Energy Research At UT Austin

June 1, 2017

Dr. David P. Tuttle
Research Fellow, UT Energy Institute
dptuttle@energy.utexas.edu
Energy Systems Research Benefits From Several Factors

• Big picture perspective
• Long-term perspective
• Multi-disciplinary approach
  • Producers and consumers
  • Technical and non-technical
  • Individual devices and network of devices
UT Austin Has Depth and Breadth of Energy Research and Education

- Geosciences
- Engineering
- Natural Sciences
- Business
- Law
- Public Affairs
- Architecture
- Social sciences & liberal arts
2009–2015 Energy Funding

Estimated Annual UT-Austin Energy Research by Category

- Renewable
- Economics, Policy, and Outreach
- Nuclear
- Fossil
- Environmental Impacts
- Energy End-use and Distribution
- Energy Conversion and Storage
- Energy Systems
- Carbon Management
UT Austin Has 325+ Faculty and Staff Researchers Who Tackle Energy

UT PI’s Studying Each Energy-Related Category

- Fossil Energy
- Energy Conversion and Storage
- Renewables
- Energy End-Use and Distribution
- Environmental Impacts
- Energy Systems
- Carbon Management
- Nuclear
- Economics, Policy, and Outreach

Note: PI’s sometimes study >1 Category
UT Austin Has 325+ Faculty and Staff Researchers Who Tackle Energy

UT PI’s per Topic

- Modeling/Simulation/Imaging
- Renewable + Nuclear + Carbon Management
- Oil and Gas
- Energy Materials
- Power Generation
- Environmental Impacts
- Storage
- Transportation
- Technology
- Efficiency
- Energy/Enviro. Policy and Law
- Water-Energy Nexus
- Distribution
- Energy Economics
- Combustion/Engines
- Construction, Building and Design

- PV/Solar
- Biofuels
- Wind
- Geo
- Nuclear
- Carbon Management
The Full Cost of Electricity (FCe-) Study

A multi-disciplinary collaborative projective across the campus of the University of Texas at Austin

energy institute
Cockrell School of Engineering
The University of Texas at Austin Center for Electromechanics
TEXAS LBJ School
The University of Texas at Austin
Lyndon B. Johnson School of Public Affairs

Center for Energy Economics
Bureau of Economic Geology
TEXAS Geosciences
The Full Cost of Electricity (FCE-) Study

Motivation

Key Points

Electric power industry is undergoing significant and rapid change

Many changes are significant and unique to this time period

Recent *downward* cost trends

- **Fossil**
  - Natural gas combined cycle and turbines dominate thermal power installations
  - Natural gas from tight formations (long-term supply, at what cost?)
- **Renewables**
  - PV and wind can be installed in small increments
  - Photovoltaic costs still declining (For how long? True cost driver?)
- **Transmission & Distribution**
  - Demand Response of consumers
  - Smart (micro) grid to the rescue?

Energy efficiency

- Investments in small increments
- Increasing efficiency via building codes and standards

Recent *upward* cost trends

- **Fossil**
  - CO2 regulation
  - Large capital requirements (coal)
- **Nuclear**
  - Large capital requirements
  - Small modular reactors lagging in demonstration
- **Renewables**
  - Wind installation costs stabilized ($/MW); power costs ($/MWh) depend on resource access
  - Hydropower decommissioning and water resource competition (e.g. Colorado River)
- **Transmission & Distribution**
  - Capital costs; NIMBY & BANANA
- **Aging power plant fleet & workforce**
  - Replacement versus new build
- **Energy efficiency**
  - Increasing efficiency causing demand hardening
The Full Cost of Electricity (FCE-) Study

Work Products

• White papers & journal publications
  • 15 topical and independent, Executive Summaries

• Interactive Calculators
  • Map-based LCOE
  • Side-by-side LCOE calculator

• Outreach and Promotion
  • December 2016 press conference in DC; + meetings
  • IEEE Spectrum blog series (~ 1 per white paper) Dec. 2016- March 2017
  • LBJ School course (Policy Research Project) on “New Electric Utility Business Models”, Fall 2016 and Spring 2017
FCoE tool creates a map of the least-cost technology in each US county

*includes a cost for externalities and considers “availability zones”
This is what the map looks like when there is no cost for externalities.
It all depends on where you are

• Don’t like our numbers?
  • Use your own!
  • http://calculators.energy.utexas.edu/lcoe_map/#/county/tech

• Want even more control?
  • http://calculators.energy.utexas.edu/lcoe_detailed/
Grid Operation Innovation
Reserve requirements declined as wind power increased

Regulation-down requirement

Regulation-up requirement
The Full Cost of Electricity (FCe-) Study
The Effect of Declining PV Prices
The Energy Infrastructure of the Future

Second generation energy related multi-disciplinary collaborative projective across the campus of the University of Texas at Austin

Principal Points of Contact
Dr. Fred C. Beach, fbeach@energy.utexas.edu, (512)475-8057
Dr. Michael E. Webber, webber@mail.utexas.edu, (512) 475-6867
Society is Facing Imminent Change of Domestic Energy Infrastructure

The Electricity Sector Value*

• **Replacement**: $5 trillion
• **Depreciated**: $2 trillion

Trillions of dollars will be spent on energy infrastructure within the next few decades.

“Energy Infrastructure” includes all infrastructure associated with extracting and processing of traditional primary fuels (e.g., oil, gas, coal, uranium), primary-to-energy carrier conversions (e.g., wind turbines, power plants), transmission and distribution of energy (e.g., pipelines, electric grid), and end-use devices (e.g., electric vehicles).

*Based on initial estimates from the Energy Institute of UT Austin
Create Decision Support Tools for Assessing the Impact of Future Infrastructure

Previous Energy Institute Study: “Full Cost of Electricity”

Developed methods and tools to determine the least-cost electricity generation technology in every county of the US.

Tools Developed for FCe- Study:
http://calculators.energy.utexas.edu/
Thank you

energy.utexas.edu

Contacts:

Dr. Tom Edgar, Director (tfedgar@austin.utexas.edu)

Dr. Michael E. Webber, Deputy Director (webber@mail.utexas.edu)

Dr. Fred Beach, Assistant Director (Fred.Beach@mail.utexas.edu)

Dr. Carey W. King, Assistant Director (careyking@mail.utexas.edu)

Dr. David P. Tuttle, Research Fellow (dptuttle@energy.utexas.edu)