Building Envelope Energy Optimization for Multi-unit Residential Buildings (MURBs)

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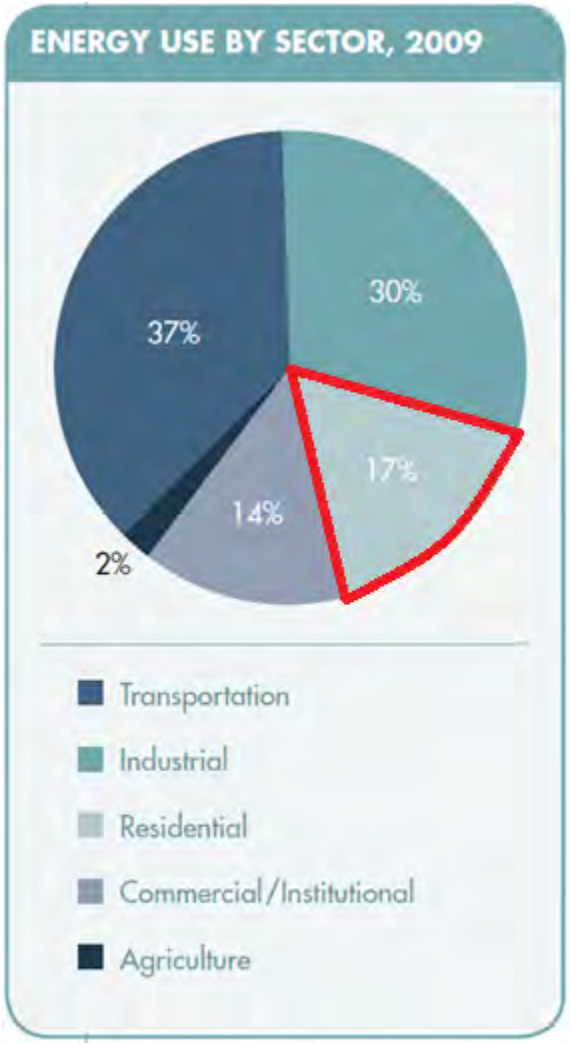
Problem: Energy and MURBs

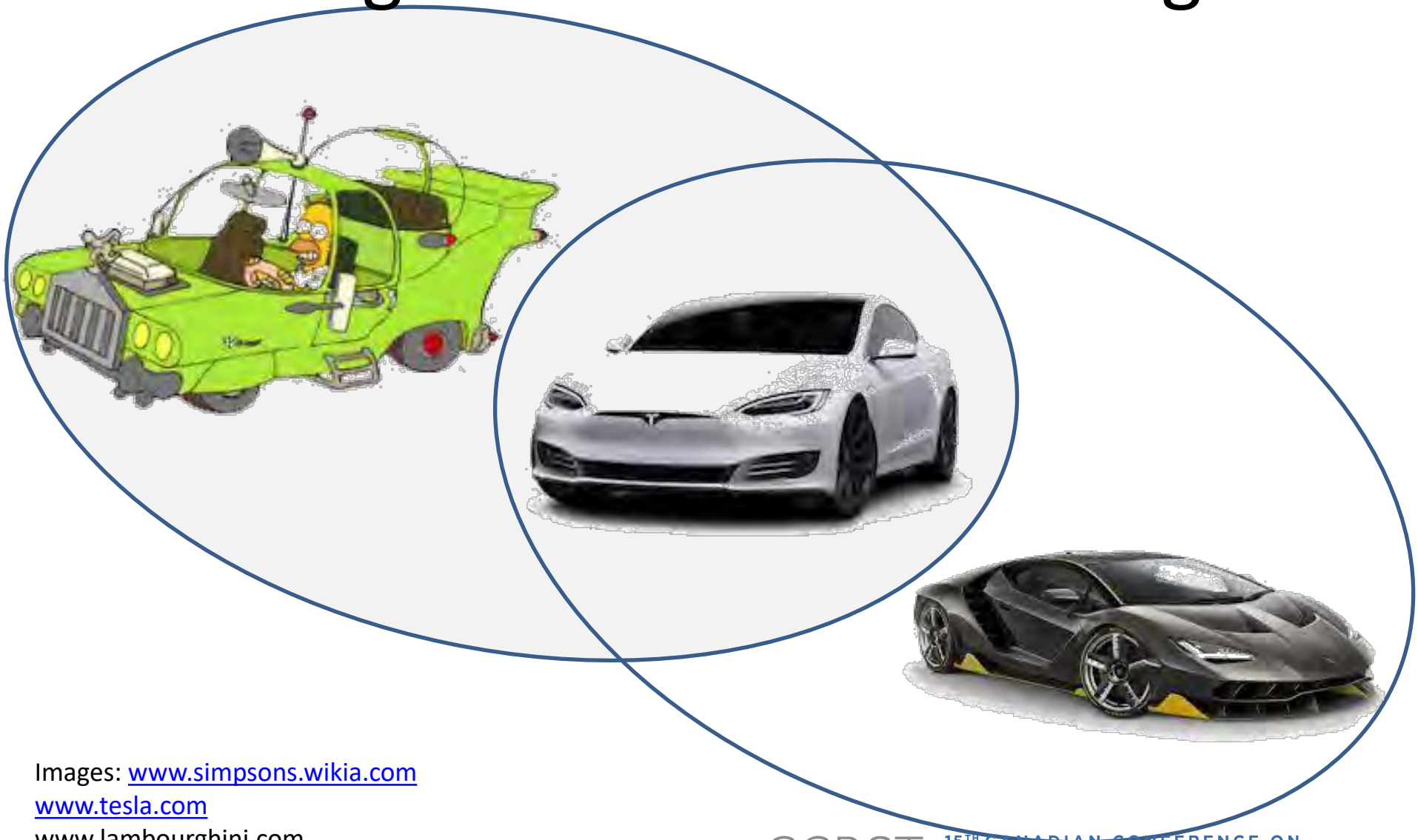


Source: *Energy Efficiency Trends in Canada 1990-2009*, Office of Energy Efficiency, Natural Resources Canada

- Residential buildings in Canada consume 17% of primary energy
- MURBs in Canada:
  - 9% of housing units (2006 Census)
  - 45% of housing unit starts (2012)

CMHC 2013. CANADIAN HOUSING OBSERVER. Available from http://www.cmhc-schl.gc.ca/odpub/pdf/67989.pdf [accessed 20 April 2016].

Design and Decision Making



Images: www.simpsons.wikia.com
www.tesla.com
www.lambourghini.com

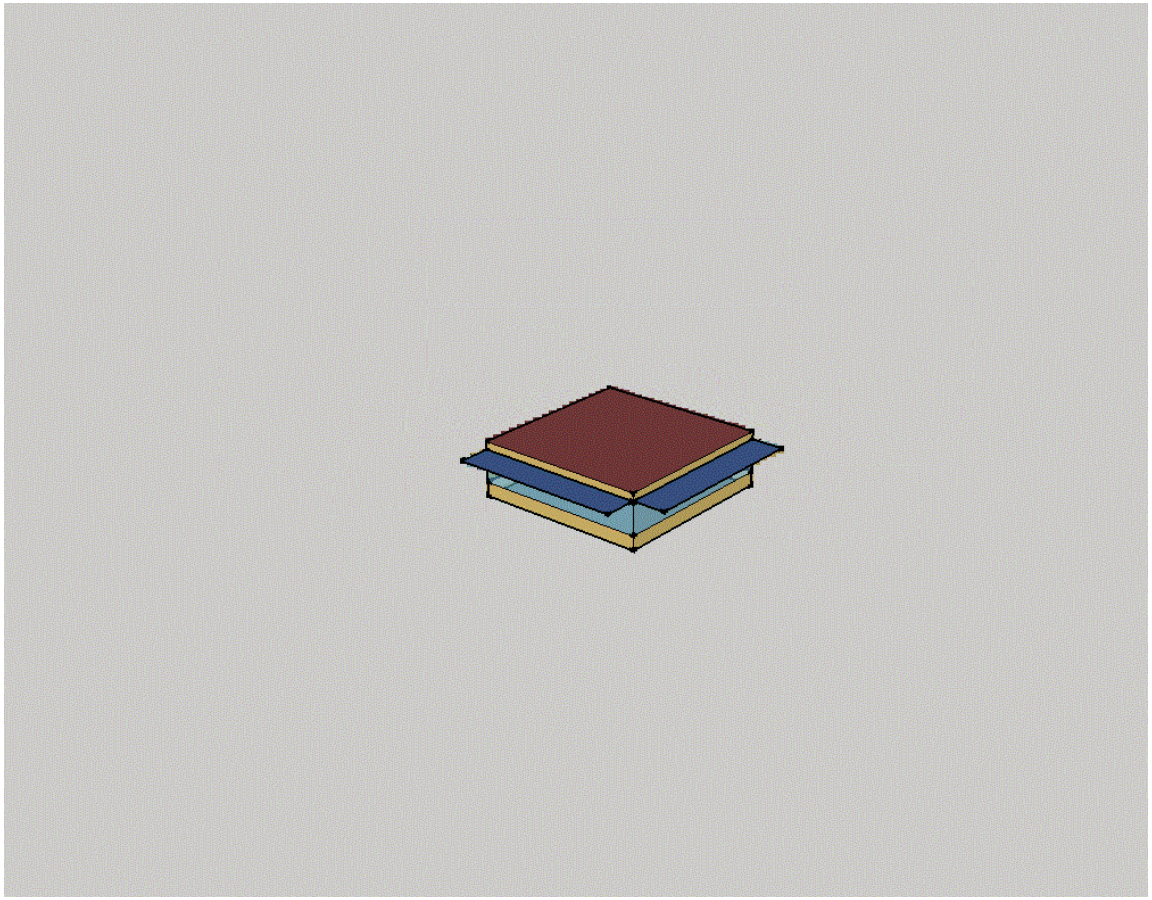
How to Influence Design Decisions

- **F**ast iteration speed
- **F**lexibility of design scenario
- **F**ocussed on decisions

Work Outline

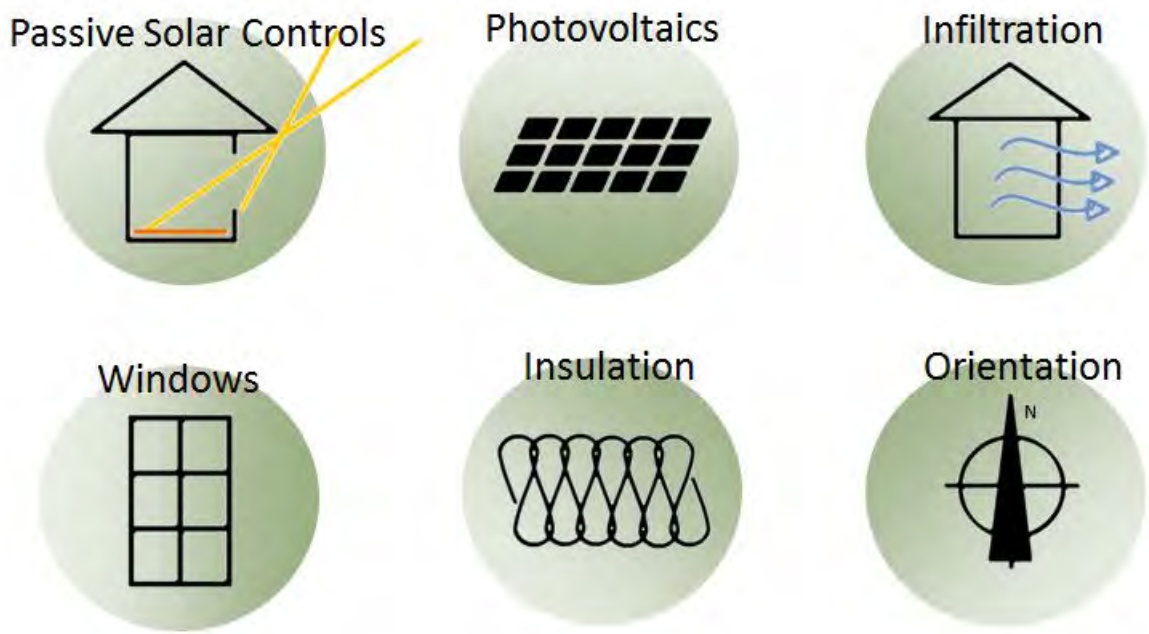
- Phase 1. **Build it** (dataset)
  - E+ model
  - Parametric study
- Phase 2. **Drive it** (analytics)
  - Ludicrous mode
  - Near-optimal mode

EnergyPlus Model



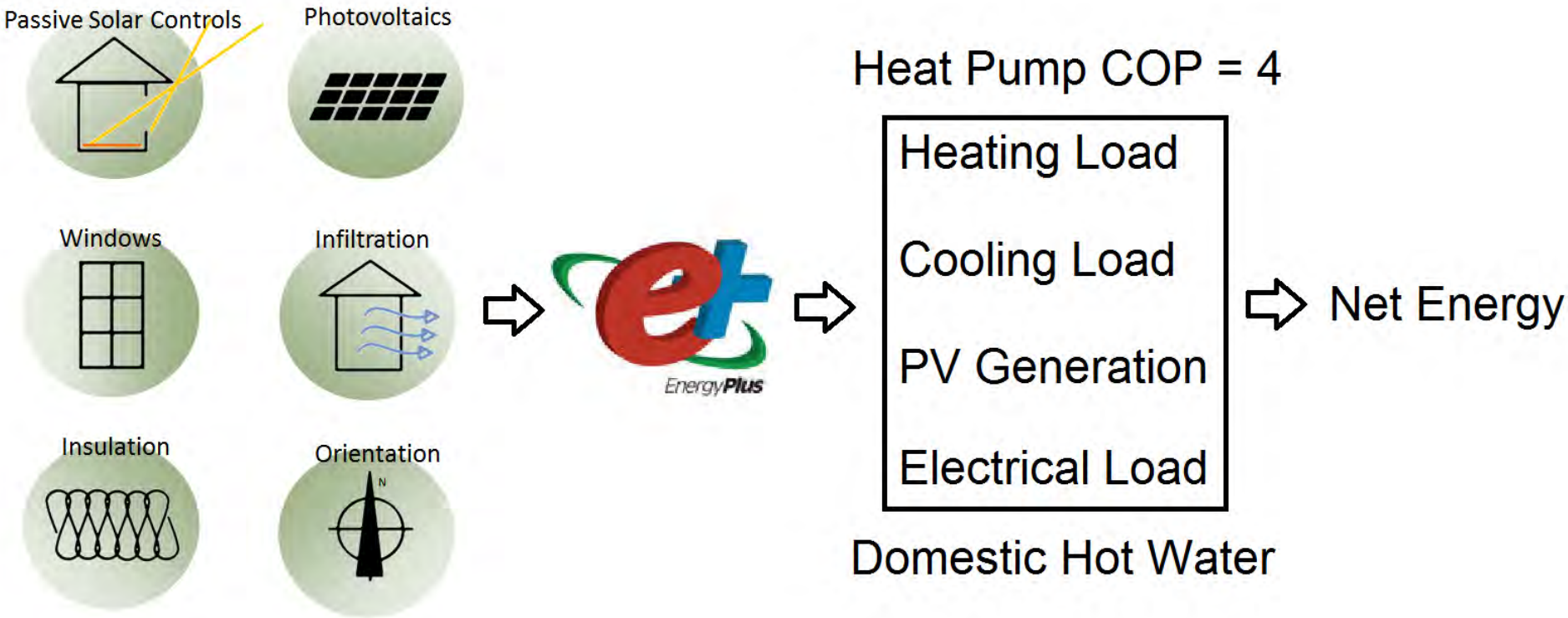
Images by Author

Parametric Study



Images by Author

Parametric Study Workflow



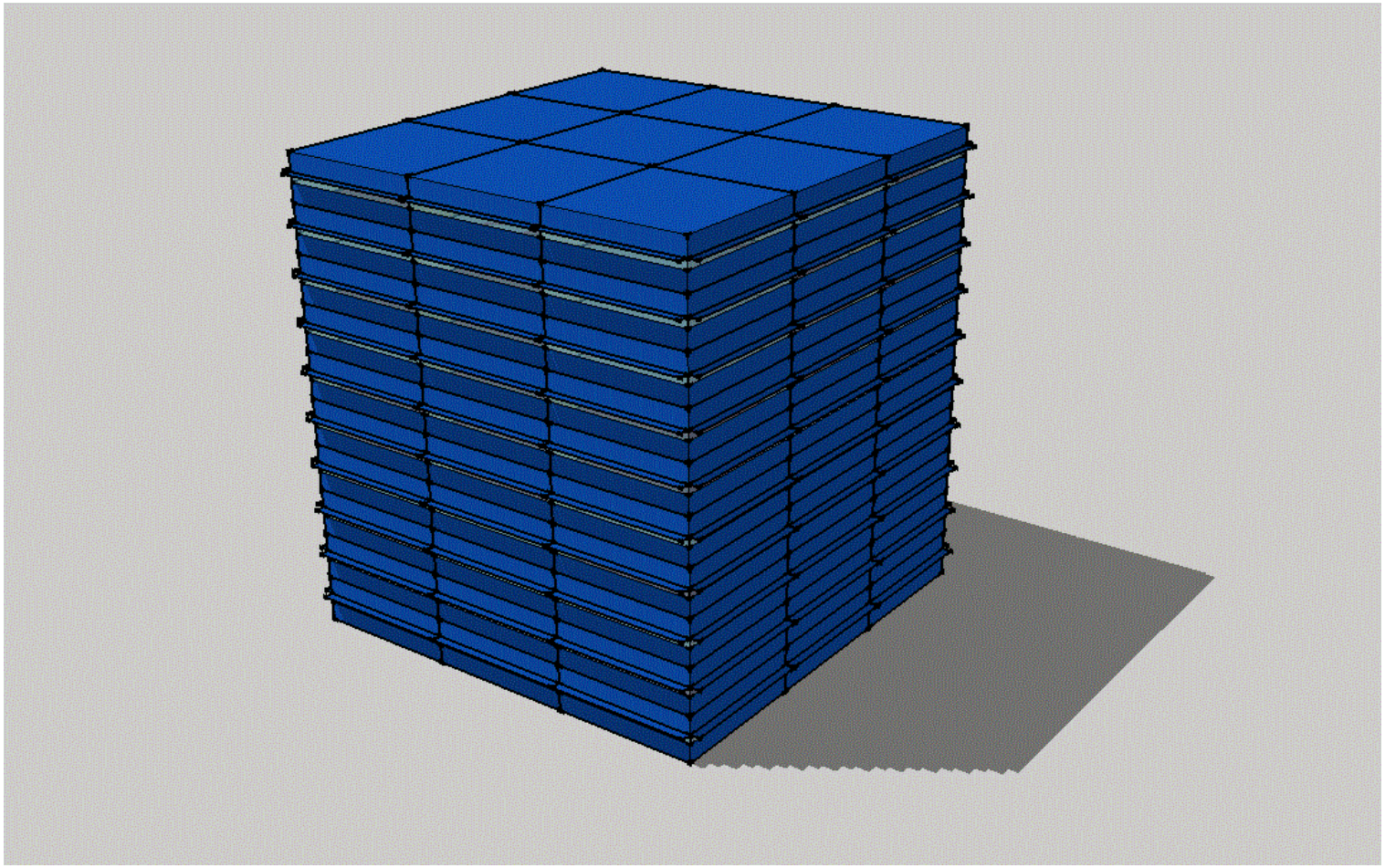
Images by Author and www.energyplus.net

Multivariate Optimization

Near-optimal Solutions

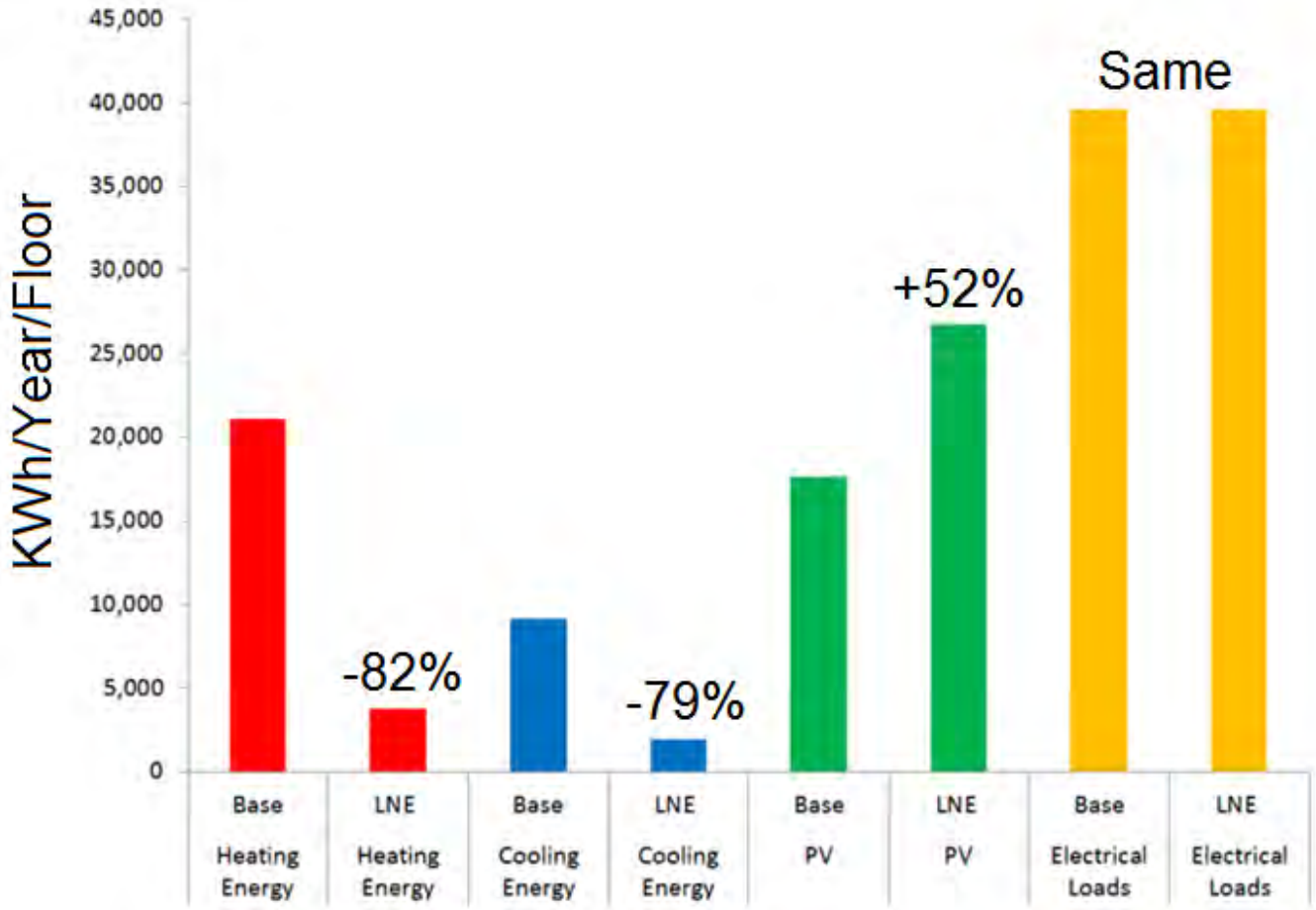
Images modified from Pixabay.com

Ludicrous Mode

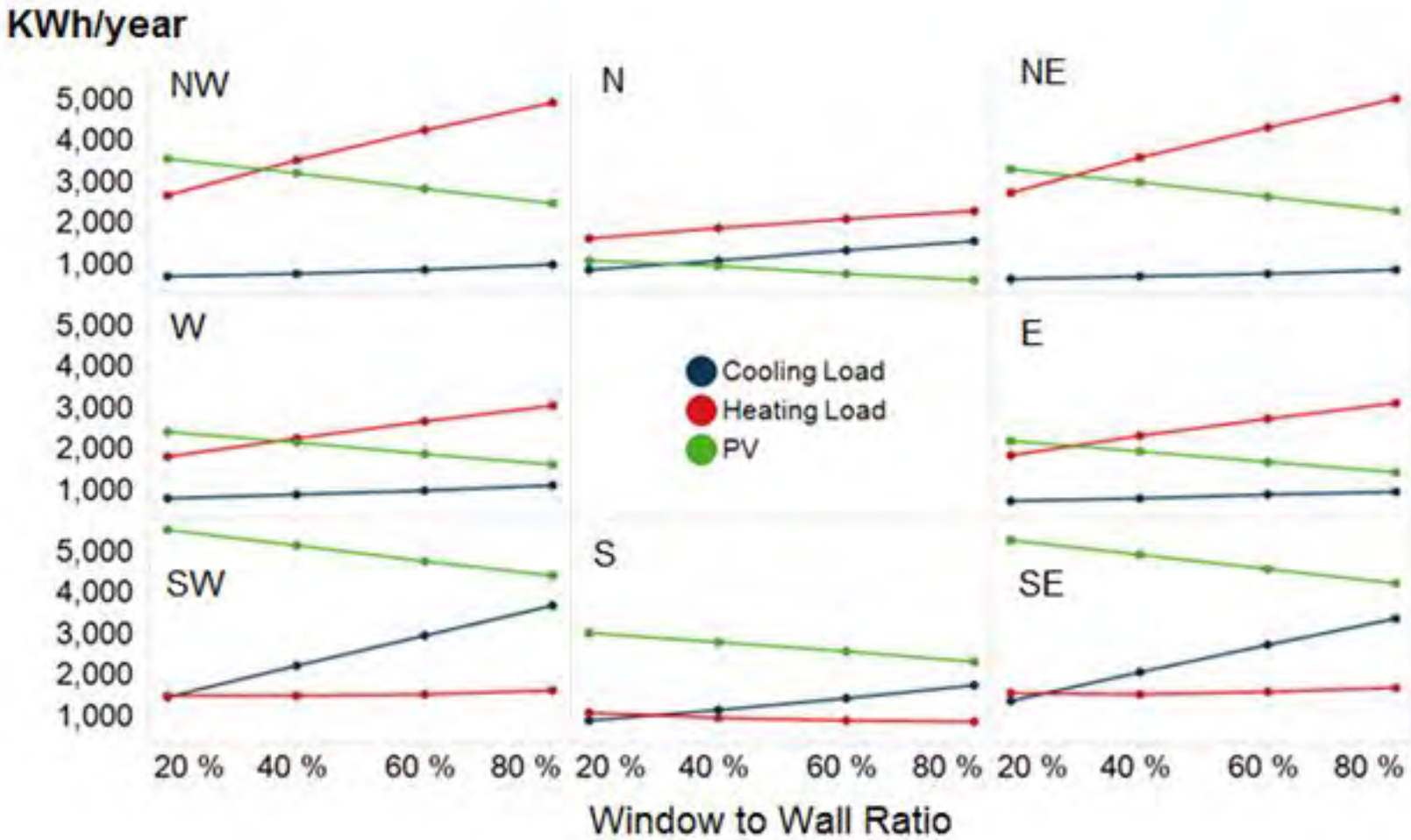


Images by Author

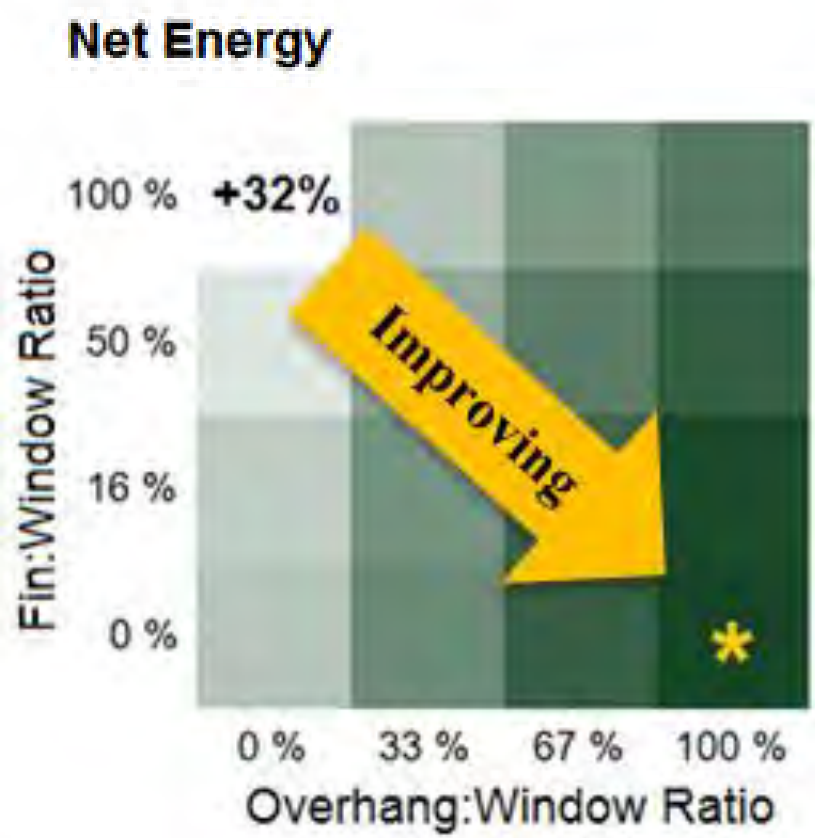
Ludicrous Mode



Sensitivity of WWR

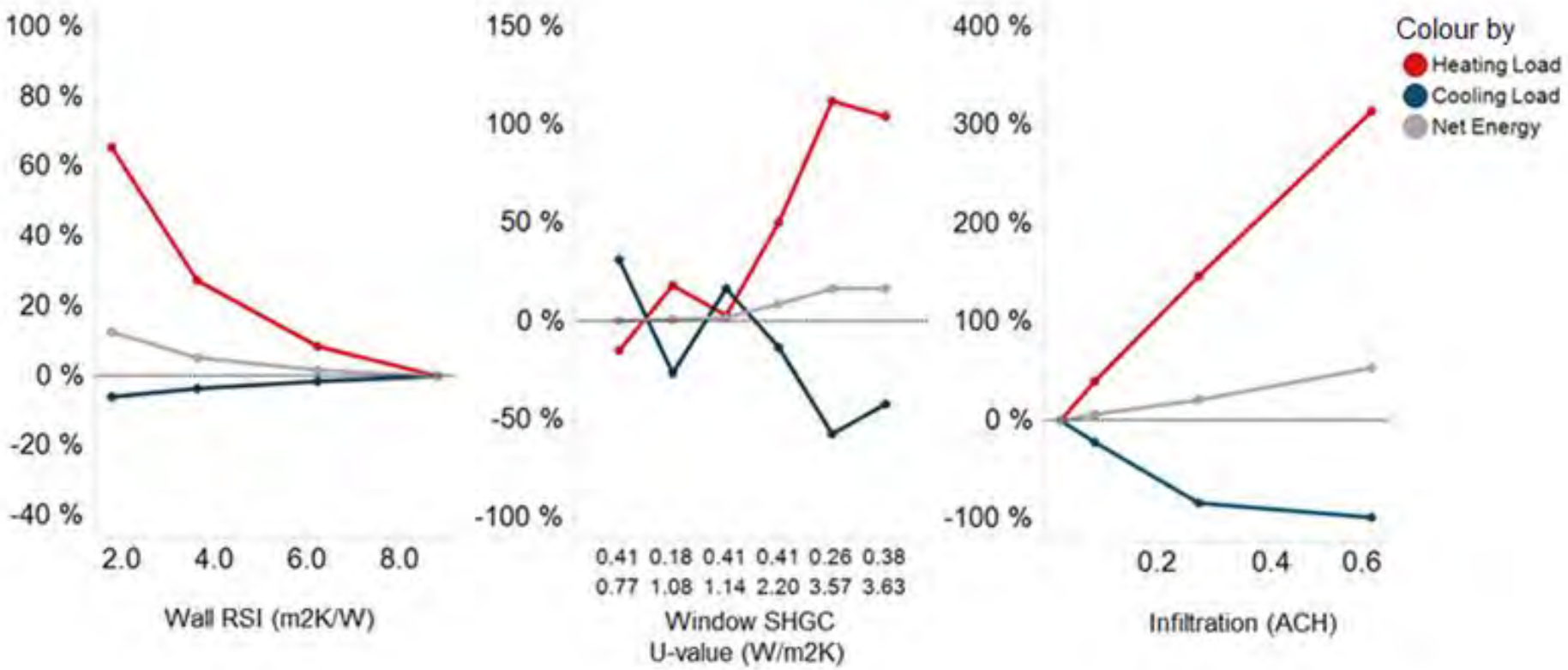


Interrelatedness of Geometry Variables



∗- Ludicrous Case

Sensitivity of Quality Parameters



Influencing the Design Process

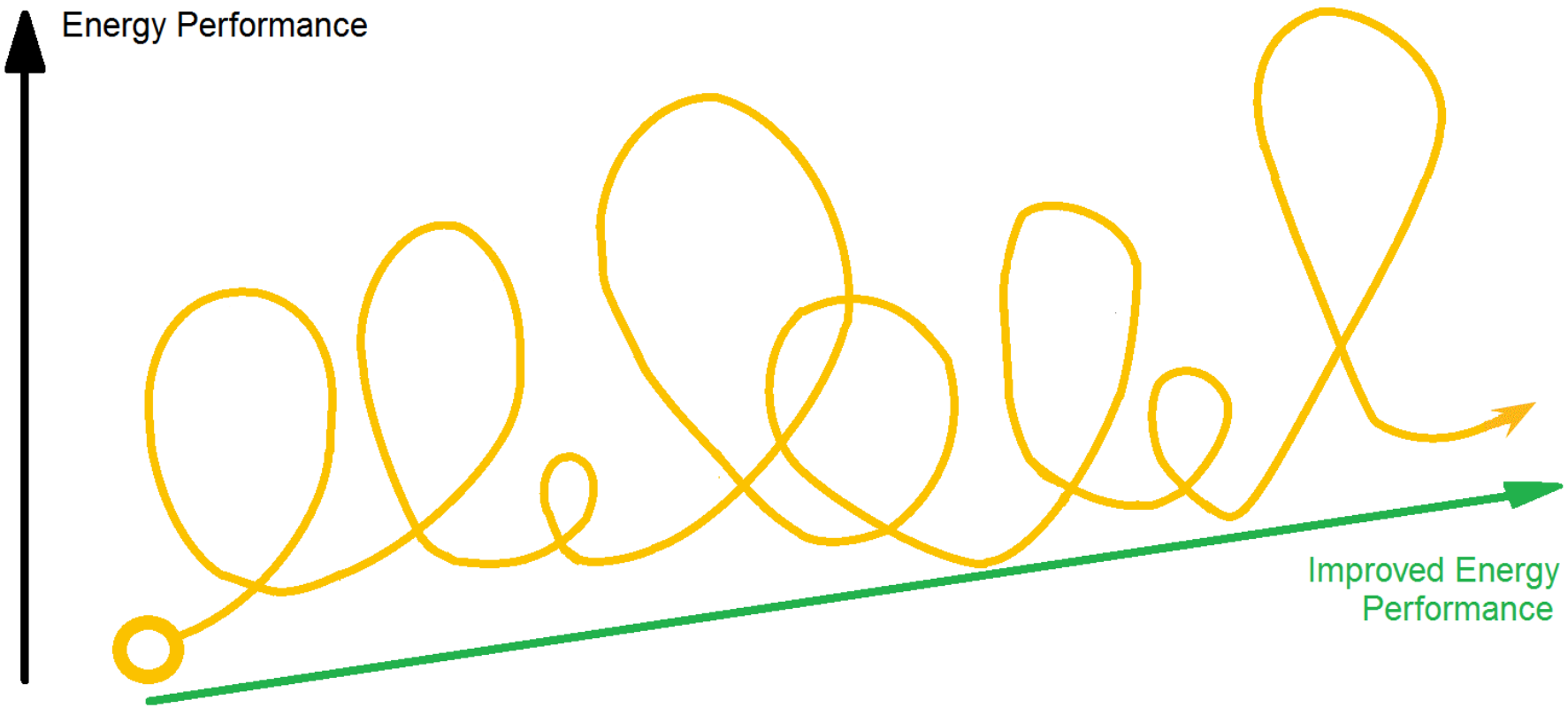


Image modified from: Wingate, C. 2012. Energy Modeling Methodology. Available from http://rp.design.umn.edu/resources/documents/Arch5993-Wingate2012.pdf.

Summary

- Balance energy performance with overall design goals to find near-optimal solutions
  - Use exhaustive search to simulate the entire design space
  - Consider sensitivity and interrelatedness of variables to find near-optimal solutions
  - **F**ast, **F**lexible, and **F**ocussed on decisions

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Questions?