where is the social science in the energy landscape?
Pathways to (urban) energy transitions

• Business as Usual
  – Technical & economic potential for change
    • + proper behavior

• Some problems with the underlying energy research domain

• Business as Unusual
  – Social Potential for change
    • Market transformation via
      – Social engagement (e.g., Polis digitocracy)
      – “Middle-out” pathways
The challenge: global energy use is rising and carbon intensive

Evolution of Total Primary Energy Supply* from 1971 to 2004

* Excluding electricity trade.
Reductions in energy-related CO$_2$ emissions in the climate-policy scenarios

Source: IEA World Energy Outlook, 2008

While technological progress is needed to achieve some emissions reductions, efficiency gains and deployment of existing low-carbon energy accounts for most of the savings.
The buildings sector offers the largest low-cost carbon reduction potential in all world regions by 2030.

Figure SPM.6: Estimated sectoral economic potential for global mitigation for different regions as a function of carbon price in 2030 from bottom-up studies, compared to the respective baselines assumed in the sector assessments. A full explanation of the derivation of this figure is found in Section 11.3.
McKinsey Curve

Global GHG abatement cost curve beyond business-as-usual – 2030

- Residential electronics
- Residential appliances
- Retrofit residential HVAC
- Tillage and residue mgmt
- Insulation retrofit (residential)
- Cars full hybrid
- Waste recycling
- Organic soil restoration
- Geothermal
- Grassland management
- Reduced pastureland conversion
- Reduced slash and burn agriculture conversion
- Small hydro
- 1st generation biofuels
- Rice management
- Efficiency improvements other industry
- Electricity from landfill gas
- Clinker substitution by fly ash
- Cropland nutrient management
- Motor systems efficiency
- Insulation retrofit (commercial)
- Lighting – switch incandescent to LED (residential)
- Low penetration wind
- Cars plug-in hybrid
- Degraded forest reforestation
- Nuclear
- Pastureland afforestation
- Degraded land restoration
- 2nd generation biofuels
- Building efficiency new build
- Gas plant CCS retrofit
- Coal CCS retrofit
- Iron and steel CCS new build
- Coal CCS new build
- Power plant biomass co-firing
- Reduced intensive agriculture conversion
- High penetration wind
- Solar PV
- Solar CSP

Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO₂e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Source: Global GHG Abatement Cost Curve v2.0
The Existing Energy Efficiency Ideal: Technical Potential (and its progeny)
What is energy research?

**Energy SUPPLY**

- **Resources**
  - Coal, oil, gas, nuclear, solar, wind, hydro, wave, biomass electricity
- **Things** that extract energy
  - Mines, generators, PV cells, dams, windmills, etc.
- **People/organizations**
  - Producers (utilities, oil companies) and manufacturers of extraction & transmission equipment

**Energy DEMAND**

- **Uses**
  - Sectors (e.g., Industry, transportation, housing)
  - Services (heat, cooling, cooking)
- **Things** that use energy
  - Cars, trucks, steelworks, brick kilns, air conditioners, buildings
- **People/organizations**
  - Consumers (people), designers & manufacturers of vehicles, industrial processes, equipment, and buildings

Energy and buildings: Where (and what) is the social?

- 80% of articles in the lit review (n=631) take a “positivist” approach
- Only 19 articles take an “interpretivist” approach
- Focus on occupants and relative neglect of organisations & institutions

Figure 1 Articles with ‘building’ and ‘energy’ in the abstract in Construction Research Set, 2000-2011 (n=211)
Similar Patterns?

India-UK Joint Workshop on Energy Demand Reduction in the Built Environment April 22nd, 2016
## Where is demand & social aspects?

<table>
<thead>
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<th>Objectives</th>
<th>LCSIG</th>
<th>NCAER</th>
<th>TERI-WWF</th>
<th>Shukla et al.</th>
<th>CSTEP</th>
<th>World Bank</th>
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- ● Full coverage: Reasonably comprehensive and transparent treatment
- 0 Partial coverage: Addressed to an extent, but falls short in some respects, including accessibility

2013 Global Building Performance Network Study

Residential Data Quality

Source: Data from Schnapp & Laustsen, 2013 p. 22
Quality Comparison: Res & Non-Res

2013 Global Building Performance Network Study

Source: Data from Schnapp & Laustsen, 2013 p. 22
SPACE COOLING GROWTH PROJECTIONS FOR INDIA: A PERFECT STORM

Large Population

Tropical Climate & Rising Temperature

Growing Aspirations

Increasing Building Floor Area

Rising Active Cooling Demand

Greater Penetration of Active Cooling

INCREASING GHG EMISSIONS
INCREASING ENERGY CONSUMPTION & PEAK DEMAND,
INCREASING HEAT ISLAND EFFECT

Slide courtesy of Satish Kumar, Indo-UK Joint Workshop on Energy Demand Reduction in the Built Environment April 22nd, 2016

Infographics right to AEEE and distributed under creative commons
COOLING DEMAND: INDIA DWARFS US & CHINA

INDIA

- Delhi: CDD 1703
- Mumbai: CDD 1902

CHINA

- Guangzhou: CDD 1086
- Shanghai: CDD 511
- Beijing: CDD 399

US

- New York: CDD 119
- Los Angeles: CDD 214

Size of bubble is a product of population and cooling degree days for that city.


Slide courtesy of Satish Kumar, Indo-UK Joint Workshop on Energy Demand Reduction in the Built Environment
April 22nd, 2016

RAC Penetration < 5%
1995 ~ 2%, 2010 ~ 100%

RAC Penetration >100%

RAC Penetration >100%

Infographics right to AEEE and distributed under creative commons
We have the technology...
The Existing Energy Efficiency Ideal: Technical Potential (and its progeny)
Motivating the Market
Is “technical potential” the right target?
Why do we need to broaden the idea of energy savings potential?
Buildings are dynamic, sociotechnical systems

Building design

Site & environment

Energy services

Occupant behaviour

Source: Gavin Killip, ECI
Behavior Can Trump Design

Proper use
Efficiency Gap as a “People” Problem: Oh, *behave*!
The New Holy Grail: Behavioral Potential

Smart use

Proper use

Good Behavior Award

Economy
Homelessness
Immigration
Global Warming
Buildings are socially and culturally “embedded” (for ill or for good)

- locality is unimportant
- energy can be squandered
- disconnectedness is normal


- static boxes
- beyond our control
- may not belong to us

The problem
Some solutions...

Information

Advice/advertising
Social potential

- Things some people do anyway
- Existing social change pathways
People as Active Participants

Ladder of Citizen Participation (Arnstein 1969)

Degrees of citizen power
- Citizen control
- Delegated power
- Partnership

Degrees of tokenism
- Placation
- Consultation
- Informing

No power
- Therapy
- Manipulation
- Feedback
- Nudge
Social Potential 1: Citizen Engagement
Multiple benefits and better buildings
Social Potential 3: Middle-out pathways
How does social change happen?

Top-Down
56%

Bottom-Up
46%

McKinsey Curve

Global GHG abatement cost curve beyond business-as-usual – 2030

Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €50 per tCO$_2$e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Source: Global GHG Abatement Cost Curve v2.0
EE Business as usual, where the “game” is to get each circle to fill in the one above it until the technical potential envelope is full. In this scenario, the “social” is conceptualized as a subset of what is technically and economically feasible.
Say social potential is an equal “idealized” envelope, composed of things that actually happen which the standard EE framing ignores. For example “cool biz”, changing clothes to match the season. Or people buying Priuses or electric cars because Al Gore said they should, or because they’re cool, rather than cost-effective. These actions are not PTEM solutions. The social potential circle could be larger or smaller, for this illustration lets say it is a similar size.
Achievable potential goes away as a concept, and is replaced by many different intersections. The overlap is larger than the old “achievable potential”. Also recognizes that all behaviors will not be “appropriate”. It shifts the frame of activity outside usual boxes.

New game is to shift technologies, costs, and behaviors towards new norms on the right (rather than growing them). Bigger emphasis on implementation, double-loop, learning; on business models & institutional action rather than consumer choice and “appropriate” behavior change.
Summary & Conclusions

• Technical potential is an ideal, not a reality
  – Even with “proper” and “smart” behavior

• Social potential is a different ideal
  – Offers different opportunities through
    • Citizen science (polisdigitocracy)
      – might increase engagement and understanding of both experts and non-experts
    • Middle-out change
      – Building capacity for public good
Thank you

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