



A Portfolio Impact Analysis Tool for Building Energy-Efficiency Technologies

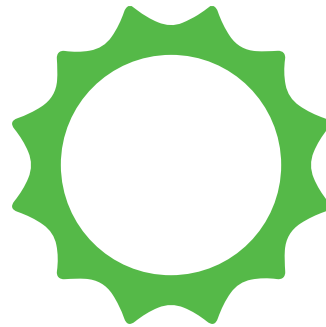
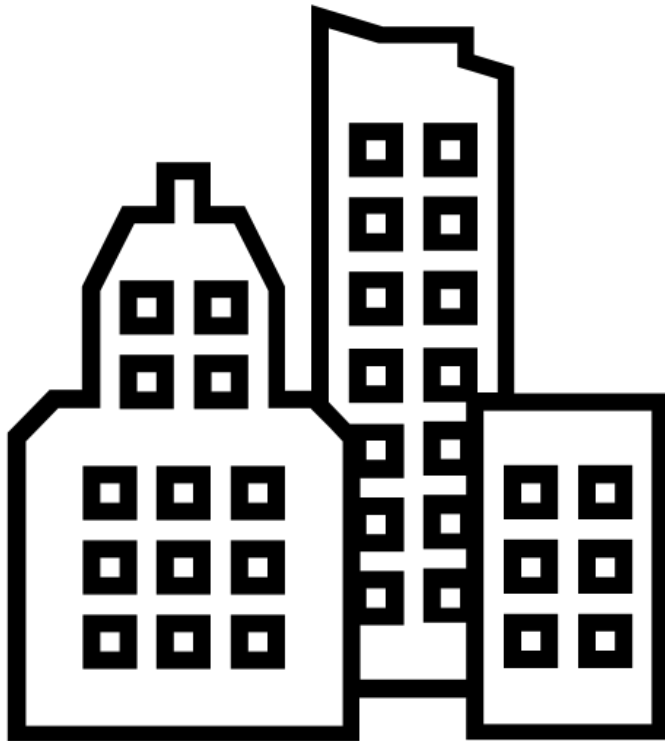
Jared Langevin and Chioke Harris

EERE/AAAS Science and Technology Policy Fellows
Building Technologies Office, U.S. Department of Energy

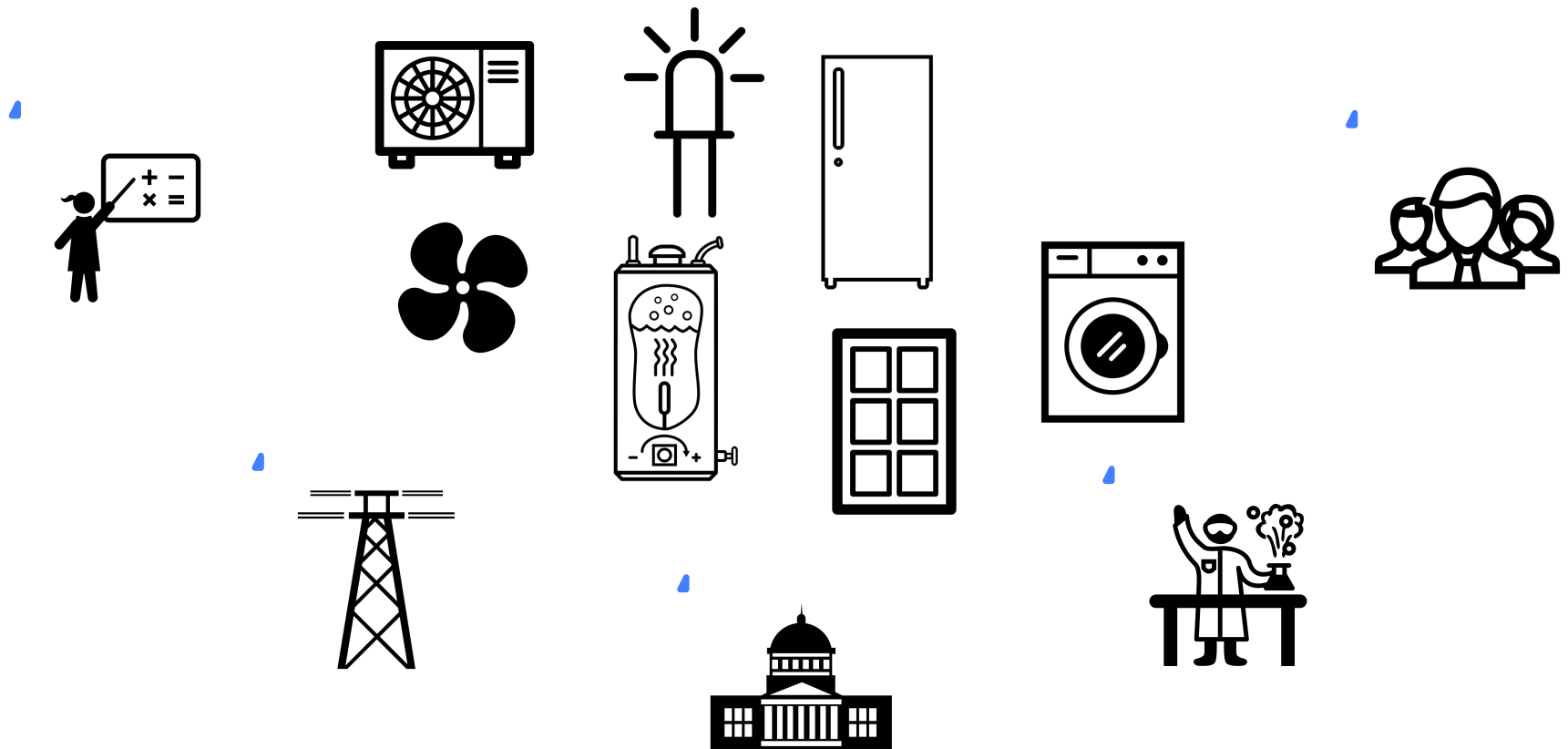
What we'll cover

1. New software for estimating national energy/CO₂ impacts of building energy efficiency measures
2. The data and modeling approach of this software
3. A vision for this software's use and development

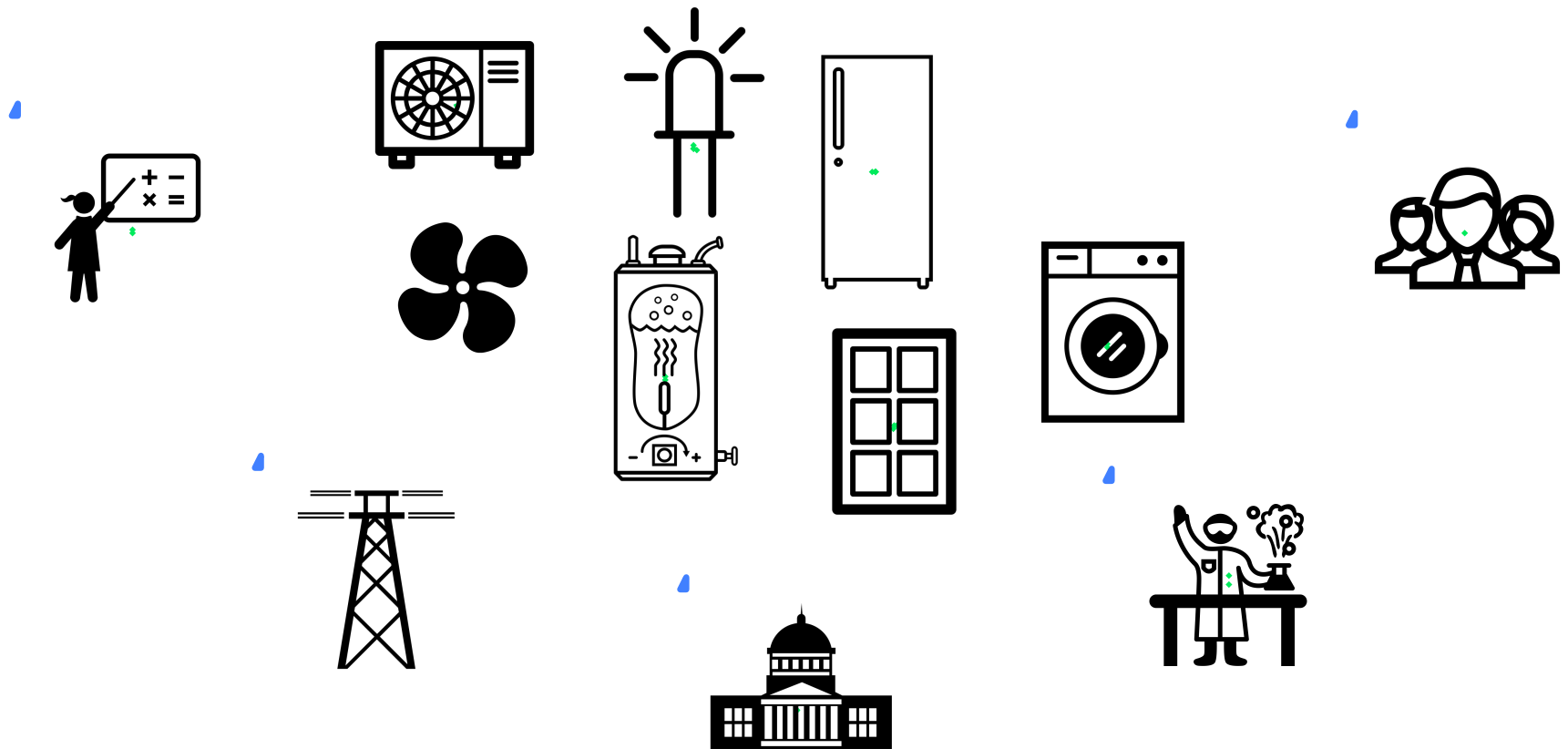
We all want low energy, low cost, healthy buildings



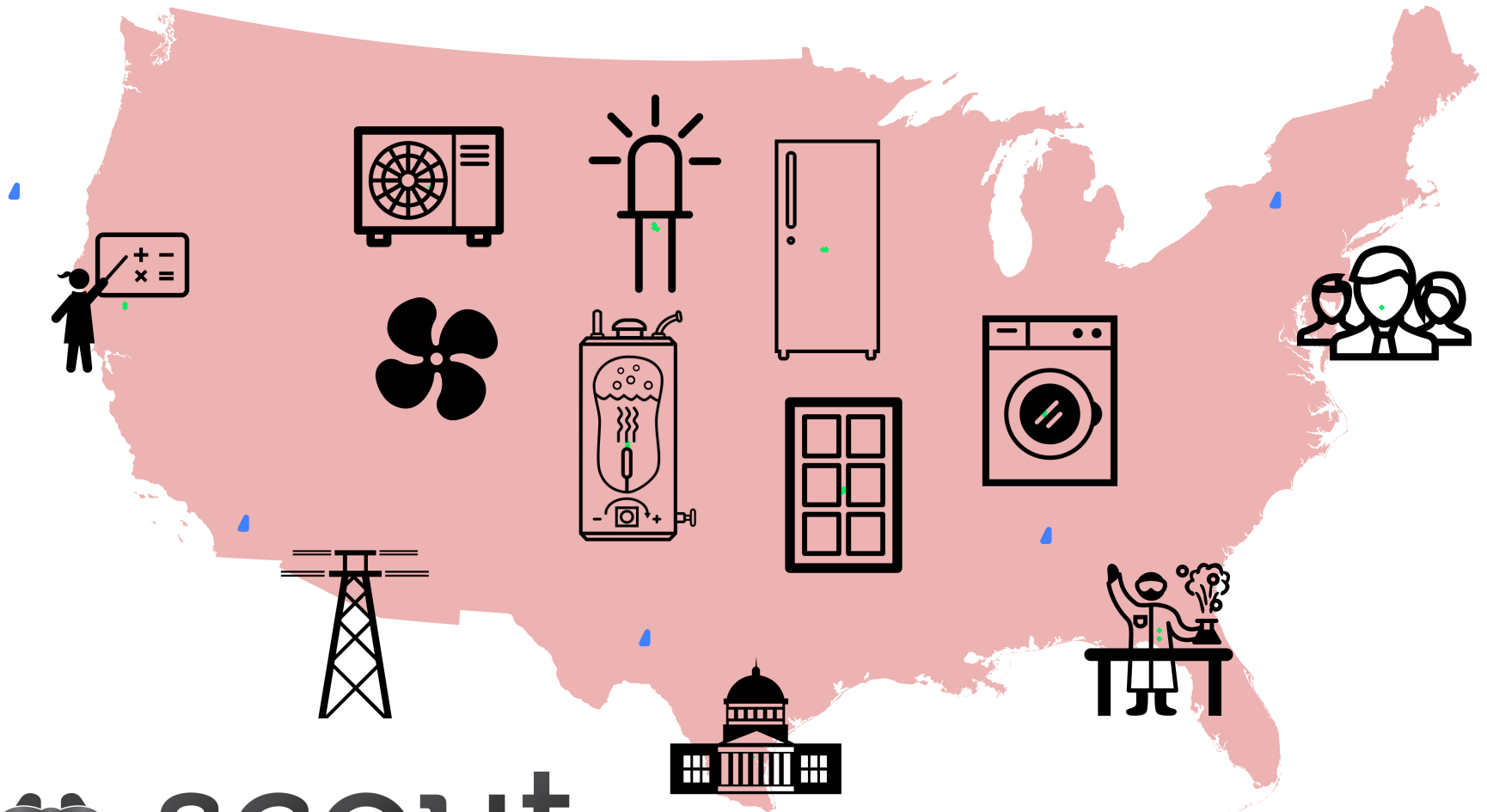
The problem: many efficient technologies, multiple perspectives



A level playing field is needed to assess efficiency impact potential

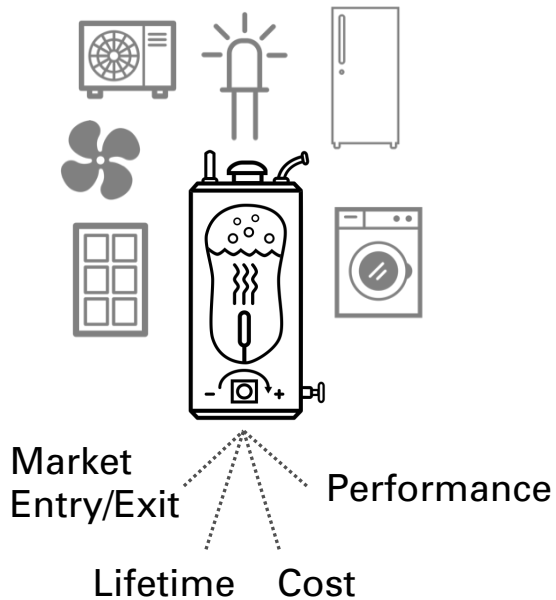


Scout establishes a common framework for impact estimation



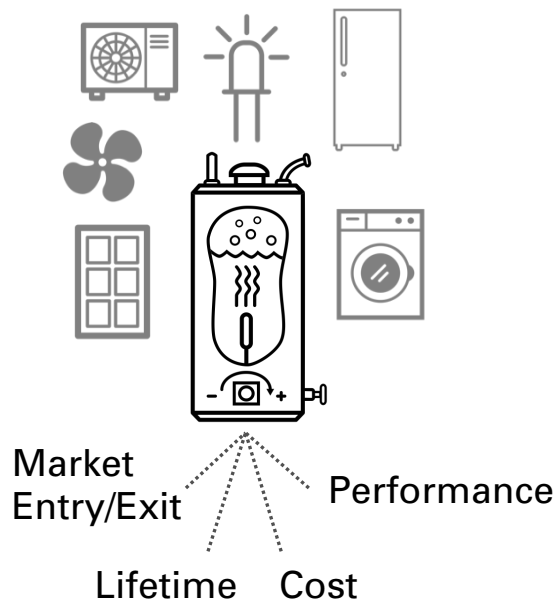
scout

Scout scales individual efficiency measures across the U.S. stock

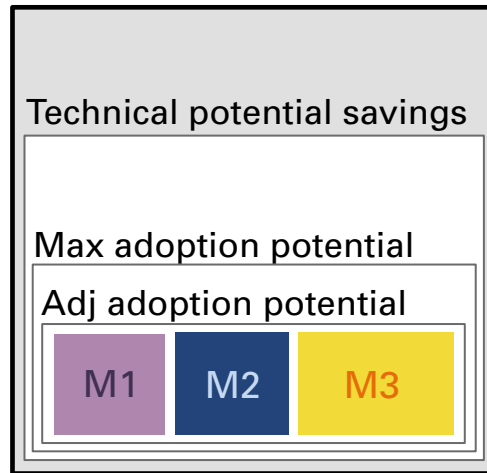


Define energy
efficient measures

Scout scales individual efficiency measures across the U.S. stock



Baseline energy/CO₂ mkt.

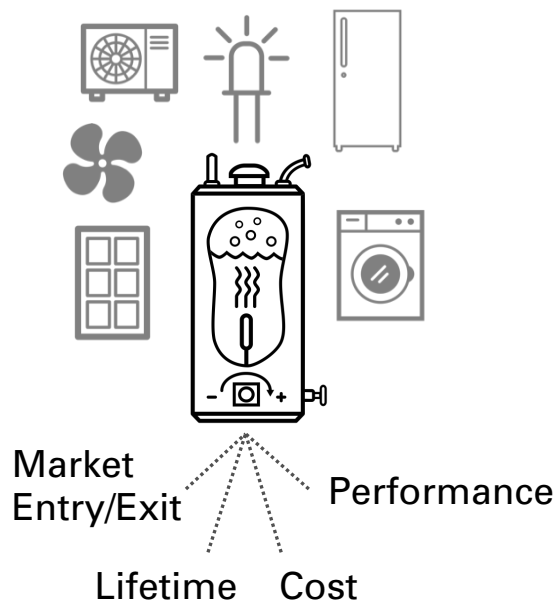


Define energy efficient measures



Apply measures to baseline energy and CO₂ markets under multiple adoption scenarios

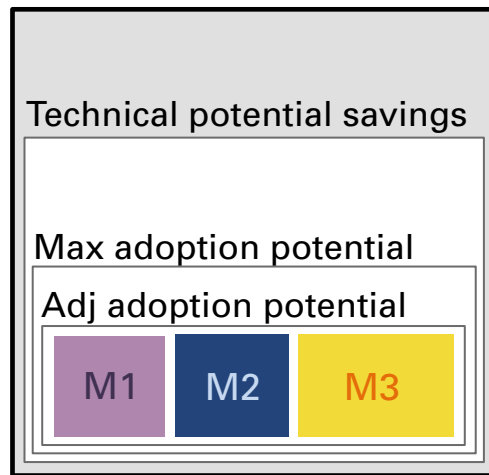
Scout scales individual efficiency measures across the U.S. stock



Define energy efficient measures



Baseline energy/CO₂ mkt.



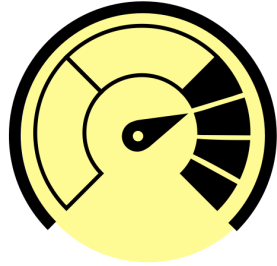
Apply measures to baseline energy and CO₂ markets under multiple adoption scenarios



Output national energy/CO₂ reductions and their cost-effectiveness



Scout measures are defined by performance, cost, and lifetime



Performance

Definition: Per unit absolute (e.g., COP) or relative (e.g., savings %)

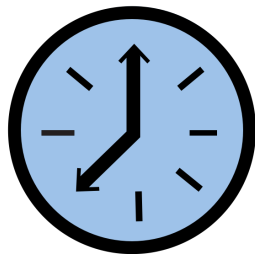
Sources: EnergyPlus, publications



Cost

Definition: Per unit installed cost

Sources: Product literature, public databases (e.g., ENERGY STAR), EIA

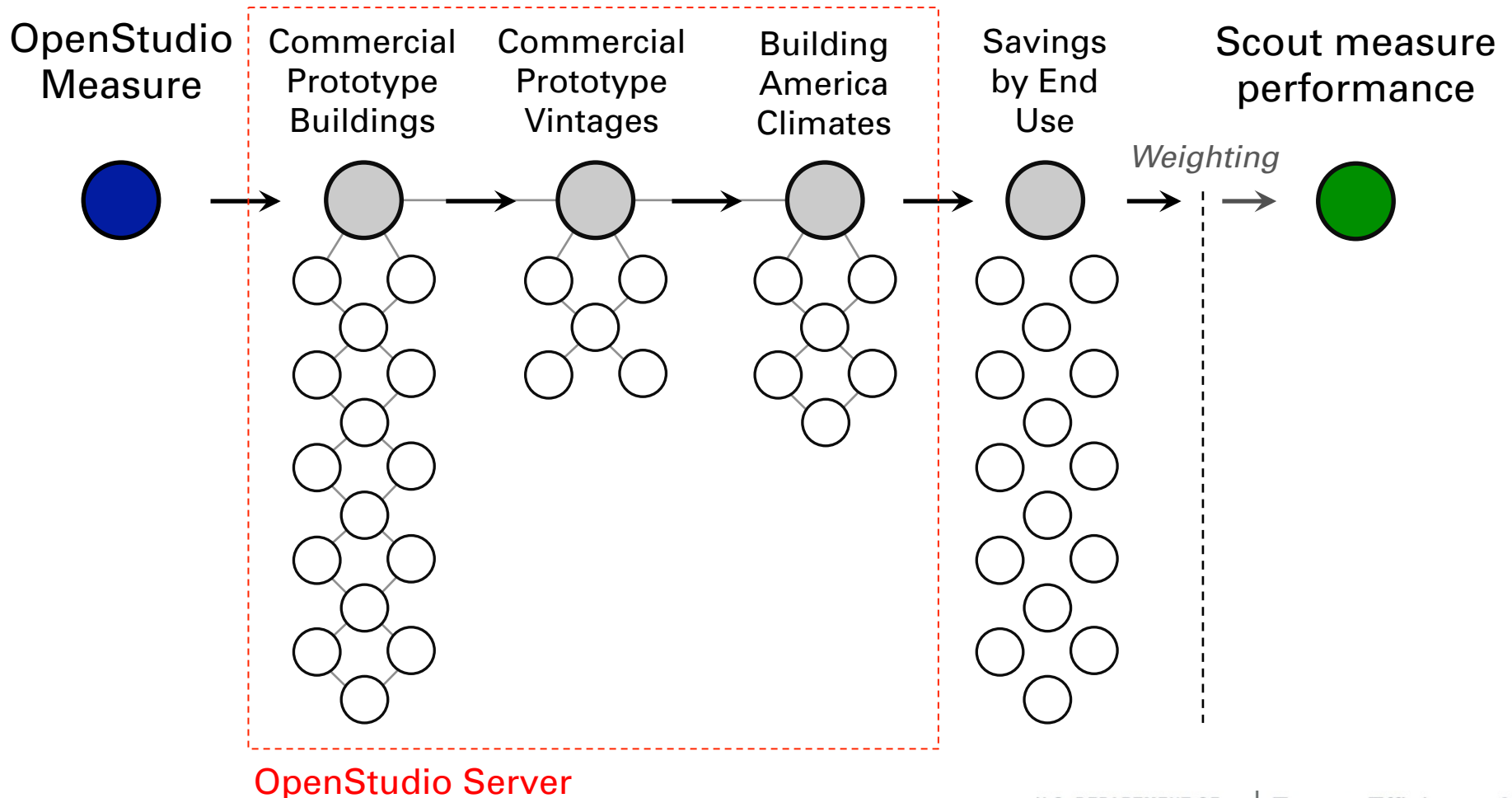


Lifetime

Definition: Useful unit life in years

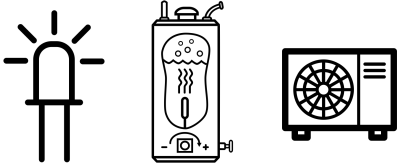
Sources: Product literature, public databases, EIA

Measure performance can be defined via EnergyPlus/OpenStudio

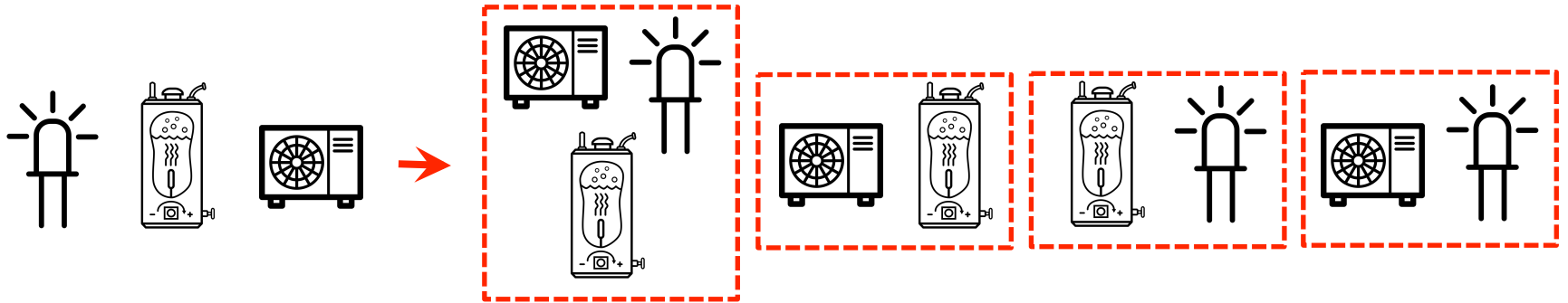


OpenStudio Server

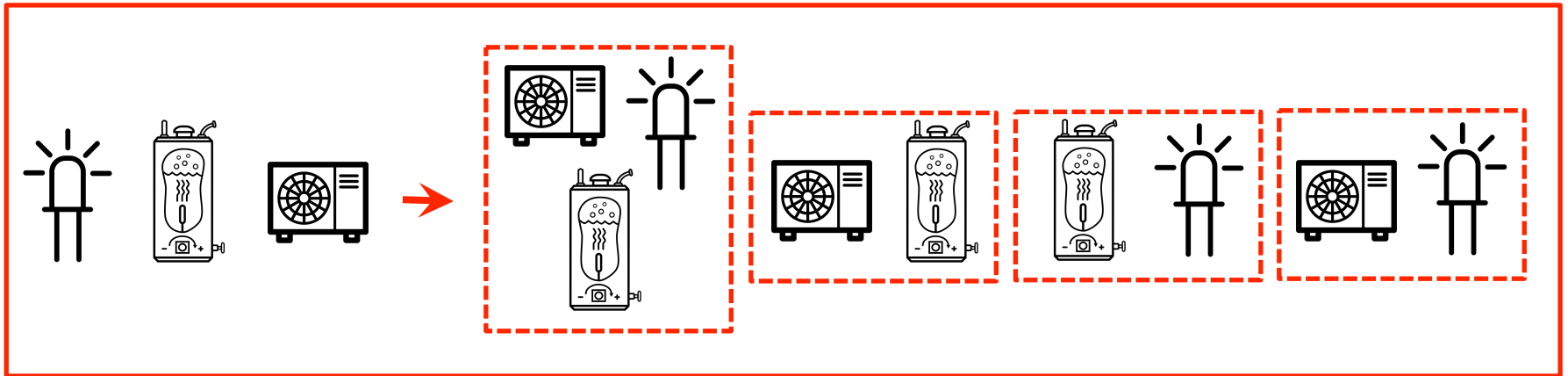
Measures can be packaged and assigned input uncertainty



Measures can be packaged and assigned input uncertainty

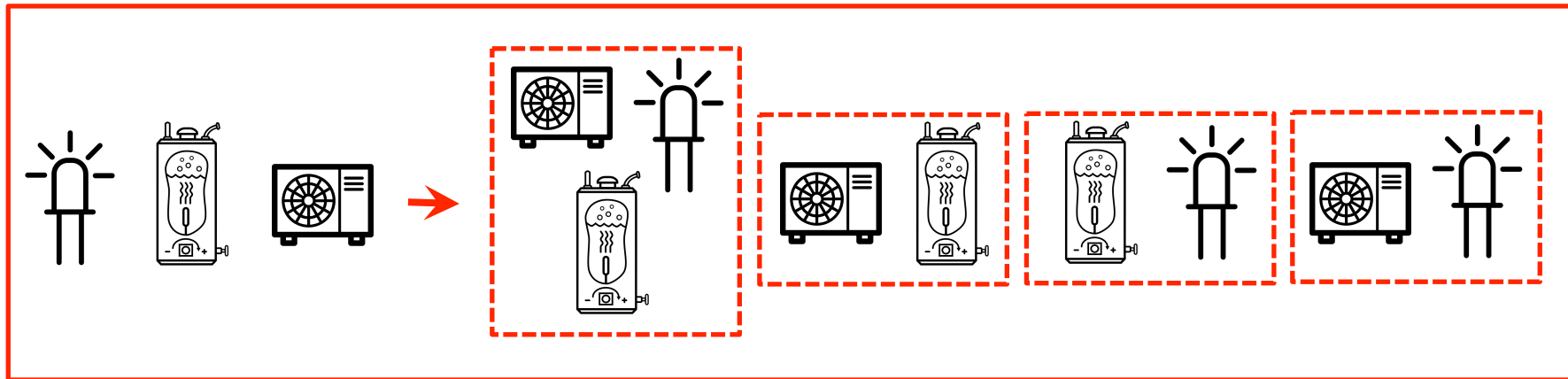


Measures can be packaged and assigned input uncertainty

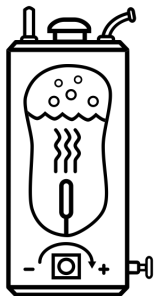


Compete individual and packaged measures

Measures can be packaged and assigned input uncertainty



Compete individual and packaged measures

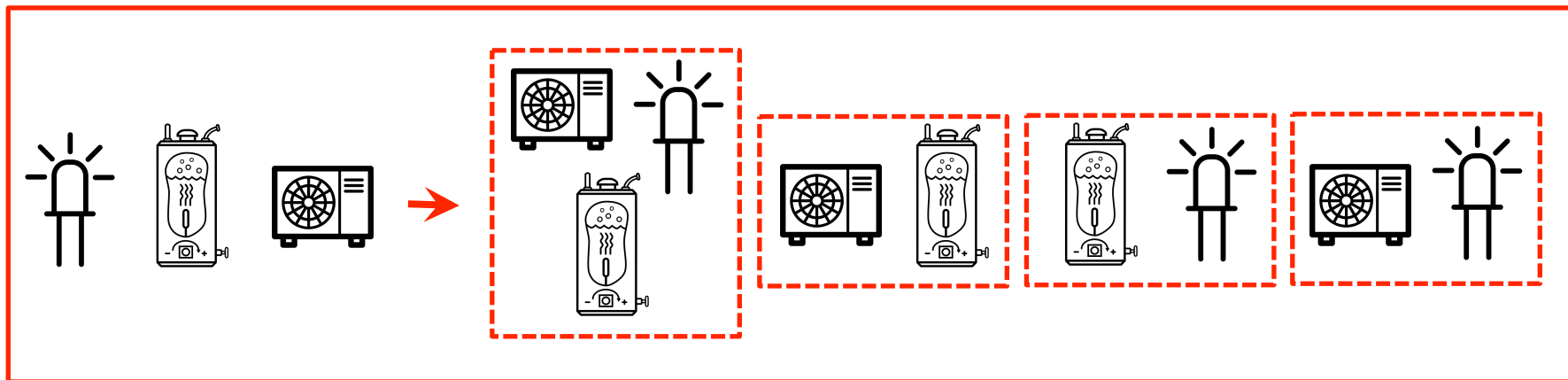


Cost: \$1850

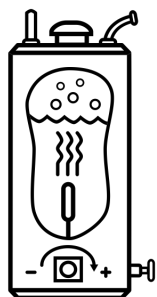
Performance: 2 EF

Lifetime: 13 years

Measures can be packaged and assigned input uncertainty



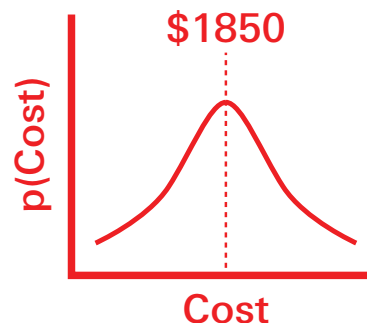
Compete individual and packaged measures



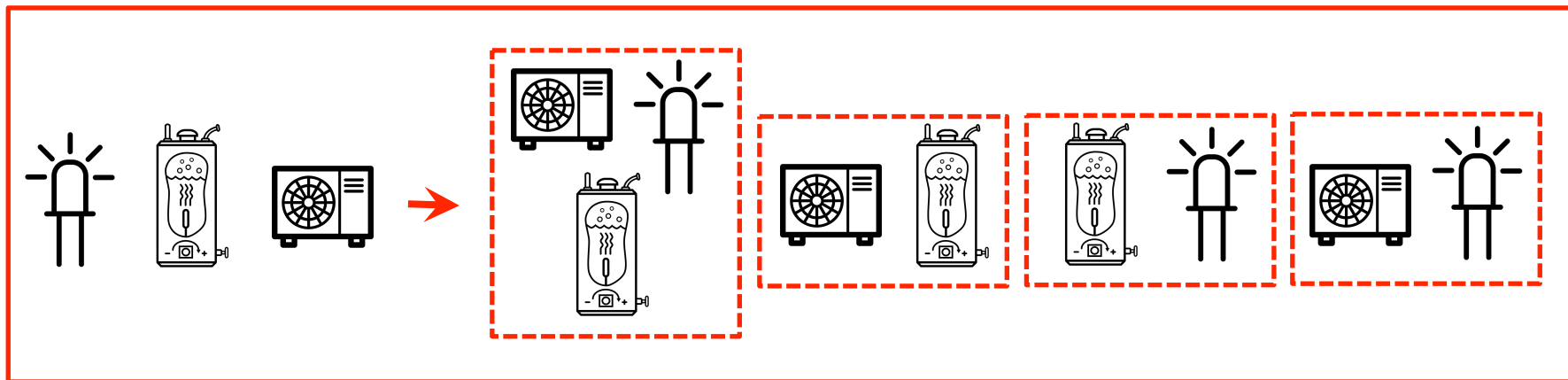
Cost: \$1850

Performance: 2 EF

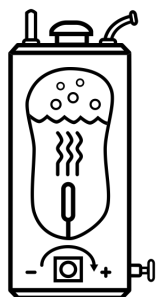
Lifetime: 13 years



Measures can be packaged and assigned input uncertainty



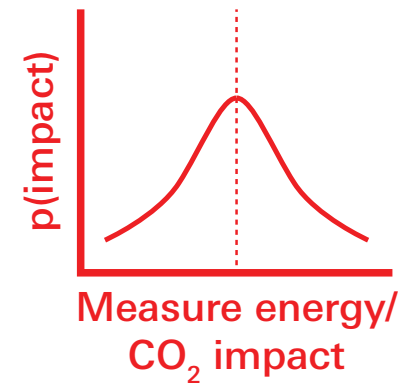
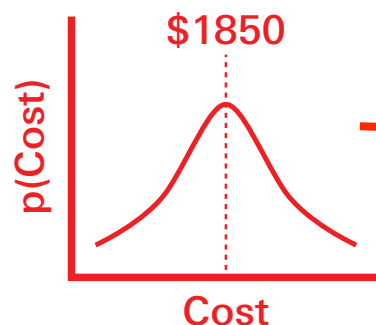
Compete individual and packaged measures



Cost: \$1850

Performance: 2 EF

Lifetime: 13 years



Measures apply to baselines drawn from EIA Annual Energy Outlook

Data reported for each year from 2009 to 2040

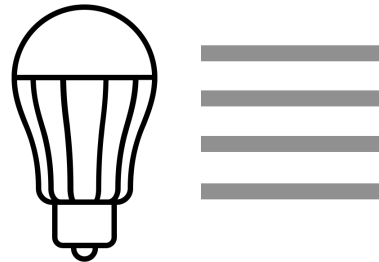
Energy Use



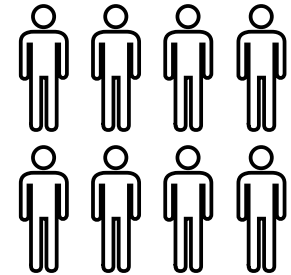
Building Stock



Equipment Characteristics



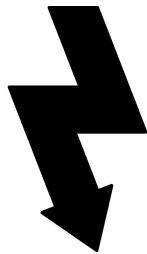
Adoption Model Parameters



Measures apply to baselines drawn from EIA Annual Energy Outlook

Data reported for each year from 2009 to 2040

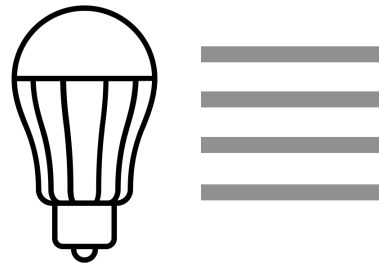
Energy Use



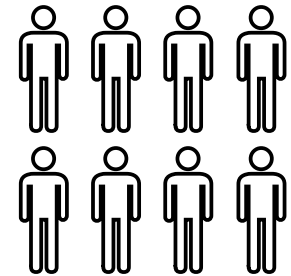
Building Stock



Equipment Characteristics



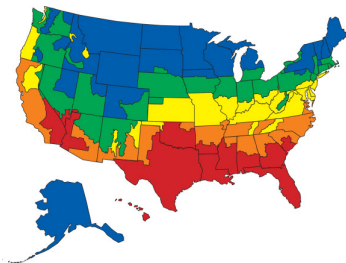
Adoption Model Parameters



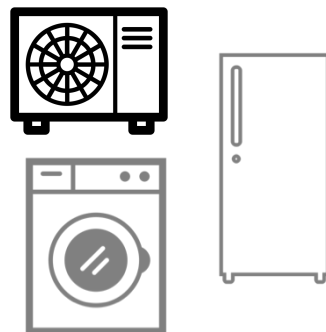
Building Type



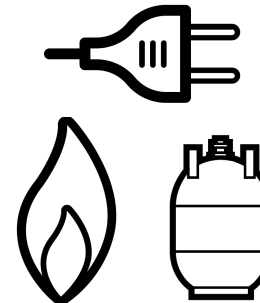
Climate Zone



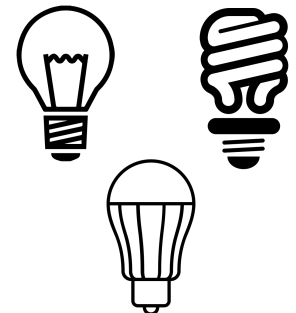
End Use



Fuel Type

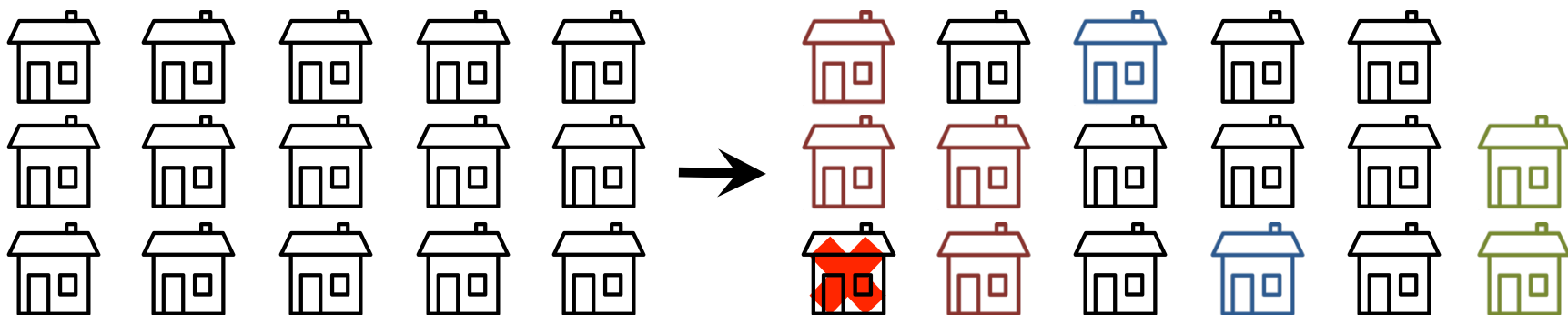


Technology

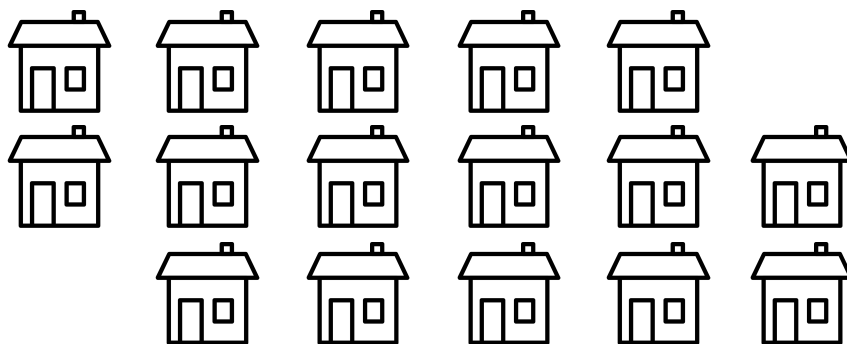


Baseline data define building and equipment stocks and flows

Year Y



Year Y+1



Existing stock



Replacement



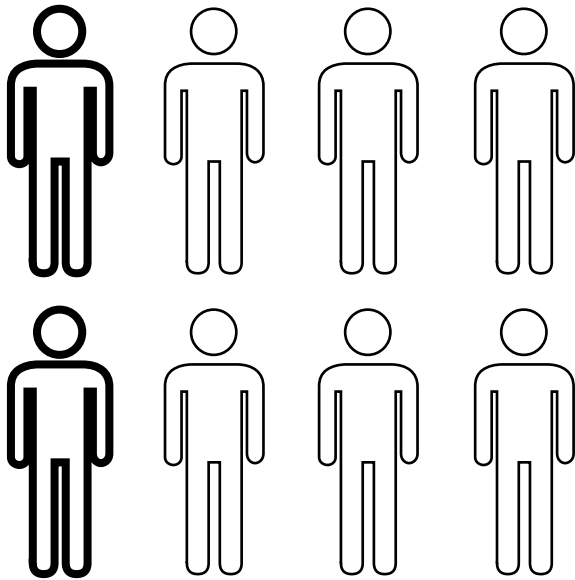
Retrofit (elective replacement)

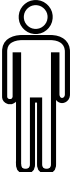


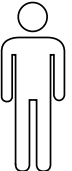
New

Measures diffuse into markets under three adoption scenarios

Total baseline market (Year Y)

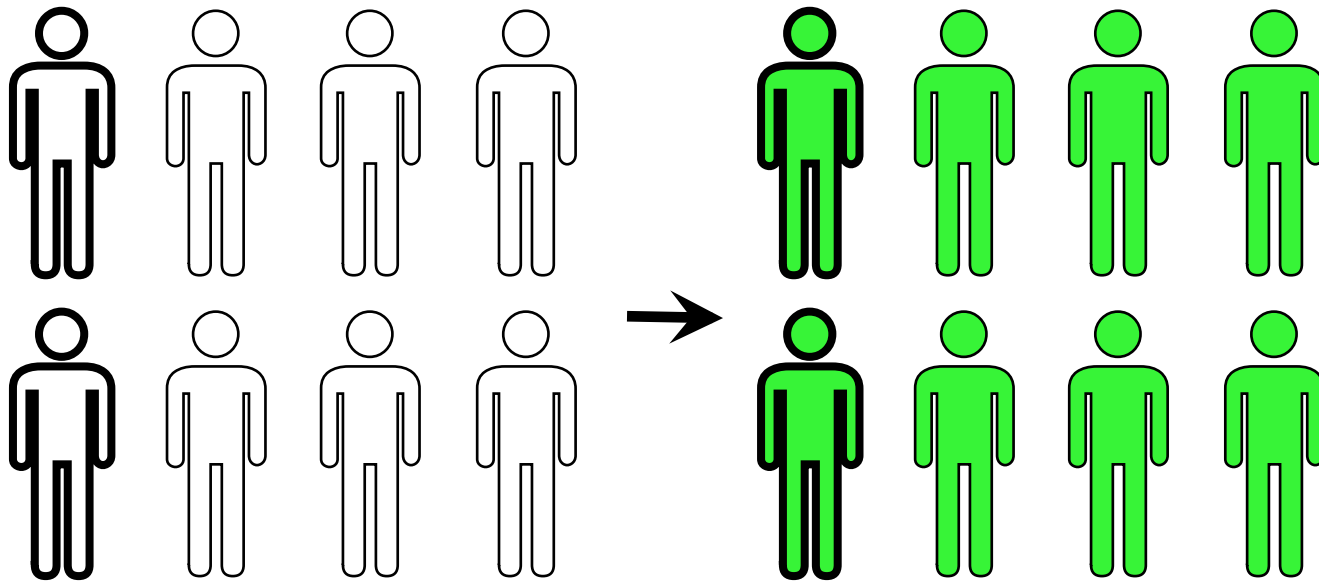


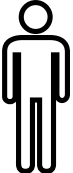
 New/replace/
retrofit
baseline
(‘Competed’)

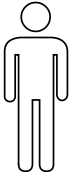
 Uncompeted
baseline


Measures diffuse into markets under three adoption scenarios

Technical Potential Scenario: Total market fully captured



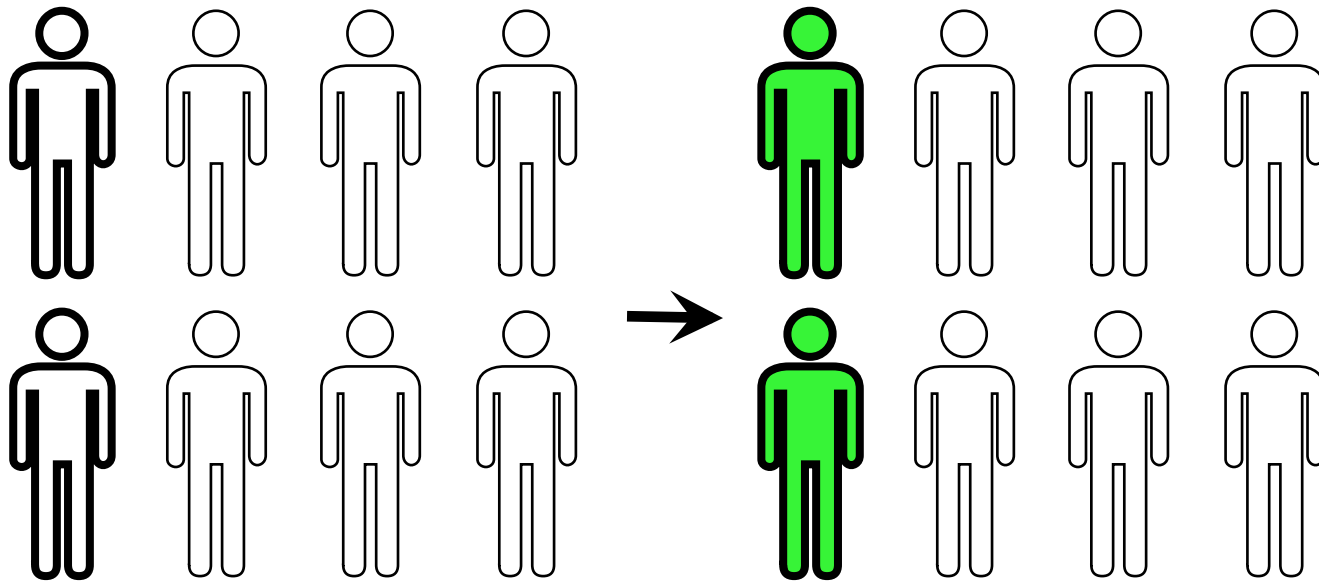
 New/replace/
retrofit
baseline
(‘Competed’)


 Uncompleted
baseline

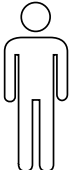
 Captured by
an efficient
measure


Measures diffuse into markets under three adoption scenarios

Max Adoption Scenario: Competed market fully captured



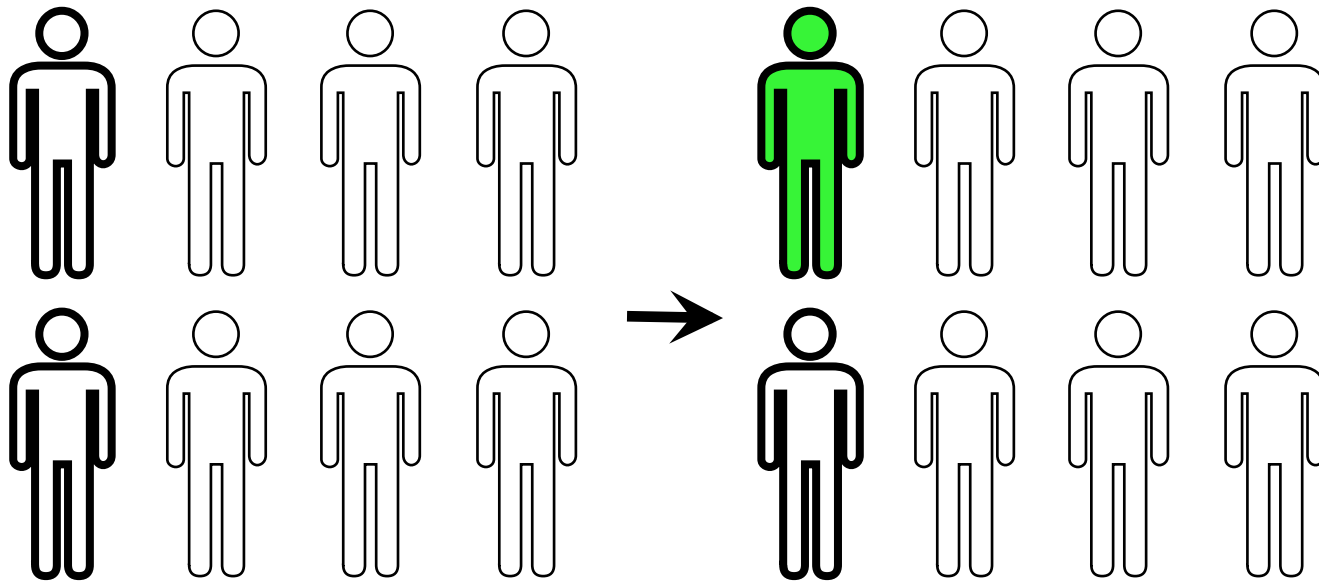
 New/replace/
retrofit
baseline
(‘Competed’)


 Uncompeted
baseline

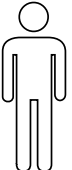
 Captured by
an efficient
measure


Measures diffuse into markets under three adoption scenarios

Adjusted Adoption Scenario: Competed market partially captured



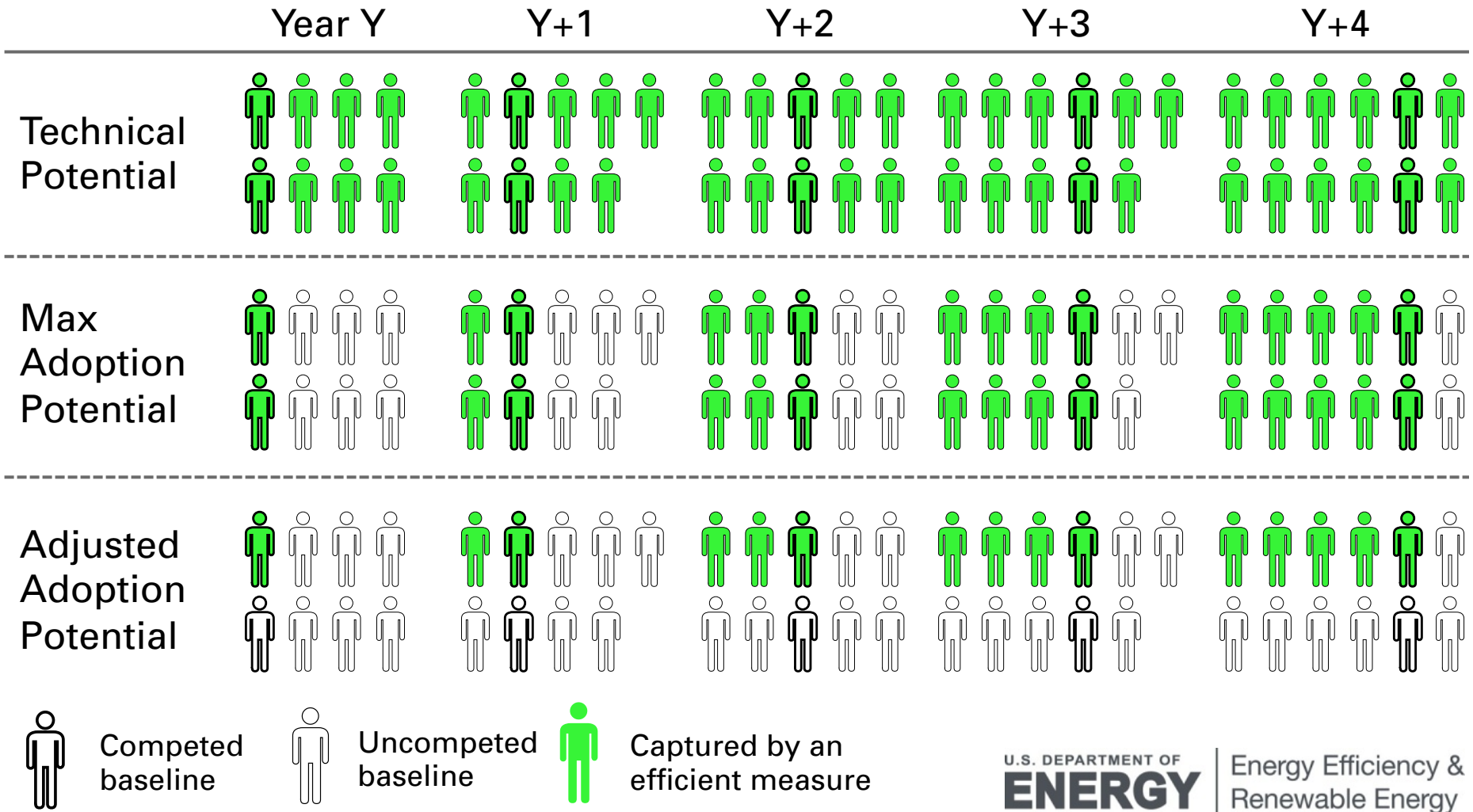
 New/replace/
retrofit
baseline
(‘Competed’)

 Uncompeted
baseline

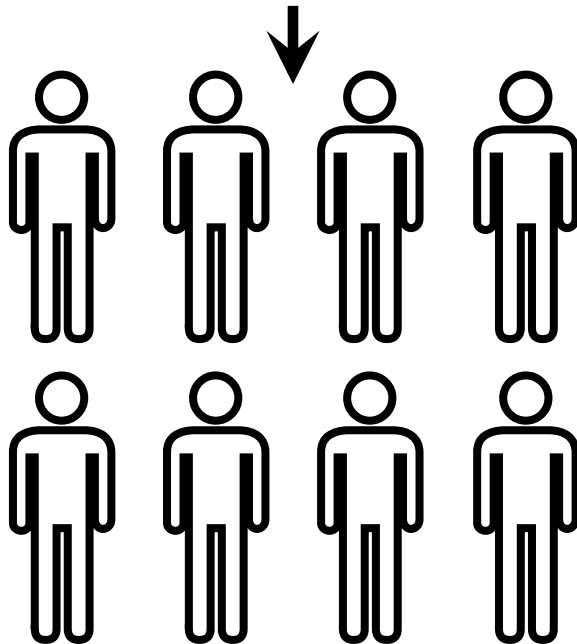
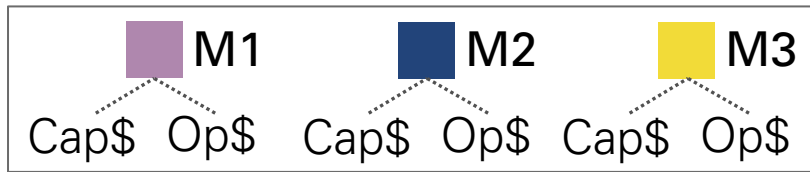
 Captured by
an efficient
measure

*** Not currently implemented**

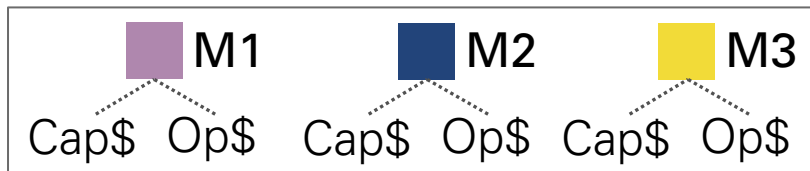
Adoption scenarios determine measure diffusion rates over time



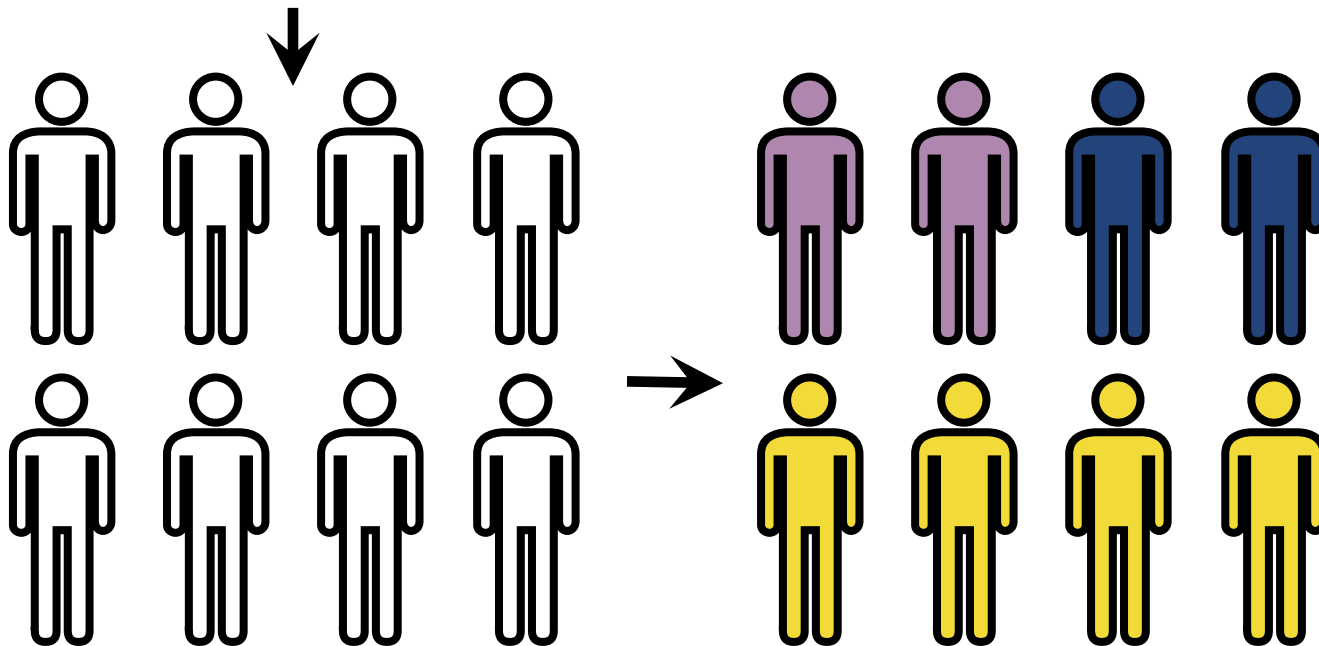
Competing measures are attributed shares of their baseline markets



Competing measures are attributed shares of their baseline markets



Measure market shares determined by per unit capital/operating costs
*(based on NEMS adoption models)



Competed baseline



Captured (M1)

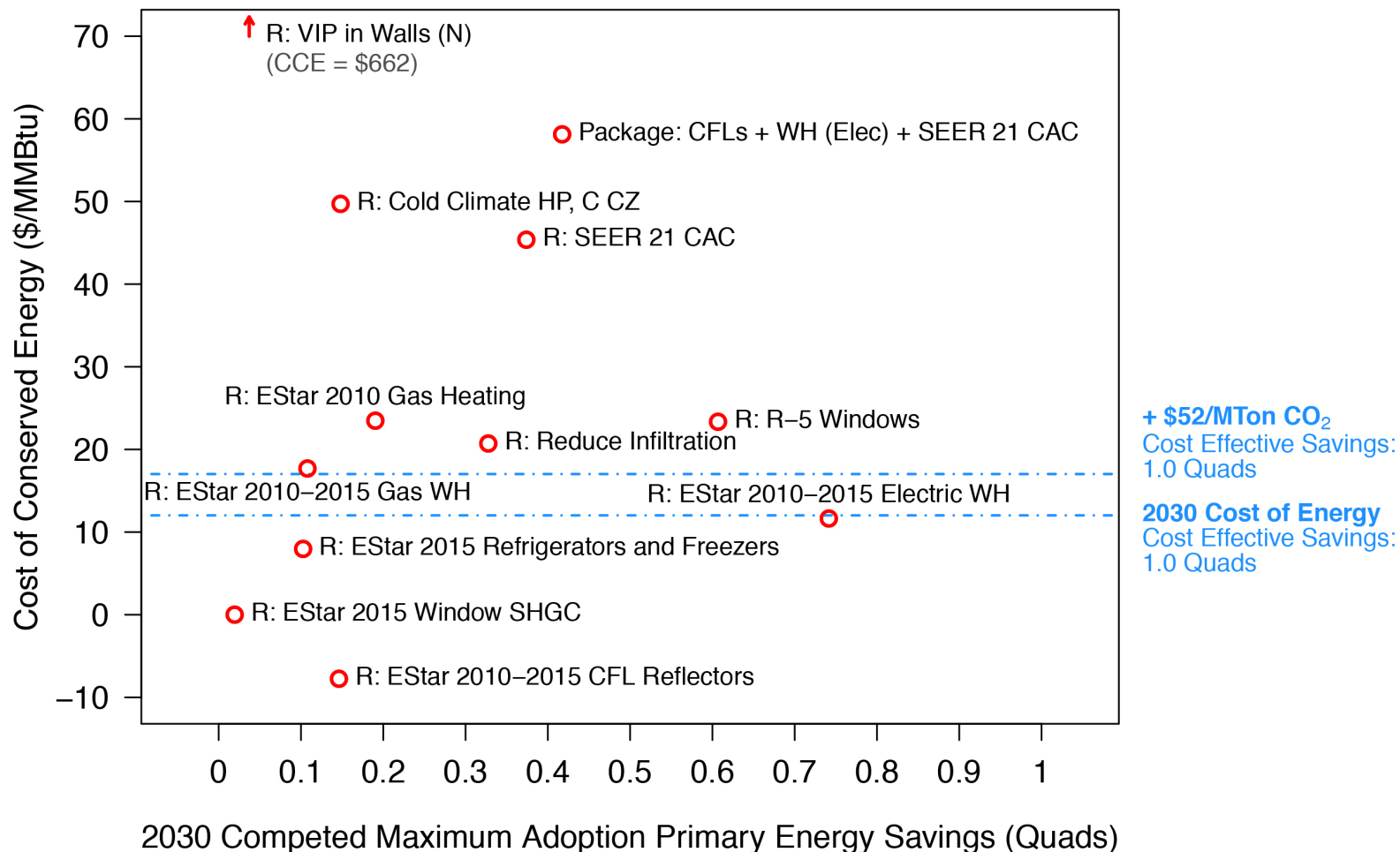


Captured (M2)

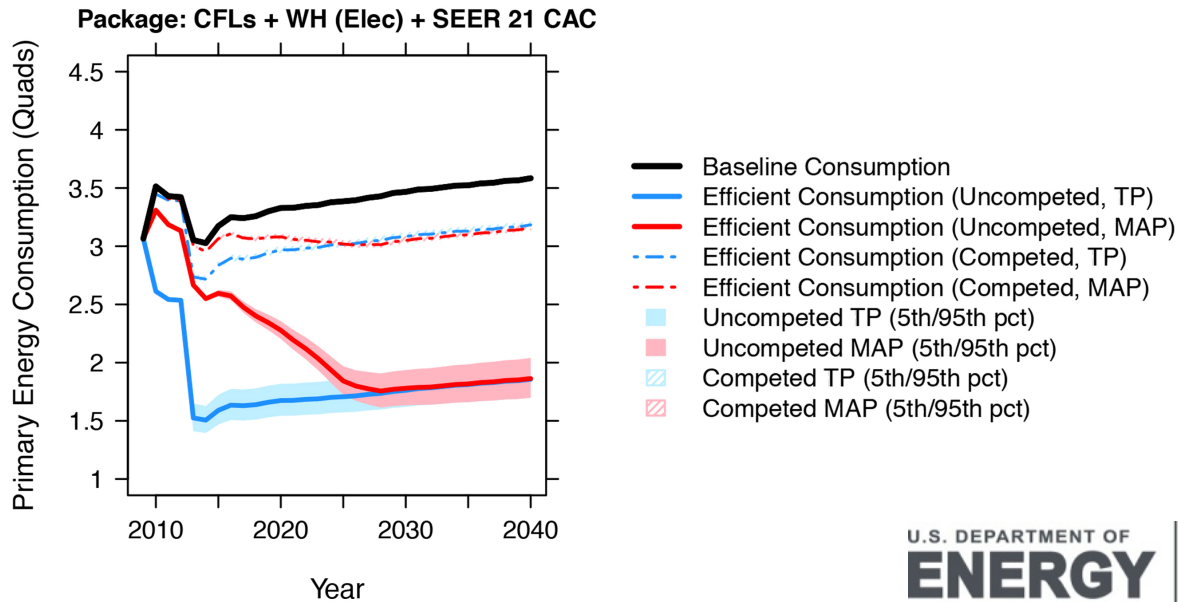
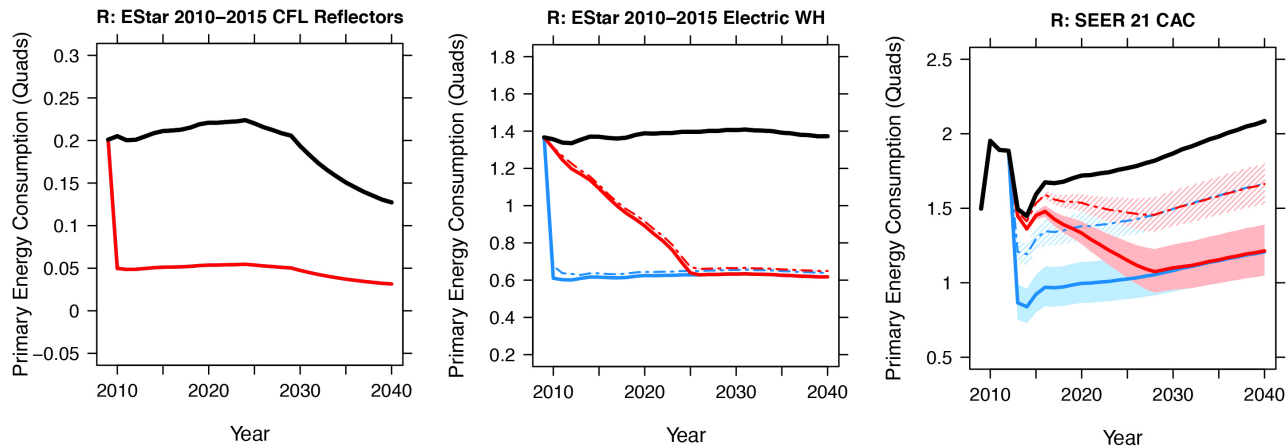


Captured (M3)

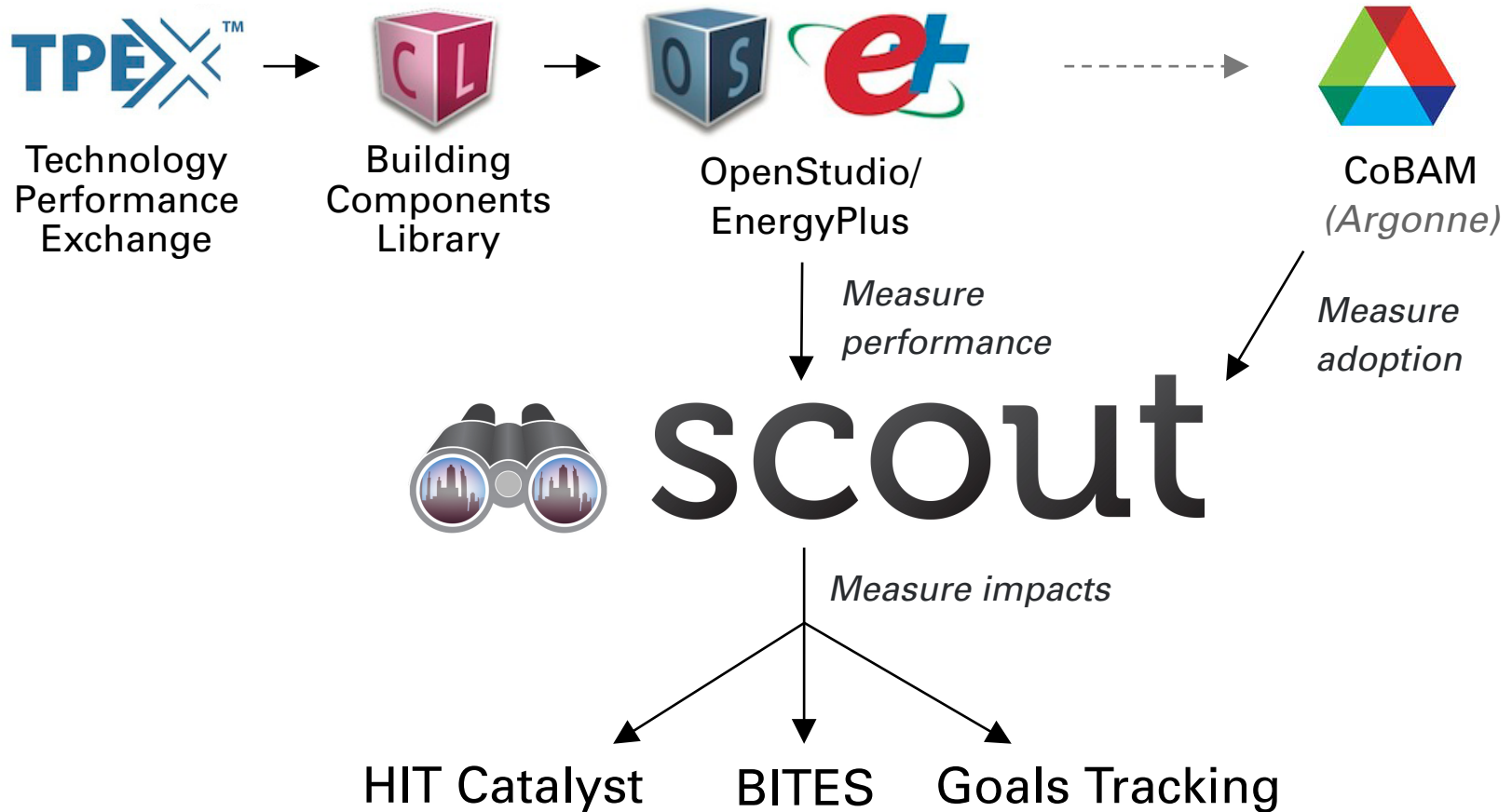
Measures are evaluated by savings impacts and cost-effectiveness



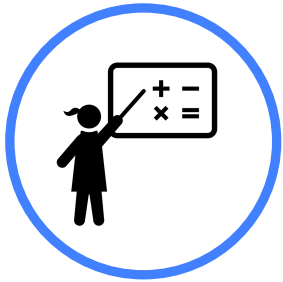
Results can show the effect of package measures, uncertainty



Scout fits into a larger BTO analysis ecosystem



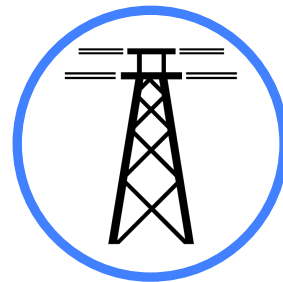
Scout is also relevant to the analysis needs of non-BTO parties



Academics, national labs, and industry partners can use Scout to communicate the larger-scale benefits of R&D breakthroughs



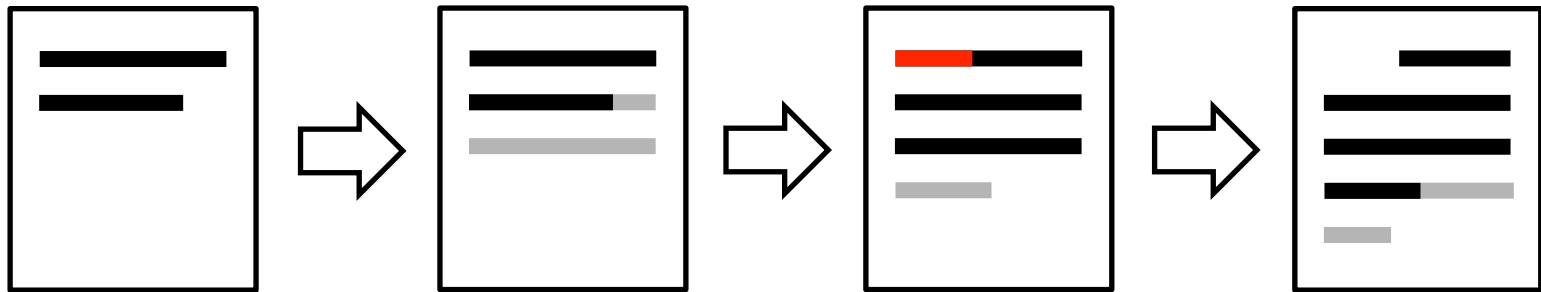
Other federal agencies can use Scout to estimate the potential impacts of funding in achieving energy and CO₂ reduction goals



Utilities can use Scout to develop 'deemed savings' values and corresponding incentives for Energy Conservation Measures

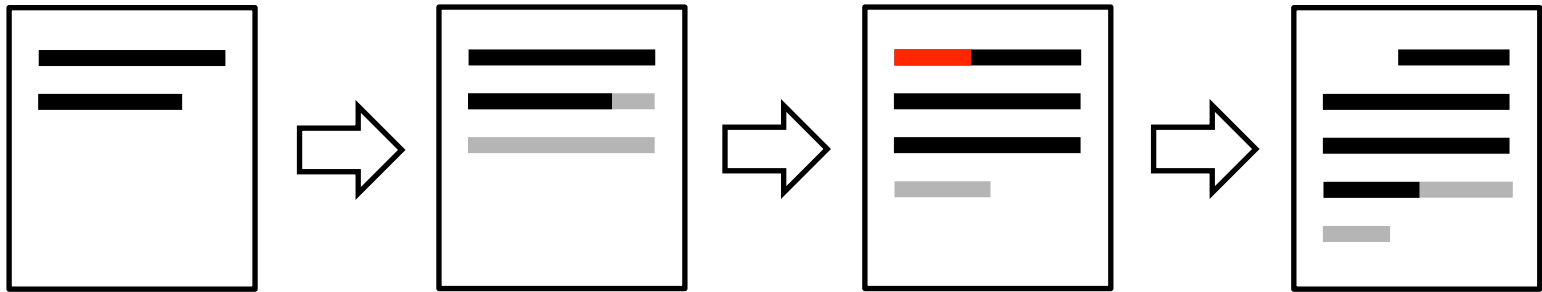
Scout is flexible to future development and expansion

Version control

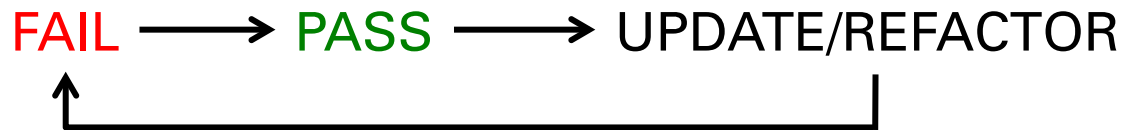


Scout is flexible to future development and expansion

Version control

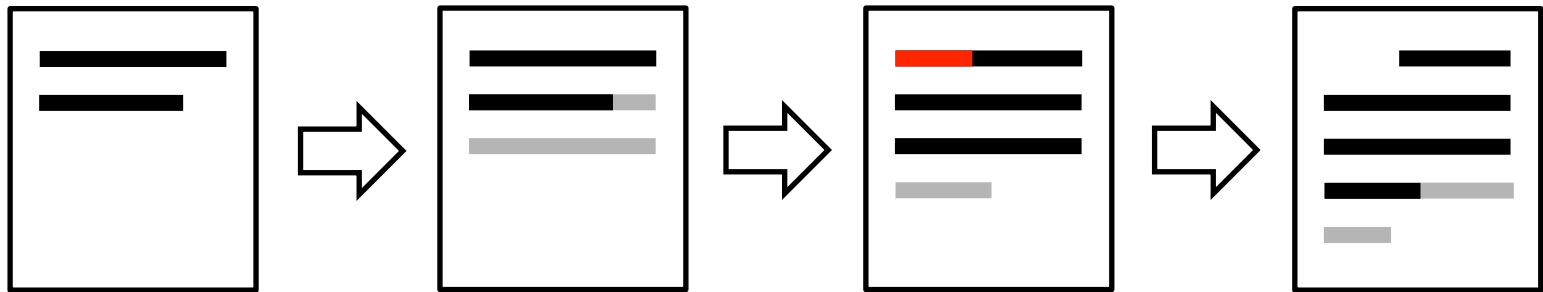


Test-driven development

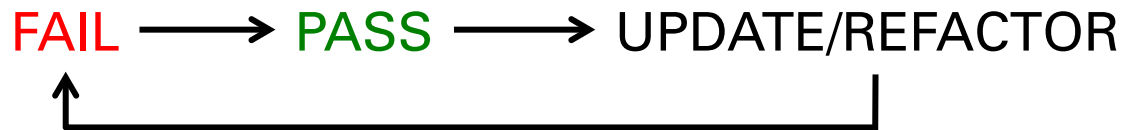


Scout is flexible to future development and expansion

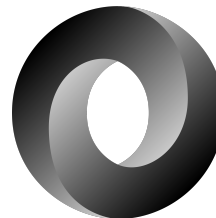
Version control



Test-driven development

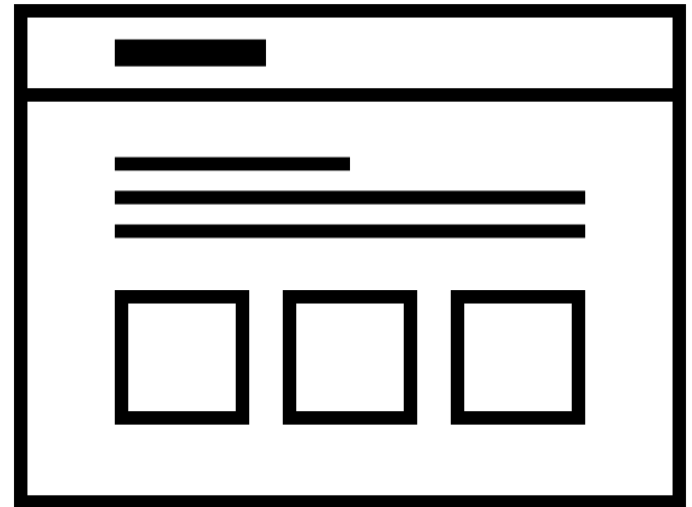


Widely adopted open-source tools and methods



BTO plans to develop a web interface for Scout to encourage wider use

- Review existing measures
- Submit new measures
- Suggest measure revisions
- Review model assumptions
- Visualize existing results
- Access model documentation



Using Scout input data, Market Calculator is available now

scout

Market Calculator

Determine the energy use associated with building components, equipment, and other end uses in residential and commercial buildings.

The Market Calculator yields the estimated energy use and CO₂ emissions associated with losses through the building envelope and appliances and devices within residential and commercial buildings in the United States. The energy use and CO₂ emissions can be divided by building type, climate zone, technology type, and other factors indicated below. CO₂ emissions reported here do not include direct emissions associated with losses of working fluids from heating, cooling, water heating, and refrigeration systems.

To obtain an estimate for a market or markets of interest, the appropriate definitions must be selected below. In each category shown, at least one selection must be made to yield a complete market definition. In some categories, multiple selections are permitted. Categories where multiple selections are allowed are indicated as such. Selections for the relevant groups are made by simply clicking the appropriate terms. Selected terms are highlighted, and clicking them again will remove them from the chosen market segment. Follow the numbered steps below, making the desired selections at each step. Once selections have been made in each category, click the 'Update' button in the Market Size box on the right side of the screen to get the energy use in the selected market and the associated CO₂ emissions.

The underlying data for this calculator are from the 2015 [Annual Energy Outlook \(AEO\)](#) released by the [U.S. Energy Information Administration \(EIA\)](#).

1. Choose a projection year

2. Select all relevant [AIA climate zones](#)

3. Choose residential or commercial buildings

Market Size

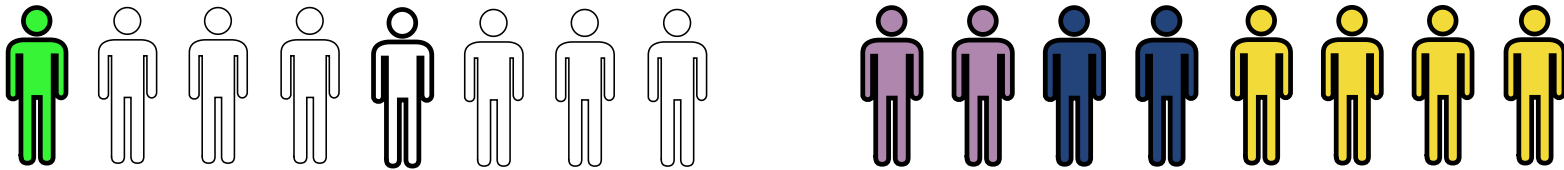
0
TBTU (primary energy)

0
MMT CO₂

<https://trynthink.github.io/scout/calculator.html>

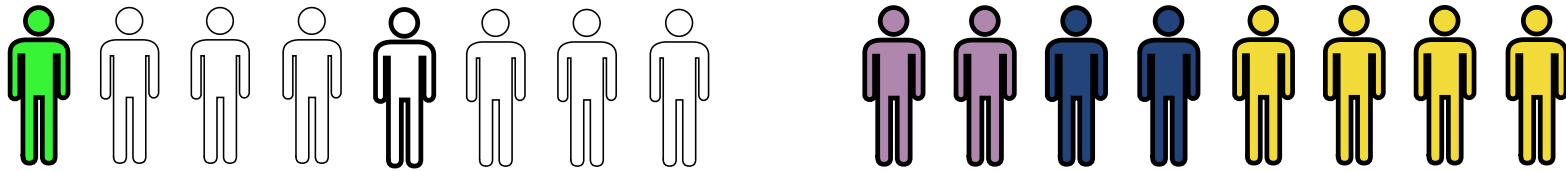
Multiple areas have been identified for future model updates

Improved representation of consumer adoption dynamics

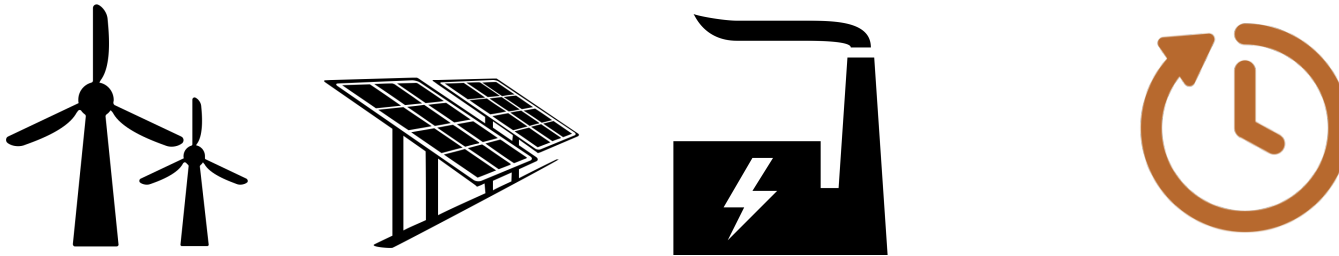


Multiple areas have been identified for future model updates

Improved representation of consumer adoption dynamics

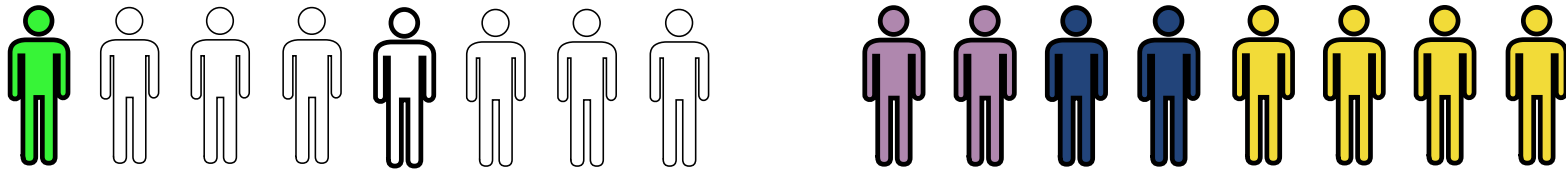


Modeling potential for peak demand reductions

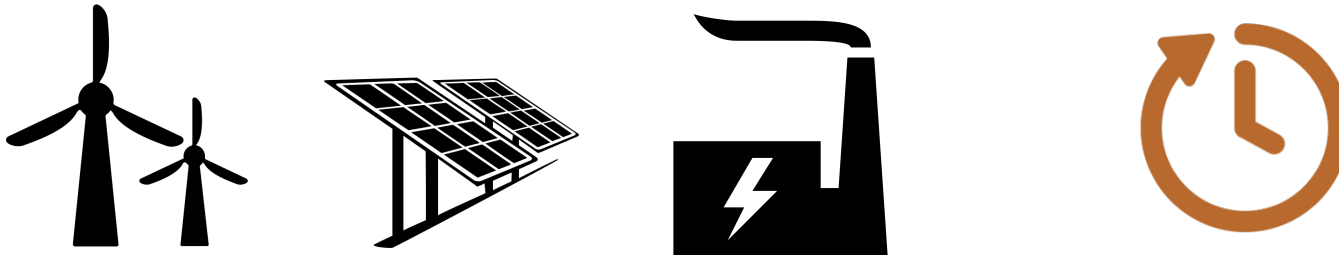


Multiple areas have been identified for future model updates

Improved representation of consumer adoption dynamics



Modeling potential for peak demand reductions



Non-energy benefits



Chioke Harris

chioke.harris@ee.doe.gov

Jared Langevin

jared.langevin@ee.doe.gov

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

Icon attributions

Slide 3: buildings (Milky-Digital Innovation); US dollar (Christopher Beach); lightning bolt (Tristan)

Slide 4: LED (Nikita Kozin); water heater (Michael Thompson); air conditioning unit (Arthur Shlain); fan (Edward Boatman); refrigerator (shashank singh); washing machine (Ed Harrison); window (Arthur Shlain); teacher (TukTuk Design); utility tower (Maurizio Fusillo); Capitol building (Kelcey Hurst); lab scientist (Edward Boatman); business team (lastpark)

Slide 6: United States (Bohdan Burmich)

Slide 9: energy dollar (Nicholas Menghini); power plant (Francesca Ameglio)

Slide 10: gauge (Nicolas Vicent); clock (Nadya Bratt)

Slide 18: energy (Edward Boatman); buildings, mosque, house (Creative Stall); school (Tran)

Slide 19: plug (Arthur Shlain); flame (Samuel Q. Green); propane tank (Carlos Salgado); fluorescent light bulb (Matt Brooks); light bulb (Marco Galtarossa); LED bulb (Alex Podolsky)

Slide 26: figure (Alexander Smith)

Slide 35: homepage (Lil Squid)

Slide 38: solar panels (Adam Terpening); turbines (Creative Stall); power plant (Iconathon); clock (Karen Tyler)

Slide 39: faucet (Carla Gom Mejorada)