Plug and Process Loads: Roles and Opportunities in Energy Resiliency

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California Plug Load Research Center
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Heading Into Next Decade

Focused on & addressed localized problems with plug loads

- Energy Efficiency
- Grid Interactive & Flexibility
- Onsite DER & ES
- Electrification
- Energy Efficiency
- More Dynamic Grid Resources & Considerations
- More Locally Dispatchable Renewable Resources
- More New Plug & Process Loads inside homes, buildings, and manufacturing facilities
- More Smart Controls & Smart Loads & Gizmos

2021
CalPlug’s Holistic Approach & Solution

1. Focus on Building & Industry sector Decarbonization

   - Buildings 26%
   - Transportation 38%
   - Agriculture 9%
   - Industry 27%

   CA End Use GHG Emissions

2. Focus on Small & Medium Manufacturers and Buildings

   >39,000
   small & medium manufacturers in CA + their buildings

   Account for 50%
   CA’s Manufacturing GDP

3. Focus on Holistic Approach & Solution

4. Start with the rapidly changing Plug & Process Loads

   - Total Energy Consumed by Buildings
     - Space Heating Cooling and Ventilation, Water heating 47%
     - Lighting 20%
     - PPLs 33%
     - Industry 27%
     - Agriculture 9%

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Starting from “The End-Use”, the nested and rapidly changing Plug and Process Loads,

By the integration of sensing, measuring, optimization, analytics, and real-time control,

To provide data and insights to enable optimal orchestration for Grid-interactive Efficient Buildings,

To develop economically and technically feasible decarbonization pathways for Small and Medium (SM) sized Commercial buildings, and SM Manufacturers and their buildings.
Energy Resiliency in Small & Medium sized Manufacturers

"the ability to resist being affected by an event or the ability to return to an acceptable level of performance in an acceptable period of time after being affected by an event closing”

--U.S. DOE on Resiliency
Technically feasible key pillars for End-use Sectors Decarbonization

**Energy Efficiency**
Use the least energy

**Electrification**
Utilize more from clean sources

**Grid Interactive & Flexibility**
Use at the right time

**Onsite DER & ES**
Offset and more flexible

**CO2 Capture & Storage**
Intentional remove CO2

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“The ability of a power system and its components to withstand and adapt to disruptions and rapidly recover from them”

In the Case of SMMs energy resilience the power system comprises the electrical infrastructure behind the electrical meter of the industrial facility.
In the event of a blackout or extreme event, SMMs designed to be energy efficient and store or produce energy onsite offer a greater level of protection to the continuity of operations and safety ramp down.

Energy efficiency increases the passive survivability of buildings—maximize the usage of limited resource available.

Onsite DER+ES: During a power outage, backup power (e.g., batteries, onsite solar, generators, or combined heat and power [CHP]) allows for continuity of operations and building habitability.
Access to SMMs?

For SMMS, the IAC has done:

**19,686** Assessments

**147,944** Recommendations

to improve SMMs energy efficiency.
Plug and Process Loads in SMMs

The general area of application of the recommendations, can be dividing into **Process related** and **non-process related**.

- **Manufacturing Process and Process Support**
  - Process Heat, Process Equipment, Air Compressor, Steam, Motor, etc.

- **Building and Administrative**
  - Lights, HVAC, Taxes, Inventory control, etc.

Opportunities in improving Process Load energy efficiency in Small & Medium sized Manufacturers.

- Implementation Cost: $35,672 vs. $21,505
- Average Payback Years: 1.34yr vs. 1.69yr

Process related recommendations have higher implementation cost, but savings are more significant therefore shorter payback period.

Implementation Rate:
- 48% Process related
- 46% Non-Process related

Higher adoption rate for SMMs to improve their process load and process support.
Onsite DER & ES in SMMs

- During normal operation
  Reduce demand charge and energy cost, if sized properly

- During blackout or fuel shortage event
  Provide resiliency and continuity of operation

- Onsite generation and energy storage type of recommendation is under the category of Reduction of downtime recommendations in IAC program
  NOT “popular” among SMMs, recommended 41 times over the decades (148,887 total recommendation), very low adoption rate 24%

- High cost and long payback period; require high resolution data to make sense the dispatch strategy for selected PPLs
Planning for Resiliency with PPLs for SMMs

More PPLs with improved Energy efficiency

- During normal grid/fuel supply
  - Reduced likelihood of demand surge that led to service disruptions
  - Lower energy cost
- During outage or shortage
  - Passive survivability
  - Utilize limited resources for longer duration
Planning for Resiliency with PPLs for SMMs

Critical PPLs connected with Onsite DER & ES

- Identify critical PPLs in SMMs
- During normal grid/fuel supply
  - Reduced demand charges
  - Support sustainability goals
- During outage or shortage
  - Uninterrupted operation of critical PPLs
SMMs Planning Resiliency with PPLs

SMMs are
- In variety of industry sub-sectors
- Have their own process power/heating requirements
- Various product specs and production cycles
- Have a high degree of process integration
- Higher cost of onsite energy source and storage systems in small scale

- Identify control strategies and critical Plug and Process Loads, to pair and size with the energy storage system for optimal dispatch during blackout

- Seek alternative fuel for Process loads to diversify the fuel supply to improve resiliency over supply shortage
SMMs Planning Resiliency with PPLs

- Estimating loads to identify energy resiliency needs
  - Timeframe of energy resiliency desired
    - Remain minimum operation
    - Safely shut down or ramp down
  - Prioritize of the loads and circuit control design
    - Know your loads! PPLs + processes
    - ES SOC and DER ramping rate and dynamics

- Planning for different type of events
  - Unpredictable events
  - Planned PSPS (Public Safety Power Shutoffs)
    - PSPS outages and resiliency plan with notifications from utility
    - Generator and battery rebate program
    - If NOT a Critical facility/infrastructure
We Welcome Opportunities for Collaboration!

Please contact Dr. Li Zhao
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THANK YOU!