U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

ComStock

National Renewable Energy Laboratory
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Project Summary

Timeline:

Start date: July 1, 2018

Planned end date: March 30th, 2020

Key Milestones

5/31/2019: Are there sufficient data sources on the U.S. building stock to merit moving forward with the modeling?

6/26/2019: Determine if the U.S. building stock model has been sufficiently calibrated to justify use by DOE-BTO

Key Partners:

Los Angeles Department of Water and Power	Southern California Gas Company

Budget:

Total Project $ to Date:

- DOE: $257k (through Feb 17th)
- Cost Share: $75k DOE, $534k Non-DOE

Total Project $:

- DOE: $1, 291k
- Cost Share: $75k DOE, $624k Non-DOE

Project Outcome:

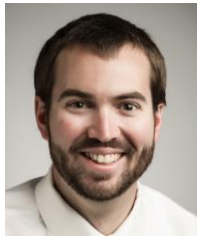
Build a model of the U.S. commercial building stock to use for R&D prioritization, technology potential studies. Calibrate this model to available data to ensure that it accurately represents the building stock.

Team

Building energy modeling

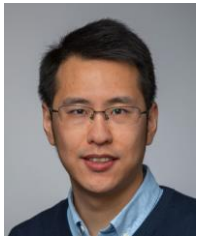
Andrew Parker, Matt Dahlhausen, Marley Prapost, Eric Bonnema, David Goldwasser, Carlo Bianchi



Data science

Ry Horsey, Liang Zhang

Challenge

How do we analyze the impacts of technologies across the U.S. commercial building stock?

- **How much** energy do measures save?

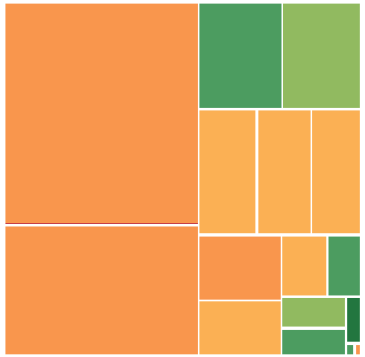
- **Where** do measures save energy?
- **When** do savings (or increases) happen?
- **Which stock segments** should each measure target?

Current Approaches

Scout & NEMS – too simple

- Geospatially coarse (census regions)
- Annual – no demand, no time-of-use
- Can't model controls
- Crude measure interaction

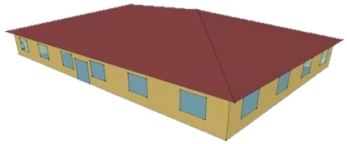
Low-granularity



DOE Prototype Buildings – too similar

- 16 "typical" detailed building energy models
- All buildings of a type are identical in every way
  - Schedules
  - HVAC systems
- Savings heavily dependent on model assumptions

All small offices in US?

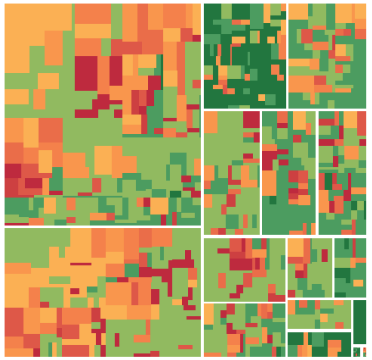


Current Approaches

ResStock – just right

- Highly granular building stock
- Sub-hourly detail
- Can model controls
- Includes measure interaction
- Advanced visualization for slicing data

High-granularity



"ResStock has become a truly game-changing analysis tool. Current ResStock users include federal, state, and city governments, utilities, non-profits, software companies, and private-sector consulting firms"

- Eric Werling, RBI program manager

Don’t reinvent the wheel, build on success

Building stock characteristics database

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Physics-based computer modeling

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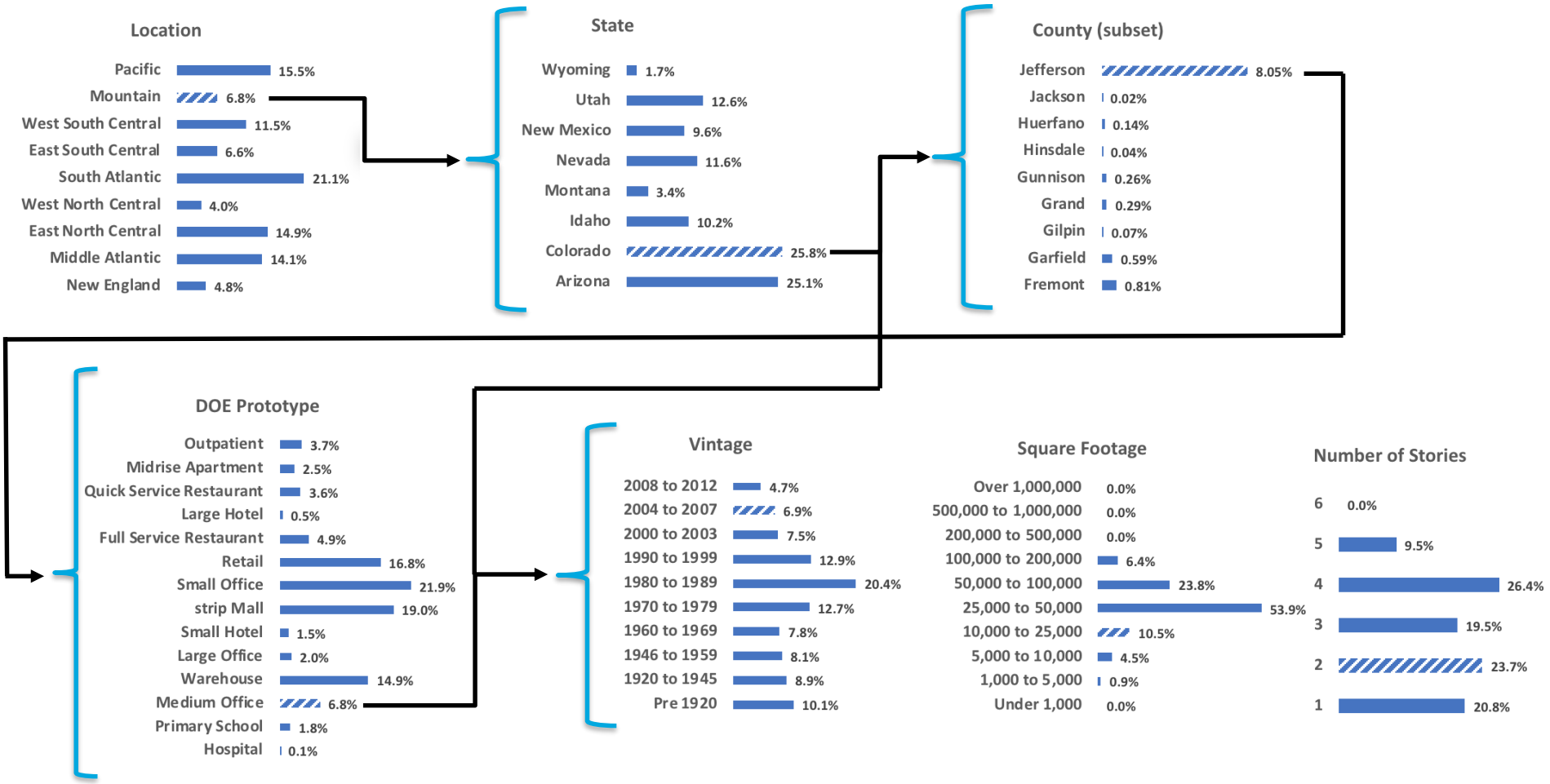
High-performance computing

Building Stock Characteristics

Microsoft:
USBuildingFootprints

Distributions

Create characteristic distributions from available data sources



Model Generation

Parametric generation of building energy models using OpenStudio Standards:

Building Definition:

Climate Zone: 5B

Building Type: Medium Office

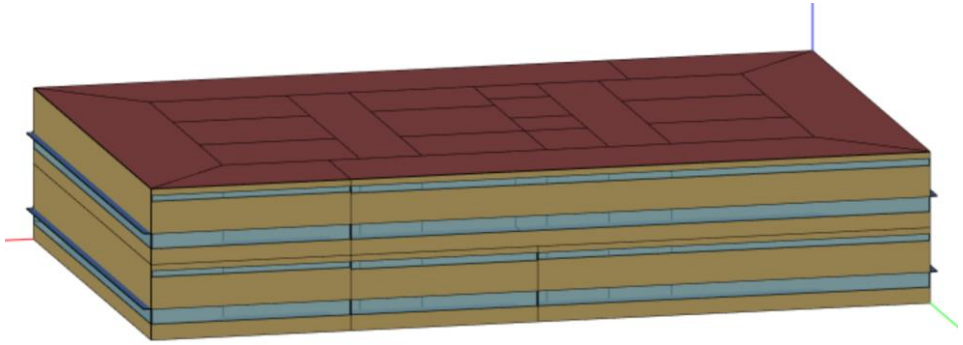
Square Footage: 20,000

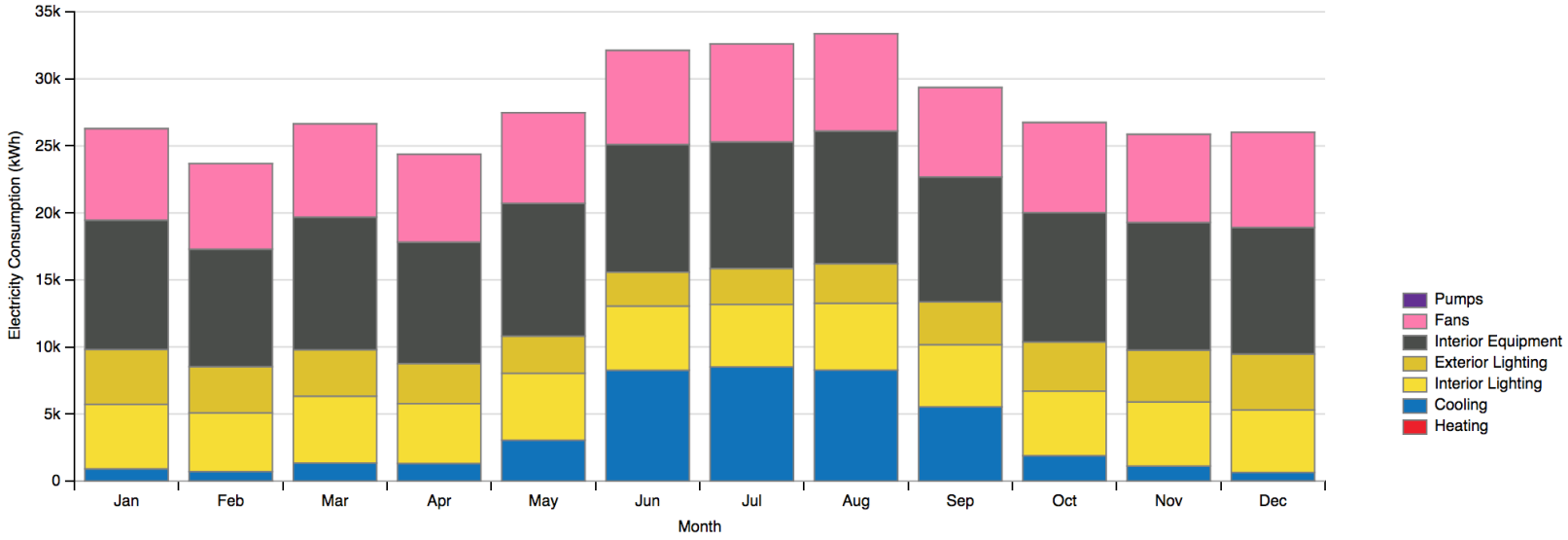
Number of Stories: 2

System Type: PSZ-AC

Year Built: 2005

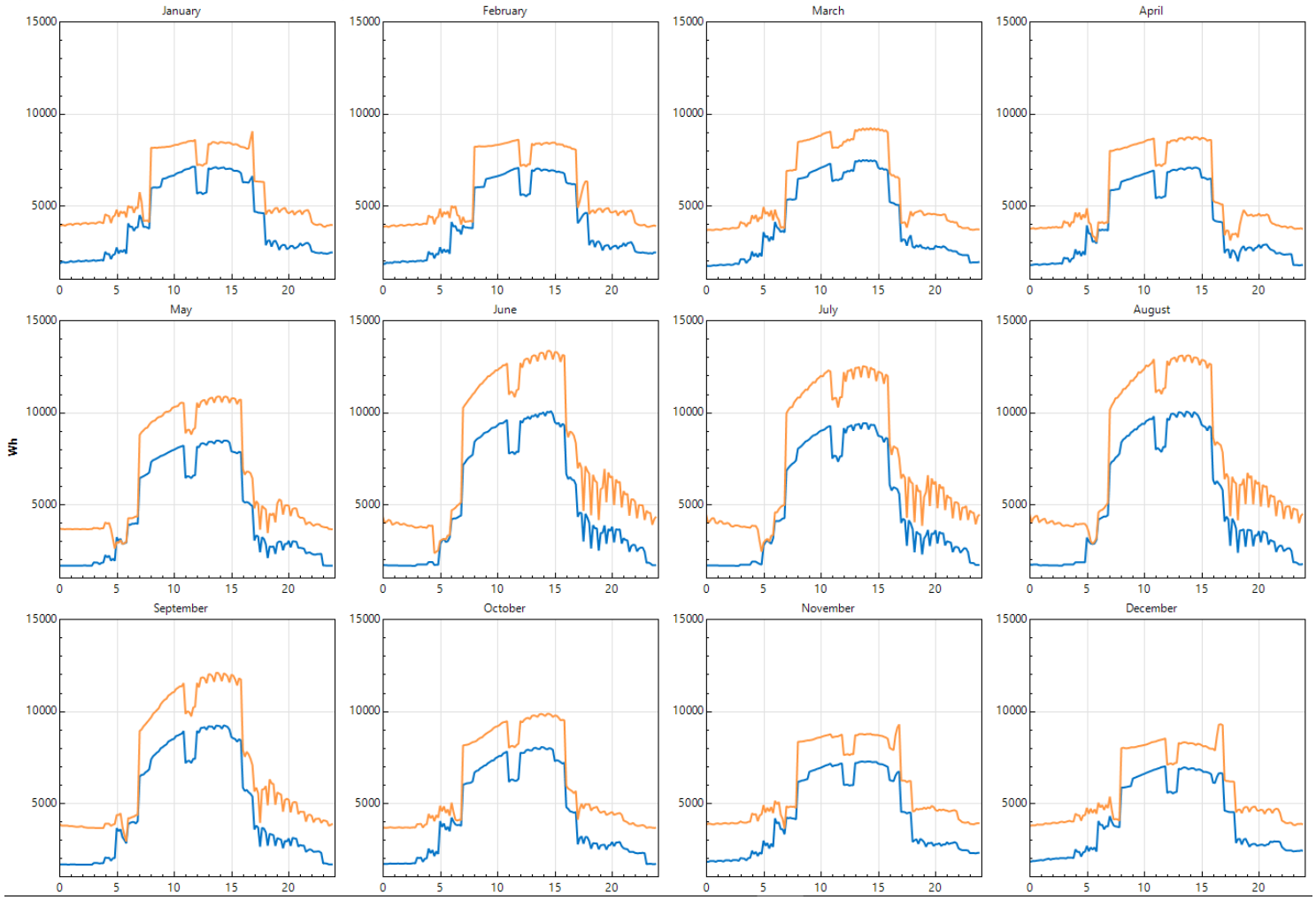
Heating Fuel: Natural Gas





Apply Measures & Calculate Savings

Average monthly load shape for before/after measure package



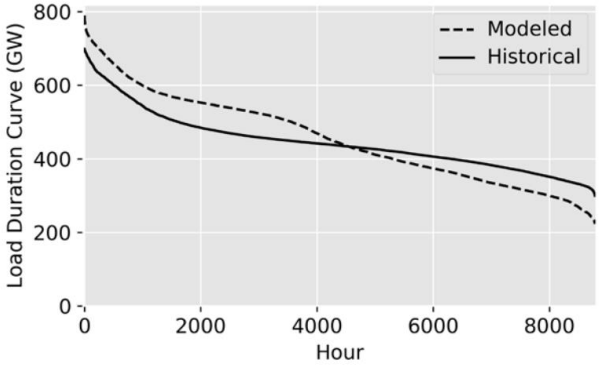
Calibration

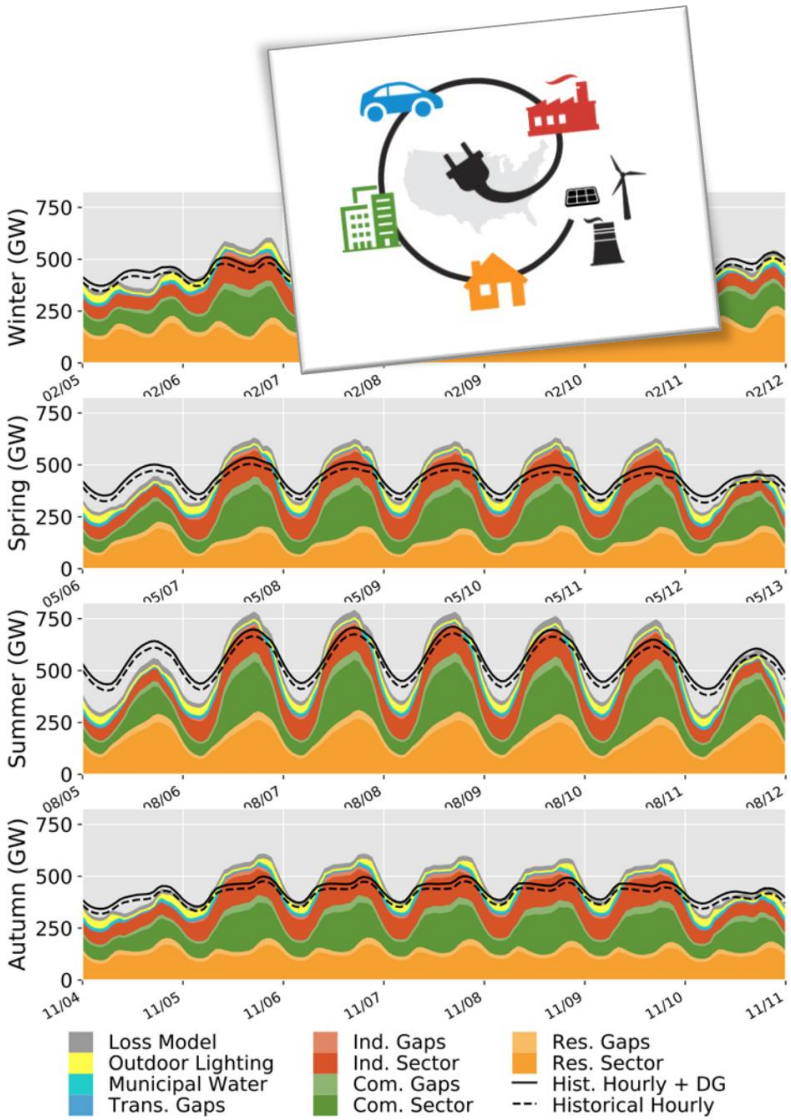
Stock

- Number of buildings
- Building use type classification
- Square footage
- Installed equipment prevalence

Energy

- EUI across climate & building type
- End-use breakdown
- Operations ‘on’ vs ‘off’
- Schedule representation



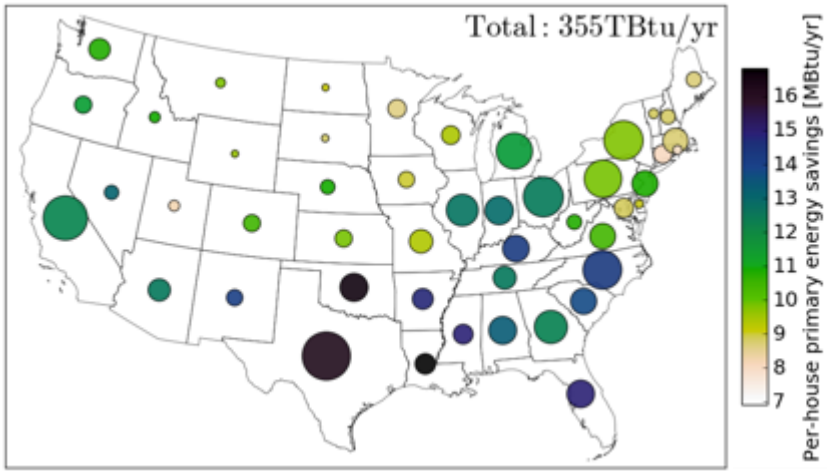


Impact

- R&D and emerging technology research prioritization
- National/state policy
- Utility programs
- Load flexibility and demand response aggregation
- City planning/market engagement
- Targeted efficiency programs

High Level Factsheets

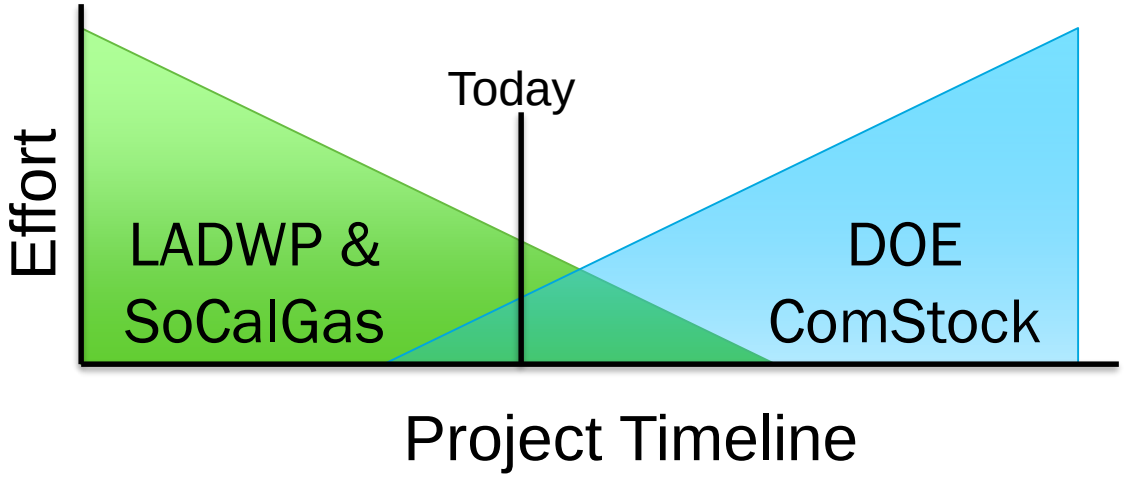
Detailed Data Analysis



Progress

Cost Share

- Electrification Futures Study (DOE OOSP)
- LADWP & SoCalGas - Deep-dive on utility territory



Currently

- Reviewing data – sources, gaps, procurement possibilities
- Addressing remaining known modeling challenges – mostly complete
- Extending end-use coverage

Stakeholder Engagement

Industry engagement to-date

- Discussions with PNNL about using for Codes & Standards analysis
- Discussions with Radiant Labs, ICF, Navigant, ComEd, etc.
  - Private sector is chomping at the bit for this capability

"How are things coming along for ComStock? We have a solicitation where we could really use the platform in the next 3-4 months."

- 3/21/2019 email from interested private sector entity

"One thing that was brought up by management today was ComStock and ResStock. They would be interested in a presentation to our group, the NRC as well as the OEE. Would that be possible at the end of the month?

- 4/3/2019 email from NRCan

Additional planned engagement

- Leveraging End-Use Load Profiles technical advisory group contacts
- Presentation at industry forums (ASHRAE, ACEEE EE as a Resource, etc.)

Remaining Project Work

Near-term

1. Finish data gaps analysis and adding data sources (end of May)
2. Calibrate model against available data (end of June)
    a) Pursuing data sources for calibration

Further out

1. Build data visualization tool
2. Create OpenStudio Measures for ECM analysis
    a) Includes measures to look at natural gas savings

Thank You

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REFERENCE SLIDES

Project Budget

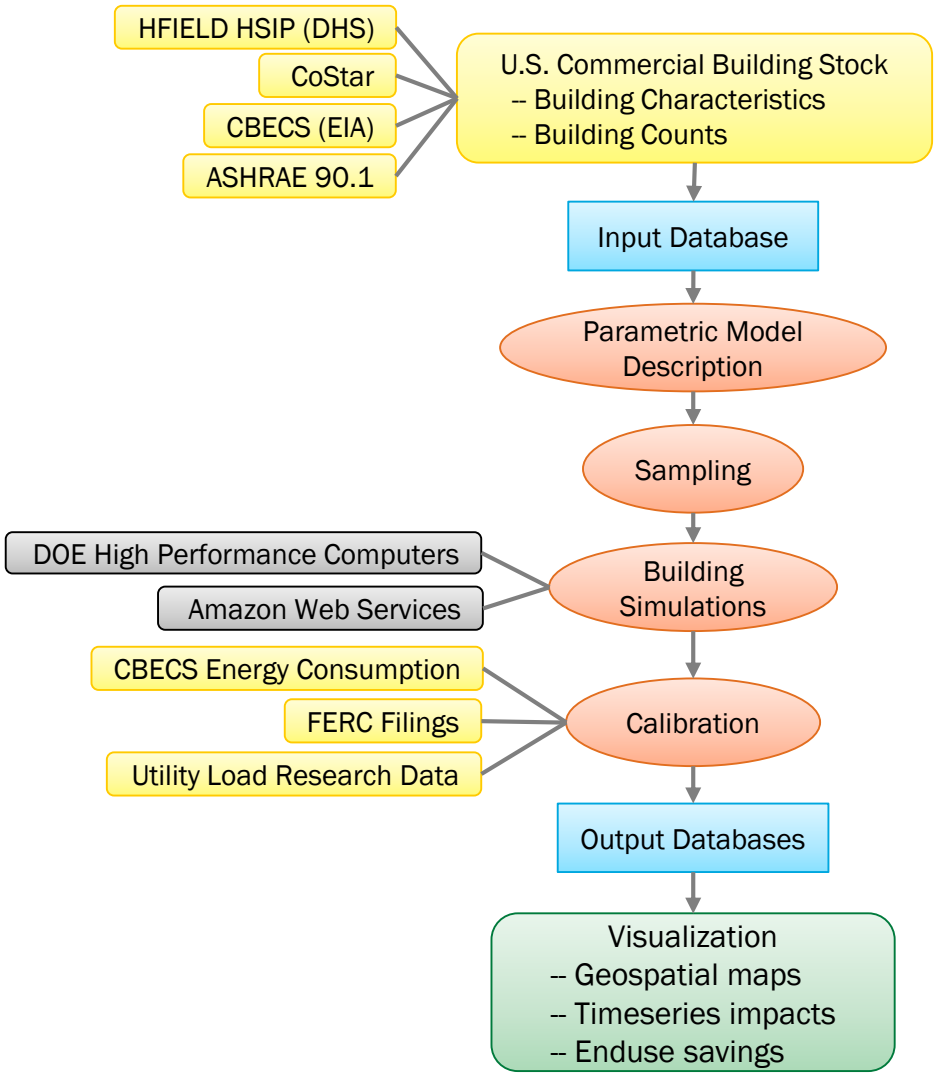
Project Budget: Originally funded after successful proof-of-concept in FY 2018
Variances: None
Cost to Date: $257k
Additional Funding: Significant cost share from LADWP and SoCalGas

Budget History					
July 1, FY 2018 (past)		FY 2019 (current)		March 30, FY 2020 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$71k	$170k	$850k	$454k	$370k	

Project Plan and Schedule

12/28/2019	NREL ComStock Presentation on Progress reviewed, updated and approved by NREL and DOE
2/15/2019	NREL ComStock Presentation on Progress reviewed, updated and approved by NREL and DOE
Peer review 5/29/2019	**Go/No-Go:** Are there sufficient data sources on the U.S. building stock to merit moving forward with the modeling? *Originally 3/29/2019 – moved at DOE suggestion to make time to create a public-facing document describing the data sources*
5/29/2019	NREL ComStock Presentation on Progress reviewed, updated and approved by NREL and DOE
6/26/2019	**Go/No-Go:** Determine if the U.S. building stock model has been sufficiently calibrated to justify use by DOE-BTO
8/30/2019	NREL ComStock Presentation on Progress reviewed, updated and approved by NREL and DOE
3/30/2020	ComStock is ready, including first analysis of measures for DOE and presentation of results

Approach: Detailed Models of Building Stock



1. Building Stock Characteristics
   - Input Database
2. Statistical Sampling
   - Parametrically-Generated Models
3. Building Simulations
   - Public/Private Computing Models
4. BEM based ECM
   - Highly introspective applicability
5. Validation/Calibration
   - Comparison to multiple data sources
6. Output Visualization
   - Multi-scale stakeholder visualizations