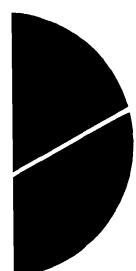


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**NOSE – Nomenclature for Sources
of Emissions**



Documents

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1. Introduction

Emission inventories are of interest to policy makers and the public due to the harmful effects of the pollutants and the cost of regulating them. There are many different users and applications of inventories and several quite different nomenclatures have been developed, few taking statistical standards into consideration. While such standards in principle exist for the branch and commodity dimensions of the inventories, there exists no standard for emission sources. Eurostat, in collaboration with DGXI and EEA, has now started to develop NOSE (NOmenclature for Sources of Emissions) a new standard statistical classification for sources of emissions. NOSE will cover emissions and discharges to land, water and air. The basis will be economic branches aggregated from NACE and emission processes defined by SNAP (Selected Nomenclature for Air Pollution) extended to other media than air.

It is often useful to distinguish between a nomenclature for bookkeeping and a nomenclature for presentation. The nomenclature for bookkeeping should be detailed, and as far as possible based on statistical standards. As emissions often are calculated, the nomenclature must also be detailed enough to allow an accurate calculation. The demands for a nomenclature for presentation will vary among users. An economist will often want emissions by groups of branches while others are more interested in emissions by equipment. A good nomenclature for bookkeeping should allow flexible aggregations into presentation nomenclatures. The SNAP nomenclature is usually aggregated into 10 «source-sector» categories. This report will mainly cover nomenclatures for bookkeeping. Standard aggregations of e.g. NACE or PRODCOM have usually a low information value when environmental data are presented because they are developed for presenting economical data. Hence, the nomenclature for presentation should be defined by the demands from the users.

SNAP has been developed without assuring a link to standard economic classifications. Such links may, however, be made by approximate methods. Several methods are possible, but the choice is often limited by the available relevant data.

This document covers a review of emission nomenclatures for air and water in use in Norway, a brief discussion of appropriate NACE branch codes for emissions and suggestions for methodologies for distributing the emissions from each SNAP code between branches.

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2. Source nomenclatures in use in Norway

Inventories of emissions to air in Norway have been made by Statistics Norway since the early seventies. The source nomenclature has been developed gradually. The current nomenclature has been used since the 1989 inventory, but the years 1980 and 1987 are currently being completely recalculated.

Total discharges to water of nitrogen and phosphorus are calculated by NIVA (Norwegian Institute for Water Research) based on point source data and additional calculations. There are no complete inventories of other pollutants. The Norwegian Pollution Control Authority operates a point source register covering several pollutants and Statistics Norway collects data for a register on discharges from waste water treatment plants.

2.1. Air

The emission inventories are made in collaboration between Statistics Norway and the Norwegian Pollution Control Authority. Statistics Norway is responsible for the model development and

definition of sources. While SNAP is a combination of branches and processes («source-sectors»), the Norwegian emission model is built with independent axes of pure branches and pure technical processes. The branch axis is aggregated from NACE and is very close to the branch classification used in the National Accounts (appendix 1). The processes have been defined for the purpose. Each emitting activity is allocated a branch and a process and is uniquely defined by these. An emitting activity may be an individual plant or an area/line source. The emissions are presented according to the demand - aggregated by branches, process, fuel or useful combinations of these. Some users also request very detailed information, which is distributed if the individual emitters not can be identified.

Box 1. The Norwegian air emission model

In the Norwegian emission inventory system all emissions are calculated in a five dimensional cube model, with the axes *pollutants*, *technical emission processes*, *emission carriers* (e.g. fuels), *economic branches* and *territorial units*. Thus, emissions may be listed by a multitude of combinations of fuels, processes and branches for each territorial unit or nationally. The combustion emissions are calculated by combining the fuel consumption distributed between emission processes and economic branches with fuel, process, branch and pollutant specific emission factors. If measured emission estimates are available, these are used instead of the calculated emissions. Emissions from road traffic are calculated in a detailed manner in a special model. Aggregated emission factors are input to the main emission model. The non-combustion emissions are estimated by combining activity data with emission factors, by more complicated calculations, estimated from measurements or taken from special investigations. They are fitted into the cube model by an appropriate emission carrier, emission process and economic branch. The models and calculations are more thoroughly described in references 1-6. Currently the model covers emissions of SO₂, NO_x, NH₃, NMVOC, CO, particulate matter, lead, cadmium, CO₂, CH₄ and N₂O.

2.1.1. Branches

The branch list is aiming at being as close as possible to the one used in the National Accounts in order to facilitate a linkage to economic data and models. The National Accounts branch list is aggregated from NACE. In addition «private households» is defined as one branch. The National Account branch list is not made for environmental purposes. It has, consequently, been necessary to make a few changes in the branch list. The service branches are specified quite detailed in the National Accounts, while some of these are insignificant with respect to emissions and little information on their energy use/emissions exist. Consequently, some of these have been aggregated. On the other hand, in the manufacturing industries many high emitting activities are aggregated in the National Accounts. Examples are found within the chemical, mineral product and metal manufacture industries. Some of these were consequently split up according to the basic NACE branches. Gas terminal (not distinguished in NACE) also had to be distinguished from the branch «extraction of crude petroleum and natural gas».

Total national emissions, as they are defined in environmental protocols, do not correspond to the activities covered in the National Accounts. E.g. sea and air traffic abroad are not included in the protocols, but some foreign activities within the country may be. It was consequently necessary to invent a helping branch; the branch «foreign activity in Norway» was defined to account for emissions from foreign ships and aircraft in Norway.

The adopted list of branches has been in use a couple of years and has proven to be appropriate for the current applications of the inventory (linkage to economic data as well as other applications). The branches are listed in appendix 1.

2.1.2. Processes

For defining the processes we did not have any statistical classification to start from. The processes were defined aiming at identifying the main emission generating activities from *the combination of*

processes and branches. The processes are grouped into three main classes: stationary combustion, mobile combustion and non-combustion. For combustion, the processes will be a list of stoves and engines. The processes are listed in table 1.

For non-combustion processes it is less straightforward to define a process list. We have defined a set of chemical and physical processes. However, these processes are not meaningful if not connected to a branch or emission carrier. The strength of this classification is that it is not always necessary to extend the nomenclature when new emission generating activities are discovered (as it is e.g. in SNAP). On the other hand, the system is more difficult to comprehend.

In addition to the listed processes in the main model, we have defined sub-processes in two satellite models for transport (road traffic and shipping). These sub-processes are directly aggregated to the processes in the main model (table 2 and 3). We are currently working on a satellite model for aircraft emissions. The preliminary processes defined are shown in table 4.

Table 1. Processes in the Norwegian emission model

Process	Emission carrier
<i>Stationary combustion</i>	
Direct fired furnaces	[Coal, Coke, Heavy oil, Gas]
Boilers	[Coal, Coke, Fuel oils, Kerosene, Gas, Wood etc.]
Small stoves	[Coal, Gasoline, LPG, Wood]
Gas turbines	[Gas, Marine diesel]
Flares	[Gas]
Fire	[Wood, Waste]
<i>Mobile combustion</i>	
Road traffic (several categories)	[Gasoline, Auto diesel]
Motorcycles	[Gasoline]
Mopeds and snow scooters	[Gasoline]
Two stroke boats	[Gasoline]
Four stroke boats	[Gasoline, Auto diesel]
Ships	[Marine diesel, Heavy oil]
Railway	[Auto diesel]
Air traffic (landing/take-off)	[Jet fuel (kerosene), Aviation gasoline]
Air traffic (cruise)	[Jet fuel (kerosene), Aviation gasoline]
Motorised tools (two stroke)	[Gasoline]
Motorised tools (four stroke)	[Gasoline, Auto diesel]
<i>Non-combustion</i>	
Oil loading (offshore)	[Crude oil]
Oil loading (on shore)	[Crude oil]
Fertiliser, ammonia and nitric acid production	[Nitrogen compounds/products]
Transformation	[Crude oil, Gas, LPG, Lime and Ca-compounds, Clay, Coal, Waste, Ore, Silicon, Metal]
Bioprocesses	[Nitrogen compounds/products, Animals, Manure, Waste, Food articles]
Liming	[Lime and Ca-compounds]
Extraction	[Crude oil, Natural gas, Coal]
Evaporation	[Solvents, Gasoline]
Boiling	[Sulphur compounds, Ore]
Redox processes	[Sulphur compounds, Ore]
Calcium carbide production	[Petrol coke]
Silicon carbide production	[Petrol coke]

Table 2. Processes of emissions from road traffic

Category	Fuel	Type	Weight	Payload
GL1	Gasoline	Passenger car	<3.5 t	<760 kg
GL2	«	Light duty	<2.7 t	>760 kg
GL3	«	Heavy light duty	2.7-3.5 t	«
GHG	«	Goods	>3.5 t	«
GHB	«	Bus	>3.5 t	«
DL1	Diesel	Passenger car	<3.5 t	>760 kg
DL2	«	Light duty	<2.7 t	«
DL3	«	Heavy light duty	2.7-3.5 t	«
DHGL	«	Light goods	3.5-10 t	«
DHGM	«	Medium goods	10-20 t	«
DHGH	«	Heavy goods	>20 t	«
DHB	«	Bus	>3.5 t	«
LPGL	LPG	Passenger car	<3.5 t	>760 kg
LPGB	«	Bus	>3.5 t	«
LNGB	Natural gas	Bus	>3.5 t	«

Table 3. Processes of emissions from ships

Branch	Process
<i>Fishing</i>	Fishing vessels
<i>Coastal traffic</i>	Cargo
<i>Oil and gas extraction</i>	Passenger
	Supply/standby
	Oil shuttle tankers
	Mobile rigs
<i>Other</i>	Other
	Rescue
	Military
	Other state ships
	Other

Table 4. Processes of emissions from aircraft

Branch	Process
<i>Civil aviation</i>	Passenger aircraft
	Helicopters/ambulance
	Small aircraft
<i>Military aviation</i>	Fighters
	Helicopters
	Freight aircraft

Examples

To illustrate how the nomenclature is used we have chosen a few examples from the emission model in box 2. See also table 7 and section 2.1.4.

Box 2. Correspondence between selected SNAP codes and the Norwegian emission model.

SNAP	Description of SNAP	Branch Norway	Process Norway
02 03 01/2	Combustion plants (boilers) in agriculture, forestry and aquaculture	230100 (agriculture), 230200 (forestry) and 230520 (Fish farms)	Boiler
03 03 11	Processes with contact- cement	232650 (Cement manufacture)	Direct fired furnace
04 03 01	Aluminium production	232730 (Aluminium manufacture)	Redox processes
06 01 04	Paint application- households	330000 (Households)	Evaporation
07 01	Passenger cars	All (in principle)	Passenger cars

2.1.3. Other air emission source nomenclatures in use in Norway

The Norwegian Pollution Control Authority runs a database of emissions (MUNIN). Statistics Norway's emission model is the main input to the air part of this database. The MUNIN database has a hierarchical structure of sources at several levels. Although it is quite detailed, the nomenclature is more appropriate for presentation than for calculations or bookkeeping. The structure is shown in table 5. MUNIN also covers other media, see section 2.2.1.

Table 5. Emission sources in MUNIN. Air

0. Not known activity	206 Paper and pulp	30112 Heavy vehicles
1. Stationary combustion	207 Chemical manufacture	301121 Trucks
101 Oil extraction	2071 Fertilisers	301122 Buses
1011 Gas turbines	2072 Carbides	3012 Diesel vehicles
1012 Flaring	2073 Petrochemicals	30121 Light vehicles
1013 Diesel engines	2074 Other	301211 Passenger cars
102 Gas terminal	208 Mineral products	301212 Light duty, < 2.7 tonne
103 Manufacturing industries	2081 Cement	301213 Light duty, 2.7-3.5 tonne
1031 Oil refineries	2082 Other mineral products	30122 Heavy vehicles
1032 Paper and pulp	209 Metal manufacture	301221 Trucks, 3.5-10 tonne
1033 Cement	2091 Iron and steel	301222 Trucks, 10-20 tonne
1034 Other mineral products	2092 Ferroalloys	301223 Trucks, > 20 tonne
1035 Petrochemicals	2093 Aluminium	301224 Buses
1036 Fertiliser	2094 Other manufacture processes	3013 Other motor vehicles
1037 Metals	2095 Anode production	30131 Motorbikes
1038 Other manufacture	211 Agriculture	30132 Mopeds and snow scooters
104 Other industries	2111 Animals	303 Leisure boats
105 Dwellings and offices	2112 Manure	304 Motorised tools
106 Waste incineration	2113 Use of fertilisers	3041 Gasoline driven
107 Tobacco	2114 Use of limestone (lakes and agricult.)	30411 2 stroke
199 Other stationary combustion	212 Landfills	30412 4 stroke
	213 Use of solvents	3042 Diesel driven
	214 Mines	305 Railway
2. Non-combustion	215 Bread and beer production	306 Aircraft
201 Oil and gas extraction	216 Use of limestone (industry)	3061 < 1000 m
2011 Fugitive emissions	217 Waste water treatment	3062 > 1000 m
2012 Extraction	299 Other emissions to air	307 Ships and boats
20121 Venting etc.		3071 Coastal traffic
20122 Crude loading (off shore)	3. Mobile combustion	3072 Fishing
20123 Crude loading (on shore)	301 Road traffic	3073 Mobile oil platforms
202 Gas terminal	3011 Gasoline vehicles	
203 Coal extraction	30111 Light vehicles	
204 Gasoline distribution	301111 Passenger cars	
2041 Loading of ships, trucks and depots	301112 Light duty, < 2.7 tonne	
2042 Loading of cars	301113 Light duty, 2.7-3.5 tonne	
205 Refineries		

For calculating emissions in local areas (e.g. cities), a more aggregated set of emission sources has been defined (table 6) [7]. These are combinations of branches and processes and have been aggregated from the main emission model. For local inventories the definition of the total emissions deviates from the one used in the national inventories. The emissions of interest in a local area are usually those with particular impact on the same area. The nomenclature in the table has to take this into account *as well as* the relation to the total national emissions as defined in the protocols (the A and U categories). This is a nomenclature of presentation, but also of bookkeeping. Though the classification is aggregated, calculations are performed at this level compensated by a high number of point sources.

Table 6. Emission sources in local inventories

0	SUM (except international shipping and aircraft)	3	Mobile combustion
1	Stationary combustion	31	Road traffic
11	Manufacturing industry	311	- Passenger cars
111	- Manufacturing industry except the energy branch	312	- Light duty vehicles
112	- Energy branch (land)	313	- Trucks
12	Public services	314	- Buses
13	Private services	315	- Mopeds and motorbikes
14	Agriculture	32	Motorised tools
15	Households	321	- Private households
16	Waste combustion	322	- Other industries
2	Processes	33	Railway
21	Petroleum industry (land)	34	Aircraft < 1000 m
22	Gasoline distribution	35	Ships and boats (harbours)
221	- Loading/depots	A	Emissions from the ocean and above 1000 m
222	- Gasoline stations	A1	Shipping
23	Manufacturing industry	A2	Fishing
24	Solvents	A3	Petroleum industry
25	Landfills	A4	Aircraft above 1000 m
26	Agriculture	U	Foreign aircraft and international shipping
29	Other processes	U1	Foreign aircraft < 1000 m
		U2	International shipping

2.1.4. Correspondence with SNAP

The Norwegian emission model is used for reporting to Corinair. Most emission activities in Norway are defined in Corinair and all sources in Corinair may be defined from the emission model or satellite models. The correspondence between the four digit level SNAP and the Norwegian emission model is shown in table 7.

Table 7. Correspondence between SNAP and the Norwegian emission model

SNAP sources - 4 digits	Norwegian model
01 Combustion in energy branches	
0101 Public power	234010 * relevant stationary processes
0102 District heating plants	234040 * relevant stationary processes
0103 Petroleum refining	232320 * relevant stationary processes
0104 Solid fuel transformation	-
0105 Coal mining, oil and gas extraction	231000, 1110, 2340, 4030, 6080 * stationary processes
02 Combustion non industry	
0201 Commercial and institutional plants	234100-259200 * relevant stationary processes
0202 Residential plants	330000 * relevant stationary processes
0203 Plants in agriculture, forestry and aquaculture	230100-230520 * relevant stationary processes
03 Combustion industry	
0301 Combustion in boilers, gas turbines and stationary engines.	231120-3720 (-energy branches) * boiler and gas turbine
0302 Process furnaces without contact	-
0303 Processes with contact	231120-3720 (-energy branches) * direct fired furnace
04 Production processes	
0401 Processes in petroleum industries	232320 * transformation, evaporation
0402 Processes in iron and steel industries	232710 * redox processes, 233710 * transformation
0403 Processes in non ferrous metal industries	232720, 30, 40 * redox processes, 232412*redox
0404 Processes in inorganic chemical industries	232412, 15 * Fertiliser prod., Calcium carbide prod., Silicon carbide prod., Boiling, Redox, 232460*transformation,
0405 Processes in organic chemical industries	232411, 16 * transformation, evaporation
0406 Processes in wood, pulp and other industries	232010-2130*boiling, 231300, 232610-50, 3140*transformation, 231510-1930*bioprocesses
0407 Cooling plants	-
05 Extraction and distribution of fossil fuels	
0501 Extraction and 1st treatment of solid fossil fuels	231000 * extraction
0502 Extraction, 1st treatment and loading of liquid fossil fuels	231110, 231120 * extraction, evaporation, oil loading (offshore), oil loading (on shore)
0503 Extraction, 1st treatment and loading of gaseous fossil fuels	231110, 232340 * extraction, evaporation
0504 Liquid fuel distribution	-
0505 Gasoline distribution	235000, 6300 * evaporation
0506 Gas distribution networks	-
06 Solvent and other product use	
0601 Paint application	In principle all branches * evaporation
0602 Degreasing, dry cleaning and electronics	232810-3630, 235000 * evaporation
0603 Chemical products manufacturing or processing	231830, 232430-60, 232500 * evaporation
0604 Other use of solvents and related activities	Several * evaporation
0605 Use of N ₂ O	(Not included, but relevant)
07 Road transport	
0701 Passenger cars	All branches * passenger cars
0702 Light duty vehicles	All branches * light duty vehicles
0703 Heavy duty vehicles > 3.5 t and buses	All branches * heavy duty vehicles, buses
0704 Mopeds and Motorcycles < 50 cm ³	All branches * mopeds
0705 Motorcycles > 50 cm ³	All branches * motorcycles
0706 Gasoline evaporation from vehicles	All branches * all gasoline vehicles
0707 Automobile tyre and brake wear	- (not relevant for the current pollutants)
08 Other mobile sources and machinery	
0801 Military	247520: Reported under the respective source
0802 Railways	236010 * Railway
0803 Inland waterways	-
0804 Maritime activities	230510, 1110, 1120, 6130, 246300, 7520 (and other branches) * ships and boats

Table 7 continued

0805 Air traffic	231110, 6200, 247520 (and other branches) * aircraft
0806 Agriculture	230100 * motorised tools
0807 Forestry	230200 * motorised tools
0808 Industry	231000-234500 * motorised tools
0809 Household and gardening	330000 * motorised tools
0810 Other	Other branches * motorised tools
09 Waste treatment and disposal	
0902 Waste incineration	258500 and 259000 * boiler and small stove (waste) All branches * flaring Not included, but of some relevance 259200 * boiler
0907 Open burning of agricultural wastes	239000, 259000 * bioprocesses, liming
0909 Cremation	
0910 Other waste treatment	
10 Agriculture, forestry and land use change	
1001 Cultures with fertilisers	230100 * bioprocesses (nitrogen), liming, evaporation
1002 Cultures without fertilisers	-
1003 On field burning	Not included, but of some relevance
1004 Enteric fermentation	230100 * bioprocesses (animals)
1005 Manure management	230100 * bioprocesses (manure)
1006 Use of pesticides	(not relevant for current pollutants)
1007 Managed deciduous forests	Included as natural emissions
1008 Managed coniferous forests	Included as natural emissions
1011 LUC-Wood biomass stock change	Calculated separately
1012 LUC-Wood biomass stock change/harvest	Calculated separately
1013 LUC-Conversion/Burning of aboveground biomass	Calculated separately
1014 LUC-Conversion/Aboveground biomass decay	Calculated separately
1015 LUC- Conversion/Soil carbon release	Calculated separately
1016 LUC-Managed land abandonment < 20 y /Aboveground biomass	Calculated separately
1017 LUC-Managed land abandonment < 20 y /Soil carbon uptake	Calculated separately
1018 LUC-Managed land abandonment > 20 y /Aboveground biomass	Calculated separately
1019 LUC-Managed land abandonment > 20 y /Soil carbon uptake	Calculated separately

The table shows the relation between each SNAP code and the sources in the Norwegian model. An opposite table, showing the correspondence between the Norwegian sources and SNAP, would prove that almost all Norwegian emission generating activities are covered in SNAP. Some activities not well defined in SNAP are, however, oil drilling (exhaust emissions), which may be reported as shipping, and liming of lakes, waste and land. Also some of our satellite models for transport and solvents show more details than the current SNAP.

However, it should be noted that a given source nomenclature is only relevant for a given set of pollutants. The Norwegian emission model covers two metals only and no persistent organic pollutants (POPs). If the pollutant list is extended, the nomenclature will probably also have to be extended, especially to cover emissions from use of products in a useful manner. Several metals and POPs will be included in Corinair-94 and future inventories. Probably, there may be sources of emissions of these pollutants which are not well covered in the current SNAP. This may especially apply to emission sources related to use of products.

Emissions of the greenhouse gases CF₄, C₂F₆, SF₆ and HFCs are to be included in the IPCC greenhouse gas inventory. These have high global warming potentials. Important sources related to

aluminium, magnesium and halocarbon production, solvent use and cooling plants are already covered in SNAP. Some major sources of these pollutants are related to the use of products and are not distinguished in the current SNAP. Sources not covered are production of SF₆, air conditioning, fire suppression, use of aerosols, foam blowing and gas insulated switch gear/circuit breakers (electrical equipment).

Norway has not done much systematic work on classifying emissions of hazardous substances. However, preparatory work for reporting to Corinair-94 has shown that the following sources are not properly distinguished in the current SNAP nomenclature: Fires in buildings and cars, extraction of metals, zinc production, chloralkali production, metal pigment production, welding electrodes, impregnation (other than wood), leakage from thermometers, laboratories and incineration of special waste (other than oil and hospital waste).

2.1.5. Recommendations

Conventional Corinair gases: Only a few changes are needed to distinguish sources that may be reported in «other» categories or unprecisely lumped together with other sources.

New greenhouse gases: New source categories should be defined related to production and use of these substances. Some sources are already covered.

Hazardous substances (heavy metals and persistent organic pollutants): Some new source categories are needed, especially related to product use. A longer list of hazardous substances than currently covered in Corinair-94 may generate a need of defining new sources.

The way of reporting emissions from products is currently a weak point in Corinair. Sometimes the branch and sometimes the product is specified in SNAP. This does not easily allow an overview of emissions related to branches and products separately.

2.2. Water and land

2.2.1. Sources

A complete inventory of inputs to the coastal areas of Norway has been made for phosphorus and nitrogen only. This inventory (TEOTIL) is based on statistical data for point sources (industry and waste water treatment plants) as well as calculations of inputs from other sources [8]. The model also includes an estimation of retention of pollutants. The Norwegian institute of water research (NIVA) has developed and operates the model. The sources defined are shown in table 8. The sources are more like pseudo branches, with no reference to technologies. Moreover the «branches» are very aggregated. Discharges from industries without own waste water treatment plants will to a large extent be included in «population». The classification is made for presenting data, not for calculations or evaluation of measures (except at a general level).

Table 8. Sources of input to water as defined in the model TEOTIL

-
1. Forest
 2. Lakes
 3. Agriculture - open fields
 4. Agriculture - cultivated meadow
 5. Agriculture - other meadow
 6. Other areas (mountains, wetlands etc.)
 7. Agriculture - point sources
 8. Population - scattered settlements
 9. Population - dense settlements
 10. Industry/other point sources
-

The Norwegian Pollution Control Authority operates a register («MUNIN») of discharges to soil, water and air of a vast number of pollutants (nutrients and toxics). The source classification is shown

in table 9. The classification is hierarchal. This classification also includes air emission sources (shown in table 5) as well as noise and waste. It is, however, far less detailed than the air classification. This may be explained by less knowledge, but also by lack of serious needs of a more detailed inventory. The classification contains the TEOTIL classification, but it is more detailed on most points. However, this classification is also mostly pseudo branch based. The only reference to technology is «waste water treatment» under population. Being quite aggregated, the nomenclature may be said to be more suited for presentation than for actually making calculations or evaluating measures other than at a general level.

Table 9. Sources of discharges in MUNIN. Water and land.

4. Area input and point sources	7. Oil and chemical discharges
<i>41 Antropogenic sources to water</i>	701 From ships
411 Area input from agriculture	702 Offshore
412 Point sources from agriculture	7021 Drilling for oil and gas
413 Aquaculture	7022 Oil production
414 Industrial sources	7023 Displacement while storing oil
4141 Mines	7024 Injection
4142 Hydrometallurgical industry	7025 Pipelines
4143 Galvano industry	703 Bunker plants
4149 Other industrial sources to water	704 Road traffic
415 Population	705 Industry
4151 Population - scattered	706 Buried containers
4152 Population - dense	707 Other sources
41521 Waste water treatment plants	
41522 Municipal waste water network	
<i>42 Background input to water</i>	

Statistics Norway's only water discharge statistics is on waste water treatment plants (SSB-avløp) [9]. The sources defined here (table 10) are related to the origin («branch») of the pollutants as well as the various kinds of treatment. Both input and treated output (discharges) from the plants are included. The system also contains statistics on disposal of sludge. Nitrogen, phosphorus, organic carbon and some heavy metals are covered.

Table 10. Waste water treatment: Classification of input, discharges and treatment in SSB-avløp. Use of sludge.

Input	Input to the municipal distribution network from dense populated areas
	- Households
	- Service companies
	- Manufacture
Discharges	Input from dense populated areas not connected to distribution network
	- Households
	- Service companies
	- Holiday dwellings
Discharges	Input from scattered populated areas
	- Permanent dwellings
	- Holiday dwellings
	Discharges from buildings not connected to waste water treatment plants
	Discharges from waste water treatment plants
	- Direct discharges
	- Mechanical treatment
	- Chemical treatment
	- Biological treatment
	- Unconventional treatment
	- Other treatment
	- Unknown treatment
	Discharges from dense populated areas not connected to distribution network
	- Households
- Service companies	
Sludge	Discharges from scattered populated areas
	- Direct
	- Sludge separation
	- Simple treatment, biological
	- Simple treatment, biological or biological/chemical
	- Sludge separation with filtration
	- Sludge separation with sandfilter
	- Separate closets
- Closed container	
Sludge	Disposed separately
	Landfilled
	Agriculture
	(Forestry - not allowed)
	Other cultivated area
	Other use

Statistics Norway has classified discharges from agricultural activities, although a model of discharges is not currently operated. The classification is used rather for collecting background statistics on responses to various measures to reduce discharges from this branch [10]. This classification is shown in table 11. It contains two main sources; diffuse discharges related to use of agricultural land and point discharges related to other agricultural activities. The sources of discharges related to use of agricultural land are given as a combination of type of production and use of inputs (fertilisers and chemicals).

Table 11. Classification of sources of discharges from agricultural activities

Diffuse sources		
Type of production	Practices connected to the specific productions	Practices not connected to the specific productions
Cereals and oil seed	Commercial fertiliser use <ul style="list-style-type: none"> • input of N and P • time of N application Type of tillage <ul style="list-style-type: none"> • autumn ploughed • autumn harrowed • spring tillage • no tillage 	Manure <ul style="list-style-type: none"> • area spread • time of spreading • amount of manure
Vegetables, field grown Potatoes Cultivated meadow	Commercial fertiliser use <ul style="list-style-type: none"> • input of N and P 	
Surface cultivated meadow and pastures Fodder crops Other area in use		
Point sources		
Manure storage facilities	<ul style="list-style-type: none"> • Animal type/amount of manure • Size in relation to animal stock • grants 	
Silos	<ul style="list-style-type: none"> • grants 	

2.2.2. Summary

Common to the MUNIN and TEOTIL classifications is that they are aggregated. The fact that they are aggregated, and with categories not aggregated according to statistical standards, does not easily facilitate a linking to standard economical branches. The MUNIN classification is a good starting point for a bookkeeping classification, but a further split is needed to specify the treatment technologies and the activity that actually is leading to the discharges. A waste water treatment plant may be classified as a secondary discharge source, while the primary source is the activity actually leading to the discharge. A classification of treatment is given in SSB-avløp (table 10) and a classification of activities in agriculture leading to discharges is given in table 11. There has not been any attempts of making classifications of other primary activities leading to discharges.

2.2.3. «SNAP» codes for water and land

As water and land are not included in the current SNAP, none of the sources are currently covered.¹ A water and land version of SNAP should reflect the potential use of the statistics. The air SNAP is very detailed with respect to sub-processes within a branch or even a certain type of plant. This is necessary because possible abatement may be put on sub-sources and because this level of detail is necessary for a detailed calculation. The question is then how a «SNAP» for water and land is to be used. If it is to be used in a Corinair type of system, it is likely that a high degree of detail is needed as these types of calculations will be more complicated than usual for emissions to air. However, less detail is needed if the nomenclature is only to be used for presentation. Some reference to types of waste water treatment (table 10) (rather than what is the originating process as in SNAP) will be useful as abatement will be used for several pollutants at this point. For diffuse sources a split between roads, agriculture, landfills and other sources will be useful. A further split showing the origin of the discharges (primary source) might be useful for the important agriculture sources (table 11). However, here standards of land use statistics should be taken into account. Primary sources will also be necessary for toxics originating from product use. All discharges should be linked to originating branch.

As for air emissions the sources must be defined by the pollutants considered. The Norwegian source list is to a certain extent specific to nitrogen and phosphorus (even if it is used for other pollutants). Considering toxics, chemicals and metals, other sources should be distinguished.

Recommendations:

It is difficult to give specific recommendations at this point, as Norway does not have very developed inventory systems for discharges to water and soil.

3. Linking NACE to emission sources

It has been suggested that the NACE version to be used in connection with emissions should contain 60-70 branches. The level of NACE should be dependent on the relevance with respect to emissions and discharges (table 12).

The list of two digit NACE branches contains about 60 branches. However, the branches 63-74 contain activities with few emissions to air and water and with obvious lacks in the availability of data. These branches may consequently be considered aggregated. The transport branches should, on the other hand, be considered to be split further. However, for use in accounting it might be an aim in itself to follow NACE strictly without any aggregation or disaggregation of branches with respect to contribution to a certain environmental problem.

This two digit branch list will be the model for the methodology examples in the next chapters.

¹ For some of the SNAP codes, especially on a higher level, there is no reference to media. While the SNAPs 01, 02, 03 (combustion) are only relevant to air, 04 (industrial processes), 05 (extraction and distribution of fossil fuels), 06 (solvent and other product use), 09 (waste treatment and disposal) and 10 (agriculture, forestry and land use change) might in principle be used for discharges to other media. However, it is not evident that the nomenclature will be directly useful for soil and water. For an integrated system it would nevertheless be useful with a correspondence between sources to air, water and land at least at the two digit level.

Table 12. General relevance of various branches with respect to emissions to air and discharges to water

Sector	Air	Water
01 Agriculture	xxx	xxx
02 Forestry	x	x
05 Fishing	xx	xx
10 Mining of coal and lignite	xxx	x
11 Extraction of crude petroleum and natural gas	xxx	xx
12 Mining of uranium and thorium ores	-	xx
13 Mining of metal ores	xx	xxx
14 Other mining and quarrying	x	x
15 Manufacture of food products and beverages	x	xxx
16 Manufacture of tobacco products	x	xx
17 Manufacture of textiles	x	xx
18 Manufacture of wearing apparel, dressing and dyeing of fur	x	xx
19 Tanning and dressing of leather	x	xx
20 Manufacture of wood and products of wood	x	xx
21 Manufacture of pulp, paper and paper products	xxx	xxx
22 Publishing, printing and reproduction of recorded media	xx	x
23 Manufacture of coke, refined petroleum products and nuclear fuel	xxx	xx
24 Manufacture of chemicals and chemical products	xxx	xxx
25 Manufacture of rubber and plastic products	xx	xx
26 Manufacture of other non-metallic mineral products	xx	x
27 Manufacture of basic metals	xxx	xx
28 Manufacture of fabricated metal products	xx	x
29 Manufacture of machinery and equipment	xx	x
30 Manufacture of office machinery and computers	xx	x
31 Manufacture of electrical machinery	xx	x
32 Manufacture of radio, television etc.	xx	x
33 Manufacture of medical and optical instruments	xx	x
34 Manufacture of motor vehicles	xx	x
35 Manufacture of other transport equipment	xx	x
36 Manufacture of furniture and other miscellaneous products	xx	x
37 Recycling	x	x
40 Electricity, gas, steam and hot water supply	xxx	x
41 Collection, purification and distribution of water	x	-
45 Construction	xx	x
50 Sale, maintenance and repair of motor vehicles	xx	x
51 Wholesale trade and commission trade	xx	x
52 Retail trade	xx	x
55 Hotels and restaurants	xx	xx
60 Land transport	xxx	xx
61 Water transport	xx	xxx
62 Air transport	xx	xx
63 Supporting and auxiliary transport activities	x	x
64 Post and telecommunications	xx	-
65 Financial intermediation	x	-
66 Insurance and pension funding	-	-
67 Activities auxiliary to financial intermediation	-	-
70 Real estate activities	x	-
71 Renting of machinery and equipment	xx	-
72 Computer and related activities	-	-
73 Research and development	x	x
74 Other business activities	x	x
75 Public administration and defence	xx	xx
80 Education	x	x
85 Health and social work	xx	xx
90 Sewage and refuse disposal	xxx	xxx
91 Activities of membership organisations	x	x
92 Recreational, cultural and sporting activities	x	x
93 Other service activities	xxx (dry clean)	xx
Private households	xxx	xxx

- = Very little importance, x = Some importance, xx = Important, xxx = Very important

4. Methodologies for linking SNAP-94 to NACE

For most SNAP codes there is a clear correspondence to a NACE code [11]. SNAP is process specific, but the processes often relate to a certain branch. For some SNAP codes, however, the activities will take place in a large number of branches. Transport is the most important example, but this also applies to parts of stationary combustion and solvent and other product use. This means that further calculations will be required to link the emissions to NACE. Possible methodologies will be reviewed in this chapter.

4.1. General methodologies

There are two main types of methodologies for calculating emissions: «top down» and «bottom up». In the top down methodologies a total (e.g. total fuel or solvent use) is known and is distributed between processes or branches. The top down methodologies are often based on material balances (fuel use, product use) which give a reasonably accurate total consumption. The data giving the distribution between branches (often called surrogate data) may be more or less correlated with the actual consumption/emissions. Examples of surrogate data are employment statistics, population statistics and National Account input-output table expenditures. This methodology is very useful if there are many individually small emission sources.

In a bottom up methodology emissions are calculated individually for each emission source and are summed to give a total emission. This methodology is only feasible when the number of emission sources is not too large and they all are known. In cases where the total is known and there are some big sources, top down and bottom up methodologies may be combined. Data sources needed in bottom up methodologies will be direct information from registers or special surveys. Often a bottom up study will be based on data for individual plants (point sources). Though bottom up studies often are recommended, the sum should always be checked against a true or approximate total. Very often, at least when the statistics on most sources is reasonably good, the largest consumption group may be determined as a residual. This residual should, at least occasionally, be checked against independent data sources.

Often the surrogate data, or direct survey data, give the distribution of commodity use (e.g. fuel) and *not* the emissions. This may cause problems as for most pollutants the relative emissions (emission factors) will vary between branches as different technologies are used in different branches.

As many emissions are related to energy use, an energy balance will be the obvious starting point and will in most cases determine the total consumption of fuels. However, the branch split in the energy balance will usually not be detailed enough. Some countries have developed energy accounts with a detailed branch split. Such an energy account will of course be a superior data source for distributing emissions between branches. The problem is that the energy accounts usually contain no information on how the energy is used.

In the National Accounts (NA) expenditures for various commodities are given for each branch in the input-output (IO) tables. The commodity classification used in the NA is often not detailed enough to be useful. This is because the classification has been developed for other purposes than environmental issues. An important feature of the Norwegian NA IO tables is that they do not always distinguish between oils for transport and oils for heating. The quality of the data is variable, examples of this are given below. Another problem is that the consumption distribution does not equal the expenditure distribution because different branches face different prices of a given commodity; Norwegian pilot surveys show discounts up to 40%. The relative prices are, however, often unknown, but corrections should be made where possible. The NA IO tables do not distinguish between consumption as a raw material (transferred to a product) and consumption leading to waste or emissions. In utilising data from the NA this distinction must be made, often based on expert judgements. Moreover there is use

of commodities not well covered in the NA IO tables, like non-market fuels (e.g. fuel wood) and internal fuel use in a plant (fuel produced and consumed in the same plant).

4.2. Stationary combustion

Stationary combustion is covered under SNAP codes 01, 02 and 03.

SNAP 01 (combustion in the energy branches) covers SNAP codes which may be allocated unambiguously to an economic branch.

SNAP 02 covers commercial and institutional plants, residential plants and plants in agriculture, forestry and aquaculture. Residential plants are to be connected with the household branch. Plants in agriculture, forestry and aquaculture are to be distributed between NACE 01 agriculture, 02 forestry and 05 fishing. If direct sample surveys on energy use are not available, it may, however, be assumed that most stationary energy will be consumed in branch 01 agriculture. SNAP 0201 (commercial and institutional plants) will have to be distributed between several branches (45-93). Typical for most branches are small units and usually little information on energy use. Sample surveys of energy use will be useful for these branches, but these are very time demanding. A list of priorities is given in table 13. Energy use per employee can be used to extrapolate the survey data to e.g. branches not covered by surveys. Another possibility is to calculate the energy use from the building space occupied. This requires statistics on building area use (absolute or per employee) and data on the average energy intensity per unit area.

Information in the National Accounts input-output tables may be used, if detailed enough, to specify stationary fuel use. Examples with kerosene and heavy fuel oil are given below (table 13). The distribution given from the NA IO tables and direct surveys are unfortunately quite different. The consumption in these branches is, however, small and hence uncertain. Light fuel oil (with higher consumption) would have been a better test example, but can, unfortunately, not be distinguished from diesel and gas oil for mobile use in the Norwegian NA IO tables.

The variation in emission factors between branches does not cause large problems for these branches, but the distribution ought to be corrected if this variation is known.

Table 13. Energy use in commercial and institutional plants. General importance of branches (all stationary fuel use). Distribution of the consumption of kerosene and heavy fuel oil for stationary use between branches. Per cent

	<i>General importance</i>	Kerosene		Heavy oil	
		<i>National accounts</i>	<i>Survey data*</i>	<i>National accounts</i>	<i>Survey data*</i>
45 Construction	xx	0	8.6	0.0	0.0
50 Sale, maintenance and repair of motor vehicles	xxx	1.1	48.1	0.0	17.7
51 Wholesale trade and commission trade	xx	3.3	:	0.6	0.0
52 Retail trade	xx	1.1	:	0.0	0.0
55 Hotels and restaurants	xx	0.0	0.0	0.0	0.4
60 Land transport	x	12.0	0.0	0.0	0.0
61 Water transport	x	0.0	0.0		0.0
62 Air transport	x	0.0	0.0	0.0	0.0
63 Supporting and auxiliary transport activities	x	0.0	0.4	0.0	0.0
64 Post and telecommunications	x	0.0	0.0	0.0	0.0
65 Financial intermediation	xx	0.0	2.2	0.0	0.0
66 Insurance and pension funding	x	0.0	0.0	0.0	0.0
67 Activities auxiliary to financial intermediation	x	0.0	0.0	0.0	0.0
70 Real estate activities	x	35.9	0.0	0.0	0.0
71 Renting of machinery and equipment	x	0.0	0.0	0.0	0.0
72 Computer and related activities	x	0.0	0.0	0.0	0.0
73 Research and development	x	0.0	0.0	0.0	0.0
74 Other business activities	x	0.0	1.8	0.0	0.0
75 Public administration and defence	xxx	0.0	4.1	91.0**	0.0
80 Education	xx	3.3	8.7	0.0	0.0
85 Health and social work	xxx	30.4	17.6	6.0	0.0
90 Sewage and refuse disposal	(xxx)	0.0	0.0	0.0	0.0
91 Activities of membership organisations	xx	0.0	0.3	0.0	0.0
92 Recreational, cultural and sporting activities	x	12.0	3.9	0.0	0.0
93 Other service activities	x	1.1	4.3	2.4	81.9

* The survey data have been generalised and extrapolated.

** This figure is due to an error in the NA

- = Very little importance, x = Some importance, xx = Important, xxx = Very important

Combustion in industry (SNAP 03) for specific industrial processes (SNAP 0302 and 0303) may be directly connected to the correct economic branch. Combustion in boilers, gas turbines and stationary engines (SNAP 0301) will in principle take place in all industrial branches. Activities covering the larger boilers and gas turbines should in Corinair be treated as point sources, and each point source is easily allocated to an economic branch. It is highly recommended for these branches to base the calculations on survey data, as a good knowledge of who is using the energy in any case will be needed to distribute the energy use by technology to produce the most accurate emission estimate (as the emission factors will vary significantly with technology). Differences in energy intensities between branches do not facilitate simplifications and generalisations. However, if survey data are not available every year, changes in production, combined with knowledge on changes in sale, may be used to estimate data for the year of interest.

Expenditures specified in the National Accounts input-output tables have, of course, the same limitations as described above as far as low relevance of commodities is concerned. In addition lack of information on bio-fuels and internal fuel use (as by-product gases) is very serious for SNAP 0301. Large consumers will get discounts on fuels, which also must be taken into account. However, the NA IO table data will probably generally be of better quality for the industrial branches than for the commercial branches.

4.3. Transport

Transport occurs in almost every branch, but the transport branches and private households are most important. Road transport is reported under SNAP 07 with a further technology split. Other mobile sources and machinery are reported under SNAP 08. For machinery, a rough split into agriculture, forestry, industry and household and gardening is given in Corinair.

There are several energy commodities relevant for transport, the most important being gasoline, kerosene, diesel, gas oil and heavy fuel oil.

SNAP 07

Various techniques may be used to distribute the emissions, or most favourable, a combination of techniques.

Gasoline consumption

A physical account of gasoline use should be made by combining survey data and calculations from the level of activity.

Manufacturing industries: Statistics Norway makes calculations from survey data, but such data are not likely to be available in all countries. If a full set of survey data not is available, calculations may be performed on the basis of consumption per employee in similar branches. It is possible that small amounts of gasoline are used for non-road purposes in these branches. This may usually be neglected if data not is available.

Agriculture and forestry: In Norway consumption data are based on surveys. If surveys on energy use in physical units not are available, expenditures often are. Calculations may also be based on activity statistics combined with specific consumption factors; kilometres driven by car, amount of timber produced etc. A fraction of the gasoline used in this branch will be used in motorised tools. About 15 % of the gasoline is used for non-road purposes in agriculture in Norway. For forestry it is assumed that everything is used off-road. The amount used off-road should be subtracted as the corresponding emissions are reported under SNAP 08.

Construction: The gasoline consumption is best determined in surveys. Generalisations may be made from the yearly variations in the number of employees. The consumption may also be calculated, if relevant activity data and corresponding specific consumption factors are available. Gasoline in this branch may be used for both tools and transport. Norwegian survey data indicates that about 1 % is used in tools.

Service branches, except transport branches: Surveys of fuel use in the service branches are often not available, and they are expensive to perform as there is a large number of small units. If surveys are partly available generalisations may be made based on the energy use per employee in similar branches. Norwegian data show a variation of 0.1-1 tonne per employee, branch 55 and 90 being in the lower end of the scale and 50 and 64 at the upper end. Activity data, the annual mileage, are not likely to be available, but will be very useful for calculating the consumption if they are.

Transport branches (NACE 60): Calculations should be activity based and made for all types of vehicles used in the various activities in these branches. Calculation example based on Norwegian data: The average fuel consumption is derived from the type of cars used, ranging from 0.085 to 0.2 l/km. The annual mileage is taken from surveys for taxis (62,400 km), but is estimated for the remaining. The number of vehicles is taken from the Norwegian car register. The calculation is shown in table 14.

Table 14. Calculation of gasoline consumption in branch 60

	Consumption (l/km)	Annual mileage (1000 km)	Number of cars (1000)	Calculated consumption (1000 tonnes)
Scheduled driving	0.120	13.0	0.4	0.4
Taxis	0.100	62.4	2.3	10.8
Cars for rent, passenger	0.085	20.0	6.4	8.0
Cars for rent, other	0.200	20.0	0.7	2.1

Household branch: Annual mileage driven is a parameter generally available. 13,700 km is used in Norway. The specific fuel consumption will depend on the vehicle fleet (age, average size); a factor of 0.085 l/km is used in Norway. The number of vehicles is generally available. Input models to Corinair, like Copert, should be used to determine these parameters. The result has been tested against a consumer survey asking for the consumption and expenditures of gasoline as well as a residual calculation. The results of all methods are in excellent agreement.

Data from the National Accounts input-output tables on expenditures for energy use may very well be used in this case. All branches pay about the same price of gasoline, except maybe some large transport companies.

A comparison between the two methods of distributing gasoline between branches is given in table 15. The methodologies give very similar results.

It is a reasonable assumption that the emissions in each SNAP (0701-0703 + 0706 and 0707) originating from use of gasoline are distributed between branches according to the gasoline consumption (subtracted gasoline used for motorcycles and mopeds - see next paragraph). Some gasoline is used for other purposes than road traffic, but this causes only minor problems. It may also be assumed that all branches use vehicles with the same technology. This is probably not quite true, but a reasonable approximation as data on the age and type of cars in the various branches probably are not available. Hence, the fuel use may be the key to distribute also the emissions.

Emissions in the SNAPS 0704 and 0705 (mopeds and motorcycles) may be allocated to private households only, if data on use in other branches (e.g. used by the police) not can be obtained.

Table 15. Consumption of gasoline for road transport. Survey data/calculations and data from the National Accounts input-output tables (NA). Per cent distribution between branches

	Surveys /calculations	NA		Surveys/ calculations	NA
01 Agriculture	0.7	0.9	40 Electricity, gas, steam and hot water supply	0.2	0.2
02 Forestry	0.1	0.1	41 Collection, purification and distribution of water	0.0	0.0
05 Fishing	0.2	0.2	45 Construction	0.7	1.7
10 Mining of coal and lignite	0.0	0.0	50 Sale, maintenance and repair of motor vehicles	12.2	1.1
11 Extraction of crude petroleum and natural gas	0.0	0.0	51 Wholesale trade and commission trade	:	4.7
12 Mining of uranium and thorium ores	0.0	0.0	52 Retail trade	:	1.9
13 Mining of metal ores	0.0	0.0	55 Hotels and restaurants	:	0.5
14 Other mining and quarrying	0.0	0.0	60 Land transport	1.3	2.0
15 Manufacture of food products and beverages	0.2	0.2	61 Water transport	0.0	0.0
16 Manufacture of tobacco products	0.0	0.0	62 Air transport	0.0	0.0
17 Manufacture of textiles	0.0	0.0	63 Supporting and auxiliary transport activities	0.2	1.2
18 Manufacture of wearing apparel, dressing and dyeing of fur	0.0	0.0	64 Post and telecommunications	2.1	1.4
19 Tanning and dressing of leather	0.0	0.0	65 Financial intermediation	0.8	0.3
20 Manufacture of wood and products of wood	0.0	0.0	66 Insurance and pension funding	0.0	0.2
21 Manufacture of pulp, paper and paper products	0.0	0.0	67 Activities auxiliary to financial intermediation	0.0	0.0
22 Publishing, printing and reproduction of recorded media	0.1	0.1	70 Real estate activities	0.0	0.2
23 Manufacture of coke, refined petroleum products and nuclear fuel	0.0	0.0	71 Renting of machinery and equipment	0.0	0.1
24 Manufacture of chemicals and chemical products	0.0	0.0	72 Computer and related activities	0.0	0.2
25 Manufacture of rubber and plastic products	0.0	0.0	73 Research and development	0.0	0.0
26 Manufacture of other non-metallic mineral products	0.0	0.0	74 Other business activities	0.6	1.8
27 Manufacture of basic metals	0.0	0.0	75 Public administration and defence	0.2	0.3
28 Manufacture of fabricated metal products	0.0	0.0	80 Education	0.4	0.4
29 Manufacture of machinery and equipment	0.1	0.1	85 Health and social work	0.8	0.7
30 Manufacture of office machinery and computers	0.0	0.0	90 Sewage and refuse disposal	0.1	0.1
31 Manufacture of electrical machinery	0.0	0.0	91 Activities of membership organisations	0.0	0.1
32 Manufacture of radio, television etc.	0.0	0.0	92 Recreational, cultural and sporting activities	0.0	0.2
33 Manufacture of medical and optical instruments	0.0	0.0	93 Other service activities	0.6	0.2
34 Manufacture of motor vehicles	0.0	0.0	Private households	78.3	78.6
35 Manufacture of other transport equipment	0.0	0.1			
36 Manufacture of furniture and other miscellaneous products	0.0	0.0			
37 Recycling	0.0	0.0			

Diesel consumption

A physical account of diesel use should be made by combining survey data and calculations from the level of activity.

Manufacturing industries: It is recommended to make calculations from survey data. If a full set of survey data is not available, calculations may be performed on the basis of consumption per employee in similar branches. In some branches diesel will be used in motorised tools and not for road traffic. This amount should be subtracted consistently with the calculations and branch distribution of emissions from these tools. Important branches are mining and parts of mineral production.

Agriculture and forestry: Consumption data are in Norway based on surveys. If surveys on energy use in physical units are not available, expenditures often are. Calculations may also be based on activity statistics combined with specific consumption factors, if available: hours of use of various equipment, miles driven by car, amount of timber produced etc.

An example: 4 litre diesel is needed to harvest and transport 1 m³ timber with modern equipment. About 4750 thousand m³ are produced in this way yearly. This gives a consumption of 15,960 tonnes diesel for producing timber.

The amount used off-road should be subtracted consistently with the emission calculation for off-road sources. If data are not available, it may be assumed that all diesel in agriculture and forestry is used off-road. These emissions are reported under SNAP 08.

Construction: The diesel consumption is best determined in surveys. Generalisations may be made from the yearly variations in the number of employees or the building activity. If activity data and specific consumption factors are available, the consumption may be calculated. Diesel in this branch may be used for both tools and transport. Norwegian survey data indicates that about 60 % is used in tools. This amount should be subtracted as the corresponding emissions are reported under SNAP 08.

Service branches except transport branches: Surveys of fuel use in the service branches are often not available, and they are resource demanding as there is a large number of small units. If surveys are partly available, generalisations may be made based on the energy use per employee in similar branches. Activity data, the annual mileage, are not likely to be available, but will be very useful for calculating the consumption if they are.

Transport branches (NACE 60): Calculations should be made for all types of vehicles used in the various activities in these branches. The average fuel consumption is derived from the type of cars used. Input models to Corinair, like Copert should be used to determine these parameters. The annual mileage is taken from surveys for taxis (62,300 km), but is estimated for the remaining. The number of vehicles is taken from the Norwegian car register. The calculation is shown in table 16. The consumption for land transport (the main part of this branch) is determined as a residual from the known total and estimated consumption in all other branches. This is justified by being the far largest consumer group of road diesel.

Table 16. Calculation of diesel consumption in branch 60

	Consumption (l/km)	Annual mileage (1000 km)	Number of vehicles (1000)	Calculated consumption (1000 tonnes)
Scheduled driving	0.34	338000*	-	120
Taxis	0.11	62.3	3.638	21
Road transport**				672

* Total mileage, passenger only. An estimate of fuel use in scheduled goods transport is added.

** Calculated as a residual

Household branch: Annual mileage driven is generally longer than for gasoline cars. 16,700 km is estimated for the Norwegian fleet. The fuel consumption will depend on the vehicle fleet (age, average size); a factor of 0.059 l/km is used in Norway. The number of passenger cars is generally available, but has to be corrected for cars used in other branches. Input models to Corinair, like Copert, should be used to determine these parameters. The result has been tested against a consumer survey asking for the consumption and expenditures of diesel. As the results were not in agreement, the assumptions in the calculation methodology will be revised soon.

Data from the National Accounts input-output tables on expenditures for energy use may very well be used in this case. In Norway, however, diesel for road traffic is bookkept together with stationary fuel oil, and this methodology cannot be used. All branches pay about the same price of diesel, except maybe some large transport companies.

The emissions in each SNAP (0701-0703 + 0707) originating from use of diesel may be distributed between branches according to the diesel consumption. This is, however, not quite accurate as some branches will have more heavy duty cars than others (the emission factors are different for light and heavy vehicles). Correction should consequently be made if data is available. The age of the vehicle fleet is less important than for gasoline vehicles.

A large fraction of diesel is used for other purposes than road traffic and should be subtracted consistently with SNAP 0806-0810.

SNAP 08

Military and railway are directly related to an economic branch.

Inland waterways and Maritime activities (0803 and 0804): Most of the emissions will take place in branch 61 (inland and coastal water transport) and fishing (branch 05). However, some emissions will also take place in NACE 63 (auxiliary transport activities), 75 (defence), 11 (oil and gas extraction), households and all other branches with own transport by ships. The extent of own transport will vary from country to country. Generalisations cannot be recommended, and the distribution should be made from survey data or National Account input-output table expenditure data if specified sufficiently. However another definition of domestic sea traffic is used in the NA IO tables compared to emission inventories. Gasoline, gas oil, diesel and heavy fuel oils are used.

Air traffic (0805): Most of the emissions will take place in branch 62 (air transport). However, some emissions will also take place in NACE 63 (auxiliary transport activities), 75 (defence), 11 (oil and gas extraction) and all other branches with own transport by planes or helicopters. Generalisations cannot be made, and the distribution should be made from survey data or National Account input-output table expenditure data (if specified sufficiently). Kerosene and small amounts of gasoline are used.

Machinery (0806-0810): For machinery, a split into agriculture, forestry, industry, household and gardening and other is given in SNAP.

Agriculture and forestry are directly related to NACE.

Industry (probably including construction) needs a split. The consumption for off-road use may be determined in surveys or calculated. Determinations in surveys tend to underestimate the consumption, as all branches not are covered. Calculations from the number of units of equipment often tend to overestimate the consumption as the time in use is very uncertain. Only consumption of diesel has to be considered. Surveys in Statistics Norway indicate that the branches 13 (mining of metals), 14 (other mining), 26 (production of mineral products) and 45 (construction) have high consumption of diesel for off-road use, but all branches have unfortunately not been investigated.

Household and gardening will need a split into households, 01 (maintenance of parks) and 90 (road cleaning/blowing of snow). The consumption for off-road use may be determined in surveys or be calculated. If data are not available, all gasoline should be allocated to the household branch and all diesel to branch 90.

4.4. Solvents and other product use

SNAP 06 consists of sources referring to a branch, a process and/or use of a specific product. This structure causes some problems because it is not possible to add the emissions and get a total for processes, branches or products. Generally a top down methodology will give very good results for emissions related to product use. However, branch information is often lost in this way. Surveys in certain important branches are of course valuable, but surveys are not suited for giving an overview as there often are several small consumer groups adding up to a significant total. National Accounts input-output table expenditure data gives information on use of products in branches, but the classification is often not detailed enough. Furthermore, the data are probably not very exact for several of the commodities. Table 17 gives an overview of the classification of relevant commodities in the Norwegian National Accounts input-output tables. Furthermore, the NA IO tables do not tell whether the paint used is water based or organic solvent based or whether the industries have technical installations to reduce the emissions.

Table 17. Directly emission generating products (other than fuels) specified in the Norwegian National Accounts input-output tables

159210 Ethanol
232003 Raw gasoline, white spirits and other distillates
241410 Hydrocarbons and derivates
241420 Alcohols and derivates
241460 Ethers, proxides, oxides and miscellaneous
242010 Desinfection agents
243010 Paint and varnishes
243021 Sparchel and putty
243023 Inks and artistic colours
244210 Pharmaceutical products
245210 Cosmetics
246210 Glue
246632 Defreezers
246640 Other chemical products

0601 Paint application: SNAPs 060101 to 060107 may unambiguously be allocated to an economic branch. SNAP 060108 is «Other industrial paint applications» while 060109 is «Other non industrial paint applications». The emissions here may take place in several branches, though the most important are covered under SNAP 060101-07. National accounts input-output table expenditures may be used for the distribution. If data are not available, it may be assumed that all important emissions are covered under SNAP 060101-07.

0602 Degreasing, dry cleaning and electronics: SNAP 060201-03 may be allocated directly to branches. 060204 «Other industrial cleaning»: this activity may take place in several branches. Data in the National Account input-output tables (table 17) are not likely to be detailed enough to give this distribution. Data may best be determined from trade organisations or product registers of hazardous substances that exist in some countries. Surveys should include solvents likely to be used for cleaning, subtracting other applications. The use of many such solvents is regulated and under rapid change. It is consequently impossible to make generalisations from year to year or between countries (e.g. consumption factors per employee).

0603 Chemical products manufacturing or processing: All SNAP codes (except 060314 «Other») refer to specific industrial processes that unambiguously may be allocated to an economic branch.

0604 Other use of solvent and related activities: SNAP 060401-04 and 060406-11 may be unambiguously connected to an economic branch. 060405 «Application of glues and adhesives» may in principle take place in all branches. Data from the National Account input-output tables may be

used for this distribution, if specified sufficiently. 060412 «Other» cannot be distributed without knowledge of what is actually reported there.

060501 «Use of N₂O for anaesthesia» will take place in one branch. 060502 «Other use of N₂O»: This mainly consists of nitrous oxide used as an aerosol propellant. An exact distribution between branches is laborious to calculate. If no data exists all emissions should be allocated to the household branch.

4.5. Other

0902 Waste incineration: 090202 «Incineration of industrial wastes» is the only activity that may take place in several branches. The distribution should be made from exact data (surveys, registers of permits etc.) as generalisation cannot be recommended.

0910 Other waste treatment: 091001 «Waste water treatment in industry» may take place in several branches. The distribution should be made from exact data (surveys, registers of permits etc.) as generalisation cannot be recommended. 091002 «Waste water treatment in residential/commercial sectors». If better data not are available, it may be assumed that the activity takes place in branch 90.

1006 Use of pesticides: The emissions (consumption) should be distributed between agriculture and forestry. Often only the total sale is available. Direct surveys of the consumers or trade organisations may give the distribution between agriculture and forestry. If data are not available all emissions should be allocated to agriculture.

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Appendix 1. Economic branches in the Norwegian emission model

Agriculture and forestry

230100	Agriculture
0140	Services related to agriculture and forestry
0200	Forestry and logging

Fishing

0510	Fishing
0520	Operation of fish farms

Energy branches

1000	Coal mining
1110	Extraction of crude petroleum and natural gas
1200	Mining of uranium and thorium ores
2320	Manufacture of refined petroleum products
2330	Processing of nuclear fuel
2340	Gas terminal
4010	Production of electricity
4020	Distribution of electricity
4030	Manufacture and distribution of gas
4040	Steam and hot water supply

Mining/manufacturing

1120	Oil drilling
1300	Mining of metal ores
1400	Other mining and quarrying
1510	Production, processing and preserving of meat and meat products
1520	Processing and preserving of fish and fish products
1530	Processing and preserving of fruit and vegetables
1540	Manufacture of vegetable and animal oils and fats
1550	Manufacture of dairy products
1560	Manufacture of grain mill products, starches and starch products
1570	Manufacture of prepared animal feeds
1580	Manufacture of other food products
1590	Manufacture of beverages
1600	Manufacture of tobacco products
1700	Manufacture of textiles and textile products
1810	Manufacture of leather clothes
1820	Manufacture of other wearing apparel and accessories
1830	Dressing and dyeing of fur, manufacture of articles of fur
1910	Tanning and dressing of leather, manufacture of luggage, handbags, saddlery and harness
1930	Manufacture of footwear
2010	Sawmilling and planing of wood, impregnation of wood
2020	Manufacture of particle board, fibre board and other panels and boards
2030	Manufacture of builders carpentry and joinery
2040	Manufacture of other products of wood
2110	Manufacture of pulp
2120	Manufacture of paper and paperboard
2130	Manufacture of articles of paper and paperboard
2210	Publishing
2220	Printing and service activities related to printing
2230	Reproduction of recorded media
2310	Manufacture of coke oven products
2322	Production of asphalt etc.
2411	Manufacture of industrial gases
2412	Manufacture of dyes and pigments and other inorganic basic chemicals
2415	Manufacture of fertilizers, nitrogen compounds and pesticides

2416	Manufacture of plastics and synthetic rubber in primary forms, manufacture of other organic basic chemicals
2430	Manufacture of paints and varnishes, printing ink and mastics
2440	Manufacture of basic pharmaceutical products and pharmaceutical preparations
2450	Manufacture of soap and detergents and toilet preparations
2460	Manufacture of other chemical products
2470	Manufacture of man-made fibres
2500	Manufacture of rubber and plastic products
2610	Manufacture of glass and glass products
2620	Manufacture of ceramic goods
2640	Manufacture of other mineral products
2650	Manufacture of cement, lime and plaster
2710	Manufacture of basic iron and steel
2720	Manufacture of ferro-alloys
2730	Aluminium production
2740	Other non-ferrous metal production
2750	Casting of metals
2810	Manufacture of fabricated metal products, except machinery and equipment
2860	Manufacture of cutlery, tools and general hardware
2870	Manufacture of other metal products
2910	Manufacture of general purpose machinery
2930	Manufacture of special purpose machinery
2960	Manufacture of weapons and ammunition
2970	Manufacture of domestic appliances
3000	Manufacture of office machinery and computers
3110	Manufacture of electric motors, generators and transformers, manufacture of electricity distribution and control apparatus
3130	Manufacture of insulated wire and cable
3140	Manufacture of other electrical apparatus and equipment
3210	Manufacture of electronic components and television and radio transmitters
3230	Manufacture of television and radio receivers, sound or video recording apparatus
3310	Manufacture of medical and precision instruments
3340	Manufacture of optical instruments, photographic equipment, watches and clocks
3400	Manufacture of motor vehicles and parts and accessories for motor vehicles
3510	Building and repair of ships and boats
3520	Building and repair of oil platforms
3530	Manufacture and repair of railway and tramway locomotives and rolling stock
3540	Manufacture and repair of aircraft and spacecraft
3550	Manufacture of other transport equipment
3610	Manufacture of furniture
3620	Manufacture of jewellery and related articles
3630	Other manufacturing
3710	Recycling of metal waste and scrap
3720	Recycling of non-metal waste and scrap

Water supply

4100	Collection, purification and distribution of water
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Construction

4500	Construction
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Wholesale and retail trade/hotels and restaurants

5000	Wholesale and retail trade, repair of motor vehicles and personal and household goods
5500	Hotels and restaurants

Transport etc.

6010	Transport via railways
6020	Tramway and suburban transport, other scheduled passenger land transport
6030	Taxi operation
6040	Other land passenger transport, freight transport by road
6080	Transport via pipelines
6110	Ocean transport, sea and coastal transport in Europe
6130	Inland and coastal water transport
6200	Domestic air transport
6201	International air transport
6300	Supporting and auxiliary transport activities
6400	Post, telecommunications

Financing, insurance, real estate and business services

6500	Financial intermediation, insurance
7000	Real estate activities
7100	Renting of machinery and equipment
7200	Computer and related activities
7300	Research and development
7400	Other business activities
8000	Education
8500	Health and social work
9000	Sewage and refuse disposal, sanitation and similar activities
9100	Activities of membership organizations
9200	Recreational, cultural and sporting activities
9300	Other service activities
9500	Private households with employed persons

Central government

246300	Supporting and auxiliary transport activities
7300	Research and development
7400	Other business activities
7510	Public administration
7520	Defence
8000	Education
8500	Health and social work
9200	Other service activities

Local government

257510	Public administration
8000	Education
8500	Health and social work
9000	Sewage and refuse disposal, sanitation and similar activities
9200	Other service activities

Private households

330000	Private households
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Foreign activity

660000	Foreign activity in Norway
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