

Harnessing Time: Using an Hourly Method to Estimate the GHG Impacts of Decarbonization Projects

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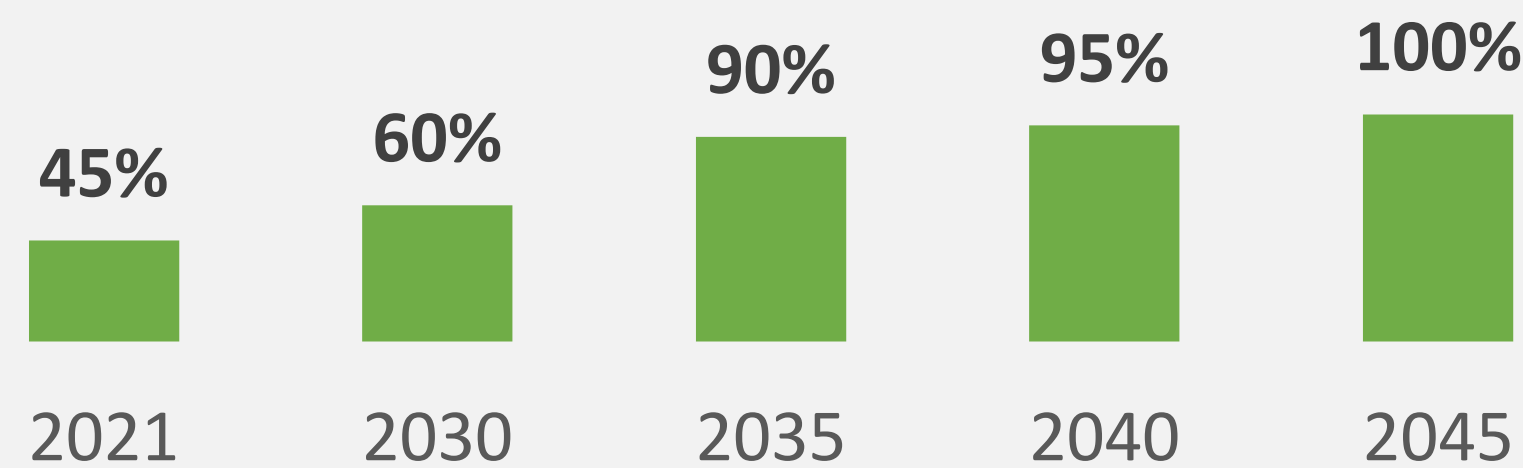


Introduction

Senate Bill 100 (2018) set a renewable goal of 60 percent renewables by 2030 and a longer-term goal of serving 100 percent of California's retail sales and state loads with RPS-certified renewable and zero-carbon energy by 2045.

Renewable Energy Growth in California

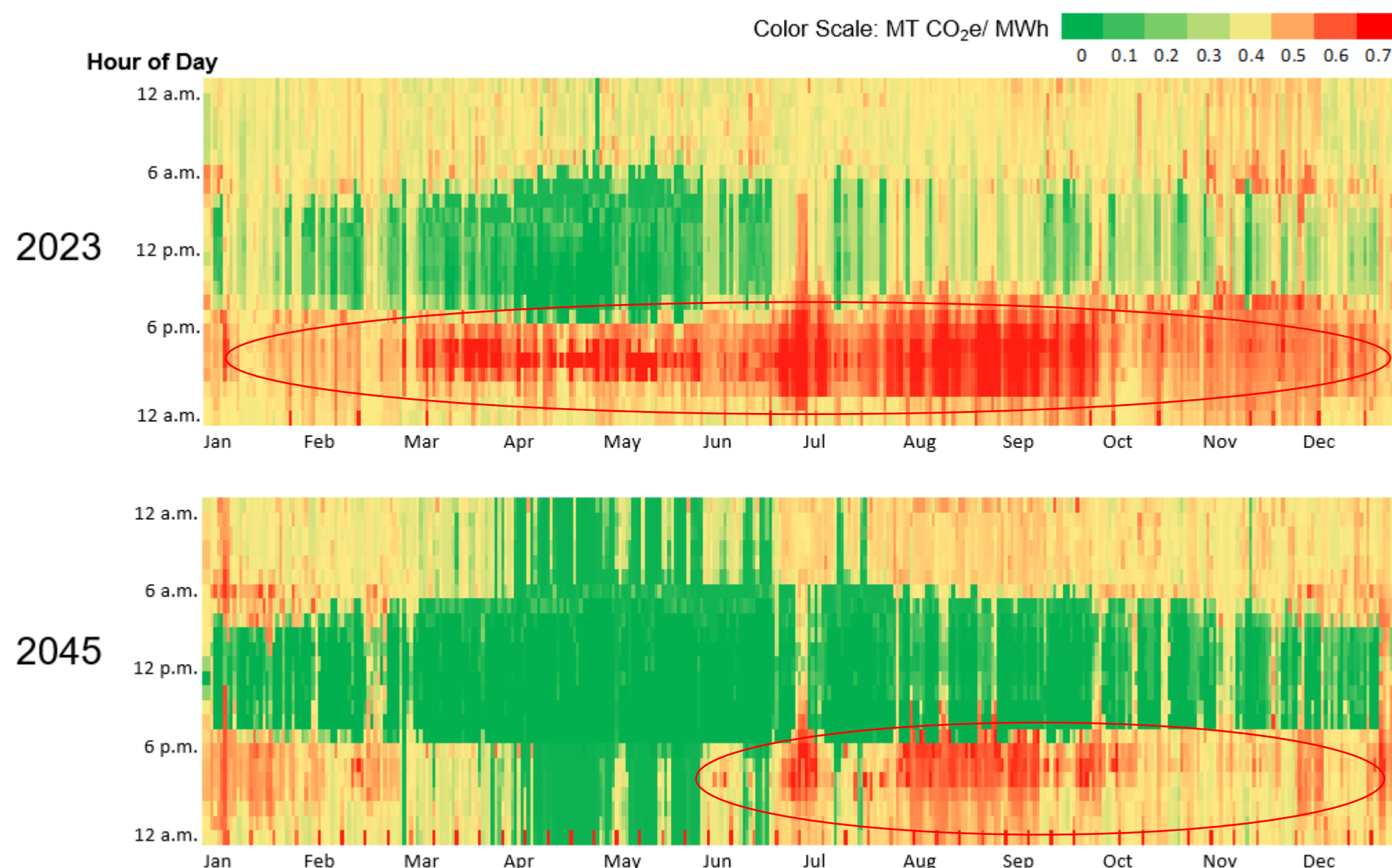
Percentage of California electricity from solar, wind, biomass, geothermal, and small hydroelectric projects



Source: California Energy Commission

Challenge

- **100% Renewable Does Not Mean 100% Carbon-Free**
 - Continued reliance on natural gas (peak hours)
 - Especially during summer evenings
- **Limitations of Using Annual Average Emission Rates**
 - Assumes zero carbon emissions
 - Underestimates or overestimates GHG impacts



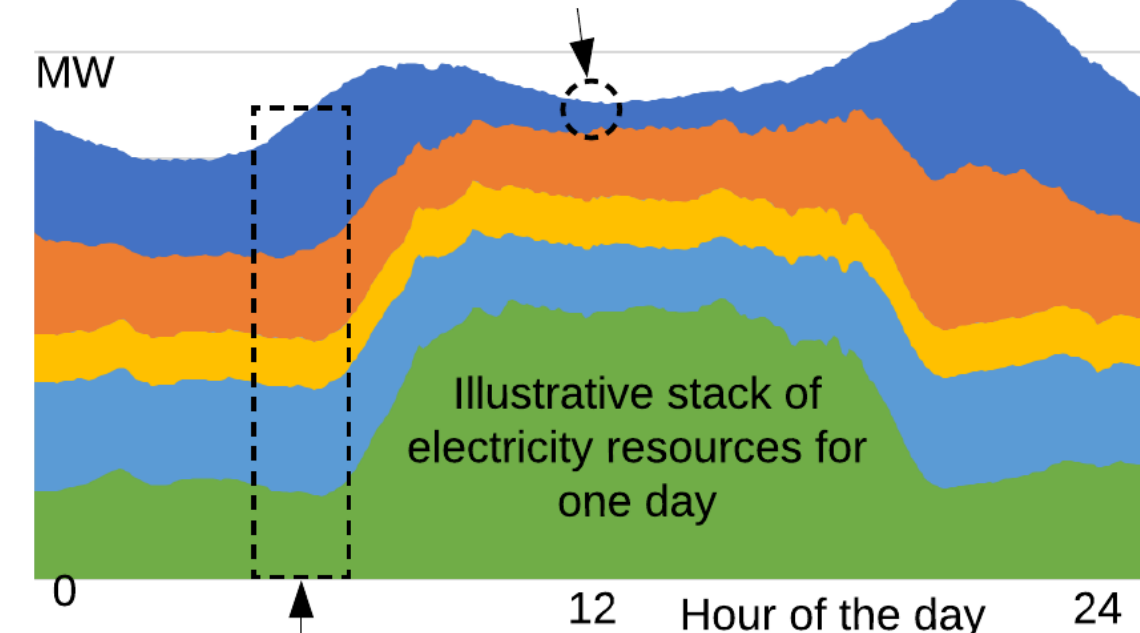
Short-Run Hourly Marginal Emissions Rates, Source: 2021 CPUC Avoided Cost Calculator

Hourly Emission Rates

- **Annual Average Emission Rates**
 - Represent the total emissions divided by the total associated electricity.
- **Hourly Short-Run Marginal Emission Rates**
 - The emissions rate of the last resource dispatched
 - Consider emissions from a fixed electricity system
- **Hourly Long-Run Marginal Emission Rates**
 - The emissions rate of the last resource dispatched
 - Consider structural changes due to actors in the grid

C Hourly Marginal Emission Rate

GHG emissions from the resource to supply the last unit of demand in a given hour.



A Average Emission Rate

Average GHG emissions based on electricity supply sources in a day, month, year. In this chart, the average emissions would represent average emissions for a full day.

B Hourly Average Emission Rate

Average of GHG emissions from all resources supplying electricity in a given hour.

Impact of Emissions Rates on GHG Estimates

Project Type/ Emission Rates	Fossil Fuel Baseline		Grid Electricity Baseline
	Replace Natural Gas Water Heater with an Electric Heat Pump	Replace Gasoline Vehicle with an Electric Vehicle	Rooftop Solar Production Reduces Electricity Use from the Grid
Annual Average Emission Rate (AAER)	Overestimate GHG Impacts		Underestimates GHG Impacts
Hourly Short-Run Marginal Emission Rate (SRMER)	Underestimates GHG impacts		Overestimates GHG Impacts

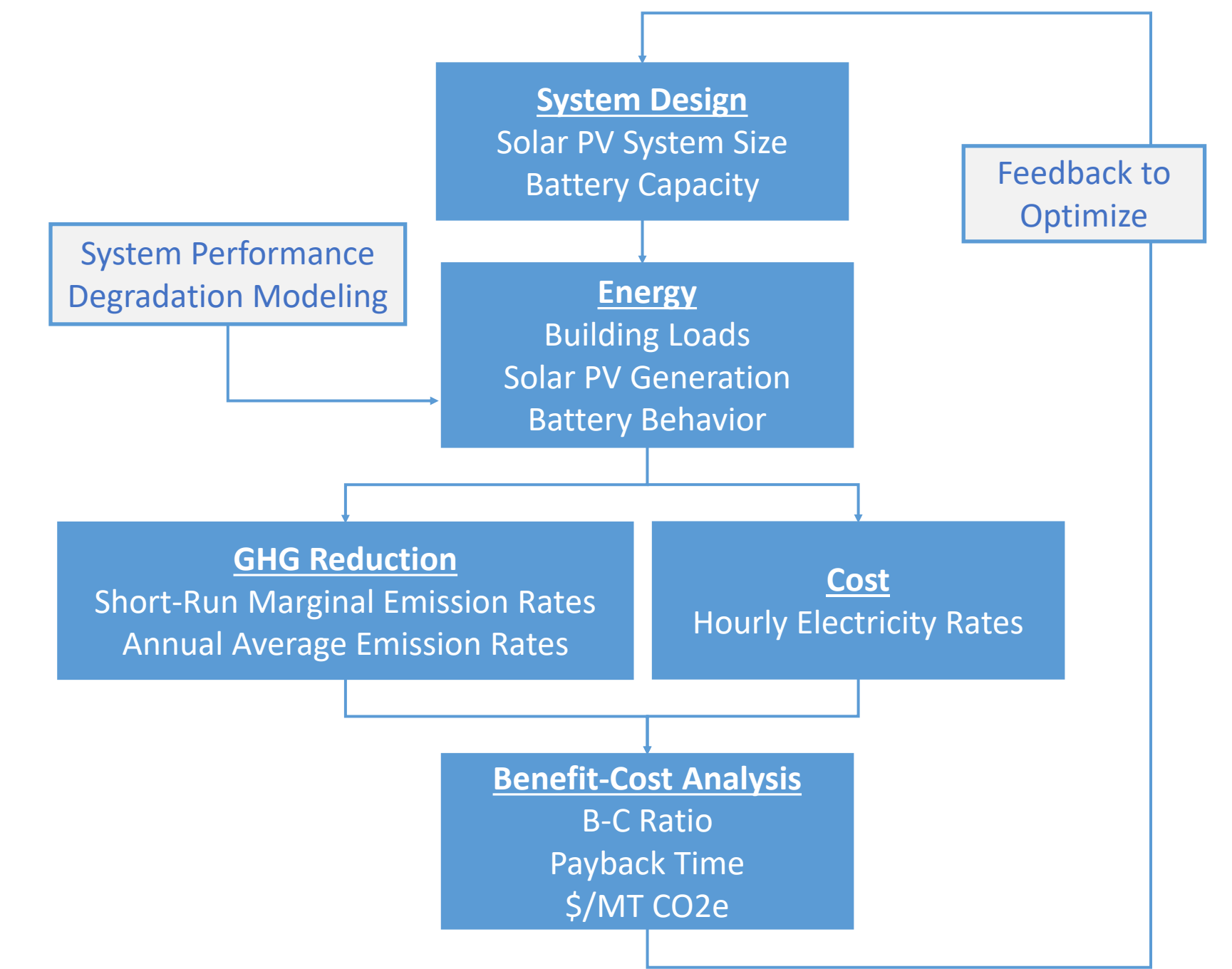
Acknowledgment |

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The Energy Policy Initiatives Center (EPIC) is a non-profit research center of the University of San Diego School of Law that studies energy policy issues affecting California and the San Diego region. For more information on the greenhouse gas analysis and climate action planning work we do, please visit www.sandiego.edu/epic.

Case Study: High School PV & Battery

Method



Results

- Using an annual average emission rate likely underestimates GHG reductions
- It is not possible to estimate the impact of battery storage using an annual average emission rate.

