Annex B – Rationale for the approach in dealing with overlap between Oil and Gas and Petrochemical industry

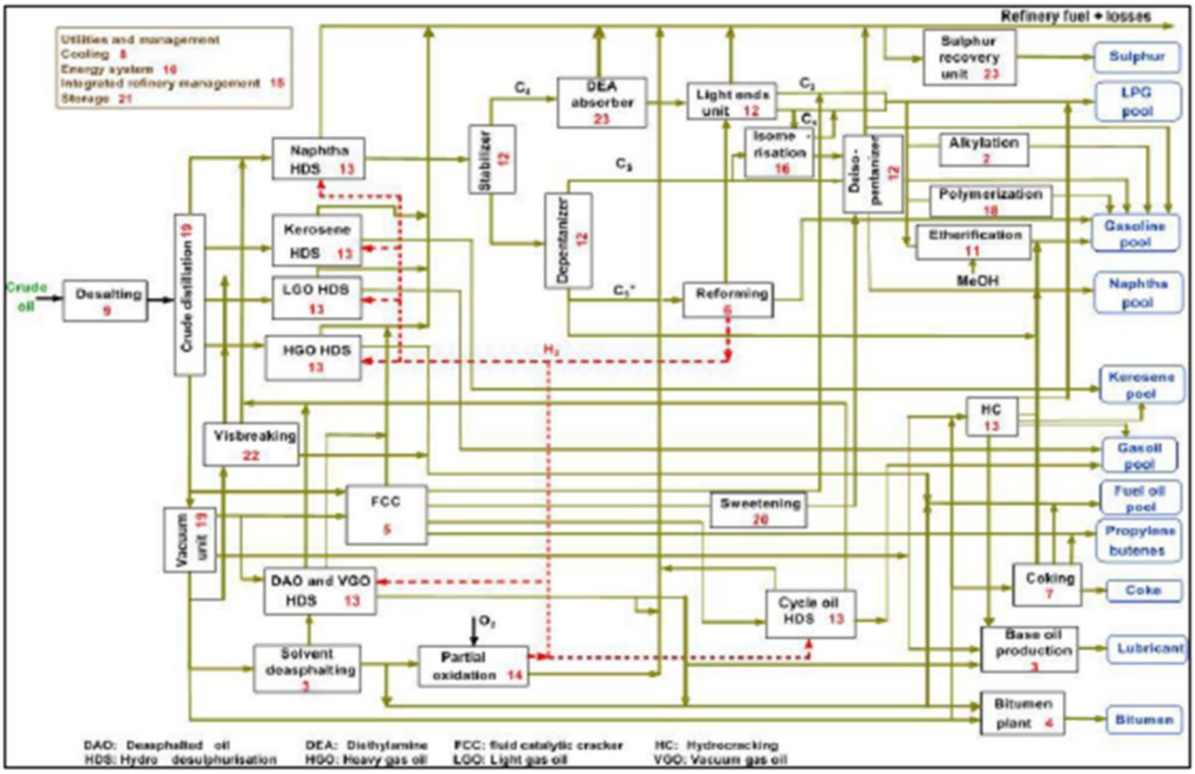
In the Oil and Gas industry, petrochemical activities often co-exist with activities related to the energy value chain. Particularly in refineries, the complexity of the highly integrated industrial processes makes it very difficult to define the boundary between scope 1 and 2 emissions from the energy and the petrochemical value chains, namely at the Fluid Catalytic Cracker unit (FCC). The FCC is one of the most important conversion processes in refineries and is used to convert heavier molecules into lighter (and more valuable) hydrocarbon fractions.

According to this guidance the emissions coming from the FCC should be considered by default by Oil, Gas and Integrated energy companies, but companies may opt out these emissions if they consider that they are mainly serving petrochemical feedstock purposes. Thus, when considering FCC GHG emissions, two options are available for Oil, Gas and Integrated energy companies: 1) the consideration of 100% of the FCC emissions, or; 2) its total exclusion, in which case they should be accounted in the petrochemical sector. Opting-out situations must always be noted and justified.

This Annex presents some data on FCC emissions, in the broad context of the Oil, Gas and Integrated energy companies, and a brief explanation on the rationale for the described approach.

Refineries are complex facilities, where the overall configuration is usually specific to the characteristics of the raw materials used and the products to be manufactured.

Figure B.1 – Treatment of non-energy flows - General scheme of a complex Oil Refinery (EC Joint Research Center, 2015)



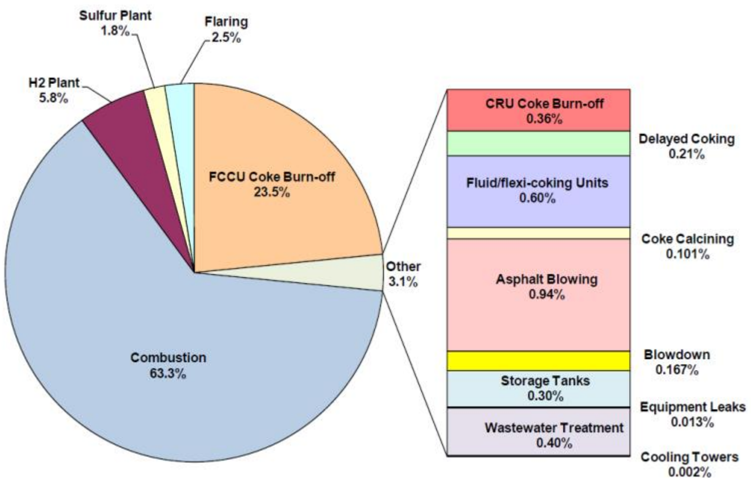
Refinery units are all different regarding their configuration, process integration, feedstock, feedstock flexibility, products, product mix, unit size and design and control systems. In addition, differences in ownership strategy, market situation, location and age of the refinery, historic development, available infrastructure and environmental regulation are among other reasons for the wide variety in refinery concepts, designs and modes of operation (EC Joint Research Center, 2015). It is not surprising that the GHG emission patterns can also vary from site to site.

Nevertheless, it is possible to establish patterns on the (GHG) significance of key refinery processes. Two different data sources presented in Table B.1 and Table B.2 show similar values concerning the emissions breakdown by process in an average refinery.

Table B.1 – Breakdown of Refineries Direct Emissions – Contribution of different sources to overall refinery GHG emissions (average and range) - Öko Institut and Ecofys (2008)

	Contribution to overall GHG emissions (%, CO_2-eq basis)		
	Average	**Minimum**	**Maximum**
Direct combustion	85	56	100
- FCC Coke on Catalyst	19	0	61
- Other fuels	66	23	99
Indirect energy	8	0	35
Hydrogen generation	4	0	29
Flare loss	3	0	19
Methane	<1	0	1

Figure B.1 – Breakdown of Refineries Direct Emissions (US nationwide emissions) (U.S. EPA, 2010)



The FCC process produces coke, which collects on the catalyst surface and diminishes its catalytic properties. The catalyst therefore needs to be regenerated continuously, essentially by burning the coke off the catalyst at high temperatures, being the main source of GHG emissions in the process (EC Joint Research Center, 2015).

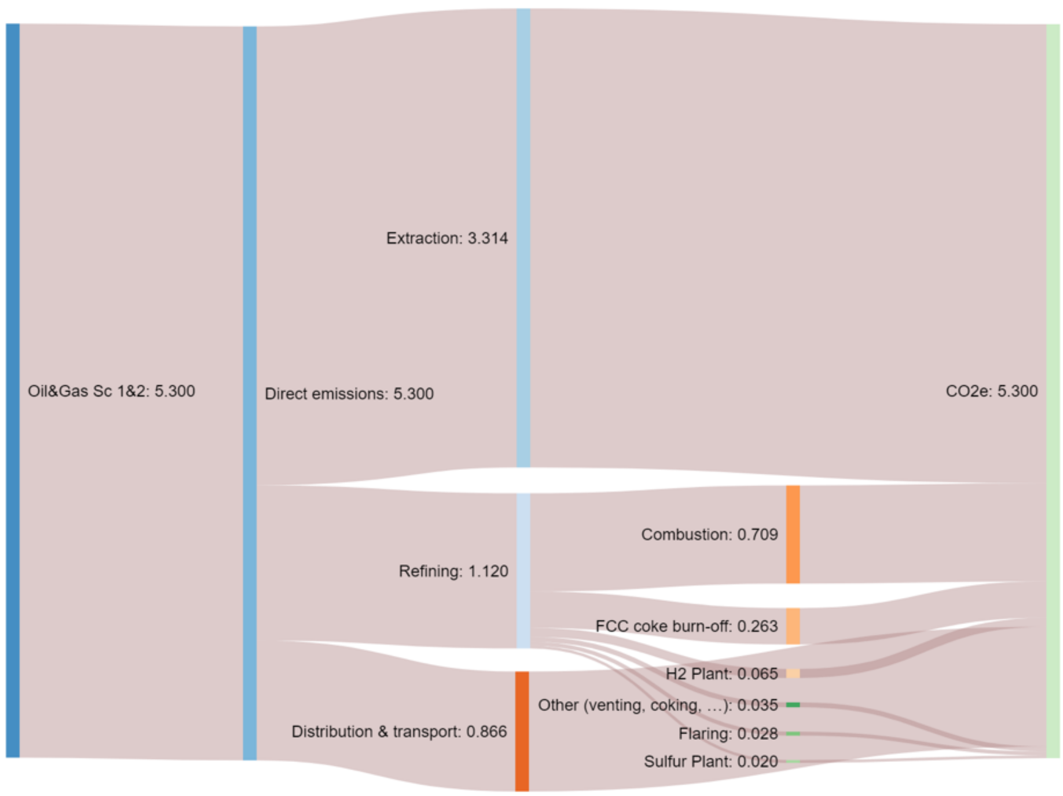
It is widely used to convert the high-boiling, high-molecular weight hydrocarbon fractions of petroleum crude oils into more valuable gasoline, and other products such as relatively high quantities of C3 and C4 gases. Both products are highly olefinic and therefore are ideal feed streams for the alkylation, etherification and petrochemical industries.

It is however virtually impossible to accurately allocate emissions associated with the production of petrochemical feedstock and energy use products. To accomplish this in a fair manner, for each site, the emissions share of petrochemical feedstock produced would have to be calculated in order to deduct the related share of CO_2 direct emissions. This could be done through (a) a carbon mass balance; (b) a global mass balance; or (c) an energy balance. In each case, there would always be complexity on the calculations and subjectivity on the results. In any case, a high cost/benefit ratio would be expected.

Considering that FCCs are also managed according to the specific demand for petrochemical feedstock products, the best solution is to let companies decide: 1) if their FCC emissions should be considered within the refinery unit and in the Oil, Gas and Integrated energy sector - if the production of energy products is dominant – or; 2) within the petrochemical unit and the Chemical & Petrochemicals sector - if the production of petrochemical feedstock is more important.

When looking at individual refinery plants, FCC emissions are often significant. However, looking at the Oil and Gas sector direct emissions (Scope 1), the relevance of the FCC is below 5% of its total direct emissions.

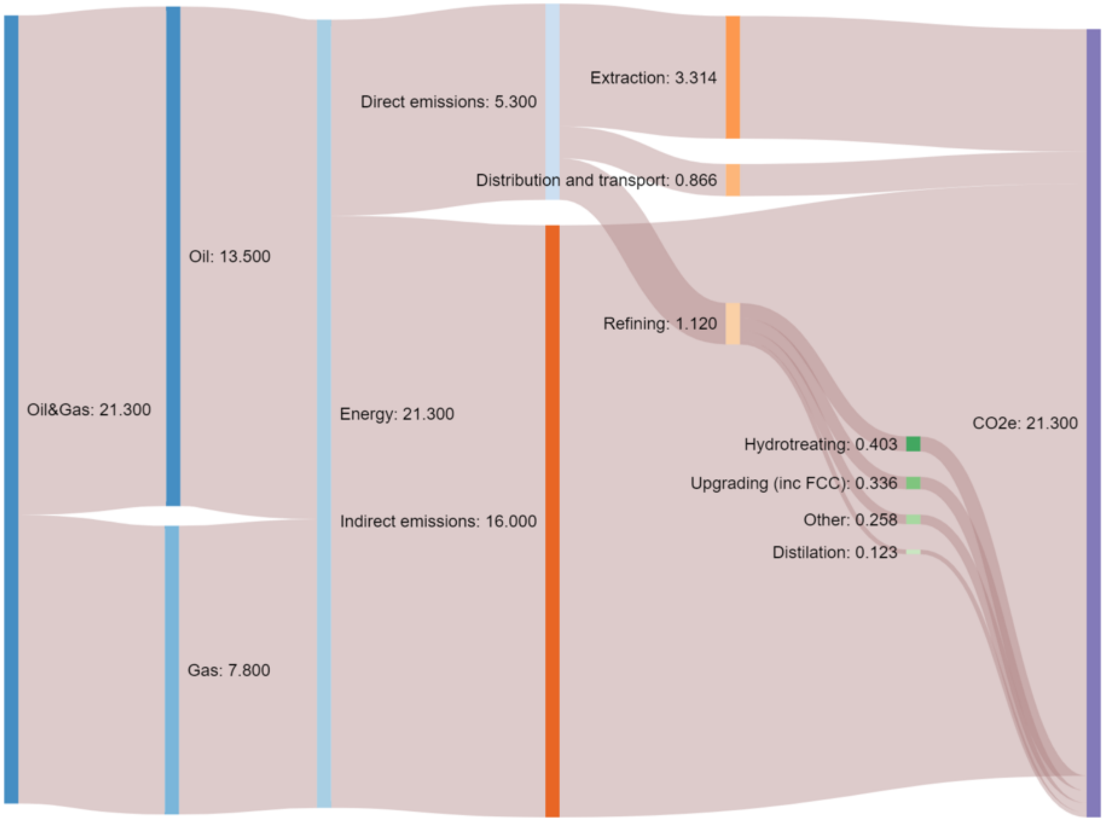
Figure B.2 – Oil and Gas Scope 1&2 Emissions (Mt CO2eq)



Sources: *Global data*: IEA (2020); *Emissions breakdown*: IEA (2018); *Distribution of Refinery processes emissions*: EPA (2010)

Furthermore, the relevance of the FCC emissions in the context of scope 1, 2 and 3 emissions of the sector is low - 1.2 to 1.6% of its total emissions.

Figure B.3 – Oil and Gas Scope 1,2&3 Emissions (Mt CO2eq)



Sources: *Global data*: IEA (2020); *Emissions breakdown and Distribution of Refinery processes emissions*: IEA (2018)

Overall, the possibility which is given to companies to choose between the accounting of FCC emissions within the Oil, Gas and Integrated energy or the Chemical & Petrochemical sectors highly simplifies the emissions accounting process and does not pose a relevant GHG emissions integrity issue, in the context of Oil, Gas and Integrated energy companies emissions inventories.

References

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