District Energy Master Plan for UC Davis Primate Research Center

February 27, 2019

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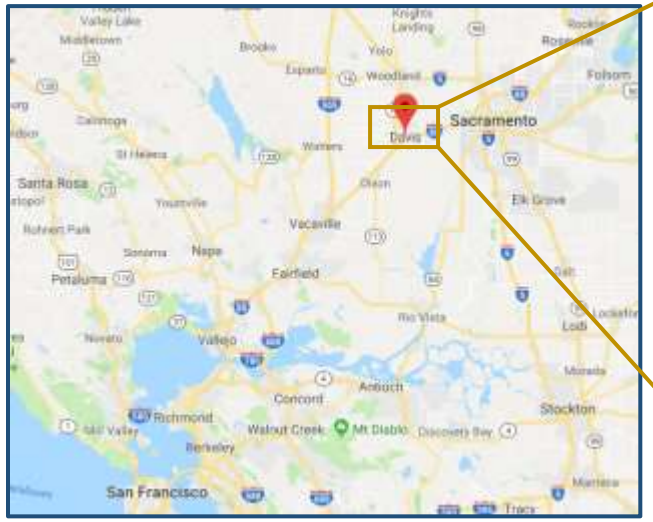
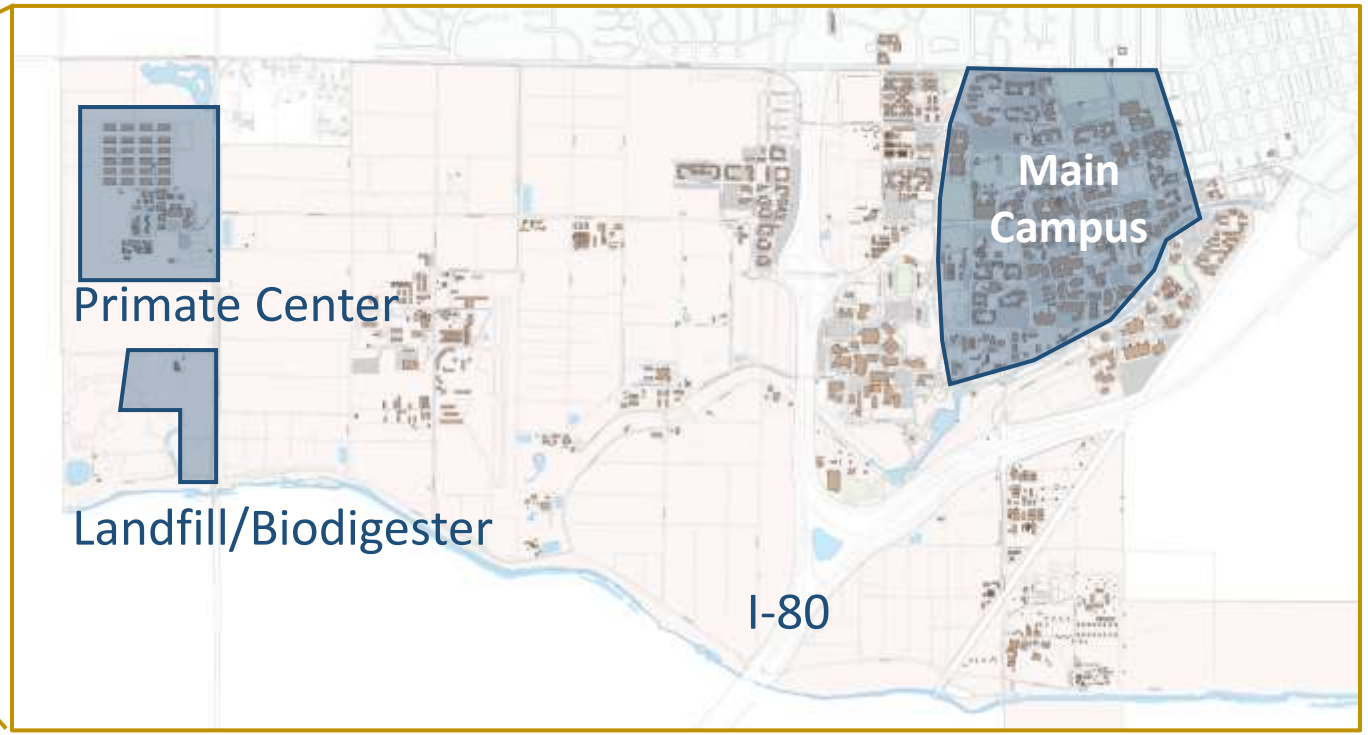
UC Davis Campus

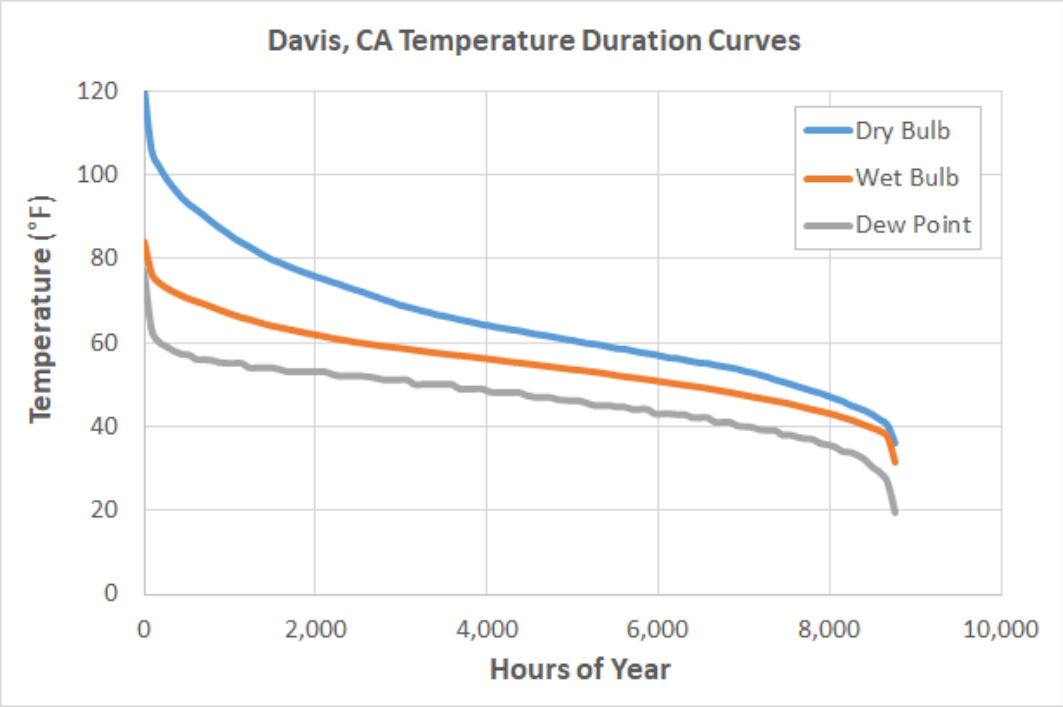
Davis, California

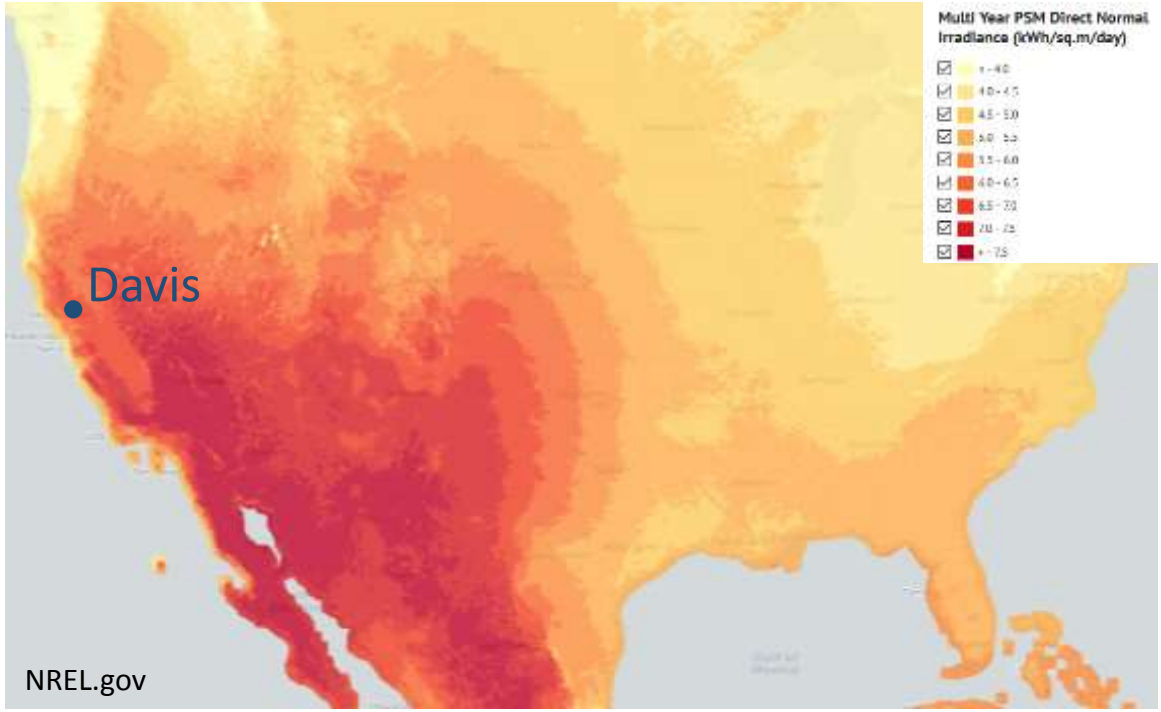


UC Davis Campus



UC Davis Climate





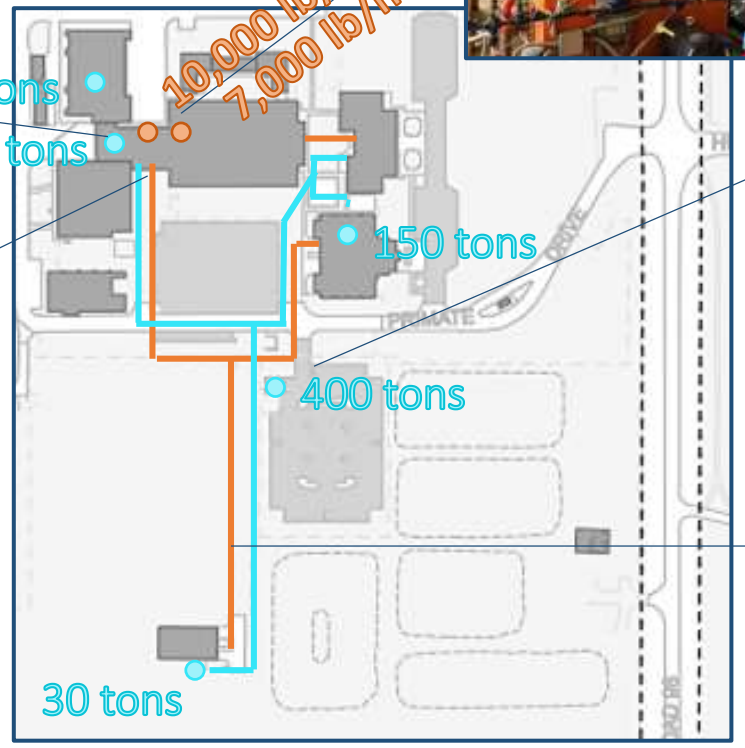
California National Primate Research Center

- CNPRC mission:
  - Improve human health and quality of life through support of exceptional nonhuman primate research programs
- Houses about 4,000 monkeys
- Research areas:
  - Behavior and neuroscience
  - Infectious diseases and immunology
  - Reproduction and regenerative medicine
  - Respiratory biology and disease

Primate District Energy Current Condition

Abs. Chiller
Over 30 yrs old

Boilers
22 yrs old



"New" Chiller and Tower
Repurposed from campus

Cooling Tower
Poor condition

Steam Piping
Needs
renewal
within 10 yrs

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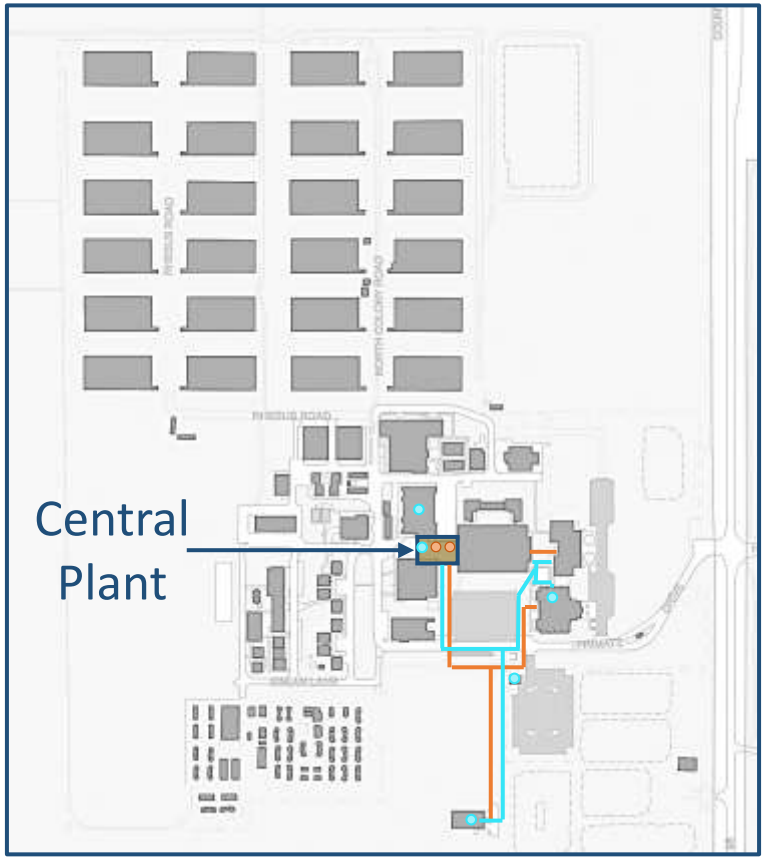
Primate Center District Energy System

UC Davis Primate Center

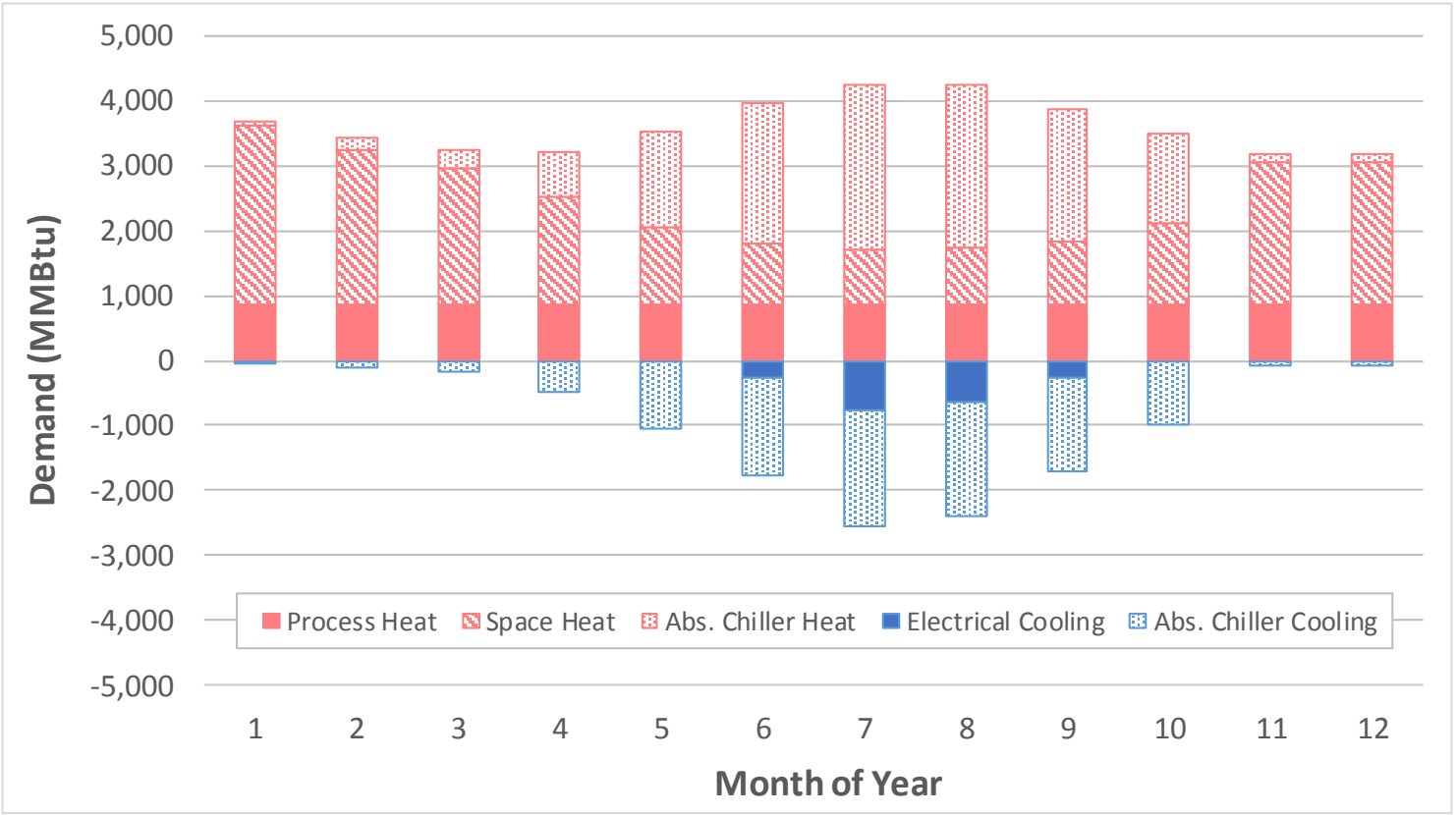


Energy Type	Units	Peak Demand	Installed Capacity
Heating (steam)	MMBtu/hr	> 10	17
Cooling	tons	600	900

Notes:
1. Heating demand includes space heating and cage washing
2. 1 MMBtu = 1,000,000 Btu

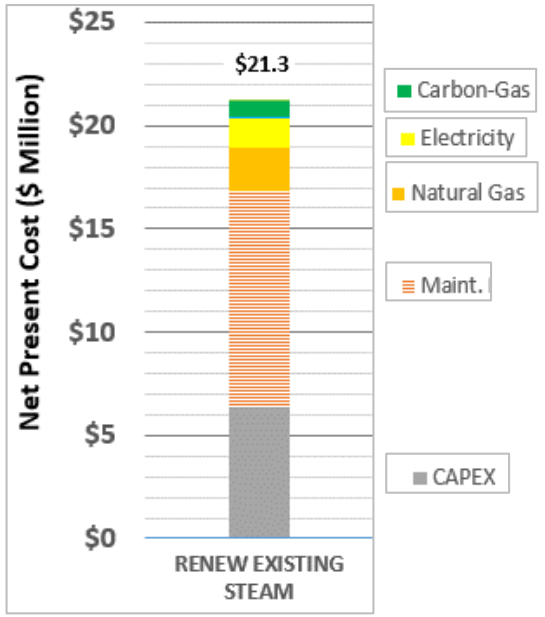
- Floor area = 17,000 ft^2
- Heated area = 8,500 ft^2

Primate Center District Energy Profile



Project Objectives

- Plant and distribution require renewal
- Redundancy needed, future capacity
- Align energy supply with UC initiatives
- Improve efficiency
- Reduce operating costs
- Minimize Life Cycle Cost



UNIVERSITY OF CALIFORNIA Carbon Neutrality Initiative

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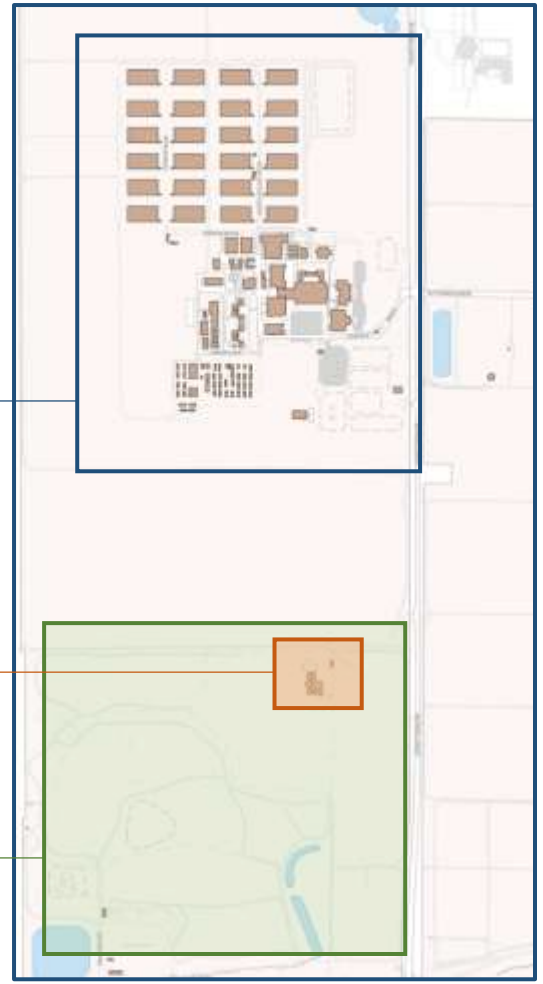
Project Phase: Engineering Study

Identify Options

- Small district and unique location provide opportunities
- Biogas sources within 1 mile, existing pipleine
- Significant surrounding land area
  - Geothermal
  - Solar thermal
  - Solar PV
- Donated solar thermal panels



Project Phase: Engineering Study

Options Investigated

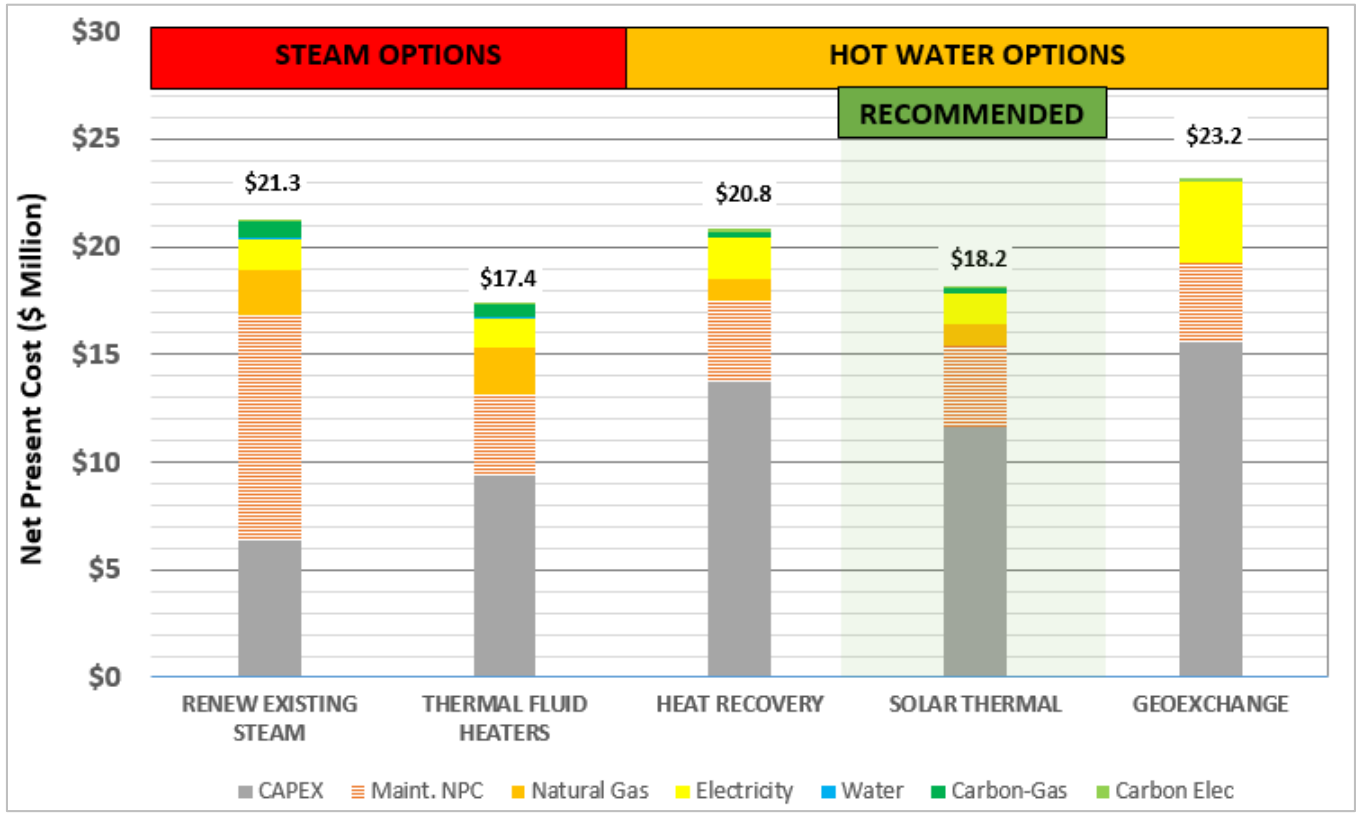
Option	Heating	Cooling
1	Renew existing steam system	Electric chillers, new tower
2	Thermal fluid steam generator	Electric chillers, new tower
3	HW boilers, heat recovery chillers (HRC), TES	HRC, electric chiller, new tower
4	HW boilers, solar thermal panels, TES	Electric chillers, new tower
5	HW boilers, geoexchange, TES	Electric chillers, new tower

Steam Options

Hot Water Options

Project Phase: Engineering Study

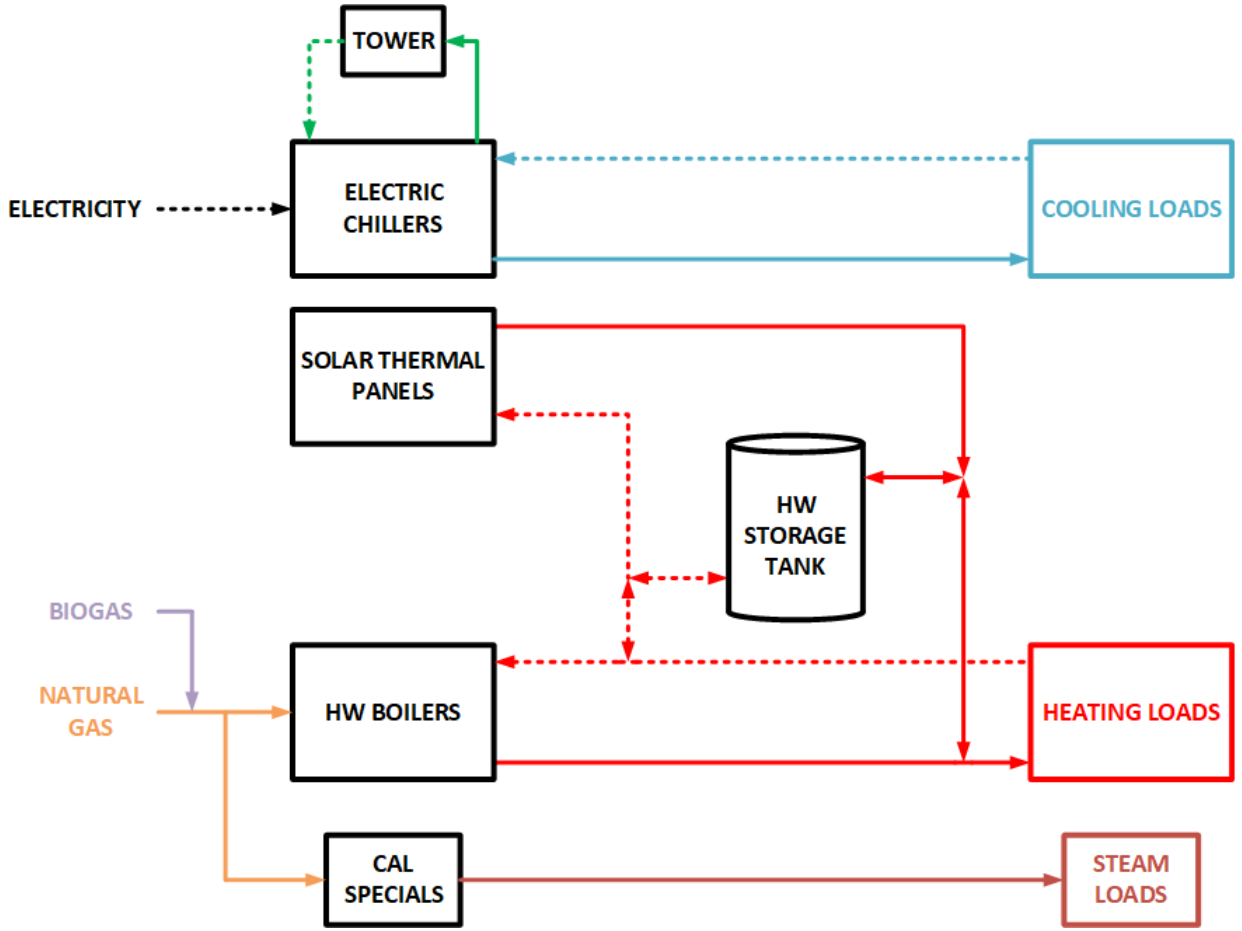
Life Cycle Cost Analysis Results



- Cooling solution same for all options
- HW advantages:
  - Achieve capital renewal
  - Lower energy use
  - Lower carbon
  - No boiler watch
- Solar thermal advantages:
  - Leverage donated panels
  - Rebates

Project Phase: Engineering Study

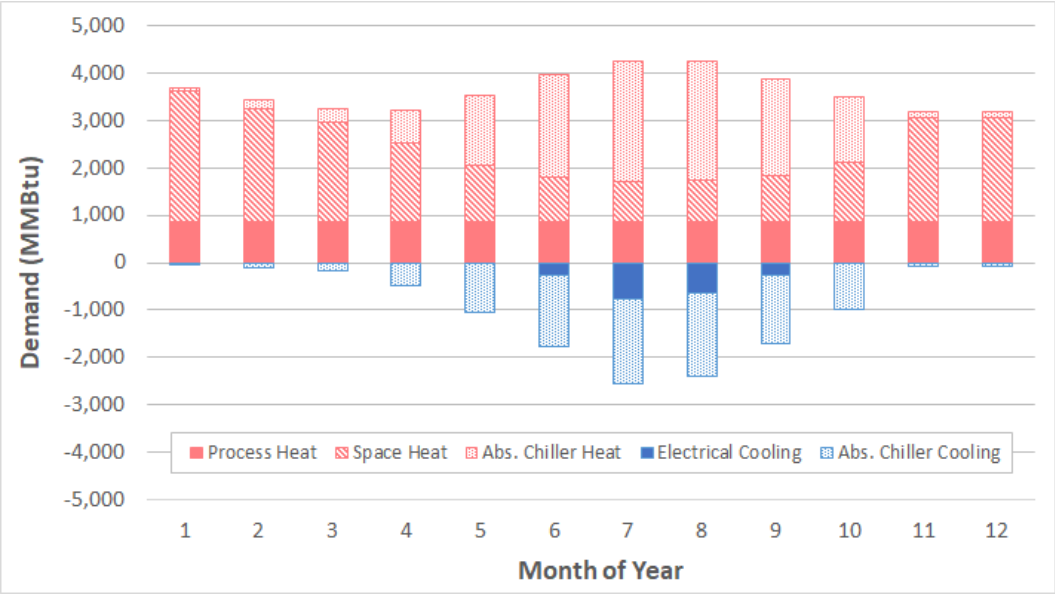
Selected Option Details



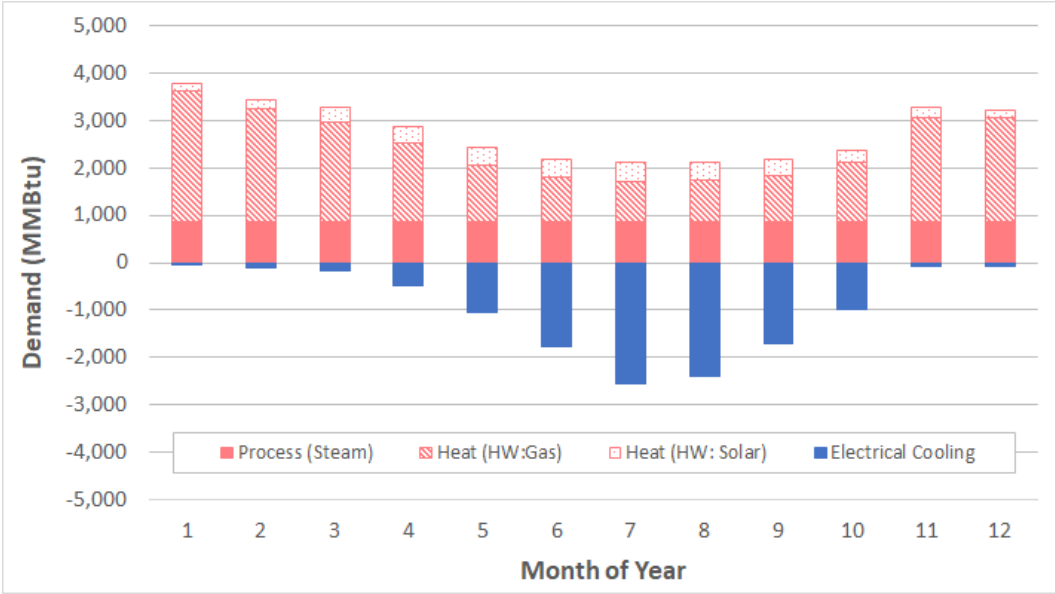
Project Phase: Engineering Study

Selected Option Details

Existing Energy Demand



Selected Option Energy Demand



Project Phase: Engineering Study

Selected Option Details

Primate Center District

300 Panels
4,000 MMBtu/yr
15-20% of heat load

Project Phase: Engineering Study

Selected Option Details

Cal Solar Initiative (PG&E Incentive)

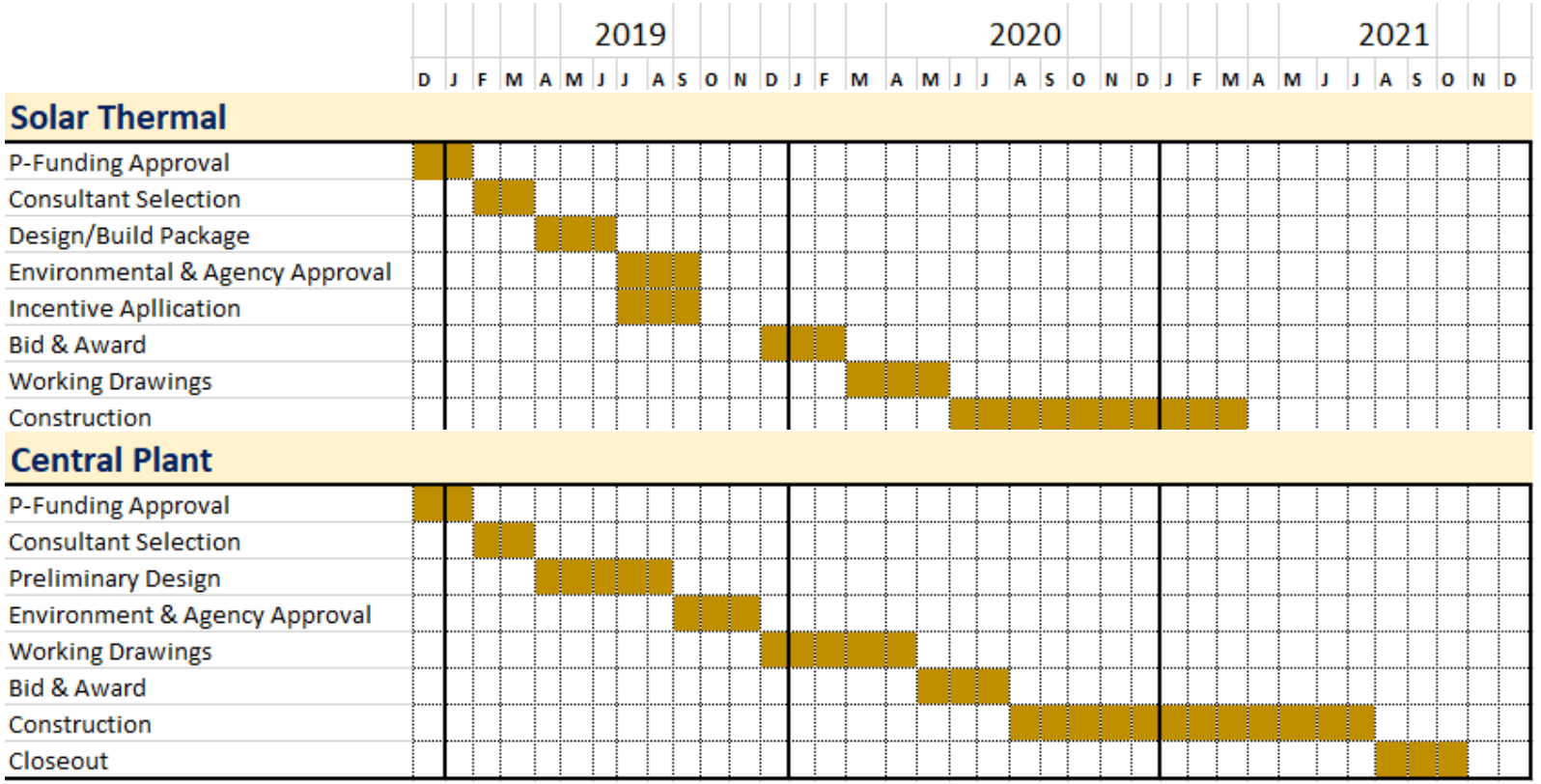
- $20/therm rebate to offset gas

$800k Rebate Potential

$1.8 MM Const. Cost (Solar Only)

Project Phase: Engineering Study

Selected Option Details



Project Phase: Engineering Study

Selected Option Details

Comparison of Existing and Selected Option Energy Use

Parameter	Units	Existing	Selected Option
Gas	MMBtu/yr	40,000	33,500
Steam production	MMBtu/yr	32,000	10,000
Hot water production (gas)	MMBtu/yr	0	18,000
Hot water production (solar)	MMBtu/yr	0	3,500
Electrical power (cooling)	MWh/yr	100	1,000

- Addition of electric chillers increases electricity but decreases gas
- Hot water supplies about 15% of annual heat load
- Fewer distribution losses for HW
- Improved HW boiler efficiency
- Process steam by local package boilers

Conclusions

- Unique site location offers attractive energy options for district energy plan
- Solar thermal and gas fuel hot water production
- HW production and distribution decrease operating expenses
- Biogas/landfill gas could satisfy entire gas demand
- Market incentives offset some construction costs
- Planned project completion in 2021

Questions