

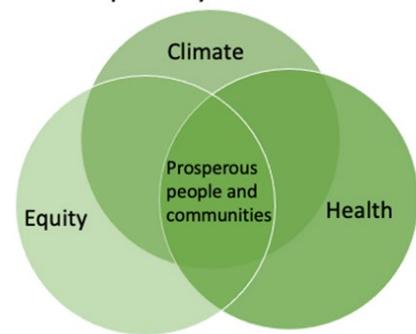
Supporting the Equitable Transition to a Decarbonized Economy

Greene Economics has worked for over 20 years on topics to support the equitable transition to a decarbonized economy. This includes

- extensive work **estimating and planning for climate impacts, risks, and adaptation**, as well as
- analyzing the **differential impacts on vulnerable communities** of color and across the income spectrum, and
- **forecasting, analyzing, reporting, and disclosing** how proposed **public policies and private strategies** can (and might not) move the planet towards the urgent target of a decarbonized economy.

As we make the move towards a decarbonized economy, Greene Economics uses economic principles to help clients understand impacts, capitalize on opportunities, and develop strategies to mitigate and prepare for change. From forecasting electric vehicle (EV) adoption and energy demand, to preparing for sea-level rise, to understanding the uncertainty of shifting policies and market responses, our team has the experience to guide clients through their unique challenges. We have created climate adaptation decision tools, developed decarbonization plans, analyzed policy-related emission leakage, conducted Taskforce for Climate-related Financial Disclosures (TCFD) compliant reports with Climate Scenario Analyses (CSAs), and generally assisted clients in preparing for the global energy transition that is underway. Much of this work involves detailed technical information related to natural disaster impacts, temperature shifts, and climate forecasts paired with demographic, economic, and social inputs as well as market-related analyses of energy demand. Greene Economics has a unique blend of these skills and is well-positioned to provide insights to public and private clients managing the shifting policy and natural environments necessary for a sustainable future. A few examples of our experience are highlighted below. Click on a project of interest or scroll down to provide an overview of some of our project work.

Economic Principles for Adaptability & Resilience



- Forecasting [climate impacts](#) such as water security, sea level rise, and flooding.
- Working with utilities to [forecast equitable policies](#) during the energy transition.
- [Designing tools](#) to facilitate resilient water infrastructure investment decisions.
- Creating a roadmap for global energy transition for a National Academy of Science, Engineering, and Medicine ([NASEM](#)) study.
- [Decarbonization planning](#) for public and private entities.
- Tailoring [decision support for investing](#) in an uncertain future.
- Quantifying economic benefits and costs of [renewable energy like wind, solar, and biofuels](#).

- Forecasting [electric vehicle \(EV\)](#) and electric truck adoption based on incentives.
- Analyzing production and emission leakage for [Emission Intensive Tract Exposed \(EITE\)](#).
- Conducting [Climate Scenario Analysis \(CSA\)](#) following TCFD guidance.
- Evaluating the economic impacts of [waste, reuse, and the Circular Economy](#).

Project Examples

Kitsap County Climate Change Resiliency Assessment, Kitsap County, WA-

Greene Economics worked with Cascadia Consulting to prepare a Climate Change Resiliency Assessment for Kitsap County that evaluated climate change drivers, impacts, and risks. The assessment included an overview of climate drivers, biophysical climate impacts, and future climate projections. For the Climate Change Resiliency Assessment, Greene Economics staff analyzed and presented syntheses of current and future climate impacts to social and economic systems including public health and healthcare services; property values, businesses, energy supply and utilities, and future economic damages; historical and archaeological sites, recreational opportunities, and Tribal cultural resources; public infrastructure and support systems; land use and development; agricultural crops, livestock, and livelihoods; insurance, municipal bonds, and County tax revenue.

ComEd Community of the Future Metrics

Greene Economics and Laisar Management Consulting are assisting ComEd/Exelon in evaluating the success of Community of the Future projects by creating a meaningful set of metrics to measure progress toward development of smart grid and advanced community energy technologies. Greene Economics is working with community stakeholders to establish the concepts most important to the Community of the Future programs. The research team is formalizing metrics that will ensure the initiative is on target to reach the desired goals. The work will culminate in application of the metrics to Community of the Future projects through 2021. All of the information including the evaluation will be compiled into one large final report and a shorter whitepaper suitable for publication.

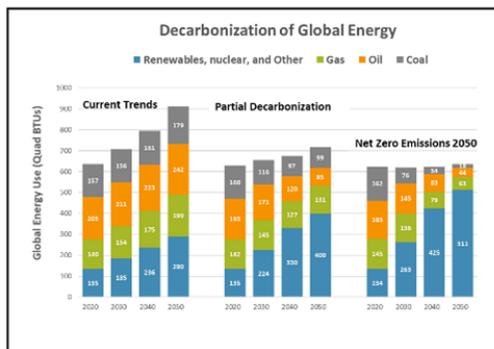


Economic Analysis of Water Infrastructure and Fisheries Habitat Restoration Needs, State of Washington Office of Financial Management – Washington

Greene Economics personnel conducted an analysis for the Washington State Office of Financial Management of the economic implications related to water infrastructure and fisheries habitat restoration needs in Washington, considering changing population, climate, land use, and demand. All of these changing parameters, and specifically climate change, are changing the way agencies and individuals make decisions for funding specific infrastructure projects. Through a review of existing data and literature, in addition to an extensive stakeholder outreach process, the team developed a large database of water infrastructure project costs, both existing and potential, categorized by type and hydrologic unit code water basin which it used to develop a 20-year forecast of investment needs pertaining to water supply, flood protection, stormwater management, and fisheries habitat restoration across the State. From the results of the literature review and stakeholder outreach process, team

economists estimated the effects on the Washington economy as a result of investing and not investing in water infrastructure projects, at the water basin level and by project type. Particular attention was paid to projects resulting in multiple benefits and prioritizing green over traditional grey infrastructure. Using IMPLAN, a regional economic impact assessment was conducted, considering the impact of investment on water dependent sectors, employment, and economic output. The final report was presented to the Washington State Legislature.

Energy Outlook Review Supporting Oil in the Sea IV, National Academies of Sciences, Engineering, and Medicine (NASEM)

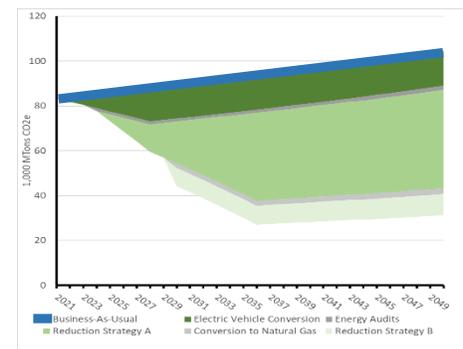


The National Academies of Sciences, Engineering, and Medicine (NASEM) contracted with Greene Economics to conduct a review of the historic and projected future energy trends in support of a new study titled, Oil in the Sea IV: Inputs, Fates, and Effects. Greene Economics reviewed information on the production, consumption, and transportation of fossil fuel hydrocarbons. Projections for hydrocarbon production, consumption, and transportation for the period between 2020 and 2050 were developed under three scenarios: current trends,

partial decarbonization, and full decarbonization. The projections employed energy forecasts from the International Energy Administration (IEA), the Energy Information Administration (EIA), American Bureau of Shipping (ABS) and those developed by Greene Economics. The review assisted the Oil in the Sea IV research committee in understanding the range of potential decarbonization pathways in the future, and therefore better understand and analyze the potential inputs, fates, and effects of marine transportation of hydrocarbons. The results demonstrated that a rapid global effort will be necessary to achieve the goals of Net Zero emissions by 2050.

Decarbonization Plan for a Publicly-Traded, Multinational Firm

Greene Economics is partnering with Keramida to analyze and potential carbon reduction alternatives and develop a decarbonization plan. Greene Economics is creating a model which forecasts total Scope 1 and Scope 2 greenhouse gas (GHG) emissions based on different combinations of carbon mitigation strategies. The mitigation strategies are being developed through a series of interviews with key firm leaders throughout the global operations. The information is being compiled into a user-friendly model with a dashboard where several assumptions in the model can be quickly altered based on a drop-down menu of options. Given the collection of assumptions selected, results will appear in table and figure format so that users can rapidly evaluate their options.



Economic Analysis of Nature-Based Adaptation to Climate Change, Nonprofit Organization – Ventura County, California

Greene Economics worked with Coastal Resilience Ventura to evaluate alternative climate change adaptation strategies. The goal of the project was to analyze all economic costs and benefits of nature-based and engineering-based adaptation alternatives for Ventura County. The approach used changes in the ecosystem service levels for both alternatives, including habitat, recreation, and erosion prevention. The built environment was evaluated for flood and hazard damages, including damages to public infrastructure. The team is working closely with stakeholders representing city governments, state agencies, emergency managers, and the U.S. Navy.

Economic Impact of Renewable Energy, Renewable Northwest – Oregon, Washington, Idaho, Montana

Greene Economics is providing economic impact studies for Oregon, Washington, Idaho, and Montana states and counties of their existing and proposed renewable energy projects. This included developing a phased approach and methodology for completing the analyses in all four states. The state analyses will be completed first, followed by the specific county analyses for those counties with renewable projects within the county boundaries. The renewable projects include wind, solar, biomass, and geothermal. Using IMPLAN modelling and data, and focusing on employment, income, and output, the direct, indirect and induced economic impacts are assessed for each of the project types, as well as the sum of the projects. Simple 2-page State and county summaries will be developed for the client, with the expectation that they likely will be provided to each state's legislature by the client in support of state legislation.

Effect of Policy Tools for Encouraging Electric Vehicle Adoption, and Electric Truck Purchases Based on Incentives - California

Greene Economics analyzed the appropriate level of subsidy needed to expedite the adoption of electric vehicles (EVs) as a mitigation measure for a new development (Newhall Ranch) in Santa Clarita, California. Based on the literature review, and the latest EV adoption data for the region, Greene Economics created a forecasting model for the impact of different policy tools on EV adoption. The analysis was used in discussions with the California Air Resources Board (CARB) to create adequate mitigation credits. In another effort, Greene analyzed the adoption of electric trucks, which is influenced by several factors including the cost of ownership and operation, battery ranges, longevity of trucks, concerns about access to charging infrastructure, government regulation, as well as environmental awareness and social perceptions. Greene Economics developed a model to show how incentives, such as financial purchase subsidies and charging infrastructure, are expected to accelerate the conversion to ETs in commercial fleets in southern California. The analysis was used in negotiations with the CARB surrounding potential GHG mitigation for proposed construction and operation of the World Logistics Center in Moreno Valley, California.



Cap and Trade Allowance Determination, Confidential Client – San Bernardino County, California

Greene Economics assisted a client in providing the California Air Resources Board with information so that the confidential client could be included in the California Cap and Trade regulations. Since the client represented a new industrial sector not included in the original regulatory process, CARB requested that the client provide information about the appropriate level of free allowances to be allocated to the firm for the Cap and Trade program. Specifically, the Greene Economics economists assisted the client in determining the appropriate leakage class and benchmark factor, given that the new industrial sector represented an Emissions Intensive Trade Exposed (EITE) sector.

Sustainability Reporting, The Manilla Electric Company (Meralco) – The Philippines

Greene Economics is currently part of a team assisting the largest electric utility in the Philippines, Meralco, in complying with sustainability reporting requirements consistent with Sustainability Accounting Standard Board (SASB), Global Reporting Initiative (GRI), UN Sustainable Development Goals (SDG), and Task Force for Climate-Related Financial Disclosures (TCFD) guidance documents for reporting of Environmental, Social, and Governance disclosures. Specifically, Greene serves as the lead energy economics expert and conducted a climate scenario analysis (CSA), which includes an interactive tool allowing the user to explore how impacts will change given a range of different climate physical and policy-linked developments. As part of this effort, the team selected appropriate metrics to be included and measured in the CSA and in the TCFD reporting.

Regulatory Analysis of Used Oil Processing and Re-refining in California

Greene Economics analyzed the used oil markets in California and the impact California Senate Bill 546 (SB 546) will have on the current market structure. Greene Economics reviewed the different end products for used oil, the unit costs and revenues for each end market, and impacts on overall regulatory funds from changes in fees and incentives for used oil collection and processing. Greene Economics examined which elements of SB 546 would improve waste diversion, collection and ultimate end use of used oil. In addition, Greene Economics examined the environmental impact of used oil and the role re-refining serves in reducing that impact on air quality and energy consumption. Estimates of benefits from reduced greenhouse gas emissions and energy savings were developed for re-refined used oil. Furthermore, estimates for resource efficiency were developed to demonstrate the opportunity of re-using a non-renewable resource. Resource efficiency was presented in the form of additional market value of re-refined products generated from a single barrel of virgin crude oil.