Energy Modeling Tool for Accessory Dwelling Units and Potential Policy and Design Implications

M.S. Architecture - Design Computing Thesis
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With increasing ADU construction, designs will need to focus on reductions in energy use and carbon. My tool will allow homeowners and designers to easily visualize energy-use, carbon and potential savings of both in early design stages.

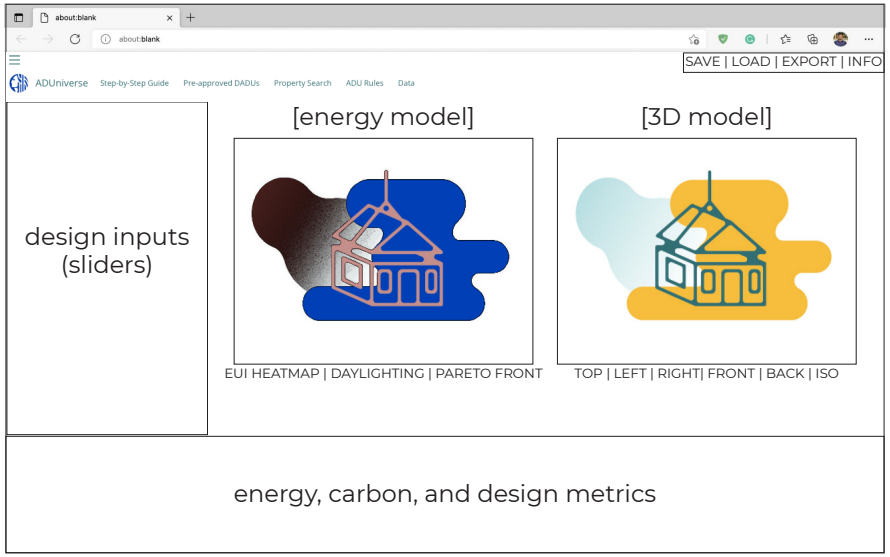
My methodology uses EnergyPlus to simulate ~100,000 varying DADU design combinations, which are used as the dataset to train a machine learning model. This model will work behind the scenes to empower a web-based design tool. Without the use of statistical inference from machine learning, users would likely have to wait upwards of 10+ seconds every time a slider is moved.

The intention is that I will be able to generate more efficient DADU designs using the tool to test the impact of several possible changes to existing Seattle land use policy. These being: elimination of front and rear setbacks, the ability to share DADU walls with neighbors through an agreement, and the effect of varying floor-area ratio allowances.

In the process, I also hope to conduct a comparative analysis of the existing 10 pre-approved DADU plans featured on the Seattle ADUniverse site. Energy metrics and carbon impacts are not currently listed and it would be a great benchmark for my project. Results could be published on the site with an 'o.k.' from the city and associated architects upon completion.

Tangible results I hope to see include a reduced carbon impact from new DADU construction and lower utility costs for residents of these new DADUs. In Seattle, our energy grid and utility costs are comparably low and cheap, respectively to other regions in the United States. As useful as this tool is locally, it could potentially have an even larger impact nationally.

MOCKUP OF DESIGN TOOL



The design tool will focus on the following design constraints and outputs:

Inputs:
- lot type (corner/infill, alley/no alley)
- placement and orientation on lot
- window-wall ratio and glazing orientations
- construction + assembly materials
- infiltration rates, etc.

Outputs:
- Energy use intensity (or EUI, the index of energy use per year per square foot of buiding)
- Embodied carbon (upfront carbon impact due to construction, shipment of materials, etc.)
- Operational carbon (annual carbon impact due to energy use)
- Potentially: estimate of annual utility costs