Assessing the role of heat-driven electricity demand in buildings on power plant emissions, air quality and health in a warming climate.

Douglas Ahl, Seventhwave

David Abel

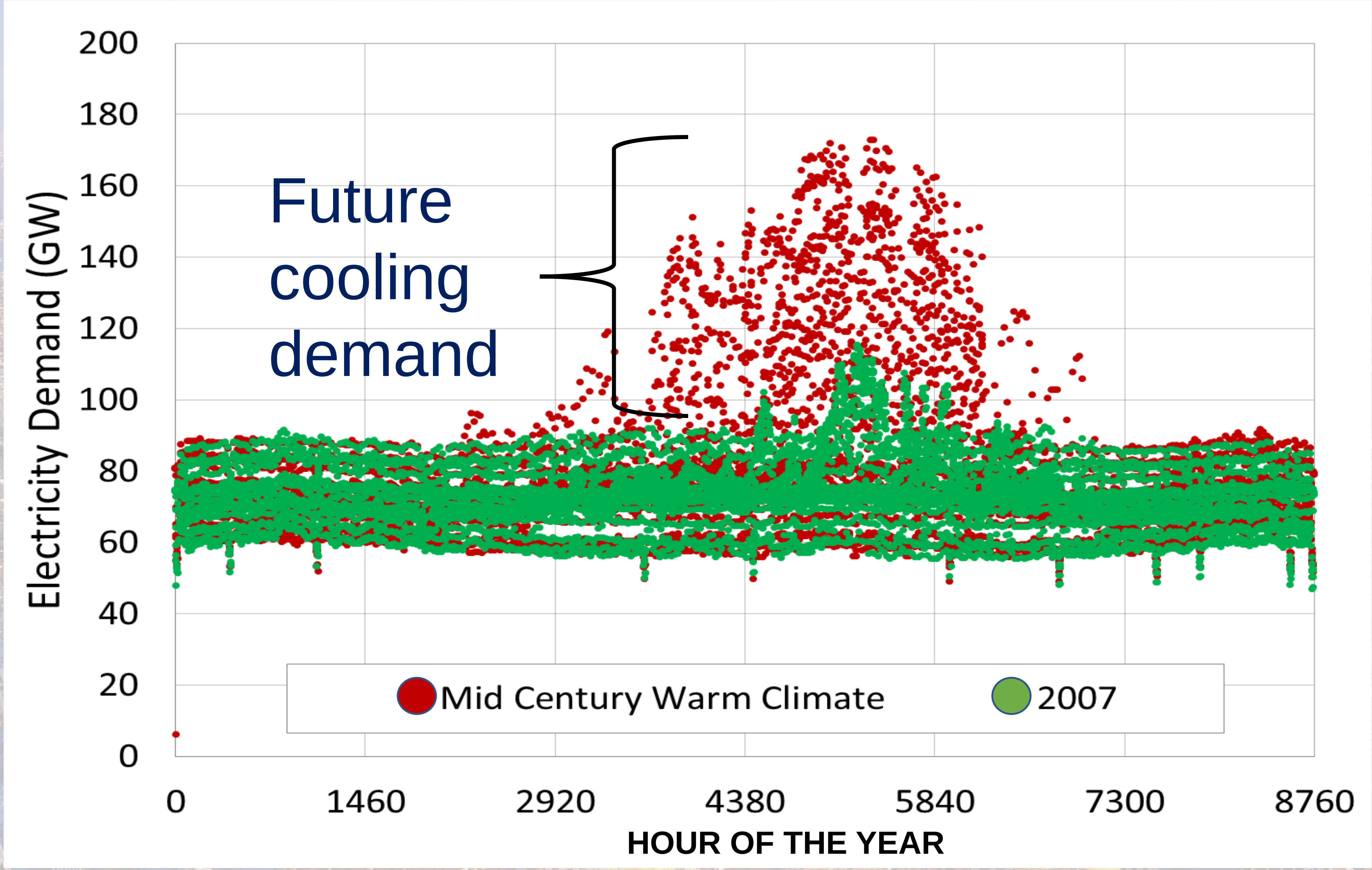
Tracey Holloway

Ryan Kladar

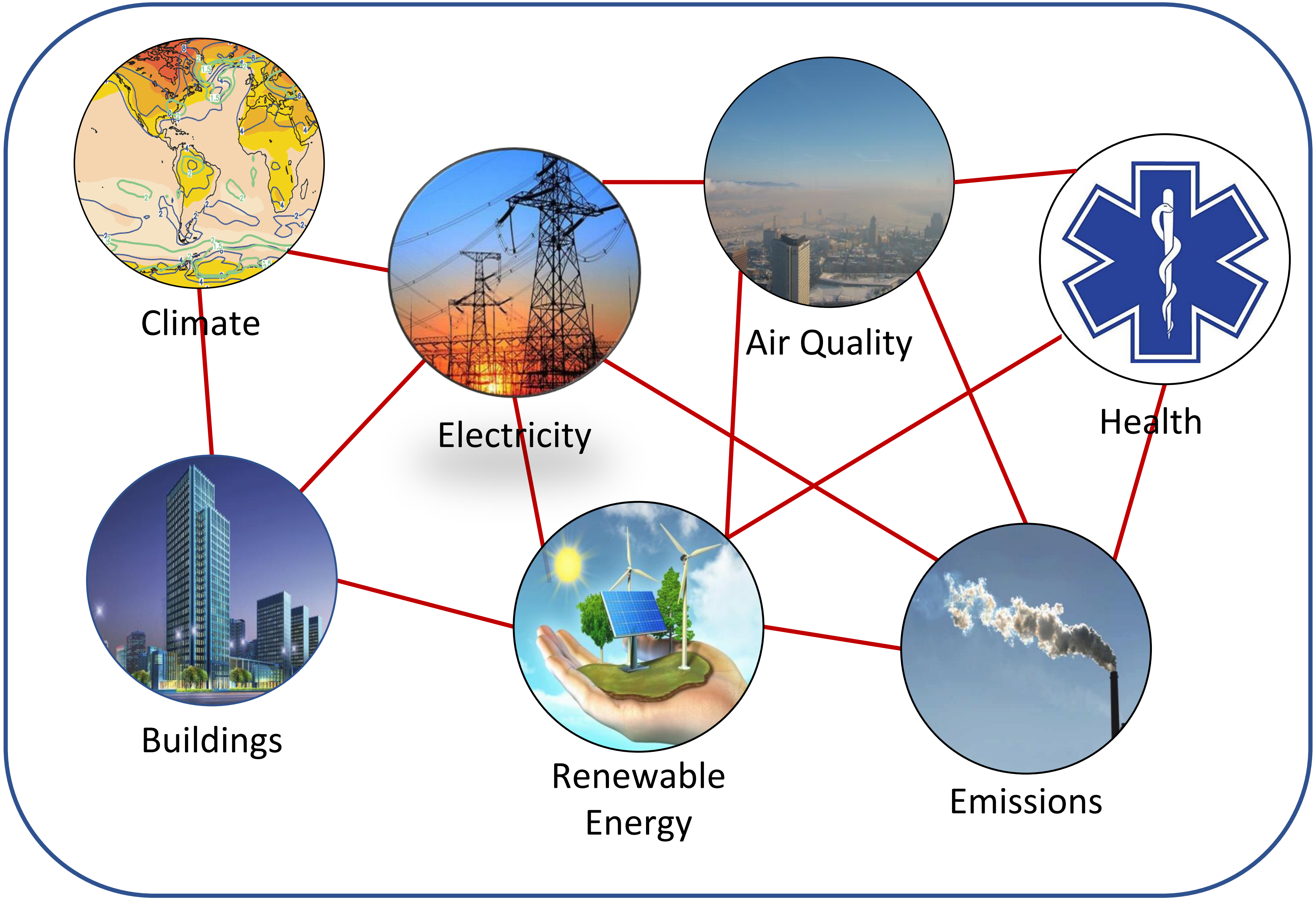
Paul Meier

Monica Harkey

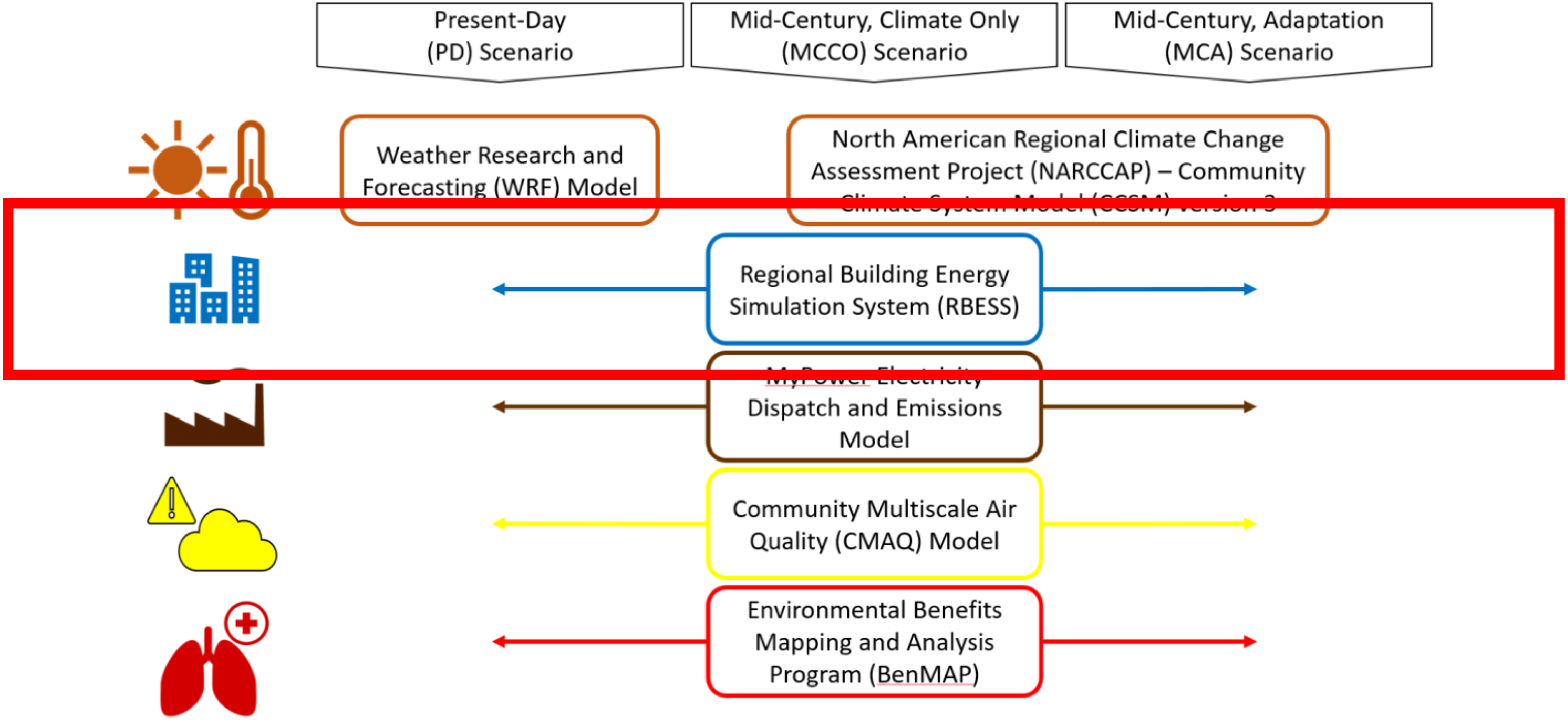
Jonathan Patz


Future cooling demand
Electricity Demand (GW)
200
180
160
140
120
100
80
60
40
20
0
0
1460
2920
4380
5840
7300
8760
HOUR OF THE YEAR
Mid Century Warm Climate
2007

Common Themes Connecting Energy and Health Issues



Adaptation of Cooling Demand and Air Quality Impacts



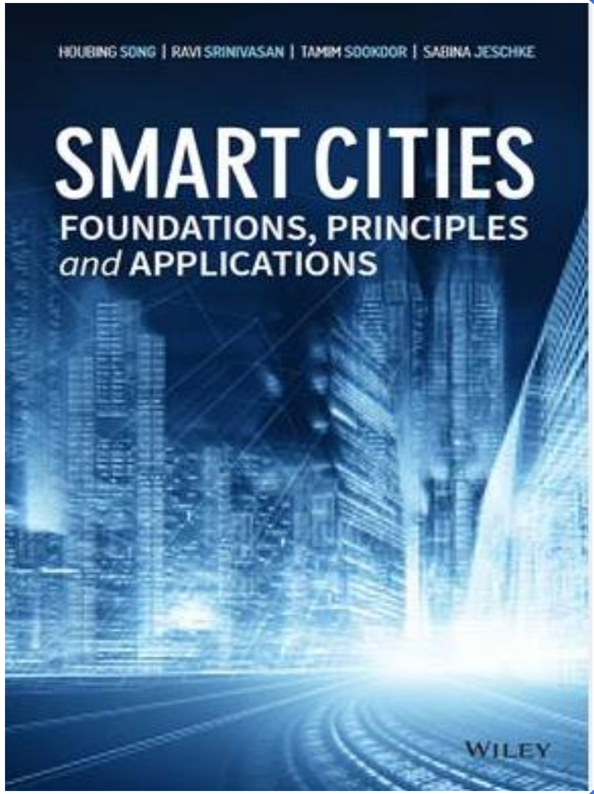
Abel et al., 2018, *PLOS Medicine* & Meier et al., 2017, *ERL*

ASHRAE JOURNAL ashrae.org SEPTEMBER 2014

Future Climate Impacts On Building Design

BY SCOTT SCHUETTER, P.E., MEMBER ASHRAE; LEE DEBAILLIE, P.E., MEMBER ASHRAE; AND DOUG AHL, PH.D.

The climate is changing as evidenced by ASHRAE Research Project 1453, which recently updated the climate zones and design conditions in ANSI/ASHRAE Standard 169-2013, *Climate Data for Building Design Standards*.[1] How will the changing climate impact building design and operation? For instance, is more cooling or heating



Environmental Science & Technology

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Response of Power Plant Emissions to Ambient Temperature in the Eastern United States

David Abel[*†], Tracey Holloway[†‡], Ryan M. Kladar[†], Paul Meier[§#¶], Doug Ahl[‖], Monica Harkey[†], and Jonathan Patz[†⊥]

PLOS | MEDICINE

RESEARCH ARTICLE

Air-quality-related health impacts from climate change and from adaptation of cooling demand for buildings in the eastern United States: An interdisciplinary modeling study

David W. Abel[1*], Tracey Holloway[1,2], Monica Harkey[1], Paul Meier[3,4,5], Doug Ahl[6], Vijay S. Limaye[1,7], Jonathan A. Patz[1,7]

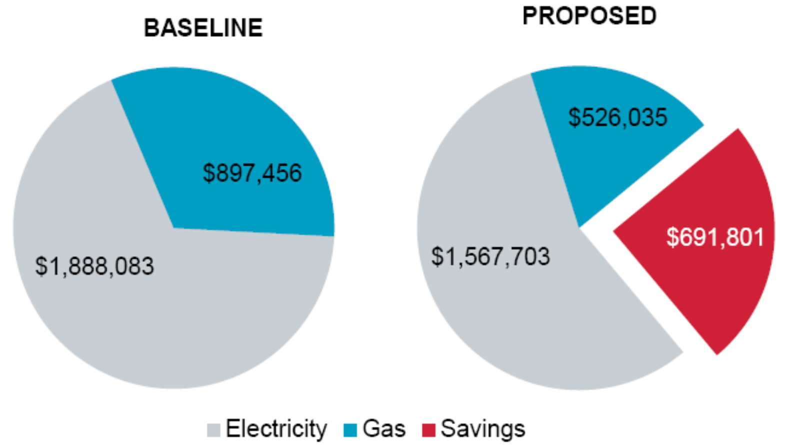
Environmental Research Letters

Impact of warmer weather on electricity sector emissions due building energy use

Paul Meier[1,2], Tracey Holloway[3,4,7], Jonathan Patz[3,5], Monica Harkey[3], Doug Ahl[6], David Abel[3], Scot Schuetter[6] and Scott Hackel[6]

Environ. Res. Lett. **12** (2017) 064014

Green Building. What are the motivating factors?



Commercial New Construction Project

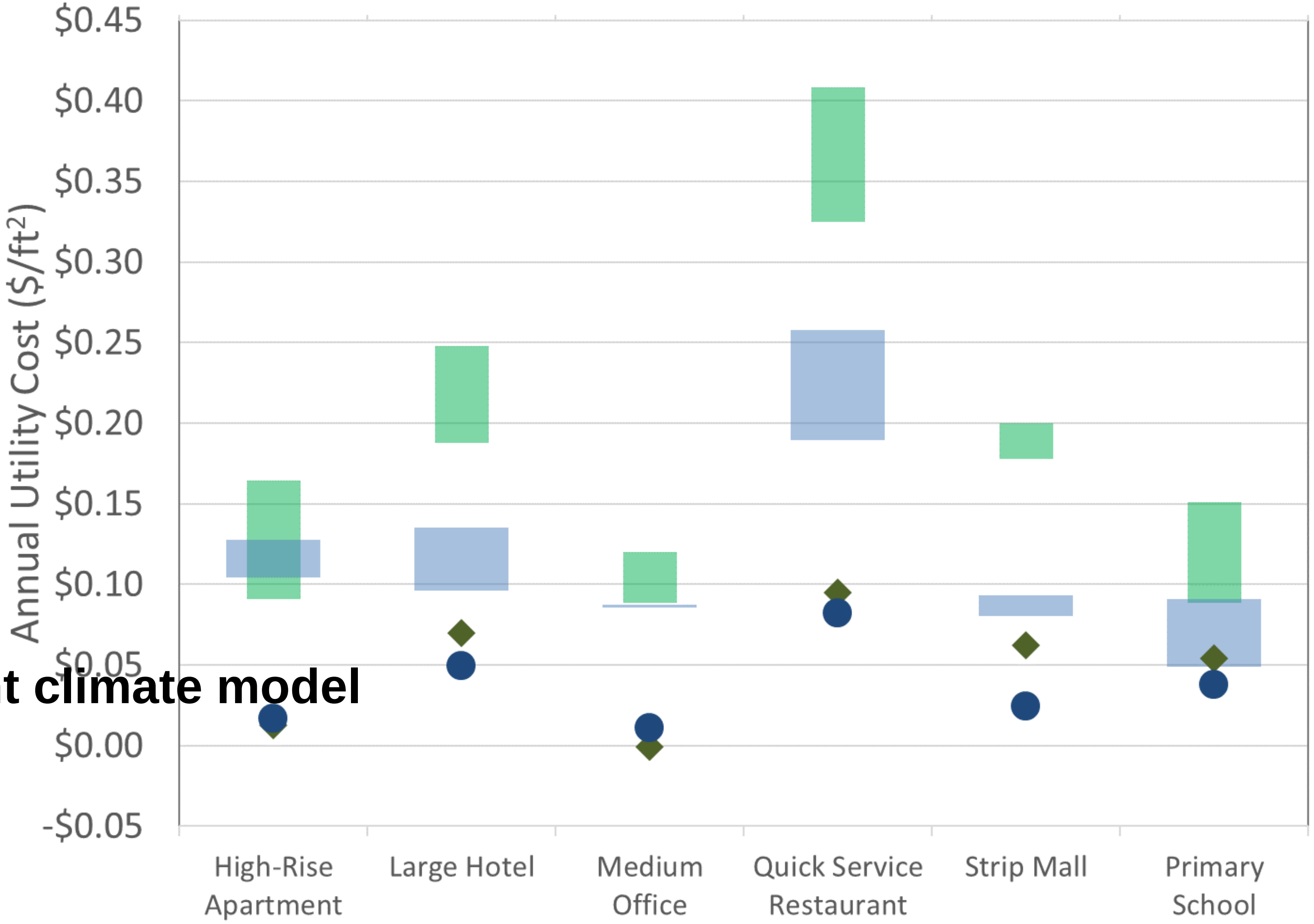
Energy Efficiency Measures (see page 3 for detailed descriptions)		Energy Savings		Peak Cooling	Incentives[1]
		$/yr	%	% Saved	$
1	Wall and roof thermal properties	-$5,964	-0.2%	-0.3%	$0
2	Window improvements	$69,765	2.5%	5.5%	$20,200
3	Lighing power density reduction	$84,272	3.0%	2.1%	$93,451
4	Daylighting controls - non patient areas	$28,231	1.0%	1.2%	$27,960
5	Supply fan static reduction	$32,233	1.2%	0.9%	$36,783
6	Supply air temperature reset	$20,310	0.7%	0.8%	$17,387
7	Temperature setback controls	$18,954	0.7%	-0.2%	$3,518
8	Energy recovery coils	$249,276	8.9%	6.2%	$0
9	Kitchen exhaust controls	$33,014	1.2%	2.8%	$18,882
10	Parking garage lighting and fan controls	$58,366	2.1%	0.0%	$66,325
11	Chilled water system improvements	$52,685	1.9%	0.0%	$59,869
12	Condenser water system improvements	$6,645	0.2%	0.0%	$7,552
13	Waterside economizer for process cooling	$22,633	0.8%	0.0%	$25,719
14	Heating plant improvements	$21,381	0.8%	0.0%	$6,651
Totals (1-14)		**$691,801**	**24.8%**	**18.9%**	**$384,297**

[1] Incentives are preliminary until approved by the utility. Approval will occur following receipt of the signed Measure Incentive Agreement

Energy efficiency climate adaptation strategies

Primary Strategies	Description
Roof Insulation	Add additional roof insulation, minimum R-20
Cooling Equipment	Upgrade to high-efficiency centrifugal chillers; minimum 0.639 kW/ton, 0.45 kW/ton-IPLV
Energy Recovery Ventilation	Install enthalpy wheel energy recovery systems on exhaust with bypass and modulation control; 70%+ latent effectiveness, ~0.7” ΔP
Secondary Strategies	**Description**
Wall Insulation	Add additional wall insulation, 2” continuous insulation
High Performance Windows	Replace existing windows with low conductivity glass and thermally-broken frames; maximum Assembly U-Value of 0.35
Tighter Envelope	Install continuous air-vapor barrier using spray on air barrier or spray foam to seal all roof penetrations (piping, ductwork, electrical) at both the top and the deck level
Heating Equipment	Upgrade to condensing gas-fired boilers; 90%+ thermal efficiency

Chicago – Impact of climate & energy codes



Different climate model

Chicago – Cost at risk due to climate & energy codes

Key takeaway:

- **Outdoor air quality-related health damages can be quantified and included in integrated resources planning and energy efficiency potential studies with the explicit objective of protecting health.**

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