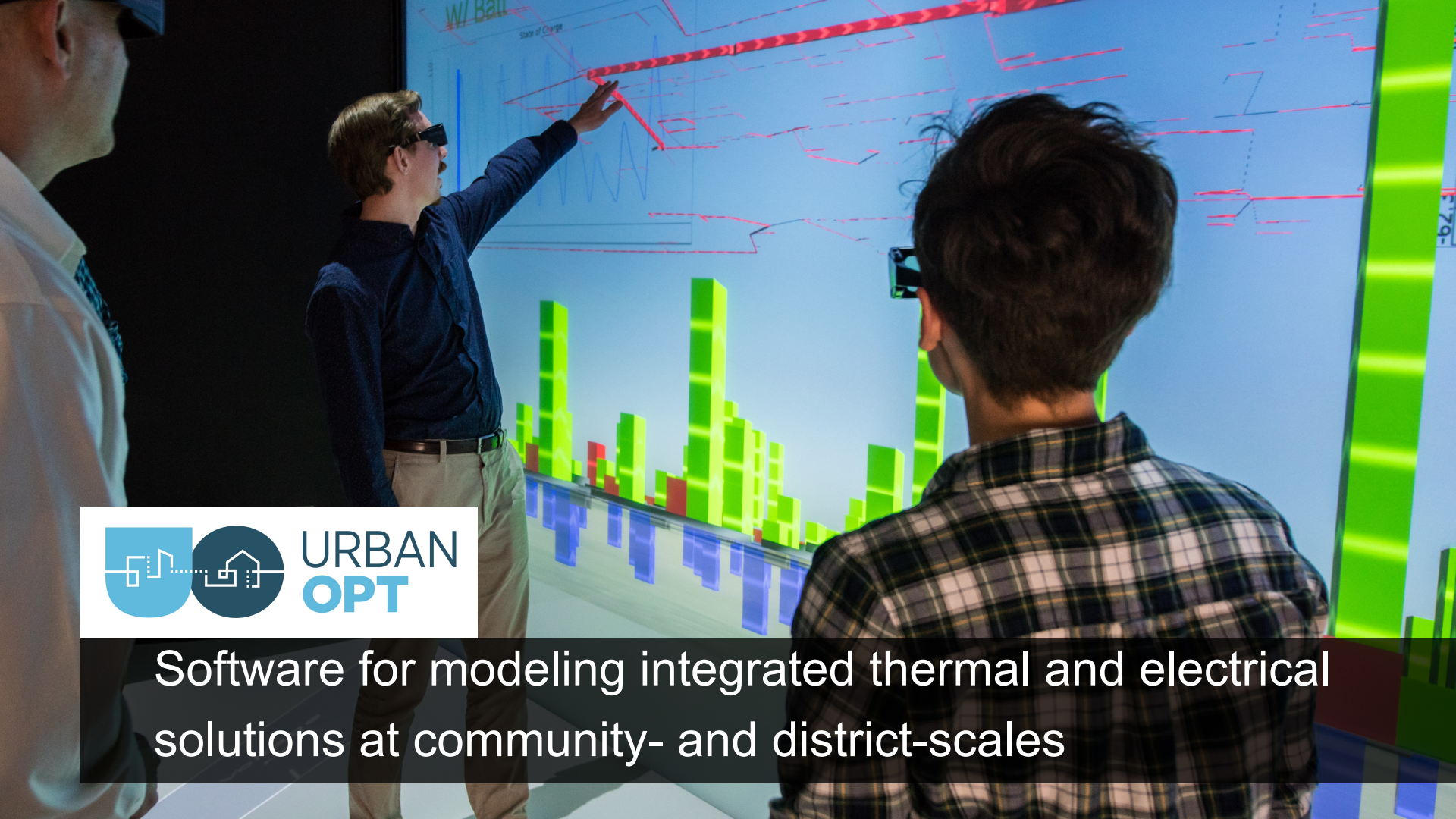
Whole-Community Energy Optimization

Bill Livingood
ASERC
April 21, 2021

Optimizing flexible buildings, DERs, and power systems at a community-scale can
unlock new levels of savings and resilience


URBAN
OPT
Software for modeling integrated thermal and electrical solutions at community- and district-scales

ORGANIZES geospatial information about buildings and energy systems

ENABLES creation of highly customized analysis scenarios

AUTOMATES generation of detailed physics-based models from simple inputs

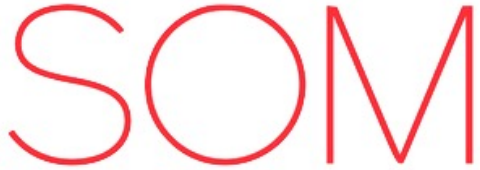
MANAGES simulations, integrations, and aggregation of results by scenario

- ***Technical Approach:*** connects physics-based building simulation platforms with calculation engines for other technologies/sectors to enable *unprecedented bottom-up analysis of integrated solutions*.

- ***Scaling Impact:*** Modular, open source platform that can be leveraged ”under the hood” in tools used by architects, engineers, utilities, energy service companies, and more.

URBAN OPT

Past and Ongoing Project Partners



URBANopt Technical Advisory Group

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BRIEF

DOE partners with Xcel, Panasonic, to test smart city ideas in Denver

AUTHOR
Robert Walton
@TeamWetDog

PUBLISHED
July 24, 2017

Dive Brief:

- The U.S. Department of Energy's Na
(NREL) is working with two compa
allowing the lab to employ and imp
- Panasonic and Xcel Energy are also

BuildingGreen

NEWS KNOWLEDGE BASE CONSULTING PRODUCT GUIDANCE CONTINUING EDUCATION PEER NETWORKS

NEWS BRIEF

True District-Scale Energy Modeling Is on Its Way

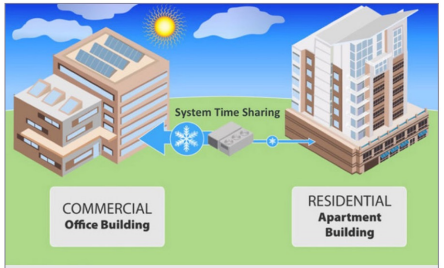
If you thought doing an energy model on one building was hard, try a whole district. But NREL is going to make it easier.

by Candace Pearson

In theory, district-scale energy systems are the future. But there's a big problem: it is very difficult to model them—which in turn makes it difficult to design them. That's now being rectified with the Urban Renewable Building and Neighborhood optimization (URBANopt), an EnergyPlus- and OpenStudio-based simulation platform being developed by the National Renewable Energy Laboratory (NREL).

By grouping a mix of load profiles close together, like a bakery that runs ovens during the day and an apartment building that needs space heating at night, district-scale energy systems can leverage efficiencies or utilize more advanced technologies, like co-generation or pairing renewables with storage. However, current energy modeling tools focus on individual buildings, leaving designers to combine the results of many simulations.

In its current form, URBANopt is already an improvement because it post-processes thermal load profiles from individual buildings into a separate district-system simulation tool. The resulting multi-building analysis enables the design

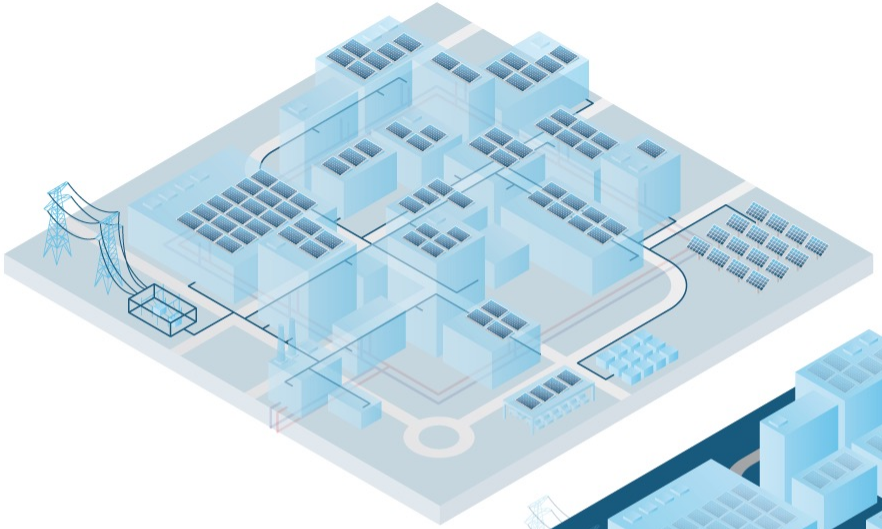


District-scale energy modeling will allow buildings with complementary loads to be matched together to utilize common mechanical equipment most efficiently.

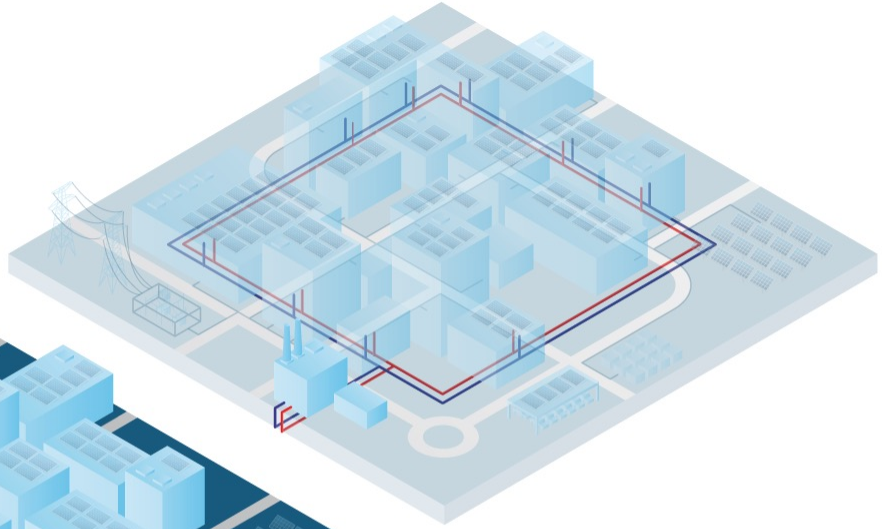
Image: URBANopt

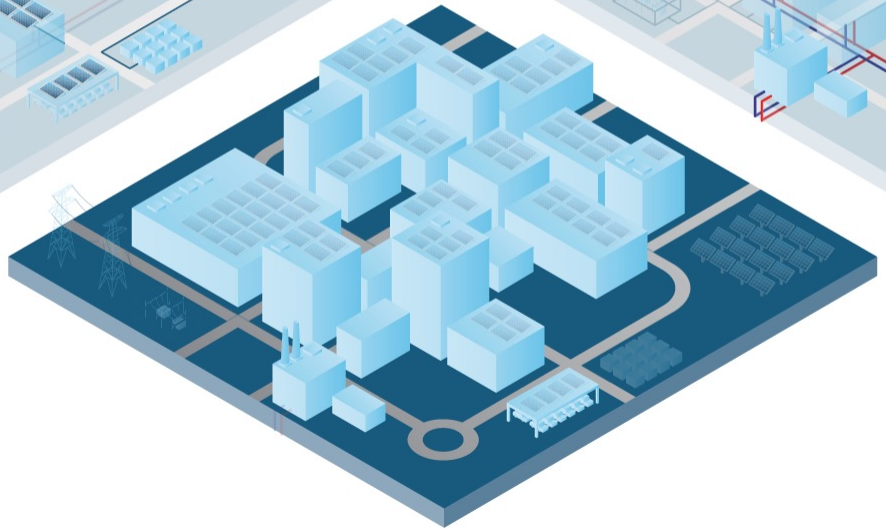
URBAN OPT

GRID-INTERACTIVITY MODULES



DISTRICT THERMAL SYSTEM MODULES





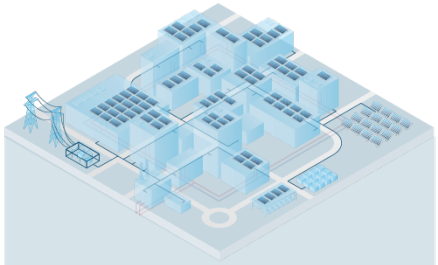
BUILDINGS CORE MODULES

URBANOPT

URBAN OPT

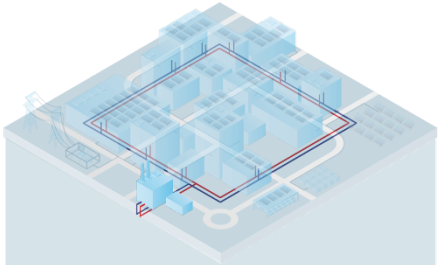
BUILDINGS CORE MODULES

- Organizes geospatial information about buildings and energy systems
- Enables creation of highly customized analysis scenarios
- Automates generation of detailed physics-based OpenStudio®/EnergyPlus™ building energy models from simple inputs
- Manages simulations and aggregation of results by scenario



GRID-INTERACTIVITY MODULES

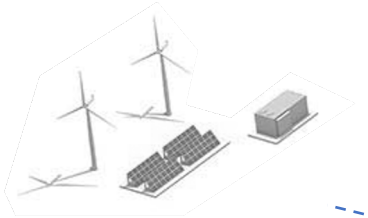
- Enables evaluation of building demand flexibility measures (e.g, pre-heat ing/cooling, ice storage)
- Allows modeling of electric vehicle charging impacts on building and district load profiles
- Integrates with REopt Lite to calculate optimal sizing/dispatching of PV and batteries at building or community scales
- Automates creation of OpenDSS electric distribution system power flow models leveraging the DiTTo translator



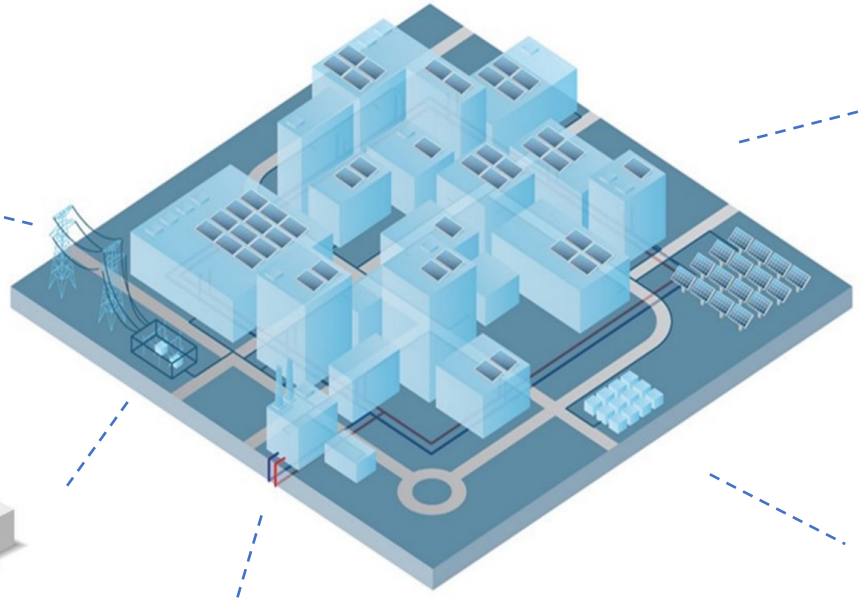
DISTRICT ENERGY SYSTEM MODULES

- Builds thermal energy system model for heating and cooling of multiple buildings from a central plant
- Invites customization of thermal network type, district plant efficiency, and building energy efficiency
- Connects seamlessly with URBANopt core module simulations
- Enables multiple types of building simulations including: time series (UO SDK), Time Series (MFRT), RC (TEASER),

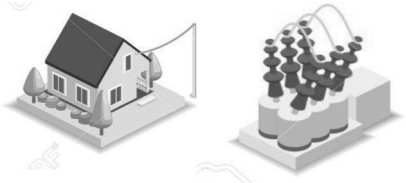
Example Capabilities



Electrical/DER



Low-Rise Residential

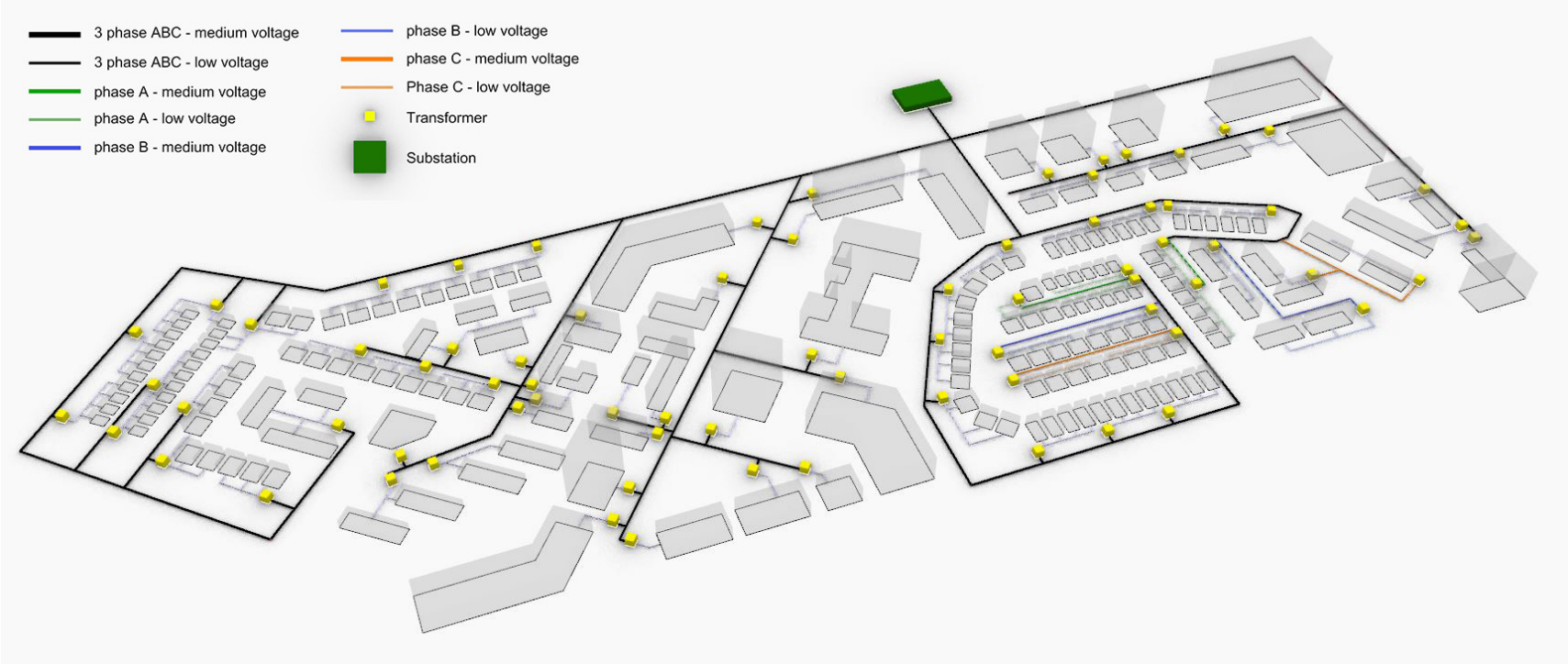


Building Load Flexibility and Optimization

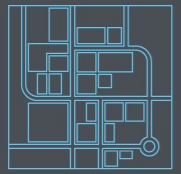
District Thermal System

Electric Vehicle Charging

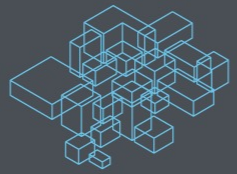
Distribution/DER Modeling



COLLECT & DEFINE DISTRICT MODEL INFORMATION



Building Footprint Data



Architect CAD Drawings

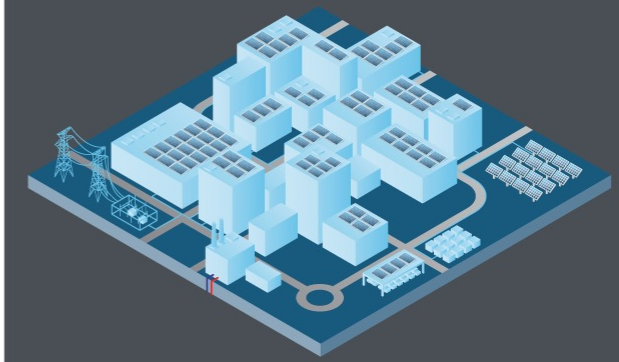
Building Attributes

NUMBER OF STORIES

ENERGY EFFICIENCY LEVEL

BUILDING USE TYPE

AUTO-GENERATE BASELINE ENERGY MODEL



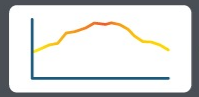
GENERATE "WHAT IF" SCENARIOS

BASELINE SCENARIO

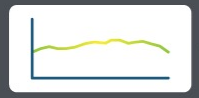
HIGH EFFICIENCY SCENARIO

HIGH EFFICIENCY & PV SCENARIO

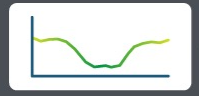
SIMULATE & AGGREGATE SCENARIO RESULTS



BASELINE RESULTS



HIGH EFFICIENCY RESULTS



HIGH EFFICIENCY & PV RESULTS

Thank You

www.nrel.gov

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