Towards a Sustainable Economy
Can We Survive Green Advice?

Stein Hansen

June 1996
Towards a Sustainable Economy
Can We Survive Green Advice?

Stein Hansen

June 1996
Acknowledgments

1. Can We Survive Green Advice? .............................................................. 1
   Background ......................................................................................... 1
   The Project Setting ............................................................................ 1

2. Operationalizing Environmental-NGO Demands in Macroeconomic Models......... 4

3. Findings from Macroeconomic Simulations............................................. 6

4. Adjusting to a Greener Society ............................................................... 11
   The Problems of Adjustment ................................................................ 11
   What About Agricultural Deregulation and the Environment? ................. 11
   Can Active Environmental Policies Promote Employment Generation? ...... 13

Summary and Conclusion ........................................................................ 15

References ............................................................................................. 17

Figures

Figure 1: Percent reduction in emissions divided by percent reduction in GDP for the alternative scenarios compared to the 2030 base case .................................................. 8
Figure 2: Scenario 3: Air Pollution Emissions, 1989=1 .................................... 8
Figure 3: Scenario 3: Percent Reduction in Emissions Compared to the Government LTP Scenario for 2030 ................................................................. 9

Tables

Table 1: Five Different Multi-Sector Growth (MSG)-Simulation Results: Percentage Deviation from the 2030 Results of the Government Base Case Scenario .................. 7
Table 2: Percentage Deviation in Private Consumption From the Base Case Scenario for year 2030 (scenario no. 3) .............................................................. 9
Table 3: National Wealth for 1989 and for 2030 in 1989 Prices for Each Scenario and the Base Case (1000 Norwegian kroner Per capita) ........................................... 10
Acknowledgments

The project for a Sustainable Economy is funded by the Ministries of Finance and Environment and the National Research Council of Norway, based on an initiative from Friends of the Earth-Norway and the Project Alternative Future of Norway.

The author is heavily indebted to Knut H. Alfsen, Pal Foyn Jepersen, Bodil M. Larsen,

Ingeborg Rasmussen and Haakon Vennemo for comments and assistance in preparation of this paper, but the author is solely responsible for conclusions and interpretations.
1 Can We Survive Green Advice?

Background

The Norwegian society and economy has changed drastically over the last 40 years. Real GDP has increased fourfold, and many activities that constituted key pillars of the economy and society in the mid-1950s are now extinct (commercial whaling and the floating of logs being two such examples). At the same time, a number of new economic activities that were not even in our vocabulary at the time, have taken on a dominant role. These include fish farming, computer hardware and software, modern means of communication, petroleum sector activities, and a series of public and private services. It was also not foreseen at that time that women would enter the labor force to the extent they have done. In retrospect we can safely conclude that our projections in the mid-1950s for the turn of the century missed the target by a large margin. Such projections will naturally build on the world as we know it today, and only to a very limited extent absorb and reflect the genuinely new developments expected towards 2030.

It appears that exogenous and external conditions faced by consumers and producers are changing at an accelerated pace. We must prepare ourselves for a life in a future world that is much more integrated and unpredictable than today’s, with a more competitive business environment and increased interdependence between individuals and nations. New technologies keep appearing and we will undoubtedly have a much better-educated labor force in the future. At the same time the demographic profile of our population is projected to include rapid growth in the share of senior citizens. While it appears virtually impossible to predict what Norway and the world will look like 40 years from now, it will be necessary to plan today for how our social welfare shall be secured the first two to three decades into the next century.

Since it takes time before changes in policies have their full effect, it is now that our policies must be carefully adjusted to meet new sustainability requirements, in order that transition shall be smooth and gradual rather than abrupt and destabilizing.

The Project Setting

In spite of the difficulties of seeing the contours of the distant future in the crystal ball, it would appear worthwhile to shed light on the potentials and limitations to economic and social development, as seen on the basis of the knowledge we possess at present with regard to technological progress, natural resources endowments, and the working of the economy. Such projections will naturally build on the world as we know it today, and only to a very limited extent absorb and reflect the genuinely new developments expected towards 2030. However, by looking ahead and carefully applying what we know today, we may become better prepared to trace important characteristics of the development ahead of us, and as a result be able to make decisions that will provide for a more sustainable development.

In Norway, we have a tradition of long term perspective planning in the above spirit. This helps explain why a unique study (Hansen, Jespersen and Rasmussen 1995) was commissioned two years ago jointly by the Ministries of Finance and Environment and the National Research Council, based on initiatives taken by the Friends of the Earth and Project Alternative Futures of Norway at the time of
Towards a Sustainable Economy

UNCED in 1992. 'Project for a Sustainable Economy' challenges the long term (1990-2030) scenarios of the official governmental 4-year long term plan which portrays a near-doubling of most per capita economic indicators by 2030, and continued increase in \( \text{CO}_2 \) emissions.

Following the Second World War, strong interest groups were formed in Norway (as in other industrialized countries) to protect and promote particular sector interests (agriculture and resource intensive export industries). These lobby groups gradually succeeded in establishing favorable conditions for their industries in the form of subsidies and strategic market positions.

Whereas this might have been useful during the structural adjustments of reconstruction of the economy following the war, it has gradually become clear that such internal transfers have economic as well as environmental costs to society. Environmental NGOs such as Friends of the Earth and independent research projects such as Project for an Alternative Future have come to see that one approach to altering the conservation-oriented policy influence of the above mentioned interest groups, is to adopt economic efficiency arguments with regard to resources management. In other words, the macroeconomic arguments that used to be the strength of the post war interest groups representing industry and agriculture, are now being adopted by environmental NGOs and used in their struggle for less pollution and a more environmentally benign production and consumption structure.

The Project for a Sustainable Economy is a result of this evolution. It joins the environmental demands of Friends of the Earth Norway with the macroeconomic models that are routinely used by the central government for national planning and budgetary purposes. The idea is to simulate long term environmental and economic impacts of imposing such demands for environmental quality on Norway's small open economy. This analysis then provides a basis for an expanded dialogue on the feasibility of various policy choices, with long term impacts on future generations, to be faced by today's decision makers.

The project has established a close professional and political dialogue involving both the Ministry of Finance and the Ministry of Environment. This was made possible because Norway has such a long tradition in integrated use of macroeconomic policy modeling. It has been further facilitated because Statistics Norway pioneered the field of resource accounting in the 1970s, and gradually expanded the coverage of environmental satellite accounts for use in the routine planning and budget work along with national income accounting. Gradually, this framework was expanded for integration into applied macroeconomic modeling with particular focus on the environmental impact of alternative macroeconomic development paths. Such analyses are now part and parcel of the budgetary process of the central government, and both the Ministry of Finance and the sectoral ministries (including the Ministry of Environment) develop scenarios by means of multisectoral long term computable general equilibrium models or medium term partial-equilibrium models. This provides a capacity to test and a capability to discuss the macroeconomic and environmental impacts of their respective policy proposals.

In order to facilitate adoption of project findings and challenge long term plans of the government in the public policy debate, the project has adopted the same modeling apparatus and the majority of the assumptions that are being used by the government. The decision to apply the same modeling apparatus is not founded in a belief that these models are specially designed to shed light on the sustainability of a certain economic development path. The rationale is rather that by adopting and applying a common set of modeling and analysis tools, a policy dialogue between NGOs and government regarding key sustainability issues is facilitated, and can more easily reach the agenda of parliament, the various political parties, and influential interest groups.

---


The purpose of the simulations presented below is therefore not to provide detailed long term forecasts, but rather to supply a broader basis with a much more varied set of development options and impacts for discussion and priority setting as regards the management of our resource base for the long term future.
2 Operationalizing Environmental-NGO Demands in Macroeconomic Models

The study contracted the Research Department of Statistics Norway to assist in the incorporation of various environmental demands of Friends of the Earth, and then to simulate Norway's environmental and economic development outlook for the next forty years as a basis for comparison with the official government perspective.

Friends of the Earth posed some fifty-four environmental demands to be taken into account by the macromodellers. A forum was established to determine how these demands could be met by the project. This forum met regularly for almost a year, and gradually established that out of the fifty-four environmental demands, twenty-six could be incorporated in the macromodels. Some of these are incorporated directly as exogenous constraints/variables, whereas others take the form of goals to be met endogenously as a result of explicit macro- or sectoral policy choices, some of which are very drastic compared to what is envisaged in the government's official long term scenarios. The remaining twenty-eight demands could not be met in any meaningful way within the existing macro-economic models, either because they were of a very local nature, or because they reflected issues and concerns presently not covered by our national income accounts or satellite resource accounts. The project has therefore initiated a series of parallel partial studies (both theoretical and empirical) to shed some light on the role of these environmental concerns as well.³

³ The detailed documentation of this project is currently available in Norwegian only in a series of working papers, and as a book, see Hansen et al (1995). An English edition of the book is in progress.

One should note that the models have been calibrated on the basis of historical data. This puts certain constraints on how far away from historical developments one can deviate and still retain some faith in the usefulness of the simulations. The initial CO₂-requiring of Friends of the Earth serves to illustrate this problem. Referring to the scientific reports from the UN Intergovernmental Panel for Climate Change (IPCC), they required a 60% annual reduction in CO₂ emissions as Norway's fair contribution to stabilizing global CO₂ concentrations. The economic and regulatory policy measures needed to achieve that were considered too far from anything the models could cope with while retaining some validity. It was therefore decided to strike a compromise and impose strong policy measures that would result in significant reductions in CO₂ emissions, both compared to the official government scenarios for 2030, as well as to actual 1989 emissions, but admittedly not meeting Norway's share of the IPCC goal of stabilizing CO₂ concentrations or some of the other activity level or output goals stated by Friends of the Earth. The presented simulations are therefore meant to illustrate possible long term environmental and economic impacts if Norway makes some drastic policy commitments today and sticks to them for an extended period by a process of gradually introducing stiffer economic and regulatory measures related to energy production and use, while at the same time retain a current accounts and public budget balance. The latter two dimensions are important to control because this permits simplification in this modeling context, by leaving out explicit monetary policy interventions, currency devaluation and active interest rate policies.
The main regulatory measure adopted in the simulations was to reduce extraction of oil and gas, and the associated investment activities, compared to that assumed in the official long term plan. This would be operationalized by stopping or postponing most of the projected developments of oil and gas fields. The main economic instrument adopted in the simulations is an isolated Norwegian CO\textsubscript{2} tax which is gradually increased year by year for all sectors of the economy until 2015, and from that time stabilized in current prices, with some key energy intensive industries exempted in one of the simulations (simulation 4).

The first simulation applied regulations only, the second simulation applied the CO\textsubscript{2} tax only, whereas the third simulation combined the two and thus adopted a more moderate growth in the CO\textsubscript{2} tax. Additional variations around the third scenario were also carried out; the fourth simulation exempts key energy intensive industries from the CO\textsubscript{2} tax, whereas the fifth simulation shows the impacts on economic and environmental indicators if labor input is reduced by 10% compared to other simulations. This last simulation is included to show the possible impacts of a significantly increased preference for leisure.
3 Findings from the Macroeconomic Simulations

The simulations suggest that there is substantial resilience in the economy when one has forty years to adjust to new conditions for production and consumption. They also suggest considerable — albeit significantly less than in the government's long term plan — growth in per capita GDP and private consumption, but the consumption pattern changes drastically away from fossil fuel intensive activities such as gasoline consumption (this is reduced by around 65% in the various CO2-tax simulations). It is important to keep in mind that the simulations adopt the same assumptions for technological improvement in each sector (for example as regards specific gasoline consumption of the future car) as are used in the official long term plan document.

It is also important to understand that full employment is implicitly assumed in all the simulations with the long term multisectoral growth (MSG) model. In the medium term model (MODAG) on the other hand, unemployment and adjustment costs are explicitly modeled. The adjustments are significant. The sectoral composition of production and employment changes significantly, away from energy and fossil fuel dependent sectors. On the other hand, overall employment impacts are less dramatic. Although there is increased unemployment for the first few years as a result of policy changes, this effect tapers off gradually.

It should be noted that the modeling requirement to "close" the model can be done in different ways, and that each way yields different results. In the present simulations, as a result of reducing oil and gas investments, overall investments are reduced, which means reduced savings (private and overall). Since private income is initially fixed, this permits increased private consumption (although over time reduced output will also reduce the level of consumption). Alternatively, one could have decided to close the model via the level of total private investments. In that case, as a result of reduced oil and gas investments, on-shore investments would have increased because private savings are fixed so long as private income is fixed. In other words, the model can be closed in a way that leads to increased on-shore investments, or in another way that leads to increased private consumption.

The long term simulations also assume a fixed current account balance. Where a deficit in the commodity and services trade arises, the balance must be made up by payments of interest, dividends and foreign aid. To the extent that interest and dividend payments are fixed, it will be foreign aid grants that must be reduced (quite substantially in some simulations) to meet the current account balance requirement. Subjecting the simulations to such current account constraints implicitly stabilizes foreign exchange and interest rates. At the same time the budget balance is quite well maintained, except for the leisure preference simulation (simulation 5) where a large deficit arises, and thus suggests that such a scenario is hardly sustainable.

Some key indicators from the five long term simulations are compared in table 1.
Towards a Sustainable Economy

Table 1. Five Different Multi-Sector Growth (MSG Simulation Results: Percentage Deviation From the 2030 Results of the Government Base Case Scenario

<table>
<thead>
<tr>
<th></th>
<th>Scen. 1</th>
<th>Scen. 2</th>
<th>Scen. 3</th>
<th>Scen. 4</th>
<th>Scen. 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNP</td>
<td>-5</td>
<td>-4</td>
<td>-8</td>
<td>-7</td>
<td>-18</td>
</tr>
<tr>
<td>Priv. Cons.</td>
<td>-9</td>
<td>-2</td>
<td>-10</td>
<td>-10</td>
<td>-22</td>
</tr>
<tr>
<td>Export</td>
<td>-1</td>
<td>-9</td>
<td>-7</td>
<td>-4</td>
<td>-17</td>
</tr>
<tr>
<td>Import</td>
<td>-3</td>
<td>-5</td>
<td>-6</td>
<td>-5</td>
<td>-13</td>
</tr>
<tr>
<td>CO₂</td>
<td>-15</td>
<td>-30</td>
<td>-35</td>
<td>-26</td>
<td>-40</td>
</tr>
<tr>
<td>NMVOC</td>
<td>-30</td>
<td>-15</td>
<td>-40</td>
<td>-40</td>
<td>-47</td>
</tr>
<tr>
<td>NO₂</td>
<td>-10</td>
<td>-15</td>
<td>-20</td>
<td>-17</td>
<td>-26</td>
</tr>
<tr>
<td>S0₂</td>
<td>+2</td>
<td>-40</td>
<td>-32</td>
<td>-12</td>
<td>-35</td>
</tr>
</tbody>
</table>

Source: MSG (Multi-Sector Growth) Simulations for Project Sustainable Economy, Norway, carried out by Statistics Norway, March 1995.

In simulation 2, a rapidly increasing CO₂ tax on top of the CO₂ tax already in place is the sole policy instrument in use (other than measures to stabilize the current account so that the exchange rate and interest rates remain stable). This appears to provide the most cost effective way of achieving emissions reductions (see figure 1 for a cost-effectiveness comparison of the 5 alternatives).

As far as emissions reductions are concerned, figures 2 and 3 show that major improvements are within reach relative to the levels in 1989 and to the base case scenario in the government’s long term plan. CO₂-emissions are reduced by 26%-40% relative to the 2030 base case scenario in the four simulations where a CO₂-tax is applied. As regards non-methane volatile organic compounds (NMVOC), emissions originate to a large extent from oil and gas field operations, and reductions are therefore greatest in the simulations with direct regulation of these sectors. S0₂-emissions on the other hand, increase slightly relative to the government base case if no CO₂ tax is introduced, but decrease significantly in the other scenarios, except for the case where energy intensive industries are exempted from the CO₂ tax (simulation 4).

In simulation 4, the effects of exempting heavy polluting industrial sectors (chemicals and metals) from the CO₂ tax is studied. This scenario is included because it is expected that strong interest groups will mobilize to protect these traditional export industries against the worsening competitive environment (and likely shutdown) that such a CO₂ tax would produce. Compared to the scenarios where all sectors pay the CO₂ tax, this one yields smaller declines in GDP-growth, but CO₂ and S0₂ emissions increase substantially relative to those of the other alternatives for 2030. As in the case of scenarios 1 and 3, foreign aid transfers must be substantially reduced (by around NOK 4 billion, equal to 10% in current prices) in order to preserve the overall current account balance when interest and dividend payments are assumed to be constant.

The project does not deal with the macroeconomic costs alone (i.e. GDP and consumption losses) of reducing various emissions. It also uses dose-response information and best available environmental and health value estimates to determine the benefits from reduced emissions and reduced traffic. It is found that when such benefits are included in the overall macroeconomic impact assessment, the percentage point loss of GDP is reduced by 0.5 to 1 percentage point. Since the direct GDP losses range from 4% (scenario 2) to 18% (scenario 5), such benefits improve the overall picture marginally, but they should nevertheless be included for completeness.

In table 2, changes in the 2030 consumption pattern compared to that of the government base case simulation are presented for the regulation/CO₂-tax combination.
Figure 1: Percent Reduction in Emissions Divided by Percent Reduction in GDP for the Alternative Scenarios Compared to the 2030 Base Case

![Bar chart showing percent reduction in emissions divided by percent reduction in GDP for different alternative scenarios.]

Alternative scenarios:
- *CO2/GDP*
- *NMVOC/GDP*
- *NOx/GDP*
- *SO2/GDP*

Source: MSG-simulations for Project Sustainable Economy, Norway, March 1995

Figure 2
Scenario 3: Air Pollution Emissions, 1989 = 1

![Line chart showing air pollution emissions from 1989 to 2029 for different pollutants.]

Source: MSG-simulations for Project Sustainable Economy, Norway
Figure 3: Scenario 3: Percent Reduction in Emissions Compared to the Government LTP Scenario for 2030

Source: MSG-simulations for Project Sustainable Economy, Norway

Table 2: Percentage Deviation in Private Consumption from the Base Case Scenario for Year 2030 (simulation 3)

<table>
<thead>
<tr>
<th>Consumption category</th>
<th>Per cent change from base case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>+2</td>
</tr>
<tr>
<td>Stationary use of oil</td>
<td>-36</td>
</tr>
<tr>
<td>Gasoline</td>
<td>-63</td>
</tr>
<tr>
<td>Car purchases</td>
<td>-10</td>
</tr>
<tr>
<td>Public transport</td>
<td>-9</td>
</tr>
<tr>
<td>Food</td>
<td>-5</td>
</tr>
<tr>
<td>Beverages</td>
<td>-10</td>
</tr>
<tr>
<td>Other goods</td>
<td>-9</td>
</tr>
<tr>
<td>Clothing and footwear</td>
<td>-9</td>
</tr>
<tr>
<td>Furniture</td>
<td>-11</td>
</tr>
<tr>
<td>Housing</td>
<td>-13</td>
</tr>
<tr>
<td>Other services</td>
<td>-7</td>
</tr>
<tr>
<td>Tourism abroad</td>
<td>-14</td>
</tr>
<tr>
<td><strong>Total Private Consumption</strong></td>
<td><strong>-10.4</strong></td>
</tr>
</tbody>
</table>

Source: MSG simulations for Project for a Sustainable Economy Statistics Norway

Sustainable development implies providing consumption choices that are no less in the future than those of the present. Such choices depend to a large extent on the value of national wealth in the future, i.e. on the management of capital, natural capital, man-made capital, institutional capital, and financial assets and debts to other countries. The simulations calculate the resilience under different policy scenarios of that part of wealth which is the easiest to measure the sum of manmade capital, petroleum wealth, and net assets in other countries. It may be seen from...
Table 3: National Wealth for 1989 and for 2030 in 1989 prices for Each Scenario and the Base Case (1000 NOK Per Capita)

<table>
<thead>
<tr>
<th>Wealth component</th>
<th>1989</th>
<th>Base case</th>
<th>Scen. 1</th>
<th>Scen. 2</th>
<th>Scen. 3</th>
<th>Scen. 4</th>
<th>Scen. 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manmade</td>
<td>545</td>
<td>1021</td>
<td>961</td>
<td>971</td>
<td>924</td>
<td>940</td>
<td>845</td>
</tr>
<tr>
<td>2. Net foreign assets</td>
<td>31</td>
<td>113</td>
<td>115</td>
<td>113</td>
<td>115</td>
<td>114</td>
<td>112</td>
</tr>
<tr>
<td>3. Petroleum</td>
<td>200</td>
<td>33</td>
<td>58</td>
<td>33</td>
<td>58</td>
<td>58</td>
<td>58</td>
</tr>
<tr>
<td>4. Leisure</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>14</td>
</tr>
<tr>
<td>Total Wealth</td>
<td>776</td>
<td>1167</td>
<td>1134</td>
<td>1117</td>
<td>1097</td>
<td>1112</td>
<td>1029</td>
</tr>
</tbody>
</table>

Source: MSG simulations for Project for a Sustainable Economy Statistics Norway

Table 3 shows that national wealth is almost doubled even when the environmental austerity measures are introduced. Manmade capital dominates overwhelmingly (almost 90% of the total), but is reduced when less petroleum revenue becomes available for on-shore investments. Petroleum wealth, however, increases when it is stored for future use. Foreign assets are insensitive to the scenario choice.
4 Adjusting to a Greener Society

The Problems of Adjustment

The long term computable general equilibrium model (MSG-5) which we have used to produce the above scenarios is not suited for answering questions about what happens during the transition from the initial situation to the new equilibrium, which we place 40 years into the future. Among other things, MSG-5 assumes full employment of resources (including labor), which assumes away one of the most pressing issues of concern to Norwegian decision makers: How will deliberate measures to affect emissions increase unemployment? In the long run of 40 years, the full employment assumption does not seem unreasonable. However, during the transition period, we need a disequilibrium model that can portray the impacts on employment of reductions in offshore petroleum activities over and above those assumed in the Governments long term perspective plan.

What About Agricultural Deregulation and the Environment?

As pointed out initially, the MSG and MODAG models are aggregate descriptions of the Norwegian economy. All sectors are therefore described in very broad terms. For those sectors that have proven to be particularly politically sensitive it would seem advantageous to have a more detailed description. Agriculture is one such sector that has been submitted to special analysis in this project because of its importance in Norwegian politics and culture, and its impact on biodiversity, rural and regional settlement patterns and income distribution.

Agriculture in Norway has traditionally been highly protected and has received substantial transfer payments. The Parliament has recently approved the governments proposal to deregulate Norwegian agriculture, but how far and how fast remains to be seen. Two alternative development scenarios are compared in the study: The first is labeled the GATT alternative and reflects Norwegian commitments through GATT with some trade liberalization and reduced transfer payments. The second scenario is labeled further liberalization. Initially, the project has approached the question of environmental impacts of these two scenarios by means of a relatively detailed sectoral equilibrium model (JORDMOD) to examine changes relative to a base case scenario for output, land use, and labor demand. A complementary model has been used to look more closely at the transition period. In both cases the scenarios focus on a situation where Norway unilaterally deregulates and liberalizes agricultural trade. By and large the model simulations have led to the following conclusions:

a) Reduced agricultural prices and lower transfer payments lead to reduced output and an increase in the average farm size.

b) These structural changes will take place gradually.

The study focuses on the impacts of deregulation and liberalization of agricultural policy on resource use and the environment. The following changes are anticipated in the use of non-renewable resources, and pollution from agriculture and biodiversity:

a) Lower output and reduced cultivated area;

---

Professor Kyrre Rickertsen has been in charge of these comparative studies for the project.
Towards a Sustainable Economy

b) Lower output prices and reduced factor input per unit of area;

c) Accelerated structural change;

d) Regional changes in production; and

e) Changes in the degree of specialization in agriculture.

Reduced output from agriculture leads to reduced use of non-renewable resources and reduced pollution from agriculture in Norway. At the same time agricultural imports will increase. The overall regional and global environmental impacts will therefore depend on resource use and emissions changes in countries with rising exports to Norway. Obviously, increased grain imports from Denmark will have a different pollution effect on the North Sea than grain imports from Argentina would have! Similarly, increased imports of dairy products from the Netherlands would pollute the North sea a lot more than the same package of imports from New Zealand. At the same time dumping of Norwegian dairy surplus would cease, and this would reduce local pollution in Norway.

In Norway's most productive grain growing areas roughly 50% of the land is cultivated. A decline in cultivated land in these parts of the country is likely to impact positively on biodiversity. Reduced agricultural profitability would also make it less attractive to clear and cultivate environmentally vulnerable wetlands and reduce the pressures on such lands. However, it is reasonable to expect a lot of the reductions in agricultural activity to take place in marginal areas where cultivated land constitutes but a small share of total land, and a reduction in cultivated areas in such regions would impact negatively on biodiversity. In countries like Denmark and the Netherlands where most land is already cultivated, the biodiversity impact is likely to be the opposite from that expected in a sparsely populated country such as Norway.

As regards the difference in input use between small and large farms, the only conclusion derived with some statistical confidence is that large farms use considerably less machinery and fuel per unit of dairy output than small farms. There is thus no apparent conflict between more efficient grain and dairy production and the use of non-renewable inputs. In line with this there is no reason to assume that a transition to larger farm sizes would impact significantly on the level of pollution from agriculture in Norway, so long as the minimum area required per animal is retained.

There are, however, good reasons to believe that a transition to larger farms will impact significantly on the land use structure on individual farm lots. A likely outcome could be reduced edges and "islands" and, as a consequence, reduced biodiversity.

Reduced producer prices from agricultural deregulation would lead to diminished demand for chemical fertilizer per unit of cultivated land. This would reduce the nitrogen runoff. Such a marginal reduction in the amount of fertilizer use would have a minimal impact on biodiversity, but if authorities also retain high subsidies per unit of cultivated land and grazing animal, then it will become more profitable for many farmers to switch to animal husbandry based on pasture feeding. This could have substantial positive biodiversity impacts. Reduced use of chemical fertilizer on marginal agricultural lands would improve the growing conditions for many stress-tolerant plant species, and increased incidence of flowering plants would be beneficial for nectar- and pollen-consuming insects.

Based on the JORDMOD simulations we cannot draw any firm conclusions about regional changes in output that would result from deregulation and trade liberalization. Among other things, the outcome will hinge upon what happens to the quota system for dairy farmers. Unless the government actively prevents an increase in livestock rearing in the Oslo region is likely to occur in response to sharp reductions in grain growing activity. Such a regional change in activity is unlikely to reduce the emission of nitrogen salts to the North Sea. However, this structural and regional change is unlikely to raise the use of non-renewable resources per unit of output, and increased animal husbandry around Oslo is likely to lead to reduced soil erosion and improved biodiversity.

Deregulation will probably affect the degree of specialization, but the direction of change is hard to predict. Deregulation stimulates
competition in a traditionally well protected sector and this may induce risk-averse farmers to diversity. What can be said, however, is that increased specialization – if it occurs – would probably impact negatively on both pollution and biodiversity.

What if the European Union (EU) were to liberalize agricultural trade and introduce policy measures that internalize the negative pollution externalities from excessively intensive agriculture? The first thing to note is that this would impact on the relative competitiveness of farming in the most densely developed farming communities in the EU. The so-called MacSharry plan and the nitrate directive of EU can serve to illustrate this point. The MacSharry plan impacts significantly on agricultural output and trade, and reduces nitrate emissions significantly. The gradual implementation of the nitrate directive will significantly reduce livestock herds in Belgium, The Netherlands and Denmark, and the accompanying excessive pollution. As a result, exports of dairy products and meat from these countries would decline significantly. Combining these two policy measures (the MacSharry Plan and the Nitrate Directive) would raise world market prices for agricultural produce and reduce pollution from agriculture. This would undoubtedly have a positive impact on Norway’s dairy and livestock sector, which pollutes a lot less than its continental competitors. If all farming communities in Europe were to internalize their respective environmental externalities, stemming mostly from pollution caused by intensification, Norwegian dairy farmers would become much more competitive.

**Can Active Environmental Policies Promote Employment Generation?**

The above structural adjustment discussion leads naturally to the question: Is it possible to combine policy measures in such a way that the environment is improved and unemployment reduced at the same time? The economy-wide general equilibrium MSG model is by definition unable to answer this question. There are, however, complementary macromodels of the Norwegian economy designed to study the medium term effects of efforts to curb pollution emissions from industry. One such model has therefore been used to supply more detailed analysis for these sectors, as a complement to the comprehensive economy-wide results from Statistics Norway.

Before describing the empirical results, a brief theoretical review of the conditions for achieving so-called “double dividends”, i.e. simultaneous improvements in employment and environmental conditions, is presented. The hypothesis is that “double dividends” can be achieved by shifting the tax burden in society from labor onto scarce natural resources (productive and absorptive). In recent years a lot of economic research has focused on clarifying how the economic system, including the system of taxes and fees, can become more efficient, and the creation of a political climate for implementing such reforms.

Two opposing views form the starting point of the analysis:

a) There is a fundamental conflict between employment and environmental considerations. We cannot have more of both, we must choose between them.

b) It is possible to pursue a policy, or policy reforms, so that both goals can be promoted simultaneously.

5 Jon Strand (forthcoming).

Environmental NGOs typically have argued for the second position by proposing the substitution of environmental taxes for taxes on labor, and have recently received support from the CEO of Norway’s Central Bank on this issue. Industry and labor unions have been far more reluctant to accept this position as a basis for long term planning of Norway’s future development.

It is obvious that measures that have a desirable environmental impact can have either positive or adverse employment impacts. The employment effects of a given environmental improvement depend both on the strength (dosage) of the measure and its very nature. As regards the nature of the policy measure, it is obvious that the immediate employment effects of the environmental improvement will be stronger if the initially unemployed are employed directly in an environmental cleanup operation, as compared to a case where the same environmental cleanup is achieved by the closing down of the polluting plants. As for the dosage of a given policy measure, it is intuitively easy to see that to require a plant to adjust its emissions by means of abatement control or process-improving investments will yield a more benign employment effect for society than a requirement that emissions be totally eliminated, with the risk that the plant will close down.

In other words, there is no clear and one-to-one relationship between the immediate impacts of such stand-alone measures and the economywide impacts. It becomes even more complex when one visualizes the authorities adopting a whole range of other policy measures (such as other types of taxes and subsidies or direct regulations) in order to promote employment, and in fact that is precisely what governments tend to do! Further complexities arise when one has to determine if the other policies (outside the sphere of employment promotion and environmental protection) are optimal in some economic sense.

The latter issue is illustrated as follows: Assume considerable unemployment, which in principle can be reduced by policy measures independent of environmental considerations (e.g. changes in corporate taxes, unemployment compensation, etc.). Assume also that it can be established that such a strategy for employment creation is the most effective approach from an economy-wide perspective. Assume then that the authorities for some reason decide not to apply these policy measures, but rather adopt policies to achieve environmental targets which have as a side effect an increase in employment (for example, imagine a policy package composed of environmental cleanup actions and subsidies to the companies’ own environmental investments). The critical question then becomes: Should the increased employment be attributed to the environmental policy measures?

When the economy at the outset is inefficiently organized (as it normally is!), one can point to a number of situations where it is reasonable to expect that improved environmental management by means of increased environmental taxation, will generate more employment. This applies when the improved environment is of direct benefit to industrial productivity, when the environmental management measures are labor intensive, and when public funding is required for the development of new and potentially profitable environmental technologies and products.

The simulations with the medium-term MISMOD model (see Håkonsen and Mathiesen, 1994) establish that by gradually expanding the dimensions of the welfare function to be maximized, and taking into account increasingly more pollutants and environmental impacts, the computed overall welfare level of a given CO2-reduction, as well as the optimal level of CO2-reduction, increases.

We have not in any way attempted to estimate the value of future damages (and benefits) of possible climate change, since these are assumed to be far in the future. The first benefits derived from a CO2 tax in our model of an initially inefficient economy refers to the effect of the payroll-tax offsetting public revenue generated by a CO2 tax that reduces CO2 emissions. Due to the assumed initial distortions and inefficiency it generates, the new equilibrium will be more efficient and yield a higher welfare level for up to a 10 percent CO2-emission reduction in our simulations. With 20 percent emission reductions, the welfare level declines marginally.

However, two more factors must be taken into account: First, the way in which the CO2-tax
revenue is recycled back into the economy affects the overall efficiency of the economy. If it were recycled directly to households in the form of a lump sum payment, the efficiency gain, the welfare effect and the employment generation effect would be less than with the above described payroll tax reduction. Second, if the welfare function is expanded to include the value of reduced pollution damages (not including possible future damages from climate change) on health, crops and property, the overall welfare will increase relative to base case, and reach its optimum if the CO2-tax were to go up to a level that would reduce the CO2-emissions by 20 percent relative to the projected basecase year 2000 level. The corresponding CO2-tax of $82 per ton CO2 would then generate enough public revenue to offset a 50 percent reduction in the employers’ payroll taxes. These simulations thus suggest that a CO2-emission stabilization policy in Norway would be a so-called “no-regrets policy” independent of the CO2 reduction goal stated by the Norwegian Parliament. The value of the economic efficiency gain and of the reduced emission damages (NOx, SO2, CH4, CO, SPM, etc.) lead to this conclusion.

The result appears to be resilient to quite significant variations in assumptions regarding the functions of the labor market, but the most energy consuming and CO2 emitting production sectors would suffer significantly, and experience structural reforms and close downs. We should also remind ourselves of the importance of the base case to which the simulations are compared; an economy with initial distortions and inefficiencies where adverse externalities are not internalized. If such externalities were initially internalized, the welfare effects from the payroll tax offsetting policy would be less, and the optimal level of CO2-emissions reductions would be around 10 percent compared to base case emission levels all. Whereas environmentalists were concerned about irreversible global warming threats, erosion of biodiversity and accumulation of toxics in the nutritional chains, all of these are assumed to be effects of excessive resource depletion, the economists were interpreted as arguing that there is virtually unlimited scope for substitution between manmade and natural capital, and that technological progress would come to our rescue and enhance carrying capacities of this planet.

This confrontation peaked when the long term perspective plan of the Government in 1993 presented a base case for the next 40 years with a virtual doubling of per capital real consumption and some 20% increase in CO2 emissions, shortly after the Rio declaration.

The purpose of this study was therefore to “hand over” the country to the environmental NGOs and study the impacts of their rulings on key economic, social and environmental development indicators. The NGO representative accepted the challenge of working closely together with the economists for two and a half years in order to have agreement on basic assumptions and policies that could be quantified and examined in a model context. The study did this by adopting and applying the very same macroeconomic multisectoral long term growth models, and the same technological, demographic, and “rest of the world” assumptions, as the official perspective study, but incorporated a large series of environmental goals and conditions (twenty-six in all) put forward by the environmental NGOs, as opposed to a completely different set of such assumptions in the official scenarios.

Thus the project has brought economic planning tools to the environmentalists and involved them actively in formulating their demands on development in the form of variables that can be handled by economic growth models used in official long term planning. This has established a completely new basis for dialogue between the two opposing sides in this development debate.

What are the key findings from the policy simulations with the different complementary growth models used?

First of all, there appears to be substantial resilience in the economy when allowed forty
years to adjust and adapt, even when it is small and open. Even with harsh policy measures such as a rapidly increasing CO₂ tax (which no other country is assumed to introduce) there will be sustained economic growth, albeit at a somewhat slower pace. However, over a forty year horizon we will experience a slowdown comparable to a ten year delay, which many would consider a rather small insurance premium to pay for the reduced risks of irreversible environmental damages, and much improved local environment conditions.

Second, it would appear quite feasible in the medium term to stabilize or even reduce CO₂ emissions and many accompanying emissions by means of revenue neutral "green" tax reforms, with minimal loss of economic growth, and perhaps with net welfare/employment gains, when taking as a point of departure that there are significant distortions and unemployment in the economy.

The study has thus shown that there is scope for a much broader debate about realistic and realizable alternative futures than what appeared to be the case on the basis of the long term perspective analysis alone. This may prove to be a valuable finding if and when firmer climate change evidence is established. The study was funded jointly by the Ministries of Finance and Environment together with the National Research Council. These parties were actively taking part in its evolution, and as a result a lot has been clarified for the NGOs as regards what such models and studies can tell us and what their limitations are."
References


