Distributed Energy Resources and Commercial Buildings

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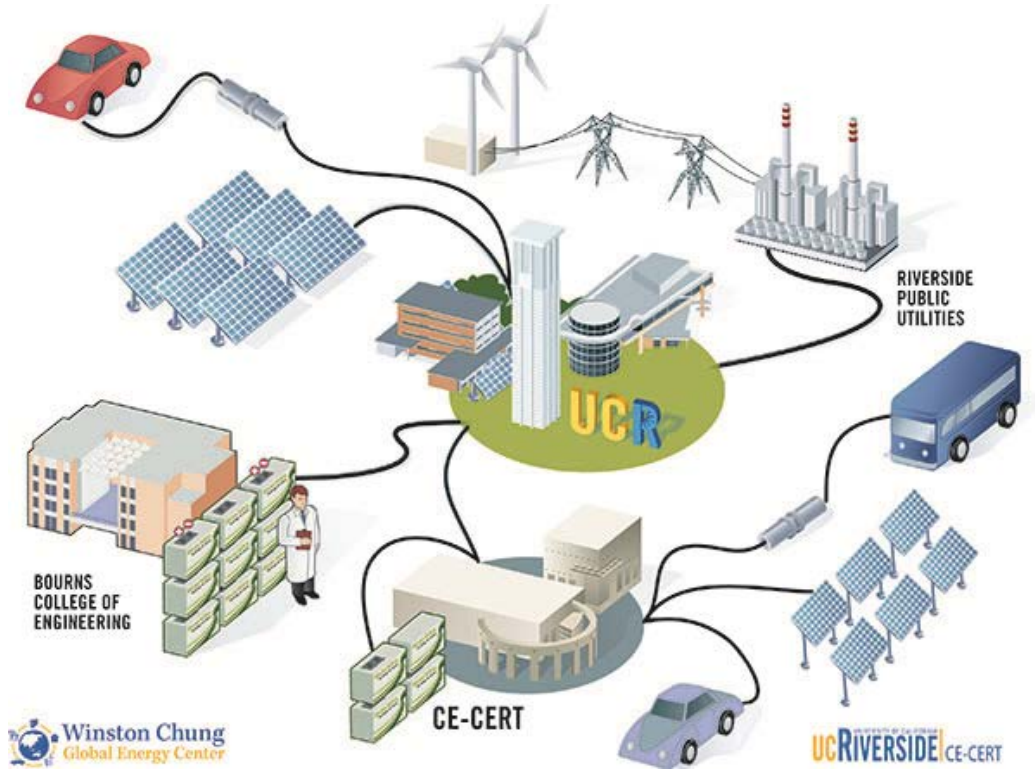
Distributed Energy Resources (DER) from the customer perspective

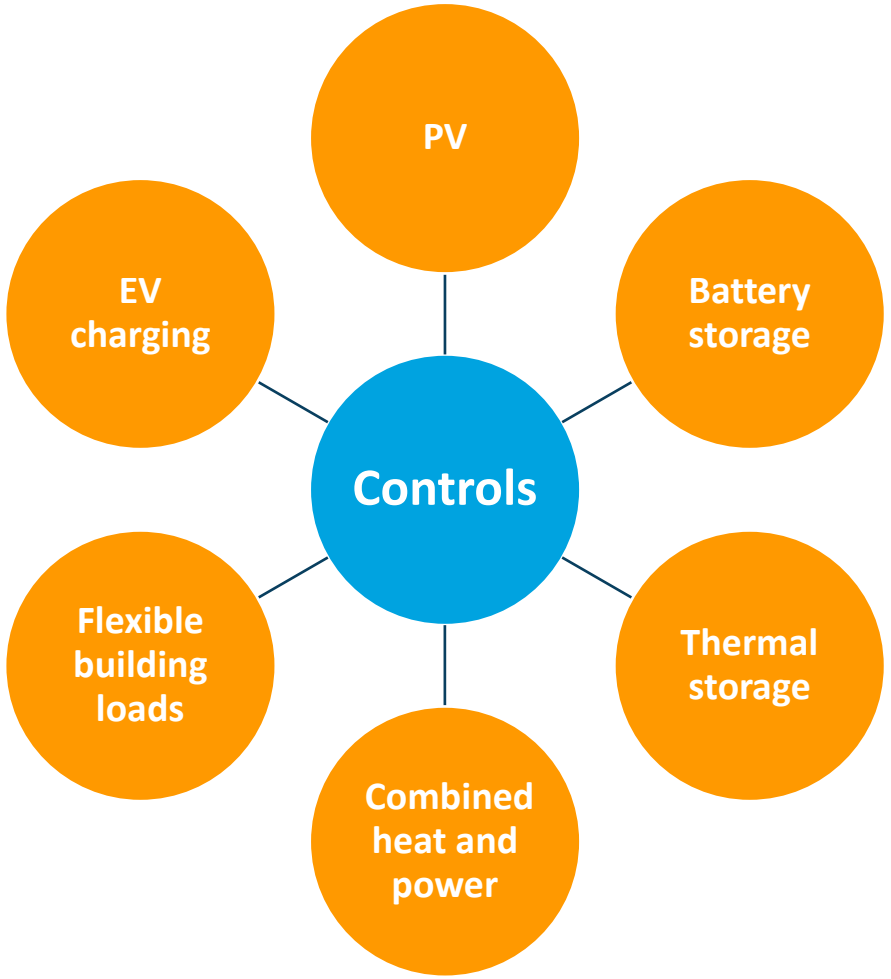
- Motivations
- Controls and integration
- Grid-interactive efficient buildings (GEB)



Source: UC Riverside, Center for Environmental Research and Technology

Customer-sited DER investments

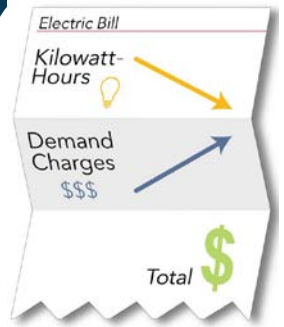
- DERs installed at a customer site typically grid-tied and may also be able to island from the grid (a microgrid)
- Using DERs, customers can **design the load shape they want** with active demand management strategies



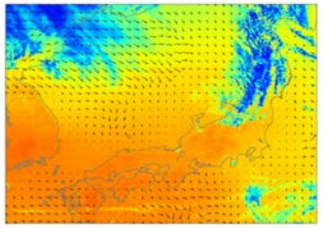
DER value streams for owners

01	**Energy Bill Savings**	• Reduce peak demand charges • Energy cost savings: Use stored energy when energy rates are high, charge storage when rates are low (energy arbitrage)
02	**Resiliency**	• Microgrid serves building loads during grid momentary and sustained outages • Protect critical loads
03	**Revenue Opportunities**	• Participate in demand response programs or wholesale markets • Provide other grid services
04	**Carbon Reduction**	• Integrate intermittent renewables • Store renewable energy when there is excess production

Customer-sited DER optimization controls



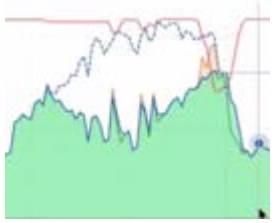
Utility rates



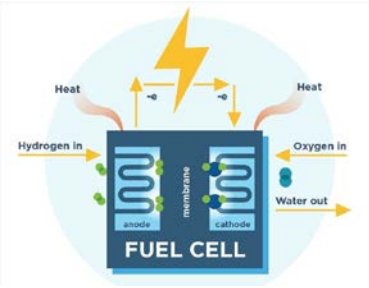
Solar power forecast

Financial value of back-up power

Battery/thermal storage state of charge



Building load forecast



On-site generation forecast

Grid Signals and Market Rules

INPUTS

DER Optimization Controls

OUTPUT COMMANDS

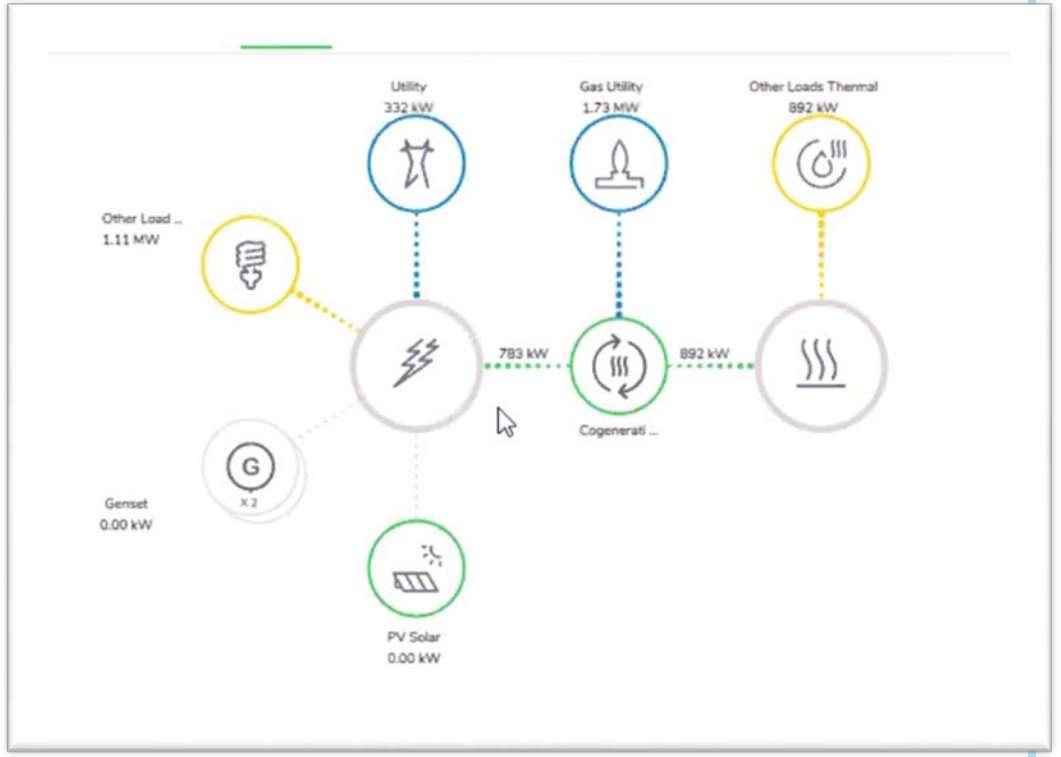
- Charge/discharge battery storage
- Charge/discharge thermal storage
- Flex building loads
- Enable/disable on-site generation
- Flex EV charging

Integrating DERs and flexible building loads

HVAC controls increasingly offer DER control capability

Benefits: reduce DER investment, simplified interface, maximize revenue and responsiveness to time-varying rates

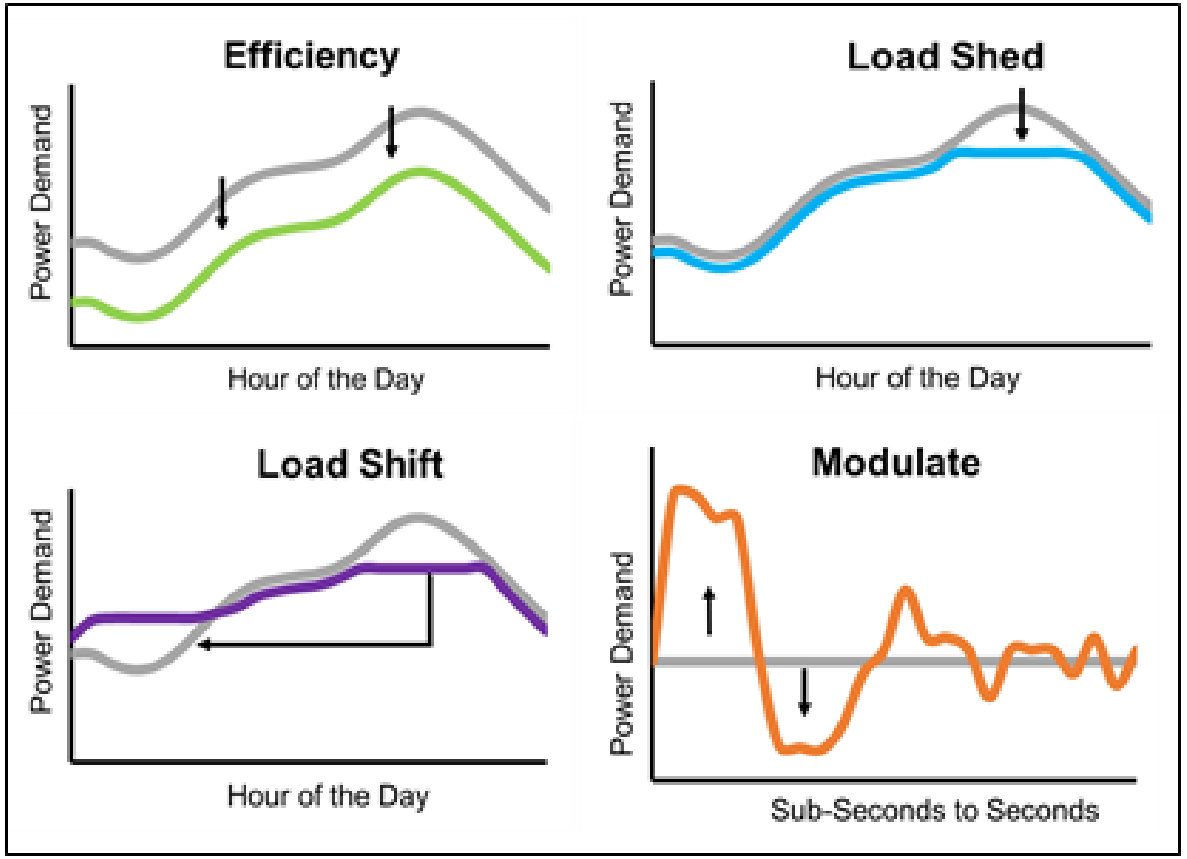
Challenges: Lack of market demand, risk of comfort impact on occupants, interoperability issues



Source: Schneider Electric EcoStruxure Microgrid Advisor

The Vision: Grid-interactive efficient buildings (GEB)

1. **Efficiency:** minimize load
2. **Load shed:** reduce load at peak demand times (event-based)
3. **Load shift:** Store energy for use during peak (routine operation and event-based)
4. **Modulate:** Increase/decrease loads or generation when called upon by grid operator



Best practices for effective DER implementation

- Efficiency first
  - Cost-effective to reduce loads before adding DERs
  - Commission building systems so they can be flexible and responsive to grid needs
- Rates are key to optimizing energy bill savings and revenue generation; may need to switch tariffs
- When adding storage (battery or thermal), predictive controls are essential
- Where cooling loads drive demand peak, consider thermal storage
- For significant thermal loads, fuel cells or combustion turbines offer steady base electric generation plus waste heat for heating loads
- Plan for potential peak demand impacts from electrification: customer-sited EV charging, heat pumps for space or water heating
- To maximize financial benefits, integrate building and DER controls

Realizing the vision: DOE Building Technologies Office GEB initiative

EFFICIENT

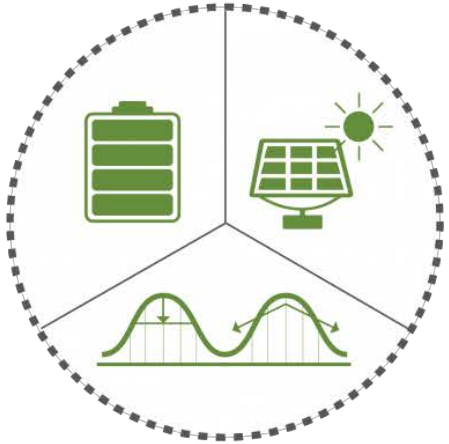
Persistent low energy use minimizes demand on grid resources and infrastructure

CONNECTED

Two-way communication with flexible technologies, the grid, and occupants

SMART

Analytics supported by sensors and controls co-optimize efficiency, flexibility, and occupant preferences



FLEXIBLE

Flexible loads and distributed generation/storage can be used to reduce, shift, or modulate energy use

https://www.energy.gov/eere/buildings/grid-interactive-efficient-buildings

CEC EPIC California Load Flexibility Hub (CalFlexHub)

- 4-year, $16M program to identify, evaluate, develop, fund and demonstrate the most promising pre-commercial technologies that advance flexible and interoperable grid-integrated energy efficiency and DER technologies

- CalFlexHub will develop:
  - Common Price and Environmental Signals
  - Capable Load Flexible Technology
  - Valuation Methodology to prioritize technologies and strategies
  - Understanding of Usability to further customer adoption and acceptance of flexible demand technologies
  - Strategies to Mitigate Financial and Health Burdens of electrification and dynamic rates on disadvantaged (DA) and low-income (LI) communities

- Partners: LBNL (lead), UC Davis, UC Berkeley, UC San Diego, UC Riverside, Momentum, Olivine, e-Radio, WattTime, Skycentrics, E3 (SMUD is a supporter)

Thank You

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Further reading: Kramer, Hannah, Rui Tang, Richard Brown, Claire Curtin, Jessica Granderson. 2020. *Market Brief: Customer-sited Distributed Energy Resources*. Lawrence Berkeley National Laboratory. March. https://eta-publications.lbl.gov/sites/default/files/curtin_-_market_brief_9-19.20.pdf.