

AutoBEM: A Workflow to Automate Building Energy Modeling

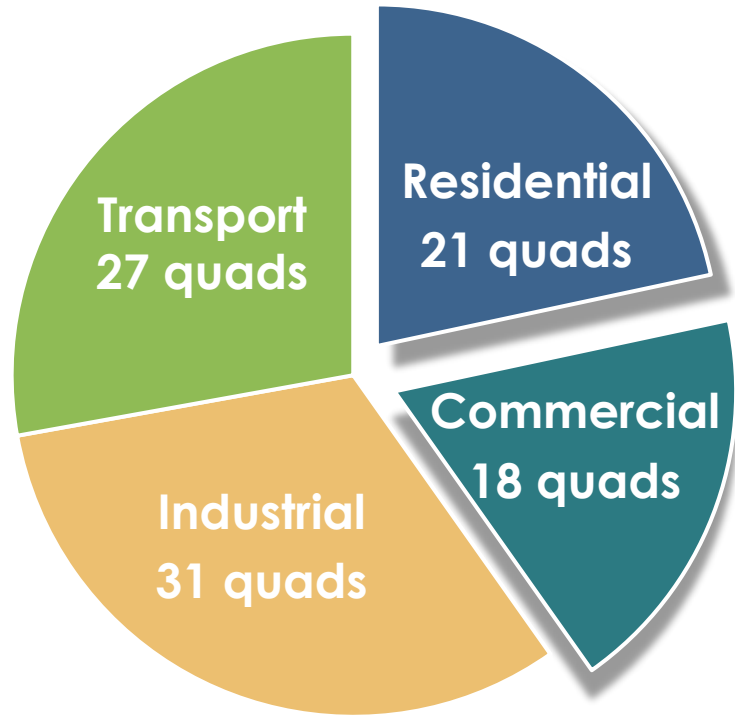
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U.S. Energy and Buildings Overview



125 million buildings

**~\$400 billion
in energy bills**

**40% energy use
39% emissions**

Goal of DOE's Building Technologies Office:
30% EUI reduction by 2030
compared to 2010 baseline

Building Energy Modeling
building descriptions + weather = estimated building
energy consumption, demand, emissions, equity, ...

Building simulation at scale

Simulation Engine and Analysis Platform
U.S. Dept. of Energy (\$100+M, 1995–?)



OpenStudio



45 million core-hours (2021)
51 million core-hours (2022)
Argonne's Theta supercomputer

Free, open-source (GitHub), community support
100 – 2,000 improvements per building

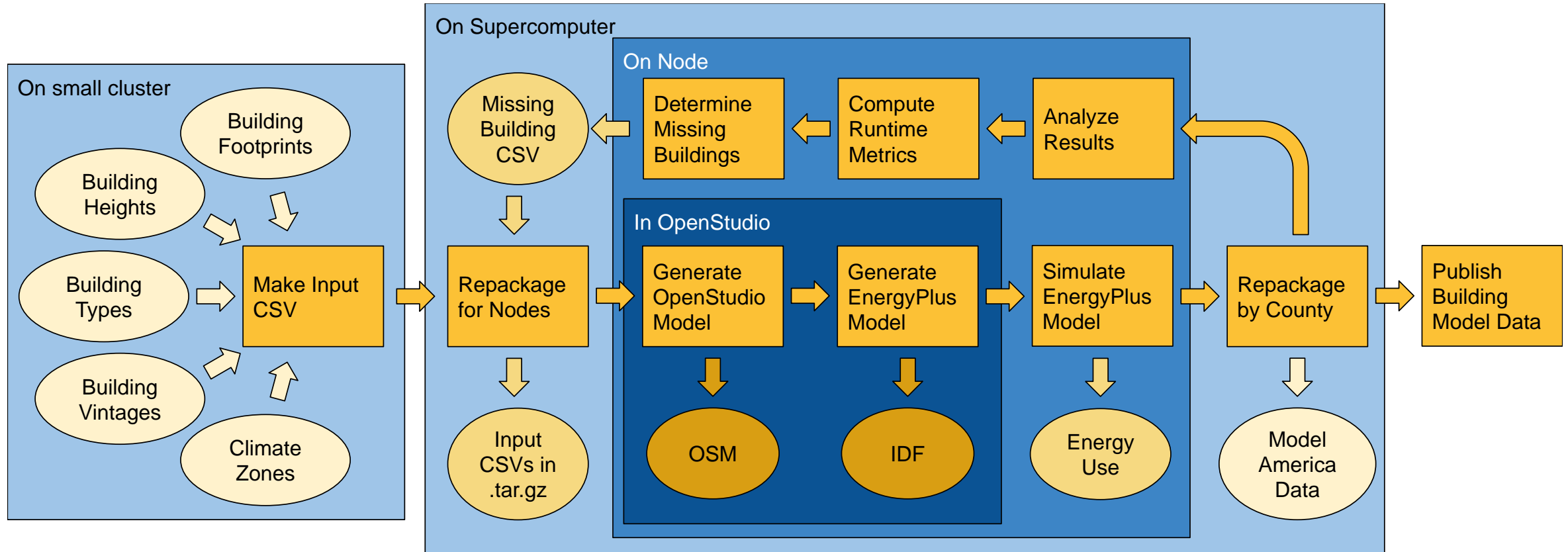
- 1,068,813 buildings/hour – generated, simulated, results stored
- Building energy modelers - \$150/hr
- Model levels and cost at Architectural, Engineering, Const. (AEC) firm

Model Quality	Typical Time	Cost
Basic	2 days	\$2,400
Functional	1 week	\$6,000
Detailed	2 weeks	\$12,000



- AutoBEM on HPC - \$6.4 billion worth of work in 1 hour

Workflow Overview



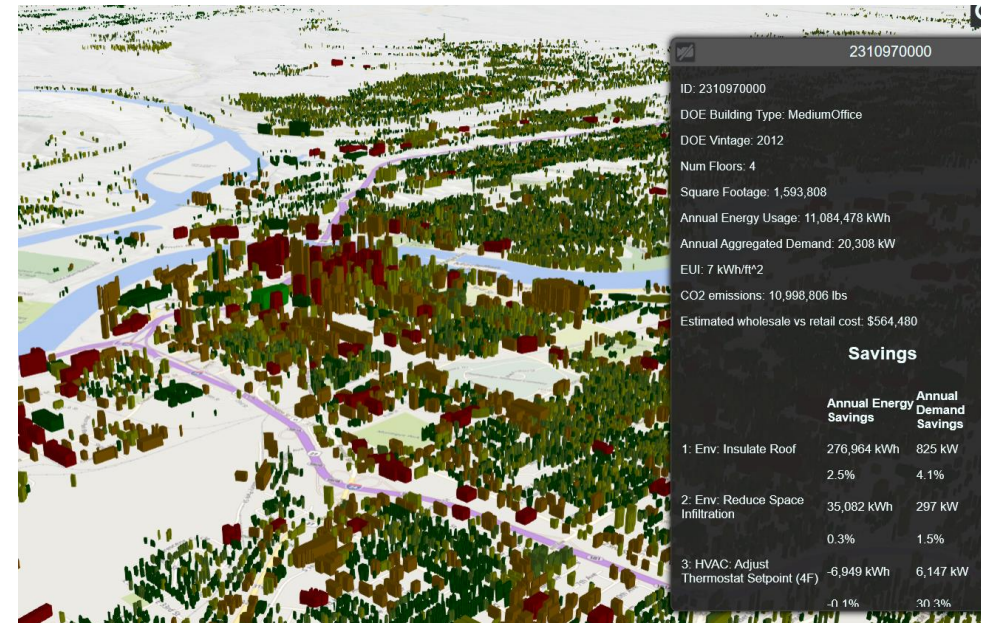
Nation-scale...

- **Free model of every U.S. building (bit.ly/ModelAmerica)**
 - 125,714,640 buildings, 124,178,694 simulated, 122,930,327 (97.8%) shared
 - OpenStudio (v3.1.0) and EnergyPlus (v9.4)
 - State_county.zip (requires [free Globus Connect Personal](#))
 - New, Joshua R., Adams, Mark, Bass, Brett, Berres, Anne, and Clinton, Nicholas (2021). "Model America – data and models of every U.S. building." ORNL Constellation, <https://doi.ccs.ornl.gov/ui/doi/339>, April 14, 2021.
- 2 years: 25 NDAs (+10 in-process), 6 CRADAs (+2 in-process, 9 proposed)
 - 1-time free dataset of desired geography and building sector: data, models, or archetypes
- Dynamic archetypes of models and floor area multipliers for any geographical region
- Automatic Building Energy Modeling (AutoBEM) software
 - Related publications: bit.ly/AutoBEM; example visualization: bit.ly/virtual_epb
- Reuse via registered U.S. Copyrights: AutoSIM, AutoGen, AutoBEMGen

Practitioners can...

- **Reduce** time/money spent creating functional building models
- **Reuse** functional models to create detailed models (specific thermal zones, appliances, occupancy schedules, ...)
- **Recycle** existing energy models to test building retrofit options (new HVAC/water heater, smart meters, ...)

Digital Twin of a Utility (every building)



bit.ly/virtual_epb