**Due Diligence and “What-if” Scenario planning for a Prospective Solar Farm**

Max 450 words

* **Objective/Scope**: Please list the objective and/or scope of the proposed paper (25-75 words).

As an alternative energy, solar is often touted as a ready replacement for fossil fuels, with its negligible carbon footprint and potential as a limitless source of energy. However, there are disadvantages to solar. Depending on its end use, it is not an “on-demand” energy source and may require battery storage for greater flexibility of use. This means that, depending on how the solar development is planned, its carbon footprint can vary widely. Batteries also add a significant CAPEX cost; this directly impacts the payback period of the project. For investors who invest based on environmental and financial considerations, having multiple scenarios modelled as part of a due diligence study would be very useful.

**Methods, Procedures, Process**: Briefly explain your overall approach, including your methods, procedures and process (75-100 words).

Our study is based on a planned solar farm on an island with nearby existing infrastructure and electrical grid requiring undersea cabling. As a prospective development, the client had parameterised the development at a very high level, confirming only information on water depth and expected area available for development. In this due diligence exercise, we (1) model the effect of solar farm and its breakeven point, (b) evaluate the potential GHG and (c) determine what effect batteries would have on (a) and (b). As a benchmark, we contrast the results against power generated via conventional LNG combustion.

Our model considers the full value chain (“cradle-to-grave”) view of the development, where we consider (a) operations (planning and installation) including the installation of underground pipes and high voltage electrical cables groundwork, (b) logistics and shipping for major “off-the-shelf” parts and components like solar panels & inverters and (c) the CAPEX, OPEX, ABEX of the components. Greenhouse gas (GHG) contributions of each component within the value chain was then determined.

Our method takes into account the uncertainty in which deterministic “Low-Best-High” outcomes of solar energy output was done. However, only the mid case will be discussed in this paper. Finally, we evaluate the payback period as well.

* **Results, Observations, Conclusions**: Please describe the results, observations and conclusions of the proposed paper (100-200 words).

Overall, Scope 1’s Battery Abandonment and Scope 3 Solar Panel and Battery Manufacturing form the bulk of emissions in the ERCE model. Considering only Scope 1 carbon emissions, there are periods of high carbon intensity during the installation and abandonment phases. However, operational carbon emissions are minimal. We also determined that carbon emitted from the abandonment of batteries might negate the reduction in carbon emissions associated with using solar, when contrasted against use of natural gas to generate the same amount of energy. The battery’s abandonment emissions overshadow all other sources of emissions as well. We also determined that the major modelled contributor for Scope 3 emissions is the manufacturing of the components. Solar panels have the greatest contribution followed by battery manufacturing. This is due to the mining and purification processes required.

The greatest uncertainty in GHG emissions comes from presence of batteries – while it seems like a net carbon emitter, the added flexibility for operations might make the use of batteries worth the cost. Due to the uncertainties present, probabilistic modelling such as Monte Carlo probabilistic method can be further applied compared to the best case used in this case study. Additionally, as an all battery solution is very carbon intensive, a mix is recommended.

* **Novel/Additive Information**: Please explain how this paper will present novel (new) or additive information to the existing body of literature that can be of benefit to and/or add to the state of knowledge in the petroleum industry (25-75 words).

Currently, most studies are comparing the life cycles of different types of solar photovoltaic (PV) components, post development. However, this paper offers a new deterministic, scenario-based approach to determine the life cycle analysis of an entire prospective solar development. This approach will help investors and solar farm developers better understand areas of high GHG emissions and potentially find ways to mitigate or offset said carbon emissions.