is not exactly a tax on CO_2 emissions but an excise duty on certain products whose combustion emits CO_2. In addition to considerable variation in the rates applied (Table 3.2, Figure 3.3), it has never been applied to industrial processes and some energy-related emissions from some obvious emitters: refining and petrochemicals, coke ovens, iron, steel, cement and glass production, for example.

The figures in Table 3.1 are based on very different kinds of evidence for the different measures, which is worth summarising to indicate how difficult policy assessment can be. The impact of the CO_2 tax on for land-based emissions is based on a CGE model largely calibrated on 1992 data and looking at changes in emissions over the period 1990-99 (Bruvoll and Larsen, 2002). The low estimated price elasticities in sectors to which it is applied and the fact that many sectors were exempted or paid lower rates explain the low impact; this is an *ex ante* estimate of the likely impact of the tax rather than an *ex post*

Box 3.5. **Main policy measures to reduce GHG emissions**

Taxes

- On emissions:
  - CO_2 tax.
  - Hydrofluorocarbon and Perfluorocarbon tax (tax on production, tax credit on elimination).
- Other taxes:
  - On certain chemicals.
  - On waste disposal.
  - On landfill (differentiated according to standards at disposal site).
- Other taxes with likely incidental effects on GHG:
  - On the purchase of new cars (differentiated according to expected CO_2 emissions).
  - On lubricating oil, beverage containers.
- Regulatory and other measures:
  - General permit system for emitters of pollutants.
  - Requirement to collect methane from landfill, prohibition on depositing wet organic waste.
  - Require carbon capture and storage for new gas fired electricity generation.
  - Target the development of wind power.
  - Promote use of heat production from biomass.
  - Promote energy saving through information and educational programmes.

Table 3.1. **Policy measures, estimated effect on domestic emissions**

Million tonnes CO_2 equivalents reduction per year

	1995	2000	2005	2007	2010	2020
Directly related to climate change:						
CO_2 tax offshore	0.6	3.0	3.0	4.5	5.2[1]	6.9[1]
CO_2 tax onshore		0.8	0.8	0.85	0.85	0.85
Requirement to collect land fill gas	0.2	0.4	0.4	0.4	0.4	0.4
Other measures in the waste sector			0.1	0.1	0.1	0.5
Tax and recycling schemes on HFC			0.3	0.5	0.5	0.5
Climate change agreement with aluminium industry[2]	0-1.3	0.5-2.7	1.6-4.5	1.6-4.5	1.5-4.2	1.8-4.3
Road transport measures[3]					0.4	0.7
Other regulations:						
VOC regulation offshore			0.2	0.2	0.3	0.1
Voluntary reductions:						
SF_6 reduction, magnesium production	1	1.4	1.8	2.1	2.1	2.1
N_2O reduction, production of nitric acid	0.7	0.6	0.5	1.2	1.2-1.6	1.2-1.6
Use of bi-carbon in cement production			0.13	0.13	0.13	0.13
Sum of implemented policy measures		5-7.2			8.6-11.7	11.5-14.6
New policies and measures post 2008:						
Emission trading scheme					0-0.3	0-0.3
Consensus with the processing industry 2009					0.2	0.2

1. Includes combined effect of CO_2 tax and EU emission trading system.
2. The lowest number reflects direct effect of the agreement, while the highest estimate includes voluntary measures taken before adopting the agreement in 1997.
3. Biofuel requirement and CO_2-related tax on new passenger cars.

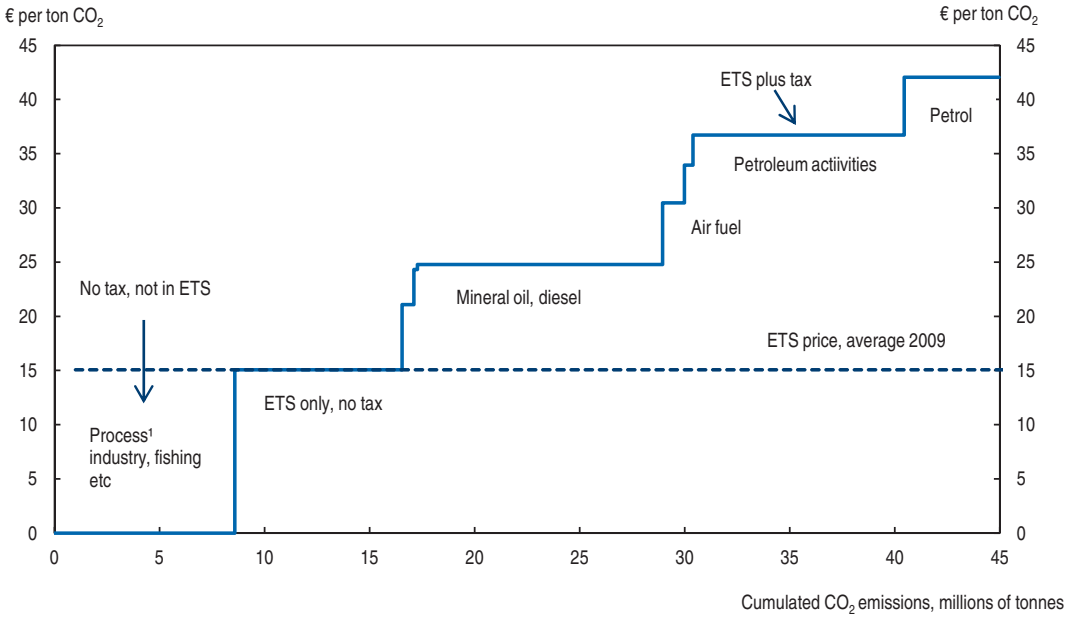
Source: Norway's fifth national communication under the UNFCCC, Table 5.5.

Table 3.2. **The evolution of the carbon tax, 1991-2009**

	Offshore petroleum	Petrol	Diesel	Mineral oil	Heating oil	Coal, coke	Fishing industry	Air transport		Sea transport	
								International	Domestic	International	Domestic
	NOK per litre unless otherwise specified										
1991	0.60	0.60	0.30	0.47	0.47	–	–	–	–	–	–
1992	0.80	…	…	…		0.30 /kg	–	–	–	–	–
1993	…	…	…	0.40	Abolished	…	–	–	–	–	–
1999	…	0.92	…	0.46	–	…	–	0.26 (then removed)	0.26	–	0.26
2001	…	0.72	…	…	0.19	…	–	–	…	–	…
2003	…	…	…	…	…	Abolished	–	–	…	–	…
2006	…	…	…	0.46	…	–	–	–	0.46	–	0.46
2008	…	…	…	…	…	–	–	–	0.56	–	…
2009	0.54	0.84	0.57	…	0.87	–	–	–	…	–	…
memo: other taxes (2009)		4.46[1]	3.50[1]	VAT							

Note: CO_2 tax is not payable on natural gas as transport fuel.
– exempt.
… tax rate is indexed on inflation.
1. On sulphur-free fuel.
Source: Ministry of Finance.

Figure 3.3. **The marginal cost of CO_2 emissions (2009)**



1. Process industry concerns mainly aluminium, ferro alloys and fertilizers.
Source: Ministry of Finance.

StatLink http://dx.doi.org/10.1787/808800232123

assessment. On the other hand, the significant impact of the tax on offshore emissions is because companies and the Energy Ministry report that the action that was taken to reduce flaring and to capture and reinject CO_2 was induced by the CO_2 tax. With the high degree of state involvement in the production of petroleum, it is hard to separate cause and effect here. Furthermore, gas export contracts specify that delivered gas should have a CO_2-content of no more than 2½ per cent while the gas in this field has a natural

CO_2-content of around 9%. Nevertheless, there was some clear influence of the CO_2 tax as, despite a strong official anti-flaring policy beforehand, emissions from flaring fell substantially once the tax was introduced; secondly, while the CO_2 tax did not change the incentive to *separate* CO_2 from natural gas, it was only the tax that made it rational to consider re-injecting it rather than emitting it to the atmosphere.

The impact of voluntary agreements is particularly difficult to assess since the agreements themselves can often be subject to gaming, whereby the industries concerned try to convince the authorities that abatement costs are higher than they actually are so that they can appear to be taking costly action, or that action they are taking would not have occurred without the agreement. This is a likely tendency even when companies are also genuinely interested in effective action. The government assesses that a significant part of the reduction in emissions up to 2003 in the aluminium industry was due to action that was actually taken before the voluntary agreement was finalised. These emissions (of perfluorocarbons, CF_4 and C_2F_6) fell by more than half between 1990 and 1997, the year of the agreement. The 2004 voluntary agreement included targets for process industries which were omitted from the Norwegian emissions trading scheme as introduced by legislation in 2005, the first plans for which, in a 2002 White Paper, were more comprehensive (Box 3.6).

Perfluorocarbons and hydrofluorcarbons provide an interesting example of a way to implement a tax when it is costly to measure emissions directly. Further reductions after 2003 have been encouraged by a tax on both production and imports of these chemicals, but this is offset by a tax credit when they are directly eliminated so that – provided the monitoring system is effective – only gases that are left to escape end up paying the tax. This tax was set at a CO_2-equivalent rate similar to that on diesel oil.

Other measures that seem to have had a significant effect on emissions, mainly of methane, are regulatory actions in waste disposal that combine a requirement to collect methane gas from landfills, introduced progressively as from 1998, and a tax on the final treatment of waste introduced in 1999. Also, measures have targeted particular sources of emissions, by agreement with industry. This kind of intervention may be simpler in Norway than in some countries because the emission source concerned is limited to a small number of companies or installations, sometimes only one in each industry. The impact is however difficult to assess due to asymmetric information between the parties.

Technology development: Carbon capture and storage

At a global level, the development of carbon capture and storage (CCS) technology would allow the use of fossil fuels at a much reduced environmental cost, especially for carbon intensive coal and non-conventional oil, of which there are large reserves. In Norway itself coal and non-conventional oil are largely irrelevant but CCS could nevertheless be useful in reducing emissions from oil and gas production and potentially some industrial processes and gas-fired power generation and in refineries. A small number of facilities are already operating, one of which is in Norway where excess CO_2 in natural gas from the Sleipner field has been separated and injected into a sandstone formation *in situ* since 1996, the world's first commercial CCS project; another, in Snøhvit, has been operating since 2007. Estimates of the likely costs per tonne of CO_2 captured, transported and sequestrated are currently quite high, at least $50 per tonne for various coal and gas technologies and more for non-conventional oil (IEA, 2008; Alberta, 2009). But these are estimates of what costs will be once CCS technology is developed and are of

Box 3.6. **Aspects of CO_2 emissions trading in Norway**

The 2005 Greenhouse Gas Emissions Trading Act introduced CO_2 trading to Norway for an initial pre-Kyoto period 2005-07, similar to the EU ETS. In fact it was always expected that it would be linked to the EU system, though this link was not initially in place.

Particularities of the system were its relatively limited coverage and the method for allocation of emission permits.

Although initial studies had suggested that 80% of total GHG emissions could be covered by a trading system (Stiansen, 1999, quoting a study by the consultancy company ECON), the system as introduced covered no more than 20% of CO_2 emissions, less than 15% of total GHG emissions. It initially excluded sectors that were subject to the CO_2 tax – but not including all sectors not covered by it – but subsequently (from 2008) the offshore petroleum sector was brought in, and is now both in the trading system and subject to the tax (at a rate reduced by an amount similar to the recent level of the CO_2 price in the EU ETS).

Stiansen (1999), discussing the mandate of the commission set up in 1999 to advise the government on the introduction of a trading system, emphasised the key problems an allocation system has to address, in particular the need not to discriminate against early movers – installations that have already invested in reducing emissions – or potential new entrants. Any form of grandfathering necessarily discriminates against new entrants and there are both political economy and efficiency arguments against simple grandfathering when a cap and trade system is first introduced.

The Norwegian system allocates allowances free to installations based on their historical emissions, which penalises early movers; this could have been avoided by allocating allowances on the basis of emissions for each installation calculated in proportion to their output rather than their emissions, as in some already existing schemes.* The authorities argue that pure grandfathering was chosen because it was important to have an allocation mechanism that was transparent and unambiguous; but alternative approaches are not very complicated in theory and their existence in other contexts suggest they are feasible in practice too.

* The Swedish NO_x tax and refund system, introduced in 1992, provides an example of how to provide both an incentive to reduce emissions and a reward to early movers. Energy producers are taxed pro rata on actual emissions while tax credits are given as a function of useful energy produced. Installations with above average emission efficiency are thus net beneficiaries of the system. The current proposal for CO_2 trading in the United States adopts a similar approach by allocating any grandfathered allowances on the basis of emissions under best-practice technology rather than actual emissions.

course highly uncertain because the different technologies required are still in their infancy; no complete combustion plant with integrated CCS has yet been built. In effect these estimates are based on the assumption that further R&D and operational experience will bring costs down substantially.

The state, together with the Norwegian oil company Statoil (of which the government owns 67%), is going to build an experimental complete carbon capture system for the Mongstad refinery. The intention is to install two different technologies for separating CO_2 from post-combustion gases and use the test facility to assess them. Intended as a public-private partnership, up to 80% of the cost (about $700 million for the test facility) is likely to be financed directly by the government with nearly all the rest financed by the publicly-

owned Statoil; the only real private involvement is of Shell (the existing minority partner in the refinery), with a 2% share.

The precise manner of cost-sharing has yet to be settled. According to the agreement between the state and Statoil of 2006 ("Gjennomføringsavtalen") Statoil will contribute the equivalent of what it would have paid in CO_2 tax on the emissions avoided, with the state financing the rest. Provided this included the cost of emission allowances in the trading system, since this is what is applied to the rest of the petroleum sector, this would make a sensible minimum contribution. In this way, the state pays the whole capital cost in excess of the carbon tax revenue, but it would have no direct share in any upside benefits to the company, except through its large equity share.

One of the technologies to be tested (Amine) is supplied by a Norwegian company and is relatively mature; the other (Chilled Ammonia) is supplied by a French company and is where Statoil Hydro expects more improvements from learning by doing to be available. It is intended that the intellectual property rights from improvements will be the property of the companies concerned but that they are to make the results openly available. To ensure that the results have broad relevance, the centre will test capture of two types of flue gas, making the testing relevant also for coal power plants.

Apart from its main purpose in developing and testing technologies, such a facility can play an important role in establishing the cost of this type of CCS.[5] Although cost estimates exist, as mentioned above, it is not clear how reliable they are, since Statoil itself expects that the initial level of costs in the experimental facility will be between 150 and 200 euros per tonne of CO_2 captured. (This compares with estimates in IEA (2008) of around 100 dollars already in 2010). Larger reductions than this would depend on future technical advances. For this reason, the experience gathered with the test facility should be valuable for energy planners.[6]

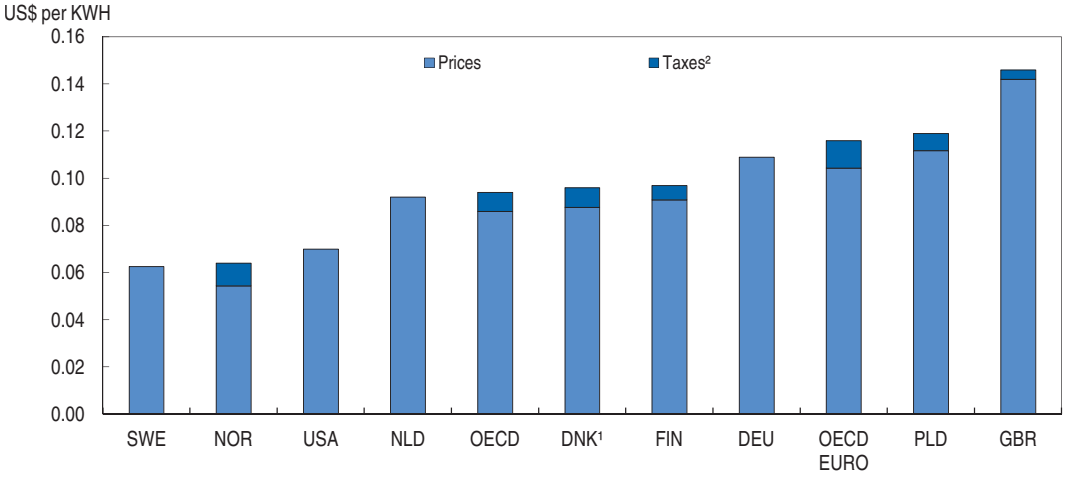
While the test facility is likely to be valuable, the longer term plan is to install a full carbon capture facility integrated in a new gas-fired combined heat and power plant at the refinery to provide power for the refinery and heat and power for the town nearby. This would be designed to capture 10 times as much CO_2 with a much larger budget. Early studies by Statoil indicate that costs may be up to € 3 billion, this is larger than the recently decided EU fund to partially finance projects in seven countries (although this would be money additional to national funding). An important question here is whether to decide to go ahead with this investment immediately or wait. In the first case, the decision as to which technology to use would have to be taken immediately, before knowing the results of the test facility (or of possible new technologies that could emerge). Since this amounts to assuming that there will be no surprises in the results of a test facility in a very new technology it doesn't make much sense and certainly seems to contradict the "value for money" rule incorporated in the sustainable development strategy. However, the government views the mere construction of a full-scale CCS facility as an additional experiment in itself. While the test facility should reveal information about the different technologies, the full scale construction will reveal information about potential problems in scaling up prototype technologies that could be equally valuable. Although the main global role of successful future developments in CCS is likely to be in coal and non-conventional oil, which will never be relevant in Norway itself, it seems appropriate that Norway could help to pioneer a technology that could nevertheless play a significant role in Norway itself and in other gas and coal producers.

Use of hydroelectric power

Carbon-free hydroelectricity supplies practically all of Norway's electricity needs at a very low resource cost. However, the opportunity cost of hydroelectric power is much higher than the resource cost. On the one hand supply is limited by installed generation capacity, but also by precipitation levels, and on the other hand demand comes not only from the Norwegian economy but also from the other countries in the Nordic electricity pool as well as a small amount from Russia and from EU countries through transmission capacity is limited. Because of the dependence of Norwegian electricity supply on precipitation, the grid connections with other countries are used to export surplus electricity and also to import electricity in periods when stored water runs low. Over the last 10 years, Norway has been a net exporter on average, with particularly substantial exports in 2007-09, of between 5 and 10% of total production.

Despite this substantial level of trade, determined by relative spot prices, average prices of electricity supplied to industry in Norway are below those in neighbouring and north-European countries (Figure 3.4). Arbitrage on the spot market is far from being enough to equalise prices because long term supply contracts are not linked to spot prices.[7] Capacity limits on the links with other countries also prevent the markets being sufficiently integrated to equalise average prices. Finally, the national grid in Norway is also constrained in its own capacity to manage domestic demand – the main generating capacity tends to be in the north and west of the country, whereas the main centres of demand are in the south and east.

Figure 3.4. **Electricity prices for industry in Norway and neighbouring countries, 2008**



1. 2004.
2. Unavailable for certain countries.

Source: IEA electricity prices except for Sweden and Netherlands which are sourced from Eurostat (Environment and Energy).

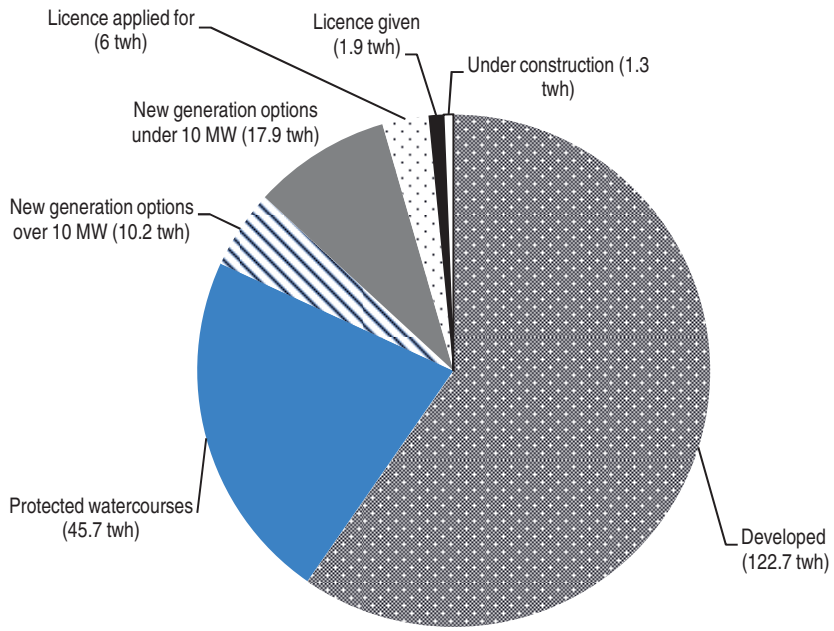
StatLink http://dx.doi.org/10.1787/808811010742

Limitations on the capacity to transfer electricity to other countries may prevent Norway from exploiting a low cost form of zero-carbon energy generation – that of significantly expanding hydroelectric production for export to EU countries where much marginal generating capacity is coal-fired. It is frequently argued that Norway's hydro

capacity is almost fully utilised, with only relatively small capacity locations remaining to be developed. In fact, this is not strictly true: approximately 20% of potential generating capacity cannot be developed because the watercourses concerned are protected under the Water Resources Act (Figure 3.5). For example, of the ten highest waterfalls in Norway, seven have been developed for hydropower and the remaining are protected under the Act. To illustrate the magnitude potentially involved, utilising, say, one half of the remaining protected capacity and exporting it would, if it replaced carbon-based generation in Europe, and did not increase electricity consumption, be equivalent to about 0.15% of EU's 2010 Kyoto target. It can be argued that in practice this would have little effect on actual emissions because both Norway and potential importers of Norwegian hydroelectricity are subject to the same overall emissions ceiling. Within any given overall emission ceiling, the reductions in emissions in the electricity sectors would be offset by higher emissions in the rest of the quota system, just as they would in the case of any particular contribution to emission reductions. However, the use of such low resource-cost emission reductions would reduce somewhat the cost to European economies as a whole of meeting a given emission ceiling, potentially allowing for a more ambitious ceiling once the resources were available.

Figure 3.5. **Hydropower potential[1] as of 1 January 2009**

Expressed in terawatt hours



1. Based upon mean annual generation capacity of 205.7 TWh, for the hydrology period 1970-99. Includes only investments where construction cost/mean annual generation is less than 3 NOK/KWh.

Source: Ministry of Petroleum and Energy.

StatLink http://dx.doi.org/10.1787/808815870380

This is not to say that the protected hydro sites *should* be exploited, it is quite reasonable to argue that a certain (already quite small) proportion of the river system should be protected, but it would be useful to express the cost of protection in terms of the higher electricity prices (partly – but not mainly – due to the EU-ETS quota price being reflected in these prices) in Europe. The perceived threat from greenhouse gas emissions

has grown considerably as understanding of its causes and effects has increased over the past two decades. The protection of some of these watercourses dates back some time – although for others the decision is very recent. It is worth considering explicitly what valuation is being placed on what is being protected against the foregone opportunities for carbon-free energy production elsewhere. Such a study could also help to provide guidelines for protection of nature in other contexts and against other alternative uses, and would be in line with the recommendations above for ongoing development of Norway's sustainable development indicators.

Expanding transmission links with Europe is feasible, the most recent expansion in fact came in 2008, with a 700 MW undersea connection to the Netherlands. Unless it turns out that this new link is unprofitable, it seems highly likely that it would be worthwhile further expanding the interconnection between Norway and other countries. A counterpart of greater integration of Norway's electricity supply with the European grid would be, given the implication that average electricity prices in Norway would rise, that hydroelectricity suppliers would make greater profits than they already do, and that some industrial consumers that may have depended on cheap electricity would be in difficulty. Electricity suppliers already pay a resource rent tax, this could be increased as prices rise. As a tax on economic rent it should have no impact on the delivered price of electricity but would capture some of the social benefit for the budget, just as is done with petroleum revenues.

Both industrial and residential consumers also pay a tax on electricity consumption, currently significantly higher for households than for industry, even though this is still not enough to bring Norwegian prices up to the levels in neighbouring countries (some of which have even higher taxes, in fact). The general tax rate for 2010 is NOK 0.1082 per kWh, while *inter alia* manufacturing industries and district heating pay a reduced tax rate of NOK 0.0045 per kWh. Electricity-intensive manufacturing processes are exempted from the tax on electricity consumption. Pulp and paper production is exempted where an energy efficiency program is in place.

In the longer run, therefore, the marginal cost of electricity[8] supplied in Norway, and therefore the shadow price that should be used in cost-benefit calculations of projects involving electricity consumption, will effectively be the price that it will fetch in the main European markets. This would reveal more clearly the implicit cost of supporting marginally profitable energy-intensive industries. Projects such as using hydroelectricity to power offshore petroleum platforms (and thereby reduce GHG emissions from their on-board generating stations) would also be unlikely to pass a cost-benefit test on this basis.

Other renewables

In September 2009 Norway and Sweden signed an understanding establishing the principles for further development of a common renewable electricity certificate market to promote the use of renewable energy in electricity generation, as from 2012. Working rather like a cap and trade system, this is an efficient way to use the price mechanism to pursue a target of generating a certain proportion of electricity from renewables. If the externalities of non-renewables – and renewables themselves – are effectively dealt with through other policy measures such as taxes or emission permits, the role of support for renewables is really reduced to a general cross-subsidy. It does have the advantage that it is designed to be technology-neutral (*i.e.* not favouring any particular kind of renewable energy) and avoids problems that can arise when using, for example, guaranteed prices for

wind energy (which technical progress can turn into an excessive, practically risk-free rate of return, as occurred in Denmark's support for wind turbines in the 1990s). The adoption of green certificates could thus justify abandoning direct public support for particular renewables. The measure is not targeted only at new technologies, future hydroelectric projects will obtain the same subsidy from the certificates as wind-power projects.

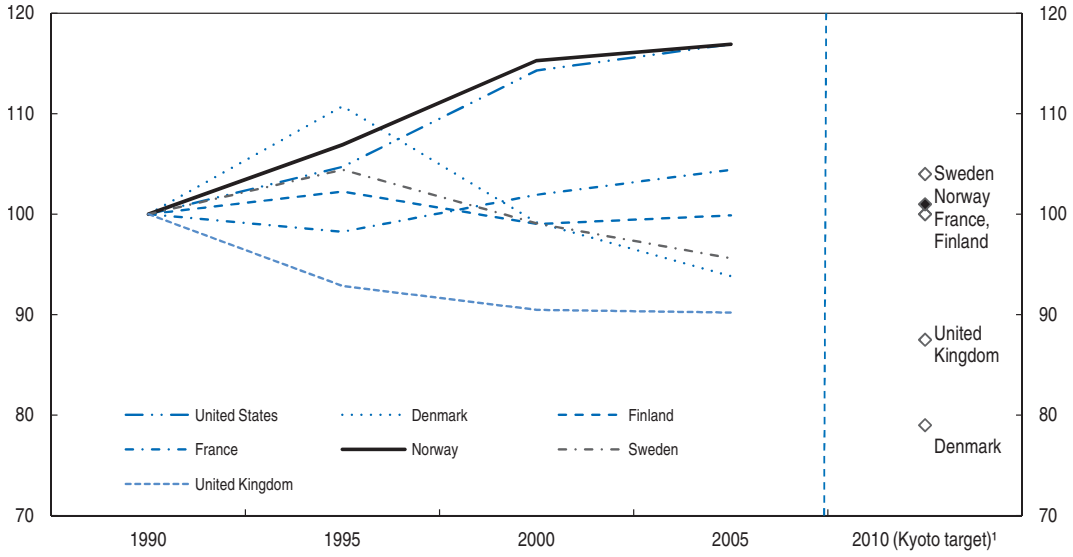
There is an argument (Bye and Hoel, 2009) that specific schemes for promoting renewables are "costly and pointless renewable fun" given the overall emissions cap given in the European emissions trading scheme (ETS), of which Norway is part. Whereas the resource cost (*i.e.* before taking into account loss of biodiversity and natural river courses) of increasing exports of hydroelectricity from Norway is relatively low, it is likely to be high for other renewables. The main argument for such policies is that new technologies need this kind of support to develop and bring down costs. Norway is in the forefront of the development of carbon capture and storage technology, but not for non-hydro renewable energy, so adopting ambitious targets for non-hydro renewables will be, if not entirely pointless, excessively costly.

Rising emissions despite ambitious targets

Despite Norway's ambitious announced targets and its array of policy measures, Norway's domestic GHG emissions have risen substantially and Norway will fully use Kyoto mechanisms to fulfil its unilateral target of cutting emissions by 10% relative to the Kyoto commitment and also partly to fulfil the Kyoto commitment target itself (Figure 3.6). The Kyoto commitment itself was less stringent than in many other countries – the target for most countries was typically a reduction of 8% compared with 1990, compared with Norway's 1% increase. This reflected the relatively high marginal cost of abatement in Norway – the high share of hydroelectric power means that "easy" reductions through fuel switching or increased efficiency in power generation are not available.

Figure 3.6. **Greenhouse gas emissions, 1990-2005**

Million tonnes of CO_2, equivalent using GWP-100 (index 1990 = 100)



1. Includes the effect of the EU burden-sharing scheme.

Source: IEA (2009b).

StatLink http://dx.doi.org/10.1787/808831474886

One of the main reasons why emission have risen significantly in Norway is the petroleum sector, almost all of whose output is for export. Because of the presence of petroleum sector and the importance of zero emission hydro power it has always been logical to expect that Norway would have to satisfy part of any emission target through trading. One way of thinking of this might be to note that nearly one quarter of Norway's emissions stem from the petroleum sector (up from only around one sixth in 1990) and that, since the output is almost entirely delivered abroad, it would be reasonable to offset at least a similar quantity of emissions through trading, if the marginal cost of reductions in actual emissions in this sector is high. It would equally be reasonable to require the petroleum companies to finance this themselves. (The petroleum sector is now part of the EU trading system and will indeed finance the offsets, except to the extent that it benefits from grandfathering.) Much of it would therefore be deducted from income for the Government Pension Fund Global. Even at current levels of domestic emissions, such purchases would be more than enough to bring Norway into line with its Kyoto-plus target of a reduction to 9% below 1990 levels.[9] At late-2009 prices of some 130 NOK per tonne, purchasing permits[10] to cover the approximately 14 million tonnes of emissions from the sector would cost around 1.8 billion NOK, no more than one percent of general government petroleum revenues.

The "right" balance between domestic abatement and emission trading (including use of offsets such as through the CDM) depends on relative abatement costs. The rise in domestic emissions is therefore not inconsistent with meeting the target. However, for periods after 2008-12 the government intends that a substantial share of reductions should come from domestic emissions. This will require more stringent measures than have been used so far, even though the marginal cost of CO_2 emissions is already higher in Norway than in many countries. As can be seen above, there is no such thing as *the* marginal cost of emissions in Norway, but many; however, the "average" marginal cost is probably higher than in most countries, given the action of the CO_2 tax combined with the trading system.

Improving policy

This higher "average" marginal cost of emitting CO_2 in Norway than in most countries, along with the logically defensible matching of a large part of petroleum sector emissions with purchases of offsets, does indeed suggest that Norway is leading from the front, or at least is among the leaders, on climate change policy. However, the simple analysis here suggests that there should be ways to reduce the economic cost of reaching existing targets because existing policies encourage high-cost measures in some sectors but risk leaving low-cost ones in other sectors untouched.

A conceptually simple step would be to extend the emission trading scheme to all sectors where emissions can be reliably measured and moving rapidly to full auctioning of emission permits, rather than the relatively slow progression currently envisaged in the European trading system (ETS). It would also make some sense to abolish the CO_2 tax at the same time. Since Norway is part of the ETS, permit allocations would have to satisfy the constraints of that system. If all emissions were covered by the ETS, the overall allocation could be set to match the Kyoto agreement requirement of emissions in 2008-12 averaging 101% of the 1990 level; this would leave the government to enter the market directly to achieve the 10% over fulfilment by purchasing and retiring emission permits out of general government revenues. An alternative would be to cut the allocated permits by this amount so that the population implicitly finances this policy as a function of its contribution to

emissions rather than through the tax system. After 2012 it is expected that the coverage of the ETS for the EU and Norway will indeed be expanded, though full auctioning will not be phased in very quickly.

Two particular objections to the idea of relying entirely on the cap and trade system can in fact be dealt with relatively easily. One is that the current price of emission allowances in the ETS may be too low for the target to be reached. If this is the case it is likely to be due *either* to mistakes that would be equally likely under alternative mechanisms such as relying on voluntary agreements *or* to the fact that market forces and relative costs give a balance between domestic abatement and foreign abatement (through net purchases of allowances from other countries) different from what is implicitly desired. As Box 3.7 points out, these and other difficulties can be dealt with while still using the ETS to give cost-effective emission reduction.

A second strong objection is related to CO_2 "leakage". Here there are two issues, one is whether it matters very much and another is whether it requires keeping potentially affected sectors out of the trading system (or indeed the CO_2 tax). Leakage is potentially a serious problem; it would occur if strong emissions policy in Norway caused a high-emission firm to close down but its production were moved either directly or indirectly to another country with a less strong policy (and no binding emissions ceiling). Norway would incur the adjustment cost of closing down part of an industry, and Norwegian emissions would indeed fall, but global emissions would not be reduced. Whether this would occur depends not just on the "price" of emissions but also other aspects of economic efficiency, wage and transport costs. Important in principle, its practical significance is an empirical matter. Evidence is hard to gather since energy-intensive industries have so far been very successful in defending their position in Norway, the European Union and elsewhere, persuading policy makers to make special arrangements. Nevertheless, some work already suggests that its overall impact would not be very great and that exemption is not the best strategy.[11]

"Grandfathering" free issues of allowances to at-risk industries is one way to deal with potential leakage, though they have to be tied to continued production. Free issued allowances linked to continued production during the trading period will however reduce the companies expected costs of emissions. Such an allocation method will therefore distort the logic of the ETS. A better alternative would be to require the industry to buy the allowances like anyone else but give them an explicit subsidy; negotiations over this would probably not be so different from those that produced the recent voluntary agreement for processing industries. It would have the advantage of making clear the cost of anti-leakage policy, both in terms of the financial cost to the budget and because it would mean the protected sector explicitly bidding allowances away from alternative users such as transport.

Whatever the specific method used to deal with leakage, the transition to charging for emission allowances rather than issuing them (on whatever basis) for free should be made rapidly. The price of allowances represents an economic rent that accrues to most emitters (not just those with a surplus to sell) so that in the initial stages of a cap and trade programme with full grandfathering based on historic emissions, most emitters are likely to be better off; the argument that it is needed to ease adjustment is therefore rather weak. It makes more sense to capture this rent for public finances (and lower taxes) than to leave it with emitters.

Box 3.7. **Can an emission permit price be "too low"?**

The current cost of CO_2 emissions in the ETS is considerably below the level of the CO_2 tax in Norway. If the CO_2 tax were abolished it would likely mean less abatement than a high uniform CO_2 tax would achieve.

The low price in the ETS might be because the amount of emission allowances issued exceeds the actual emission target, or because actors in the market are poor predictors of abatement costs, or because they do not expect the penalty for non-compliance to be very strong.

Excessive issuance of allowances did occur in the preliminary 2005-07 period of the European ETS. However, allocation is now centralised and banking is allowed, so that unused emissions from one period can be held over for future use. With time, this should ensure that, even if there were too many allowances issued in the early period, or if participants in the market have underestimated the costs of abatement, actors should soon learn from their mistakes as prices would rise suddenly if the supply began to be unexpectedly tight. GHG abatement is a long-term policy; while countries have started later than they needed to it is still possible to allow learning by doing.

An alternative interpretation of the price being "too low" is simply that it would mean less domestic abatement in Norway than policymakers intended, with Norwegian emissions perhaps rising but being offset with sharper reductions elsewhere. In fact this is the whole point of Norway joining the ETS so should perhaps not be a surprise. Nevertheless, this could undermine Norway's wider policy objectives if it feels that it needs to demonstrate the feasibility of reductions in domestic emissions in a high income country. In this case, if there were a specific target for domestic emissions, a parallel domestic trading system could be envisaged; emitters would not be able to use ETS allowances to comply with the domestic system, but could still sell surplus ETS allowances. If there were no specific target for emissions, just a desire to "do more", the CO2 tax could be retained but applied at a uniform rate to all emitters.

In the United Kingdom a recent policy change inverts this logic. Having previously tried to use a CO_2 price (for use in cost-benefit analysis) based on the estimated costs of damage from climate change, the United Kingdom has now decided to use a target-based measure, calculating the estimated shadow price of CO_2 emissions that would achieve their target. The United Kingdom has separate GHG reduction targets for sectors subject to the ETS and for "non-traded" sectors and therefore operates with two shadow prices, that for the non-traded sector being over twice that for the traded sector (which is the actual or expected price of permits in the ETS). (See DECC, 2009.)

One aspect of the *Klimakur* programme is to assess the likely costs of specific measures to reduce GHG emissions in Norway, similarly to the assessment presented in McKinsey (2009). The resulting abatement cost curve can help to assess the trade-off between domestic abatement and that achieved through emissions trading. But it can be particularly useful to assess policy options in other areas, especially non-CO_2 gases and issues such as waste-management. It can also guide public policy in areas such as infrastructure investment where, for example, increased investment in railways is often thought to be good policy because average emission intensity for certain existing rail transport can be low relative to alternatives, whereas new investment, for example in high speed trains may have wildly excessive costs, if undertaken as part of climate change policy (Nilsson and Pyddoke, 2009). But policymakers should be wary of using *Klimarkur* to

develop sectoral emission targets where market mechanisms such as the CO_2 tax and the ETS can operate without difficulty.

Another transport related tax that might be redundant is the very high purchase tax on cars, which Norway shares with some other Nordic countries and Israel. In principle, just like the high rate of CO_2 tax on motor fuel, this restricts consumer choice more than is necessary to meet the aggregate emission targets. Furthermore, as a tax on purchase rather than use of a vehicle, it addresses emissions only very indirectly, if at all.[12] This tax probably reduces average car ownership and so reduces problems such as congestion. A comparative study of taxation in Nordic countries shows that the vehicle tax strongly influences the size and composition of car ownership, reducing per-kilometer energy consumption and CO_2 emissions (TemaNord, 2008). But one aspect of policy where Norway has been a pioneer, but has perhaps under-exploited its lead, is in urban road pricing. This now operates in several major cities, but basically as a fixed access fee; it has not followed advances in technology that would allow explicit congestion charging. However, although the car tax's objectives could be met in other, theoretically more efficient, ways, one could argue that its wide social acceptance[13] is a good measure of its actual cost and since it reduces the need for measures elsewhere, there is a good argument for retaining it.

Why low cost may not be low cost

"Economic instruments" are efficient where conditions are appropriate. However, there are plenty of reasons why other instruments are necessary, usually having their origin in information problems. One set of such difficulties arises in monitoring and measurement (where the emission of interest can neither be feasibly measured at the point of emission nor be inferred from a close proxy). Another is where it may be difficult for final consumers to get the information about what the impact of economic instruments is on their budget, notably when purchasing items (houses, consumer durables) where the associated emissions and any related taxes or fees, may occur over a long period in the future. Some measures that appear to have negative costs of abatement for individuals seem not to be implemented when they "should" be profitable without any specific regulation (the McKinsey report assesses that changes such as improved domestic appliances, lighting and insulation, and motor vehicles, would be profitable without any specific incentive). The *Klimakur* programme could usefully assess the hidden costs that slow action in these areas, to see whether they are due to lack of information, to actual resource costs that may be hard to measure, such as the time needed to plan and organise housing modifications, or to the different attitudes to cost that may be embodied in high individual time preference rates.

Some of these factors can be dealt with by educational programmes, while for other factors regulations such as building codes are useful. Residential patterns have a long-lasting influence on transport demand, one reason why the price elasticity of demand for motor fuel is so low. Urban planning policy should also therefore take account of the results of *Klimakur*. In particular, impact analyses should already be systematically evaluating the changes in GHG emissions associated with projects that affect travel patterns using a realistic estimate of the "shadow price" of CO_2. Surprisingly, this does not seem to be the case yet.

Box 3.8. **Recommendations on climate change policy**

- Substantially reduce the divergence of rates in the CO_2 tax and include the process industry, fishing and farming.
- Consider widening the coverage of the trading system outside sectors specified by EU directives. *Potentially*, abolish the CO_2 tax and incorporate all sectors in the trading system, using minimum and maximum prices to ensure some abatement while preventing excessive costs, making use of inter-temporal banking and borrowing to smooth prices.
- More generally, work to bring marginal abatement costs in line everywhere. Be sceptical of arguments on leakage, noting that CO_2 tax exempted sectors have achieved some of the largest emission reductions.
- Use the Klimakur report to help assess the required level of the marginal tax or permit price for GHG emissions to meet announced targets, but not to specify sectoral emission targets which can hinder cost-effective policies.
- Require forward-looking policy analyses (including infrastructure and urban and regional planning decisions) to use an explicit shadow price for GHG emissions in cost-benefit calculations. The shadow price should be consistent with Norway's international commitments, and is likely to be quite high for future emissions. Analysis could use high and low variants to take some account of uncertainty.
- Given the increasing urgency of action on climate change, consider undertaking a comprehensive assessment of constraints on cost-effective increases in the supply of hydropower and other renewable energy, which could for example supply European markets thereby reducing the cost of emission reduction there and earning significant returns for Norway.
- Continue Norway's pioneering role in investigating carbon capture and storage, making clear that the decision to go for the full scale installation at Mongstad is itself experimental – to gain information from the unprecedented scaling-up of the technology.
- Voluntary agreements should be pursued where their role is to improve information, encourage co-operation and diffusion of GHG-efficient technology, or for educational purposes, but not in return for exemption from the CO_2 tax or the cap and trade system.
- Progressively eliminate that part of taxation on the purchase of cars which is not linked to environmental damage per car, where other more direct tools are available. Expand the use of road charging, linking it to congestion and potentially to local pollution conditions. Ensure that urban and regional planning takes into account the future constraints it will impose on transport options.

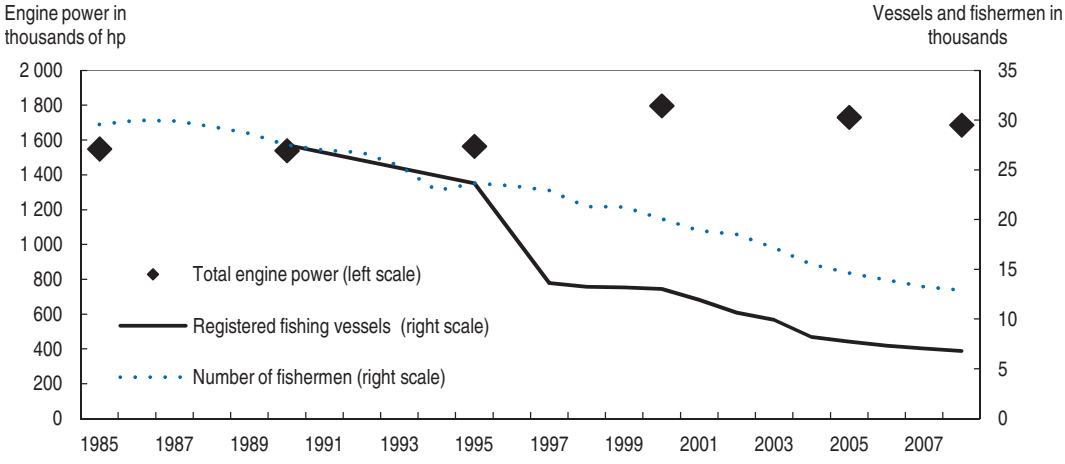
Fisheries

The fishing industry, and its contribution to the Norwegian economy, has changed a lot over the past few decades. The relative importance of catching fish in the wild (the capture fisheries) has steadily declined, while fish farming (aquaculture) has grown rapidly in importance. Contributing about 1.3% of GDP in 1970, the capture fisheries now provide under 0.5% of mainland GDP, with about the same contribution now coming from aquaculture. This chapter deals exclusively with the capture fisheries, where the issues of sustainable use of natural resources are more obvious (though highly complicated) and where Norway, despite its small size, is one of the world's major actors, taking nearly 3% of

the total world catch. Environmental issues are nevertheless important for aquaculture. For example, there are potential disease problems where Norway's stricter regulations on the allowable density of aquaculture installations may have played a role in limiting the spread of disease which has recently severely affected Chile, one of Norway's key competitors in aquaculture. Aquaculture also depends on the capture fisheries for producing feed.

Overall there has been a long term trend decline in the number of fishing vessels in the Norwegian fleet and in the number of fishermen (Figure 3.7). It is not so clear that this represents a decline in fishing capacity, however. As the average size of vessels increases, the total physical capacity can rise even as the number falls, and changes in technology mean that fewer people are needed for any given size of vessel. One measure of this is the total engine horsepower[14] of the fishing fleet which has shown no systematic decline over the past two decades. But this measure probably underestimates trends in actual fishing capacity because technology has also improved the ability of vessels to find and catch fish; any given quantity can be caught in less time, so a vessel can make more frequent trips.

Figure 3.7. **Capacity in the fishing industry**



Source: Statistics Norway.

StatLink http://dx.doi.org/10.1787/808833346808

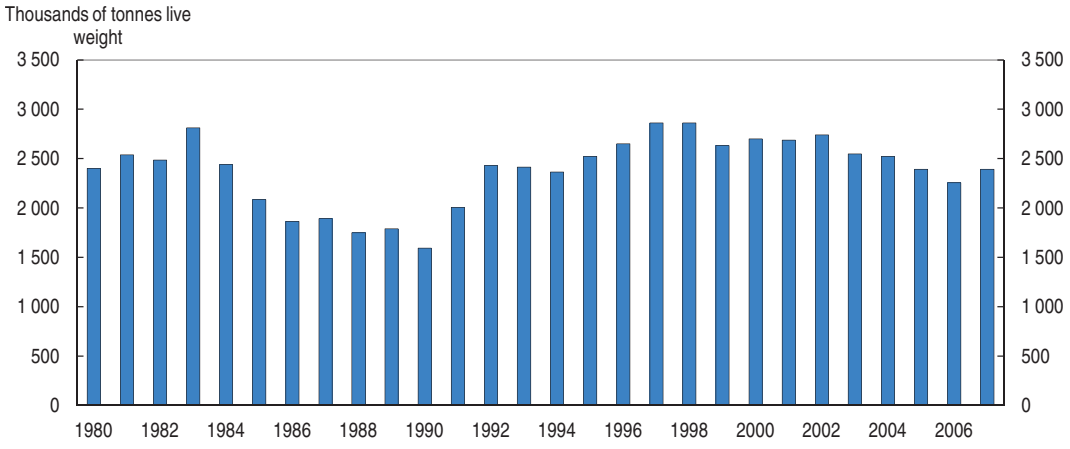
Indeed, the total catch of the Norwegian fishing industry, measured by weight, has not declined over the long term. During the 1980s there was a significant decline when the capelin fishery collapsed but the overall catch soon recovered even before the herring stock, which itself had been practically wiped out in the late 1960s, was rebuilt (Figure 3.8). In recent years the total catch has been somewhat below the peaks of some years in the 1970s and late 1960s, but still at quite high levels historically.

The profitability of the fishing fleet has also improved as the number of vessels declined. In the 1990s many fleets were operating at a loss and there were significant budgetary subsidies to the industry. By 2008 subsidies have been largely phased out, with the exception of exemption from taxes on fuel, including from the CO_2 tax (Box 3.9).

Setting limits on fishing

The need for resource management in fisheries was perhaps first apparent in Norwegian waters at the end of the 1960s, when the key herring fishery collapsed almost

Figure 3.8. **Total fishing catch, 1980-2007**



Source: Statistics Norway.

StatLink http://dx.doi.org/10.1787/808847412487

Box 3.9. **Implicit subsidies in fisheries: Energy and CO_2 taxes**

In common with many other countries – Iceland, France, Spain, the United States, to name a few – Norway exempts fishing vessels from certain taxes. In Norway both the basic tax on fuels and the CO_2 tax are fully reimbursed for vessels refueling in Norway. (By contrast, unlike most countries, Norway does tax fuel for both domestic sea and domestic air transport.) Fishers are also subject to a more favourable income tax regime. According to Album (2008) these two exemptions cost NOK 254 million in 2005, a figure which rose to 310 million in 2008. This was only some 0.15% of GDP but is frequently 10-50% (sometimes over 100%) of operating profits in certain sectors of the fishing fleet. As Album points out, as an employment supporting measure this is inefficient as the value of the exemptions per employee varies enormously; the largest benefits obviously go to the vessels whose fuel use per tonne of fish caught are largest, and these are generally those with few workers.

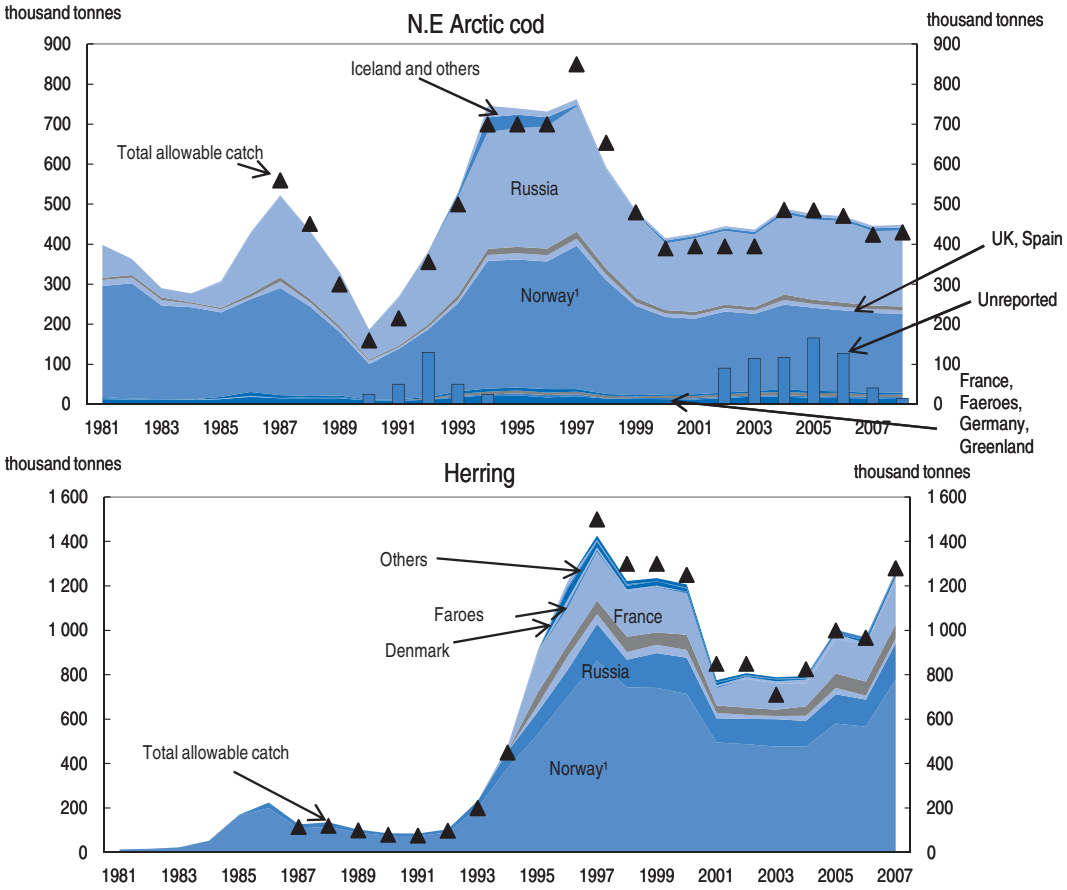
Estimated fishery subsidies in 2009 include income tax allowance for fishermen of NOK 290 million and CO_2-tax exemption of NOK 135 million. A NO_x tax exemption through voluntary agreements is worth another NOK 135 million. Other advantages are a high depreciation rate for fishing vessels and some operational grants.

entirely, following a period in which the annual catch had actually been rising as more and better equipped vessels from various countries had been exploiting the stock. Once it had collapsed the stock of herring took over 25 years to recover, and had changed its spawning and migratory behaviour in the meantime. The North Sea herring population is still very low, though the Norwegian spring spawning herring population has recently risen to historically high levels. The population of cod has also been subject to at least two periods of partial collapse in the past two decades. These two fisheries together provide the bulk of the revenue for Norwegian fishing vessels, although a number of other species are also of economic interest. The rest of this section concentrates on North East Arctic (Barents Sea) Cod and Norwegian Spring Spawning Herring.[15]

A key aspect of these fisheries is that they are shared with other countries. A large number of countries are involved, though for herring and cod the principal ones are Russia

and the European Union (Figure 3.9). While over-fishing can occur even within a national fishery, it is obviously even more likely when shared between countries, so efforts to manage stocks necessarily require international co-operation. Open access regimes are now very rare, nearly all fisheries are managed by setting a limit on the total amount of fish that can be caught from each stock in any one year – the Total Allowable Catch (TAC). Table 3.3 sets out the main agreements that regulate Norwegian fisheries, showing the total allowable catch for the fishery as a whole, along with the national quota allocated to Norway.

Figure 3.9. **Sharing fish with other countries**



1. Availability of Norwegian estimates of unreported catch: 1990-94 and 2002-08.

Source: ICES (2009).

StatLink http://dx.doi.org/10.1787/808865067263

The process of setting limits on catches starts with the International Council for the Exploration of the Sea (ICES) which provides scientific advice[16] on what a safe level of catch would be. As well as recommending a particular level for the total allowable catch to be set for each managed fishery, ICES specifies a lower level which should allow the stock of fish to expand and an upper level at which it would decline. The agreed TAC tends frequently to be in the upper end of this range. This is not always due to the difficulties of international negotiation, however. The current ICES advice on Norwegian coastal cod is to set a zero TAC, but Norway has not done this because of the adverse short-term consequences for coastal communities. Current policy for coastal cod, which is an

Table 3.3. **Total allowable catch and national quotas in 2004 and 2005 for some of the important species in Norwegian fisheries**

Species	The economic zone or area	Agreement between Norway and:	TAC for all countries (tons)		Norwegian national quota (tons)	
			2004	2005	2004	2005
Cod	North of N62 °N[1]	Russia	506 000	492 000	224 600	218 700
	North Sea	EU	27 300	27 300	4 114	4 114
	Skagerrak	EU	3 900	3 900	127	127
Haddock	North of N62 °N	Russia	130 000	117 000	71 500[2]	65 300[2]
	North Sea	EU	77 000	66 000	14 435	13 918
	Skagerrak	EU	4 755	4 018	200	169
Saithe	North of N62 °N		169 000	215 000	154 000	200 000
	North Sea	EU	190 000	145 000	93 800	72 400
Herring	North of N62 °N[3]	No agreement[4]			470 250	578 500
	North Sea West of 4 °W	EU	460 000	535 000	131 624	155 150
	Skagerrak	Sweden, Denmark	70 000	96 000	9 336	12 804
Capelin	North of N62 °N	Russia				
	Iceland, Jan Mayen and Greenland[5]	Iceland, Greenland	985 000	210 000	103 047	33 481
Mackerel	North Sea, North of 62 °N and west of 4 °W	EU	446 961	344 562	148 728	114 437
Blue whiting	International waters	No agreement[6]				
Redfish	Greenland NEAFC	EU NEAFC			5 230	3 500
Shrimp	Skagerrak	Sweden, Denmark	10 710	10 710	4 991	4 991
	Greenland	EU			2 830	2 750
	NAFO	NAFO			1 985[7]	1 985[7]

1. Norwegian Coastal Cod (20 000 metric tons in 2004 and 21 000 metric tons in 2005) included.
2. Norwegian Coastal Haddock (5 000 metric tons) included.
3. Norwegian Spring Spawning Herring.
4. Due to disagreement regarding the allocation of the Norwegian Spring Spawning Herring stock, the states involved – EU, Norway, Iceland, Faeroe Islands, Greenland and Russia – have not yet adopted a management regime for this stock.
5. Quotas for the 2004/2005- and 2005/2006-seasons.
6. Due to disagreement regarding the allocation of the blue whiting stock, the states involved – EU, Norway, Iceland, Faeroe Islands, Greenland and Russia – have not yet adopted a management regime for this stock.
7. Days at Sea.

Source: Country note to 2006 *Fisheries Review*.

ecologically complex population, includes a system with more strict regulations inside fjords than outside fjords. The authorities are developing a rebuilding plan and will ask ICES to evaluate whether it is consistent with the precautionary approach. If not, they will ask for suggestions for modification or alternative plans.

In addition to catch limits there are many rules on what equipment should be used, generally to avoid catching fish that are too young (so as to safeguard the ability of the stock to reproduce) and to allow fish of the non-targeted species to escape. These rules can be legally enforced for vessels at sea when they are in some country's territorial waters, but enforcement is also the responsibility of the country of registration of the vessel. Most of Norway's shared fisheries are in waters covered by a national jurisdiction, although not all of the Barents Sea cod stock, for example. The Norwegian coast guard makes nearly 2 000 at-sea inspections every year, compared with the Norwegian fishing fleet of over 6 000 vessels, not to mention foreign vessels fishing in Norwegian waters. As is the case for most countries, Norwegian law allows Norwegian vessels to fish only in areas which are subject to some national regulation or to a regional management scheme in which Norway participates.

Enforcing limits on fishing

The success of all these efforts at conservation depends strongly on enforcement. The Norwegian authorities feel that their system of both at-sea inspection and, especially, the monitoring system for landings is quite effective. Hanneson (2008) has estimated the probability of a given vessel being detected fishing illegally in one way or another at about 12%.[17] Although an illegal catch can be confiscated, fines, at least for first offenders, do not seem to be very high and *a priori* the return on illegal fishing may be positive. The authorities argue that such calculations do not necessarily give the right impression of the effectiveness of enforcement because they have some knowledge of which types of vessels are more likely to be offenders and can target them for more frequent inspections. Nevertheless, they intend to increase the number of at-sea inspections.

Inspections on landings are facilitated by the fact that all fish landed in Norway have to be sold by or with the approval of one of six publicly recognised first-hand sales organisations. For herring and similar fish, there is only one agency, with a statutory monopoly, following the merger of some smaller agencies. These agencies handle only the landing, inspection and sorting of fish which are then sold on to wholesalers or processors. The records of these agencies are used for matching vessels' cumulative catches against their quotas. A significant number of landings are also inspected by the ministry. The agencies are present in all Norwegian ports and some in other countries as well. There is clear potential for collusion in this system, although the small number of organisations involved may also mean that it could easily be detected. The Norwegian authorities argue that one of the key barriers to collusion is the collective and individual interest that all vessels have in ensuring that others do not cheat, since that would put all their future livelihoods at stake. This is hard to verify, but commands a consensus among fishery researchers. In addition the size of penalties is important, as is the kind of offence to which they are applied. For example, there is a significant difference between the way Norway and the European Union treat discarding unwanted catch at sea, though it is hard to be sure which is in fact superior (Box 3.10).

The system nevertheless operates to a considerable extent on a degree of trust. There are nearly a quarter of a million recorded landings of fish each year. Of these the Fisheries Directorate of the Ministry makes a direct inspection of about one in a hundred (of which, in 2008, just over 1½ per cent resulted in either a written warning or police action). The coastguard makes about 2 000 at-sea inspections per year; this frequency has increased recently, though the overall duration of inspection activity has remained the same, so the time devoted to each inspection has fallen. The sales organisations' main role in enforcement is to ensure that accurate records are kept of *declared* catches and landings, but in addition they undertake some specific inspections, of about one in two hundred landings in 2008.

Serious violations of fishing regulations can result in a vessel being put on Norway's IUU (Illegal, Unreported and Unregulated fishing) list. While on the IUU-list, vessels may not land or tranship fish, take delivery of supplies or services in Norwegian waters, may not fly the Norwegian flag and are denied access to Norwegian ports; 45 ships are currently on this list.[18] If they subsequently accept certain conditions, they may be removed from the list. The final sanction that the authorities use is the black list. Instituted in 1994, it currently lists nearly 150 vessels that have either violated Norwegian fisheries regulations in waters under Norwegian fisheries jurisdiction or are listed on the IUU lists of regional

Box 3.10. **To discard or not to discard?**

In the European Union fisheries it is illegal for a vessel to land over-quota fish or those that do not satisfy other restrictions (notably on minimum size/age) but it is not illegal to discard them. In Norway a vessel with an illegal catch, which can happen accidentally (for example as a by-catch when fishing for a different species), will be told to cease fishing or move to another area, but it is prohibited from to discarding the illegal catch; on landing such fish the excess may be confiscated but it is more likely to be purchased by the authorities, perhaps at a discount to the market price. Which method is better for conservation?

The answer is not obvious. Quite apart from deliberate over-fishing, some level of accidental illegal or over-quota catch is always likely. If they are thrown back into the sea ("discarded") they do not survive (with rare exceptions) so although they may conceivably provide food for some other species they do not help the conservation of their own species; nor do they contribute to satisfying market demand for fish, so more fish than are needed for this are caught. Rather than throw them into the sea a vessel may hope to land them illegally or transfer them to an intermediary who will land them in a port outside the national or EU jurisdiction.

If a vessel is able to land such fish there are two key advantages. One is that they are not wasted and the other is that they are recorded. The disadvantage is that there is some economic incentive to over-fish, which seems counter-productive. The Norwegian view is that allowing discards while penalising landings provides an economic incentive to systematically fish for large and higher priced fish and systematically discard "unwanted" fish – so-called "high grading". However, the EU did introduce a ban on high grading in the North Sea in 2009, Furthermore, a vessel's record of overfishing can be monitored and the economic incentive removed in the case of persistent offenders. Of course, the incentive to over-fish and sell the fish outside the set of monitored ports (in the case of Norway, this means outside Norway) remains the same, so that the equilibrium may well involve more over-fishing.

Whether this is the case will depend on relative enforcement and monitoring efforts, how it is split between monitoring landings and at-sea inspections, as well as the attitude of fishermen themselves, which may vary across different countries. Even if it does result in higher over-fishing, the advantage of a better recording of catches is not insignificant. Conservation efforts depend on accurate statistics and biological models that properly reflect stock dynamics (even with accurate statistics on catches, estimation of the underlying stock is still difficult). In Norway, data on catches and landings are thought to be relatively reliable.

In Norway the discard ban is part of a package of measures aiming at avoiding unwanted catches in the first place (selective gears, area closures, by-catch rules). As a consequence, high-grading is not allowed in Norwegian waters. The Norwegian authorities strongly believe in the usefulness of the discard ban, and the European Commission, in its review of the Common Fishing Policy, has drawn attention to it as a possible improvement in its own set of policy tools.

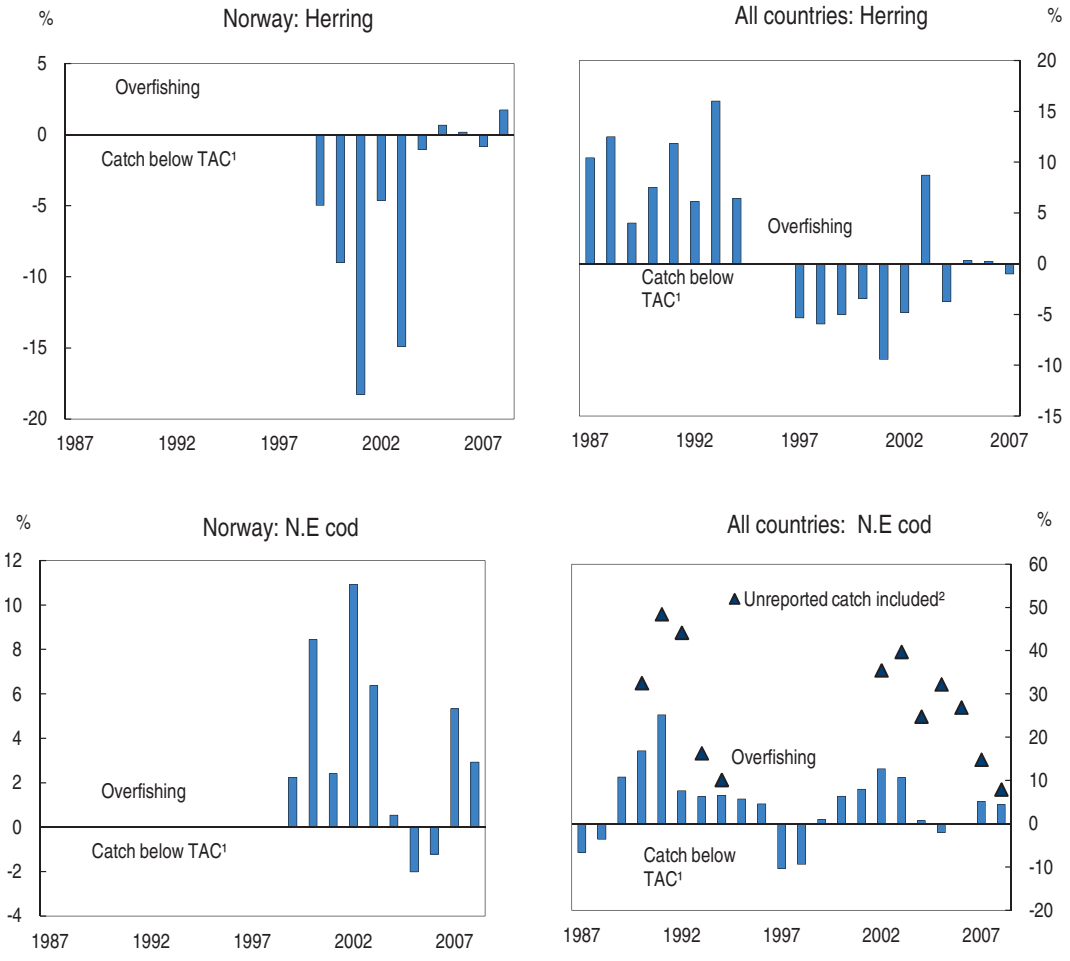
fisheries management organisations. There is no provision for removing vessels from this list.[19] These lists reveal one of the difficulties for fishing inspectorates, in that many of the vessels have sailed under a number of different flags, and may also have changed their name several times. In September 2009, members of the UN Food and Agriculture Organisation agreed a treaty[20] that would, if effectively enforced, improve the effectiveness

of this kind of measure by refusing port access to foreign ships that cannot justify the legitimacy of their catch and requiring ships' flag countries to take action against their own vessels subject to such refusal.

The actual results of enforcement efforts are mixed – and they are also difficult to analyse because data on overall catches are not fully reliable. Considering the tendency of total allowable catches to be set relatively high, it should be important to ensure that they are not exceeded. The example of spring spawning herring suggests that in recent years this has been successful, as the total officially recorded catch has exceeded the TAC only once since 1997 (Figure 3.10). In the years prior to this, ICES data show systematic overfishing, even though up to 1994 the fish were largely confined to Norwegian waters,[21] and these were the years during which the stock was remaining low, despite low catch levels by historical standards (see also Stokke, 2000 and Churchill, 1998). In the late 1990s and subsequent years, aggregate compliance was much better and the stock has recovered very rapidly.

Figure 3.10. **Aggregate fishing quotas are not always well respected**

Total catch minus TAC, Norwegian spring spawning herring and North-East arctic cod



1. Total allowable catch.
2. Including unreported catch shows, for example, that in 2007 while the reported catch exceeded the TAC by 5% the total (reported plus estimated unreported) exceeded it by 15%.

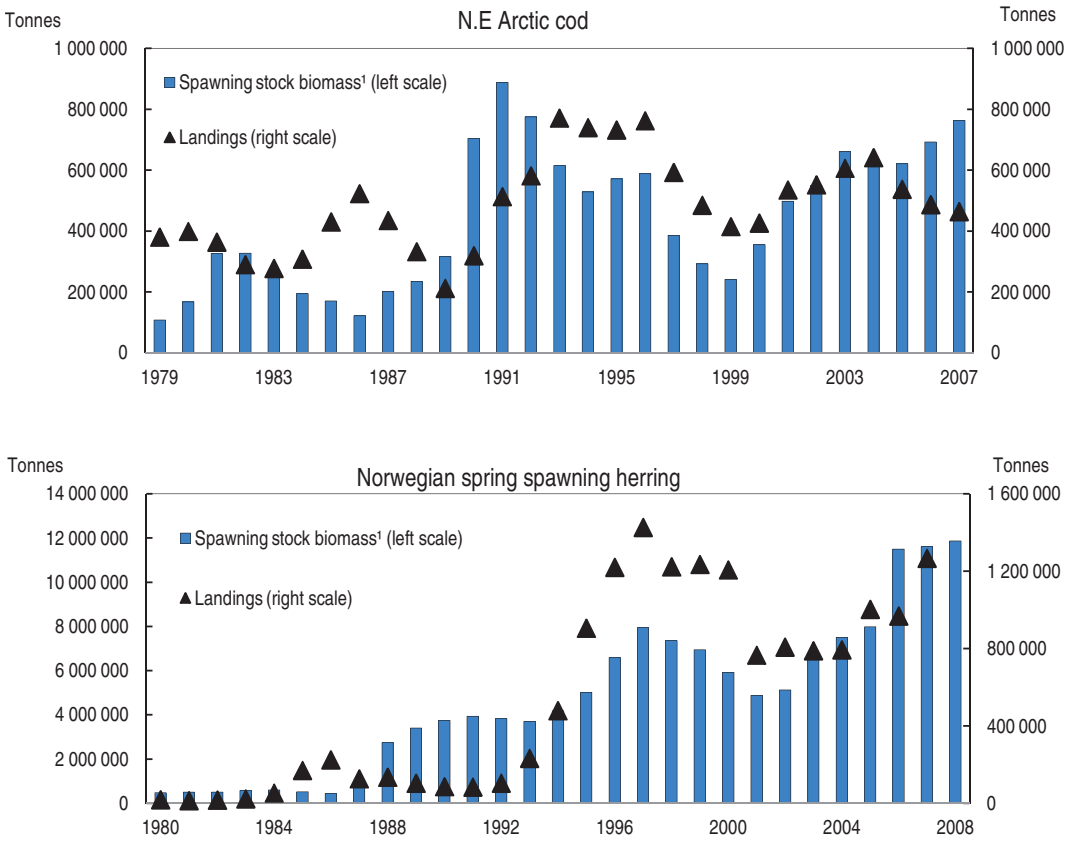
Source: Norway Ministry of Fisheries and Coastal Affairs.

StatLink http://dx.doi.org/10.1787/808866376486

For North East Arctic cod the record is somewhat different (Figure 3.10). There have been quite wide swings in the discrepancy between the actual catch and the TAC, both for all countries taken together and for Norway alone (for Norway, data were not available prior to 1999). But there has been a general tendency towards overfishing even using data from recorded catches. When estimates of unreported catch are included, overfishing has frequently amounted to over 20% of the TAC. Estimates of unreported catch are obviously in themselves very uncertain. They are not available for all years. Both Norway and Russia have published estimates for certain years, and the Norwegian estimates are higher. ICES includes the Norwegian estimates in its data for total catch. Norway has increased its efforts to reduce illegal and unrecorded fishing, mainly by seeking co-operation in non-Norwegian ports where fish may be landed.[22]

While it seems obvious that overfishing will lead to declining stocks, the link between levels of catch and changes in fish populations is not straightforward; many other factors are relevant. Nevertheless, simple comparisons suggest some recent success for cod stocks. From the early 1980s up to around the year 2000, total landings seem to move quite closely in line with the estimate of the spawning stock biomass (SSB: the SSB is a measure of the quantity of fish of reproductive age, rather than of the total stock) which is what one would expect if the "safe" catch is a function of the stock (Figure 3.11). For conservation

Figure 3.11. **Total catch and the total stock**



1. A measure of the size of the reproductive stock.

Source: Norway Ministry of Fisheries and Coastal Affairs.

StatLink http://dx.doi.org/10.1787/808887128017

policy to work effectively, the stock itself should be affected by earlier catch levels, but the relationship is complex. For herring the SSB rose suddenly in the early 1990s even though there was no particular change in the very low level of catch; it then stabilised although the catch stayed low before increasing again at the same time as the catch in the late 1990s. Subsequently the ability of the stock to rise after 2005 may also be related to the maintenance of the total catch below the perhaps prematurely optimistic levels of 1997-99.

One of the key "other factors" that affects the evolution of a particular fish stock is what is happening to related stocks. Different fish populations either compete with or feed on each other.[23] The last sharp decline in cod was related not just to cod fishing but to the collapse of the capelin stock on which it feeds. Thus over or under fishing can be harmful or beneficial to other fisheries, depending on their position in the food chain. The implication of this is that TACs should be set on some kind of eco-system basis. While this idea is sound, better data and understanding of the links is likely to be needed before it is feasible, even without taking into account the more complicated international agreements that would be likely to be needed.

The impact of fisheries management on the industry

The objective of sustainability is not inconsistent with a high level of economic return. The fishing industry has a collective interest in maintaining a high stock in order to extract a high harvest, even if the economically optimal stock is necessarily smaller than the maximal biologically sustainable stock. But enforcing the Norwegian share of the TAC in each fishery requires strong intervention in what was previously felt to be the right to go and fish in open access fisheries. Following the lead of, in particular, New Zealand, the method that Norway has chosen is to allocate shares of the overall Norwegian quota to different vessel groups, and then distribute this quota among the vessels holding the necessary licences to participate in the groups. This allocation is based on a fixed key system, giving the vessels a certain share of the group quota, and thus a share of the TAC. Individual vessels may have quotas for several different fisheries.

Some aspects of this system and its management are likely to generate "local" economic inefficiency, though they may be justified by the fact that the global outcome, *i.e.* for the industry and economy as a whole, is superior. A fundamental reason for this is the backward sloping long run supply curve that exists in capture fisheries: as fishing effort increases, the catch rises but after a certain point it reduces the stock so much that the long run average catch begins to decline. So for a potentially wide range of total catch there is a low cost and a high cost solution (see *e.g.* Nielsen, 2006, Figure 2). The resource saving in the low cost solution can be quite significant (quite apart from any environmentally-motivated conservation effort) but only the high cost solution is a market equilibrium in open access. It follows that even an imperfect management system can be better than risking returning to the "bad" equilibrium. However, it remains important to look for ways to improve efficiency where this can be done without jeopardising fisheries management.

Corporatism

The Ministry of Fisheries and Coastal Affairs sets policy. Its executive arm, the Fisheries Directorate, is responsible for implementing policy and the Institute of Marine Research is the research agency giving technical advice. However, the Fisheries Directorate plays very little role in allocating quotas because this is done according to long term allocation keys both at the group and vessel level. The industry has played an important

role in the establishment of these allocation keys. At the other end of the process, the handling agencies have a kind of statutory quasi-monopoly. In the case of herring and other pelagic[24] fish, the Norges Sildesalgslag is a full monopoly, as described earlier.

Quotas are issued in quite a specific form. They do not simply specify a quantity of a particular species of fish but the type of fishing gear that is to be used and the area in which it is to be fished. Unlike in some other countries that use individual quotas, Norwegian quotas are tied to a particular vessel.[25] Trade in quotas cannot be separated from trade in the vessel to which they are attached. Taken together, all these factors add up to a high degree of policy-encouraged corporatism and self-regulation by the industry, likely to generate regulatory rents, insider/outsider restrictions and possibly low productivity.

Monopoly rent or resource rent?

As noted previously, profits have been much higher over the last 10 years than they were earlier. This also coincides with a period when the TACs were perhaps beginning to bite more effectively. If this meant less competition for scarce stocks, fishing vessels could perhaps afford to take more time to catch their allocations if this allowed them to lower costs. With the catch restricted so that markets were not over-supplied but with stocks of key fisheries nevertheless rising, revenues increased. Some of this revenue is likely to be a regulatory rent, at least on the surface, *i.e.* apparently attached to the possession of a fishing quota. Certainly fishing quotas are quite valuable, although exactly how valuable is difficult to know because trading is very restricted. It is said that a fishing vessel with a quota is worth four or five times as much as the same vessel without one. But this may not say very much because the value of a second-hand fishing vessel, often with limited versatility, may not be very high.

But while it is likely that some fishing profits are a rent, they are not so much a regulatory rent as a resource rent, since the regulations themselves simply translate the common resource constraint into private property, which is economically efficient rather than the reverse. Nevertheless, some of the income is still rent and could reasonably be taxed – for example by charging an annual fee for each quota. To some extent this already occurs, as the expenses of the fisheries control system is partly financed out of landing fees and other charges on vessels. However, such charges finance only part of these expenses while the industry benefits substantially from reduced fuel taxes discussed earlier. It may be felt that significant progress has been made in weaning the industry off its earlier dependence on subsidies so some support should be retained, particularly as it is important in remote coastal communities. To the extent that this is true, the wider sustainability arguments might suggest that tax subsidies to employment (though these are already available for remote communities) rather than to energy use would be more appropriate.

Although fish landing and handling agencies have some attributes of monopolies, it is unlikely in practice that they generate the supply or price problems that monopolies are normally associated with, since they are part of a system whose *aim* is to restrict supply. The handling agencies are in fact exempted from normal competition law. This is because their role is highly specific, perhaps more like the role of the commodity exchange than of an industrial company. They act as agents through which fishing vessels supply fish to the processing industries, almost always by public auctions which usually occur before the fish are even landed. The pelagic fish agency for example provides very detailed information on

prices and quantities on its website (*www.sildelaget.no*) including the position of vessels with respect to their quota for different species.

The role of quotas

In Norway there was strong reluctance among the fishing community to the original introduction of individual tradable quotas, even when it seemed clear that fishing stocks were threatened. Now that the quota system is in place it seems (according to the Fisheries Directorate and a number of researchers), on the contrary, to play an important role in generating support for fisheries management in the fishing community. The tradability, even if limited, of a quota gives it a value and quota owners have an interest in maintaining the value. Since this value is likely to diminish if the fish stock declines,[26] the existence of the quotas gives existing fisherman a direct interest in limiting the overall catch and ensuring compliance by other fishermen. This interest is likely to be greater with restrictions on quota trading, since in that case the value of the quota is more directly related to the individual's future catch.

Rebuilding fish stocks, particularly given the limited understanding of exactly what determines outcomes, requires a degree of integration of biological, social and economic information, to ensure the needed degree of co-operation among the different actors (Cox and Khwaja, 2009). Quota-based management may thus be both part of the technical solution to fisheries management and part of the process of ensuring support within the industry.

Barriers to productivity improvement?

As the number of vessels and the number of fishermen have declined steadily, the average level of labour productivity in the industry has increased. One of the ways that this is brought about in "normal" industries is through more efficient operators capturing the market from the less efficient ones or from adopting measures to improve economies of scale. In the fishing industry, the restrictions on trade in quotas slow this process and prevent some of the mechanisms from working at all. Since the fishing capacity of the fleet is considerably higher than the overall TAC, many vessels and their crews are effectively underemployed. It would make economic sense, especially in times of very low TACs, for vessels' owners to transfer their quota to another vessel (either one of their own or, for a fee, to a competitor). This is not allowed, however. Quotas can be transferred to another vessel, say from vessel A to vessel B, but only if A is sold to the owner of B who must then scrap one of the boats; after that he retains the quota of the surviving vessel but only 80% of that of the scrapped vessel. The remaining 20% is returned to the pool to augment everyone else's quota. Furthermore, this kind of transfer can occur only within restricted geographical areas and between vessels operating with the same technology.

This clearly slows potential productivity improvements, but there are some justifications for it. The most persuasive is based on conservation. The greater the excess capacity in the fleet, the greater the temptation to cheat and the higher the costs of monitoring. By ensuring that quota transfers are generally accompanied by a physical reduction in capacity through scrapping,[27] the system encourages a reduction in capacity. It does, however, create a more or less impenetrable barrier to entry. A potential new entrant with a more efficient vessel could only get a quota by buying an existing vessel but would not get that vessel's full quota.

Box 3.11. **Recommendations on fisheries policy**

- Norwegian fisheries management is at least as effective in encouraging sustainability as in most other countries. If Norway nevertheless wanted to lead further from the front it might wish to instigate an independent (*e.g.* by a non-European country or fishing organisation) assessment of over-fishing in fisheries exploited by Norway and compliance by the Norwegian industry in particular.
- If assessment of the trial discard ban on joint Norwegian-EU fisheries proves positive, Norway should work for its extension to other shared fisheries in the North Sea.
- Ask the Competition Authority to investigate the fishing industry to assess whether conservation management *unnecessarily* restricts competition.
- Unless it can clearly be shown that sustainability would be threatened, relax the conditions on trading quotas. A first stage might allow *temporary* transfers (against payment) between vessels without any change in ownership or vessel scrapping.
- Announce the gradual phasing out of the exemption on fuel taxation in co-ordination with neighbouring countries, and the introduction of a charge on quotas to fully finance expenditure on monitoring and enforcing fisheries management policy. (This would not exclude finance from general taxation for, for example, health and safety policy as in any other industry.)
- Assess the compatibility of Norway's aims, and of its monitoring and enforcement regimes, with those of the European Union.

Notes

1. The "level 3" indicators in the EU system are much more numerous but are designed to represent actions or explanatory variables that affect the level 2 indicators.
2. Assuming that net emissions are calculated ignoring the impact of changes in land use and forestry Norwegian emissions taking account of land use and forestry are much lower. The reduction in net emissions due to these effects is much more significant for Norway than for most countries. Due to difficulties of estimation and verification, these changes are excluded from the calculations of emissions for the purposes of the Kyoto Protocol. Taking them into account could be expected to reduce the relative burden on Norway; however, Norway has announced that it will continue to ignore them for the purposes of its own announced emissions targets.
3. See, for example, the importance given to the "peer review" of Norwegian sustainable development policy by Swedish academics and officials, and the interest of the latter in it.
4. However, Norway has not done as well as the average Annex 1 countries if the USA is also removed from the comparison.
5. This covers only the cost of the carbon capture. Its transport and storage will be dealt with in a separate project by GassNova, a government agency recently established for this purpose.
6. The Norwegian prime minister has described it as the equivalent for Norway of what the moon landing was for the United States.
7. Many of the most energy-intensive industrial plants (including some GFG-emission intensive industrial processing plants) obtain low priced electricity on very long-term contracts, a substantial number of which are expiring over the next year or so.
8. In practice there is no single strict marginal cost, which will depend on time of day, the season and so on. But the current bias in "average" marginal cost seems clear.
9. Nothing is simple, however. Emissions from this sector were already 8 million tonnes in 1990. Perhaps only the increase from this level should be "eligible" for purchasing offsets. In fact there is no economic logic that can determine the "right" balance between domestic abatement and permit trading, especially when marginal costs of domestic abatement measures range from well below the trading price to well above it.

10. Here and elsewhere the word "permit" or "allowance" is used for what the Kyoto Protocol refers to as an AAU (Allowable Amount Unit) and other trading systems may refer to in other ways.
11. See, for example, Neuhoff *et al.,* (2007), OECD (2009), Dröge (2009).
12. In addition, the structure of the tax is such that the implicit penalty for CO_2 emissions is higher – per unit of CO_2 – when they are made from a large car than from a small car (Braathen, 2009).
13. The car-buying behaviour of Nordics living abroad suggests that, without this tax, there would indeed be more and larger cars on Norwegian roads.
14. A more obvious measure of total displacement tons cannot be used because statistics on a consistent basis are not collected.
15. It is difficult for a relatively short section to cover many important aspects of the fishing industry. For example, it is often relevant that there are different varieties of cod, as well as several different populations that have different spawning and migration patterns. Unless otherwise stated, in the rest of this chapter, "herring" excludes North Sea herring, where the current low level of the stock is estimated at only around one tenth of the spring spawning herring, and "cod" includes both Barents sea cod and the coastal cod fishery. For an overview of the Norwegian fisheries see Gjøsæter *et al.* (2008).
16. Much of the analysis is done by scientists from national research organisations working in joint teams under the auspices of ICES.
17. More precisely, a 12% chance that an illegally caught fish would be in an inspected catch.
18. As of 22nd October 2009: *www.fiskeridir.no/fiske-og-fangst/iuu-listen*. There are 10 Russian-registered ships on this list. There are only 2 registered in OECD member countries, both from the UK.
19. Some Icelandic vessels were been removed in 1999 nevertheless, as one of the conditions that Iceland imposed on was a key agreement (the Loophole Agreement) on managing cod (Stokke, 2009).
20. The "Agreement on Port State measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing".
21. After 1994, perhaps due to changes in water temperature, the stock moved further north.
22. One of the ways in which overfishing of cod is thought to occur is where vessels that may have, either deliberately or accidentally, caught cod as well as their main target haddock, land the cod outside Norway and record the catch as all haddock.
23. Or themselves. Large cod eat small cod when other food is scarce.
24. "Pelagic" fish, such as herring and mackerel, live in mid-depth water, largely independently of the sea floor, except for spawning. "Demersal" fish, such as cod, haddock and flat fish, live on or near the sea floor.
25. This is a simplified description. Vessels are subject to both licensing and quota arrangements. Licences and permits are issued annually. Non-tradable vessel-specific quotas are issued for the life of the vessel. "Structural" quotas, that can be traded (subject to the restrictions described in the main text) along with the vessel, are issued for 20 years. Structural quotas were first introduced in 1984 for certain fisheries and have covered all fisheries since 2004. Structural quotas were suspended at the end of 2005 and re-introduced in mid-2007.
26. Not necessarily, since if the price elasticity exceeds unity a cut in supply increases revenue. But costs per fish caught probably increase as the stock declines, so a net benefit from declining sticks is probably just a theoretical possibility.
27. Even sales to non-Norwegian owners for use elsewhere are prohibited. This might seem unnecessary, but also follows a conservation logic.

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