Pacific Northwest
NATIONAL LABORATORY

RES*check* Basics

2022 Department of Energy National Energy Codes Conference
Building Energy Codes Program

July 19, 2022

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Senior Research Engineer

U.S. DEPARTMENT OF ENERGY BATTELLE

PNNL-SA-174904

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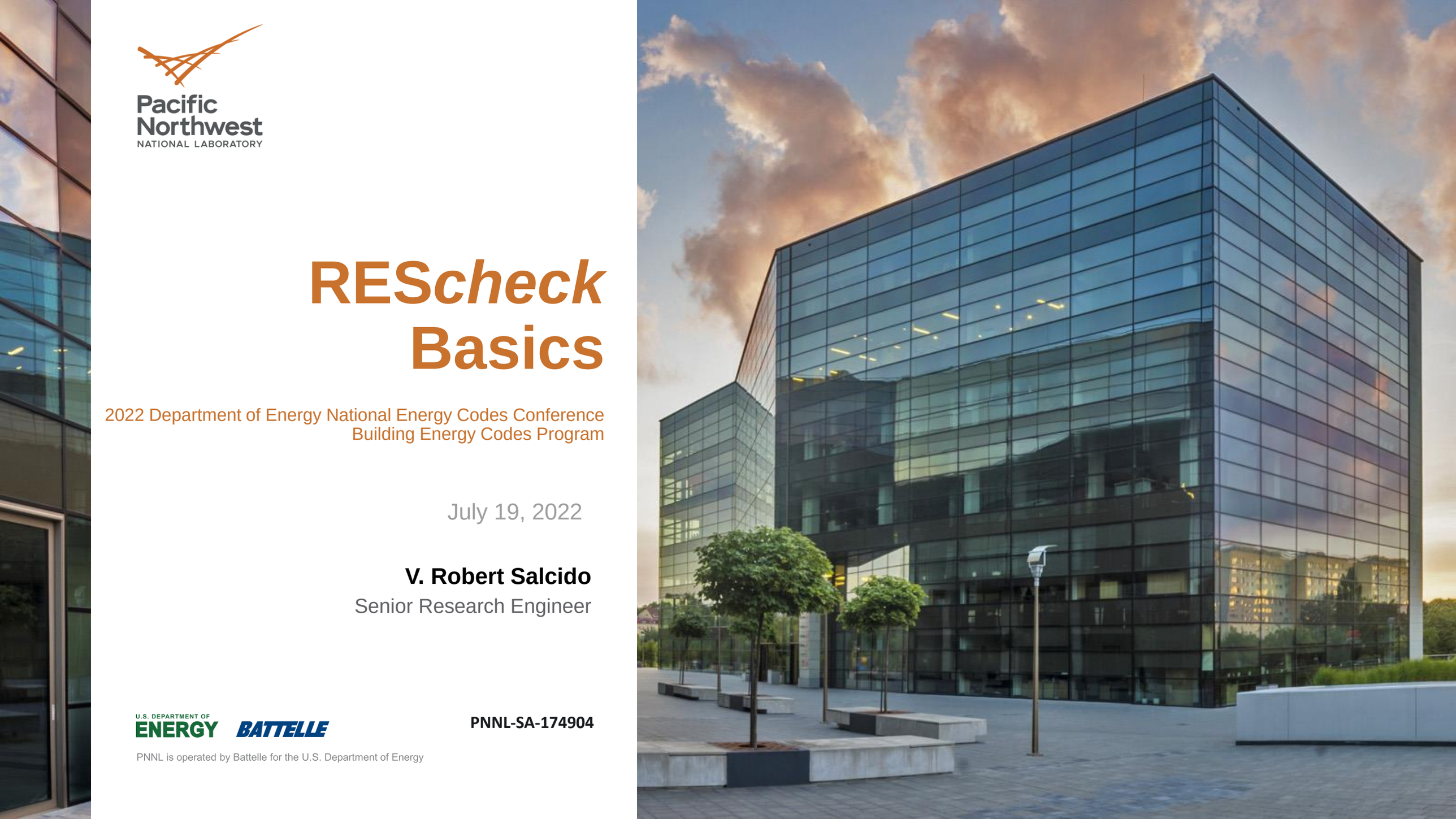
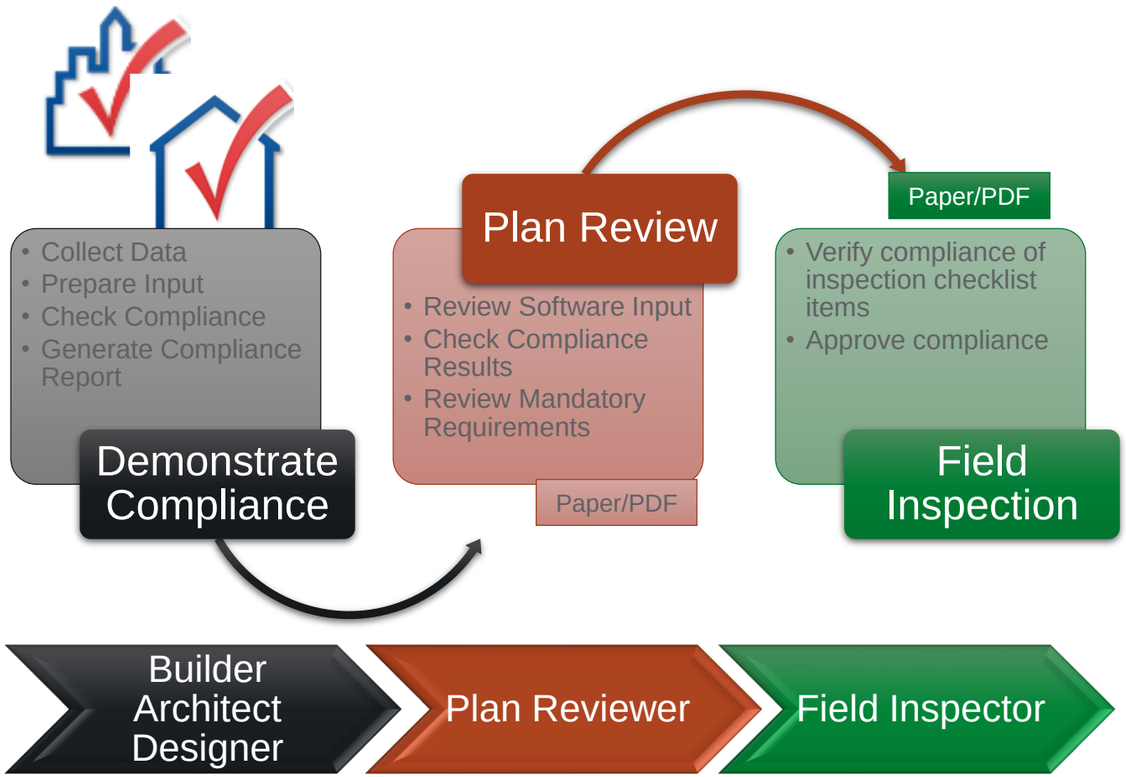
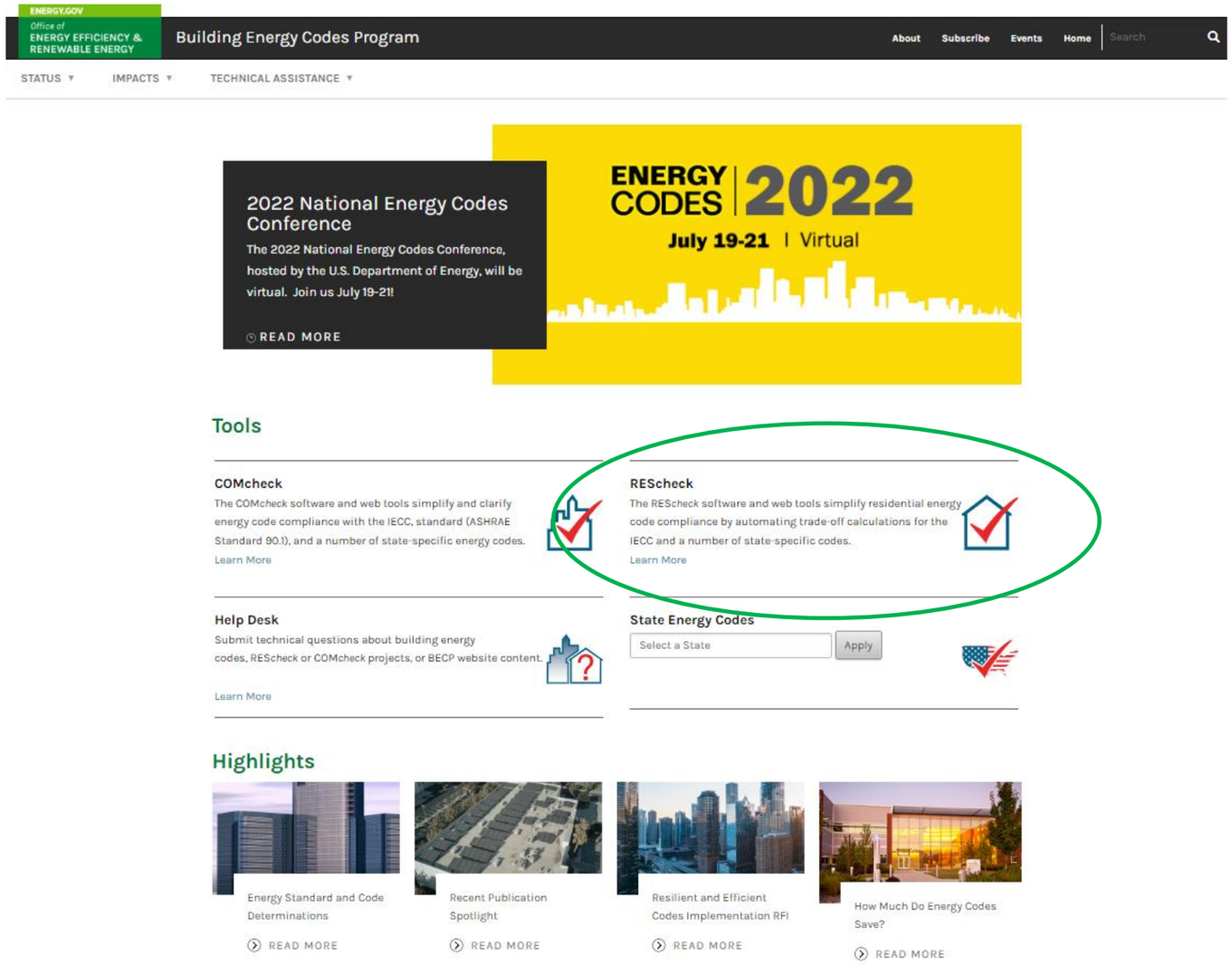


RES*check* Current Use Scenario



BECP Tools used only during “Demonstrate Compliance” Stage

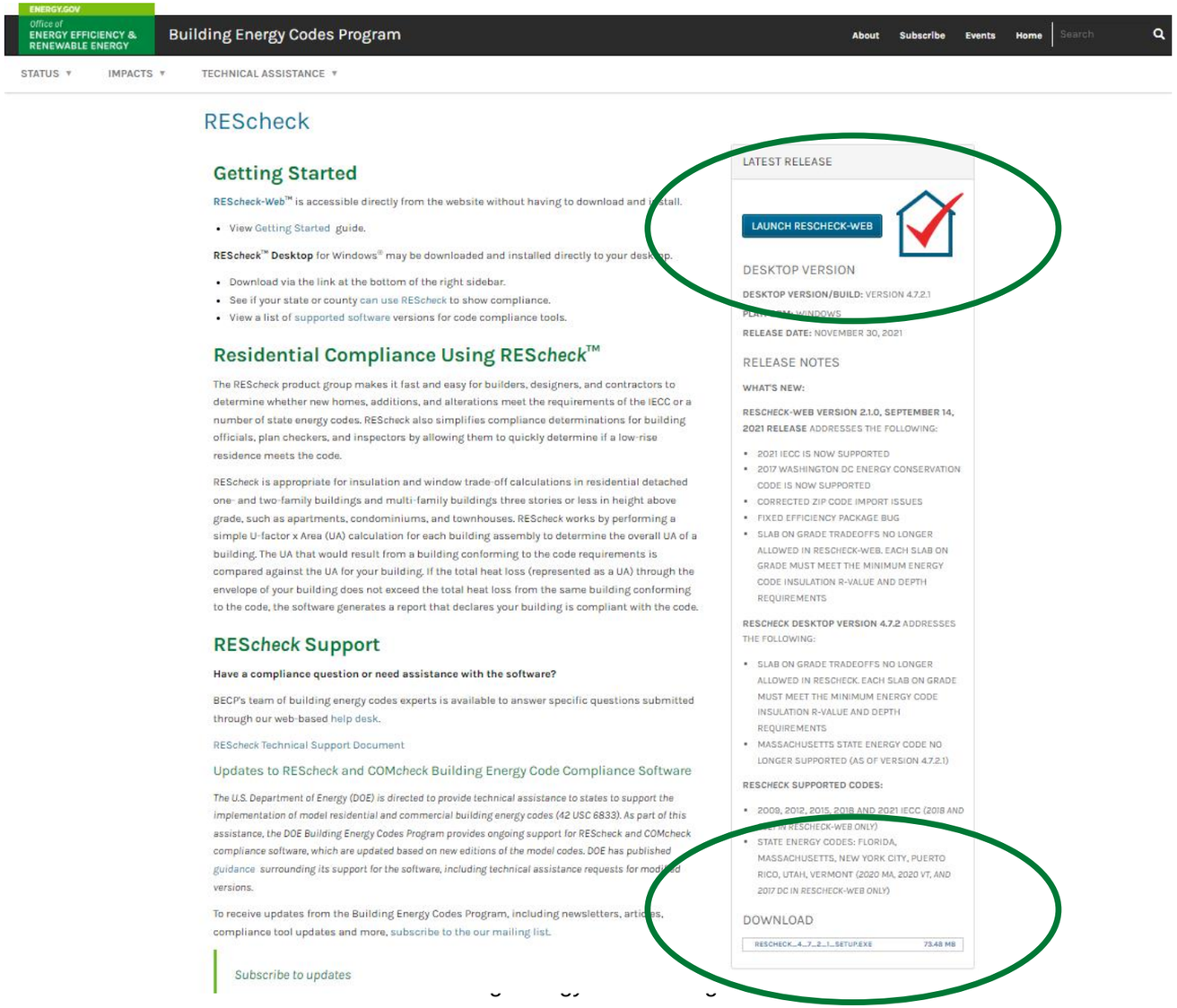
www.energycodes.gov



Building Energy Codes Program

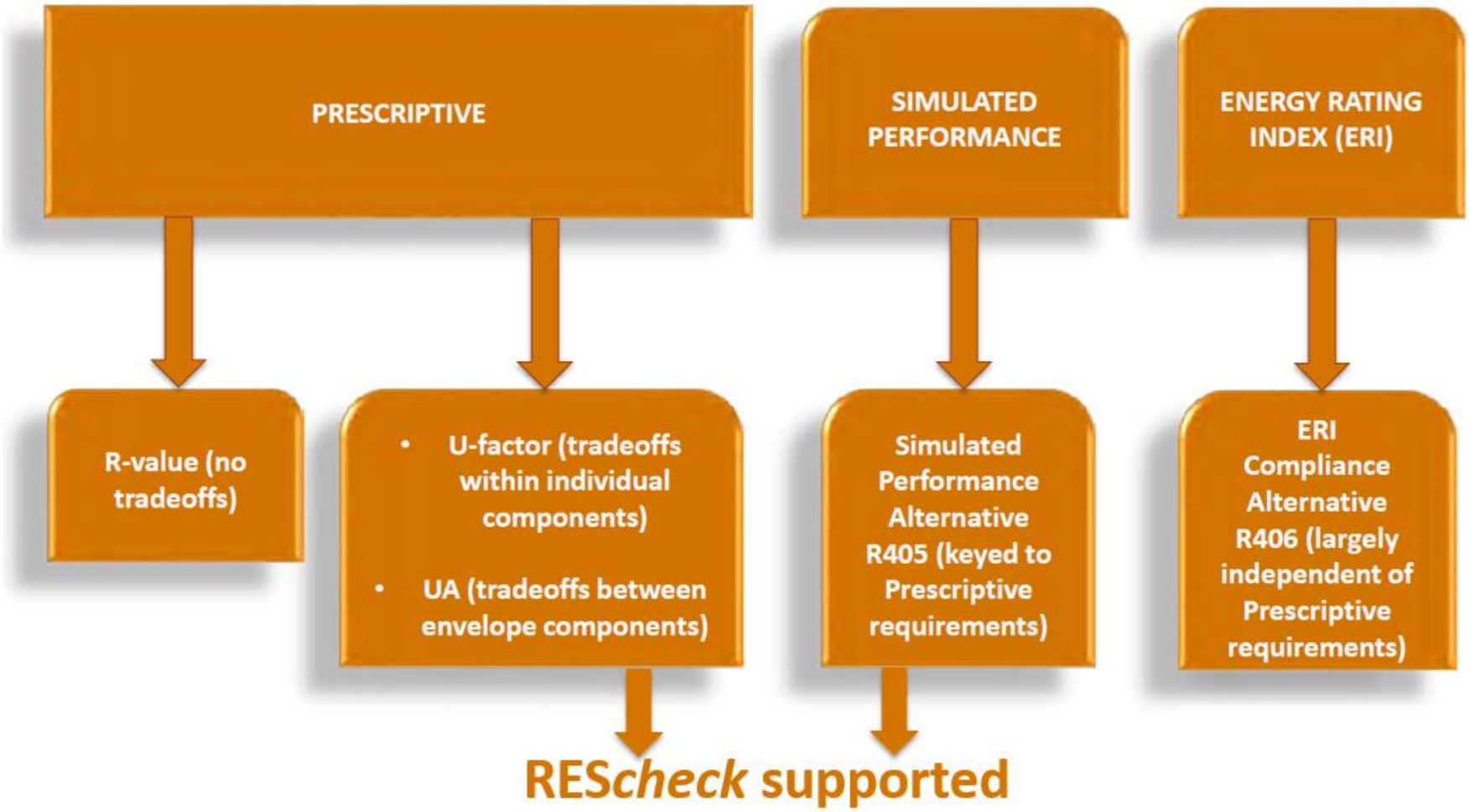
RES*check* Page

https://www.energycodes.gov/rescheck



RES*check* Currently Supported Energy Codes

Residential Energy Code Compliance



RES*check* Supported Compliance Methods

- **Total UA**
  - Considers thermal conductance of envelope assemblies
  - “Trades-off” UA from above-code assemblies to below-code assemblies
  - UA = U-factor x Area for each building assembly
  - Sum UA for Proposed Building compared to SUM UA for Code (Budget) Building

- **Performance Alternative**
  - Considers the whole building energy performance
  - Based on simulated performance of your building compared to an equivalent code building
  - Requires additional inputs (over UA approach): building orientation, minimum of four walls having unique orientations, and a minimum of one roof and floor
  - Envelope trade-off only, no mechanical equipment trade-off

Energy Code Envelope Assembly Requirements

TABLE R402.1.2
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19

TABLE R402.1.4
EQUIVALENT *U*-FACTORS[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.045	0.057	0.028	0.050	0.055

Walkthrough RES*check* Steps

Register for Account
Log In

Select the appropriate code

Enter project information

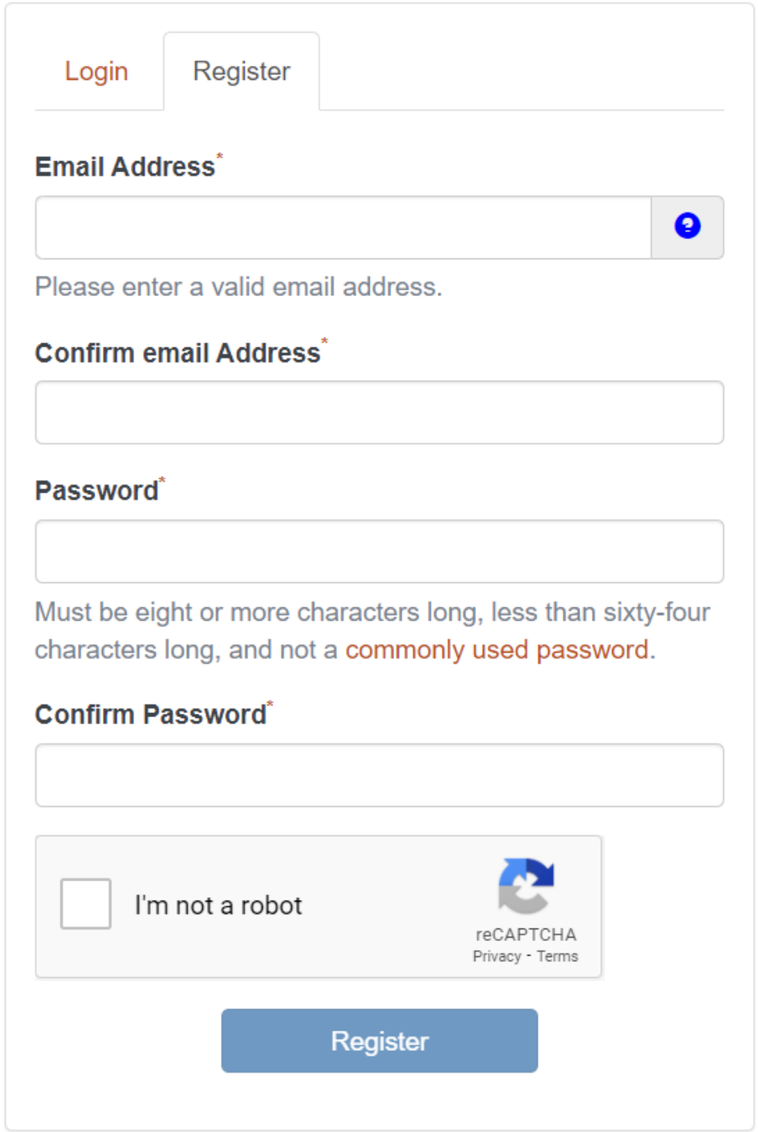
Enter building components

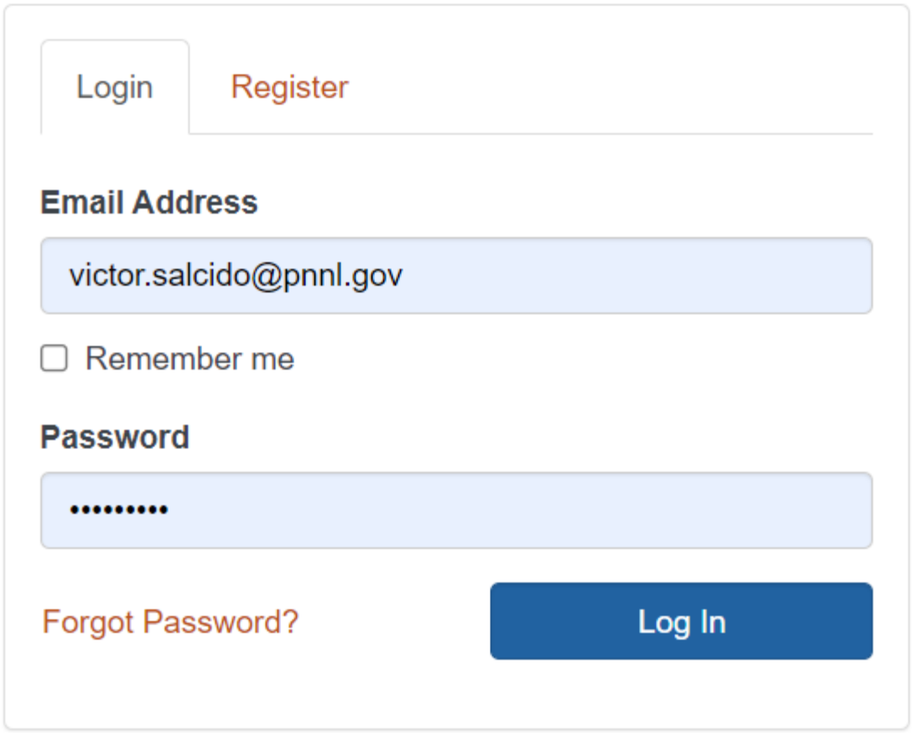
Enter mechanical equipment (optional)

Review Mandatory Requirements

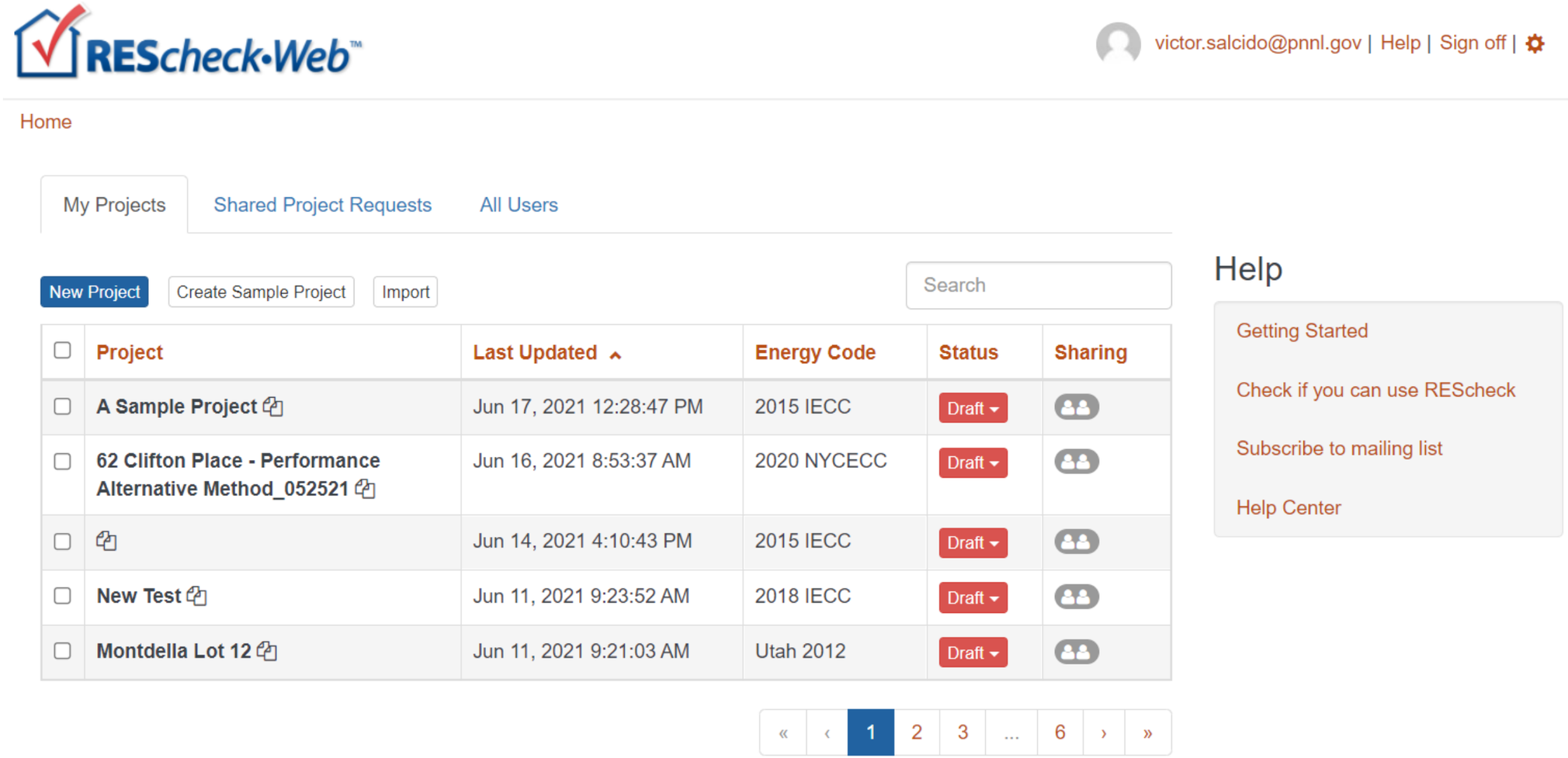
Reports
View/print/save

RES*check-Web*: Registration and Account Log-In

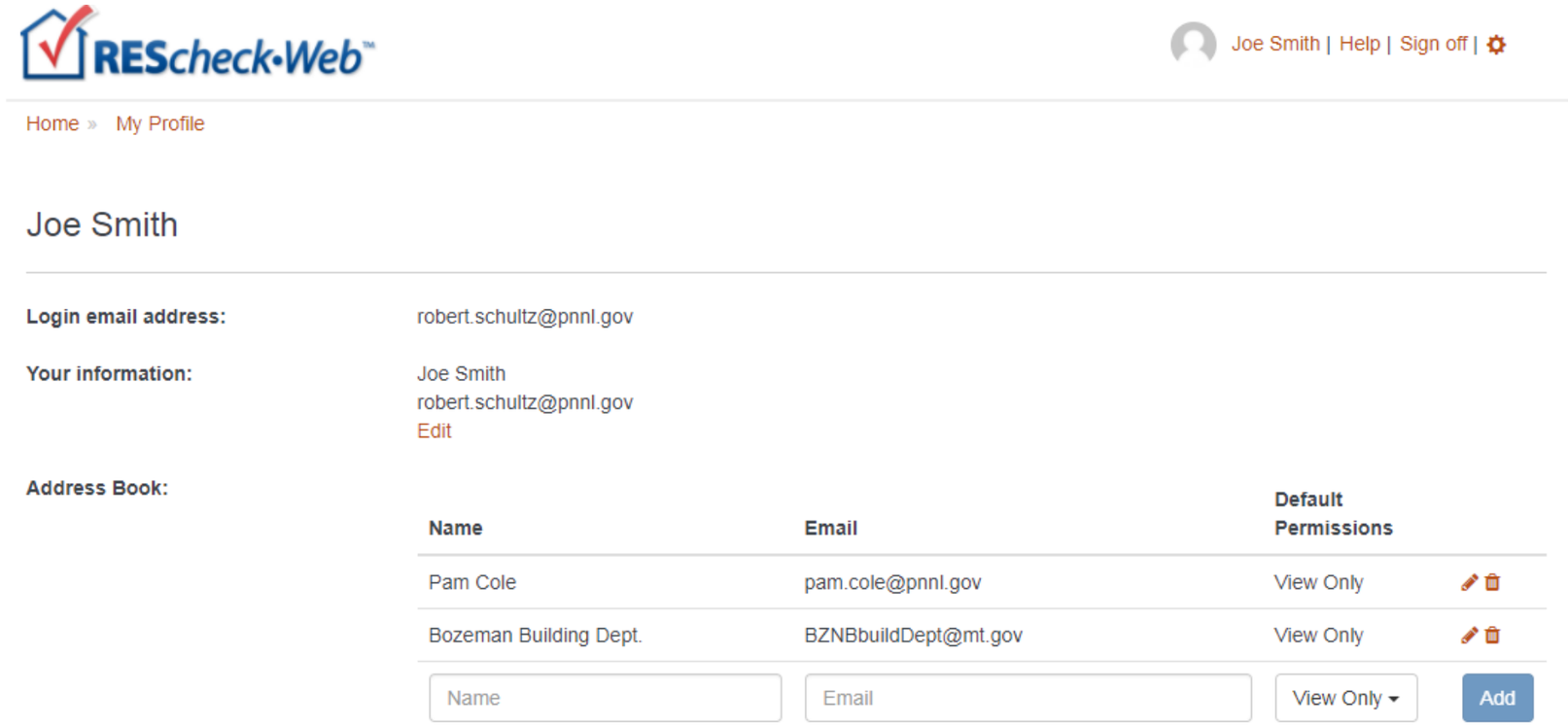




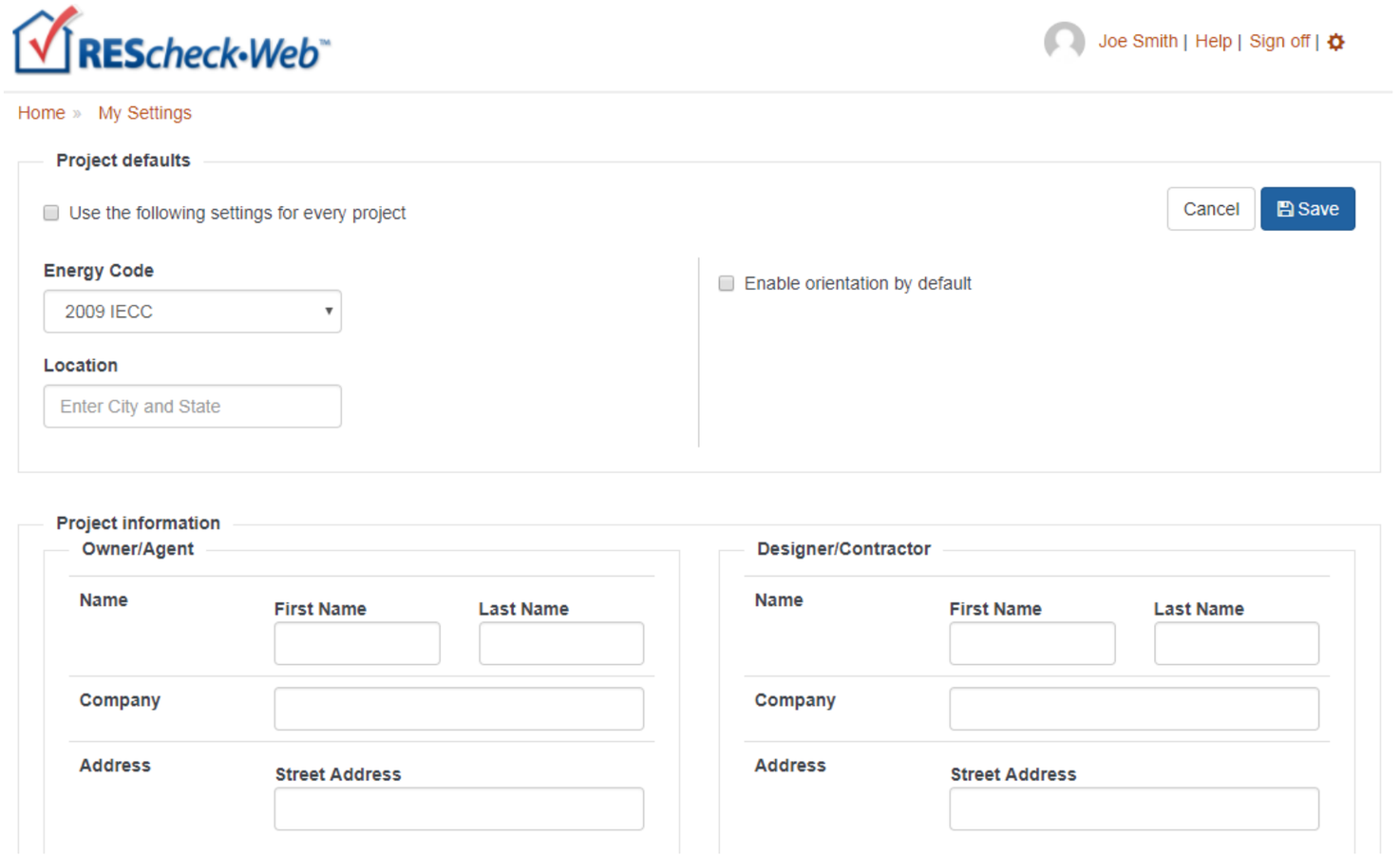
Home: My Projects (aka Project Dashboard)



My Profile

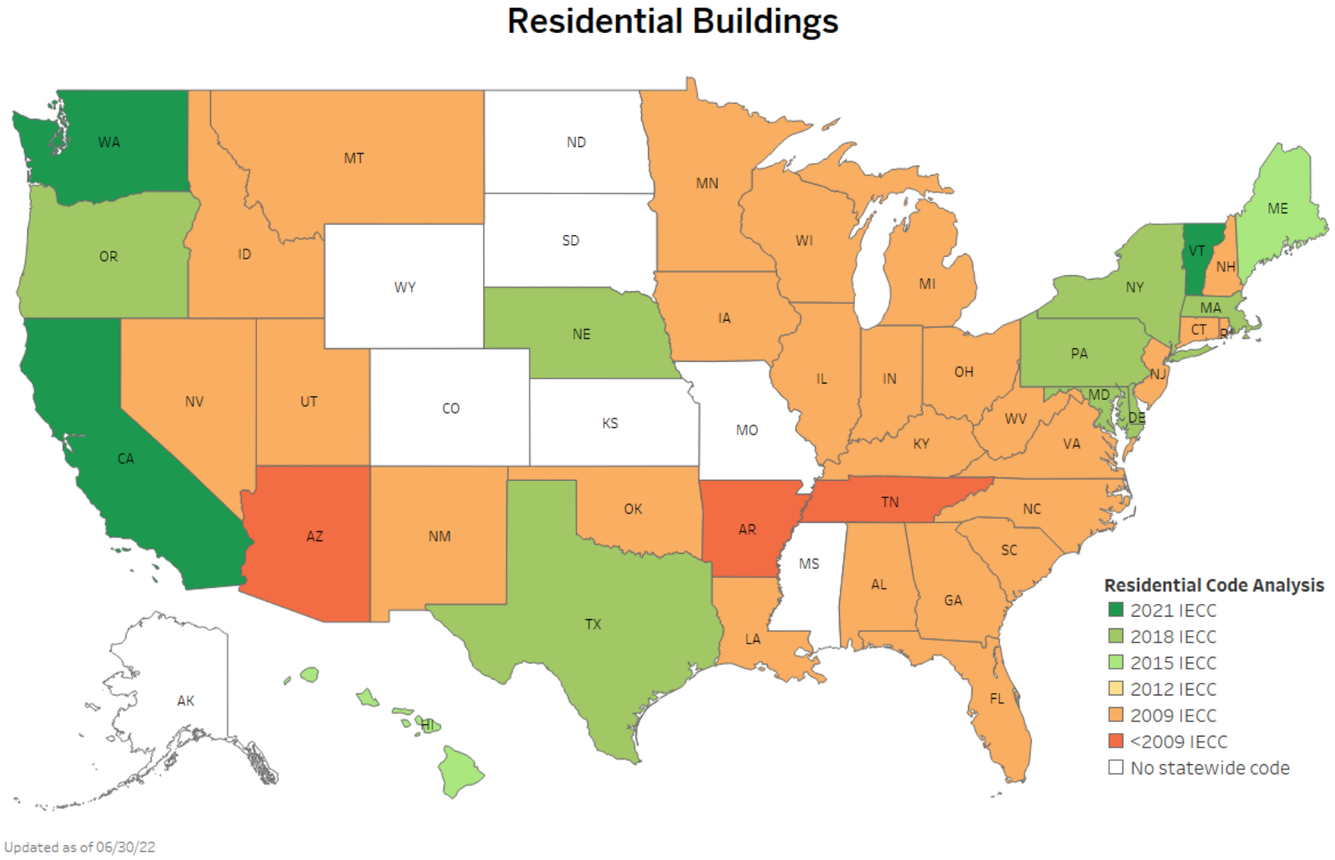

REScheck·Web™
Joe Smith | Help | Sign off |
Home » My Profile
Joe Smith
Login email address:
robert.schultz@pnnl.gov
Your information:
Joe Smith
robert.schultz@pnnl.gov
Edit
Address Book:
Name
Email
Default Permissions
Pam Cole
pam.cole@pnnl.gov
View Only
Bozeman Building Dept.
BZNBbuildDept@mt.gov
View Only
Name
Email
View Only
Add

My Settings


REScheck·Web™
Joe Smith | Help | Sign off |
Home » My Settings
Project defaults
Use the following settings for every project
Cancel
Save
Energy Code
2009 IECC
Location
Enter City and State
Enable orientation by default
Project information
Owner/Agent
Name
First Name
Last Name
Company
Address
Street Address
Designer/Contractor
Name
First Name
Last Name
Company
Address
Street Address

Select the Appropriate Code

- Applicable to your state/ jurisdiction (Code menu)



Project Tab: New Project

Project | Envelope | Compliance ✖

Cancel | Save | Report | Compliance Check

Project Info:

Project Title*

Energy Code:
What's my code?
2009 IECC

Location
Enter City and State or County and Sta

Project Type
- New Construction
- Addition
- Alteration

Compliance Method
- UA Trade-Off
- Performance Alternative

Building Characteristics

Construction Type
- 1- and 2-Family, Detached
- Multifamily

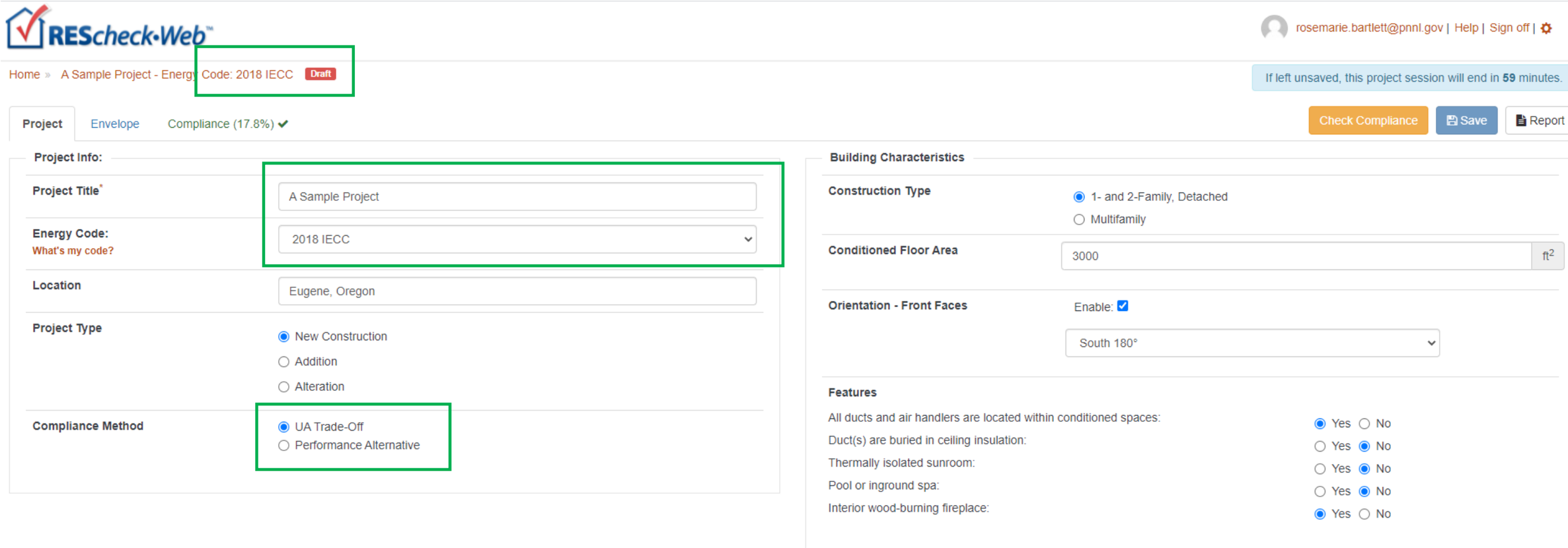
Conditioned Floor Area ft²

Orientation - Front Faces Enable:

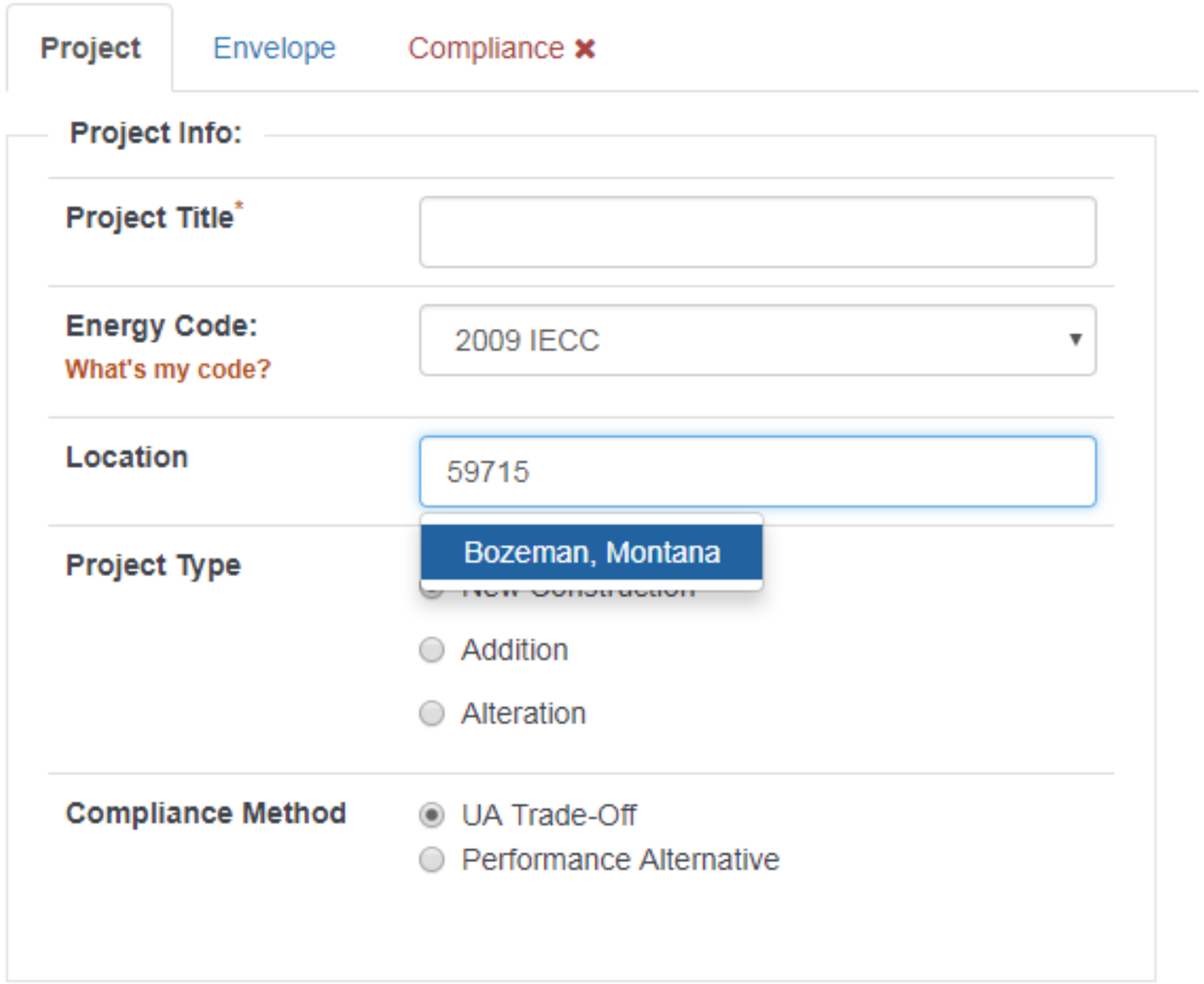
Features

All ducts and air handlers are located within conditioned spaces:	Yes / No
Thermally isolated sunroom:	Yes / No
Pool or inground spa:	Yes / No
Interior wood-burning fireplace:	Yes / No

Energy Code, Location, Project Type, Compliance Method



Project Location Specification



Project Tab: Project Type

- Select New Construction, Addition or Alteration on Project screen
  - Additions

    User choice:
    - Addition only
    - Addition plus existing home
  - Alterations
    - Only include those assemblies being altered
    - Exemptions may apply (“Alteration Details”)

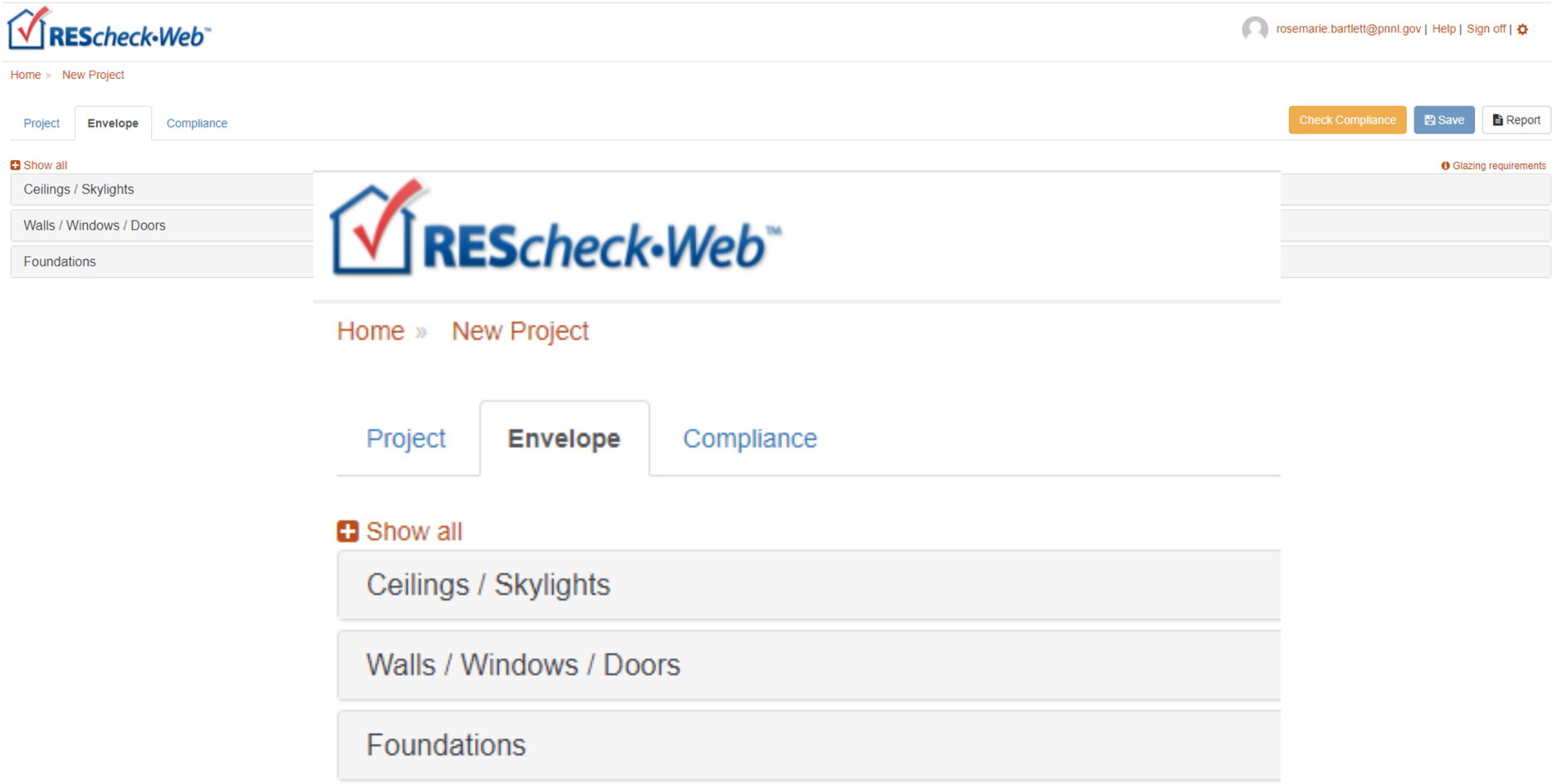
Building Characteristics

- 1- and 2-Family, Detached
- Low-rise Multifamily

Building Characteristics: Multifamily

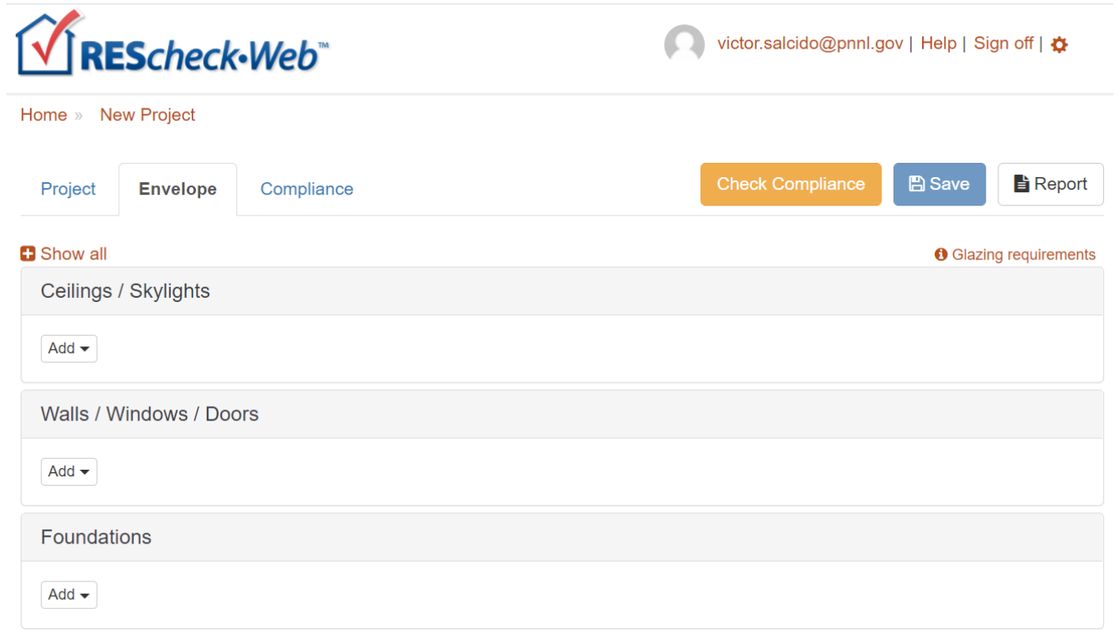
- Multifamily if
  - All multifamily buildings three stories or less in height above grade and
  - Contain three or more attached dwelling units
  - Examples
    - Apartments
    - Condominiums
    - Townhouses
    - Dormitories
    - Rowhouses

Envelope Tab



Envelope Helpful Hints

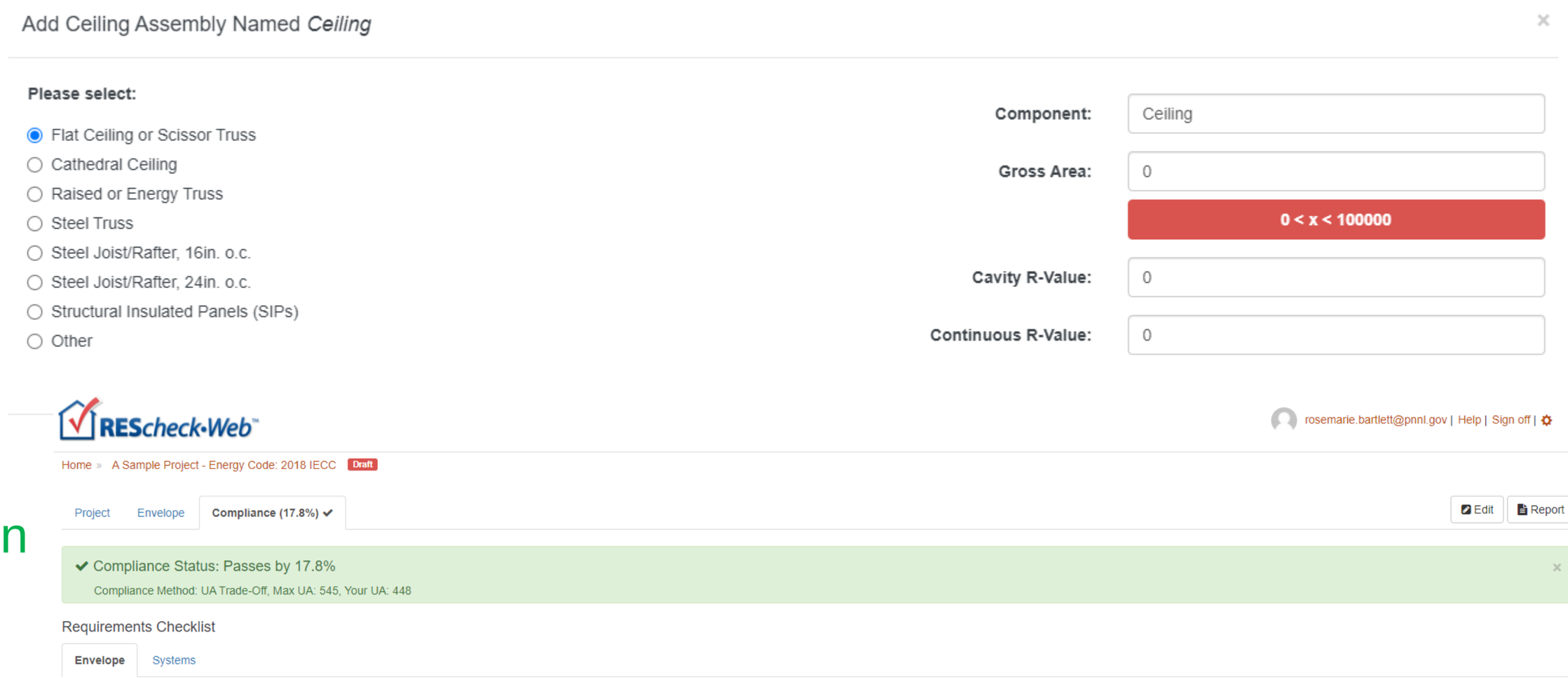
- Don’t have to use every button
- Can group “like” components
- Gross area (except slab-on-grade)
  - Gross *wall* area to include peripheral edges of floors (area of band joist and subfloor between floors)
- Use “Other” assembly as needed



Color Cues

Red

Green



What is the Building Thermal Envelope?

Entering Building Components

Enter only applicable building components

Envelope Tab

Project | **Envelope** | Compliance (15.2%) ✔ — Cancel | Edit | Report

Show all — Glazing requirements

- Ceilings / Skylights (1 assembly)
- Walls / Windows / Doors (4 assemblies)
- Foundations (2 assemblies)

Project | **Envelope** | Compliance (15.2%) ✔ — Cancel | Edit | Report

Show less — Glazing requirements

- Ceilings / Skylights (1 assembly)
- Walls / Windows / Doors (4 assemblies)
- Foundations (2 assemblies)

Floors	Assembly	Gross Area	Orientation	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor
Floor 1	All-Wood Joist/Truss Over Unconditioned Space	3000		35	0	0.028
Basement	Solid Concrete or Masonry	1000	Unspecified	0	15	0.05

Envelope Full View Example

Project | **Envelope** | Compliance (15.2%) ✔ — Cancel | Edit | Report

Show less — Glazing requirements

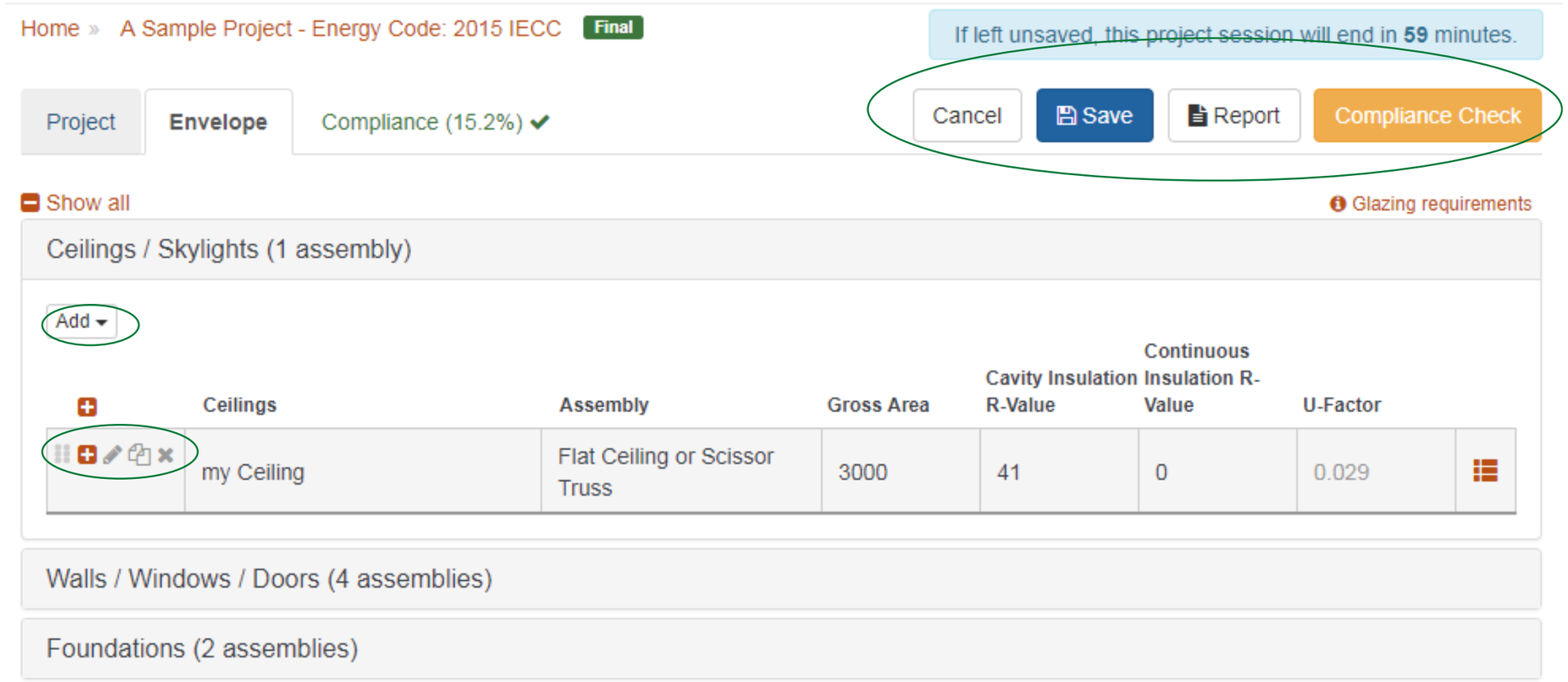
Ceilings / Skylights (1 assembly)

Ceilings	Assembly	Gross Area	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor
my Ceiling	Flat Ceiling or Scissor Truss	3000	41	0	0.029
Skylights	**Assembly**			**Gross Area**	**U-Factor**
mySkylight	Metal Frame Single Pane			20	0.5

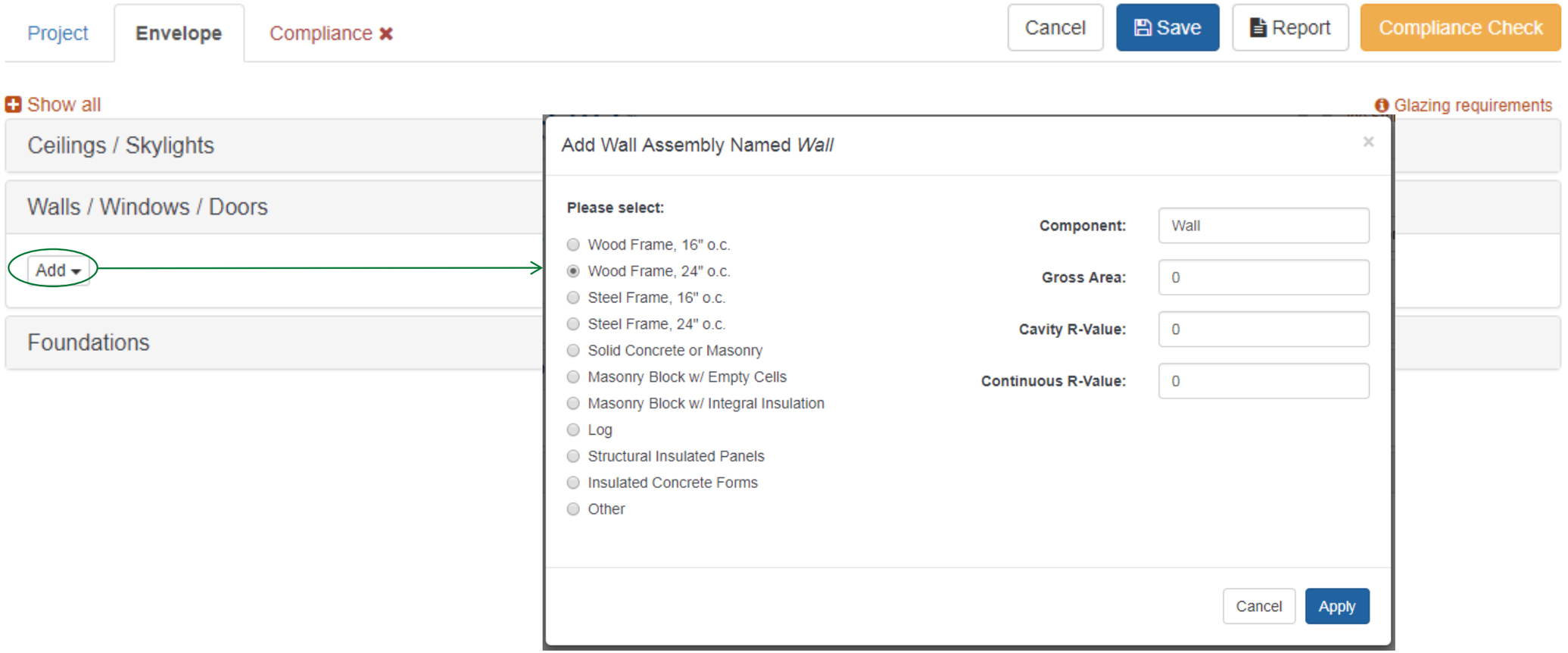
Walls / Windows / Doors (4 assemblies)

Walls	Assembly	Gross Area	Orientation	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor
Wall 1	Wood Frame, 24" o.c.	1200	Front side	21	5	0.042
Doors	**Assembly**				**Gross Area**	**U-Factor**
Door 1	Solid Door (under 50% glazing)				32	0.7
Wall 2	Wood Frame, 24" o.c.	1200	Front side	21	5	0.042
Windows	**Assembly**				**Gross Area**	**U-Factor**
Window 1	Metal Frame Single Pane				16	0.25
Window 2	Metal Frame Single Pane				16	0.25
Window 3	Metal Frame Single Pane				16	0.25

Envelope Tab (edit mode)



Envelope Add Wall Example

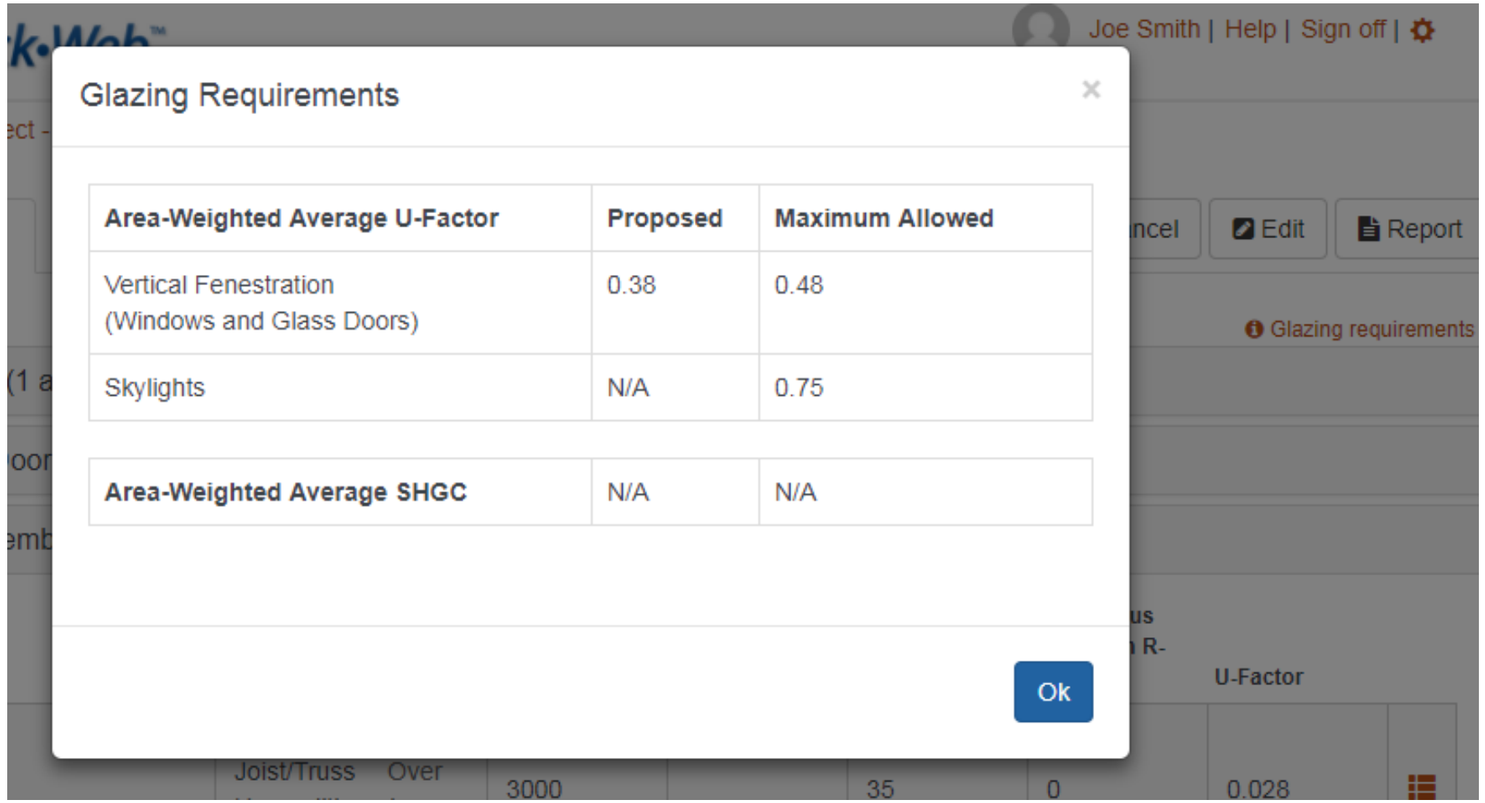


Cavity vs. Continuous

Cavity R-value – used for insulation placed between structural members

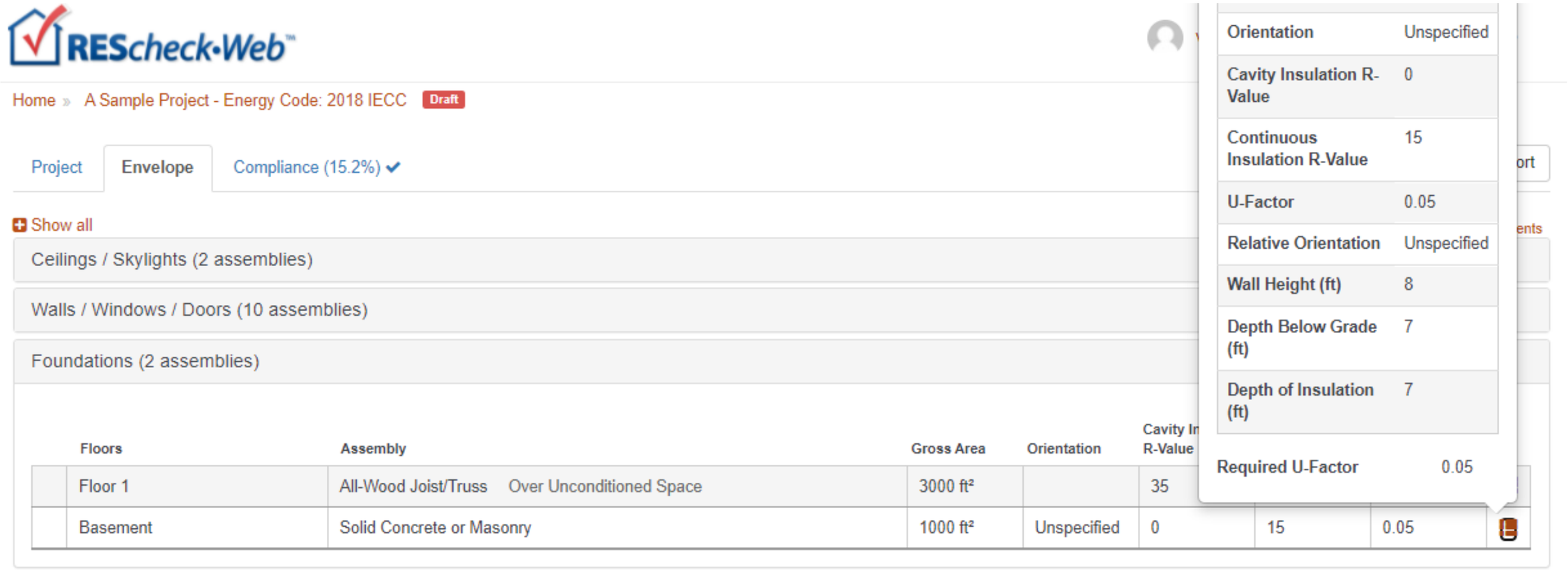
Continuous R-value – used for insulation that is continuous across the structure (e.g., rigid insulation)

Envelope Glazing Requirements



Fenestration: U-Factors and SHGCs

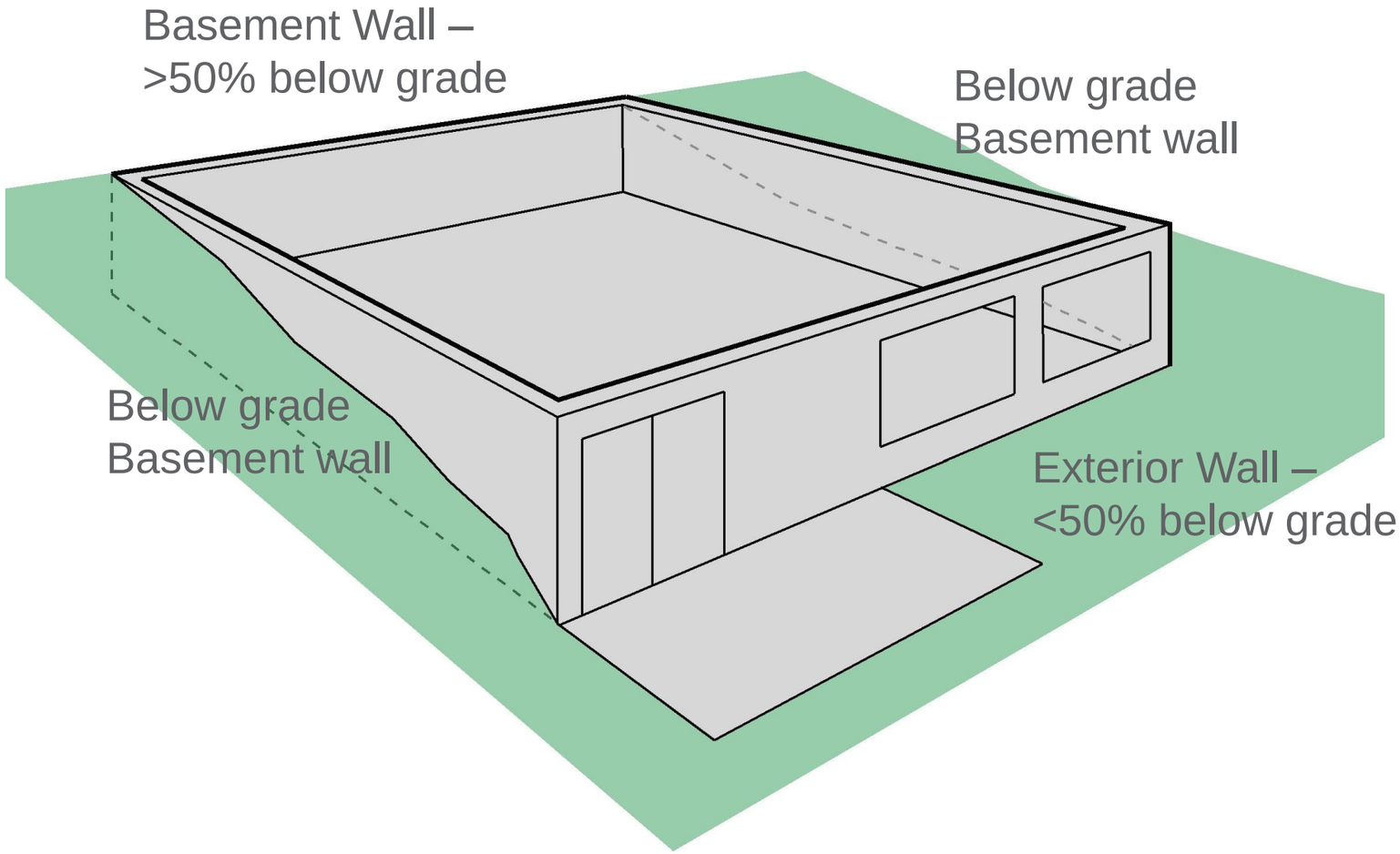
Envelope Show Assembly Details



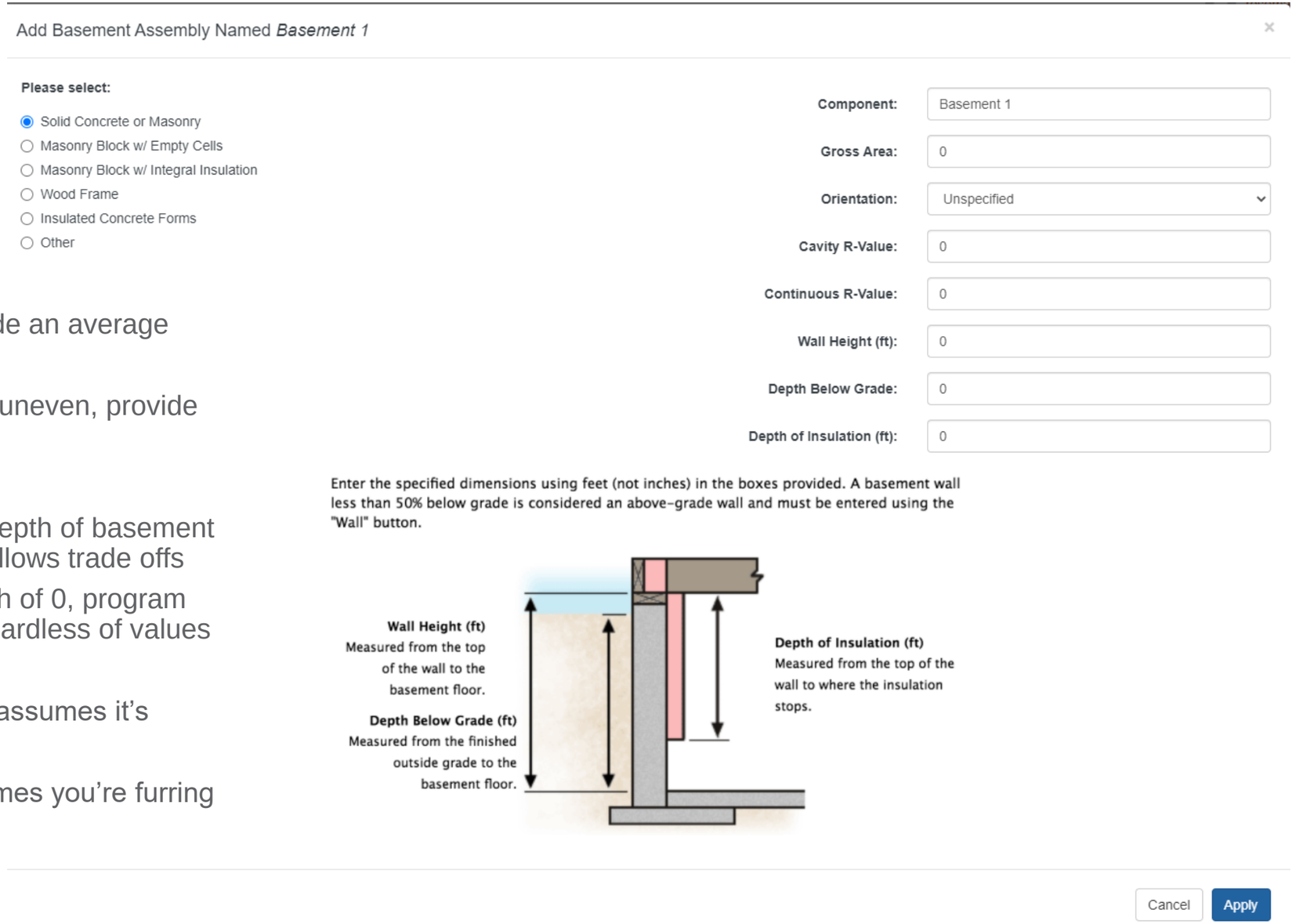
Foundations – what button to use

Basement	• Basement is conditioned
Floor	• Separates conditioned from ambient or unconditioned space
Crawl Wall	• Crawl space is not vented to the outside and floor above is NOT insulated

What's a Basement Wall?



Basement Wall



- Wall Height: If not uniform, provide an average height
- Depth Below Grade: If sloped or uneven, provide an average depth below grade
- Depth of Insulation
  - Requirements are for full depth of basement wall (to 10 ft); RES*check* allows trade offs
  - If you enter insulation depth of 0, program assumes no insulation, regardless of values in the insulation fields
- Continuous Insulation: Software assumes it's exterior rigid
- Cavity Insulation: Software assumes you're furring out on the interior

Crawl Wall

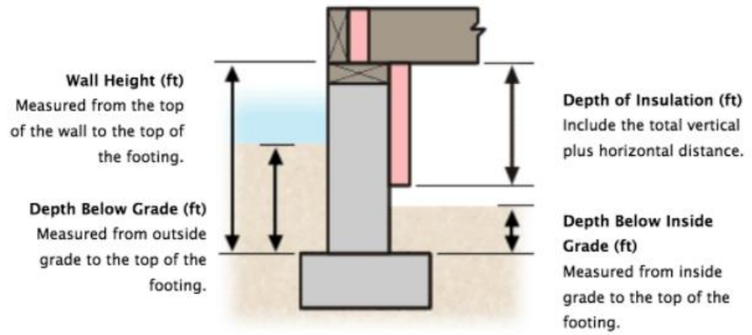
Add Crawl Assembly Named *Crawl*

Please select:

- (●) Solid Concrete or Masonry
- ( ) Masonry Block w/ Empty Cells
- ( ) Masonry Block w/ Integral Insulation
- ( ) Wood Frame
- ( ) Insulated Concrete Forms
- ( ) Other

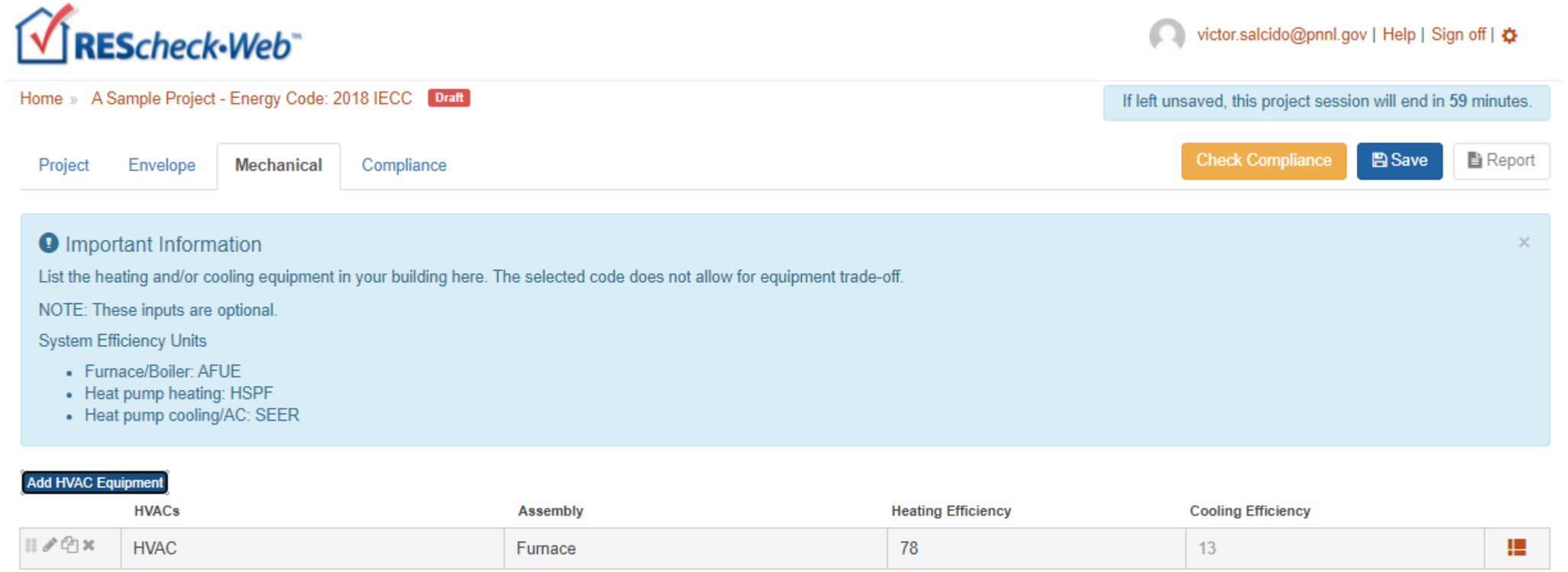
Component:	Crawl
Gross Area:	0
Cavity R-Value:	0
Continuous R-Value:	0
Wall Height (ft):	0
Depth Below Grade (ft):	0
Depth Below Inside Grade (ft):	0
Depth of Insulation (ft):	0

The crawl space wall option applies only to walls of unventilated crawl spaces. Enter the specified dimensions in feet (not inches) in the boxes provided.



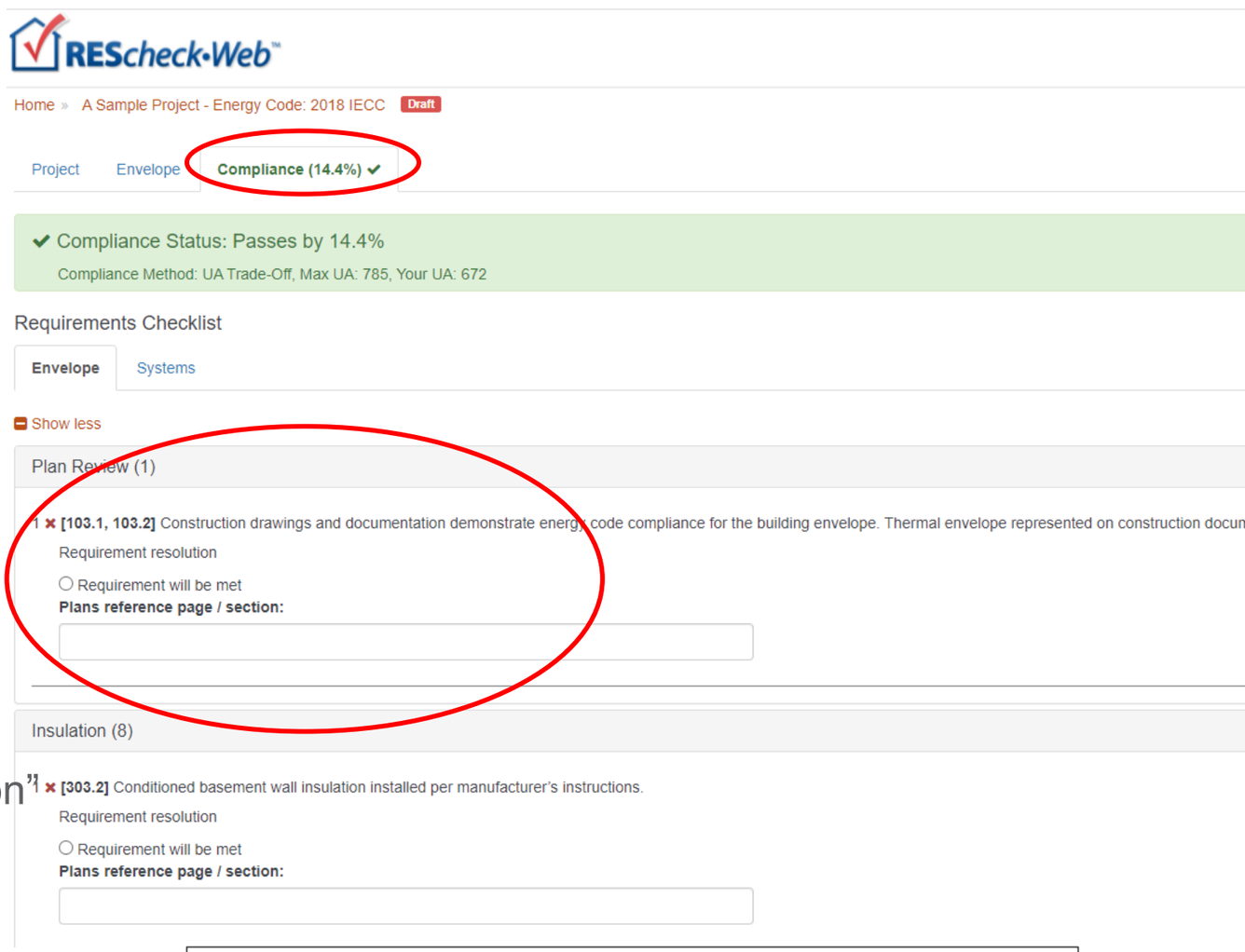
Cancel Apply

Mechanical Tab – Performance Alternative Only



Compliance Tab

- Mandatory requirements
  - Air leakage
  - Building mechanical systems and equipment
  - Service water heating
  - Duct construction, insulation, testing
- For each requirement, the user
  - Chooses an applicable “compliance option”
    - Requirement will be met
    - Exempt or Exceptions
    - Requirement is Not Applicable
  - Notes how compliance for applicable requirements are documented



This information is shown on the report in the “Comments/ Assumptions” column of the Inspection Checklist

Compliance Tab (edit mode)

Project | Envelope | **Compliance (15.2%)** ✔ | Cancel | Save | Report | Compliance Check

✔ Compliance Status: Passes by 15.2%

Compliance Method: UA Trade-Off, Max UA: 553, Your UA: 469

Requirements Checklist

Envelope | Systems

Show less

Plan Review (1)

1 ✖ **[103.1, 103.2]** Construction drawings and documentation demonstrate energy code compliance for the building envelope. Thermal envelope represented on construction documents.

Requirement resolution

Resolution will be met

Plans reference page / section:

Compliance Failing – Helpful Hints

- Review building plans to ensure all components are entered correctly
- Confirm takeoffs (areas) are correct
- Confirm insulation values
  - Double check cavity vs. continuous entries
- Confirm fenestration values
  - Double check ratings on windows and doors (U-factor and SHGC)
- Compare proposed U-factors with required U-factors
- Evaluate UA data

Evaluate Assembly Performance

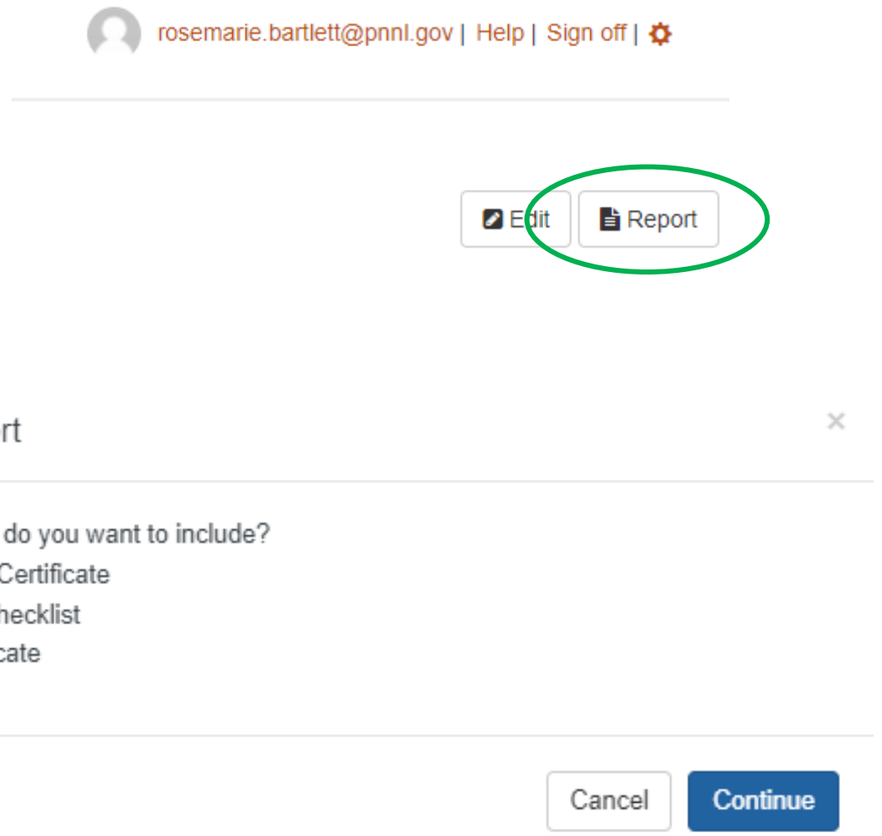
TABLE R402.1.4
EQUIVALENT *U*-FACTORS[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.045	0.057	0.028	0.050	0.055

Wall	Wood Frame, 16" o.c.	1000	Unspecified	19	5	0.045	
Wall 1	Wood Frame, 24" o.c.	1000	Unspecified	19	5	0.044	
Wall 2	Steel Frame, 16" o.c.	1000	Unspecified	19	5	0.071	
Wall 3	Steel Frame, 24" o.c.	1000	Unspecified	19	5	0.064	

Reports

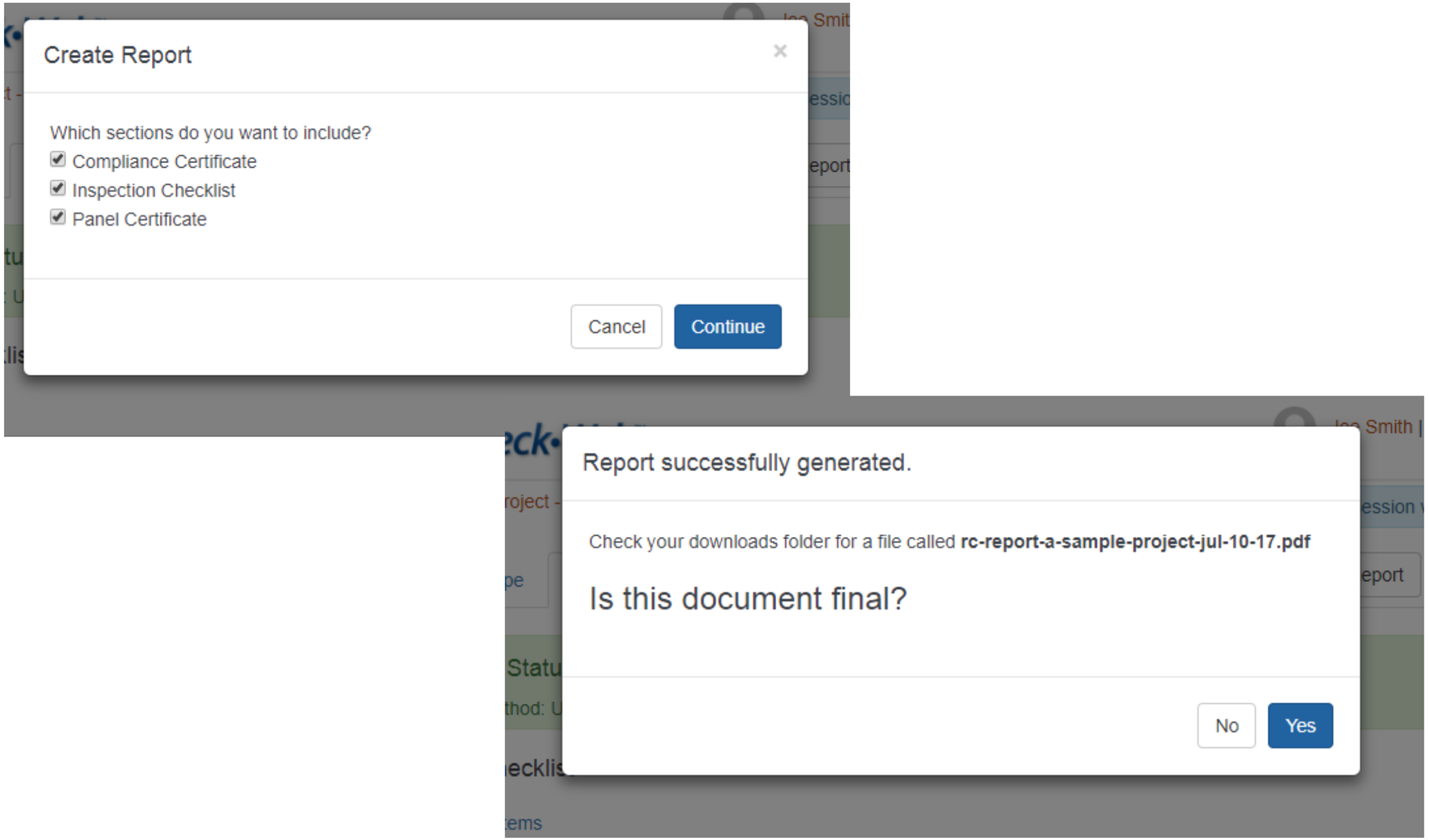
- Choices, choose any or all
  - Compliance Certificate
  - Inspection Checklist
  - Panel Certificate



Reports

- Requirements
- Inspection checklists set up by phase of construction
  - Plan Review
  - Footing/Foundation
  - Rough-in
  - Final

Reports


Create Report
Which sections do you want to include?
Compliance Certificate
Inspection Checklist
Panel Certificate
Cancel
Continue
Report successfully generated.
Check your downloads folder for a file called rc-report-a-sample-project-jul-10-17.pdf
Is this document final?
No
Yes

Reports – Sample Compliance Certificate

Generated by RES*check-Web* Software

Compliance Certificate

Project A Sample Project

Energy Code:	**2018 IECC**
Location:	**Eugene, Oregon**
Construction Type:	**Single-family**
Project Type:	**New Construction**
Orientation:	**Bldg. faces 180 deg. from North**
Conditioned Floor Area:	**3,000 ft2**
Glazing Area	**2%**
Climate Zone:	**4 (4546 HDD)**
Permit Date:	
Permit Number:	

Verify energy code, location, construction type, and conditioned floor area

Construction Site:
123 Main St.
Dogtown, WA 99352

Owner/Agent:
R. Franklin
321 W. Tenth
Dogtown, WA 99532
509.888.7777

Designer/Contractor:
Anne Hatchet
Acme Home Designers
555 Paire Ridge
Dogtown, WA 99532
509.888.999

Compliance: Passes using UA trade-off

Compliance: **17.8% Better Than Code** Maximum UA: **545** Your UA: **448**

The % Better or Worse Than Code Index reflects how close to compliance the house is based on code trade-off rules.
It DOES NOT provide an estimate of energy use or cost relative to a minimum-code home.

Evaluate Assembly Performance (cont)

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Prop. U-Factor	Req. U-Factor	Prop. UA	Req. UA
my Ceiling: Flat Ceiling or Scissor Truss	3,000	41.0	0.0	0.029	0.026	86	77
mySkylight: Metal Frame	20			0.500	0.550	10	11
Wall 1: Wood Frame, 24" o.c. Orientation: Front	1,200	21.0	5.0	0.042	0.060	50	72
Wall 2: Wood Frame, 24" o.c. Orientation: Front	1,200	21.0	5.0	0.042	0.060	48	69
Window 1: Metal Frame Orientation: Front	16			0.250	0.300	4	5
Window 2: Metal Frame Orientation: Front	16			0.250	0.300	4	5

Reports – Sample Compliance Certificate, cont

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Prop. U-Factor	Req. U-Factor	Prop. UA	Req. UA
my Ceiling: Flat Ceiling or Scissor Truss	3,000	41.0	0.0	0.029	0.026	86	77
mySkylight: Metal Frame	20			0.500	0.550	10	11
Wall 1: Wood Frame, 24" o.c. Orientation: Front	1,200	21.0	5.0	0.042	0.060	50	72
Wall 2: Wood Frame, 24" o.c. Orientation: Front	1,200	21.0	5.0	0.042	0.060	48	69
Window 1: Metal Frame Orientation: Front	16			0.250	0.300	4	5
Window 2: Metal Frame Orientation: Front	16			0.250	0.300	4	5

Reports – Sample Compliance Certificate, cont

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Prop. U-Factor	Req. U-Factor	Prop. UA	Req. UA
Basement: Solid Co Orientation: Unsp Wall height: 8.0' Depth below grad Insulation depth:	1,000	0.0	15.0	0.050	0.050	50	50

Verify Compliance Statement is Signed

Verify Values are Consistent with Plans

Compliance Statement: The proposed building design described here is consistent with the building plans, specifications, calculations submitted with the permit application. The proposed building has been designed to meet the 2018 IECC requi RES*check* Version : REScheck-Web and to comply with the mandatory requirements listed in the RES*check* Inspection Che

Name - Title

Signature

Date

Envelope Sample Inspection Checklist

Section # & Req.ID	Foundation Inspection	Plans Verified Value	Field Verified Value	Complies?	Comments/Assumptions
402.1.1 [FO4][1]	Conditioned basement wall insulation R-value. Where interior insulation is used, verification may need to occur during Insulation Inspection. Not required in warm-humid locations in Climate Zone 3.	R-____ R-____	R-____ R-____	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	*See the Envelope Assemblies table for values.*
303.2 [FO5][1]	Conditioned basement wall insulation installed per manufacturer's instructions.			☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	
402.2.9 [FO6][1]	Conditioned basement wall insulation depth of burial or distance from top of wall.	____ ft	____ ft	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	*See the Envelope Assemblies table for values.*
303.2.1 [FO11][2]	A protective covering is installed to protect exposed exterior insulation and extends a minimum of 6 in. below grade.			☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	
403.9 [FO12][2]	Snow- and ice-melting system controls installed.			☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	

Additional Comments/Assumptions:

Panel Certificate

2021 IECC Energy Efficiency Certificate

Insulation Rating	R-Value
Above-Grade Wall	24.00
Below-Grade Wall	15.00
Floor	35.00
Ceiling / Roof	49.00
Ductwork (unconditioned spaces):	_____

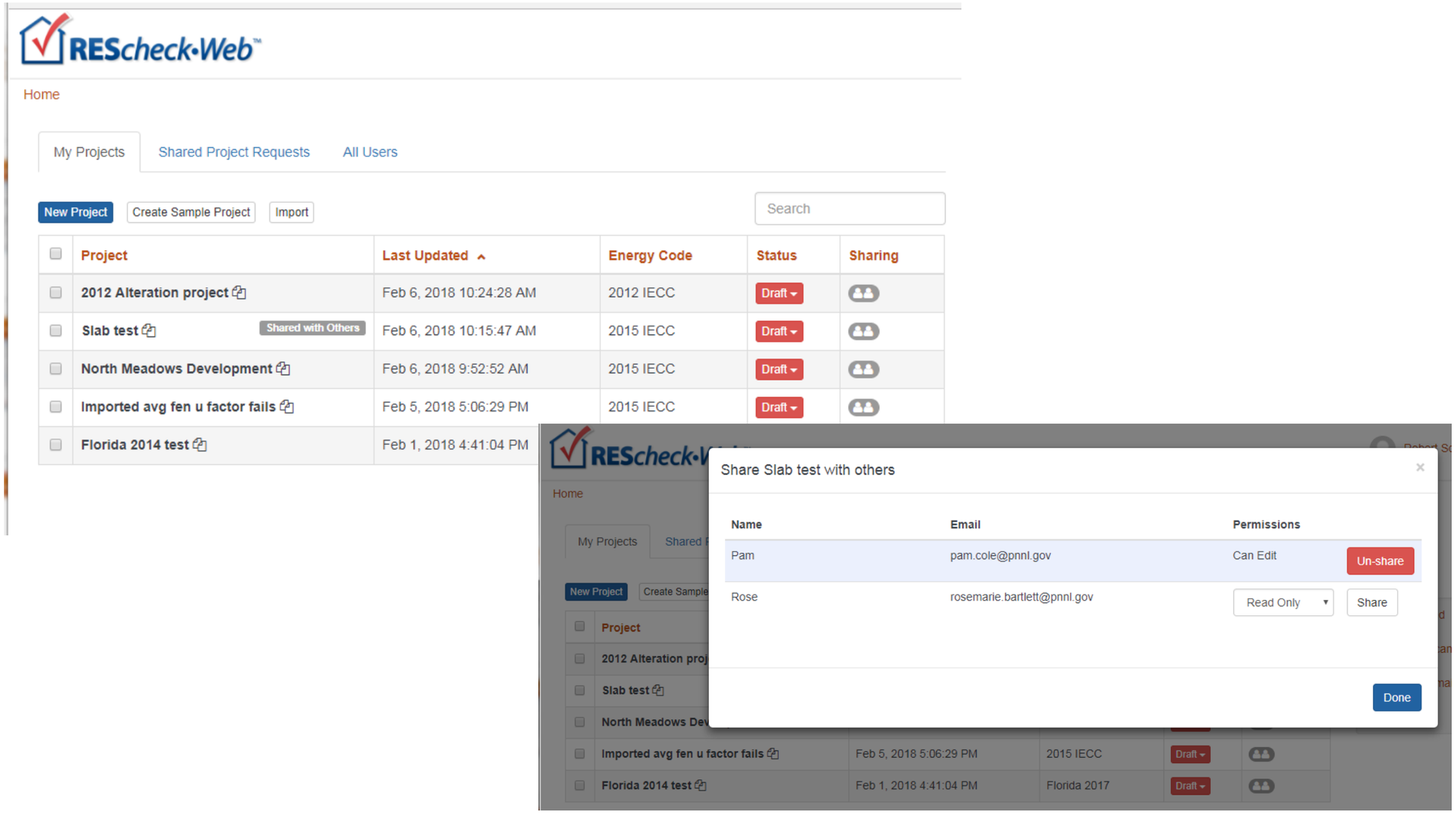
Glass & Door Rating	U-Factor	SHGC
Window	0.25	
Door	0.70	
Skylight	0.50	

Heating & Cooling Equipment	Efficiency
Heating System:_____	_____
Cooling System:_____	_____
Water Heater:_____	_____

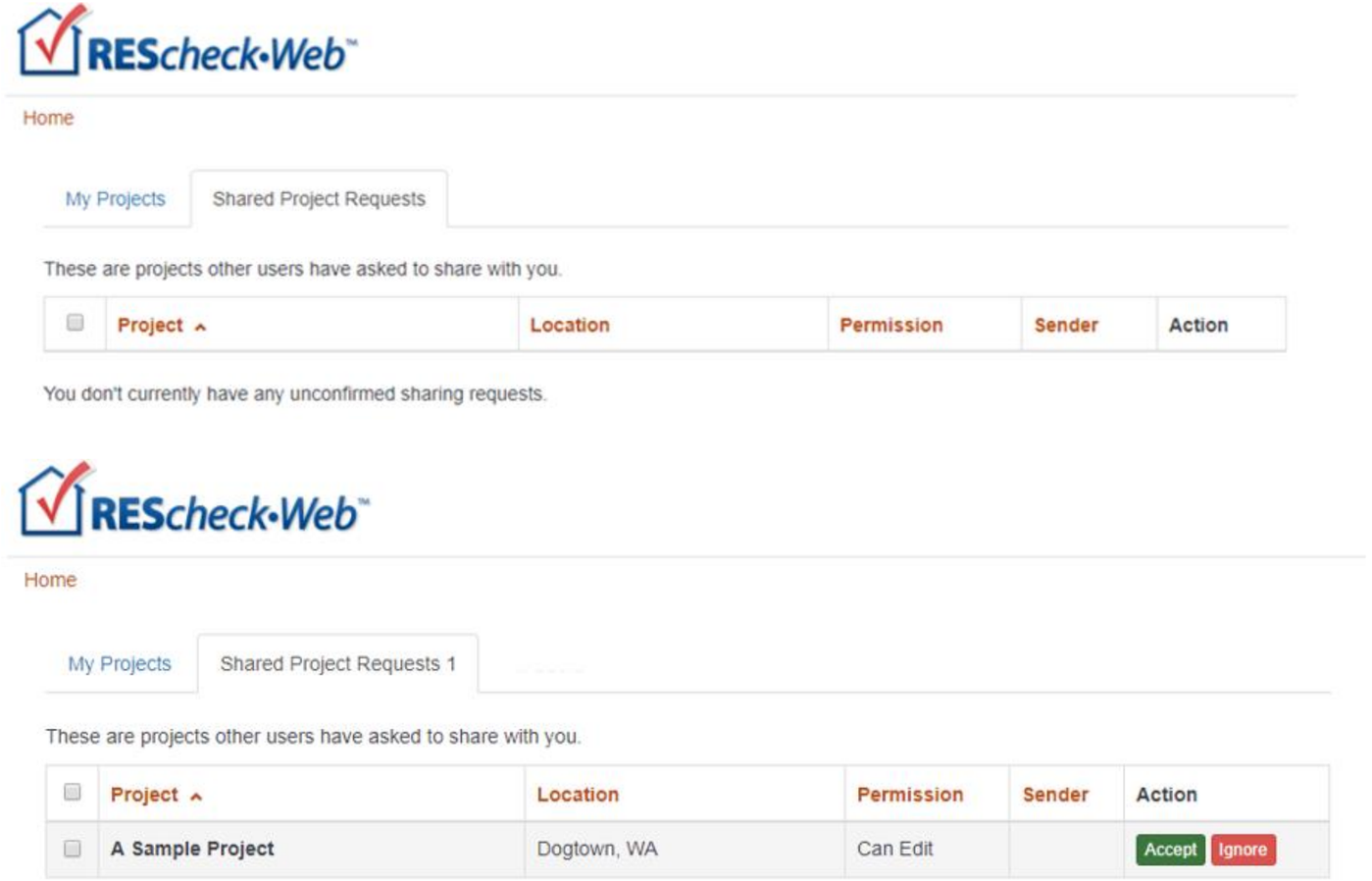
Name: _____ Date: _____

Comments

RES*check-Web* Project Sharing

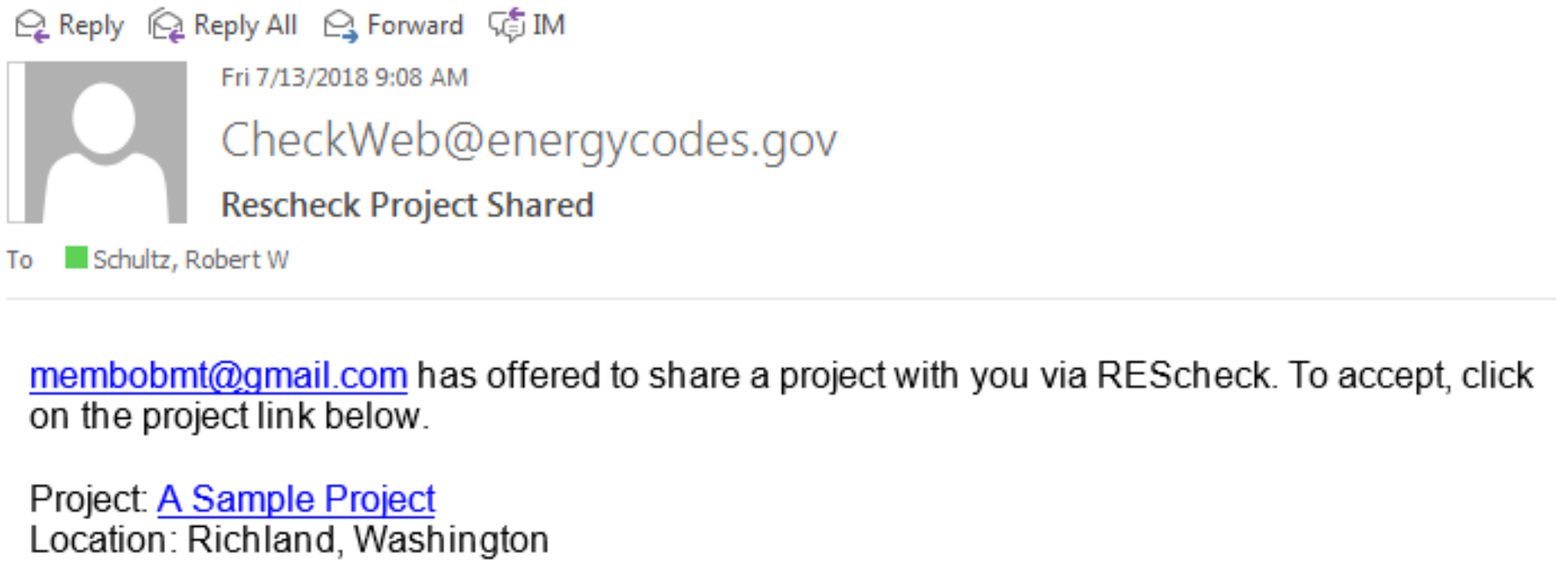


Sharing Projects: Shared Project Invitation

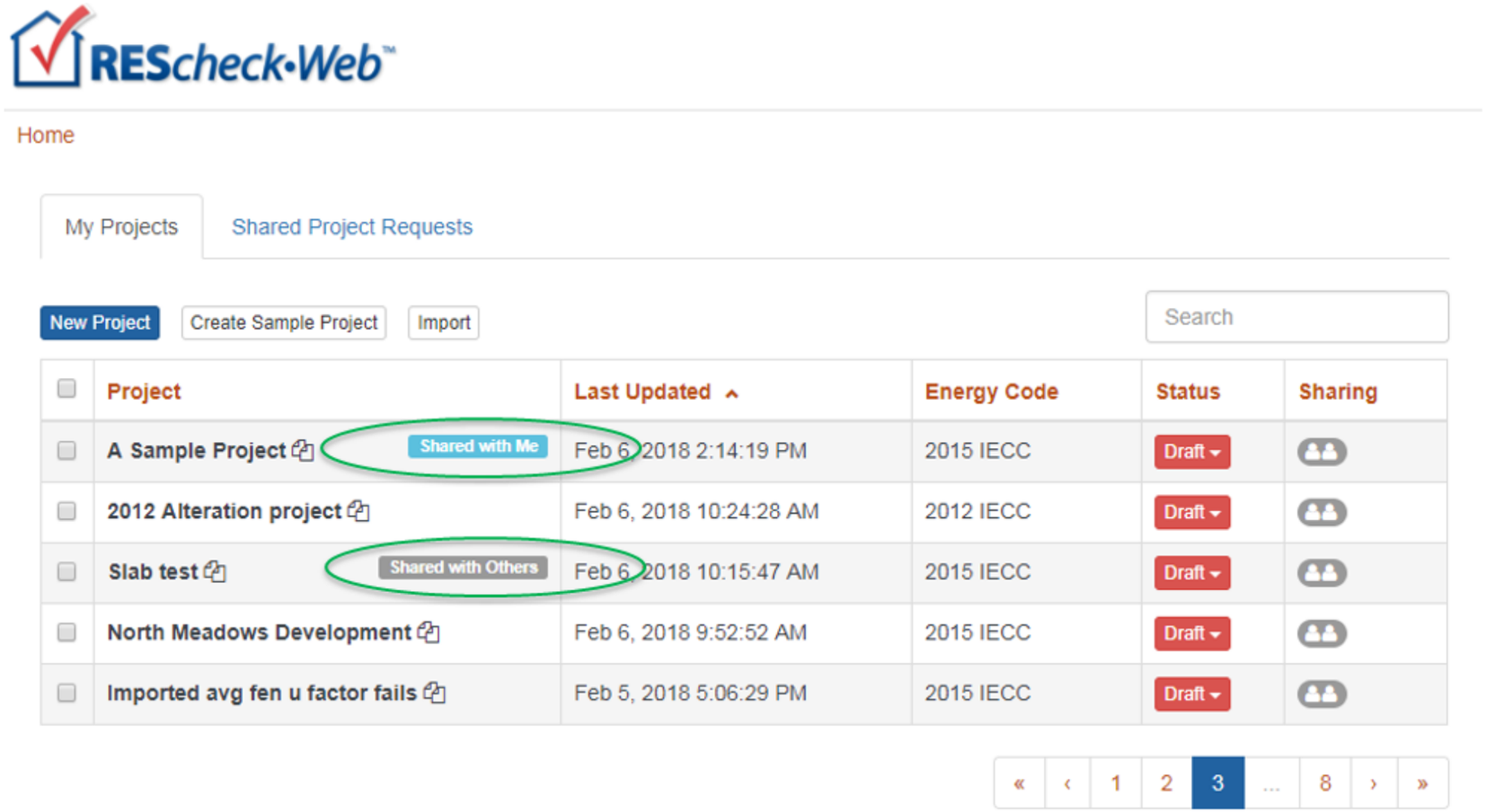


Sharing Projects: Email Invitation

Shared project recipient will receive email with invitation to accept the "share"



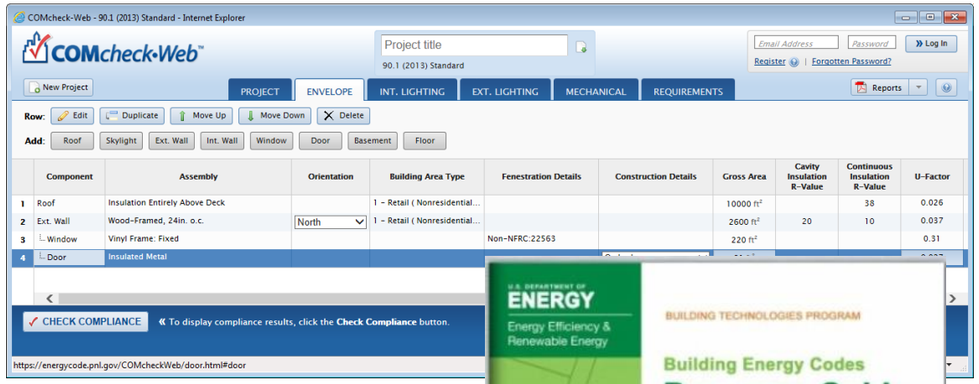
Sharing Projects: Shared Projects

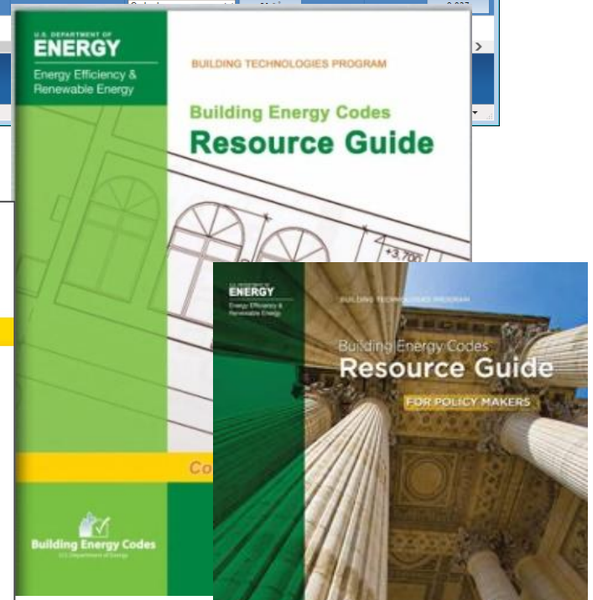


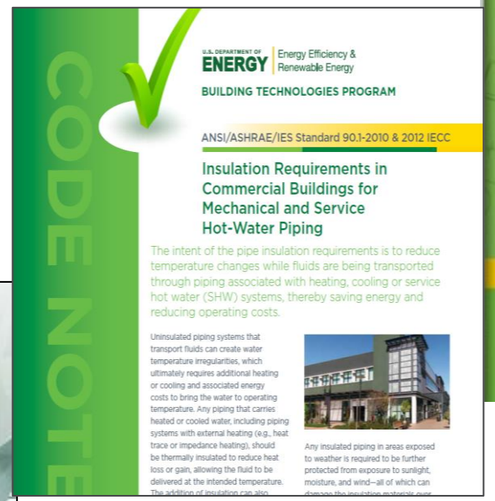
U.S. DOE: BECP Resources

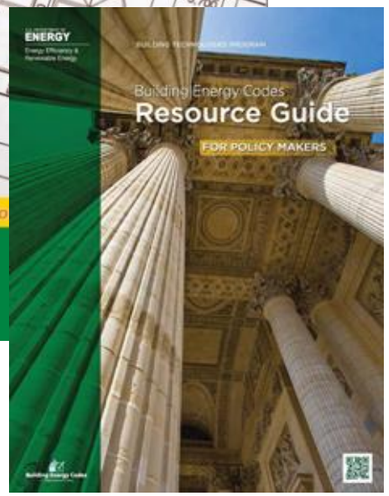
- Compliance software
- Technical support
- Code notes
- Publications
- Resource guides
- Training materials

www.energycodes.gov









ENERGY CODES 2022

2022 NATIONAL ENERGY CODES CONFERENCE
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July 19-21 | Virtual

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Building Energy Codes
U.S. DEPARTMENT OF ENERGY

- If you want AIA LUs or a Certificate of Attendance for self-reporting to ICC or RESNET, WRITE DOWN THIS LINK:

www.energycodes.gov/necc/2022_credit_request

Once you have attended your last conference session, go to the link, request credits or a certificate, mark the sessions you attended, and submit!

NOTE: This link will only be active until Monday, July 25

THANK YOU!!!

V. Robert Salcido
victor.salcido@pnnl.gov

Building Energy Codes Program
www.energycodes.gov

BECP help desk
http://www.energycodes.gov/resource-center/help-desk

Pacific Northwest
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Thank you