Statistics Norway
Research Department

Knut H. Alfsen

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Why Natural Resource Accounting?

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Knut H. Alfsen

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Abstract:
The paper briefly outlines the content and structure of the Norwegian natural resource accounts as these have been developed over the years. Initially, work on the natural resource accounts was motivated by a desire to improve the management of natural resources within a national context. Over time, it was gradually recognised that lack of systematically organised data is not the main obstacle to a satisfactory resource management in Norway. Therefore, more emphasis is now put on trying to integrate environment and resource issues within the traditional economic planning tools, highlighting the linkages between economic development, natural resource use and environmental concerns. The integration secures consistency between economic analysis and analysis of important environmental and resource issues such as air pollution and energy use. In our view this provides better support for decision makers than the often suggested proposal of "correcting" GDP or other aggregates of the national accounts.

Overall, the aim of the paper is to illustrate the importance of organising the natural resource accounts in a manner that facilitates its usefulness for analytical purposes. This will enhance the probability that the linkages between economic, natural resource, and environmental issues are brought to the attention of the decision makers. Quite often it turns out that one can show, even with a limited set of data, that proper management of natural resources and the environment makes economic sense.

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Address: Knut H. Alfsen, Statistics Norway, Research Department,
P.O.Box 8131 Dep., N-0033 Oslo, Norway. E-mail: kha@ssb.no

«Therefore, those of us who have authored and promulgated our own approaches should be careful with our missionary zeal. What we are doing may be the correct course in the countries for which we have gained our experience. They may be totally inappropriate elsewhere»
(H. Peskin, 1996)

1. Introduction

There is currently great activity in many countries to establish natural resource accounts (NRAs) of various kinds. The surge in interest for this endeavour can perhaps be traced back to the World Commission on Economy and Development's report «Our common future» (WCED, 1987) and the follow-up conference in Rio de Janeiro in 1992 (UNCED). Also the process of revising the system of national accounts (SNA) (Commission of the European Communities, et al. , 1993) and the emergence of a «blue book» on Integrated environmental and economic accounting (United Nations, 1993) may have played a role in promoting natural resource accounting. Finally, the International Association for Research on Income and Wealth (IARIW) and other organizations have arranged a series of seminars on environmental accounting[1]. These events, and the growing recognition of the economic and ecological importance of a proper management of the natural resources, have led to a number of initiatives to establish NRAs. Given the cost of establishing even rudimentary resource accounts, and in particular the demand it put on educated man-power in the developing countries undertaking the exercise, it may be worth while to spend some time thinking about why we need NRAs, and in what form they are likely to be most useful. To this end I will in this paper offer a brief overview of the history of natural resource accounting in Norway the last 20 years and try to extract some lessons from our experiences[2]. Although one should recognize the warning from Peskin (a veteran in this field) quoted above, and despite the fact that Norway is a small and peripherally placed country with

[1] IARIW's last conference, organized jointly with the UN University, took place in Tokyo in March 1996.
[2] Extracts from the Norwegian natural resource accounts together with analyses based on them are published annually by Statistics Norway (Statistics Norway, various years).

its own particular resource and environmental concerns, it is my belief that the lessons I will present here are of more general interest and applicability.

The paper is organized as follows. Section 2 describes the origin and organization of work with the natural resource accounts in Norway. We then proceed in section 3 to describe in more detail the structure of the natural resource accounts, and in section 4 to say a few words on the use of the accounts for analytical purposes. Section 5 finally concludes and summarizes our main lessons and recommendations.

2. The origin and organization of natural resource accounting in Norway

Norway is among the fortunate countries in the world which is richly endowed with natural resources of many kinds. Traditionally, exploitation of forests and fish have been important sources of income. After the turn of the century energy resources like hydro power and, more recently, petroleum resources have contributed significantly to the industrialization of Norway and brought us up among the rich countries of the world (measured per capita). Being a sparsely populated country, Norway is also well endowed with environmental resources like clean air and water and unspoiled nature.

After a period of rapid economic development following the second world war, voices of concern were, however, beginning to be heard on behalf of the environment in the late 1960s. Several important books from Resources for the Future, together with more popular titles like The silent spring (Carson, 1962) and Limits to growth (Meadows et al., 1972) provided the background for this concern. Decades of intensive expansion of the hydro-power system had gradually lead to increased opposition from conservationists seeking to preserve at least some of the more spectacular waterfalls. Oil and gas were discovered outside the Norwegian coast and, with rising petroleum prices, this augmented the concern for proper management of these valuable resources. Some of the fish stocks were over-exploited, threatening the resource base of the coastal population of Norway. Large reforestation programs had been initiated although production from already existing forests was not

fully utilised. Agricultural questions, among them the question of the optimal degree of self sufficiency in agricultural products, were raised, and plans for the use of scarce arable land and soil were requested.

In this setting the Norwegian Ministry of Environment (MoE) was established in 1972, and a search for suitable management tools for natural resources and the environment was initiated. NRAs was seen as an important part of the necessary tool kit, and from 1978 Statistics Norway was given task of developing such accounts for Norway. The aim was to ensure a better long term resource management by:

- providing new and better suited data for monitoring of resource use and long term management purposes,
- avoiding double efforts in data collection and analysis,
- providing data in a form compatible with traditional economic statistics to facilitate integrated analyses of natural resource and economic issues,
- developing a standard procedure for presentation of data and analyses on natural resources and the environment.

However, not all relevant data on natural resources fit naturally into an accounting framework. Typically, data on *material resources* where *quantity* is of prime importance is conveniently organised as accounts, while data on *environmental resources* like clean air and water, where the *quality* of the resource is of more concern, is better served by other types of data organisation[3].

Letting the central statistical office, in this case Statistics Norway, be responsible for the development of the NRAs turned out to be a wise choice. Statistics Norway is responsible for national accounting in Norway and also the development and operation of some of the economic planning models employed by the Ministry of Finance and other ministries. Co-ordinating the work on the natural

[3] See for instance Alfsen et al. (1992a) and Alfsen and Sæbø (1993) on the topic of environmental indicators.

resource accounting with ongoing work on tools for economic planning turned out to be useful for a number of reasons:

- Locating the work on natural resource accounting to Statistics Norway has assured access to statistical expertise and closeness to primary statistics used in the development of the natural resource accounts.
- In Statistics Norway, the resource accounting framework was naturally based on existing economic standards and sector classification schemes, thus ensuring general consistency in the sectoral classification of economic and resource related data and statistics. In particular, the linkage to the UN Standard of National Accounts (SNA) has made it possible to integrate important natural resource variables and relations within already existing macroeconomic models,
- Use of a common set of standards and models in the analysis of resource issues has facilitated the communication between the ministries responsible for the management of the economy and the ministries responsible for the management of the natural resources; e.g. the Ministry of Finance and the Ministry of Environment, and precluded the development of competing data sets, models, etc.

Thus, two right choices was initially made concerning the institutional location of the work on natural resource accounting and the emphasis of comparability between NRAs and economic statistics.

2.1. Historical development

In the initial phase of resource accounting, considerable efforts were made to establish resource accounts for *energy*, *fish* and *land use* (Alfsen et al., 1987, Alfsen and Bye, 1990, Statistics Norway, 1981, Lone 1987, 1988). In addition, less detailed accounts were made for *minerals*, *forests* and *sand and gravel*. Thus, the ambition level of the accounting project was quite high from the outset, covering a large number of different resources. The main reason for this was, of course, a generally growing concern for the scarcity and mismanagement of these resources, but also *a belief that one of*

the greatest stumbling blocks for a rational management was the lack of adequate and systematically organised data. These concerns and beliefs have, however, changed over time. Thus:

- The two oil price shocks of the 1970s and the reactions to these shocks seemed to indicate that there was no immediate danger of depletion of the non-renewable resources. It became clear that dooms-day prophecies brought forward by for instance the Club of Rome disregarded important regulating factors brought about by responses to resource prices. Thus, problems with the management of natural resources turned out to be different from those which originally motivated the establishment of the resource accounts.

- It also emerged that the problems of attaining a rational management of natural resources *were not primarily due to lack of data.* Rather, political and bureaucratic bodies appeared to resist the introduction of new and partly unknown constraints and considerations in the existing planning and decision making procedures.

- Finally, the effort necessary to develop and maintain a comprehensive accounting system was clearly underestimated in the first period.

Basically, of all the accounts developed, only the energy account was used actively by the government. The reason for this can be sought in the tight integration of energy issues that was achieved in the macroeconomic modelling tools employed by the government. Already at an early stage the economic models were extended to include energy as a separate input factor in production. Also, the energy producing sectors were described in some detail.

Later, the energy accounts were supplemented by emission inventories of a number of polluting compounds, and the models modified accordingly. The harmonisation of the classification scheme used in the energy accounts, the emission inventories and the national accounts were crucial in the development of integrated economy-energy-emissions models.

These experiences have resulted in *a stronger focus on a few economically and politically important issues*; namely management of Norway's considerable *energy resources*, and important environmental issues like *air pollution*, where several international protocols regulate national emission levels. The forest and fish accounts are, however, continued on a minimum basis, while accounting of land use and minerals at present has been discontinued.

Presently, there is a continuing effort to integrate resource and environmental issues into the *existing* economic planning procedures in Norway. To use existing and operational models as a core for the environmental extensions is seen as a more useful approach than striving for establishment of parallel and more or less separate resource and environmental planning procedures. This is mainly because extensions of already operational models seem to be more easily accepted by policy makers than the introduction of entirely new model concepts. Thus, over the years, the sectoral macroeconomic models employed by the Ministry of Finance for medium and long term economic projections have been disaggregated and extended to include energy and air pollution variables. Integrated forecasts are now routinely made of economic development, demand for energy and the consequences for emissions to air of several important polluting compounds[4] (i.e. sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO_2), non-methane volatile organic compounds (NMVOC), particulate matter, lead (Pb), methane (CH_4) and nitrous oxide (N_2O)). In addition, the models have recently been extended further to also incorporate *waste generation* in manufacturing and consumption activities, see Bruvoll and Ibenholt, 1996.

Summarising, the development in natural resource accounting in Norway has been from a broad coverage of many resource categories to a more selective approach with greater emphasise on analysis and integration of resource issues in economic planning.

[4] See for instance the early attempt in emission forecasting in the Government's Long Term Programme for the period 1974-1977 (Ministry of Finance, 1972), or the lastest application in the current Long Term Programme for the period 1994-1997 (Ministry of Finance, 1993). Other studies include Bye et. al. (1989), Moum (ed.)(1992) and the white papers NOU (1988), NOU (1992) and NOU(1996) which focus on the issue of green taxes.

3. The structure of the Norwegian resource accounts

The Norwegian resource accounts are kept in *physical units* and comprise the following three sub-accounts: i) Reserve accounts, ii) extraction, conversion and trade accounts, and iii) end use accounts. The meaning of the term *reserve* is clarified in Figure 1 below (McKelvey's box).

Figure 1. McKelvey's box

	Physical resource base	
	Discovered	**Undiscovered**
Economic	**Reserves**	
Sub-economic	**Resources**	
Non-economic	**Resources not likely to be economic in the future or not obtainable by present technology**	

Figure 1. Structure of the material resource accounts

I. Reserve accounts	
Beginning of period:	Resource base
	Reserves (developed and non-developed)
	Total gross extraction during period
	Adjustments of resource base (new discoveries, reappraisals)
	Adjustment of reserves (new technologies, cost of extraction, transport, etc., resource price)
End of period:	Resource base
	Reserves (developed and non-developed)
II. Extraction, conversion and trade accounts (by sector):	
	Gross extraction
	- Use of resource in extraction sectors
	= Net extraction
	Import
	- Export
	=Net import
	Changes in stocks
For domestic use:	Net extraction + net import ± changes in stock
III. End use accounts (by sector):	
	Domestic use by economic sectors

By *reserves* is meant discovered resources that are economically extractable with today's technology. The reserves will vary from year to year due to extraction, price fluctuations, technological development and new discoveries. The overall structure of the material resource accounts is illustrated in Figure 2.

Reserves of biotic resources are usually called *stocks*. In this case the stock accounts show how the stocks change due to recruitment and growth, revaluation (because of better knowledge), natural death and extraction (catch or harvest).

A couple of points is worth noting with regard to the structure illustrated above.

- *First*, the accounts consist of more than the reserves accounts (often presented as NRA in the international literature). This is essential when it comes to using the accounts for management purposes. It is then important to know *who* are going to be affected by a change of policy. The end use account is essential for this kind of analysis.

- *Second*, although the accounts are kept in physical units, they are complemented with price information whenever *market prices* are available, allowing tables in monetary terms to be generated.

- *Third*, the sectoral structure of the extraction, conversion and trade accounts and the end use accounts follow the classification in SNA. This facilitates the inter linkage between the resource accounts and the national accounts.

- *Fourth and finally*, the accounts for the different resources differ with respect to details in the various parts of the accounts (I, II and III). Thus, a biotic resource like fish requires a relatively detailed reserve account with specification of age structure and localisation of the different fish stocks. The end use part of the accounts is, however, quite simple, since relatively few sectors use fish as an input factor in their production. For energy the situation is different, since energy is an important input factor in almost all sectors of the economy.

This is illustrated in the three tables below (tables 1-3), showing the energy accounts for Norway for the year 1990. Note that reserves have been subdivided into non-developed and developed reserves. We also present an extract from the forest accounts in table 4 and a time series for the forest balance in figure 3.

Table 1. Energy reserves account 1990

	Coal	**Oil**	**Natural gas**	**Hydro power**
	Mill.tonnes	Mill.tonnes	Bill. Sm^3	TWh
Non-developed reserves				
Beginning of period		203	896	42.7
Adjustments of resource base		18	0	-0.1
Planned developed		103	17	
Developed		-29	-4	-0.3
End of period		295	909	42.3
Developed reserves				
Beginning of period	13.3	779	365	107.8
Adjustments of resource base		90	-17	
Developed		29	4	0.3
Gross extraction	-0.3	-82	-28	
End of period	13.0	816	324	108.1
Developed and non-developed reserves at end of period				
	13.0	1,111	1,233	150.4

Table 2. Extraction, conversion and trade 1990

	Coal 1000 t	Coke 1000 t	Wood, waste, etc. 1000 toe	Crude oil 1000 t	Natural gas Mill. Sm^3	Other gases and LPG 1000 toe	Petrol 1000 t	Paraffin 1000 t	Middle distillates 1000 t	Heavy oil 1000 t	Elec-tricity GWh	District heating GWh
Extraction of coal												
Production	303											
Intermediate use									-4		-22	
Extraction of oil and gas												
Production				80,659	27,642	962	201					
Intermediate use					-2,037				-197	-14	-95	
Hydro power production												
Production											121,382	
Intermediate use							-3		-5		-1,331	
Primary production	303			80,659	25,605	962	198		-206	-14	119,934	
Import	713	901		1,623		1,121	642	102	827	593	334	
Export	-254	-119		-68,493	-25,380	-1,134	-2,564	-412	-3,610	-973	-16,241	
Norwegian purchase abroad								30	82	1,126	5,875	
Foreigners purchase in Norway								-30	-80	-44	-62	
Change in stocks	-13	-18		-1,473		-36		-12	-4	39		
Primary supply	749	764		12,316	225	913	-1,724	-320	-1,911	5,458	104,027	
Oil refineries												
Production		161				937	3,944	1,068	5,949	1,320		
Intermediate use				-12,742		-703	-211	-2	-115	-529	-448	
Thermal power												
Production											369	
Intermediate use									-2		-27	
Hydro power and district heating												
Production											97	1,413
Intermediate use	-21		-98						-2		-336	
Other supplies			989			80	54	14				
Losses											-7,237	-547
Statistical errors	26	-10		426	-225	-4	-274	-110	213	254	362	
Use outside the energy sectors	754	915	891			1,223	1,789	650	4,132	6,503	96,807	866
Domestic use	754	915	891			1,223	1,789	650	2,819	459	96,807	866
As raw material	595	890				1,112						
Domestic energy use	159	25	891			111	1,789	650	2,819	459	96,807	866

Table 3. Use of energy outside the energy sectors. 1990

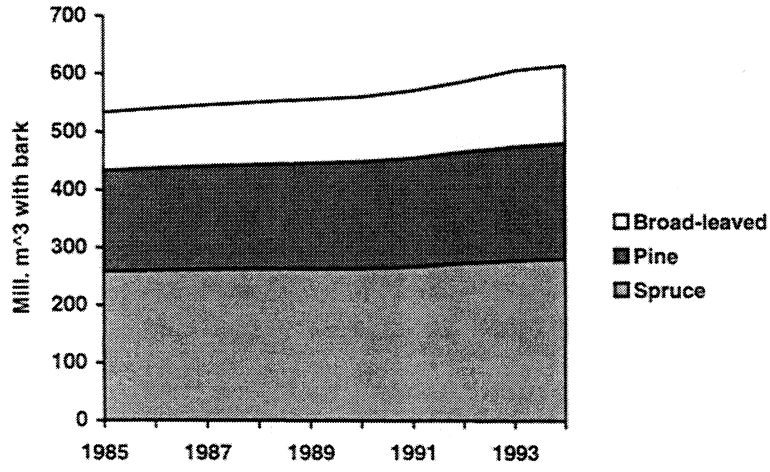
	Coal 1000 t	Coke 1000 t	Wood, etc 1000 toe	Other gases and LPG 1000 toe	Petrol 1000 t	Paraffin 1000 t	Middle distillates 1000 t	Heavy oil 1000 t	Electri-city GWh
Total	754	915	891	1,223	1,787	650	4,132	6,503	96,807
Agriculture and fishing	5				16	1	640	19	680
Agriculture	5				12	1	164	5	680
Forestry					1		18		
Fishing					3		458	14	
Mining and quarrying				0			36	20	708
Metal ore mining				0			12	19	499
Other mining							24	1	209
Manufacturing	742	913	409	1,220	12	1	324	324	44,572
Manuf. of food, etc.	3	1	1	3	4		109	87	2,285
Manuf. of textiles, etc.				0			7	5	158
Manuf. of wood products			103	0	1		20	9	730
Manuf. of paper products	6		301	0			6	65	6,805
Printing, publishing etc.				2	2		3		403
Manuf. of ind. chemicals		178	4	1,177			7	49	5,169
Manuf. of chemical products	112	114		3	1		31	25	923
Manuf. of cement, etc.	120	10					4	4	197
Manuf. of other mineral prod.	17	10		5			26	28	563
Manuf. of iron and steel	70	2					5	18	655
Manuf. of ferro-alloys	413	433		0			4	1	7,453
Iron and steel founding	1			0			1		148
Manuf. of primary aluminium		151		1			47	6	14,431
Manuf. of other non-ferrous metals		14		17			2	20	2,210
Rolling and founding of non-ferrous metals				3			3		192
Other manufacturing				7	4		49	7	2,250
Construction					8		207		530
Wholesale and retail trade, etc.					189	2	178	1	5,995
Wholesale and retail trade					187	2	164	1	4,740
Hotels and restaurants					2		14		1,255
Transport and storage					72	405	2,201	6,132	1,449
Railway transport							32		640
Motor bus transport					1		106		
Taxi, etc.					19		12		
Other land transport					12		434		12
Ocean transport							1,314	6,045	
Coastal and inland water transport							276	87	
Air transport					3	405			
Supporting services					4		19		294
Post and telecommunication					33		8		503
Finance and insurance					54		18		1,504
Other private services					43	1	59	4	2,244
Public administration and defence					6	86	144	4	8,827
Public administration except defence					3		13		1,077
Education and research							26		2,630
Health and welfare institutions							36	4	2,874
Other public services					3	86	69		2,246
Private households	7	2	482	3	1,387	152	327	1	30,299

Note: Includes energy commodities used as raw material.

Table 4. Forest account: Use balance - summary. 1984

	Saw logs	Pulp wood	Fuel wood	Wood waste	Sawn wood	Boards	Pulp	Paper
			1000 m^3			1000 tonnes		
Harvesting	5 952	4 227	1 284	-	-	-	-	-
Imports	189	1 037	73	763	504	49	120	280
Exports	-215	-295	-8	-181	-459	-67	-574	-1 266
Change of inventory	141	207	-	86	8	15	-3	4
Primary supply	6 067	5 176	1 349	658	53	-3	-457	-982
Industry								
Sawing	-5 658	97	83	2 341	2334	1	-	-
Boards	-14	-320	-	-575	-1	330	-	-3
Pulp	-	-4 903	3	-1 643	-	-	1 788	-
Paper	-	-	-	-	-	-	-1 423	1 455
Other supply	39	2	888	271	129	2	-	159
Losses, statistical errors	271	-40	-132	-537	126	146	98	3
Use outside conv. sectors	705	15	2 191	515	2651	476	6	621
Agriculture, Fishing	363	-	-	86	-	-	-	-
Prefabrication of houses	172	-	-	-	220	50	-	4
Building articles	147	8	-	20	569	33	-	-
Furniture	3	7	-	-	138	81	-	-
Paper products	-	-	-	-	-	-	5	280
Printing	-	-	-	-	-	-	-	147
Newspapers	-	-	-	-	-	-	-	150
Other manufacturing	20	-	51	264	49	10	1	40
Construction	-	-	-	117	1 508	302	-	-
Trade and Transport	-	-	-	-	-	-	-	-
Government	-	-	-	-	58	-	-	-
Households	-	-	2 140	-	-	-	-	-
Unspecified	-	-	-	-	109	-	-	-

Figure 3. The Norwegian forest balance, 1985-1994. Million m^3 with bark.



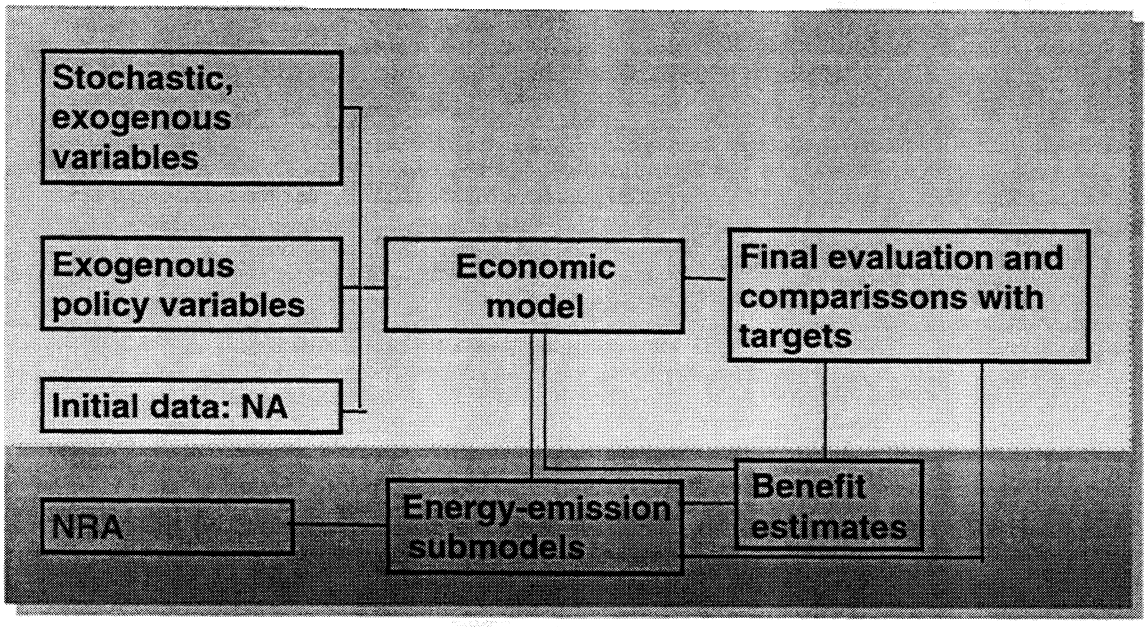
In addition to accounts for material resources like fish, forest and energy, related statistical information is collected for environmental resources. In particular, the energy account (end use account) is an important and necessary foundation for the *emission inventories*, which at present cover sectoral

emissions of sulphur dioxide, nitrogen oxides, carbon monoxide and carbon dioxide, particulate matter, non-methane volatile organic compounds, lead, methane and nitrous oxide.

4. Use of the natural resource accounts for analysis

Natural resource accounting in Norway is not considered as a goal in itself, but rather as a way of providing systematised data for analytical purposes. Thus, information based on the energy accounts and the associated emission inventories have been integrated into more comprehensive analytical tools by expanding the macroeconomic planning models[5], see figure 4.

Figure 4. Integrated economy-environment models.



These extended macroeconomic models are now used by the government and other administrative bodies on a routine basis. Some recent examples of their use are reported by two Green Tax Commissions (NOU, 1992 and 1996) and the government's Long Term Programme 1994-1997 (Ministry of Finance, 1993). Earlier studies include SIMEN (Studies of Industry, Environment and

[5] The use of models in the policy process has a long tradition in Norway going back to the pioneering work of Leif Johansen in the early 1960's (Johansen, 1974). The development of the models are further described in Bjerkholt et al. (1983), Longva et al. (1985), Offerdal et al. (1987), Holmøy et al. (1994) and Alfsen et al. (1996). Some reflections on the use of integrated models are given in Alfsen (1991, and 1992).

Energy Towards 2000, Bye et al., 1989), an analysis of climate policy problems on a national scale (Moum (ed.), 1992), and a white paper on structural adjustments of the Norwegian economy (NOU, 1988).

By integrating the resource and environmental data with economic models, several aims are achieved.

- *First*, consistency between economic planning, expected growth in energy use and the resulting emission to air is secured in the model based forecasts.

- *Second*, by providing output tables covering both economic, energy and environmental variables, the linkage between these policy areas is brought to the attention of the policy makers.

- *Finally*, by making a single modelling tool available to both the Ministry of Finance and the Ministry of the Environment (among others), communication among the different branches of the government is enhanced.

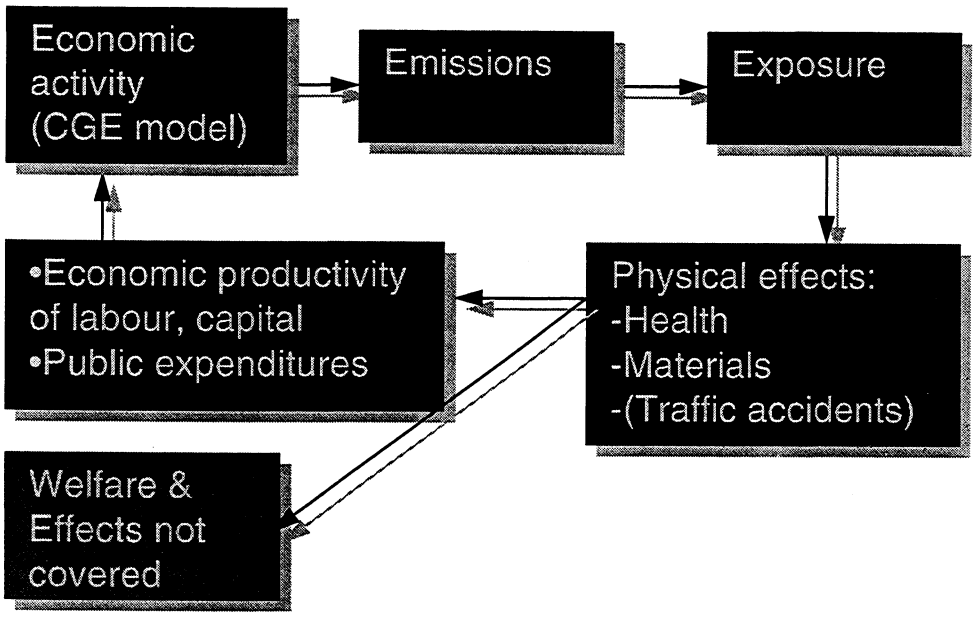
Typically, three types of questions are addressed by the integrated models:

- What are the likely future developments with regard to economic growth, demand for energy and emissions to air? Are environmental targets compatibles with the economic goals?
- How will a change of policy (e.g. introduction of environmentally motivated taxes or regulations) affect the projected development, both with respect to the economy and the environment?
- How will future development in the state of the environment and availability of energy resource affect the economic development?

In order to address the last question, the models have been supplemented with relations between emissions to air, concentration of air pollutants in different regions of the country, physical damage to buildings and human health of air pollution and the effects of these damages to economic productivity of real capital and the labour force and effects on public budgets, see figure 5. Also the cost to society of traffic accidents is included in this «package» of feedbacks from the environment to the economy.

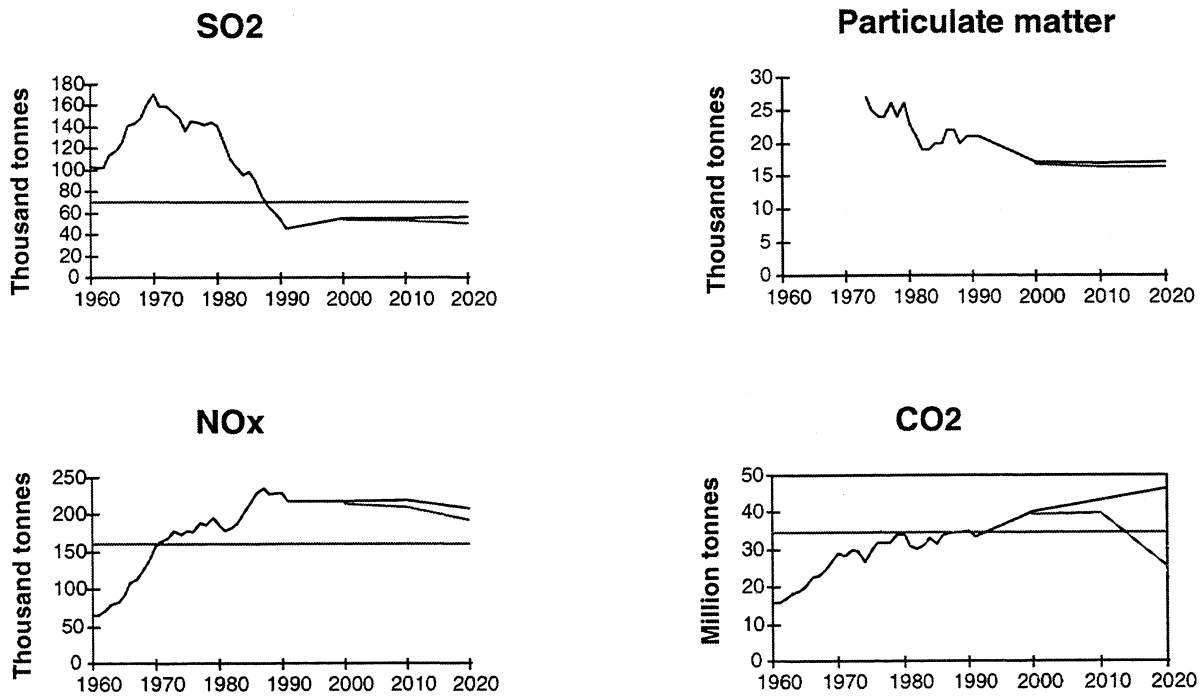
See Alfsen and Rosendahl (1996) for a more detailed description of this simultaneous modelling of economic growth and emissions to air.

Figure 5. Assessing the value of environmental services with integrated economy-environment models



Presently, the model apparatus is utilized on a routine basis not only by the Ministry of Finance, but also by other ministries like the Ministry of Environment and the Ministry of Industry and Energy. Figure 6 shows some typical results from an analysis of carbon taxation in Norway. Lately, also some of the larger Norwegian NGOs has used the model in order to illustrate the feasibility of alternative, and in their view, more sustainable policies. Thus the models function like a mediator among several politically important agents, forcing the environmental aspects of economic policy to be taken into account by the Ministry of Finance, while at the same time showing the Ministry of the Environment and the NGOs some of the economic consequences of pursuing a «greener» policy. As such the development of integrated models can be said to be a success in Norway and it has certainly brought the policy debate forward.

Figure 6. Some effects of a carbon tax in Norway.



5. Discussion and some conclusions based on Norwegian lessons

We have briefly outlined the structure of the Norwegian resource accounts and their historical development from the 1970s until today. Over the years a pragmatic approach has been followed with emphasis on the use of the resource accounts for analytical purposes. The integrated models are all extensions of disaggregated macroeconomic planning models traditionally used by governmental bodies. This has facilitated the introduction of environmental concern in the planning process in Norway. Furthermore, by using the same modelling framework for analyses of both economic and environmental policies, consistency in behavioural and other key assumptions are secured. Finally, linking physical resource accounts and environmental statistics to economy-wide models provides for better and more comprehensive information on the value of natural resources and environmental services than through more partial studies. For these reasons, we strongly recommend a strategy where resource and environmental issues through their physical characteristics are integrated into already

operational economic planning tools. This is in contrast to a strategy where new and separate models for resource and environmental analysis are developed in addition to existing models.

To summarize the lessons that seems to be implied by the above story, we note that:

1. The development of NRAs should be demand driven, i.e. there should exist a clearly specified need for the accounts with specific questions to be answered. Without one or more specified end users of the accounts, one runs the risk of vasting valuable resources on developing accounts that no one will use. Also, by focusing on the questions to be anwered by the development of NRAs, one will have useful guidance with regard to the many questions that are bound to arise during the construction of NRAs. Presumably one will quite often find that the questions posed cannot be answered by NRAs alone, but must rely on the use of numerical models. A typical example will be alternative economic and environmental forecasts under different resource policy regimes (e.g. without and with a resource tax). The role of the NRA in this case will be to provide necessary data for the calibration and estimation of the parameters in the model.

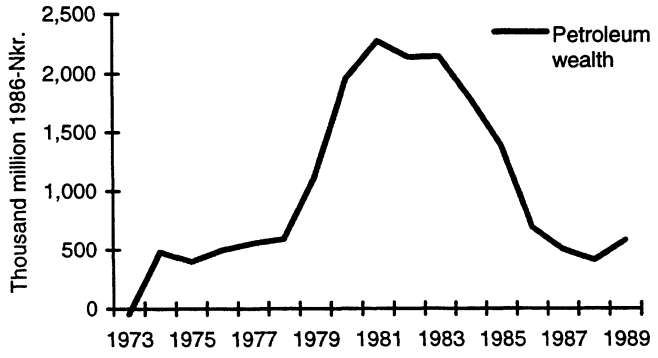
2. In order to facilitate the use of NRAs for such purposes it is imperative that they are organized according to the classification standards employed in the model. Usually this implies a classification of sectors and commodities according to the System of National Accounts (SNA).

3. In considering the management of natural resources it is usually not enough to account for the amount of the resources (reserves accounts); also the use of the resources should be accounted for (conversion, trade and end use accounts). This is necessary in order to be able to say something about who is going to be affected by a change in resource policy, and in the next round, how they may react to a change in policy and how will this in turn affect the resource depletion or harvesting.

4. The question of the values of the resources is likely to arise. This is an important question of course, but unfortunately seldom possible to answer unambiguously and in a manner suitable for accounting. For non-marketed resources (like for instance most environmental services) valuation

from the supply side (cleaning costs, etc.) will usually differ substantially from a valuation from the demand side (willingness to pay/accept, etc.), and the correct valuation will depend crucially on which questions are asked. In this case it is, in our opinion, better to keep the natural resource accounts in physical units and rely on additional analysis to provide answers to the question of the value of resources. Also in the case of marketed resources (e.g. material resources like oil, gas, timber, fish, etc.) the valuation is also problematical, since the value of the resources to society will depend on expectations about the future technological development as well as the development in prices and extracted volumes. If the past is anything to go by, these expectations will fluctuate very much. Figure 7 illustrates this by showing the development in the Norwegian petroleum wealth from 1973 to 1989. The petroleum wealth in a specific year is calculated as the net present value of future petroleum rent based on official forecasts of prices and extraction rates as perceived in that year.

Figure 7. The petroleum wealth in Norway based on official price prognoses, 1973-1989.



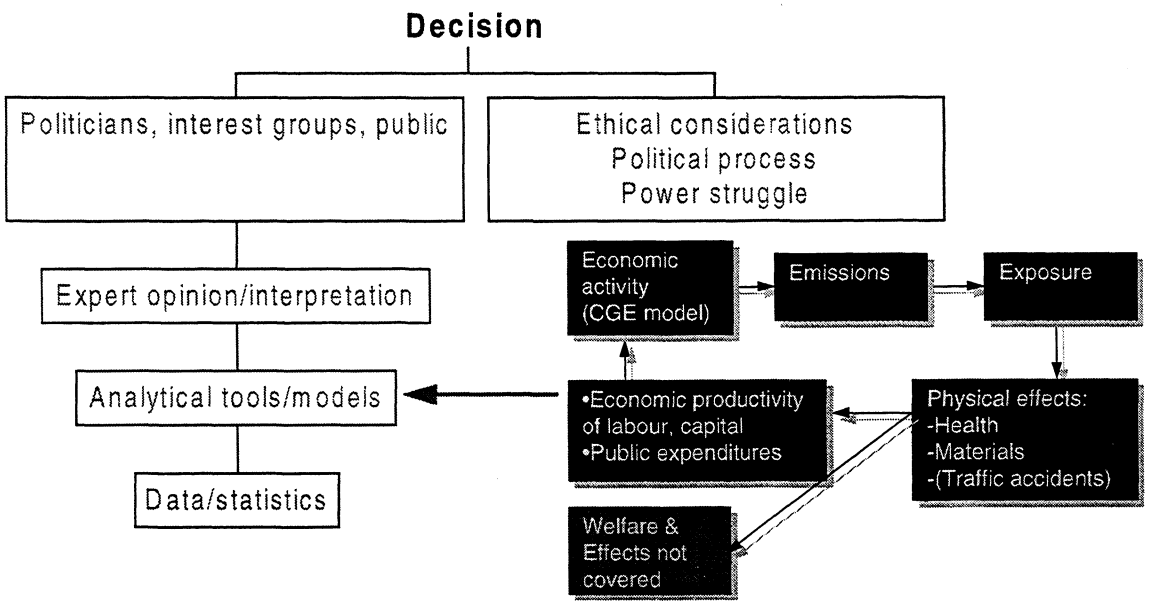
The variation in wealth, which is of the order of 2 000 billion 1986-Nkr, is dominated by changes in price expectations. For comparission, we can mention that GDP in Norway in 1990 was of the order of 660 billion Nkr. Again, we therefore recommend that the accounts are kept in physical units, and that additional valuation exercises are carried out as analytical projects when the need arises. Basically, the uncertainties inherent in the valuation of natural resources seem to be so large that they are likely to detract from the value of NRA rather than add value to the accounts.

5. However, even the choice of physical units may sometimes be problematical. For instance, in the case of forest accounting one is faced with the question of «what constitute a forest?». Not all trees are part of a forest. Should the area covered by the forest or the volume of the trees be used? What about the stock of non-timber resources (both material resources and environmental services)? The answers to such questions once again depends on for what purpose the NRA is constructed. So even physical NRAs are likely to be useful only within a specific context. If this context is too narrow or temporarily fragile, it is probably not worth developing the NRA at all.

6. Since countries differ a lot, both with regard to the endowment of natural resources and stage of economic development, but also with respect to political system and institutional set up, it follows from what has been said above that the optimal NRA system is likely to vary among countries. For this reason it is difficult and probably not very wise to set up a natural resource accounting system entirely according to «international standards» or other countries' schemes (cf. the citation from Peskin at the start of this paper). This makes the current trend in natural resource accounting, with a number of countries developing accounts according to «fixed» rules, somewhat worrisome. Instead one should carefully think through in each case what type of problems one is facing and whether a suitable NRA is likely to be useful for formulating a rational resource policy. International comparability is of course enhanced by following standards in natural resource accounting, but this is seldom a major concern within the context of natural resource and environmental managment.

Let me end this paper by emphasising once more that the underlying rationale for natural resource accounting is that the NRA should give support to the decision making process. A useful framework to keep in mind is perhaps the one shown in figure 8.

Figure 8. A framework for NRA



Decision making in the society usually involves a number of groups. First of all the actual decision makers (usually politicians), but also special interest groups and in some sense the general public. Into the decision making process enters considerations of many kind; ethical judgements, information on political consequences, sometimes threats etc. as part of a power struggle, and finally advice from experts. This expert advice is usually founded on interpretation of analytical studies and research which often is based on formal or informal models of (parts of) society. These models are in turn based on data and statistics, including sometimes the natural resource accounts. From this sketch of the decision making process it follows that the value of NRA for the decision makers depends on

1. the availability of experts to carry out and interpret research relevant for the decisions,

2. the availability of analytical tools (usual models) able to address the questions posed by the decision makers,

3. the links from the data to the models to the experts interpreting the results and, finally, to the decision makers.

The success or failure of NRAs in supporting the decision making process thus depends on a lot more than the accounts themselves. Analytical tools are, as already mentioned several times, usually necessary, and of course the human capital to use and interpret the results. The communication (i.e. the links between the elements in the above figure) must also be adequate, and this is, at least in Norway, often the weakest link in the chain from NRAs and data to decision makers. When contemplating the development of NRAs it is important to keep this in mind, in order to avoid overinvestments in perhaps the easiest part of the process; collecting and organizing data.

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Statistics Norway
Research Department
P.O.B. 8131 Dep.
N-0033 Oslo

Tel.: + 47-22 86 45 00
Fax: + 47-22 11 12 38

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