Climate MRV for Africa – Phase 2 National Greenhouse Gas Inventory: Non-Energy Products From Fuels And Solvent Use

Lead partner

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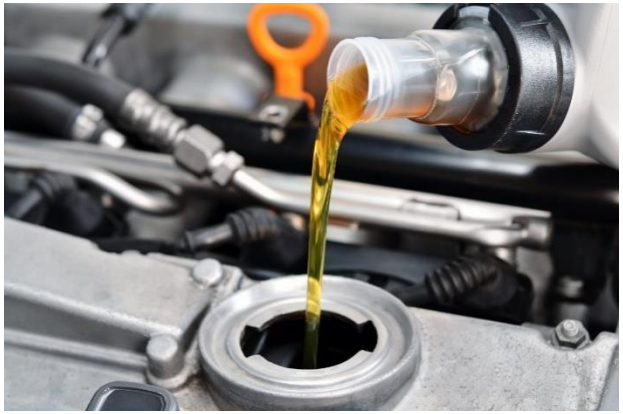
Introduction to : NON-ENERGY PRODUCTS FROM FUELS AND SOLVENT USE

- The products covered comprise lubricants, paraffin waxes, bitumen/asphalt, and solvents.
- Emissions from further uses or disposal of the products after first use are to be reported in the Waste Sector (if incinerated) or in the Energy Sector (energy recovery)



Introduction: NON-ENERGY PRODUCTS FROM FUELS AND SOLVENT USE

- The production and use of asphalt for road paving and roofing and the use of solvents derived from petroleum and coal are either not sources or are negligible sources of direct greenhouse gas emissions.
- They are included here as they are sometimes substantial sources of non-methane volatile organic compounds (NMVOC) and carbon monoxide (CO) emissions which eventually oxidize to CO2 in the atmosphere.
- The resulting CO2 input can be estimated from the emissions of these non-CO2 gases. Emissions from asphalt are mostly negligible while, it may have some significance in case of solvents.

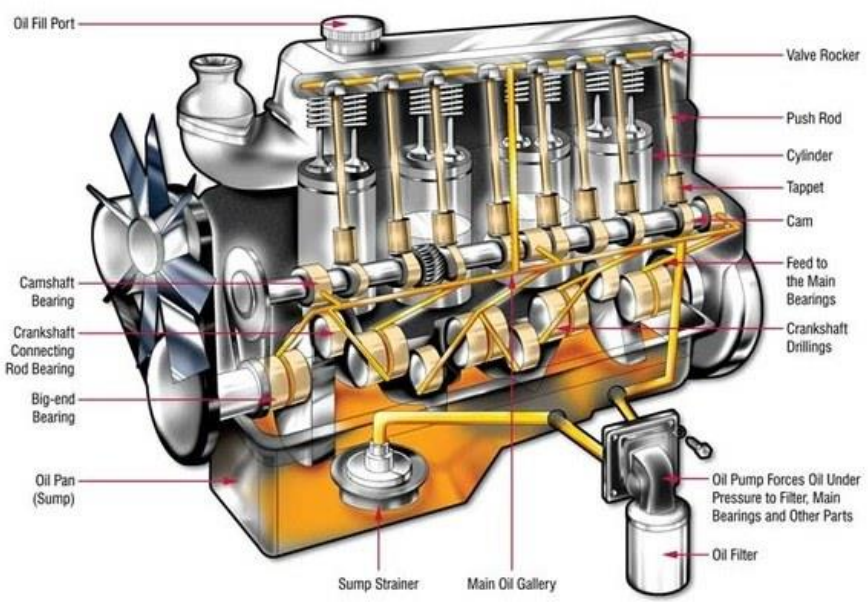
Introduction: NON-ENERGY PRODUCTS FROM FUELS AND SOLVENT USE

The emission factor for calculating (CO2) emissions from non-energy product uses is composed of:

- A carbon content factor
- A factor that represents the fraction of fossil fuel carbon that is *Oxidised During Use* (ODU).

Introduction: NON-ENERGY PRODUCTS FROM FUELS AND SOLVENT USE

ODU represents actual co-combustion of the fraction of lubricants that slips into the combustion chamber of an engine, during first use only of lubricants and paraffin waxes and not to subsequent uses.



Emissions from NON-ENERGY PRODUCTS FROM FUELS AND SOLVENT USE

EQUATION 5.1
BASIC FORMULA FOR CALCULATING CO_2 EMISSIONS FROM NON-ENERGY PRODUCT USES

$$CO_2\ Emissions = \sum_i \left(NEU_i \bullet CC_i \bullet ODU_i\right) \bullet 44/12$$

Where:

CO_2 Emissions = CO_2 emissions from non-energy product uses, tonne CO_2

NEU_i = non-energy use of fuel *i*, TJ

CC_i = specific carbon content of fuel *i*, tonne C/TJ (=kg C/GJ)

ODU_i = ODU factor for fuel *i*, fraction

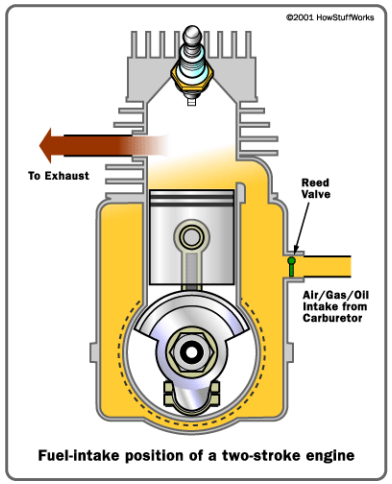
44/12 = mass ratio of CO_2/C

LUBRICANT USE

- Lubricants are mostly used in industrial and transportation applications.
- Lubricants can be subdivided into:
  - Motor and industrial oils,
  - Greases, which differ in terms of physical characteristics, commercial applications, and environmental fate.

LUBRICANT USE

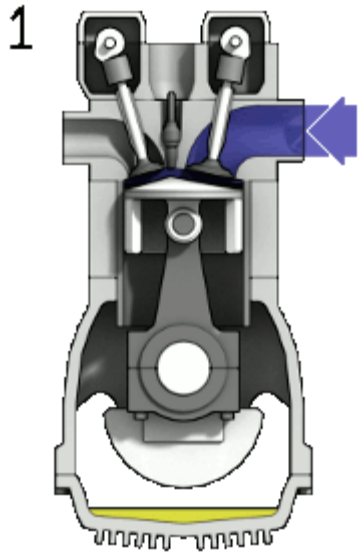
- The use of lubricants in engines is primarily for their lubricating properties and hence, emissions are therefore considered as non-combustion emissions (IPPU Sector).
- In the case of 2-stroke engines, lubricant is mixed with another fuel and thus on purpose co-combusted in the engine, the emissions should be reported under (Energy Sector).



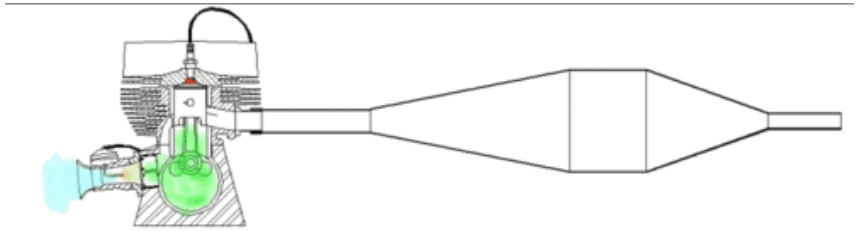
http://www.personal.psu.edu/cxc11/UAV_PROPULSION/TWO_STROKE_ANIMATION.HTML

LUBRICANT USE

4-stroke engines



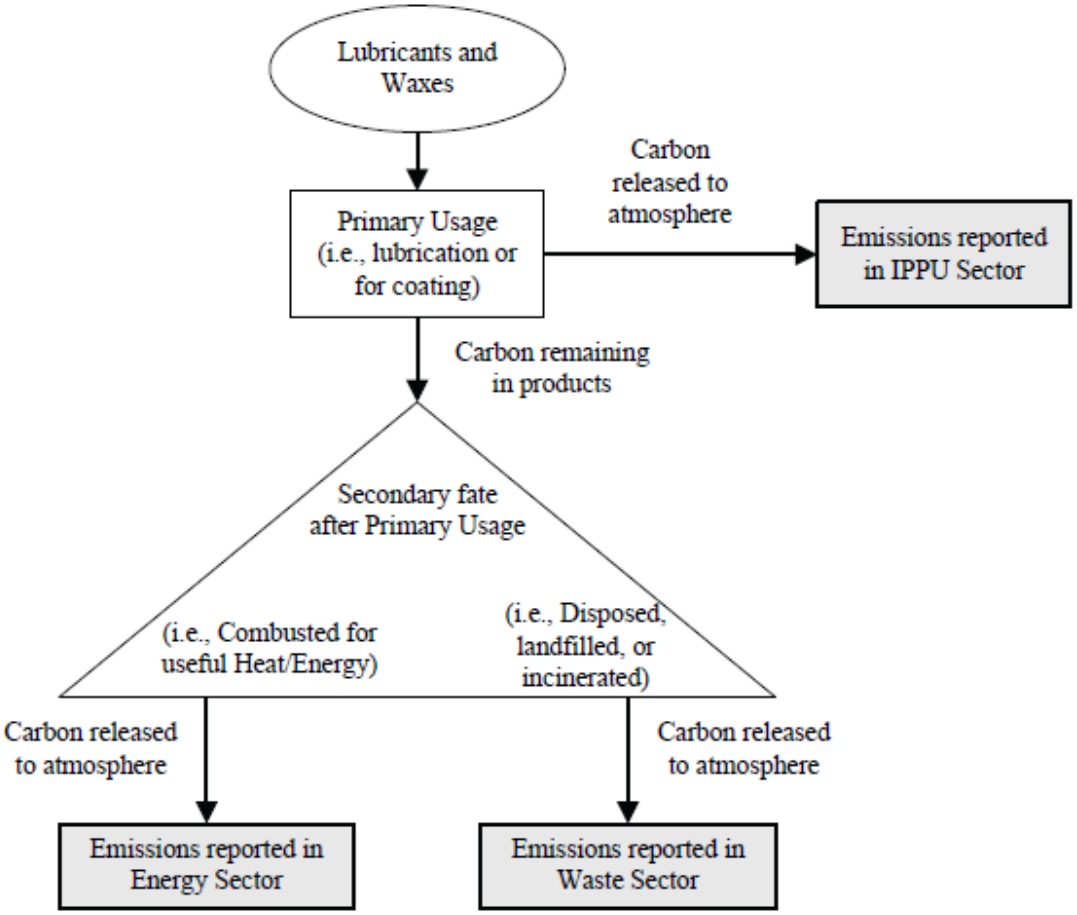
2-stroke engines



Source: https://commons.wikimedia.org/wiki/File:4StrokeEngine_Ortho_3D_Small.gif

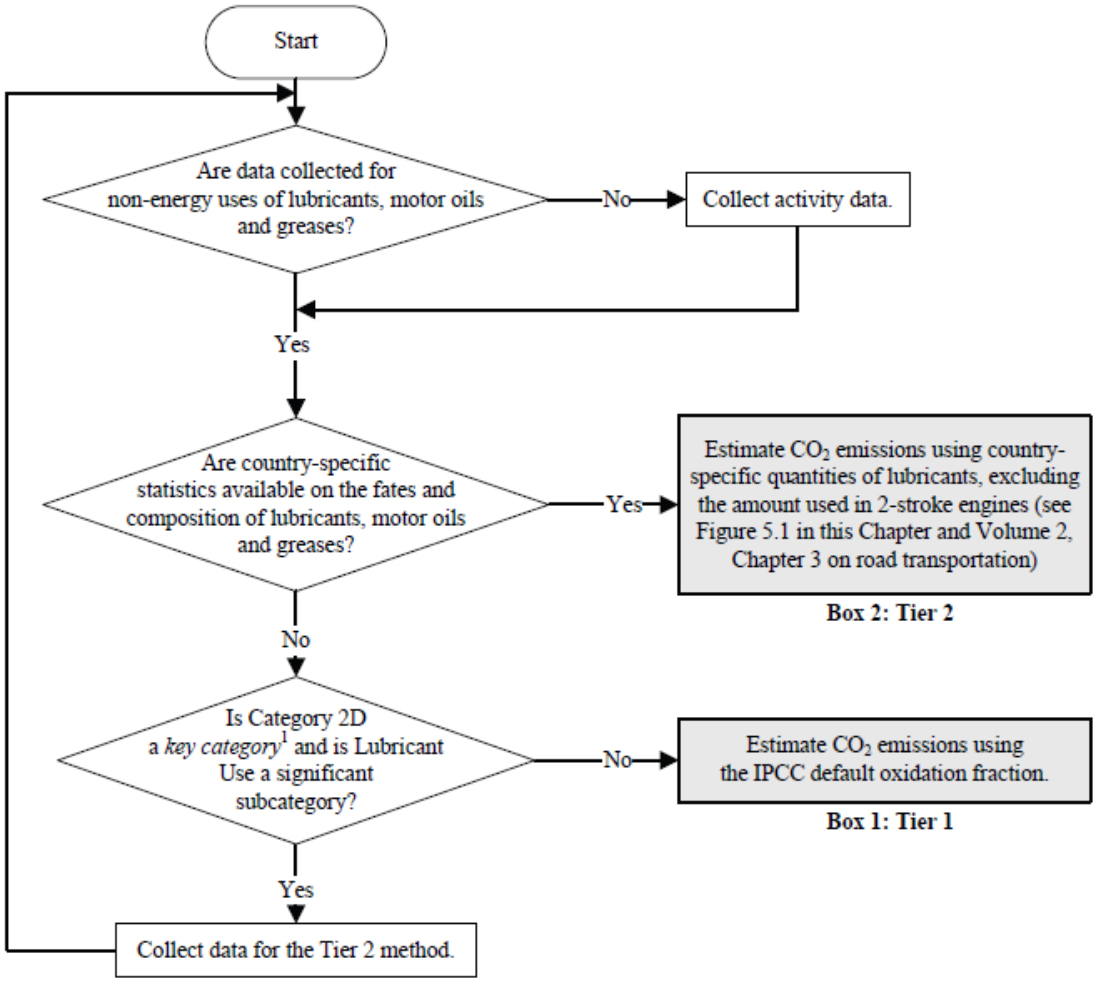
LUBRICANT USE

Figure 5.1 Sectoral allocation of emissions from lubricants and waxes



Decision Tree for CO2 from Non-Energy Uses of Lubricants

Figure 5.2 Decision tree for CO_2 from non-energy uses of lubricants



Tier 1 Method

IPCC 2006: Tier 1 Method

Tier 1: CO2 emissions are calculated with aggregated default data for the limited parameters available and the ODU factor based on a default composition of oil and greases in total lubricant figures (in TJ units):

EQUATION 5.2
LUBRICANTS – TIER 1 METHOD

$$CO_2\ Emissions = LC \bullet CC_{Lubricant} \bullet ODU_{Lubricant} \bullet 44/12$$

Where:

CO_2 Emissions = CO_2 emissions from lubricants, tonne CO_2

LC = total lubricant consumption, TJ

$CC_{Lubricant}$ = carbon content of lubricants (default), tonne C/TJ (= kg C/GJ)

$ODU_{Lubricant}$ = ODU factor (based on default composition of oil and grease), fraction

44/12 = mass ratio of CO_2/C

Tier 1 Emission Factor

- Having only total consumption data for all lubricants, the weighted average ODU factor for lubricants as a whole is used as default value.
- Assuming that 90 % of the mass of lubricants is oil and 10 % is grease yields an overall ODU factor of 0.2

TABLE 5.2
DEFAULT OXIDATION FRACTIONS FOR LUBRICATING OILS, GREASE AND LUBRICANTS IN GENERAL

Lubricant / type of use	Default fraction in total lubricant [a] (%)	ODU factor
Lubricating oil (motor oil /industrial oils)	90	0.2
Grease	10	0.05
IPCC Default for total lubricants [b]		**0.2**

[a] Excluding the use in 2-stroke engines.
[b] Assuming 90 percent lubricating oil consumption and 10 percent grease consumption and rounded to one significant digit.
Source: Rinehart (2000).

Tier 1 Activity Data

- Data on the non-energy use of lubricants are required to estimate emissions, with activity data expressed in energy units (TJ).
- To convert consumption data in physical units, e.g., in tons, into common energy units, e.g. TJ, calorific values are required.
- Basic data on non-energy products used in a country may be available from production, import and export data and on the energy/non-energy use split in national energy statistics.

Tier 2 Method

IPCC 2006: Tier 2 Method

Tier 2: Relies on detailed data on the quantities consumed per type of lubricants use and, preferably, country-specific emission factors should be used. The emission factors are composed of fuel type specific carbon content and the ODU factor:

EQUATION 5.3
LUBRICANTS – TIER 2 METHOD

$$CO_2\ Emissions = \sum_i \left(LC_i \bullet CC_i \bullet ODU_i\right) \bullet 44/12$$

Where:

CO_2 Emissions = CO_2 emissions from lubricants, tonne CO_2

LC_i = consumption of lubricant type *i*, TJ

CC_i = carbon content of lubricant type *i*, tonne C/TJ (= kg C/GJ)

ODU_i = ODU factor for lubricant type *i*, fraction

44/12 = mass ratio of CO_2/C

Tier 2 Activity Data

- Additional information may need to be collected to determine the amount of lubricants being used in 2-stroke engines, which should be excluded from the Tier 2 method.
- The individual quantities applied as motor oil/industrial oils and as greases need to be separately known.

Uncertainty Assessment

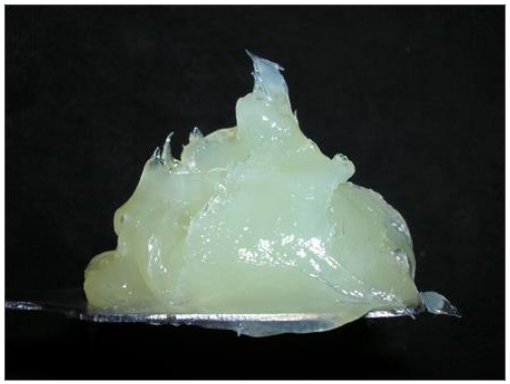
- The default ODU factors developed are very uncertain, as they are based on limited knowledge of typical *lubricant* oxidation rates. Expert judgment suggests using a default uncertainty of 50 percent.
- For quantities of non-energy products, a default of 5 % may be used in countries with well developed energy statistics and 10-20 %in other countries.

QUALITY ASSURANCE AND QUALITY CONTROL

- It is *good practice* to check the consistency of the total annual consumption figure with the production, import and export data.
- It is recommended to compare the amounts discarded, recovered and combusted and the amount used in 2-stroke engines, if available, with total consumption figures to check consistency of activity data and ODU factors.

PARAFFIN WAX USE

- This category, includes such products as petroleum jelly, paraffin waxes and other waxes.
- Waxes are used in a number of different applications e.g. candles, corrugated boxes, paper coating, board sizing, food production, wax polishes, surfactants and many others.



http://www.picgifs.com/graphics/candles/graphics-candles-692313-756274/

PARAFFIN WAX USE

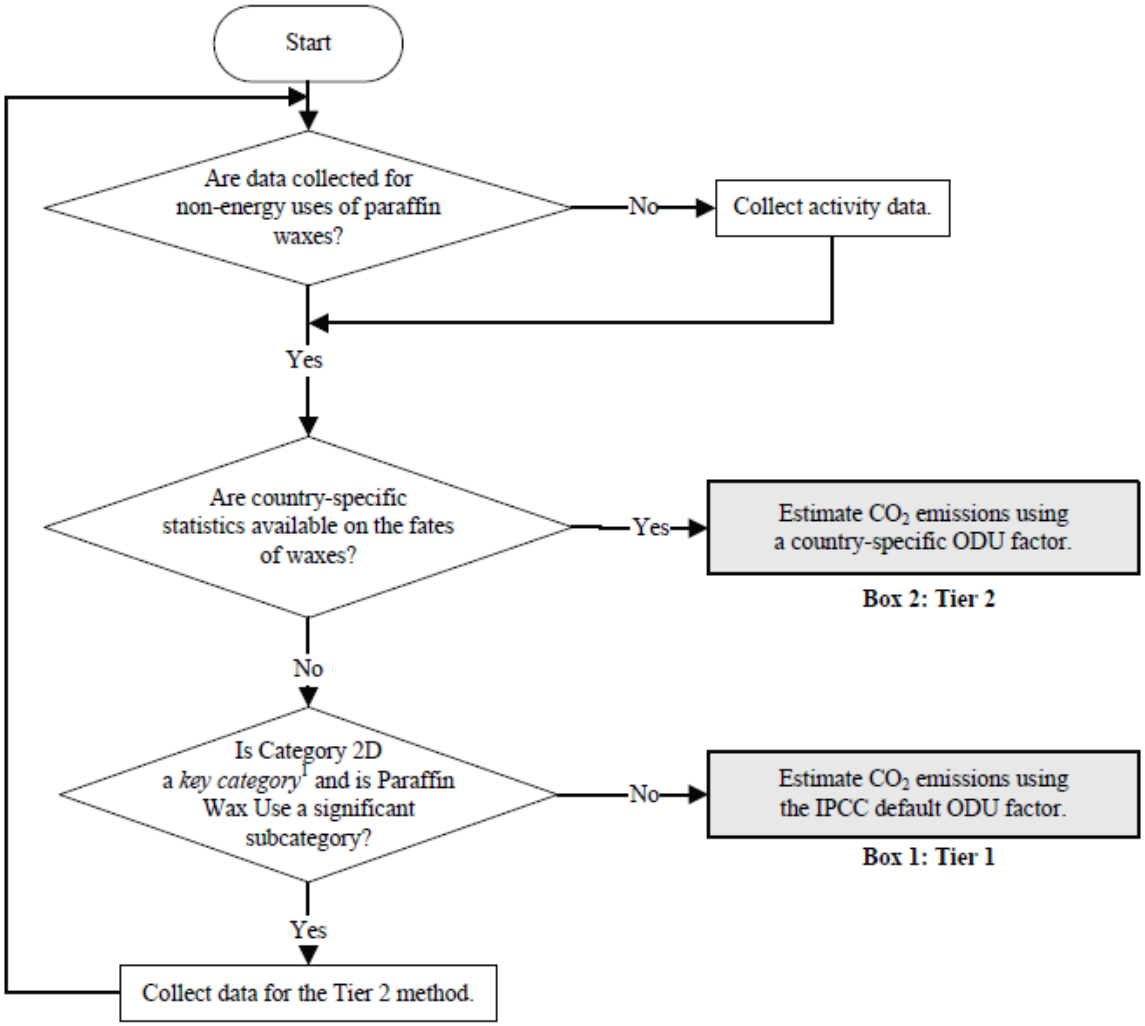
- Emissions from the use of waxes derive primarily when the waxes or derivatives of paraffins are combusted during use (e.g., candles), incinerated or in wastewater treatment.

- In the cases of incineration and wastewater treatment the emissions should be reported in the Energy or Waste Sectors, respectively

http://bestanimations.com/HomeOffice/Lights/Candles/Candles.html

Decision tree for non-energy uses of paraffin waxes

Figure 5.3 Decision tree for CO_2 from non-energy uses of paraffin waxes



Tier 1 Method

Tier 1 Method

- Tier1: CO2 emissions are calculated using aggregated default data for the limited parameters available:

EQUATION 5.4
WAXES – TIER 1 METHOD

$$CO_2\ Emissions = PW \bullet CC_{Wax} \bullet ODU_{Wax} \bullet 44/12$$

Where:

CO_2 Emissions = CO_2 emissions from waxes, tonne CO_2

PW = total wax consumption, TJ

CC_{Wax} = carbon content of paraffin wax (default), tonne C/TJ (= kg C/GJ)

ODU_{Wax} = ODU factor for paraffin wax, fraction

44/12 = mass ratio of CO_2/C

Tier 1: Emission factors & Activity Data

- It can be assumed that 20 % of paraffin waxes are used in a manner leading to emissions, mainly through the burning of candles, leading to a default ODU factor of 0.2.
- Data on the use of paraffin waxes are required, with activity data expressed in energy units (TJ).
- Converting consumption data in physical units (e.g. tons), into energy units (TJ), calorific values are required.
- Basic data on non-energy products used may be available from production, import and export data and national energy statistics.

Tier 2 Method

- Tier 2 method relies on detailed data on the quantities (and possibly the types) of paraffin waxes produced and their respective use as well as country-specific emission factors.

EQUATION 5.5
WAXES – TIER 2 METHOD

$$CO_2\ Emissions = \sum_i (PW_i \bullet CC_i \bullet ODU_i) \bullet 44/12$$

Where:

CO_2 Emissions = CO_2 emissions from waxes, tonne CO_2

PW_i = consumption of was type *i*, TJ

CC_i = carbon content of wax type *i*, tonne C/TJ (= kg C/GJ)

ODU_i = ODU factor for wax type *i*, fraction

44/12 = mass ratio of CO_2/C

Tier 2: Emission factors & Activity Data

- Where specific details on the uses of paraffin waxes, countries can determine their own country-specific ODU factors based on national knowledge.
- These factors can be combined with either the default carbon contents or a country-specific carbon contents if any are available.
- Basic data on non-energy products used may be available from production, import and export data and national energy statistics.

Uncertainty Assessment

- The default carbon content coefficient is subject to an uncertainty range of ±5 %.
- The ODU factor is highly dependent on specific-country conditions and the default value of 0.2 exhibits an uncertainty of about 100 %.
- For quantities of non-energy products, a default of 5 % may be used in countries with well developed energy statistics and 10-20 % in other countries

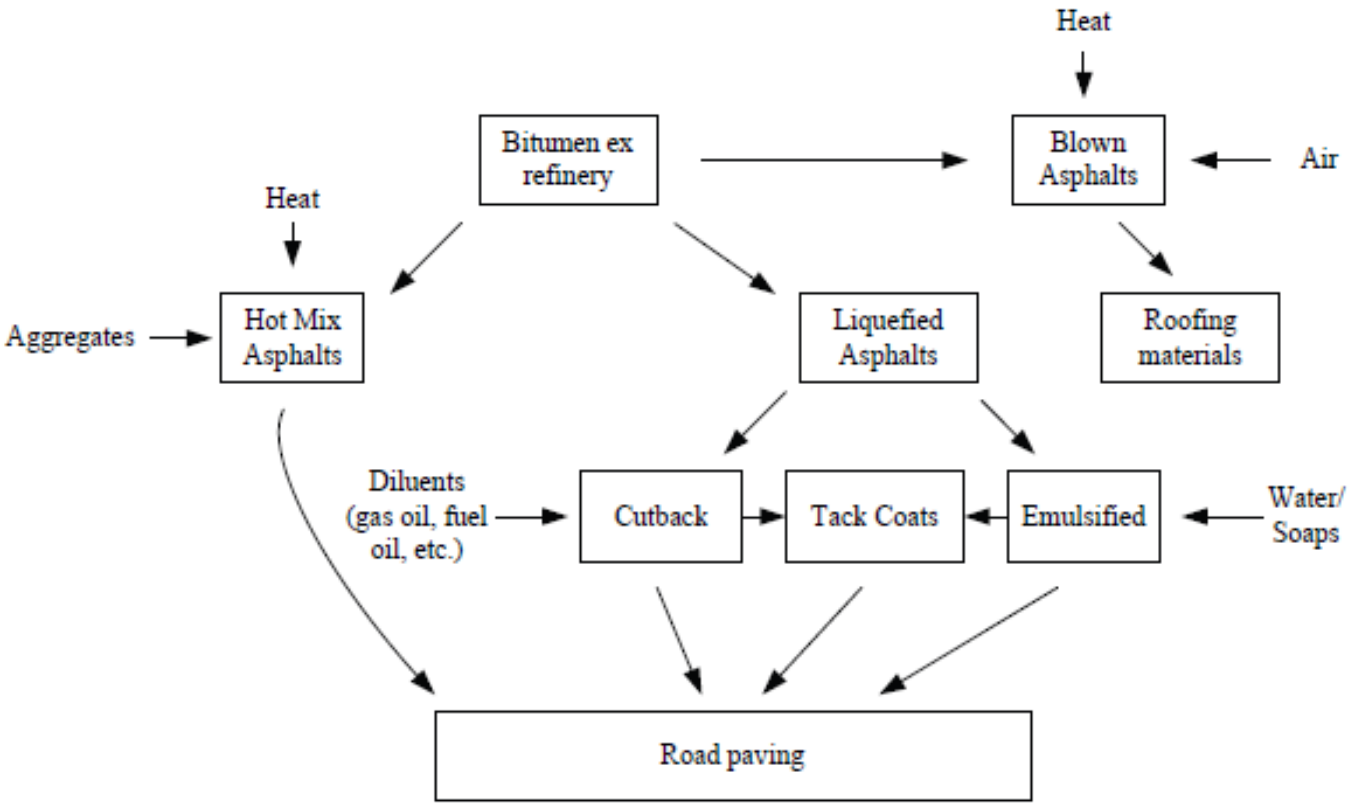
QUALITY ASSURANCE AND QUALITY CONTROL

- It is *good practice* to check the consistency of the total annual consumption figure with the production, import and export data.
- The amounts discarded, recovered and combusted, if available, may be compared with total consumption figures in the calculation to check the internal consistency of activity data and ODU factors.

ASPHALT PRODUCTION AND USE

- This source category comprises the non-combustion emissions from the production of asphalt in asphalt plants other than refineries and its application e.g. paving and roofing as well as subsequent releases.
- The production and use of asphalt results mainly in emissions of NMVOC, CO, SO2 and particulate matter, while the fate of the remaining hydrocarbons are stored in the product.

ASPHALT PRODUCTION AND USE



Direct greenhouse gas emissions, e.g., CO2 or CH4, associated with the production and use of asphalt are negligible.

SOLVENT USE

- The use of solvents manufactured using fossil fuels can lead to evaporative emissions of (NMVOC), which are subsequently further oxidized in the atmosphere.
- Fossil fuels used as solvent are notably white spirit and kerosene.
- White spirit is used as an extraction solvent and as a solvent for cleaning, degreasing and in aerosols, paints, wood preservatives, varnishes and asphalt products.

SOLVENT USE

- 'Solvent Use' is treated as a separate category because it requires a different approach to emissions estimation other emission categories.
- Solvent Use is often the largest source of national NMVOC emissions and its share may vary between 5 % and 30 %.

Thank you!

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