IHS Markit™

Carbon Footprint and Allocation in an Integrated Refinery-Petrochemical Complex

PEP Review 2021-10

November 2021

Soumitro Nagpal
Executive Technical Director

RJ Chang
Vice President

Process Economics Program

Contacts

Soumitro Nagpal
Executive Technical Director, Process Economics Program
soumitro.nagpal@ihsmarkit.com

RJ Chang
Vice President, Process Economics Program
rj.chang@ihsmarkit.com

Michael Arné
Vice President, Process Economics Program
michael.arne@ihsmarkit.com

PEP Review 2021-10

Carbon Footprint and Allocation in an Integrated Refinery-Petrochemical Complex

Soumitro Nagpal, Executive Technical Director
RJ Chang, Vice President

Abstract

Investors are looking more closely at operational indicators for a better understanding of company performance in reducing emissions. Currently, there is no consistent basis for estimation of emission intensities of a facility, thus making reliable comparisons between environmental, social, and governance (ESG) performance of companies a challenge.

This review is part of a broader IHS Markit effort to develop a consistent emissions estimation methodology spanning the upstream oil and gas, midstream/downstream oil refining and gas processing, and petrochemicals industries. We illustrate the proposed methodology by developing specific carbon footprint emission estimates of transportation fuels as well as the major bulk olefin and aromatic-based petrochemicals derived from a world-scale, highly integrated, refinery-petrochemicals/crude-oil-to-chemicals (COTC) complex.

In this review, we present a detailed material and energy balance from a recent crude-oil-to-chemicals (COTC) project that includes a deep conversion refinery processing 400,000 barrels per day (20 MMtpa) of crude, a mixed-feed steam cracker, and downstream petrochemicals. The carbon emissions from each process unit are determined. Carbon footprints are allocated to each of the major products based on the cumulative energy consumption of all process units involved in their production plus the life cycle carbon footprints of all external feeds used in the complex.

The following aspects distinguish this study from earlier carbon footprint studies for fuels and petrochemicals:

- The scope covers an integrated petroleum refinery, steam cracker, and petrochemical complex versus stand-alone refinery analysis.
- A very high refinery conversion or intensity with extensive hydrocracking, catalytic cracking, and catalytic reforming versus less energy-intensive refinery configurations.
- CO_2 allocation by energy consumptions at individual process unit level, not treating the refinery as one block.
- Energy consumption data is based on a real COTC that has recently been built, not a generic analysis.
- Includes lifecycle carbon footprints of all external feeds to the complex. Thus, the calculated product carbon footprint (CF) and carbon intensity (CI) are for the product life cycle (well-to-gate) starting from upstream feed production to refinery-petrochemicals complex exit gate.

Contents

Tables

Figures

Appendix C Figures

IHS Markit Customer Care:

CustomerCare@ihsmarkit.com
Asia and the Pacific Rim
Japan: +813 6262 1887
Asia Pacific: +604 291 3600
Europe, Middle East, and Africa: +44 1344 328 300
Americas: +1 800 447 2273

IHS Markit™