MICROGRIDS

Relevant LBNL Work on Solar Heating and Cooling

Chris Marnay

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(collaborators: Wei 冯威 Feng, Nicholas DeForest, Judy Lai, Jason MacDonald, Andrea Mammoli, Gonçalo Mendes, Afzal Siddiqui, Michael Stadler, Johannes Thiemann, Nan 周 南 Zhou)

presentation at

First Task Definition Workshop

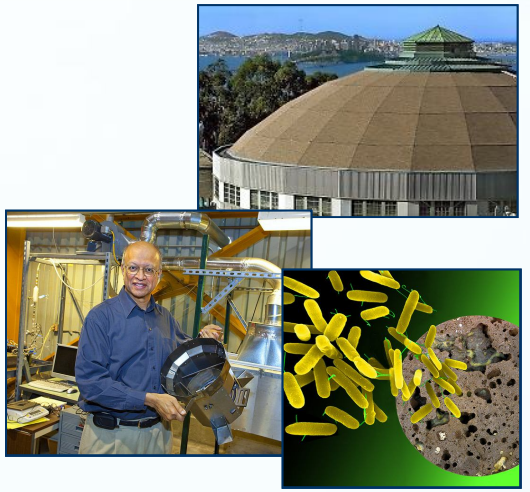
New IEA Task on New Generation Solar Cooling Systems

Paris, 21 Mar 2013

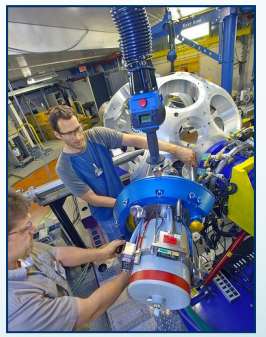
Berkeley Lab

Managed by the University of California for the United States Department of Energy

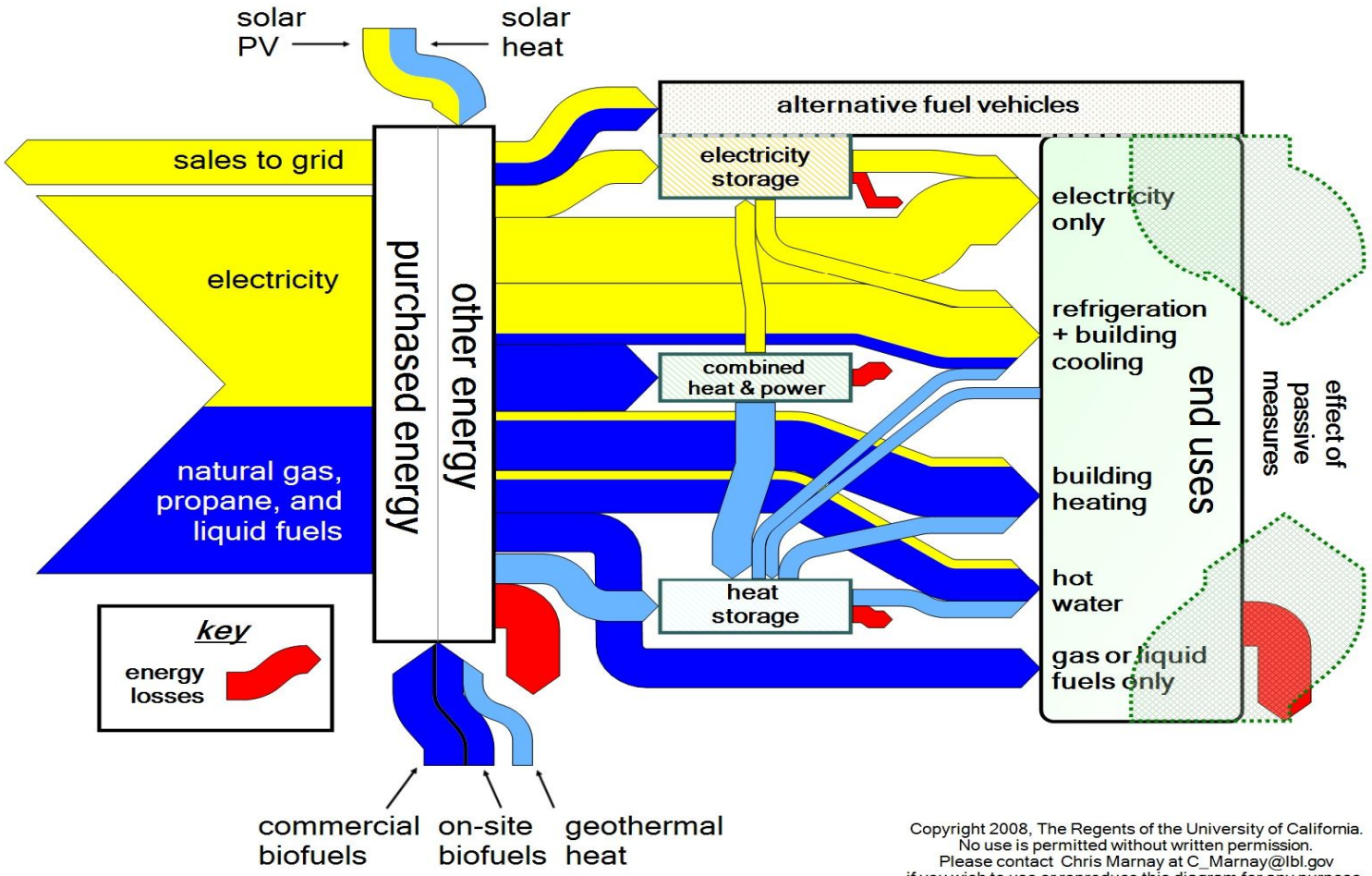
Lawrence Berkeley National Laboratory



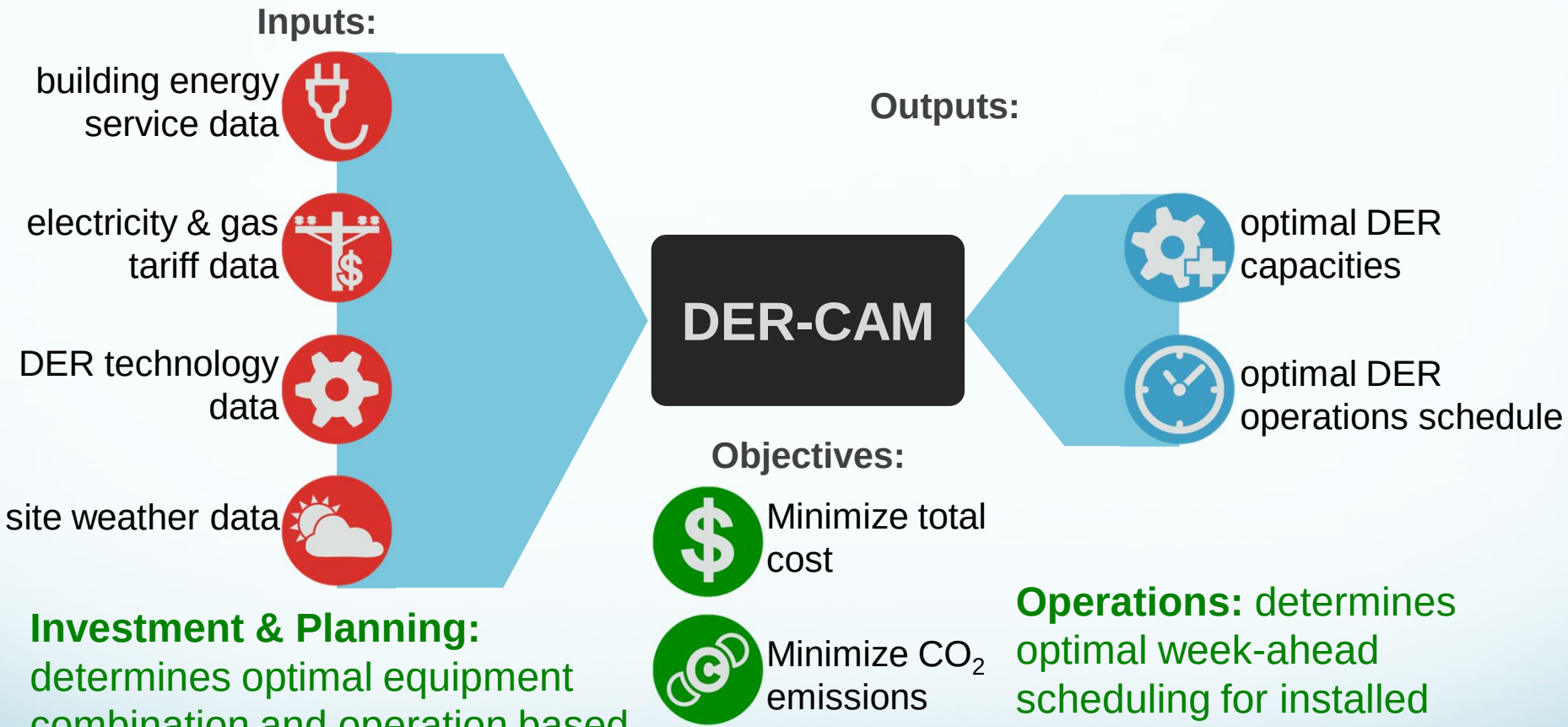
- 80 ha next to U.C. Berkeley campus, ≈4500 employees, ≈half technical
- broad research areas, & typically ≈600 foreign visitors at any time
  - National Energy Research Scientific Computing Center (NERSC)
  - Joint Genome Institute (JGI), Joint BioEnergy Institute (JBEI)
  - Energy Biosciences Institute (Helios), world's biggest public partnership, etc.
- Environmental Energy Technologies Division
  broad interdisciplinary research agenda, but with a buildings focus
- Grid Integration Group focused on microgrids, demand response, & storage
  within Energy Storage and Distributed Resources Dept.
  with batteries, fuel cells, combustion, etc.



DER-CAM Concept



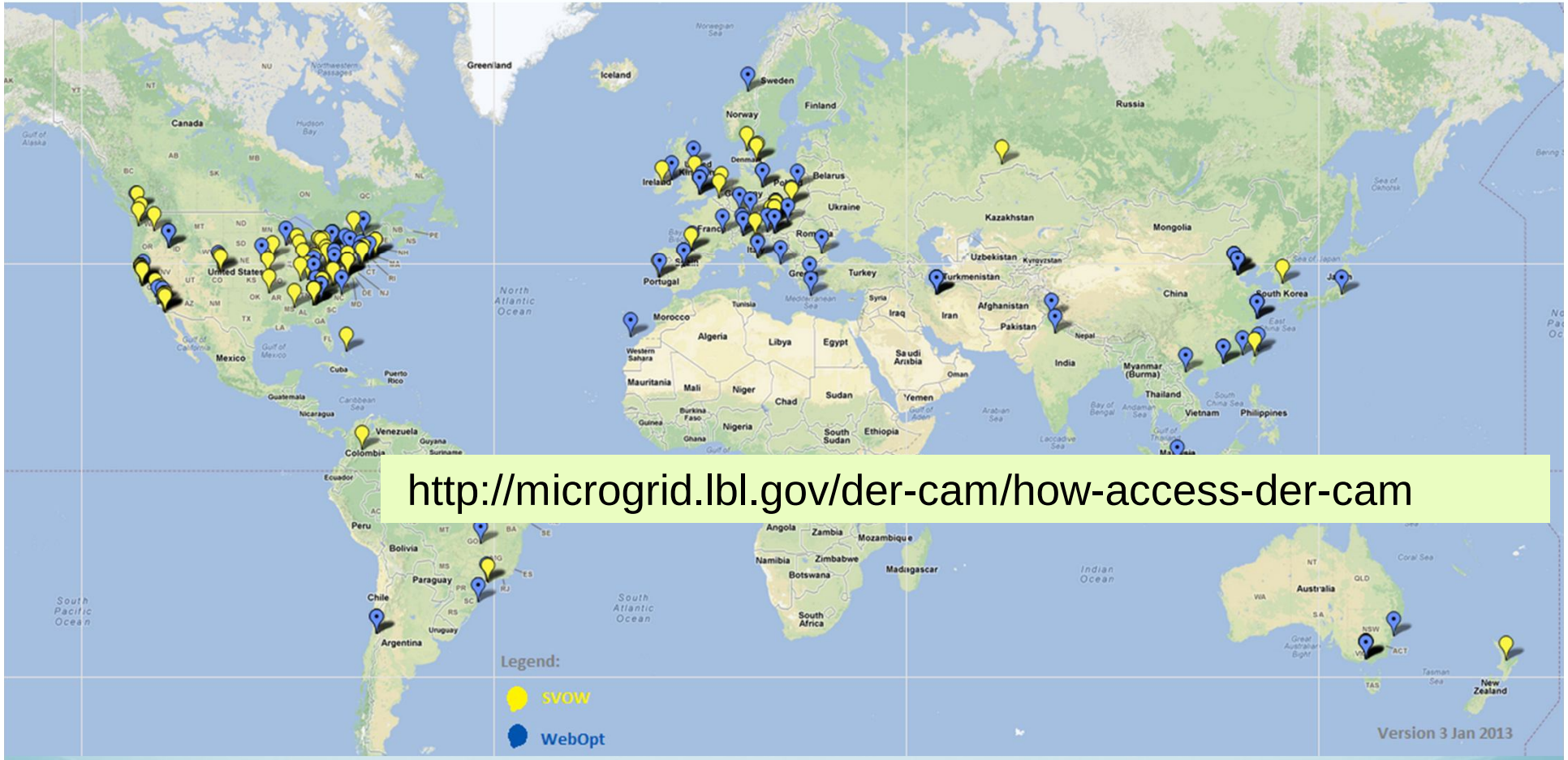
DER-CAM Data Flow



Investment & Planning: determines optimal equipment combination and operation based on *historic* load data, weather, and tariffs

Operations: determines optimal week-ahead scheduling for installed equipment and *forecasted* loads, weather and tariffs

DER-CAM Users



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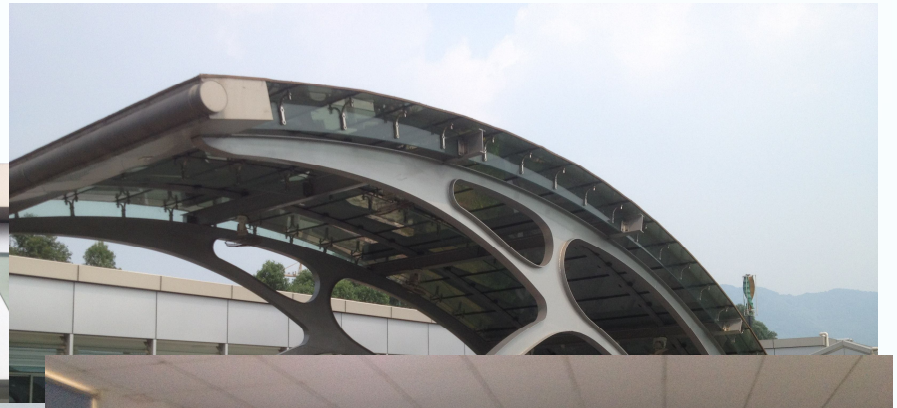
UNM Mech. Eng. Blg.

XingYe HQ Building, Zhuhai



Summary

- introduction to Berkeley Lab
- interest in new task
  - inputs from A, other technology performance, building loads, tariffs, etc.
  - produce optimal equipment fleets and operating schedules
  - B2: control strategy analysis & optimisation (also B1 & B5, C & D)
- ongoing R&D
  - control of UNM Mech. Eng. Building, and others in Albuquerque (Prof. Andrea Mammoli partner)
  - collaboration with Chinese researchers on solar applications
  - optimisation of microgrids generally
- input and responsibilities to task
  - optimisation of complex mixed systems
  - analysis of single buildings, or market assessment
  - actual closed-loop building control demonstration
  - analysis in support of dissemination

Thank you!

http://microgrid.lbl.gov

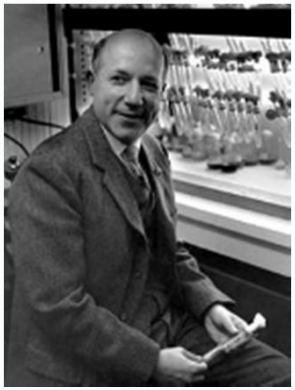
http://www.youtube.com/watchv=3XuCJBvq6Sk

Lawrence Introduces Big Team Science

LBNL: The First DOE National Laboratory

13 Nobel Prizes

Luis W. Alvarez



Melvin Calvin

Owen Chamberlain

Steven Chu

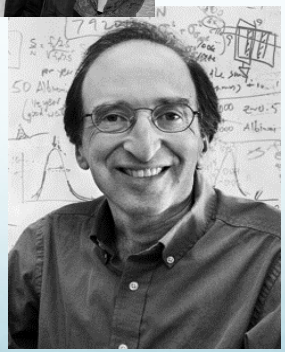
Donald A. Glaser

Ernest Orlando Lawrence

Intergovernmental Panel on Climate Change (IPCC)

Yuan T. Lee

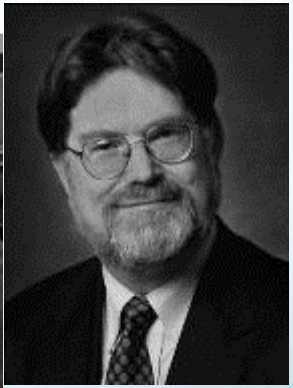
Edwin M. McMillan



Saul Perlmutter

Glenn T. Seaborg

Emilio G. Segrè



George F. Smoot

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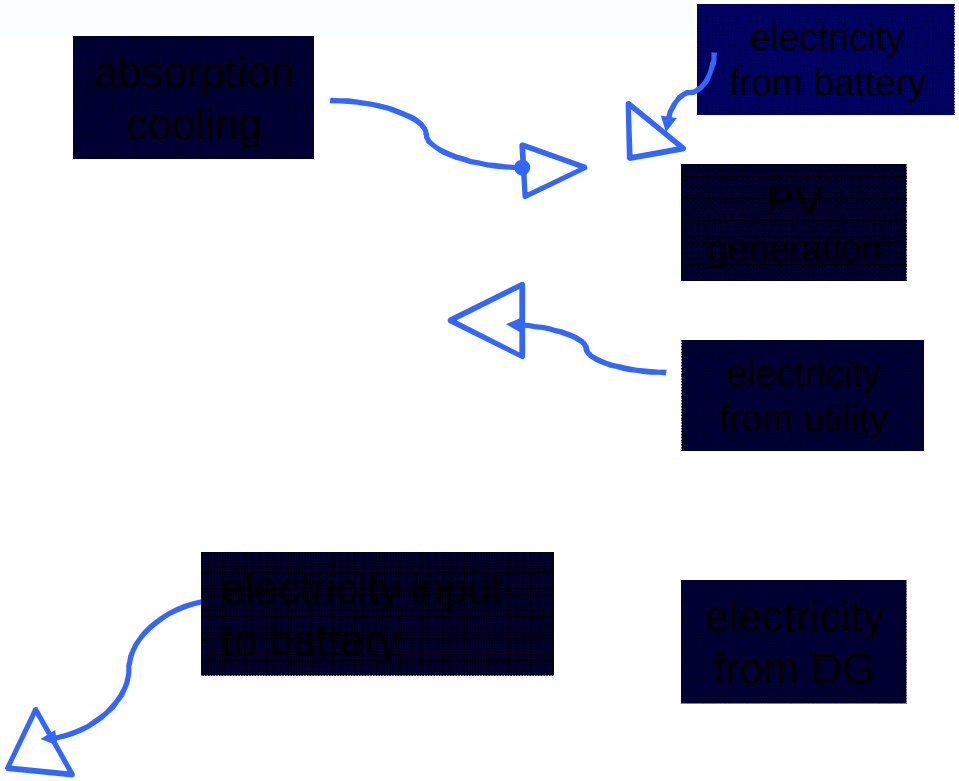
CO_2 Min. of a S.F. Hospital

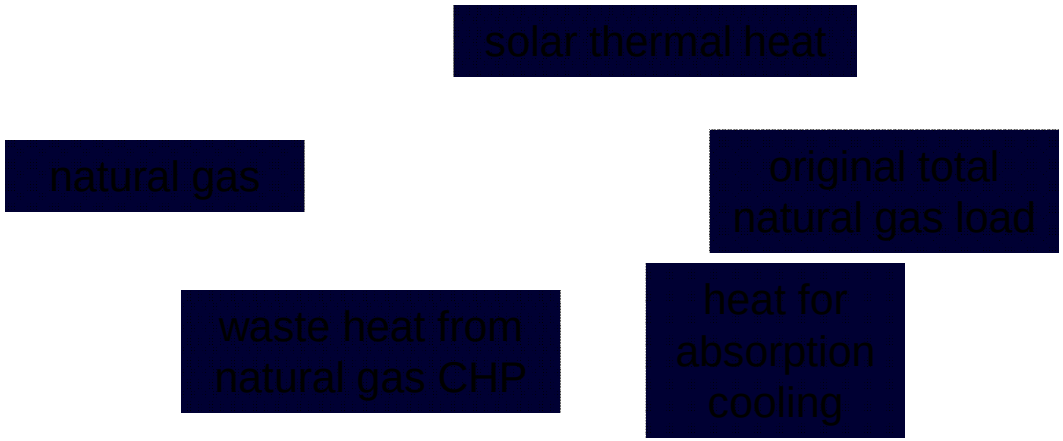
- large San Francisco health care building
  1.8 MW peak, 11 GWh/a
- flat loads, typical diurnal minimum ≈800 kW, 70% CF
- CO2 minimizing lowers footprint by 39%
- 1.42 MW CHP (4 x 250 & 7 x 60), 404 kW PV
- 742 kWh bat., 265 kWt solar thermal
- 180 k$ or 9% increase in annual energy bill
- limited by solar area constraint & clean grid power

Electricity Balance



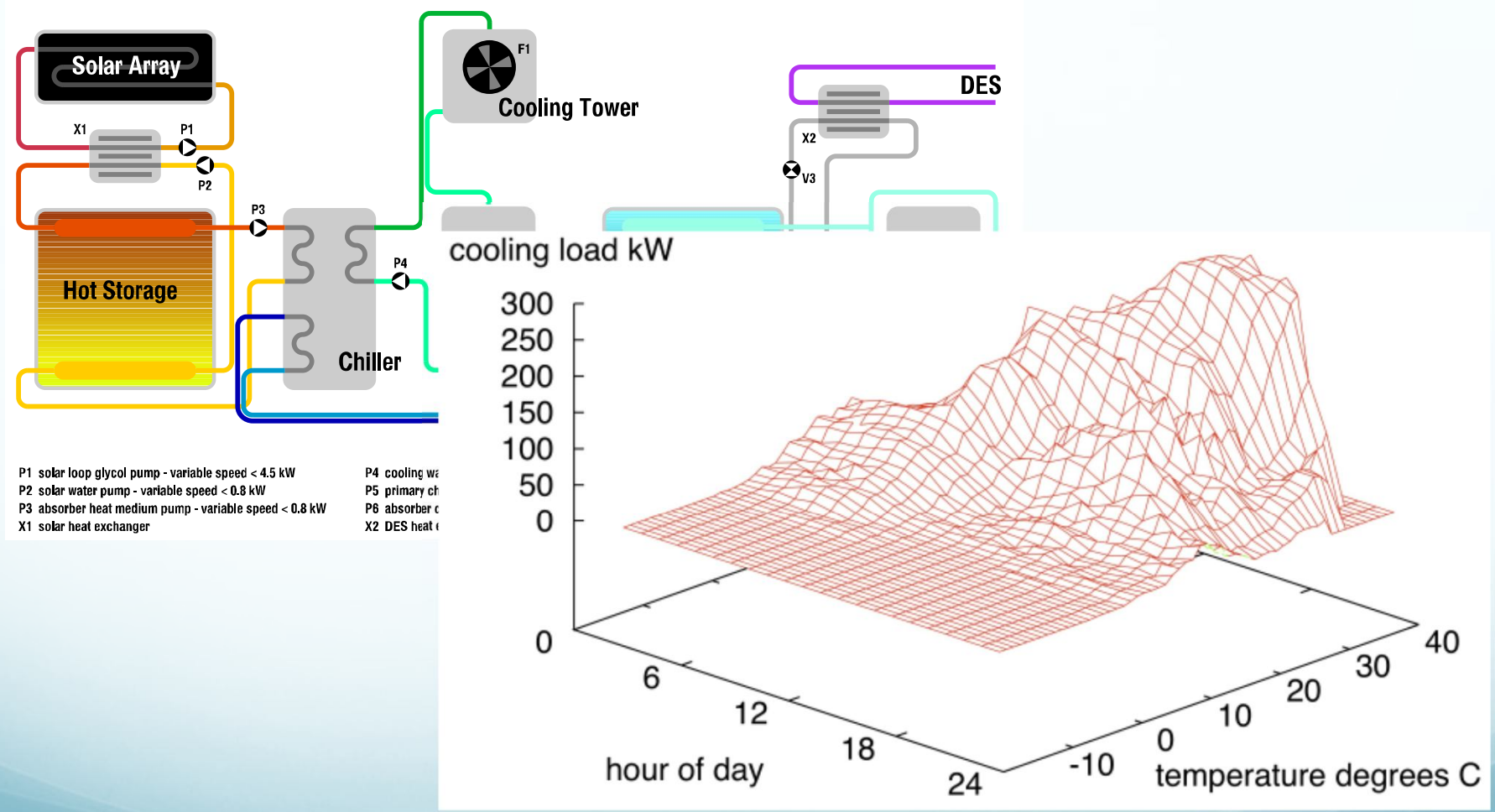
July weekday

Heat Balance

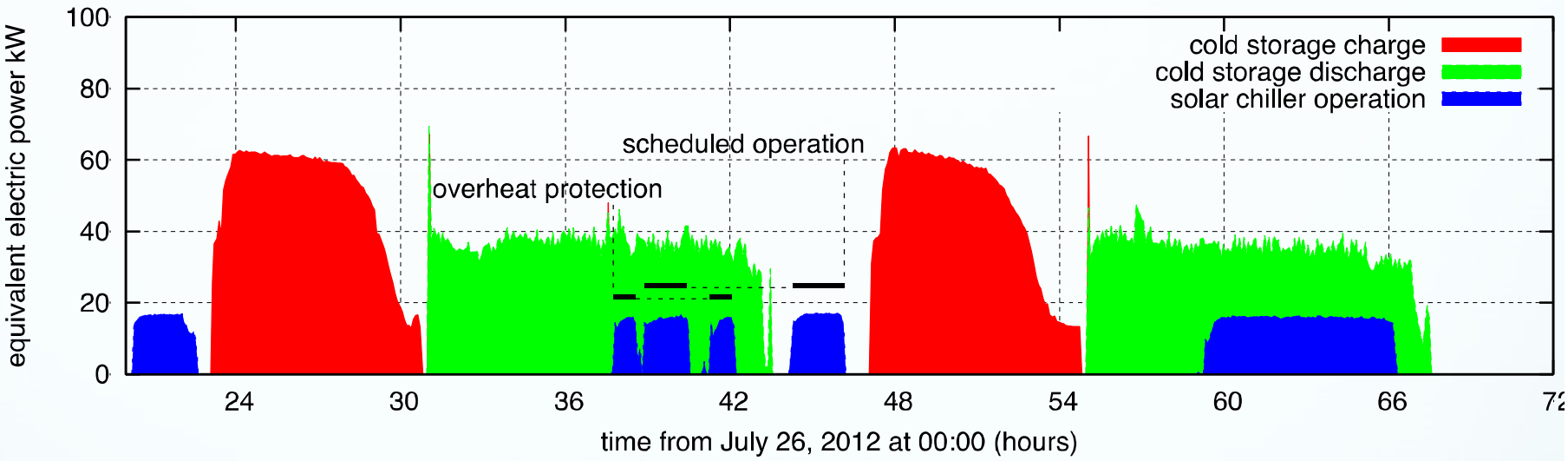


July weekday

UNM ME Building Thermal System



Scheduling Comparison



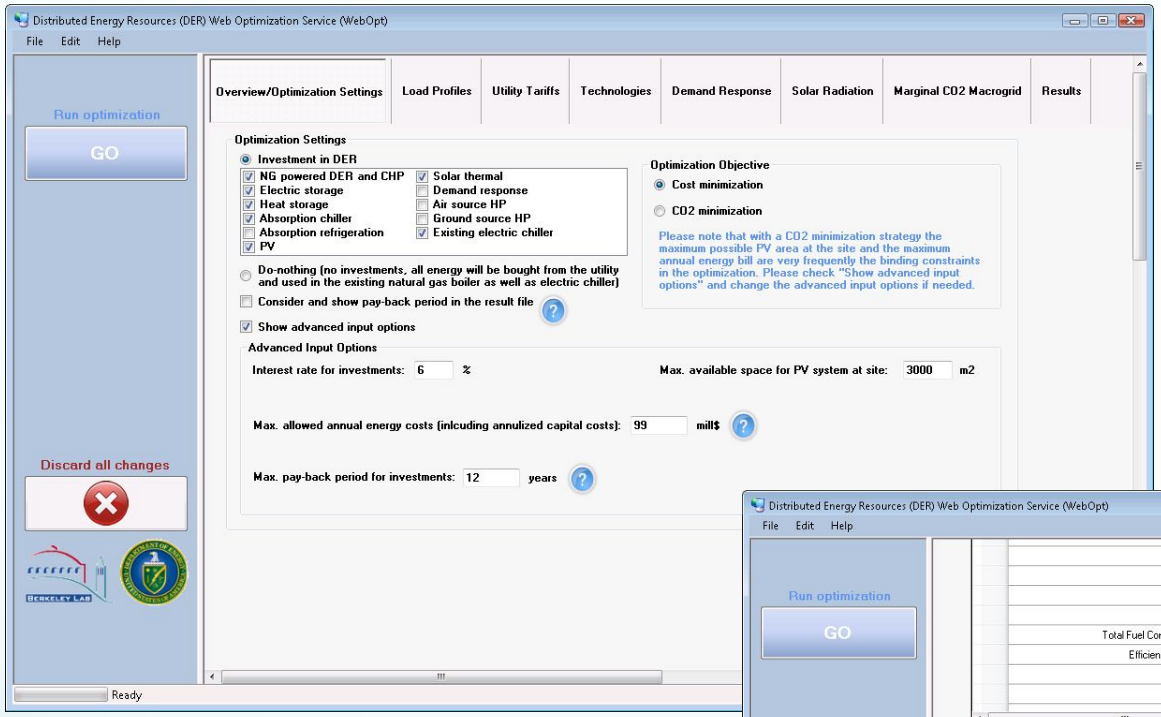
- **Alternate weeks used standard scheduling and Operations DER-CAM**

  schedules not dramatically different

  use of absorption chiller is different

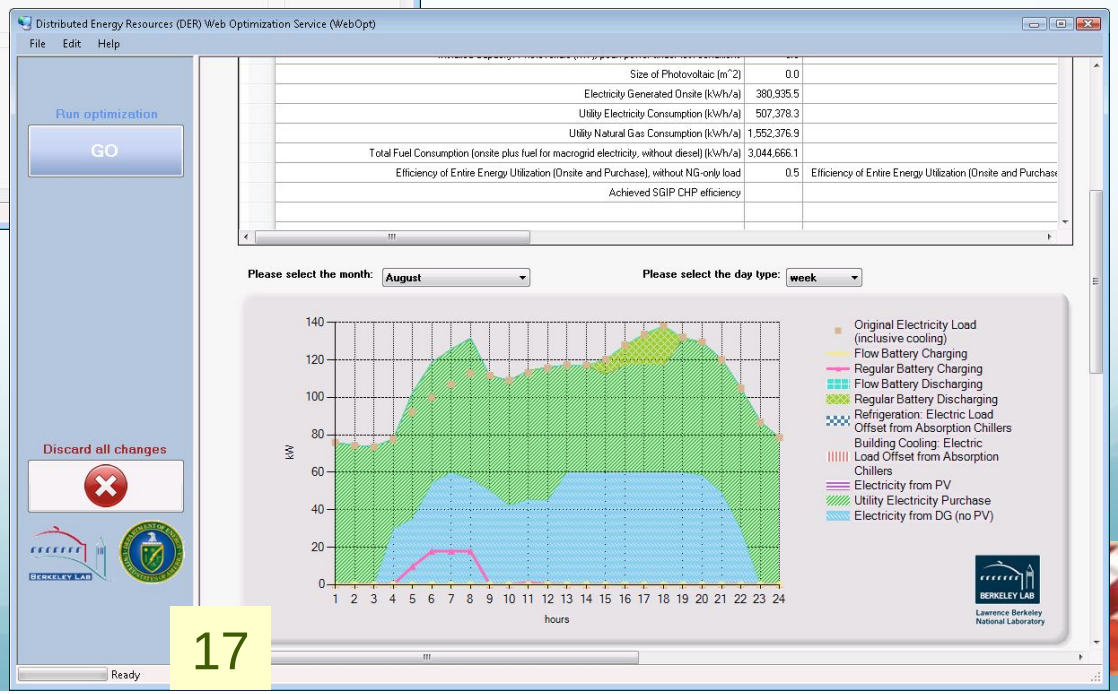
  already low costs reduced by 30%

Investment & Planning (WebOpt)



DER-CAM Web-Service for natural gas fired CHP, PV, solar thermal, electric storage, heat pumps, and absorption chillers

- no direct EMS coupling / feedback



http://microgrid.lbl.gov/der-cam/how-access-der-cam

BERKELEY LAB

Operations DER-CAM Data Flow