DER-VET Task Force

ESIC Working Group 1: Grid Services and Analysis

Miles Evans | EPRI
Halley Nathwani | EPRI
Giovanni Damato | EPRI

September 3, 2020

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- To divide markets or technologies;
- To allocate customers/suppliers/territories;
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- The webcast is being recorded along with all Q&A. Your participation provides consent to that recording.

- As a result, please make sure your phone is on mute throughout the webcast unless speaking. Do not place your phone on hold.

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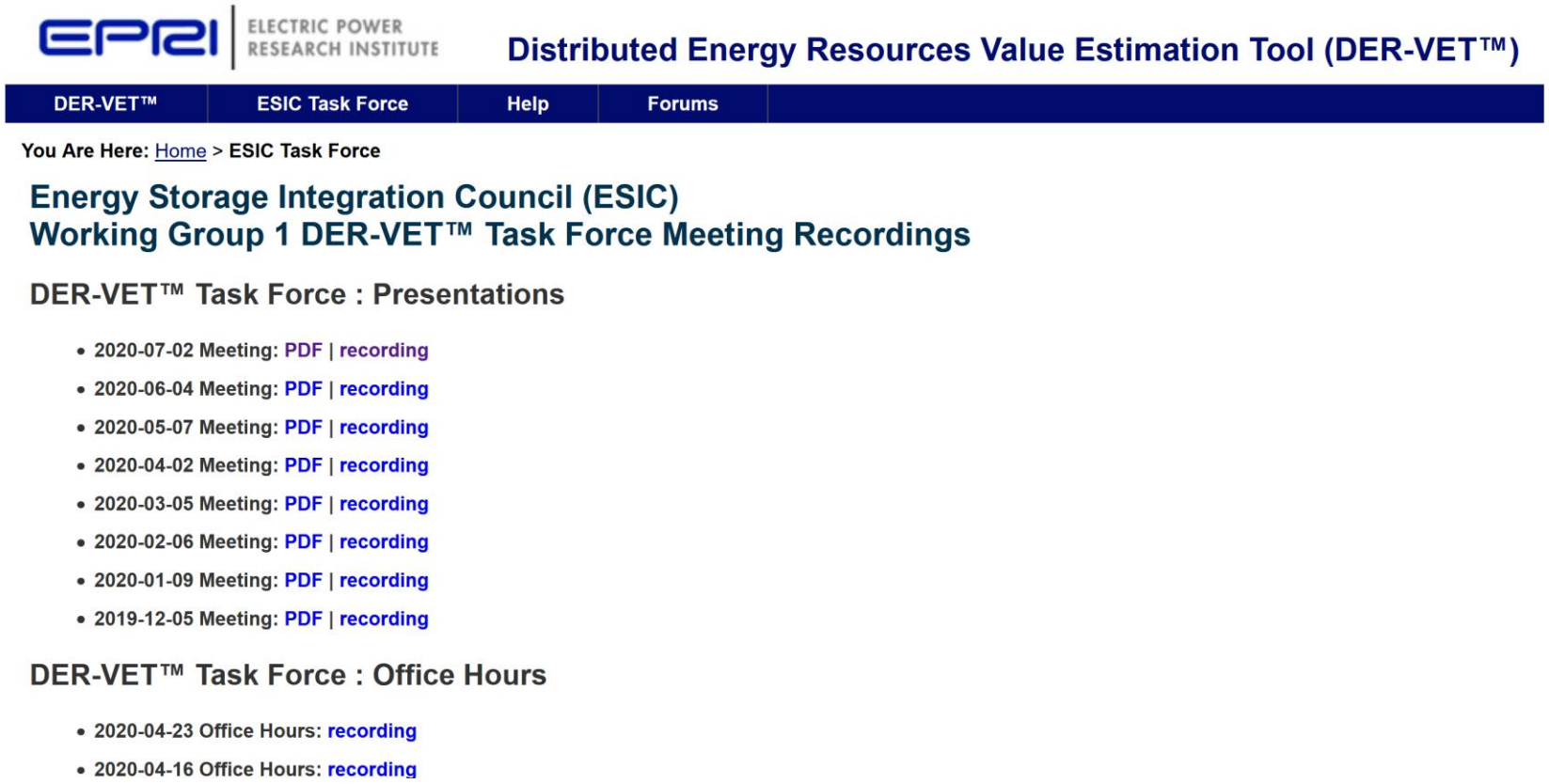
Agenda

- Announcements
- Electric Vehicles
- Combined Heat and Power

Announcements

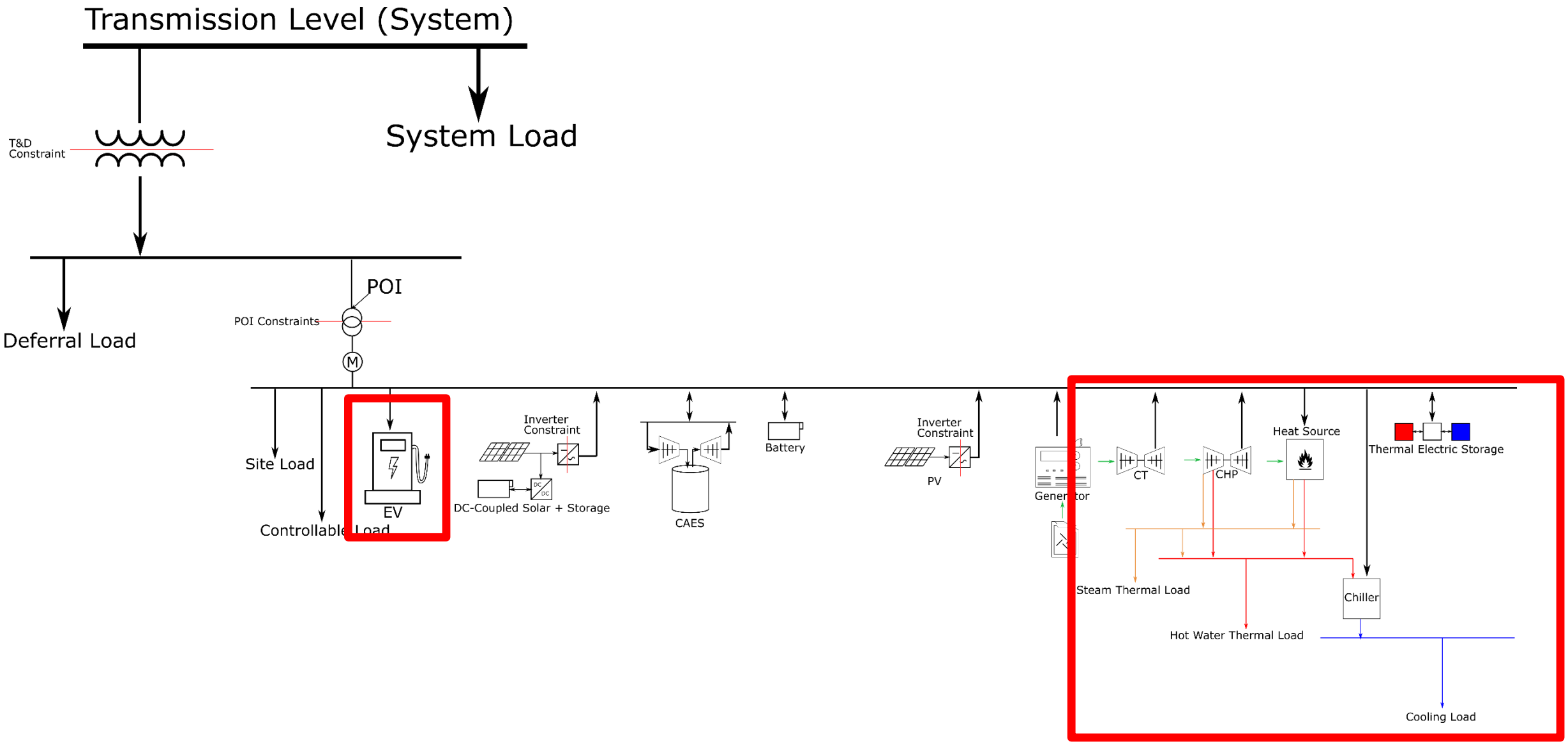
DER-VET Task Force Presentations and Recordings Moved

- www.der-vet.com/esictf



Electric Vehicles

Current DER-VET Single Line



EV Types

Focus in DER-VET Version 1

- Home charging
  - Overnight, one vehicle (can instantiate multiple), repetitive charging
- Workplace/Campus charging
  - Multiple vehicles, non-repetitive, partial controllability, curtailable
- DC Fast Charging
  - On-demand, high-power charging
- Public Transport
  - High-power, high-energy, repetitive charging for busses and other public transport vehicles
- Off-Road EVs
  - Repetitive charging for industrial EVs, e.g. cargo handling equipment

EV Capabilities

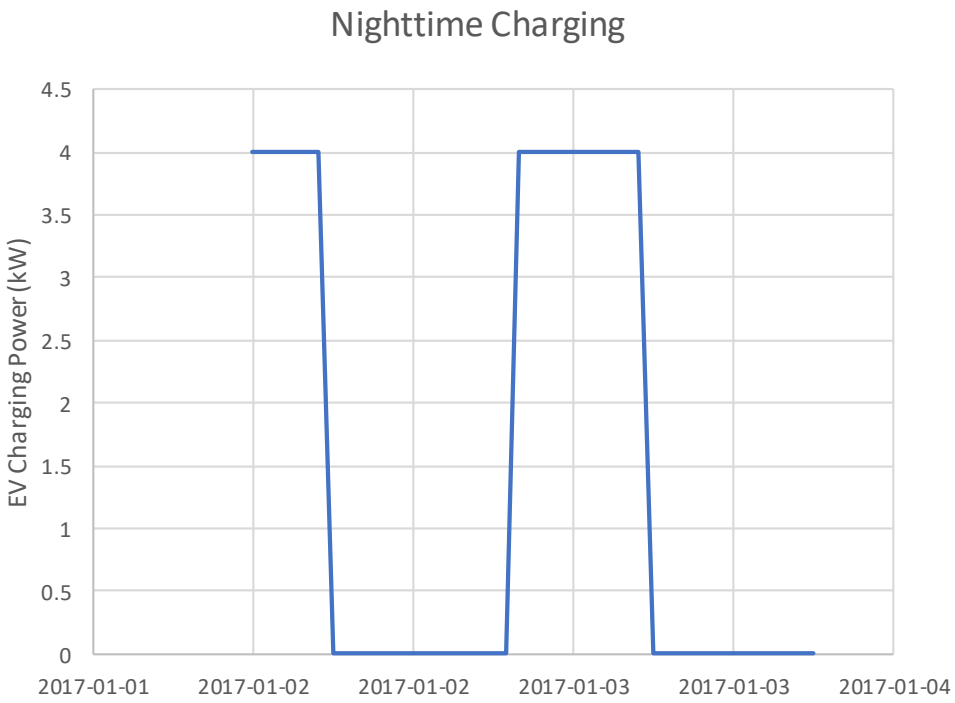
Focus in DER-VET Version 1

- Non-controllable load
  - EVs are not controllable and their charging requirements must be satisfied
- Managed charging
  - The timing and power of EV charging can be controlled
  - No energy discharged from vehicle batteries
- Reliability
  - EVs can supply critical load during grid outages (energy discharged from vehicle batteries only during outages)
- Vehicle-to-Grid
  - EVs are fully controllable and can be used for grid services, though their charging requirements need to be fulfilled.

Home Charging

- Vehicle plugs in and out at the same times every day
  - E.g. plug in at 8pm and plug out at 6am.
- Vehicle needs to charge the same amount of energy every night.
  - E.g. 20 kWh every night
- Vehicle charging power$_i \in [0, ch_\max_rated]$

- The vehicle's charging will be managed to minimize overall costs while fully charging every day.
  - Limit charging during peak price hours
  - Minimize demand charges if applicable
  - Respect all POI constraints with every other DER



Workplace/Campus Charging

- Baseline charging load is a time series load profile
- Some of this is considered controllable and can be shifted within certain periods, but not between periods.
  - A period would be a work day most often
- EV charging can be curtailed, with a cost of lost load penalty

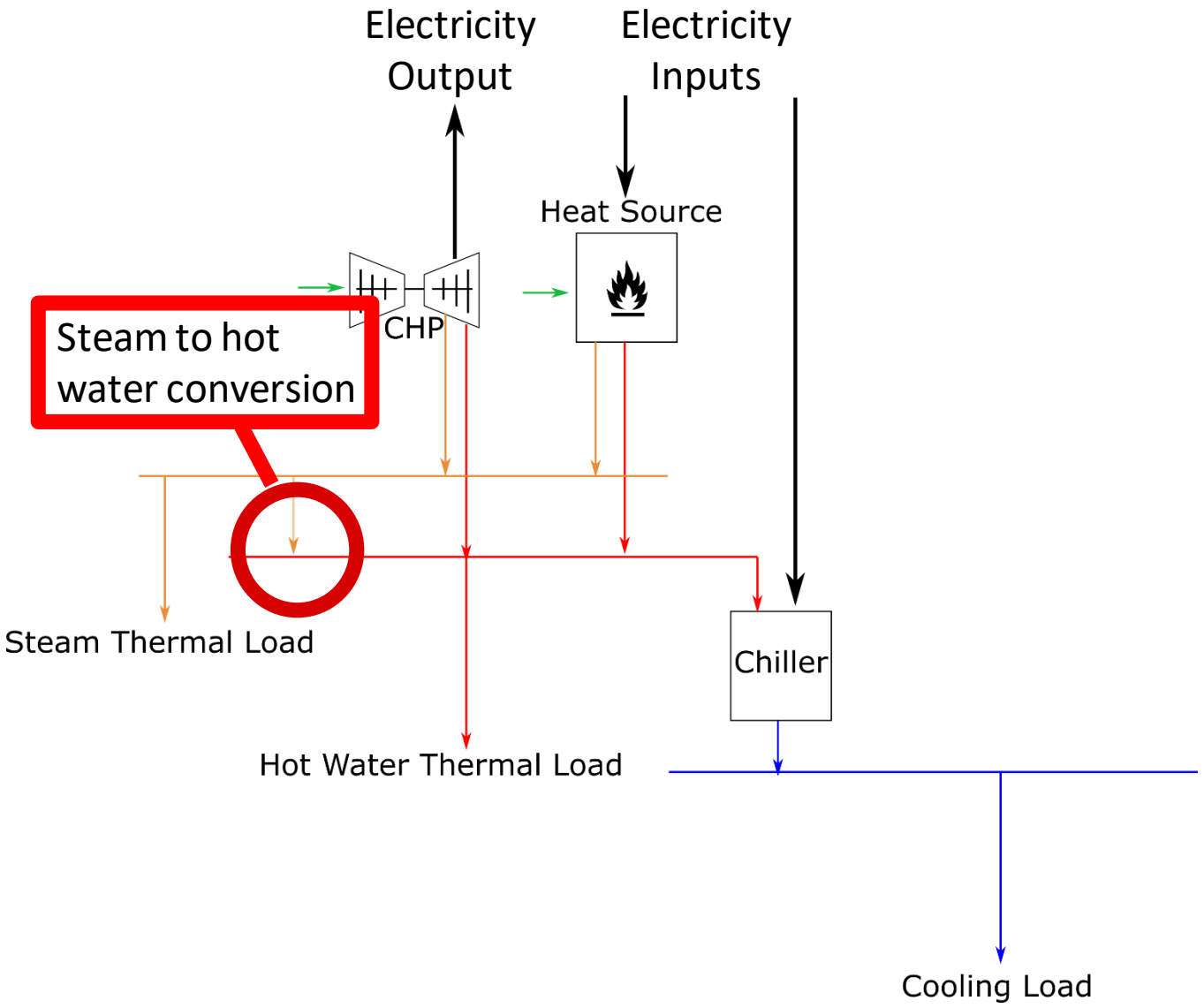
$$\sum_{t=work_{start}}^{work_{end}} ev_{ch_t}$$

$$= \sum_{t=work_{start}}^{work_{end}} ev_{load_t} * work_{controllability} \; for \; every \; day$$

Combined Heat and Power

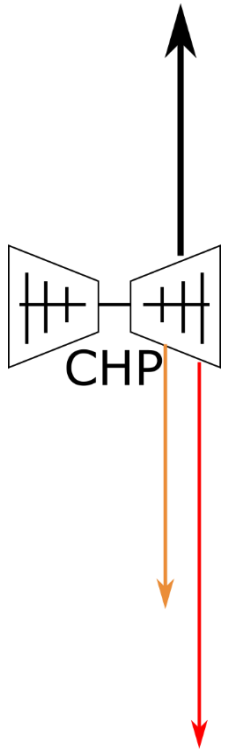
CHP Diagram

- Separate steam, hot water, and cooling thermal loads
- Thermal load must be served by on-site DERs (cannot be supplied by an external grid)
- Steam can be converted to hot water but not the other way around
- Heat can be converted to cooling through a chiller
- Excess heat generation can be ‘dumped’ to make a solution feasible
  - Electric power constraints could cause a conflict



CHP Formulation

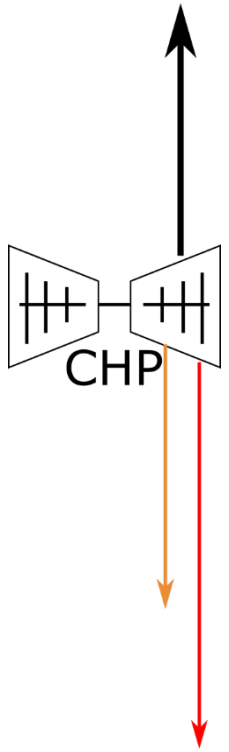
- Constant electric power to heat ratio
  - Applies even if generating at part load



$$\frac{\text{Electric Power (kW)}}{\text{Steam Thermal Power (kW)} + \text{Hot Water Thermal Power (kW)}} = \text{Constant}$$

CHP Formulation

- Maximum steam ratio
  - May over-generate hot water and dump the excess to meet steam load



$$\frac{\text{Steam Thermal Power (kW)}}{\text{Hot Water Thermal Power (kW)}} \leq \text{Constant}$$

CHP continued

- Standard engineering judgement to be included in DER-VET
  - For example, the COP for chillers
    - COP 1.2 two-stage (> 3MW)
    - COP 0.7 single-stage (< 2MW)

- User must use their own knowledge to ensure the thermal loads are addressable by the DERs selected.
  - DER-VET will not consider temperature or any other parameter – only distinguish steam vs hot water.

Next Meeting

Regularly-Scheduled Meetings

- Next Meeting – **Thursday October 1, 11:00 am Pacific Time**

Together…Shaping the Future of Electricity