Co-Adoption of Solar, Storage, and/or Electric Vehicles by Residential and Commercial Customers

Minhua Long, Electric Power Research Institute
Margaret Taylor, Lawrence Berkeley National Laboratory

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Solar + Battery Storage + Electric Vehicle?

What would influence adoption decisions?

How would co-adoption make impacts?

When would it happen?

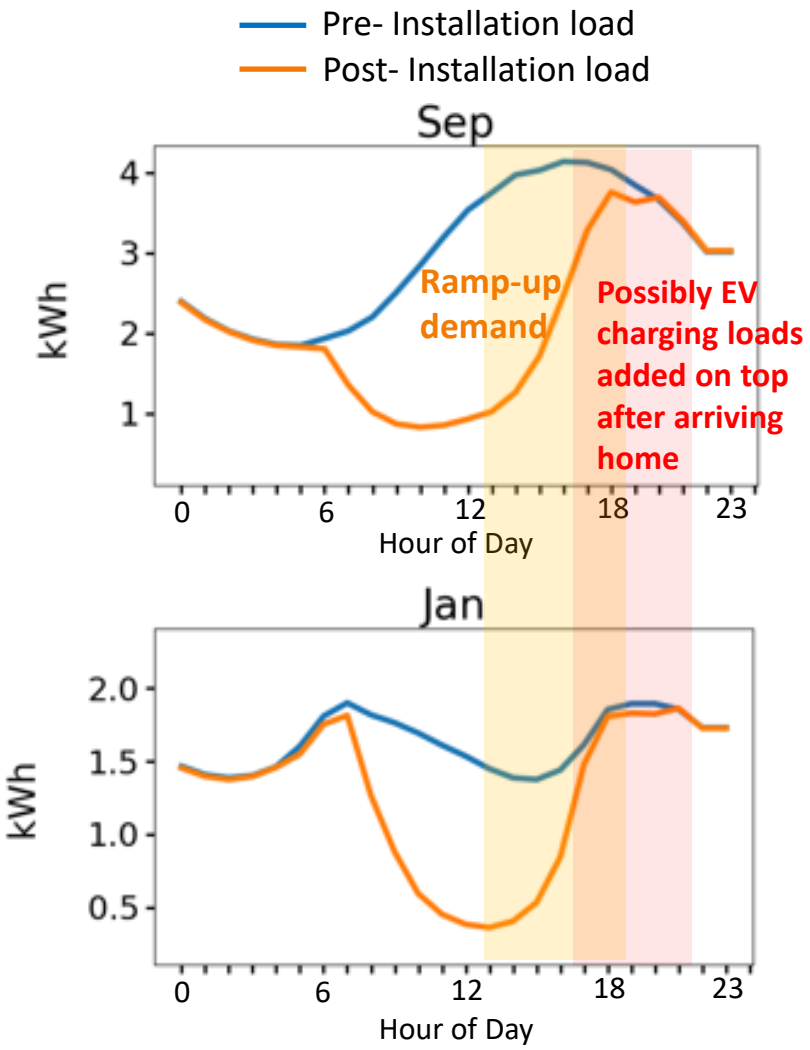
Finding one piece of a puzzle for the future of energy

Why care about co-adoption

- Decarbonization
- Grid operation
  - "Duck Curve"
  - New added loads as the result of electrification (e.g. EV, Electric Heat Pump)
  - How can battery storage help?
- Resiliency
  - Battery storage as power backup
  - EV with bi-directional charging
- Rate design
  - Net Energy Metering
  - Value Stack

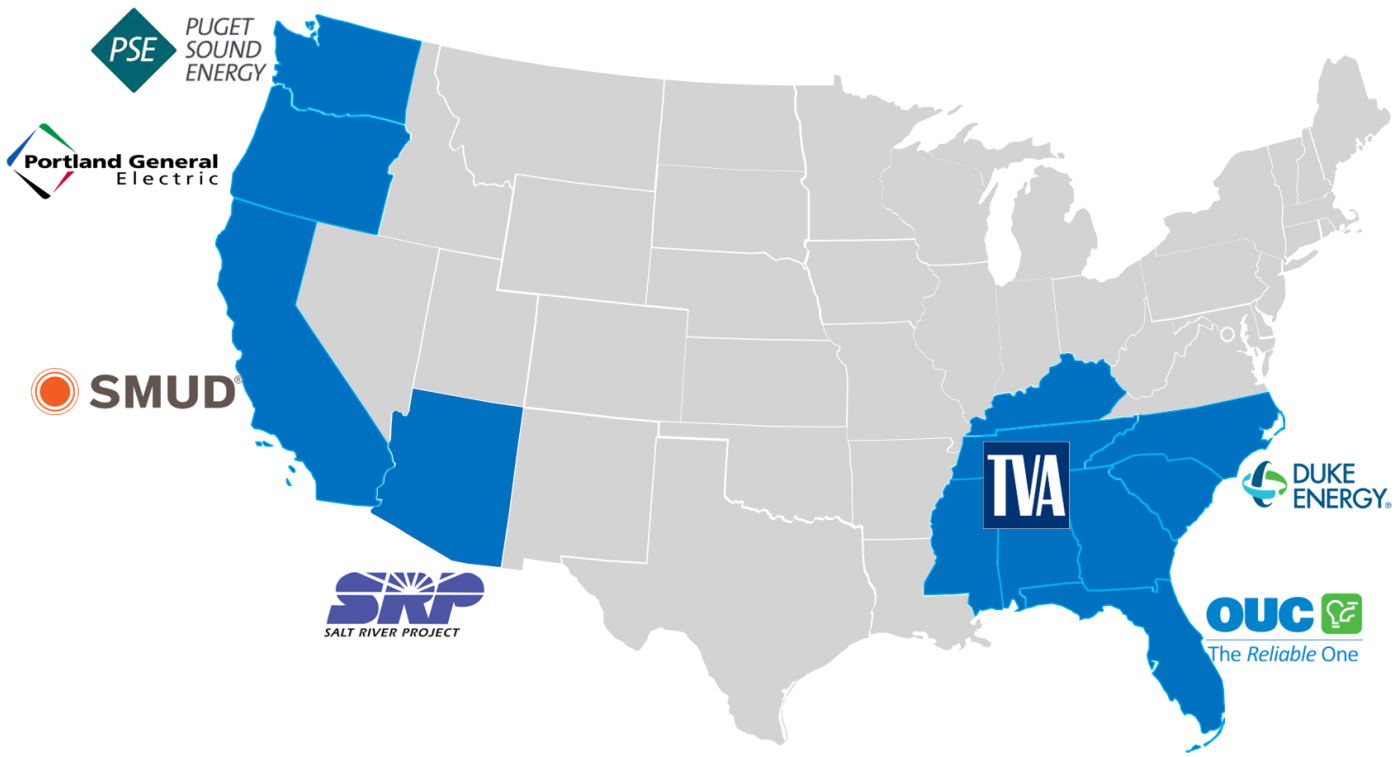
Co-Adoption is just a start.
Coordination among the technologies is the key!

Example of pre- and post- rooftop solar installation load profiles



(Data source: 151 residential customers located in Salt River Project service area that installed rooftop solar in 2018.)

Collaborating organizations



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Key targets for engagement

Residential & commercial electricity users

- Utility customer samples
  - ✓ Survey
  - ✓ Load data
- 3rd party panel provider to sample national population
  - ✓ Survey

Key project audiences

- Utilities, multiple departments
- Consumers, incl. limited income

Project scope

- Elicit stated preferences of residential and commercial customers towards co-adopting PV, storage & EVs
- Improve tools for forecasting co-adoption of DERs
- Map the co-adoption landscape through nationally and regionally validated assessments at fine geographic resolutions

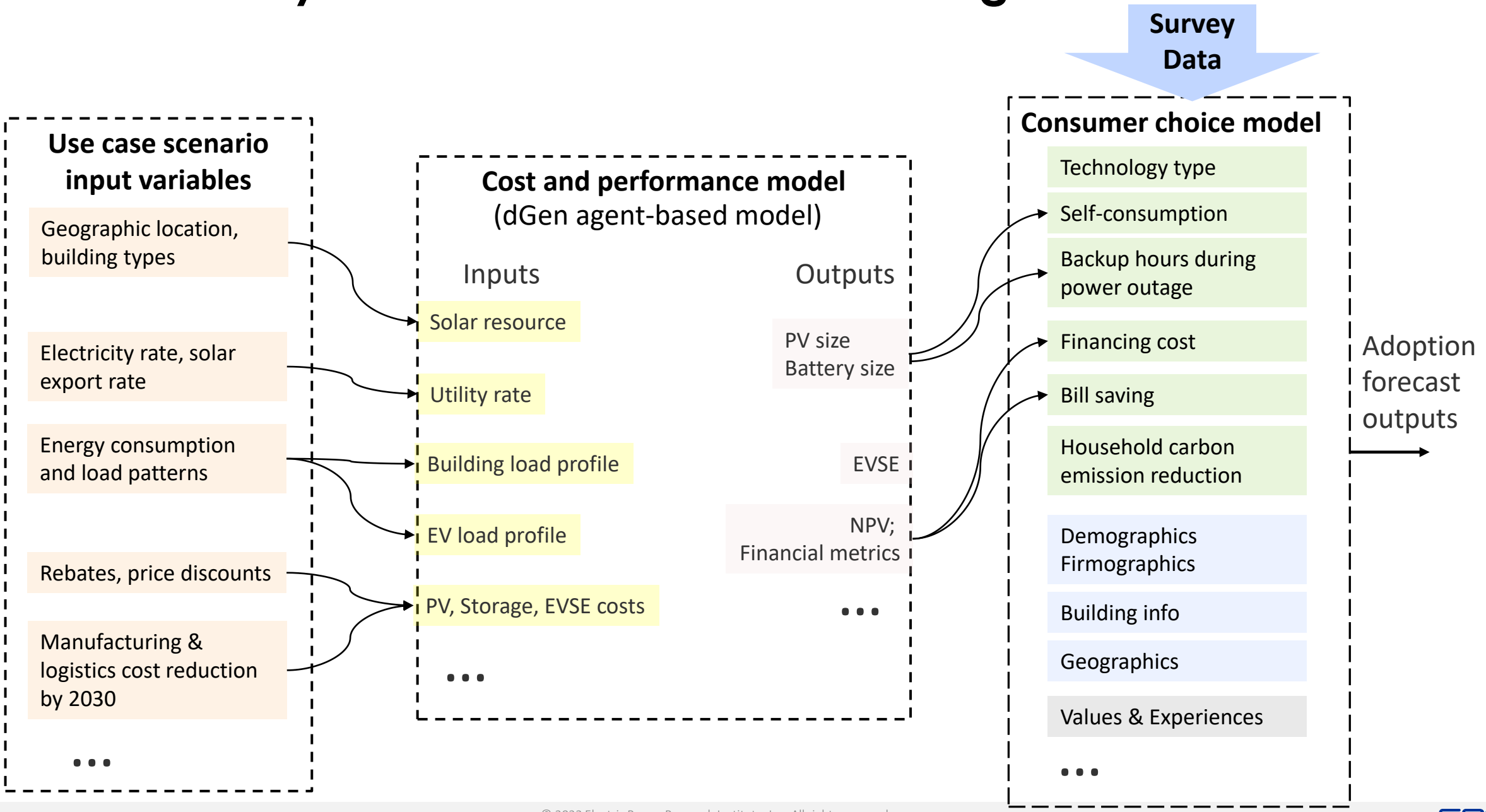
DER Technology Value Map

National surveys to quantify customer preferences

Integrated choice model into open-source, agent-based adoption model

Insights from scenario-driven co-adoption forecasts; Public access to aggregated and anonymized project data

How the surveys inform the forecast modeling



Survey design overview

- Capturing tradeoffs in the decision making of technology adoption
- Providing respondents with education materials for meaningful technology option comparisons
- Reaching out to key decision makers

  Residential:

  - Final or shared decision making in solar/battery installation

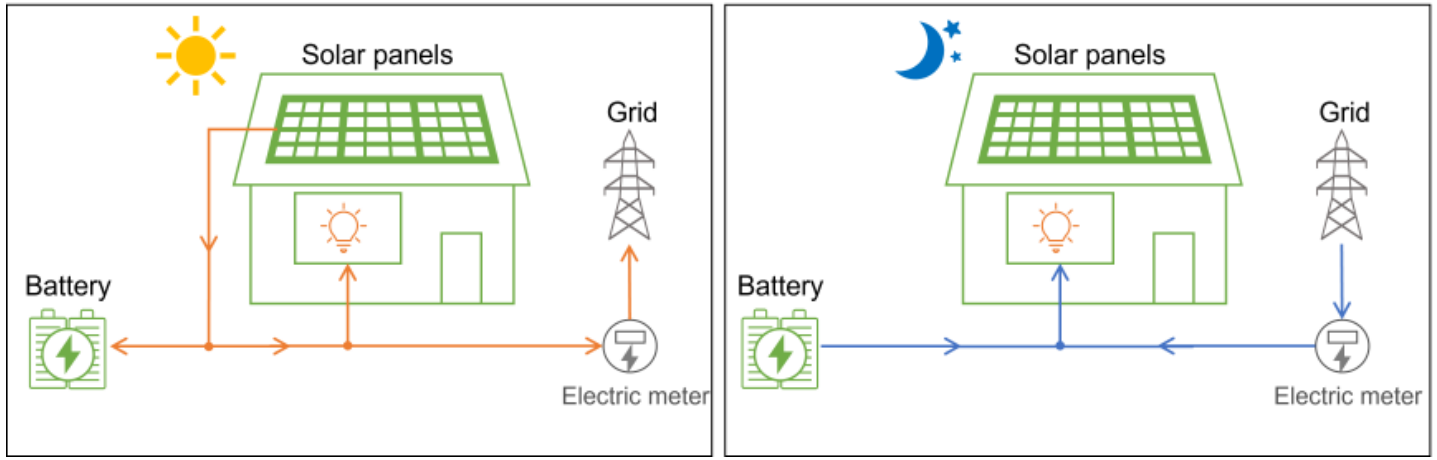
  Commercial:

  - Sustainability/facility/energy manager
  - Procurement staff
  - Fleet manager

Snapshot of discrete choice experiment: using hypothetical options to estimate how consumers weigh technology attributes in decisions

System Features (Hover over each item in this column to see what it means)	Solar System 1	Solar System 2
Technology	Rooftop Solar Only	Rooftop Solar + Battery
How your solar production is consumed	Use it or Export it	Use it or Store it
Monthly electricity bill saving	Up to 50%	Up to 75%
Backup during power outage	None	1-2 days
Monthly financing cost (12-year loan term)	$100	$150
Household carbon emission reduction	Reduce 30%	Reduce 60%

Snapshot of information sections (with text explanation in the survey) that help respondents understand how the technologies work



Learning from pre-testing (think-aloud approach)

- **Whether the survey captures the important attributes in decision making**

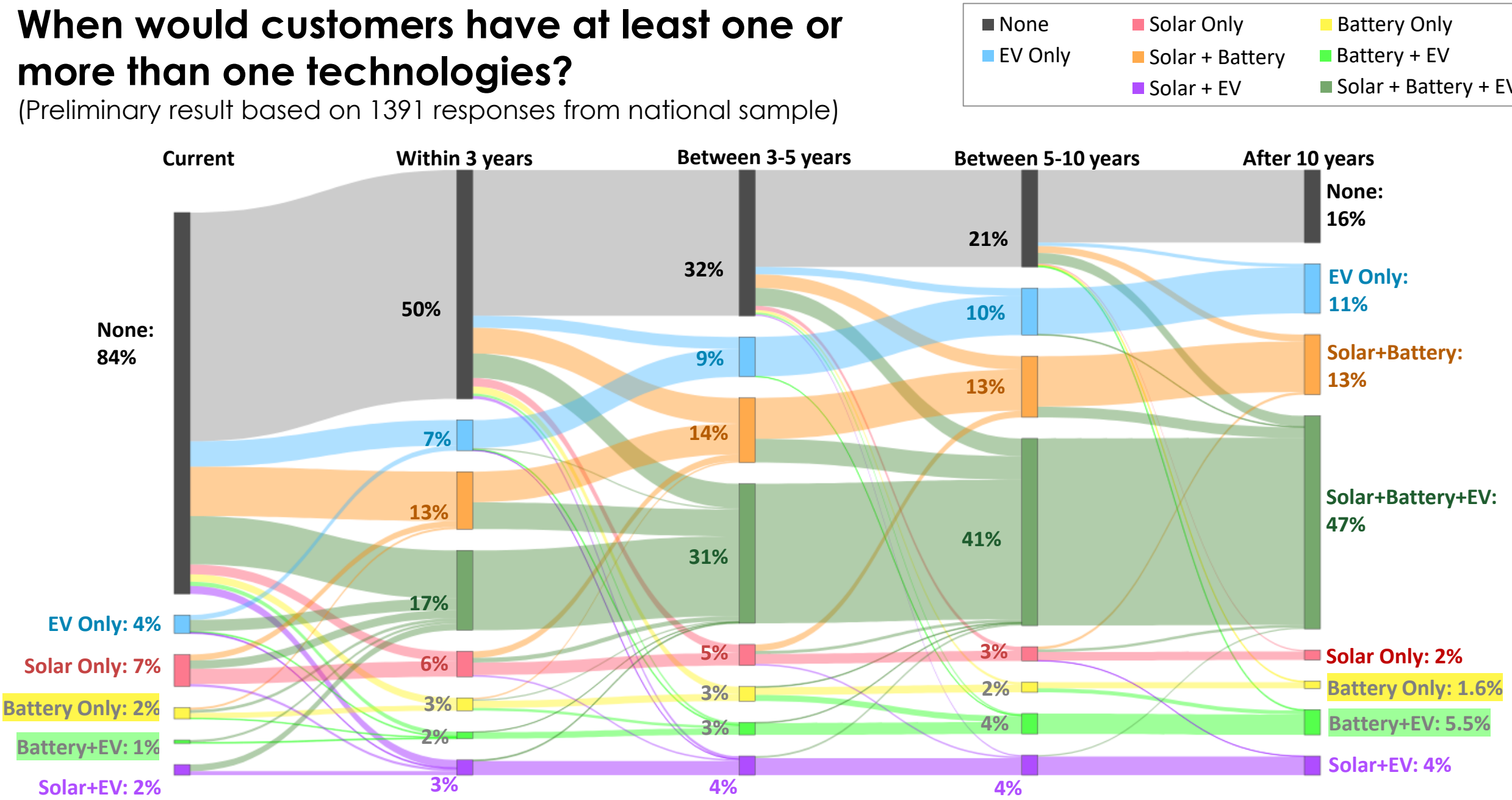
  We observed the tradeoffs, for example:

  - Between cost and benefits (backup power, bill saving, emission reduction)
  - Between household benefit and environment benefit

- **Presenting attributes to be informative for "modelers" but easy-to-understand for general customers**
  - For residential customers: "Self-Consumption Rate" or "Self-sufficiency Rate" → "Use it or Lose it", "Use it or Export it", "Use it or Store it"
  - For commercial customers: how decision makers measure cost of investment and return on investment
- **Misconception about solar**
  - *"I thought going solar would allow my home to go off-grid"*
  - *"I saw solar panels on our neighbors' rooftops. Are those what you mean by 'community solar'?"*
  - *"Why this option costs more but not result in greater bill saving?"*
- **Things that we cannot address in this 15-20 minutes survey:**
  - Different financing and payment models
  - Factors in the whole lifecycle – permitting, installation, incentive application, interconnection, operation, maintenance, degradation, etc.
  - Complex human behavioral factors and dynamics
  - Information searching and decision making are adaptive and interactive processes

When would customers have at least one or more than one technologies?

(Preliminary result based on 1391 responses from national sample)



Coming soon…

- Fielding among utility partners' territory
- Launching commercial survey
- Conjoint analysis results and dGen simulation
- Comparing notes with "revealed preference" data analytics (current adopters load profile study)