SNAP CODE: **040100**

SOURCE ACTIVITY TITLE: **PROCESSES IN PETROLEUM INDUSTRIES**
Overview

NOSE CODE: **105.08.00**

NFR CODE: **1 B 2 a iv**

The petroleum refining industry converts crude oil into more than 2500 refined products, including liquid fuels (from motor gasoline to residual oil), by-product fuels and feedstocks (such as asphalt, lubricants, gases, coke), and primary petrochemicals (for instance, ethylene, toluene, xylene). Petroleum refinery activities start with the receipt of crude for storage at the refinery, include all petroleum handling and refining operations, and terminate with storage preparatory to shipping the refined products from the refinery. (U.S. EPA 1985a and Poten and Partners Inc. 1988) The distribution and marketing of the products of a refinery are considered separately under SNAP sub-sectors 0504 and 0505.

Not all petroleum refinery processes that could result in the emissions to the air are included under SNAP code 0401. The following lists the major refinery processes and associated operations along with the SNAP code(s) most likely to apply to these operations (using currently available SNAP94 codes):

Table 1: Refinery Processes and Associated SNAP Codes.

	Process	SNAP	Description
1.	Feed Stock handling and storage	050401	Marine Terminals
		050402	Other Handling and Storage
2.	Separation Processes	040101	Petroleum Products Processing
3.	Petroleum Conversion Processes	040101	Petroleum Products Processing
4.	Petroleum Treating Processes	040101	Petroleum Products Processing
		060310	Asphalt Blowing
5.	Product Blending	040101	Petroleum Products Processing
6.	Product Storage and Handling	040104	Storage and Handling of Products in Refinery
		050501	Refinery Dispatch Station
7.	Auxiliary Facilities	030104	Combustion
		030105	Combustion
		010306	Process Furnaces
		040103	Sulphur Recovery Plants
		0405	Organic Chemical Production
		091001	Waste Water Treatment in Industry
		091002	Waste Water Treatment In Residential /Commercial Sector
		090202	Incineration of Industrial Wastes
7.	Auxiliary Facilities (Continued)	090203	Flaring in Oil Refinery
		090205	Incineration of Sludges From Water Treatment
		090400	Landfills
			Cooling Towers
			Vapour Recovery and Blowdown Systems

*this may be included with product storage and handling

Estimating NMVOC emissions due to spills and accidental discharges is considered outside the terms of reference for this manual, although a separate SNAP code could be created to record this information where it is available.

Petroleum refineries are significant sources of SO_2 and VOCs, with lesser emissions of particulate, NOx and CO.

In North America in 1985, the percent contributions to total anthropogenic emissions were estimated for non-combustion emissions from this sector as summarised in Table 2.

Table 2: 1990 Non-Combustion Emission from Petroleum Refineries Exposed as a Percent of Total Anthropogenic Emissions

Country	Particulate*	SOx	CO	NOx	NMVOC
Canada		1.0	0.1		8.5
United States 1985		1.3	0.4	0.3	3.7

* = PM is detailed in the relevant individual chapters

See chapter ACOR and other relevant chapters for contribution from individual activities as listed above.

Percentage contribution to non-combustion VOC emissions from refineries in Canada in 1988 (CPPI and Environment Canada 1991) from the various non-combustion sources were estimated as in Table 2.

Table 3: Percent Contribution to Total Non-Combustion VOC Emissions - Canada 1988 (CPPI/Environment Canada 1991)

Process	Percent Contribution	Total Percentage
Process Sources (FCCU Only)		4.7
Fugitive Total		46.8
Pumps	5.1	
Compressors	1.5	
Valves	31.5	
Flanges	1.9	
P/R Valves	2.7	
O/E Lines	0.5	
Sampling System	0.4	
Drains	3.2	
Storage/Handling Total		25.9
Tanks	15.6	
Handling	10.3	
Waste Systems Total		22.6
Cooling Water	3.1	
Waste Water	18.8	
Land Farming	0.6	
Vent	<0.1	
Flare	0.1	
TOTAL		100

Swedish estimates of VOC emissions from oil refineries using the DIAL technique to quantify VOC emissions indicated that product storage represented a much larger portion of total emissions, in the order of 60 to 75 percent. Process emissions represented 25 to 35 percent, with water treatment emissions being under 5 percent.

Some work on NMVOC emissions from refineries has been done by the CONCAWE (for example, CONCAWE reports No. 2/86, 6/87, 52/87). In 1983 refineries contributed 2.2% and 2.4% to total anthropogenic NMVOC emissions in OECD Europe and EEC-10 countries, respectively. It is not clear if this includes combustion emissions from these sources. In

another CONCAWE report (52/87 1877), in which emissions from a typical refinery are reported, fugitive emissions contributed 53% by weight of non-combustion NMVOC emissions. Other sources included were tank storage, loading losses and wastewater treatment.
In Poland in 1992, refineries contributed 1% of total anthropogenic VOC emissions. In Russia, the oil and gas industry (mainly oil extraction and oil refining) emitted 1262 ktonnes VOC/year (year not specified) (Tsibulski 1993).

The simplest emission estimation method for petroleum refineries would be to use emission factors that estimate emissions from all of the above sources, based on the crude throughput, and assigning these emissions to SNAP code 0401.

A review of 29 Canadian refineries found a THC emission of 0.4 to 3.2 kg THC/m3 feed charged (CPPI and Environment Canada 1991), with an average of 1.1 kg/m3. VOC emission factors reported in a review for Corinair and EMEP (Veldt 1991) were (in kg/mg): Corinair 0.5, FRG 0.4, USA 0.65, Poland 0.88, USSR 12, Lithuania 2.4. The proposed default emission factor for NMVOC was 0.5 kg/mg. A Corinair report (CEC 1991a) stated that 11 West European refineries emitted an average of 0.35 kg VOC/t crude, ranging from 0.13 - 0.55 (source was not referenced). The default NMVOC emission factor for all refinery emissions in another Corinair report (CEC 1991b) was .225 kg/t of input for modern designs and .90 kg/t input for old designs. An overall VOC emission factor of 0.35 kg/m3 was calculated for an Austrian refinery (Winiwarter 1994).

The review of 29 Canadian refineries mentioned above (CPPI and Environment Canada 1991) also included estimates of 1988 emissions of particulate, SO_2, NOx and CO due to non-combustion sources at these refineries. These have been converted to emission factors, based on total refinery feed, as summarised in Table 4. These are very general emission factors in that the actual emissions for any given refinery will depend very heavily upon the portion of the total refinery feed that goes into specific processes.

Table 4: General Emission Factors for Non-combustion Emissions from Petroleum Refineries (CPPI and Environment Canada 1991)

Contaminant	Emission Factor (kg/m^3 refinery feed)	Sources Considered
Particulate	0.006	FCCU only
SOx	0.8	vac. tower, cat. cracker, fluid coking, S plant, S.W.S., incin., caustic regen., flares, vents, off gases, others.
NOx	0.05	catalytic cracking
CO	0.08	FCCU only