

The Effects of Regulatory and Utility Policy on the Lifecycle Valuation of Solar PV

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Objective

Analyze the impact of utility policies on the Life Cycle Cost of Energy (LCOE) for Solar PV generation through a comprehensive scenario analysis.

Scenario Analysis

- Examines implications of multiple possible system states
- Multi-Variable Sensitivity Analysis
- Apply Scenario Analysis to Different Combinations of Utility and Regulatory Policies

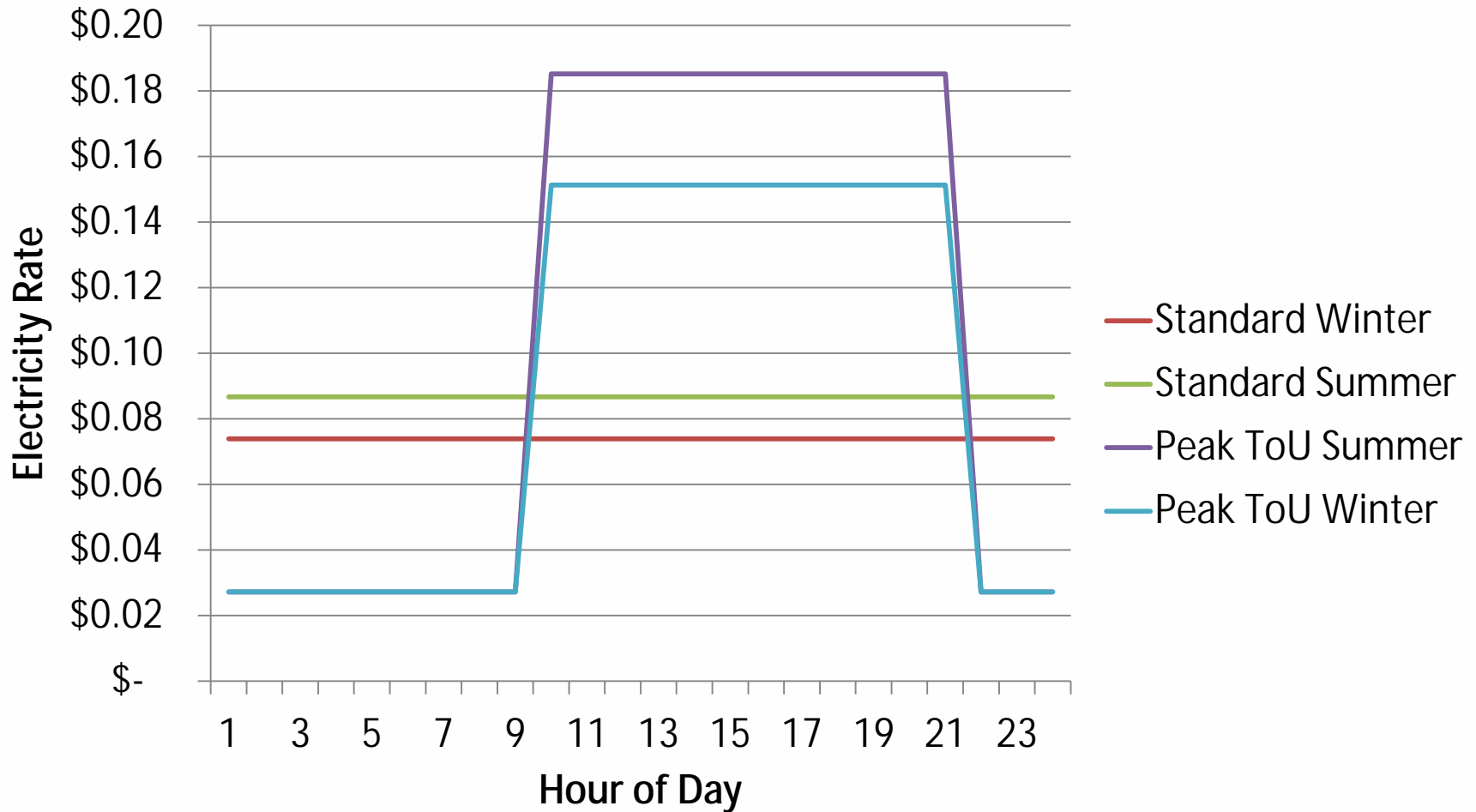
Policies Analyzed

- Residential Renewable Energy Tax Credit
- Feed-In Tariff Surcharge
- Value of Solar Tariffs
- Peak Time of Use Rate Schedules
- SuperPeak Time of Use Rate Schedules

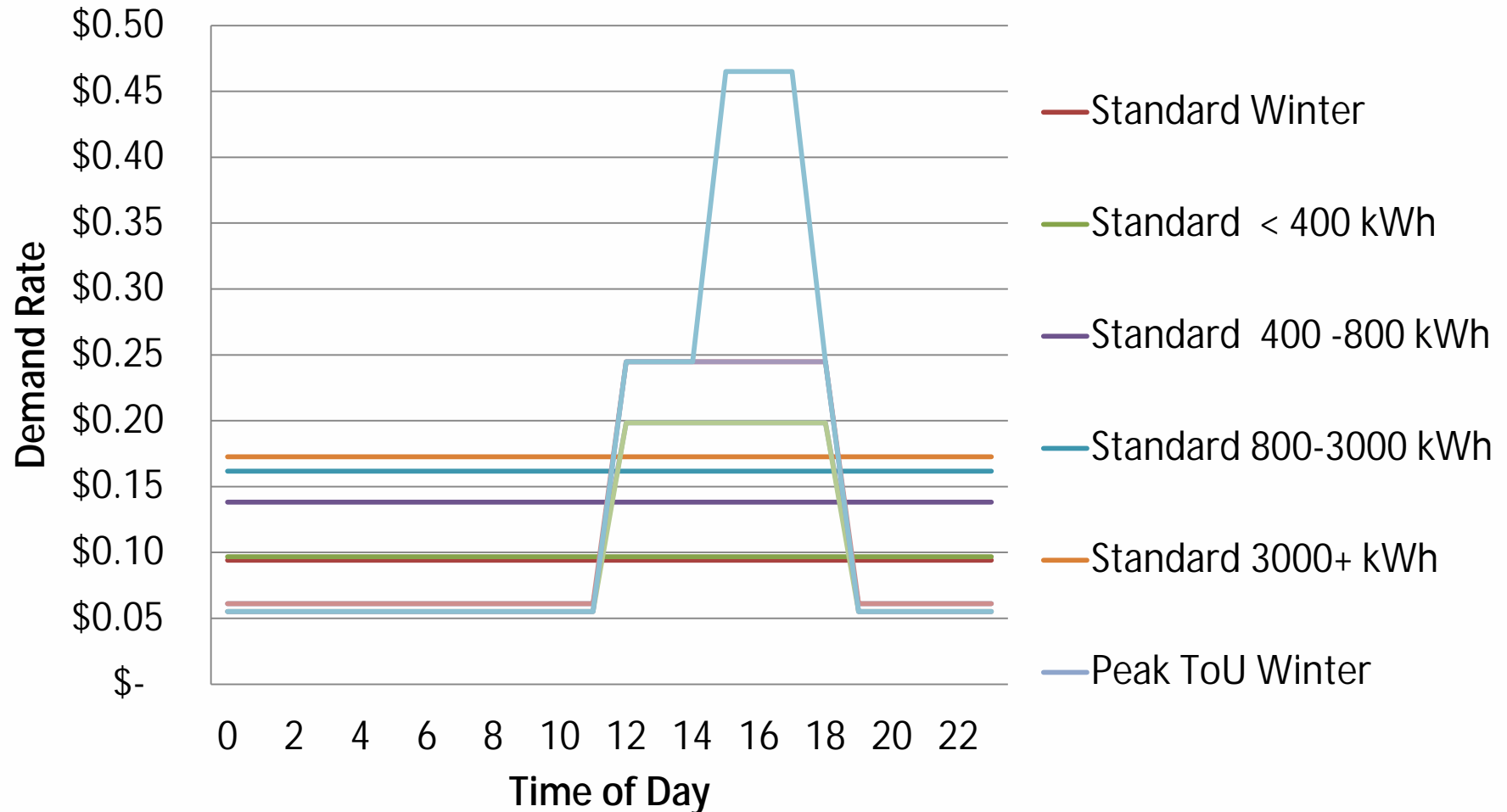
Residential Renewable Energy Tax Credit

- **Federal Tax Credit**
 - Created by the Energy Policy Act of 2005
 - 30% of the total installed cost of renewable energy projects
 - Applicable to Solar PV, Solar Thermal, Fuel Cells
 - Set to Expire December 31st, 2016

Minnesota Rate Schedules



Arizona Rate Schedules



Arizona FIT Surcharge

- **Feed-In Tariff Surcharge**
 - Allows for the sale of electricity to the utility by residential and commercial consumers
 - Charge implemented by utility to recover financial impacts of solar
 - Set at \$0.70 per kW of Installed AC Capacity
 - Applicable to New Installations

Minnesota Value of Solar Tariff

- Proposed Methodology to Quantify the Benefits of Distributed Solar Generation
- Locked-In Contract
- Typically Used for Large Scale Installations
- Replaces Net Metering

Solar Generation Data

- **PVWatts Hourly Generation Data**
 - Phoenix, AZ
 - Minneapolis, MN
- **Model 5 kW DV Roof Mounted Unit**
 - Installed Cost at \$3.3 / Watt
- **Based on National Solar Radiation Database (NSRDB)**
- **Modeled Solar Irradiance Data (TMY2)**

Electricity Demand Data

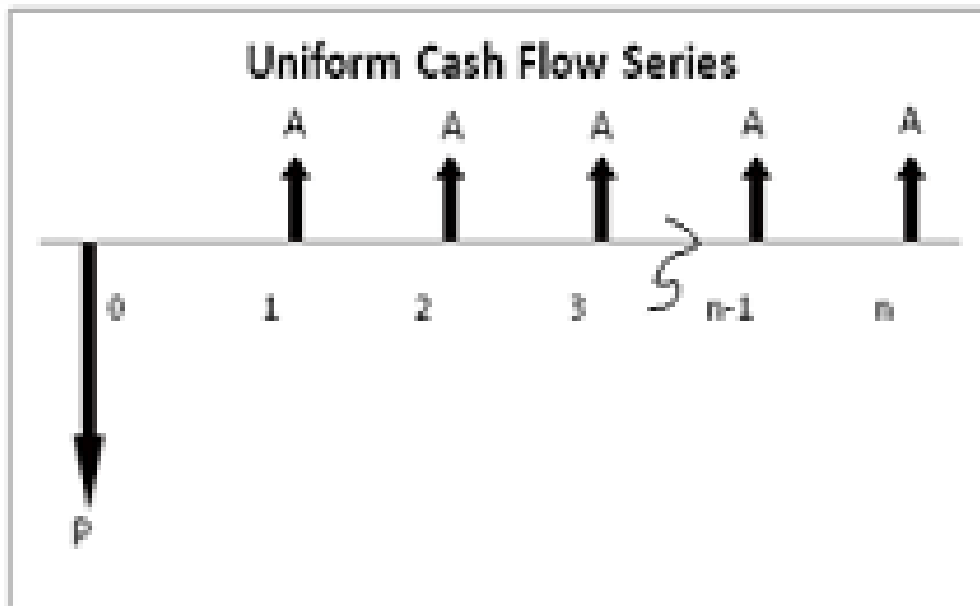
- **Based on Building America House Simulation Protocols**
 - NREL project to model demand using geographic and meteorological data
 - General model of appliance, HVAC, and lighting usage

Robert Hendron and Cheryn Engebrecht, "Building America House Simulation Protocols," 2010.

Engineering Economics

- Determine the overall economic viability or worth of engineering projects
- Based on manipulation of the Time Value of Money (TVOM)
- TVOM can be represented by several variables
 - Rate of Return (RoR)
 - Weighted Average Cost of Capital (WACC)
 - Any Applicable Interest Rate

Annualized Worth



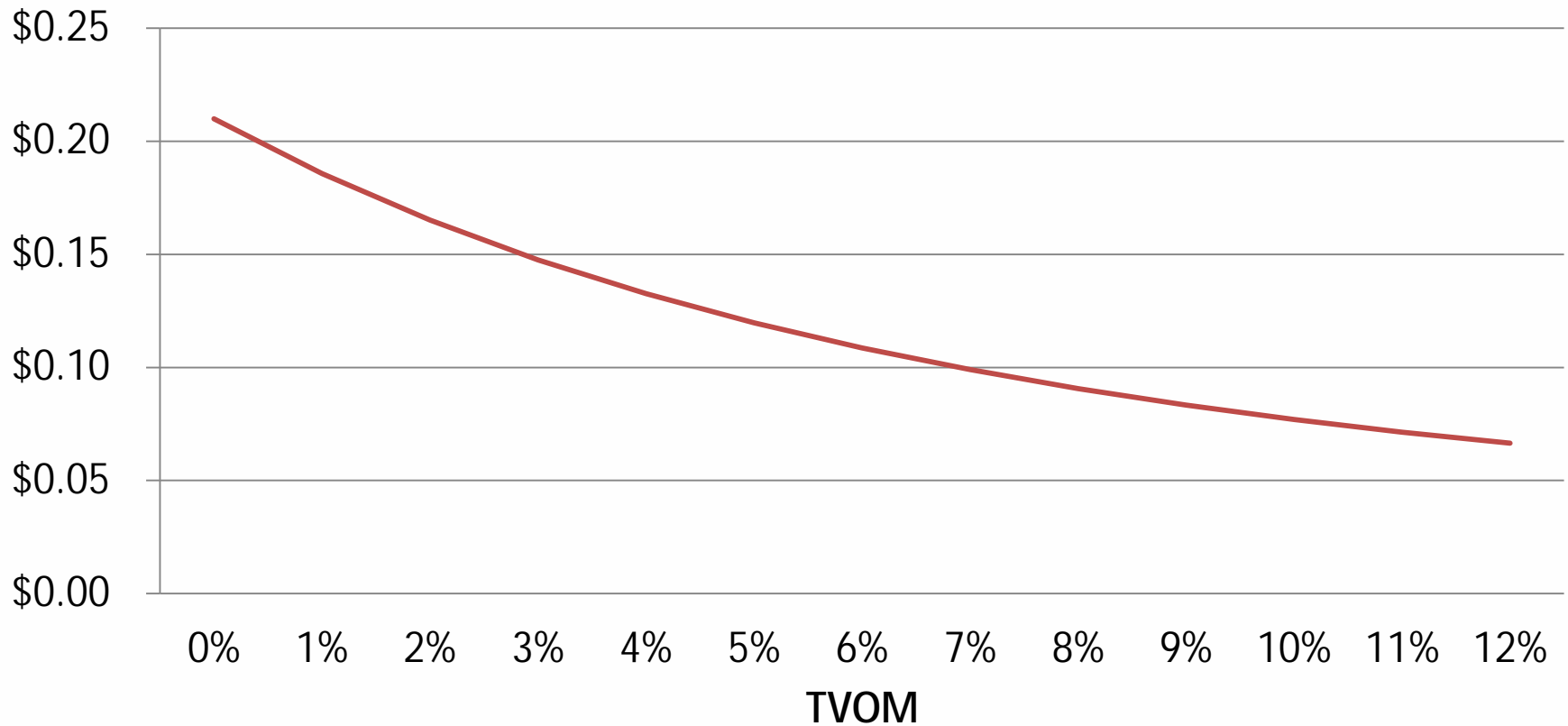
$$A = P \frac{i(1+i)^n}{(1+i)^n - 1}$$

Arizona Annual Costs

	Rate Schedule	Without Solar	With Solar	With STC, No ITC	Cost of Solar with ITC	Cost of Solar with ITC and STC
Before Surcharge	Standard	\$1,487.23	\$1,615.46	\$1,064.74	\$906.74	\$866.74
	ToU (Peak)	\$1,774.47	\$1,514.59	\$963.88	\$805.88	\$765.88
	ToU (SuperPeak)	\$1,946.86	\$1,683.77	\$1,133.06	\$975.06	\$935.06
After Surcharge	Standard	\$1,487.23	\$1,657.46	\$1,106.74	\$948.74	\$908.74
	ToU (Peak)	\$1,774.47	\$1,556.59	\$1,005.88	\$847.88	\$807.88
	ToU (SuperPeak)	\$1,946.86	\$1,725.77	\$1,175.06	\$1,017.06	\$977.06

Arizona FIT Surcharge

Present Value of Surcharge per Watt

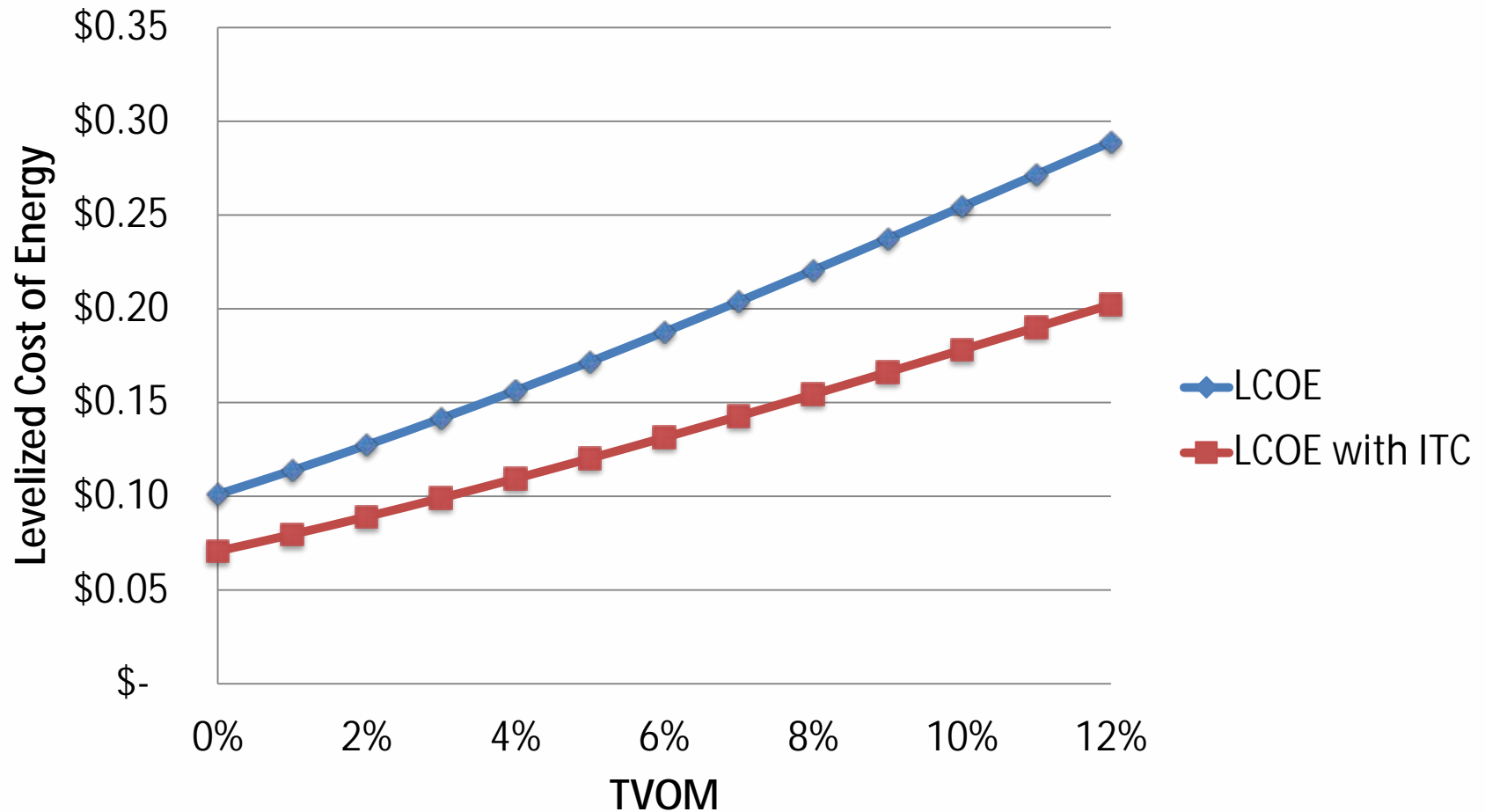


Levelized Cost of Energy

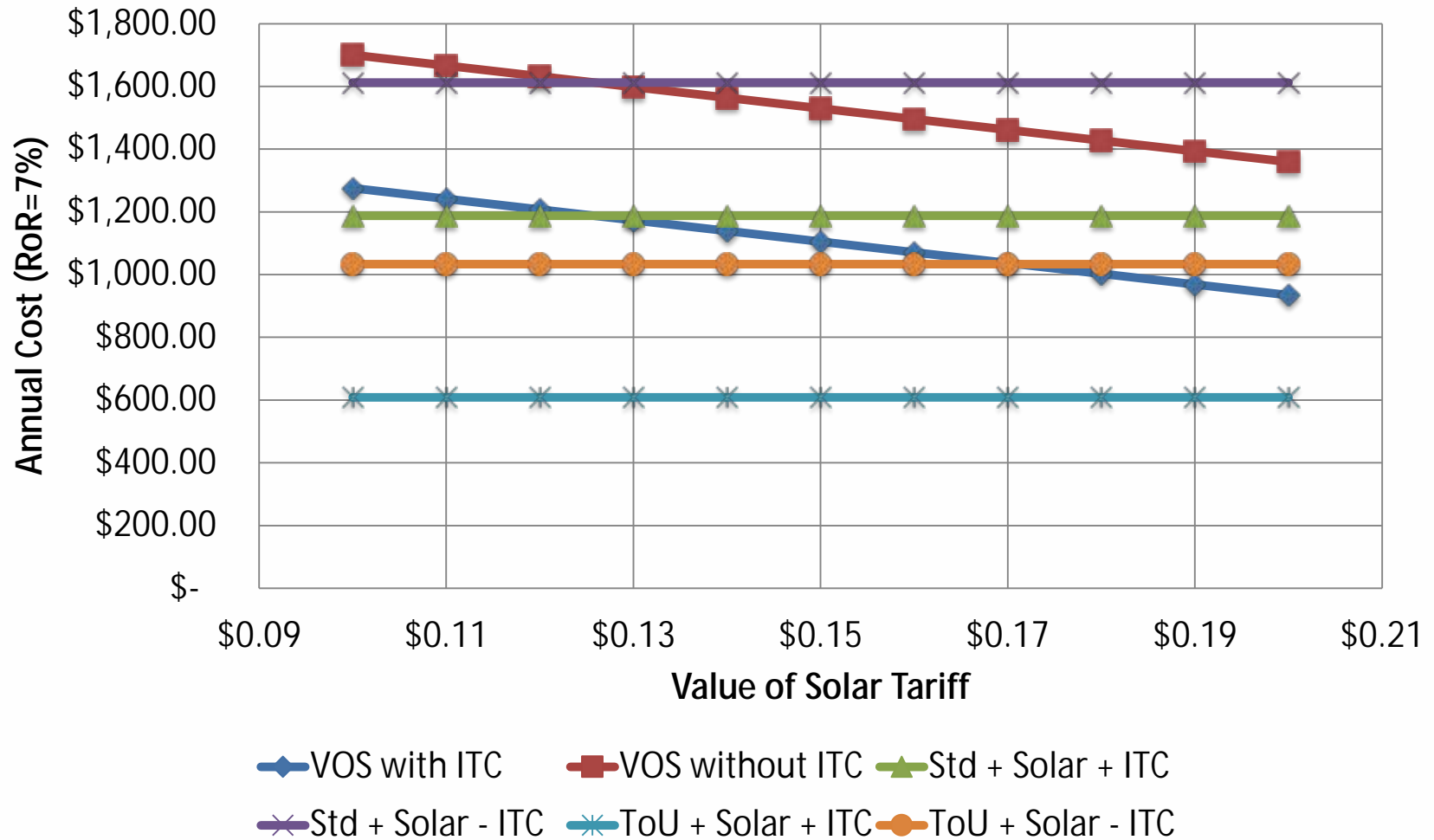
- Determines the lifetime equivalent cost of energy
- Includes Capital, Fuel, and Operational Expenses
- Discounts cash flows and energy generated to a common time frame for comparison

$$\text{LCOE} = \frac{\sum_{n=1}^t \left(\frac{C}{(1+r)^n} \right)}{\sum_{n=1}^t \left(\frac{E}{(1+r)^n} \right)}$$

Baseline LCOE @ Minneapolis



Minnesota Solar Valuation



Conclusions

- Feed-In Tariff Surcharge can increase the Present Value of Solar Costs by up to \$0.21/W
- Value of Solar Tariffs may be more appropriate for solar power providers
- Time of Use Rates are the most advantageous policy to Solar PV Viability
- LCOE is not always the best economic measure
- Applicable Retail Rider + Premium