Redefining possible.

USING BUILDING ENERGY MODELING TO INFORM THE NEXT DESIGN

Our Experience Creating the COMPASS Energy Benchmarking Tool

Building Energy Simulation Forum (BESF)

December 19, 2018

Speakers

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RWDI

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RWDI

Agenda

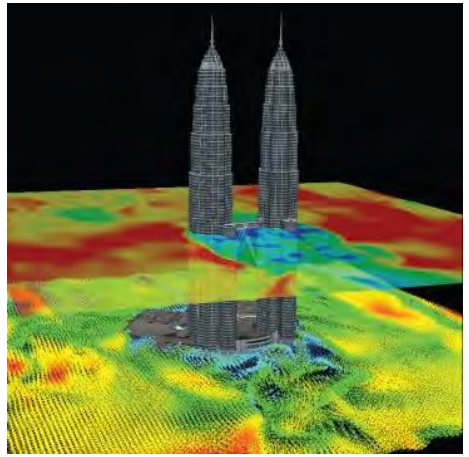
1. Introduction
2. Existing Benchmarking Tools
3. COMPASS Origins
4. COMPASS Description
5. COMPASS Demo
6. Takeaways & Next Steps

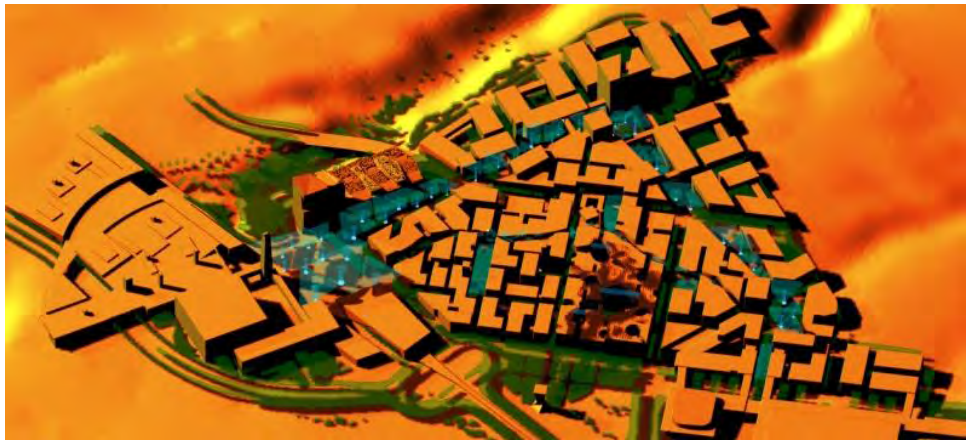
How do you make energy decisions at the onset of projects?

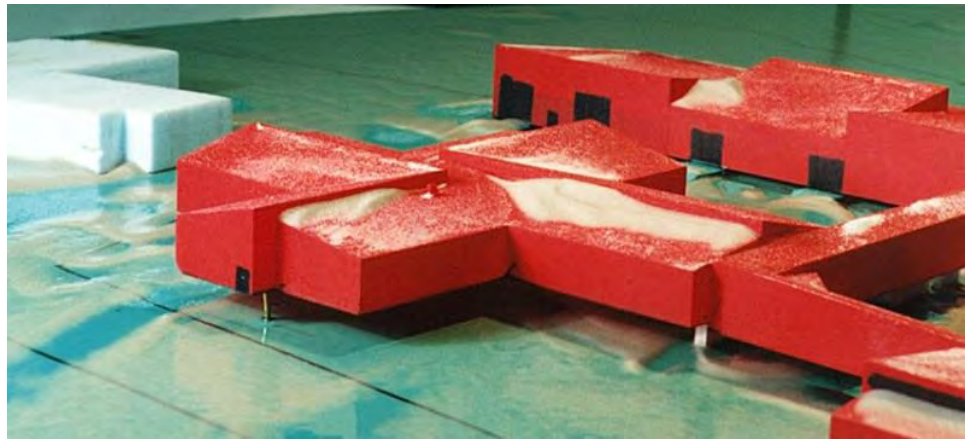
What benchmarking data do you use?

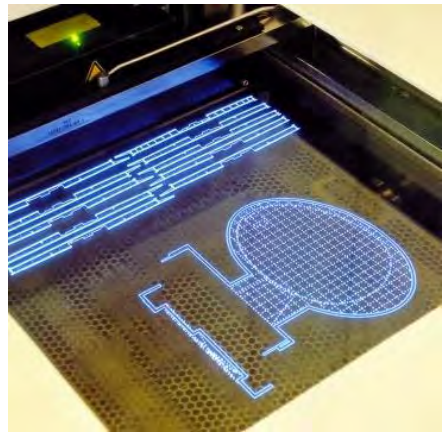
Introduction

RWDI

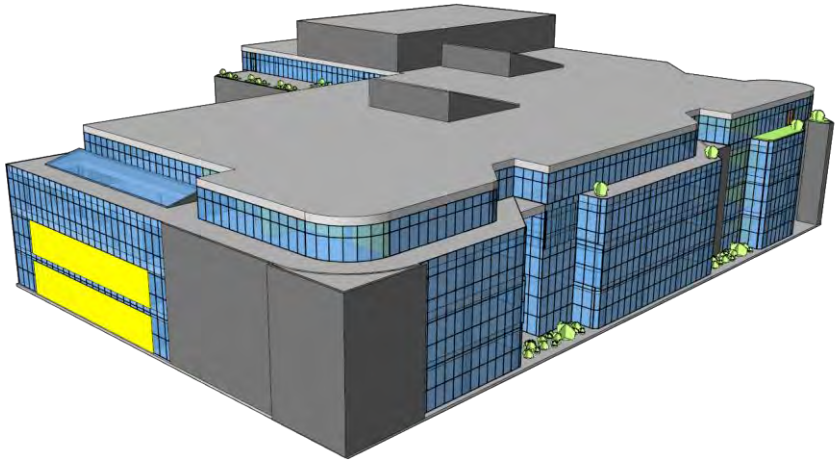


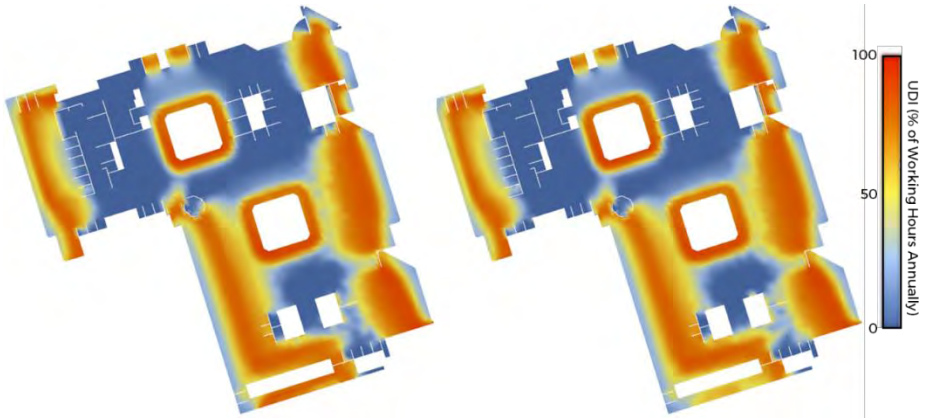


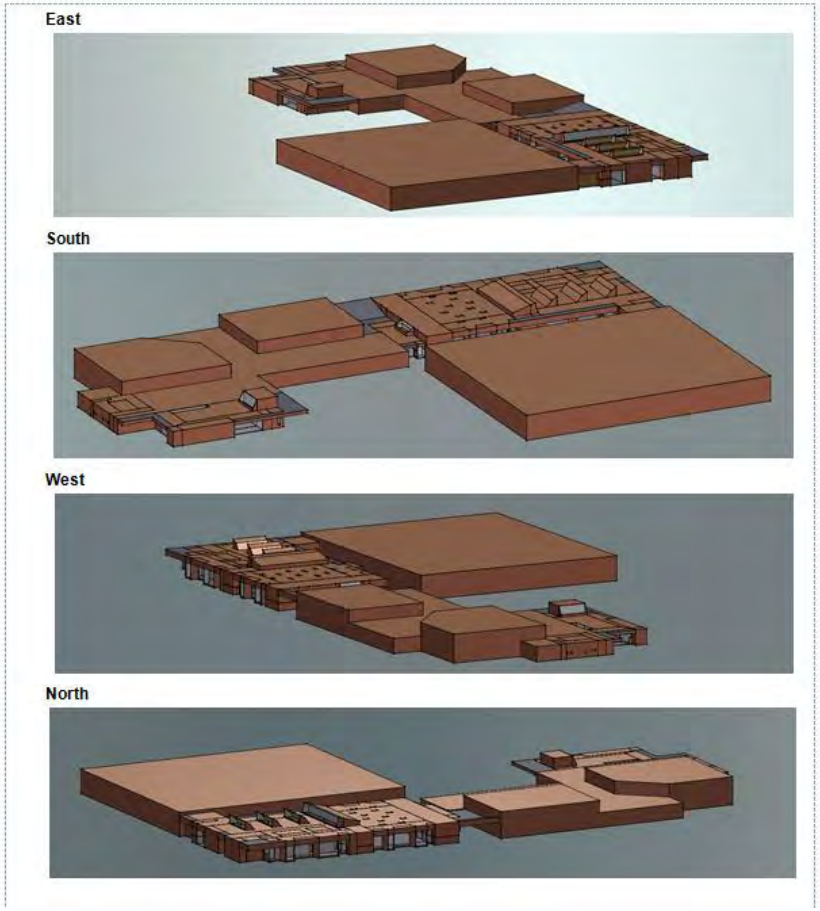


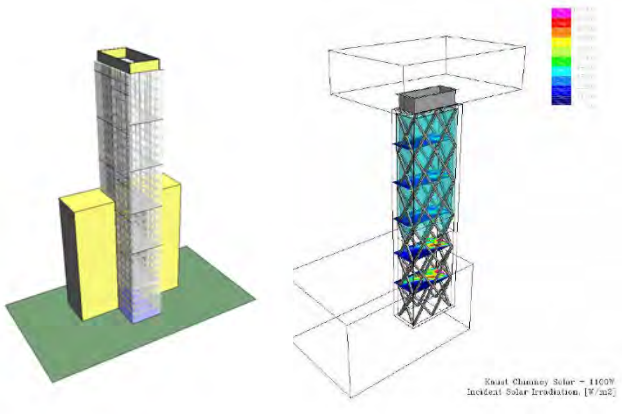


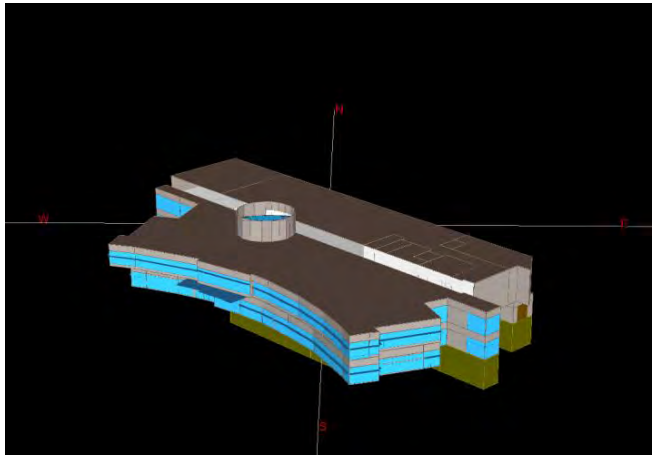
RWDI











Energy Modeling

- LEED (ASHRAE 90.1)
- Oregon Energy Code
- Seattle Energy Code
- Title 24
- IECC
- ETO Incentives
- ECM runs

Hundreds of models, tons of data points

Wouldn’t it be Nice

- Harness energy modeling experience
- Document & learn from our successes and failures
- Simplify reporting
- Learn from & share with the design community
- Apply current design knowledge, maintain security

Existing Benchmarking Tools

Existing Tools

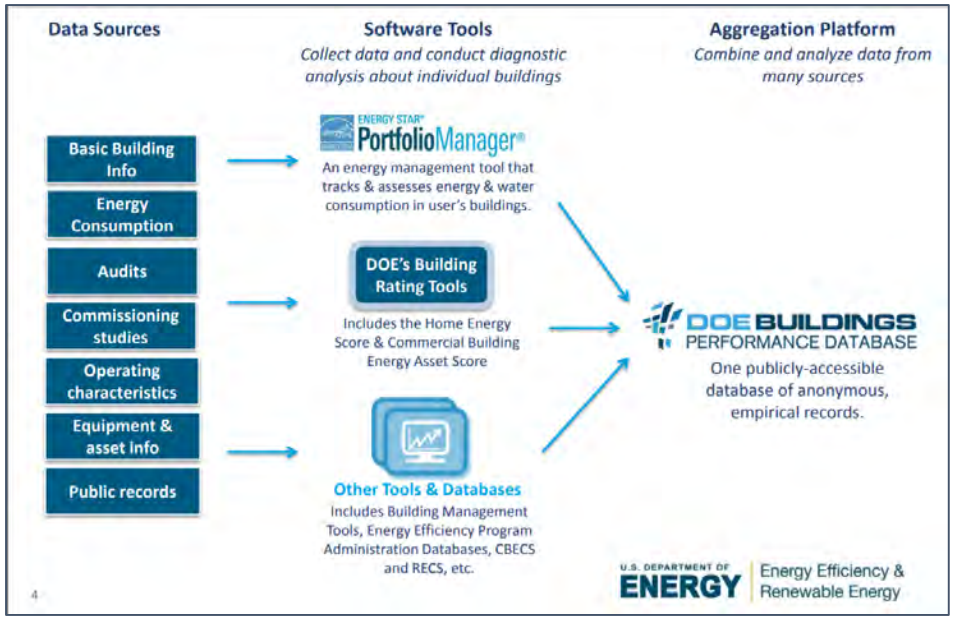
Commercial Buildings Energy Consumption Survey (CBECS)

- Statistically representative sample of building stock
- Latest 2012 (2018 coming)
- Benchmarking existing buildings
- Analyze trends, impact of policy

Existing Tools

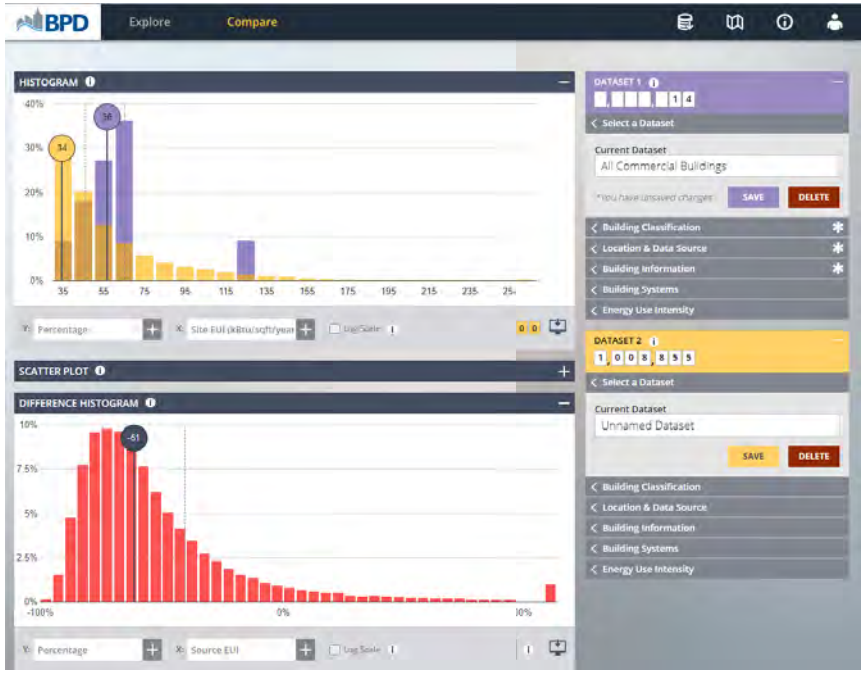
Building Performance Database (BPD)

- DOE / LBNL – June 2013
- Largest publicly available source of building energy performance data
- ~1 million existing commercial and residential buildings



Existing Tools

Building Performance Database (BPD)



- Location, use + physical & operational characteristics
- Determine large trends, inform energy based decisions across markets and regions, establishing benchmarks, etc…
- Lacks data points for design learning

Existing Tools

AIA 2030 Design Data Exchange DDx

- 2030 challenge reporting system
- Firm wide portfolio
- Ease of tracking and submission for AIA 2030, progress reports
- Better design thinking, but minimal inputs for design

Existing Tools

BEST Directory

Building Energy Software Tools

Formerly hosted by US Dept. of Energy

Home | FAQ | Software Listing | About | Contact | Sign In | Register

Search

Capabilities

- [ ] Whole Building Energy Simulation
- [ ] Load Calculations
- [ ] HVAC System Selection and Sizing
- [ ] Parametrics and Optimization
- [ ] Energy Conservation Measures
- [ ] Code Compliance
- [ ] Ratings and Certificates
- [ ] Utility Bill and Meter Data Analysis
- [ ] Weather Data and Climate Analysis
- [ ] Building Automation
- [ ] Building Energy Auditing
- [x] Building Energy Benchmarking
- [ ] Building Energy Monitoring
- [ ] Lighting Simulation
- [ ] Air Flow Simulation
- [ ] Life Cycle Analysis
- [ ] Solar and Photovoltaic Analysis
- [ ] Support Services
- [ ] Training Services
- [ ] Other

Building Type

- [ ] Subsystem Level
- [ ] Commercial

Software Listing

Total Listed Programs: 18

Benchmark My Building

Is your building energy efficient? This building energy performance tool by Lucid, ENERGY STAR & the DOE will tell you in seconds. Try it today!

Building Energy Benchmarking

Commercial, Residential

Last Software Update: 01 June 2017 | **Last Entry Update:** 18 July 2018

Ratings ☆☆☆☆☆ | Reviews **0** | **Add to compare**

AET (Architect's / Engineer's Energy Tool.)

AET is a Windows 10 App for quick energy use evaluations of commercial or residential buildings, and can be used by homeowners as well as students, archictects and engineers. Included is a built-in weather database for over 2000 cities worldwide.

Whole Building Energy Simulation | Weather Data and Climate Analysis | Building Energy Benchmarking

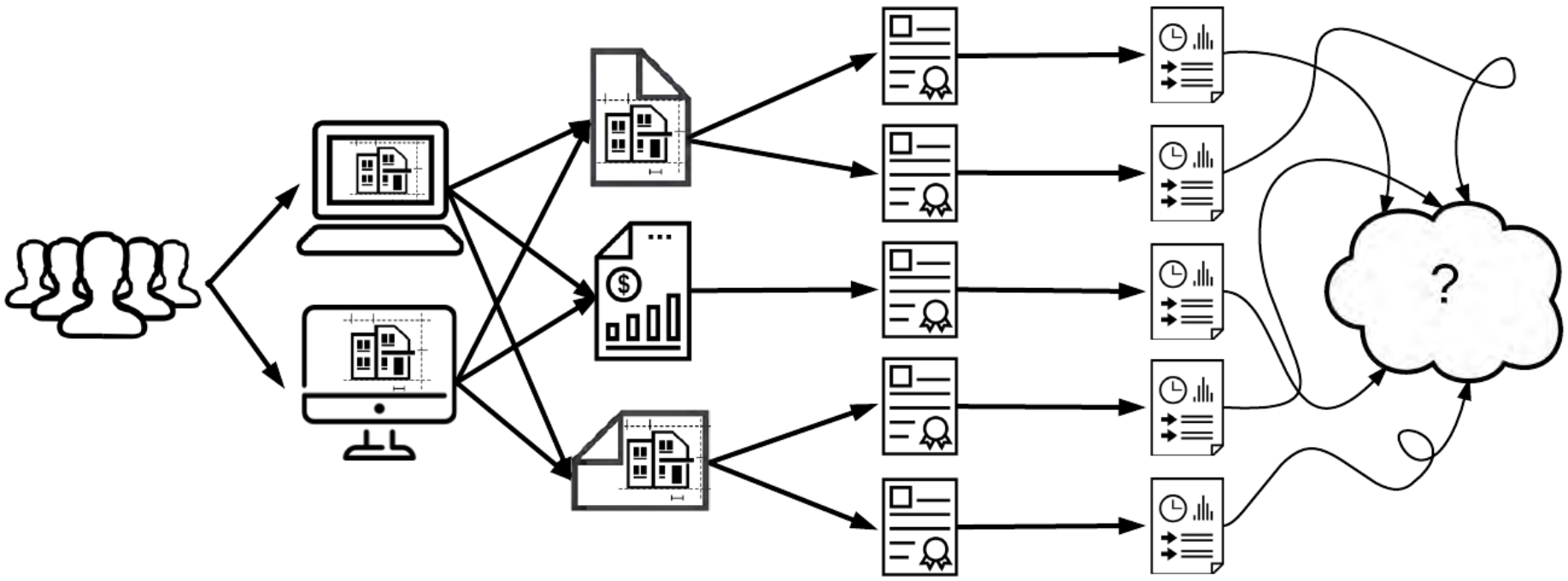
Commercial, Residential

Last Software Update: 05 August 2018 | **Last Entry Update:** 07 August 2018

Ratings ☆☆☆☆☆ | Reviews **0** | **Add to compare**

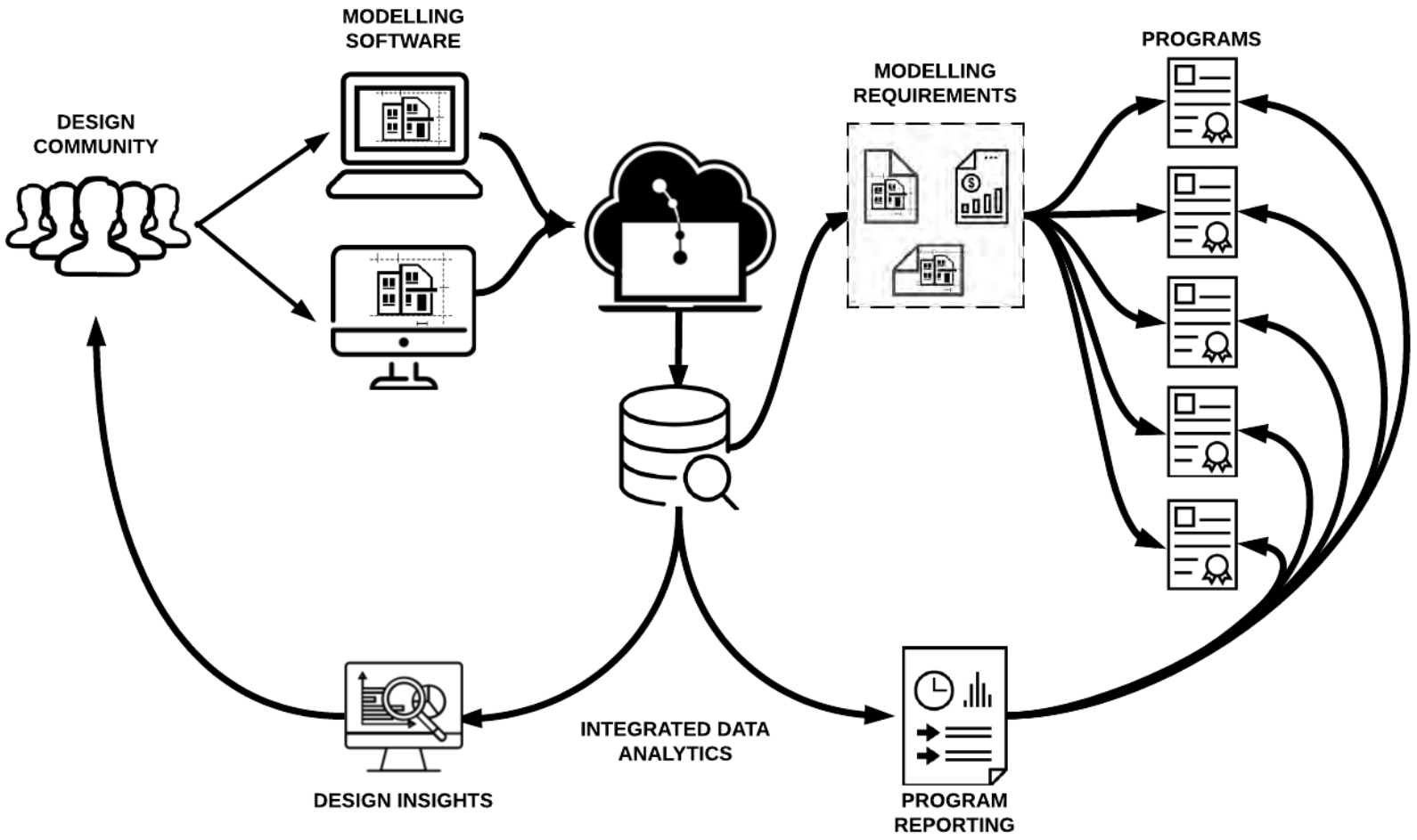
State of Play

DESIGN COMMUNITY	MODELLING SOFTWARE	MODELLING REQUIREMENTS	PROGRAMS	PROGRAM REPORTING	INTEGRATED DATA ANALYTICS
Architects Engineers Energy Modellers	eQuest IES EnergyPlus	Reference Comparison Energy Use Intensity Energy Cost Reduction	ON Building Code LEED 2030 Challenge HPNC Toronto Green Standard	Regulatory Requirement Progress Tracking Policy Development	Minimal



COMPASS Origins

COMPASS



The Value Proposition

Creating tools to enable conversations

- Experts & non-experts a like
- A common language
- Multiple lenses

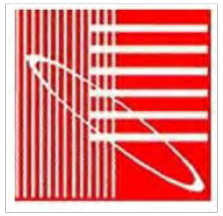
Foster an environment of continuous learning

- Redefining success
- Data collection

We are a community of designers

- How do we package our knowledge to create better buildings?
- Leverage data to advocate for change
- Can we share and learn from each other?

Development Funding

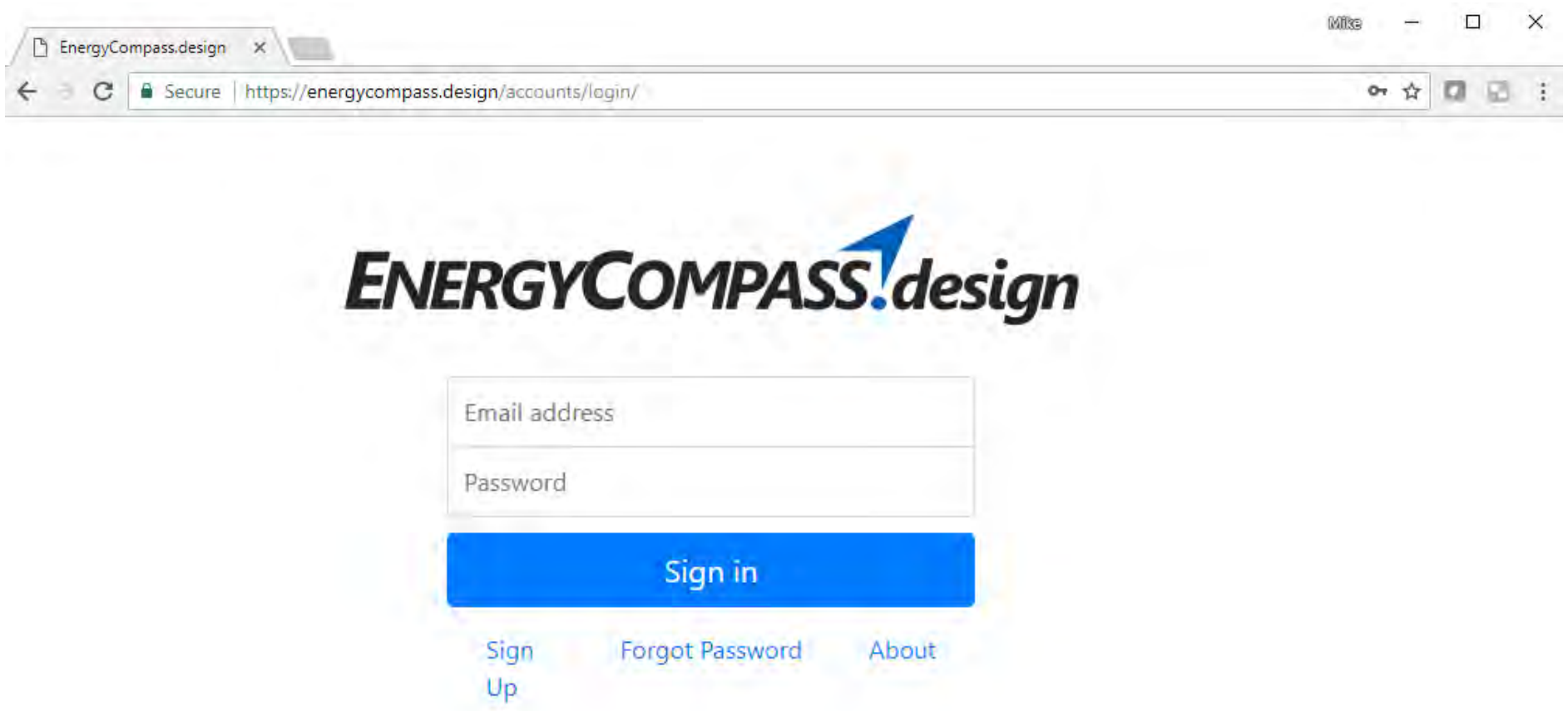


IBPSA Canada

Governance

Letters of Support & Beta Tester

COMPASS



COMPASS Description

COMPASS Inputs

v1 built in Tableau

Python based code – compatibility

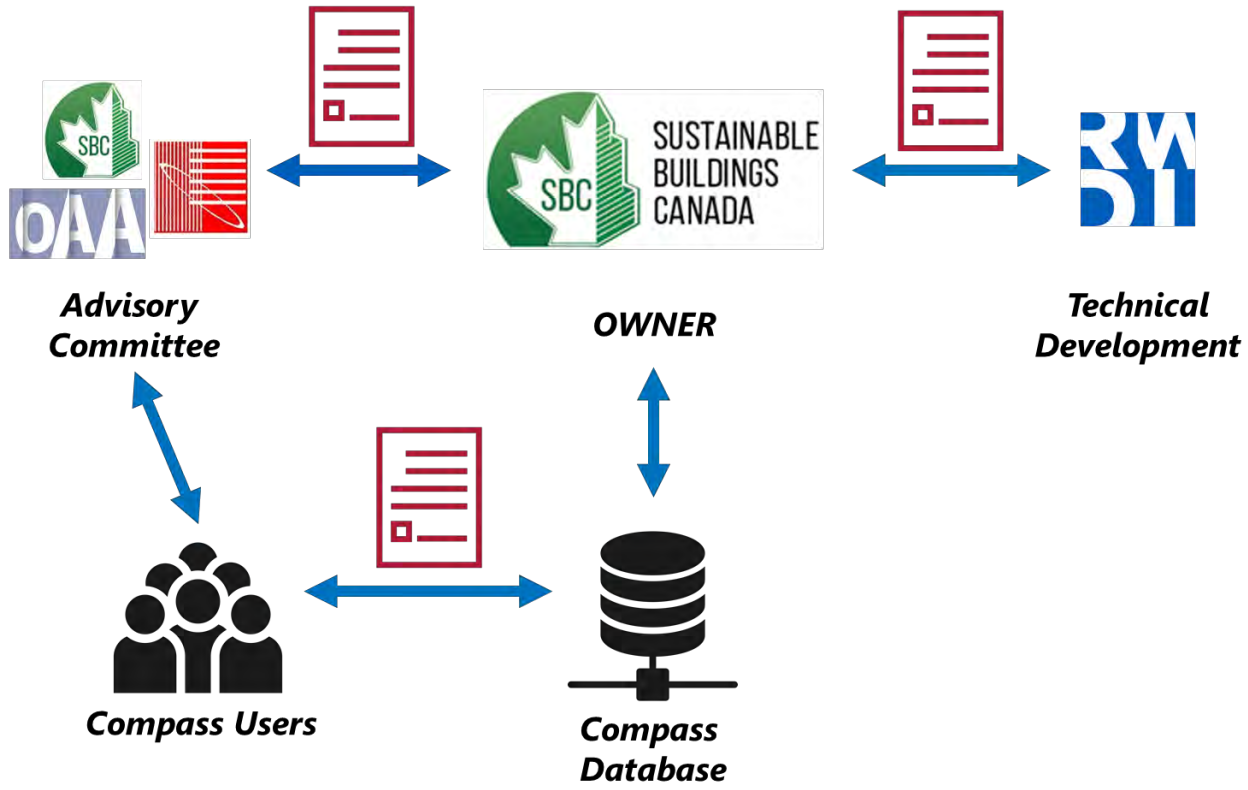
Drag and drop uploading

Visualization tools

Third party data storage - privacy

COMPASS Privacy

Governance Approach



COMPASS Inputs

Drag and drop energy model files:

- eQuest
- IES VE
- Energy Plus

As designed

Baseline

Alternate (ECM) runs

Privacy settings

COMPASS Outputs

Extracts 400 variables

Energy breakdown – end-use breakdown, fuel-type breakdown… filter

Bubble chart – how does your project compare against the database… sort by like characteristics

Parallel Coordinates – tool displays building characteristics, use to compare how they impact total energy performance

Version Details (edit)

Version Name	As-Built
Included in Public Database	Yes

Shared Results

Area	5,000m² - 1,000m²

Interior Lighting	14	kWh/m²
Task Lighting	0	kWh/m²
Plug Loads	25	kWh/m²
Space Heating	14	kWh/m²
Space Cooling	9	kWh/m²
Heat Rejection	0	kWh/m²
Pumping	0	kWh/m²
Ventilation Fans	6	kWh/m²
Refrigeration Display	0	kWh/m²
Heat Pump Supplementary	3	kWh/m²
Domestic Hot Water	34	kWh/m²
External Usage	1	kWh/m²
Total	107	kWh/m²

Improvement over reference	21	%

COMPASS Outputs

Building Properties

Area	5,976	m^2
Volume	16,394	m^3

Energy Uses

	Electricity (kWh)	Natural Gas (kWh)
Interior Lighting	84,668	0
Task Lighting	0	0
Plug Loads	150,668	0
Space Heating	52,958	28,897
Space Cooling	56,006	0
Heat Rejection	0	0
Pumping	938	0
Ventilation Fans	36,751	0
Refrigeration Display	0	0
Heat Pump Supplementary	19,841	0
Domestic Hot Water	0	203,626
External Usage	7,884	0
Total	409,684	232,523

Enclosure Details

	Roof Area (m^2)	Skylight Area (m^2)	WWR
Roof	1,686	0	0%

	Wall Area (m^2)	Window Area (m^2)	WWR
North	608	157	26%
North East	61	38	62%
East	560	181	32%
South	615	299	49%
South West	95	61	64%
West	485	155	32%
Total	2,425	891	37%

	U-value (S.I) $W/m^2 \cdot K$	R-value (S.I) $m^2 \cdot K/W$
Walls Above Grade	0.318	3.145
Walls Below Grade	0.102	9.784
Windows	1.953	0.512
Roof	0.165	6.073
Enclosure Above Grade	0.608	1.646

Gains

People	363	People
Lighting	37	kW
Equipment	65	kW

Mechanical Systems

Heating Load exc. OA	-330	kW
Heating Load inc. OA	15	kW
Cooling Load exc. OA	252	kW
Cooling Load inc. OA	262	kW
Plant Heating Capacity	-296	kW
System Heating Capacity	311	kW
Plant Heating Efficiency	0	%
System Heating Efficency		%
Plant Cooling Capacity	204	kW
System Cooling Capacity	58	kW
Plant Cooling Efficiency	0	%
System Cooling Efficiency		%
Supply Air Rate	16	m^3/s
Outside Air Rate	1	m^3/s
Fan Load	9	kW

COMPASS Outputs

Energy Breakdown

View where buildings expend their energy.

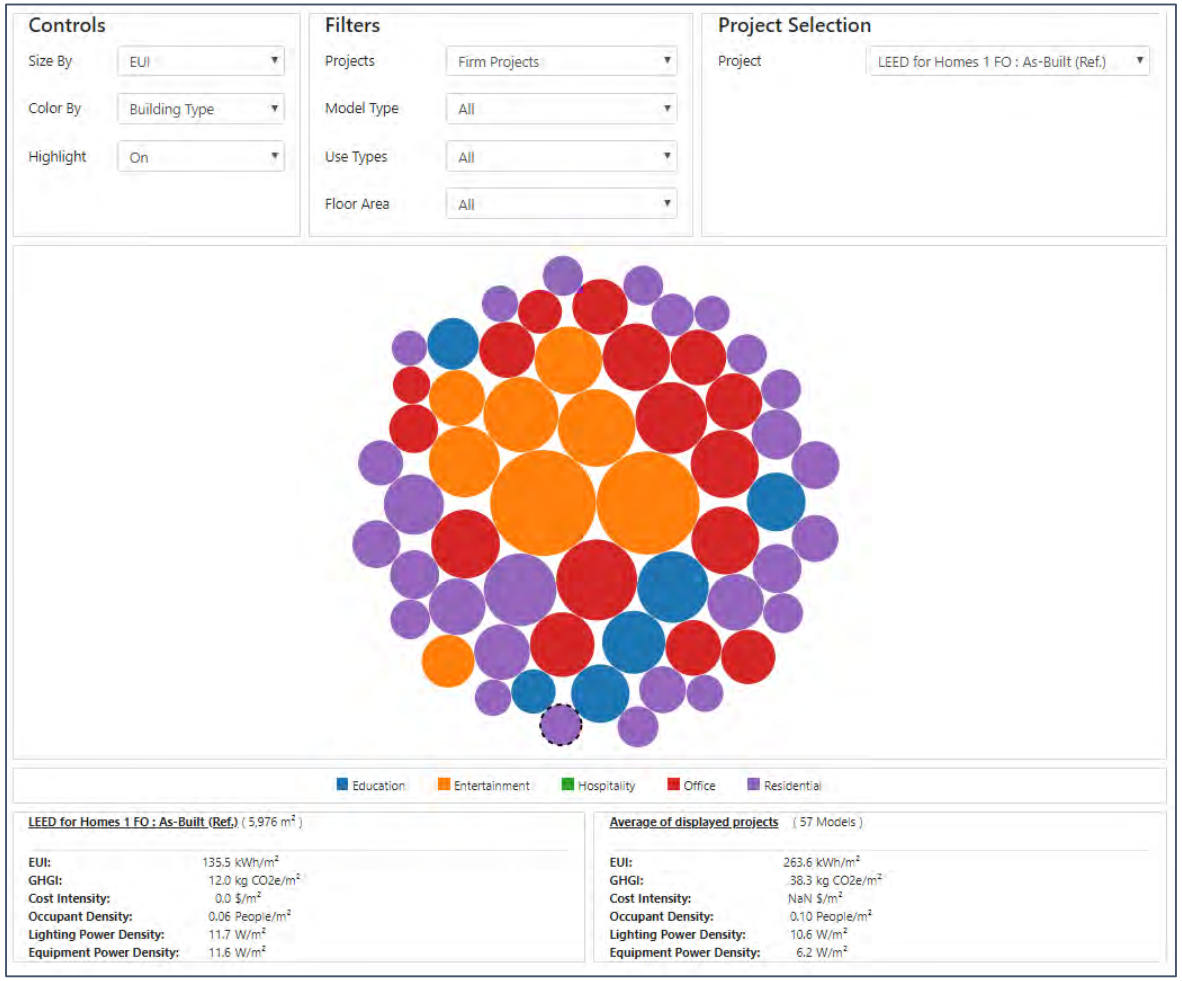
Bubble Chart

Compare various impacts of projects within the database.

Parallel Coordinates

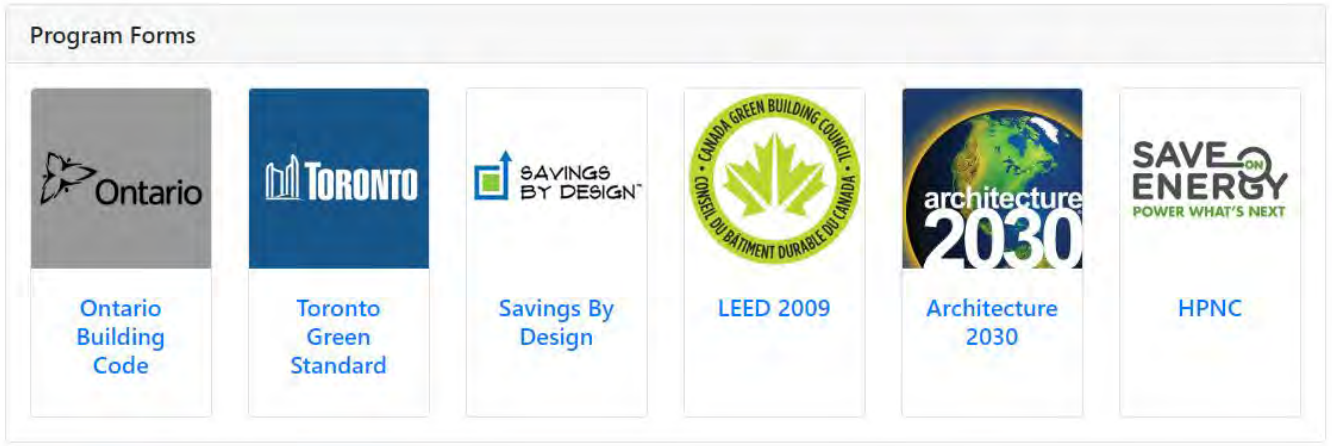
Explore how various building characteristics impact energy usage and GHG intensities.

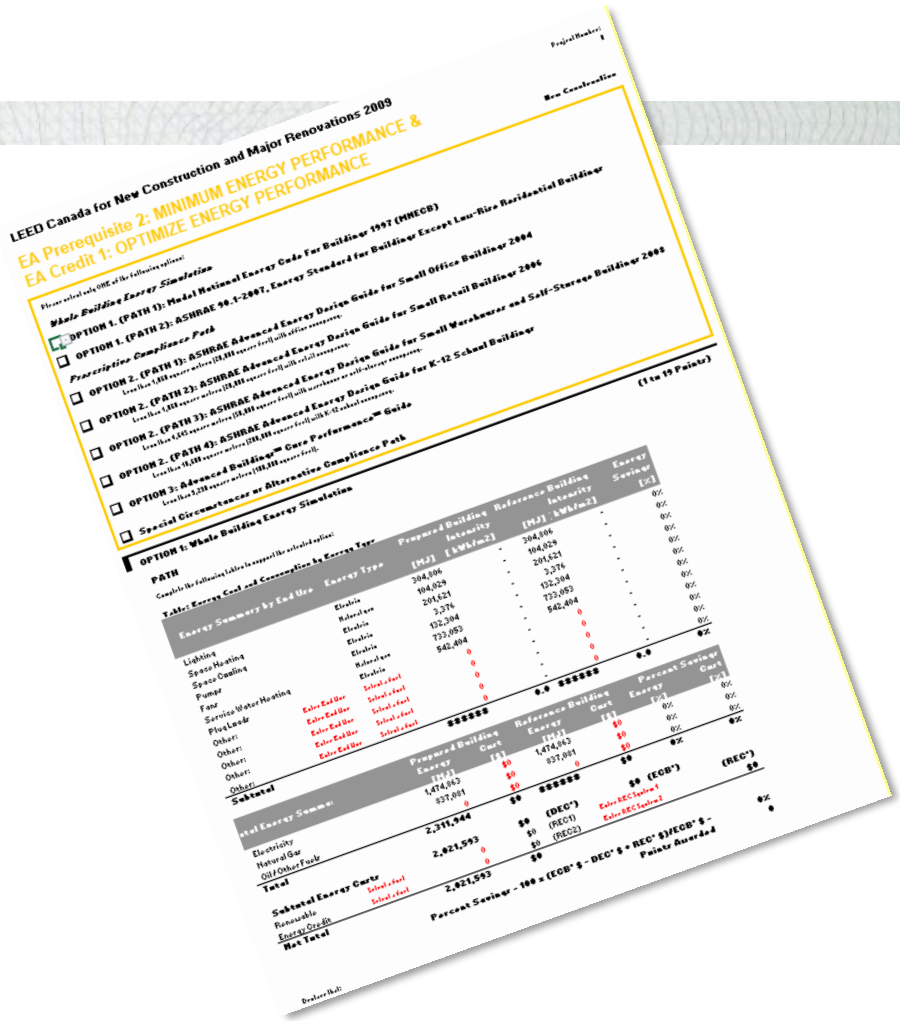
COMPASS Outputs



COMPASS Outputs

Submission reports

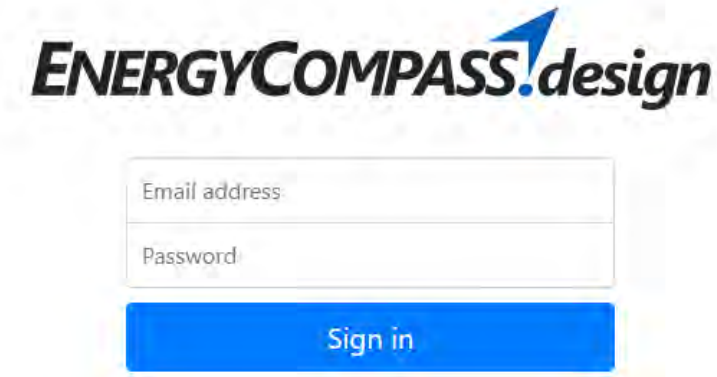




COMPASS Demo

Your Next Steps

1. Call to action
2. We need Portland, Oregon and PNW projects
3. Help inform local design!



Our Next Steps

1. Pushing past beta…
2. Expand regional capabilities
3. Units
4. Improving search capabilities
5. User help & feedback

QUESTIONS

THANK YOU

Redefining possible.

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