2015 Shared Solar Economic Value Proposition

May 2016

Agenda

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Executive Summary

- The stated goal of Task 5.1 was to collect shared solar investment data from local projects, and analyze the value proposition to stakeholders, aggregating and modeling the project costs (investment) and ongoing costs/benefits (revenue/savings) by ownership and business model.

- Task 5.1 was undertaken by first identifying the stakeholders impacted by community solar, and then determining the cost and benefit streams to each party.
  - > For this deliverable, the stakeholders analyzed included subscribers and system owners.
  - > Utility stakeholder costs and benefits were investigated, but due to complexities with Commonwealth Edison being a wires-only company, typical costs and benefits cited in literature and recognized in other shared solar projects do not apply. The discussion of utility costs and benefits will be further investigated during the next phase of this project.

- Since data did not exist for local community solar projects, an economic model was built to determine the solar value for a hypothetical system owner and subscriber in Cook County. Data for this hypothetical system was vetted with the National Renewable Energy Laboratory, GTM Research, the National Community Solar Partnership, and a working group of regional stakeholders. Because no definitive experience exists in Cook County for these costs, a consensus among stakeholders on all input values was not achieved. A base case and sensitivity parameters were defined from these discussions and shown in the model here.

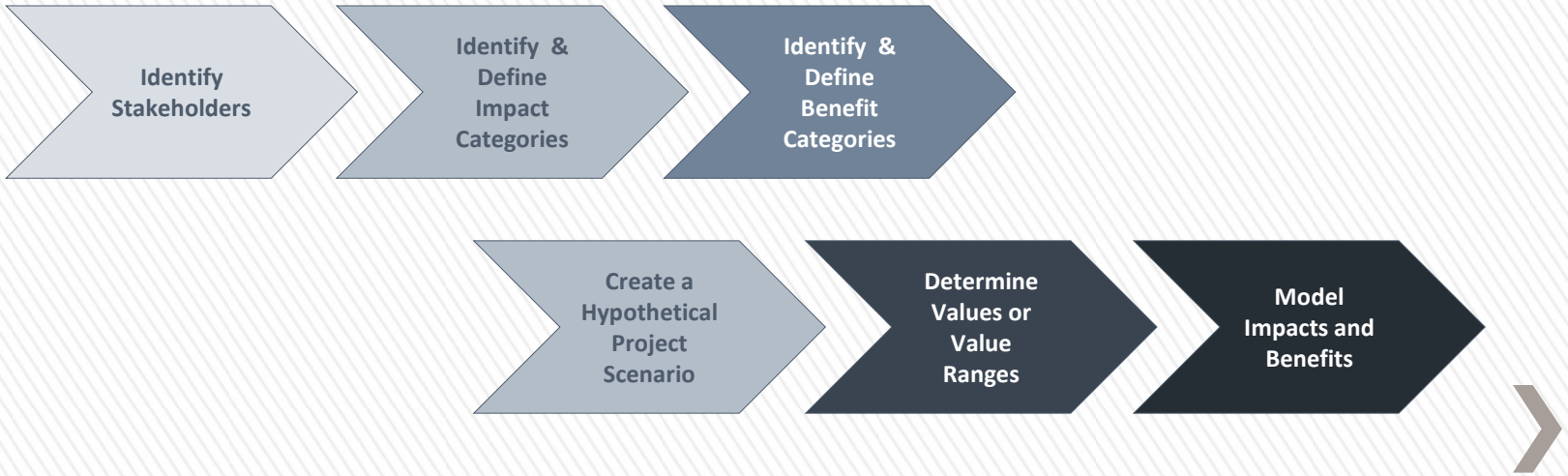
Executive Summary (Continued)

- The model results indicate a positive business case for community solar can exist, provided that certain key conditions are met, including:
  - > System owners have tax appetites or can make arrangements to sell those tax credits,
  - > Solar Renewable Energy Credits (RECs) are available to system owners at or near the latest procurement price over the next 5-years,
  - > Costs associated with bill crediting are minimized.

- For subsequent analysis of utility benefits and costs, further study is proposed as part of the Local Impacts Assessment model being developed beginning in Q3 2016 in the following areas:
  - > Bill crediting mechanism beyond pilot programs,
  - > Quantification of grid benefits,
  - > Applicable credit rate for commercial and industrial participants in community shared solar programs,
  - > Alternative rate structures to reflect conditions wherein subscribers would receive credits for purchasing electricity from community solar projects.

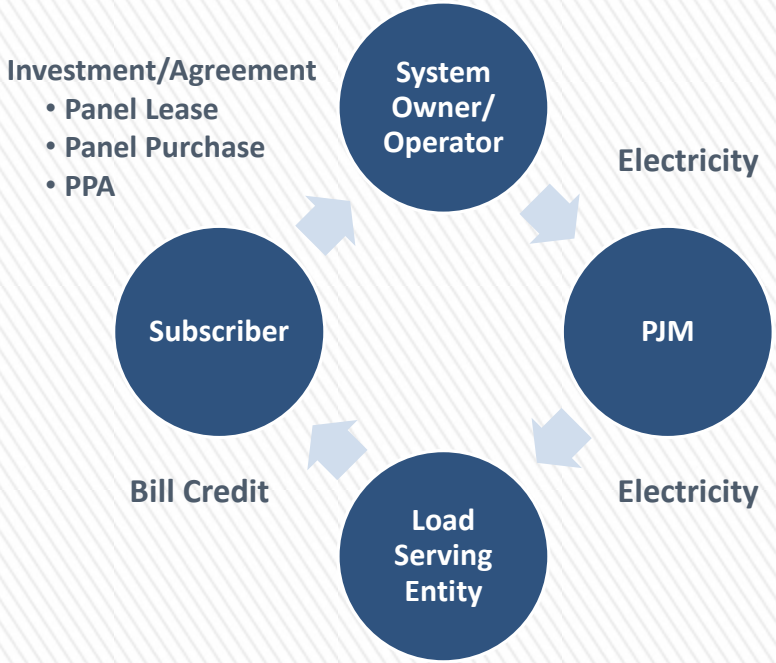
Task 5.1 Value Proposition Objectives

- The goal of Task 5.1 is to collect shared solar investment data from local projects, and analyze the value proposition to stakeholders, aggregating and modeling the project costs (investment) and ongoing costs/benefits (revenue/savings) by ownership and business model
- Impacts and benefits of community shared solar were identified for different stakeholders, primarily system owners, subscribers and the local utility. As indicated, the Utility value proposition was deferred due to complexities in representing the benefits and costs for a wires-only utility (ComEd)
- Because Cook County has yet no example of community shared solar implemented, cost and benefit data was analyzed for a hypothetical shared solar system



Value Proposition: Stakeholder Overview

- Community solar expands access to solar power to previously untapped market segments: renters, those with unsuitable roof space, and households facing financial barriers to rooftop installation
- Many possible configurations and accompanying business models exist for community shared solar. In the simplest form, the community solar model involves a system owner, electric utility (if not the system owner), and subscribers
- Cook County presents a unique scenario because Commonwealth Edison, the local transmission and distribution utility, delivers electricity to local residents, but is not responsible for electricity generation. The system owner is generating electricity that is wheeled to PJM:



System Owner Value Proposition

- Community solar system owners can take the form of many entities, but they are typically responsible for operation of the array and managing subscriber participation, from acquiring subscribers to handling customer service. The system owner receives payment from subscribers, either upfront or over time, depending on the subscription model

- Costs for the system owner include costs of installing the physical system, consisting of system hardware, engineering and installation labor, as well as permitting and interconnection. They will also be responsible for site preparation, ongoing system operation and maintenance (O&M), as well as customer acquisition and customer service

- In addition to subscriber payments, system owners are often eligible for state and federal incentives. Entities without tax appetites, such as nonprofit organizations, government bodies, and regulated utilities, are typically unable to take advantage of federal tax credits without partnering with a tax equity investor
  - > Federal Investment Tax Credit (ITC)[1]: the ITC allows commercial, industrial, and utility owners of photovoltaic (PV) systems to take a one-time tax credit equivalent to 30% of qualified installed costs
  - > Modified Accelerated Cost Recovery System (MACRS) [1]: In addition to grants and tax credits, federal tax policy allows businesses to depreciate their investments in solar projects on an accelerated basis. For projects taking the ITC, the depreciable basis must be reduced by half the value of the ITC
  - > Solar Renewable Energy Credits (SRECs) [1]: A REC represents the collective environmental benefits as a result of generating renewable energy. In most cases, RECs are sold on a per MWh basis

[1]Definitions from NREL's "A Guide to Community Solar: Utility. Private, and Non-profit Project Development"

Subscriber Value Proposition

- Subscribers participating in a community shared solar program receive credits on their electricity bill for energy that is generated from their portion of the solar array

- Several models exist for customer participation
  - > Panel Purchase: Customers pay an upfront fee for all of the future generation from a panel and receive bill credits for the electricity generated. While not modeled herein, customer can finance these panel purchases, lessening the upfront burden but increasing overall costs
  - > Panel Lease: Customers pay an ongoing fee for all of the future generation from a panel and receive bill credits for the electricity generated. Due to the fact that panel generation decreases over time (derate), the quantity generated and bill credit also decline
  - > Power Subscription: Customers subscribe to receive a fixed generation (kWh) quantity per month and receive a credit on their bills for that amount

- While bill crediting is the primary benefit stream for subscribers, in some instances the Panel Purchase method allows subscribers to take advantage of state incentives and federal tax incentives
  - > Federal Investment Tax Credit (ITC) incentive
  - > Modified Accelerated Cost Recovery System (MACRS) tax incentive
  - > Solar Renewable Energy Credits (SRECs)

- Other local financial incentives, such as state or utility incentives, may also be available to encourage customer participation in shared solar programs. State incentives are no longer available in Illinois

Task 5.1 Scope

- While the costs and benefit categories for the subscriber, system owner, and utility have been researched as part of this assessment, the financial assessment has focused on the benefit streams between the subscriber and the system owner

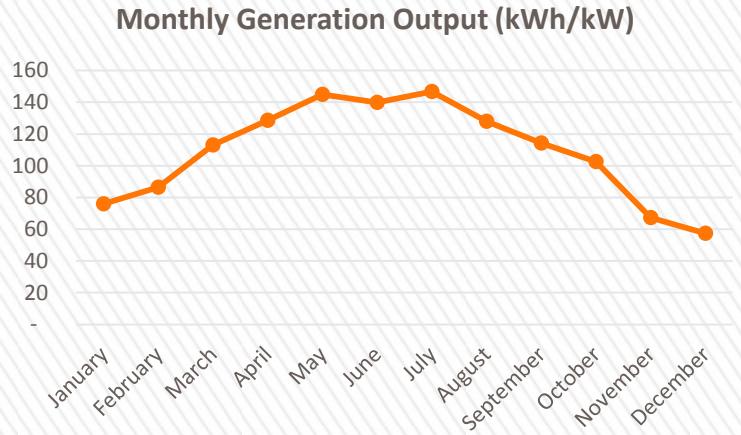
- A number of uncertainties revolve around utility interaction with community shared solar that would limit the value of creating a financial model in the context of this single project Value Proposition:
  - > Significant grid benefits are not expected to be realized from a single system, but a higher market saturation of community solar may produce measurable benefits. Additionally, assigning a year to when utility benefits are recognized also presents a significant challenge in financial modeling. Some accrue over time, while others will be recognized at a single point in time and possibly years after system has been built.
  - > Decisions have not yet been made regarding how bill crediting will be performed for a large-scale deployment of community solar, so a single project may incur a greater portion of the burden in this analysis.
  - > Currently, investor-owned utilities in Illinois such as ComEd are allowed to own generation, but not transact that power into a wholesale or retail market.

- These issues will be further explore in Task 5.2 of this project: Local Impact Assessment

- The financial model was created to demonstrate the anticipated net costs and benefits of community shared solar to a subscriber and third-party system owner.

Key Modeling Assumptions

- The financial assessment was conducted for a single hypothetical system. A number of business-level and system-level assumptions were made in the model
  - > Subscribers are credited at the current residential retail electricity rate of ***$0.1027/kWh***. Electricity generated from the unsubscribed portion of the system was assumed to be sold on the electric market at $40/MWh. The annual energy cost increase was modeled to be 2.78% per year.
  - > The power production in year 1 is assumed to be 1,350 kWh per kW, which decreases at 0.5% annually (see generation curve to right).



  - > For the purposes of this model, it was assumed all subscribers are residential customers.
  - > The average panel size was assumed to be 300 W, and the average subscriber was assumed to lease/purchase/subscribe power from 10 panels.
  - > Total installed PV system cost was measured to be $2.37/Watt[1]
  - > Costs and benefits were measured over a 25-year period.
  - > Bill crediting was assumed to be performed manually. The costs associated with manual bill crediting are described in Task 3.3: Bill Crediting Analysis. However, because these bill crediting costs are absorbed by the utility, the impact was not seen in the System Owner or Subscriber outputs.

[1]For a ground mount system

Key Modeling Assumptions (Continued)

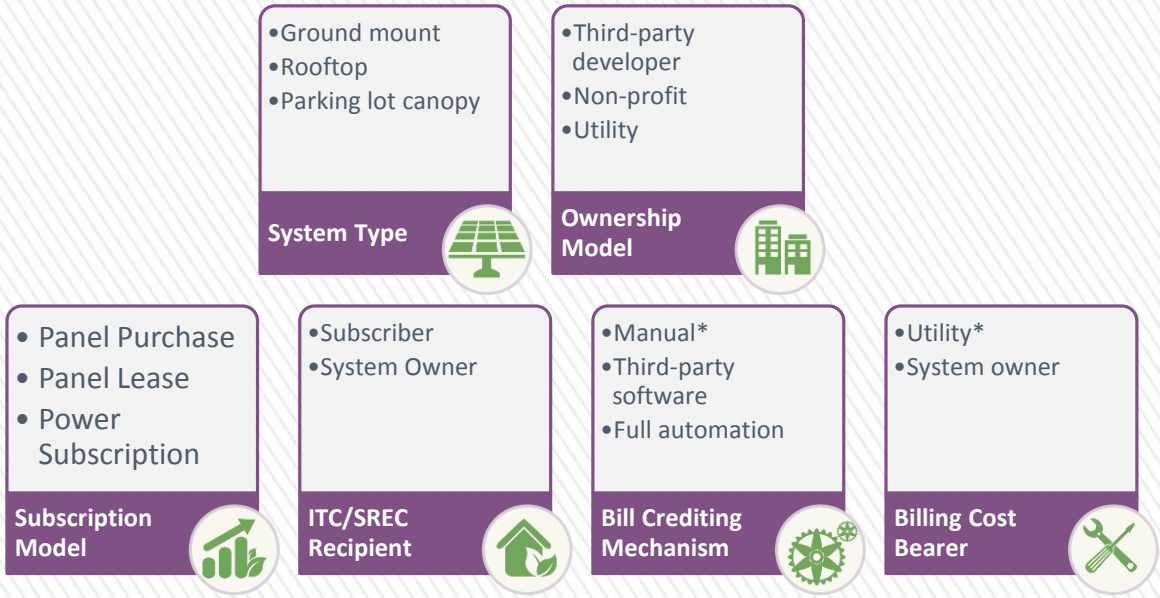
- Model outputs used to assess the financial viability of the project include:
  - **Net Present Value (NPV):** the difference between the present value of cash inflows and the present value of cash outflows. NPV is used to analyze the profitability of a projected investment or project. A positive net present value indicates that the projected earnings generated by a project or investment (in present dollars) exceeds the anticipated costs (also in present dollars). Generally, an investment with a positive NPV will be a profitable one and one with a negative NPV will result in a net loss
  - **Internal Rate of Return (IRR):** a metric used to measure the profitability of potential investments. Internal rate of return is a discount rate that makes the net present value (NPV) of all cash flows from a particular project equal to zero. IRR calculations rely on the same formula as NPV does. Generally speaking, the higher a project's internal rate of return, the more desirable it is to undertake the project
  - **Return on Investment (ROI):** a performance measure used to evaluate the efficiency of an investment. ROI measures the amount of return on an investment relative to the investment's cost. To calculate ROI, the benefit (or return) of an investment is divided by the cost of the investment, and the result is expressed as a percentage or a ratio
  - **Simple Payback Period:** the length of time required to recover the cost of an investment

- Purchase price, lease price, and power subscription are *outputs* based on a specified system owner IRR of 10%. This IRR was assumed based on discussion with regional developers, who indicated this was a target threshold for investing in a project in Cook County.

[1]Definitions from Investopedia

Flexible Model Inputs

- The model includes toggles that can be used to examine how various program components (see below) impact the financial metrics for the system owner and subscriber:



- Additional flexible inputs allow users to enter any value to further examine impacts on these metrics. Flexible inputs include:
  - > System Size
  - > System Subscription Rate
  - > SREC Values
  - > Financial Incentives

A subsequent semi-automated solution is being developed by ComEd and will be ready in the coming months. This will significantly reduce costs from the manual option. Neither option is realized in the model because they only impact the Utility Value Proposition, which was not modelled.

Base Case Model Scenario

- Different scenarios can be analyzed using the model to determine how these inputs impact the financial metrics for each stakeholder group. The model outputs include: Net Present Value.

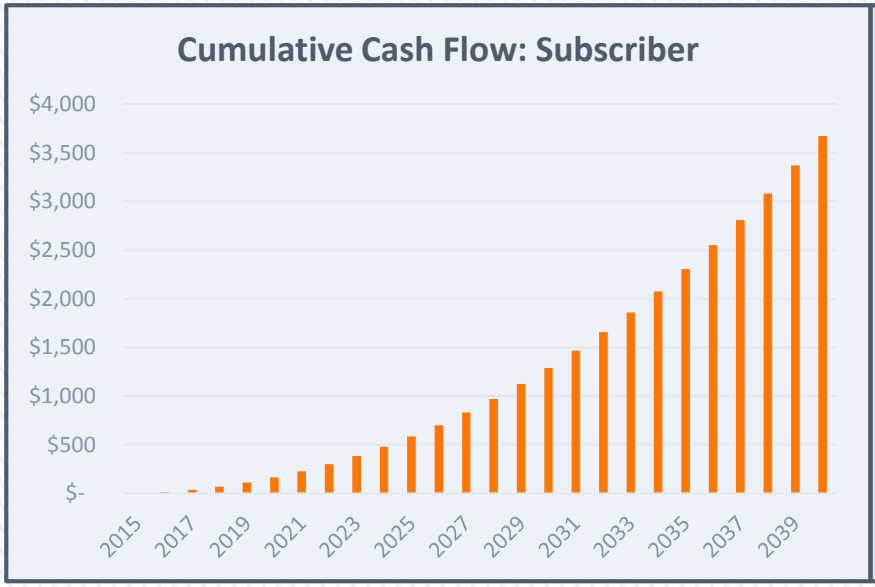
- A "Base Case" configuration was developed through conversations with stakeholders given current business models and practices. To determine the relative impacts of different variables, a sensitivity analysis was run modeling alternative scenarios:

Variable	Base Case	Alternates
System Type:	Ground-mount	Rooftop; canopy
Ownership Model:	Third-party	Non-profit
Subscription Model:	Panel Lease	Panel purchase; PPA
ITC/SREC Recipient:	System Owner	Subscriber
Bill Crediting Mechanism:	Manual	Third-party software; fully automated system
Billing Cost Bearer:	Utility	System owner
System Size:	1,000 kW	500 kW; 2,000 kW
System Subscription Rate:	80%	60%, 100%
SREC Values:	$137.15 for first 5 years	$0; $137.50 first 5 years, $50 after
Financial Incentives:	$0	$1,000/kW
System Owner IRR:	10%	8%, 12%

Base Case Analysis: Subscriber

- Under a leased structure, the subscriber pays less for a panel than they would to purchase electricity, producing a positive trend in cumulative cash flow. In the year 1, the panel lease price is equivalent to $0.1021, compared to the retail electricity rate of $0.1027/kWh

- Savings are expected to be greater in the later years because the price of electricity was modeled to increase at a rate of 2.78% annually, while the panel lease price remains the same and output decreases by just 0.5% annually

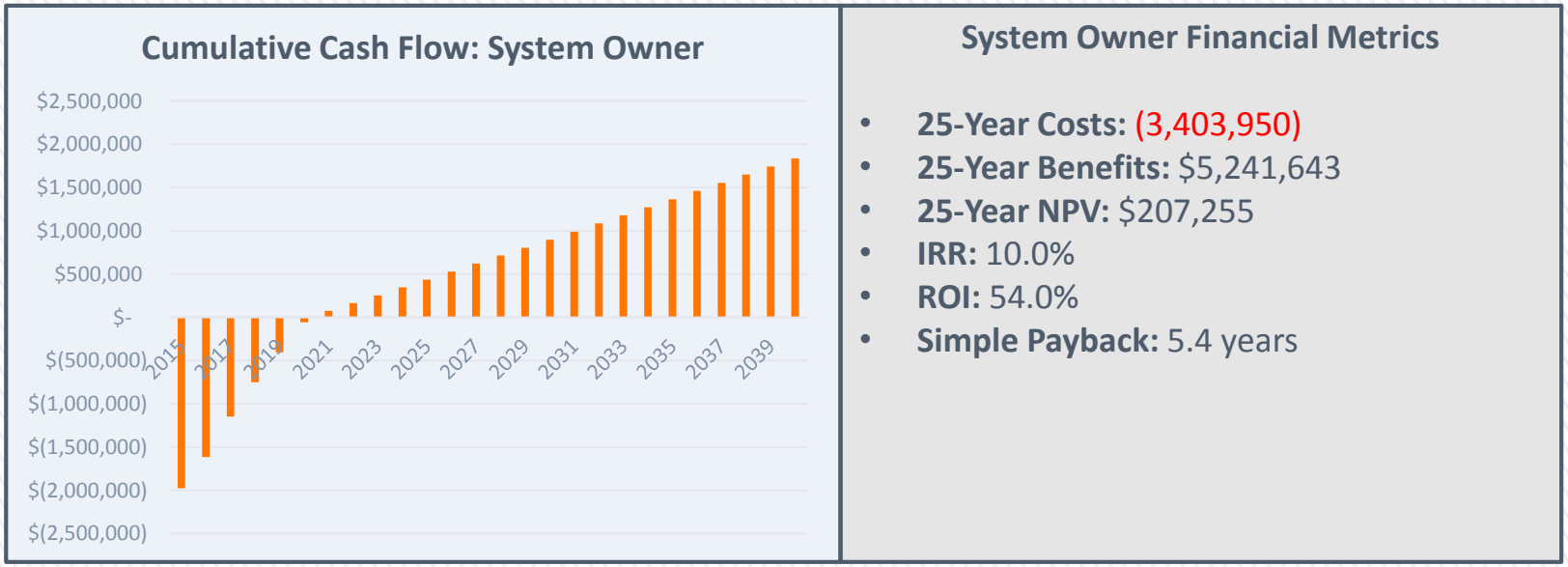


Subscriber Financial Metrics

- **25-Year Costs:** ($9,990)
- **25-Year Benefits:** 13,663
- **25-Year NPV:** $846
- **IRR:** N/A
- **ROI:** 36.8%
- **Simple Payback**: N/A

Base Case Analysis: System Owner

- By setting the system owner IRR to calculate the panel lease price, the system owner has a positive revenue stream over time
- Assuming the system owner takes on no debt to finance the system, the system owner is expected to break even in year 6

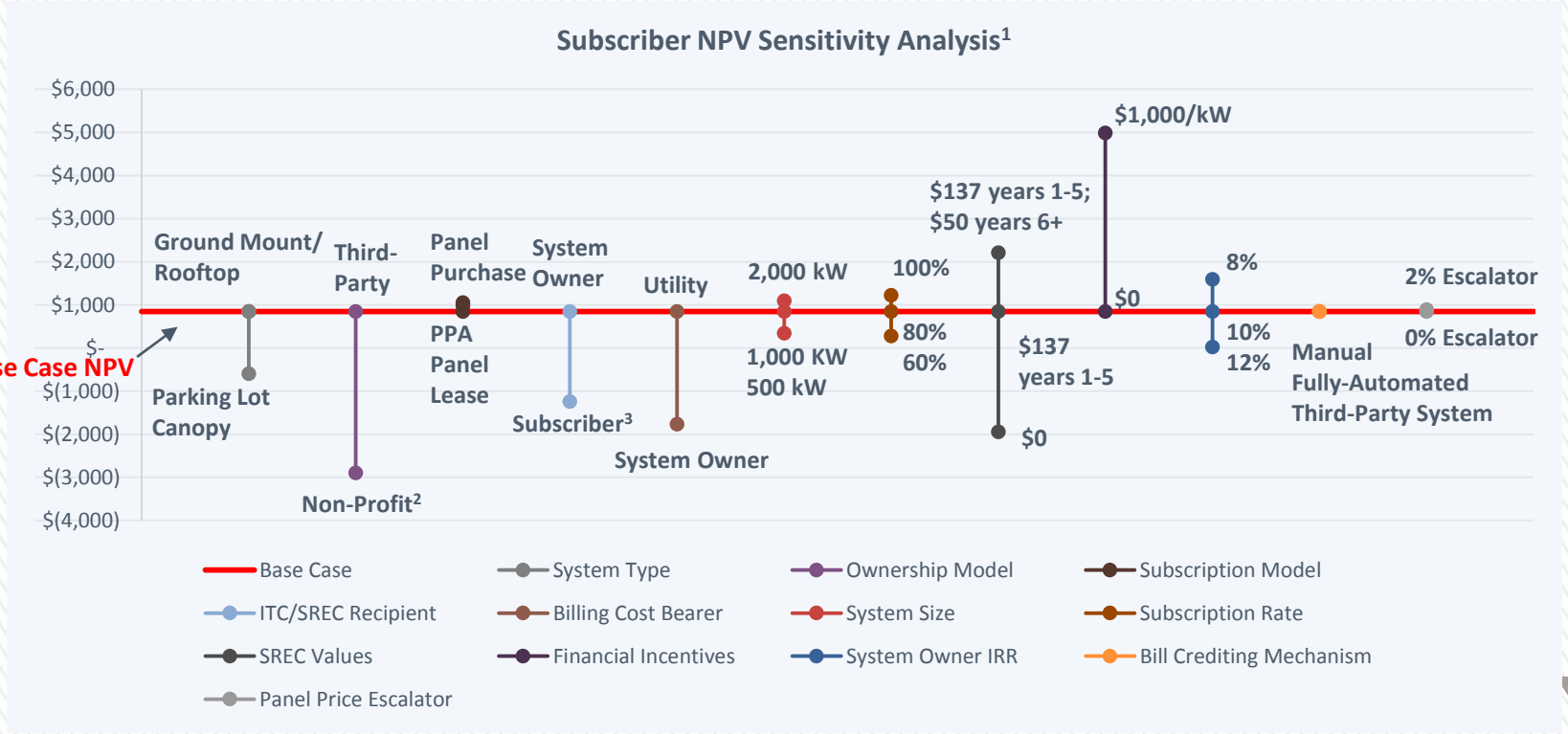


System Owner Financial Metrics

- **25-Year Costs:** (3,403,950)
- **25-Year Benefits:** $5,241,643
- **25-Year NPV:** $207,255
- **IRR:** 10.0%
- **ROI:** 54.0%
- **Simple Payback:** 5.4 years

Stakeholder NPV Ranges: Subscriber

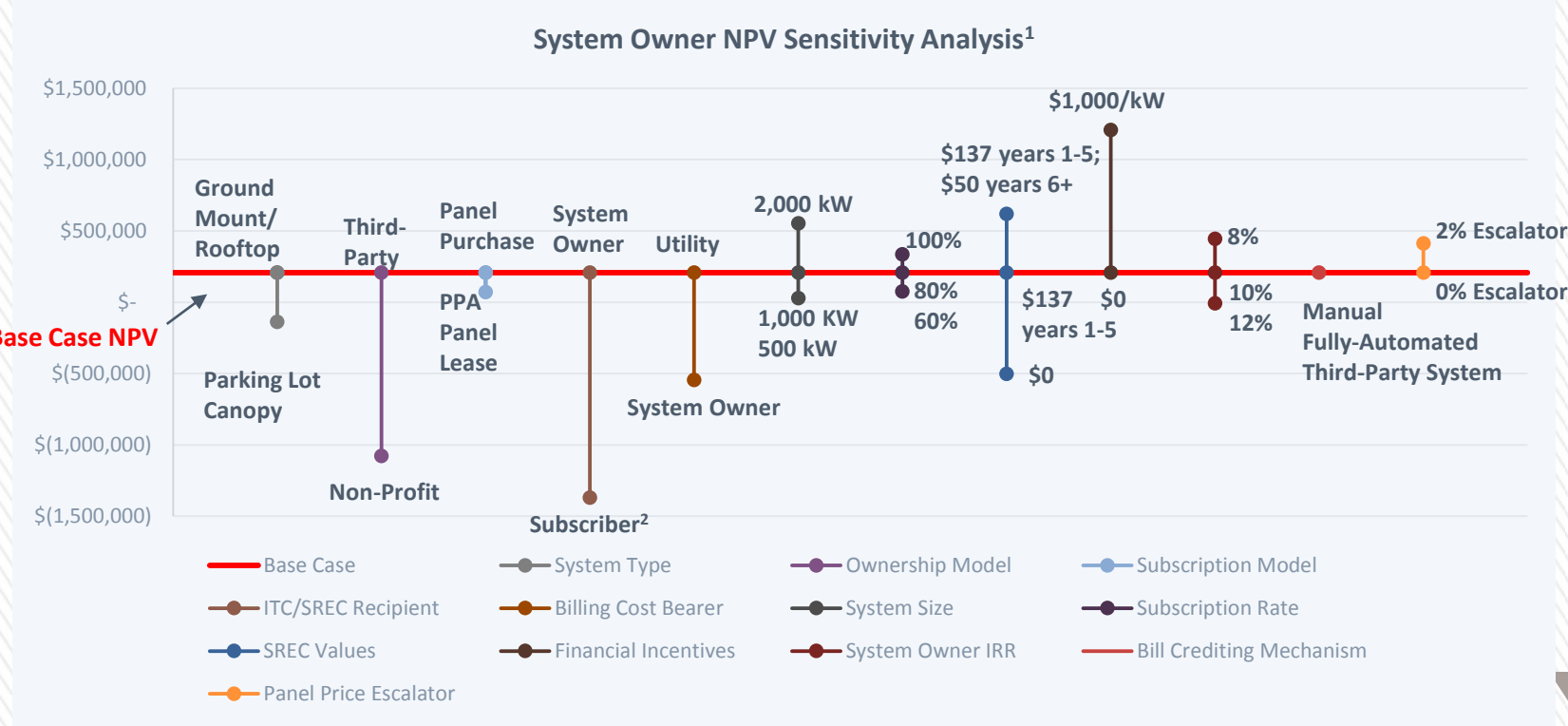
- A sensitivity analysis was performed to determine the impact of individual parameters on the subscriber NPV. The Base Case scenario NPV is shown in red. The magnitude and direction of each sensitivity is represented by the vertical lines. For example, increasing SRECs values in years 6+ from $0 to $50 has a greater impact on improving NPV than increasing the system subscription rate from 80% to 100%



[1]Base Case system owner IRR held constant
[2]NPV for Non-Profit was set to $0 instead of holding IRR at 10%
[3]Under a leased panel scenario it's unrealistic to assume the subscriber would receive the ITC; this scenario hurts subscriber NPV because of the increase in costs from the system owner required to maintain a constant owner IRR of 10%

Stakeholder NPV Ranges: System Owner

- A sensitivity analysis was also performed to determine the impact of individual parameters on the system owner NPV. The Base Case scenario NPV is shown in red. The magnitude and direction of each sensitivity is represented by the vertical lines



[1]Base Case subscriber panel price held constant

[2]Under a leased panel scenario it's unrealistic to assume the subscriber would receive the ITC; this scenario hurts subscriber NPV because of the increase in costs from the system owner required to maintain a constant owner IRR of 10%

Key Findings

- While the base case analysis indicates that a positive business case for community solar is possible for the system owner and subscriber, the financial metrics are not supported if certain conditions are not met.

- Because the system owner IRR was held constant in this analysis, if a certain metric reduces system owner NPV, the costs are instead passed through to the subscriber; similarly, if a certain metric increases system owner NPV, the benefits are passed through to the subscriber. Note: the relationship between parameters is not static so the results are not linear. Further, allocation of benefits to subscribers is conditional on the project goals and economics and can be changed with any individual project financial model.

- The ownership model has the largest potential impact to subscriber costs. The loss of these benefits causes panel subscription prices to increase to maintain IRR for the system owner.
  - ***Non-profit ownership models produce a lower NPV for subscribers than a system hosted by a third-party. Non-profits are not eligible for tax credits, and it was assumed in this model that these entities were not partnering with a tax equity investor*.***

- The magnitude and recipient of benefits has a significant impact to the business case for the subscriber and system owner. SRECs are necessary for a positive economic condition for both system owners and subscribers.
  - When the ITC and SRECs flow directly to the subscriber instead of the system owner, the subscriber's NPV decreased due to the increase in panel lease price by the system owner that would be required to maintain a constant IRR of 10%
  - Increased SREC values have a positive impact on the system owner. If the benefits are passed through to subscriber, they will also produce a positive impact to the subscriber
  - Financial incentives have a positive impact on the NPV of the system owner and subscriber when the benefits are passed through, but a negative impact on the NPV of the utility

Key Findings (Continued)

- Panel lease and PPA agreements have almost the same impact to subscriber and system owner, as the subscriber is paying a fee over time for the power purchased from their share of the system. Purchasing a panel produces a positive shift in NPV for the subscriber but negative shift for the system owner. Panel leasing typically involves paying a smaller amount upfront. ***While purchasing the panel upfront makes the financials appear more attractive for the subscriber, many customers may not be able to afford a lump sum panel purchase (no financing is assumed), deterring them from participating in the program.***

- When billing costs are passed through to the system owner, the system owner NPV will decrease or subscriber NPV will decrease if the costs are passed through to the subscriber base. Because the base case assumes costs for performing bill crediting are not attributed to the system owner, the selection of the bill crediting mechanism (manual, fully automated, or third-party supplied) does not impact the system owner or subscriber business case.

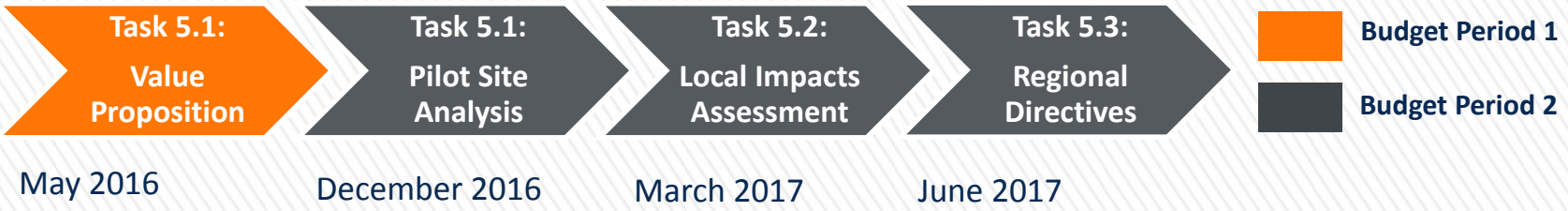
- A smaller system size reduces NPV for the system owner and subscriber due to losses in economies of scale related to administrative costs. Parking lot canopy systems resulted in a lower NPV for system owners and subscribers than rooftop systems. This increased racking cost for system owners decreases NPV of the subscriber when these costs are passed through.

- Applying an annual escalator minimally impacts subscriber NPV because the panel prices in year 1 drop to maintain a system owner IRR of 10%

Next Steps

- This financial model will feed into additional project areas:
  - > **Pilot Site Analysis (Task 5.1)** - conduct feasibility studies for the selected pilot sites, including individual business case financial models, and disseminate lessons learned
  - > **Local Impact Analysis (Task 5.2)** - use model to aggregate costs and benefits on a regional level, forecasting initially enabled community solar projects ands projected growth, to derive total local net benefits of increased shared solar systems.
  - > **Regional Directives (Task 5.3)** - apply anticipated solar deployment levels against city, county and state renewable energy goals and the expected contributions from this initiative.

- Projected Timeline:



Task 5.2: Local Impacts Assessment

- The goal of Task 5.2 is to simulate the costs/benefits at each pilot site, to aggregate across all comparable sites and to project growth regionally to derive total local net benefits of increased shared solar systems. The analysis will model each alternative configuration to show the potential effects of barrier reduction within Cook County.

- Key issues have been identified as needing further analysis before the value of large scale community solar deployment can be fully understood, particularly as they relate to utility costs and benefits.

- Intended areas of study for Task 5.2 include:
  - Bill crediting mechanism for utility bill crediting beyond pilot programs
  - Quantification of grid benefits
  - Quantification of scaled utility impacts
  - Applicable credit rate for commercial and industrial participants in community shared solar programs

- Clarification of key policies guiding community shared solar are also expected to be decided upon before 2017, that may inform the Task 5.2 assessment:
  - Resolution on pending legislation allowing Commonwealth Edison power generation and transactions
  - Resolution on pending legislation impacting meter aggregation policies
  - Resolution on utility incentives for community shared solar