

# Chapter 11

## Greenhouse Gas Emissions from the Petroleum Industry

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### ABSTRACT

*Greenhouse Gas (GHG) emissions occur, more or less, in all aspects of the petroleum industry's activities. Besides the direct emissions of some GHG, the petroleum industry is also characterised with high energy intensity usually followed by emissions of adverse gases, especially at old facilities, and also the products with high emission potential. Being the global industry and one of the major players on global market, the petroleum industry is also subjected to global regulatory provisions regarding GHG emissions. In this chapter, the impact of global climate change on the petroleum industry is discussed. The emissions from the petroleum industry are analysed with a special focus on greenhouse gases that occur in petroleum industry activities and types and sources of emissions from the petroleum industry activities. In addition, recommendations for estimation, monitoring, and reductions of GHG emissions from the petroleum industry are given.*

### INTRODUCTION

Even though the impact of greenhouse gas (GHG) emissions on global climate began at the end of 18<sup>th</sup> century, its scientific analysis yet started more than a century later. Since the impact is global, inconsistent and it happens on a long time scale, for a long time there was no initiative, neither on state nor on companies' level to control, accept responsibility, and take actions regarding GHG emissions. Today the largest share of the responsibility for the adverse environmental impact due to GHG emissions lies on industry and energy sector.

The petroleum industry (oil and gas industry) was throughout history bounded by environmental pollution, either through unsustainable resource utilization or through unsustainable use of the environment as the final point of the petroleum industry's waste disposal. In the 21<sup>st</sup> century, apart from facing and meeting the ever-growing global energy demand, petroleum industry is also faced with the challenges and risks brought by global climate changes and efforts for its containment. Generally, natural

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gas is considered to be a bridge fuel that will enable the overall dependence on fossil fuels over coming decades, because, compared to oil, and especially to coal, utilization of natural gas results with lower emissions. Also, since in many regions conventional reserves of oil and gas are becoming depleted, the development of unconventional gas reserves like shale gas, tight sands or coalbed methane, which in recent years took significant uplift, additionally encourages that concept.

The petroleum industry is one of the most powerful and globally outspread businesses of the modern society. With its multinational companies, the petroleum industry became the global industry operating in almost every part of the world. It is also the industry subjected not only to globally adopted regulations, but also regional and local legislations. Due to its high energy intensity and products of high carbon content (oil and natural gas), and thus high GHG potential, petroleum industry is directly linked with the rise of global GHG emissions.

GHG emissions occur, more or less, in all aspects of petroleum industry's activities. The petroleum industry is, beside the direct emissions of some GHG, also characterised with high energy intensity usually followed by high emission intensity, especially at old facilities, and also products with high emission potential.

Emissions from petroleum industry depend upon the quantity of oil and natural gas produced and consumed. According to the research made by the American Petroleum Institute (API), refinery activities account for 75% of the emissions and the rest (25%) is emitted from oil and natural gas exploration and production sector. Regarding refinery emissions, most of the emission burden lies upon catalytic cracking, hydroprocessing, and reforming, from which the emissions are respectively around 22%, 15%, and 8%. During exploration and production of oil and natural gas, more than 50% of the emissions are the direct consequence of flaring (Hrnčević, 2008; Lev-On, Ritter, & Retzsch, 2001).

The petroleum industry commonly consists of two big sectors/ systems, namely the oil system and the natural gas system. All the petroleum industry activities are generally grouped in two major business spheres, namely the upstream and the downstream activities. Segments of the petroleum industry with the associated GHG emissions are shown in Figure 1. Exploration and production of oil and natural gas, natural gas processing, oil or condensate storage at the production site, and on- field crude oil, condensate and natural gas transportation are considered to be the upstream activities. The downstream activities stand for transmission and storage of oil/ oil products and natural gas outside the production field (long- distance pipelines), crude oil refining, and oil and natural gas distribution and retail. Integrated petroleum companies may also have activities associated with energy production (electricity, heat and steam production, etc.), mining, petrochemical production and carbon capture and storage (CCS).

In order to meet the GHG problem, petroleum industry has to obtain adequate knowledge of its emission sources, the emission inventories and those parameters affecting the individual emissions, but also the knowledge of the economy impact of introducing alternative emission control technologies. This knowledge is necessary to evaluate alternative technologies that can control and reduce GHG emissions. Also, in order to diminish business risks brought by global climate change, and to sustain and improve its long- term competitive advantages, respecting the globally applied GHG reduction regulations, and considering the nature of its core business, the petroleum industry has recognised the necessity of implementation of climate change factors into the corporative business strategies. Besides taking only internal action towards GHG emission reductions, and thus improvement of its emission reduction profile, petroleum companies are also forced to take some projects outside their "boundaries" that will result in emission reductions and thus beneficiary emission allowances for the company.

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