



Hawai'i Natural Energy Institute Research Highlights

Energy Policy & Analysis

Greenhouse Gas Life-Cycle Emissions Analysis

OBJECTIVE AND SIGNIFICANCE: HNEI provides regular technical analysis and assistance to the Hawai'i Public Utilities Commission (PUC). In response to a request from the PUC in late 2019, HNEI is conducting a study to provide estimates for the life-cycle greenhouse gas (GHG) emissions of various energy resources and production technologies in Hawai'i. The objective is to provide Hawai'i-specific quantitative life-cycle assessment of GHG emissions to support the PUC's decision making under Hawai'i Revised Statutes § 269-6(b). Specifically, "to review the current peer-reviewed literature, reports, and available life-cycle databases, identify the range of reported life-cycle emissions from Hawai'i-relevant energy resources and technologies, and finally to provide a reference range specific to their application in Hawai'i."

BACKGROUND: Hawai'i has been in the forefront of integrating renewable energy technologies into its energy mix. In 2008, the state launched the Hawai'i Clean Energy Initiative (HCEI) with the goal to substantially reduce the use of fossil fuels. Following a number of modifications, the current RPS goal is 100% renewable energy for electricity by 2045.

Recently, life-cycle analyses (LCA) for GHG emissions in Hawai'i has become more important. The PUC, as part of its decision making, is required to consider GHGs. A number of lawsuits have emerged that require these types of analyses.

PROJECT STATUS/RESULTS: HNEI has completed a comprehensive literature review of existing LCA studies and conducted further evaluation of those applicable for Hawai'i and, where possible, considered specific Hawai'i operations to provide greater clarity. HNEI was not asked to, nor did HNEI, undertake an independent assessment of GHG emissions for any specific technology. The study, based on the available published literature prior to March 2021, provides a review of the literature and a preliminary estimates of the range of the GHG emissions for technologies of interest.

While some renewable energy generation technologies do not emit CO₂ at the point of use, there often are embedded emissions that are created during the full life-cycle of the technology. A full accounting of emissions requires that emissions arising from

these other steps, such as production (mining and manufacturing), operation and maintenance, and disposal/reuse, be included. All energy technology will have some GHG emissions when the complete life-cycle is considered – even if the production of electricity at the point-of-use does not produce any GHGs. Based on the literature and additional analysis conducted by HNEI, the range of estimates for life-cycle emissions was found to be very wide. Even for well-defined technologies, such as PV, substantial ranges were found, partly due to variations in the technology, but also due to variations in the manufacture of the components.

For other technologies, such as biomass and biofuels, existing studies can provide general guidance, but variation in the type of feedstock, the conversion technology, and the final disposition of waste (i.e., the resources required for re-growth of new biomass resources) requires comprehensive site-specific studies. For biomass and biodiesel combustion, large amounts of CO₂ may be emitted at time of generation, but depending upon the biomass source, operations, and life-cycle assumptions, considerable offset of these emissions is possible through new plantings or sequestration. Recently, some publications offer contradictory conclusions regarding biomass emissions and their timing. These conclusions are based on the temporal differences, in terms of the immediate combustion of biomass-derived fuels and the time it takes to regenerate these resources. HNEI is evaluating these analyses and will incorporate the findings in the final report.

Following the development of the draft deliverable, HNEI intends to convene a meeting of stakeholders from Hawai'i and experts from the U.S. Department of Energy's national laboratory system. HNEI expects to convene this expert panel in late 2023 with a final report to the PUC by early 2024.

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