CREST

Center for Research in Energy Systems Transformation

Open House
12:45 to 4pm, 406 Cory Hall

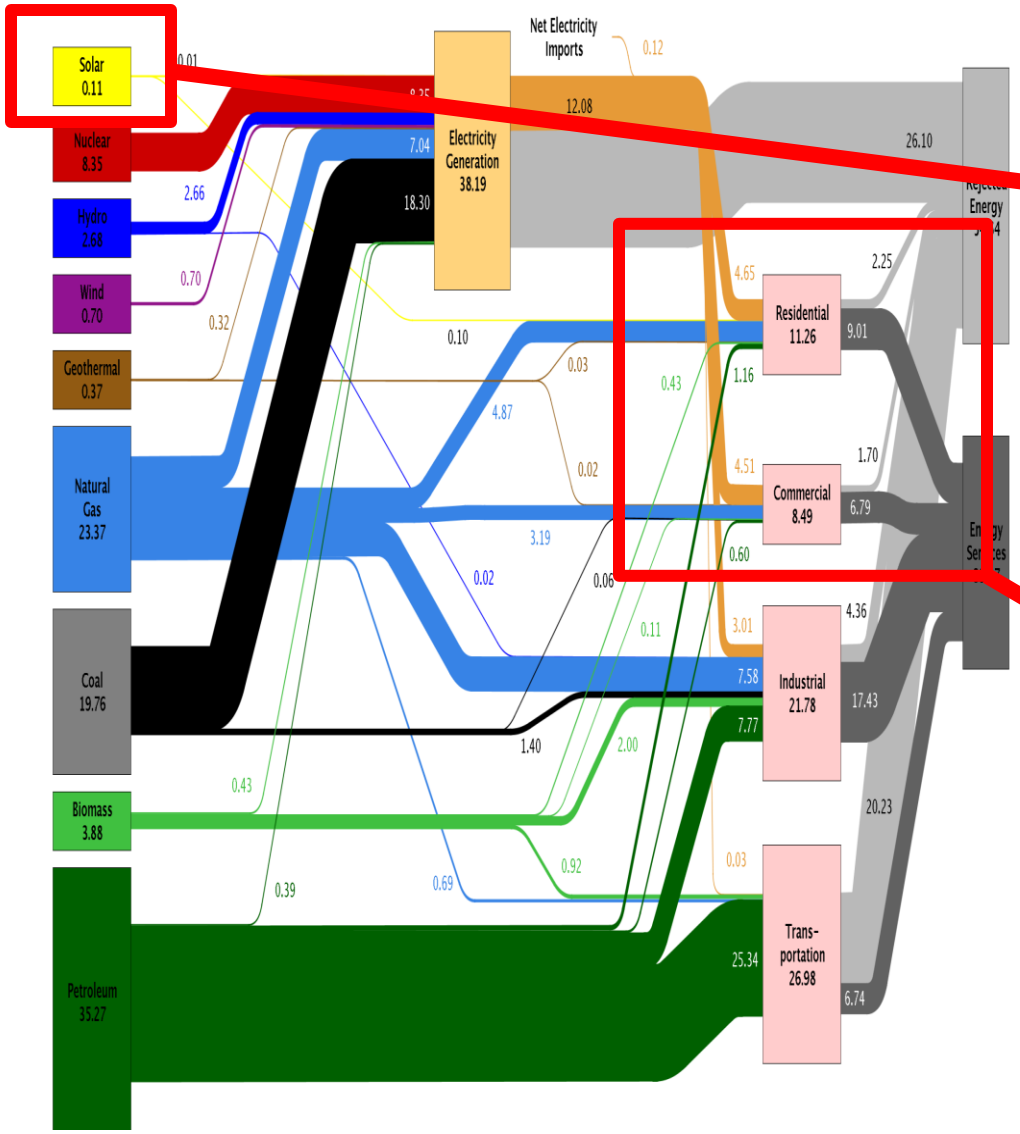
Patrick Scaglia and Costas Spanos
plus ~20 UCB PIs and ~30 International Collaborators

Mehdi Maasoumy

PhD Candidate

University of California, Berkeley

US Energy System and important sub-systems

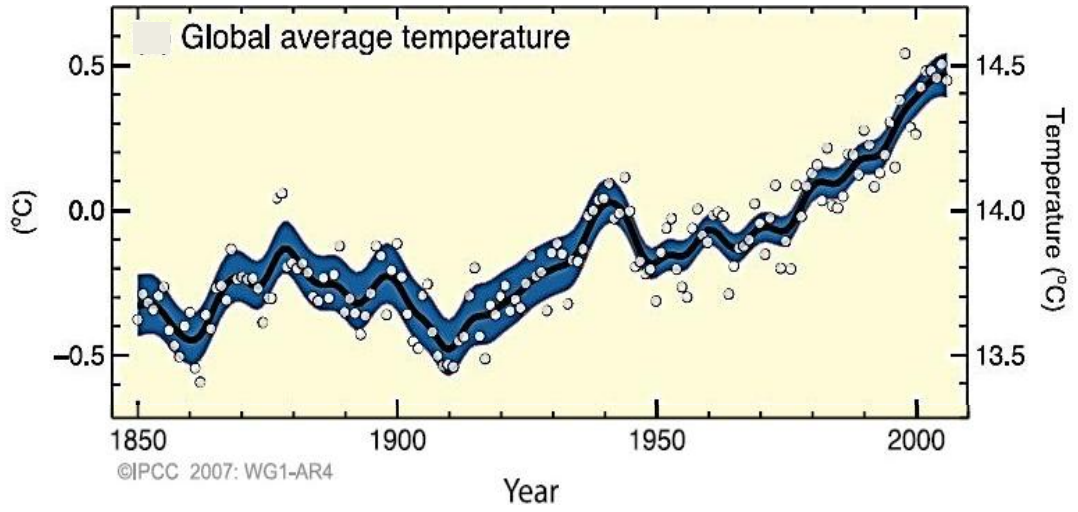


Materials ⇔ Systems ⇔
Grid Integration ⇔ D-R ⇔
Markets ⇔ Policy

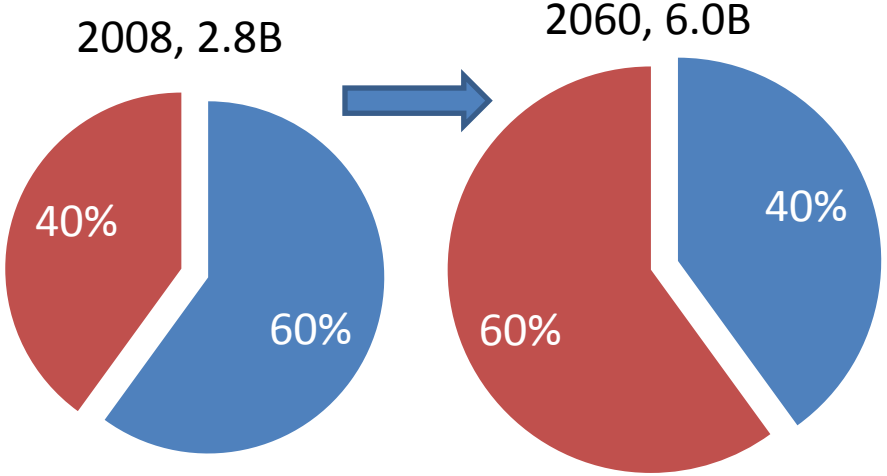
Grid ⇔ Building ⇔
Occupant ⇔ Design ⇔
Materials ⇔ Life Cycle ⇔
Policy

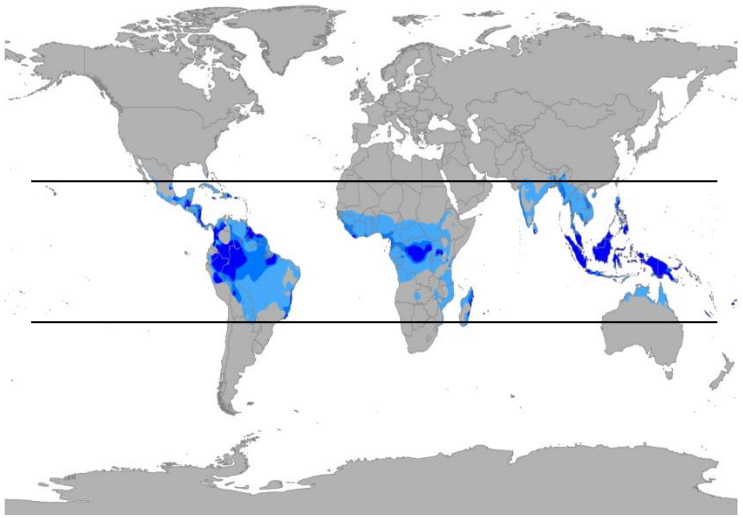
Courtesy LLNL

Climatic and Demographic Change



People Living in the Tropics





Energy Systems *must* Change

- **California Global Warming Solutions Act:**
  - Reduce greenhouse gas emissions to 1990 levels by 2020 (30% below the 600 MMT forecast).
  - A further 80% cut below 1990 threshold by 2050.
- **European Union Renewables Directive:**
  - Member states to produce a pre-agreed % of energy consumption from renewable sources
  - EU as a whole shall obtain at least 20% of total energy consumption from renewables by 2020.
- **Singapore Energy Conservation Bill:**
  - Reduce its greenhouse gas (GHG) emissions by 16% from the 2020 business-as-usual scenario.
  - Reduce its energy intensity by 35% from 2005 levels by 2030.

…

CREST Ecosystem

US

China

CREST

Roadmapping
International policy
Business models

Next Generation Lighting (Marvell)

Living Lab for the Built Environment (Siemens)

Tsinghua

Sustainable Tropical Buildings

Innovative Materials for Energy

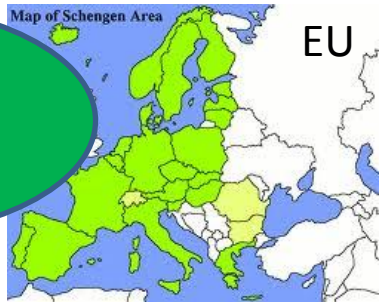
Open Source Test Beds

BEARS (NRF, NTU, NUS)

Singapore

TI

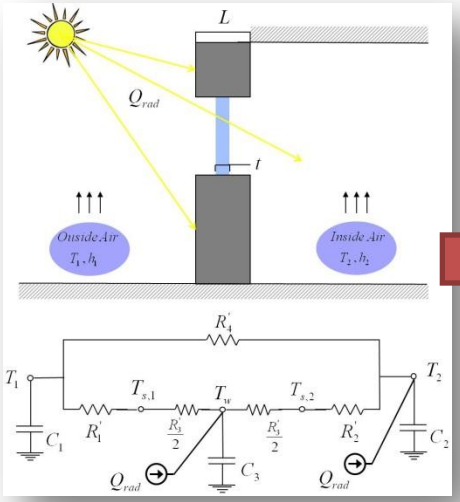
EU



Example: SinBerBEST

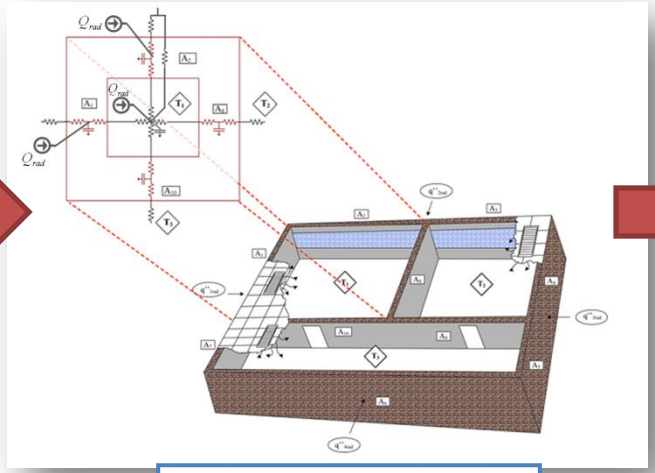
Energy in Smart Tropical Buildings

Mathematical Model



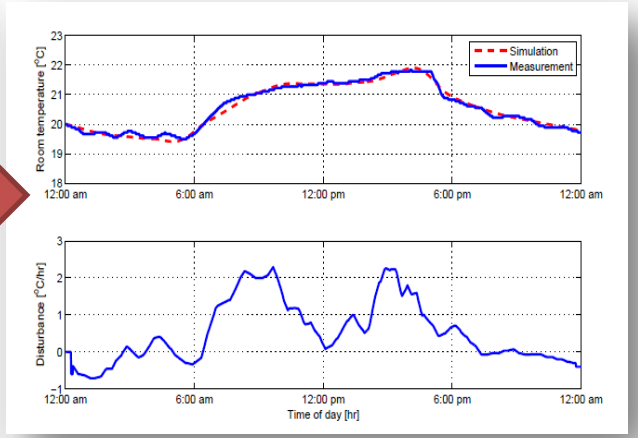
$$\frac{dT_{w_i}}{dt} = \frac{1}{C_{w_i}}\left[\sum_{j\in\mathcal{N}_{w_i}} \frac{T_j - T_{w_i}}{R'_{ij}} + r_i\alpha_i A_i q''_{rad_i}\right]$$

Scale-up to Building Level

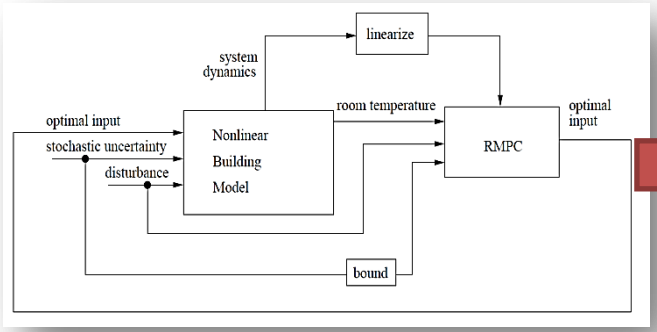


$$\dot{x}(t) = Ax(t) + Bu(t) + d(t)$$
$$y(t) = Cx(t)$$

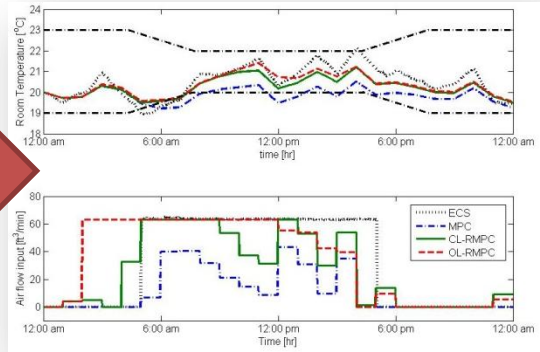
Data-Driven Predictive Model



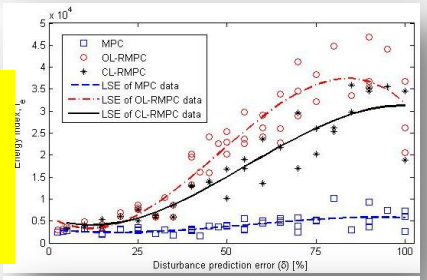
Control Architecture

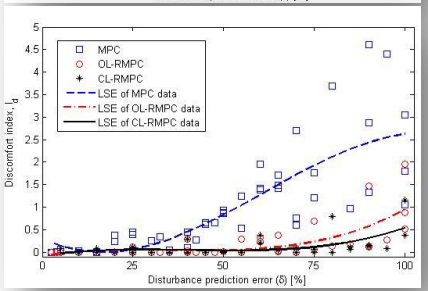


Optimal Performance



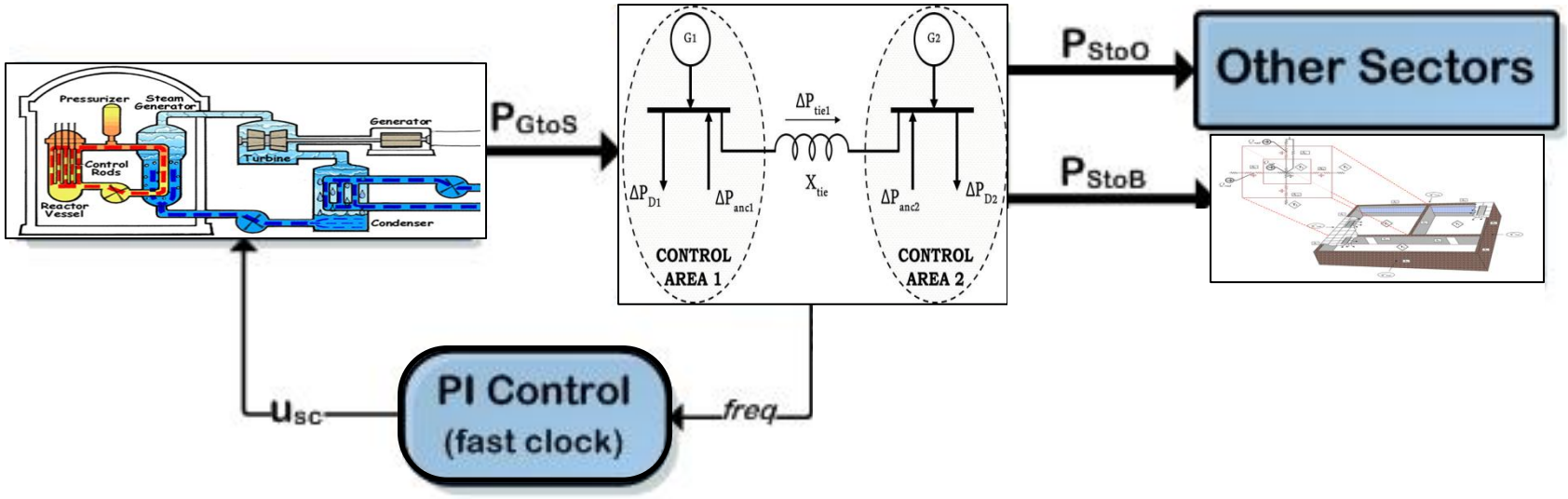
Energy Saving > 50%





Example: SinBerBEST

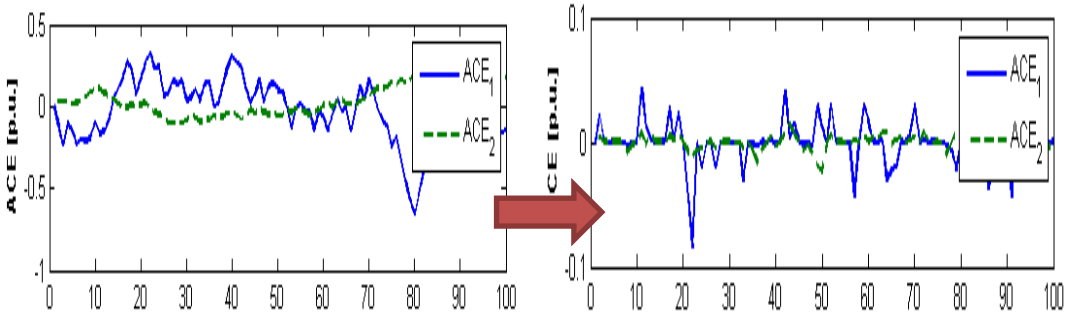
Ancillary service to Grid from Buildings



$$\min_{u_{anc}} \quad \sum_{i=1}^{n} \int (ACE^i(t))^2 \, dt$$

s.t.
$$x(k+1) = Ax(k) + B_2 u_{anc}(k) + Ed(k)$$
$$U_{anc}^{min}(k) \le u_{anc}(k) \le U_{anc}^{max}(k)$$
$$|u_{anc}(k) - u_{anc}(k+1)| \le L_{anc}^{max}(k)$$

Where: $ACE_i = \Delta P_{tie}^i + \beta^i x_1^i$

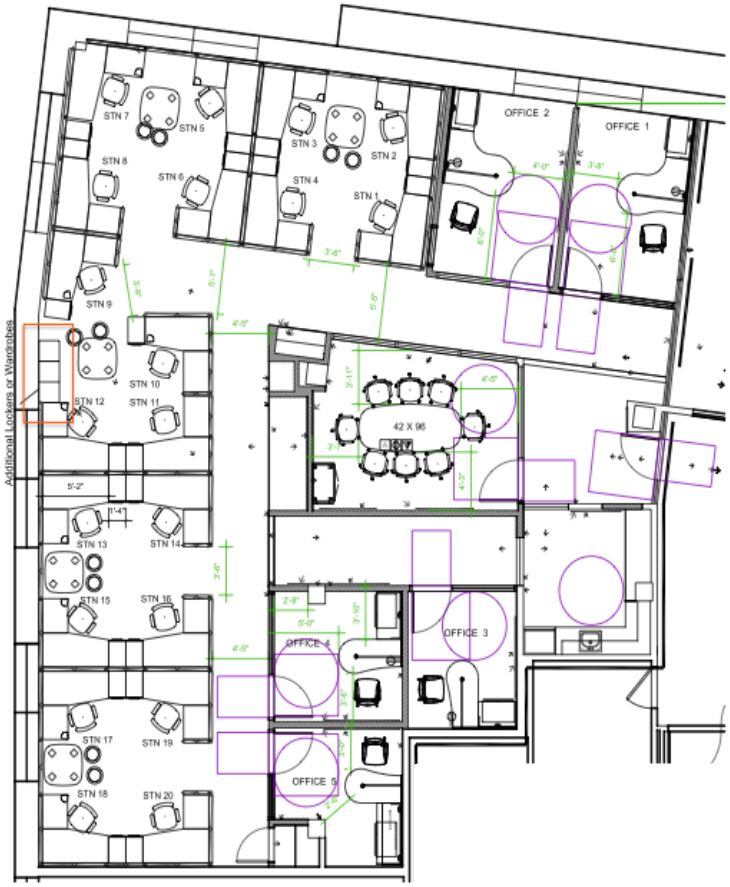


ACE(rms)=1.06
No Ancillary

20X reduction

ACE(rms)=0.05
With Ancillary

visit our brand new headquarters



Lunch 12:45 - 1:30pm

Poster Session 1:30 - 4pm

Overview & Introductions 2 - 3:30pm

406 Cory Hall