A Monte Carlo Based Approach to Greenhouse Gases Emissions Modelling and Forecasting

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The importance of greenhouse gas (GHG) inventory assessment, monitoring and auditing becomes increasingly necessary in oil and gas project evaluations. As the industry (as a whole) is looking towards “net-zero” goals/targets, some companies have begun carrying “internal” carbon costs, reflected in projected CAPEX and OPEX. Companies that do this often want to be proactive in analysing their carbon footprint.

Currently, companies only report their emissions “post-production” (calculated from produced, processed and used volumes), but shareholders and markets are demanding increasing transparency and are expressing interest in knowing beforehand what volumes of GHG could potentially be produced, to mitigate/plan-for GHG “hot-spots”. However, forecasting GHG is challenging, because there is often a lack of clarity as to whether a particular source of emission should fall under Scope 1, Scope 2 or Scope 3 or what potential sources of GHG uncertainty there is.

In this paper, I will describe a methodology, based on a Monte-Carlo (MC) Simulation built in python, to model the potential emission forecasts for a hypothetical offshore oil field development. The model will present an annual emission forecast over the project lifetime and also evaluate its associated carbon cost. A probabilistic method like MC accounts for production and development uncertainties, while adhering to ISO 14064 and IPIECA’s guidelines on evaluating Scope 1, 2 and 3 emissions for oil and gas developments.

The simulator would allow operators to identify and hence plan for mitigation of carbon sources at an early stage. It would also allow operators to forecast the project’s lifetime carbon emissions and economic viability. Finally, by comparing the simulation with emissions “post-production”, operators can also determine if their mitigative process are indeed bearing fruit or if more needs to be done to correct for GHG production.

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