

SYLLABUS: Energy Efficiency and Smart Grid Strategies for a Sustainable Future

15.S05 - 6 credits - Spring 2017 – H1 ONLY: Feb 7 - March 16

Lecture: Tuesday, Thursday: 1-2:30PM (E62-446)

<https://stellar.mit.edu/S/course/15/sp17/15.S05/>

Instructor: Harvey Michaels

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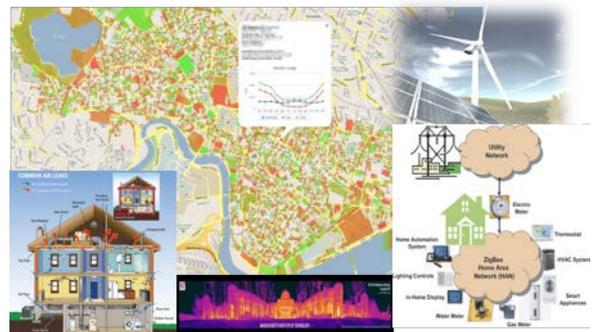
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15.S05 Energy Efficiency and Smart Grid Strategies for a Sustainable Future explores the future opportunities for energy management in a new era of intelligent buildings, grids, electric vehicles, as well as connected cities and people. This subject explores energy management practice and innovation through:

- building technologies including systems, analytics and controls
- energy/grid economics and policy
- strategies: community, social norms, apps and behavior, management finance and marketing innovations



While now a \$25 billion field, energy management is on the cusp of transition and expansion, despite policy headwinds, as grid economics, consumer interests, and technology enable building energy (70% of all electric use) to dramatically reduce and as well, to modulate in a manner that stabilizes an electric grid increasingly powered by intermittent solar and wind energy. To address climate change, among our greatest challenges, scientists agree that energy management is the largest single component of an achievable solution. Most countries, states, cities, and the strong majority of US voters also agree.

During the six week class, we will assess what works, as well as where innovation is needed, regarding:

- how new approaches to financing, technology, services, analytics, and ICT can be applied to intelligent efficiency solutions,
- the potential for increasing consumer benefits for energy efficiency through greater value, comfort, technology, trust, simplicity, resilience, public recognition.
- the economic and regulatory policy landscape, including new revenue streams including grid incentives for demand-responsive load, and new EPA clean air rules that require fossil power plants to seek carbon offsets.
- the opportunity for new business models, and as well how established companies interested smart energy are approaching the market; including CISCO, Apple, Tesla; building-to-grid companies, such as EnerNOC and Schneider; smart energy companies such as Opower and Nest; and building energy management companies such as AMERESCO, Winn Development and Next Step Living.
- societal and political considerations of sustainability, equity and local values – including benefit-cost determination from a regulatory perspective as well as case studies of smart and sustainable city initiatives.

Class member perspectives and requirements:

Summary: Class members will have the opportunity to investigate strategic approaches to the energy demand management field as they choose, from the perspective of entrepreneurs, managers, policymakers or investors. Class members are expected to attend and engage effectively in the 11 scheduled sessions. Lectures on the technologies, actors, business models, and new opportunities of the energy management field are supported by readings, brief assignments, and optional meetings with market participant guests (outside of class time).

Preparatory readings: will be assigned for each focus area to support discussion. As some class members bring prior expertise, while others may be completely new to the focus area, optional supplemental readings for those with less background will be offered as well.

Assignments: Two modest but thoughtfully prepared assignments are requested:

- *Informed Foundation:* class members choose a class foundation topic, as a facet to one of the focus areas, prepare a 1 page prepared commentary as well as one PowerPoint slide for discussion in an appropriate class.
- *Idea or Approach:* Building on the foundation, class members offer an approach to enabling efficiency (business, policy, or program) to achieve a significant impact in energy and carbon benefits, with a short 2-3 page case paper and PowerPoint presentation, with attention to feasibility and scalability.

Key focus areas this semester: For each, we consider the current status, future trends, and key opportunities and controversies.

1) *Emerging technologies:* As the year of the “Internet of Things”, we will explore how it relates to energy management and grid stabilization, from cloud-communicating wall thermostats to smart charging of electric vehicles,

2) *Analytics:* Energy intelligence systems have opened new paradigms, including “no touch audits”, hypertargeting, maps and apps, “efficiency meters”. How do these work, what is the opportunity, and what remains to be done?

3) *Financing:* Radical finance models are needed to overcome efficiency market barriers of first cost, uncertainty of payoff, time, and risks. Rooftop solar is now offered with “no money down, guaranteed positive cash flow”, and the market response has been phenomenal. Can the same be done with energy management? What innovations are needed to make this work.

4) *Marketing:* Web social networks and community-based marketing can galvanize action – how can we apply these to scale energy management to provide a large share of a climate change solution?

Key Readings: See <https://stellar.mit.edu/S/course/15/sp16/15.S05/> open to all class participants.



Instructor Bio: Harvey Michaels teaches energy management strategy at the MIT Sloan School of Management, and participates in research with MIT Sloan Sustainability Initiative, Center for Energy and Environmental Policy Research, Climate CoLab, and MIT Energy Initiative. He provided leadership to MIT’s *Efficiency Forward* Campus initiative, and serves as advisor to cities including Boston and Cambridge, as well as Massachusetts utilities on community energy and climate action. Harvey previously founded two leading energy management companies: Aclara Software which provided the analytics for utility customer efficiency and smart grid; and XENERGY (now DNV-GL) which innovated in efficiency services, financing, resource studies and analysis systems.

Tentative Class Schedule:

Week 1: February 7 and 9: *Introduction and market framework.*

- *Negawatts:* Energy efficiency economics and policy, current and future – Principles of Integrated Resource Planning/utility efficiency
 - Estimating Impacts and establishing cost-effectiveness.
 - Evaluation methods: Process and Impact
 - utilities as marketers vs. table-setters.
- *Market models:* the progress and remaining opportunities of building energy management and relationship to the energy supply system.. Market actors - EE services, ESCOs, EMCS, software, consulting.

Week 2: Feb 14 and 16: *Where we're headed: Towards the future energy supply/demand ecosystem.*

- *Smart Power:* Grid to buildings: DR, Dynamic Pricing, Smart Grid. We look at the relationship of energy efficiency to the Smart Grid, with specific examination of grid connection to intelligent building efficiency and demand response: players, model, funding, trend, future
- *Smart Climate:* Creating carbon savings with energy management. Climate model, funding, trend, future. How to play EPA 111 (d), Cap/trade.

Week 3: Feb 21- no class – Presidents Day/Monday sched. Feb 23: *Intelligent Efficiency Analytics*

- *Analytic Software Markets:* Building EKG systems, information and behavior, process automation.
- *Analytic Software Methods:* Statistical/Engineering models, proximity analysis, Green Button.

Week 4: Feb 28, March 2: Marketing and Financing: Overcoming market failure by *making it easy to buy.*

- *Giving customers what they want:* connecting energy management to value, comfort, technology, trust, simplicity, resilience, public recognition.
- *Community Engagement:* Creating effective partnerships with cities and community based entities.
- *Web 2.0 Social Marketing* – applying the “Solarize” case to efficiency and smart grid, working with smart cities.
- *Elegant financing:* Creating a zero down and guaranteed positive cash flow business model, property tax-based financing (PACE).

Anticipated guest: ESCO finance leader

Week 5: March 7, 9: Emerging Technologies meet the *Utility of the Future:*

- *Internet of Things meets Grid of Things:* Grid market models, cloud managed devices:
- *Comprehensive integration:* How can energy efficiency integrate with renewables, electric vehicles, and distributed generation? Possible directions for new regulatory models.
- *Ancillary services:* managing building end uses as a competitor to grid battery storage.

Anticipated guest: Energy IoT leader

Week 6: March 14 and 16: Breakthrough strategy development. We consider as a class: Which ideas have the potential to change everything? And how do we go from a good idea to reality and scale?

- *Analysis:* market size, value, driving demand, reducing risk, time, up-front costs.
- *New on-ramps:* Integration with renewables, trades and building services.
- Reflection and discussion of class ideas for innovation in achieving efficiency at scale.