From Concept to Pre-Certification

From Concept to Pre-Certification

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NEW ECOLOGY
Community-Based Sustainable Development

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NEW ECOLOGY
Community-Based Sustainable Development

New Ecology, Inc.

A mission driven non-profit focused on making affordable housing healthy and sustainable with offices in Boston, Baltimore and Wilmington.

Buildings modeled in WUFI	→	90+
Feasibility Studies Completed	→	45
Registered PH Projects	→	33
Pre-Certified Projects	→	20
Certified Projects	→	2

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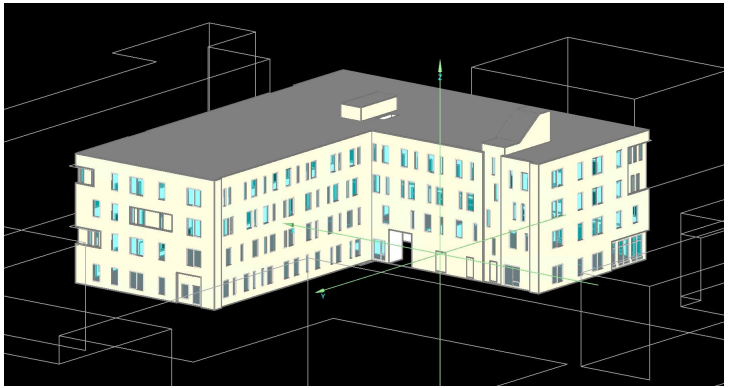
AGENDA

- Affordable Housing – Why it's important?
- Typical Approach
- Project Manager Perspective
- Energy Modeler Perspective
- Lessons Learned.



PHIUS

August 5, 2020

Mr. Konieczny,

I'm pleased to inform you that project #1660: Old Colony Phase Three C is now a pre-certified *PHIUS+ 2015* project. Congratulations to you and your team.

In the next few days, please review the Project Details listed in the database and update them as necessary, as the project is now publicly visible. (We have set the iCFA, AHD, PE, and Heat Load to match the energy model.) Also, if you have any new photos for marketing or publicity purposes, please upload these to the Photos tab.

Thank you for choosing PHIUS+ 2015, and best wishes to your team on achieving final certification. Please contact us when commissioning is complete and you are ready for final certification review, or earlier if you have any other issues to discuss.

Regards,

James Ortega
Lisa White
Graham S. Wright
Isaac Elnicave
Andres Pinzon

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Affordable Housing: Why it's Important (To Passive Projects)

Starts and Stops = many projects in the pipeline

- Funding: Multiple sources with multiple requirements
- Low Income Housing Tax Credits (LIHTC) – Provides incentives for entities to invest in affordable housing projects to offset taxable income with generated tax credits over a 10 year period
- Application and timing
  - Qualified Allocation Plan (QAP) rewards PH certification
  - Applications accepted 2x per year
  - Requires significant design progress before funding is awarded
  - Start and stop based on awards and projects in pipeline
  - When awarded, then rush to closing
- Immediate start of construction

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Typical Approach vs NEI Approach

NEI

In-house resources for all stages and separated by role. All participate in the design stage.

Typical

CPHC is the project manager and energy modeler. A Phius Verifier is brought on at start of construction

Role	Benefit
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Typical Project – Define Objectives

Cut through the noise

Start Early – during scope development (per-SD)

Set sustainability objectives early (Design Charrette)

- Passive House? LEED? EGC? NGBS? Other?
- Local Requirements?
- Focus on IAQ?
- Resiliency?
- Metering?
- Central systems?
- All electric?
- Renewables?

INTERNATIONAL WELL BUILDING INSTITUTE™

Resilienc

WaterSense Meets EPA Criteria

U.S. GREEN BUILDING COUNCIL USGBC

phius

ICC INTERNATIONAL CODE COUNCIL

Enterprise

boston planning development ag

NGBS GREEN™ Home Innovation Research Labs

ZERO ENERGY READY HOME U.S. DEPARTMENT OF ENERGY

INTERNATIONAL LIVING FUTURE INSTITUTE℠

ENERGY STAR

EPA Indoor airPLUS QUALIFIED HOME

Environment Department

BERDO REPORTING FORM

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CUT THROUGH THE NOISE

FOCUS THE TEAM

Resiliency

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Typical Project – Define Performance

Set expectations high w/o fear!

Highlight critical PH requirements and define a 'starting point'

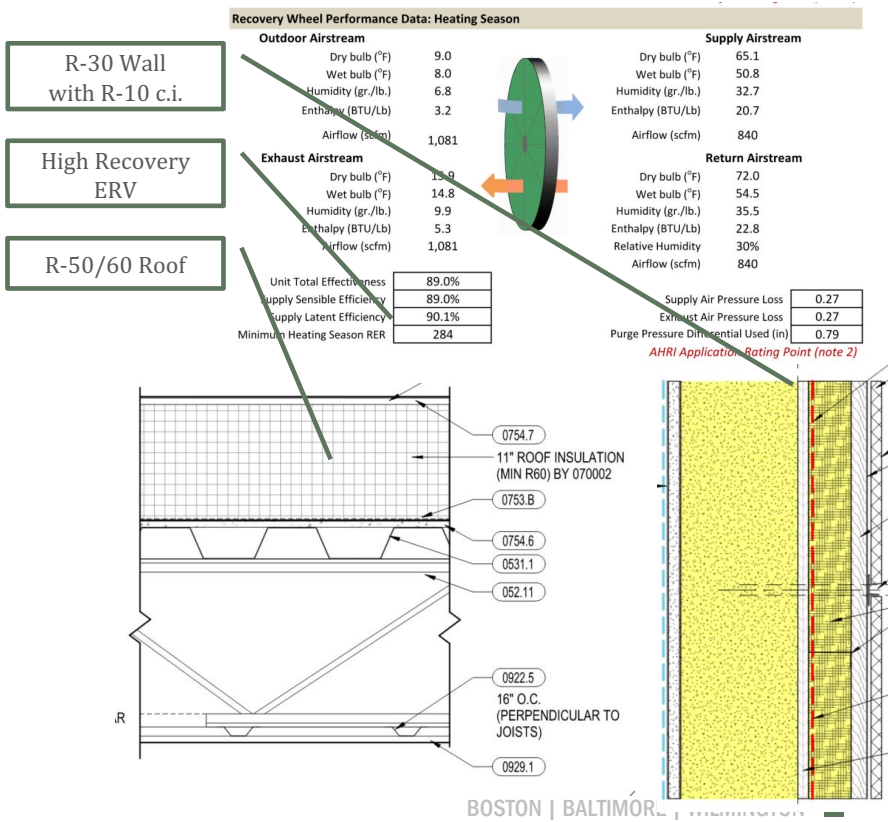
- Envelope Performance (CZ = 4/5)
  - **INFILTRATION – 0.06 CFM50/ft²**
  - R-50 - 60 Roof; R-30 wall with c.i.
  - R-10 – 15 slab/foundation; U-0.15 windows
- Ventilation Performance
  - ~80% recovery efficiency; 1 W/cfm electrical
- Heating/Cooling
  - Heating COP>3.7 @ 47F; Cooling COP>5 @ 95F DB

PM SETS EXPECTATIONS HIGH
MODELER SETS ASSUMPTIONS LOW

R-30 Wall with R-10 c.i.

High Recovery ERV

R-50/60 Roof



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Typical Project – Complete Feasibility

Make informed decisions with limited information

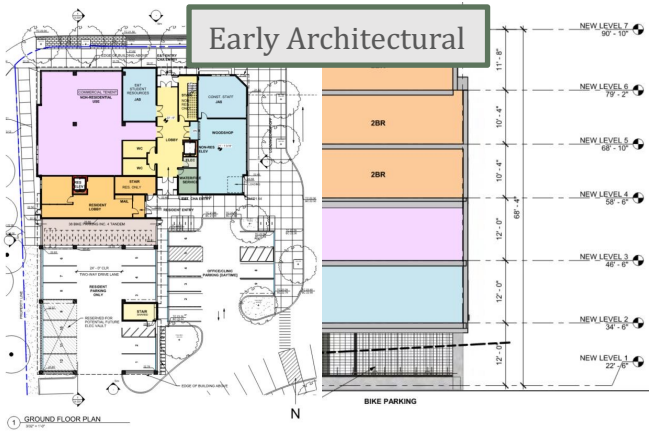
Request Minimum Information:

- HVAC, Plumbing, and electrical narratives
- Architectural concepts
- Floor plans and representative sections
- Make assumptions (more on this later from Nick)

Define Reference Building

- Based on previously completed building by same developer
- Based on minimum code

Early Architectural



Early Mechanical

Conceptual Mechanical System Options

Job Name: Rindge Commons, Cambridge, MA
Job #: 1937
Date: 10/22/2019 Rev.1

The following is an outline of preliminary HVAC system options for Rindge Commons based on the following owner and team feedback from the charrette on 9/20/19:

1. The project will likely pursue PHIUS+2018 or PHIUS+ Core certification as an alternate path to satisfy Cambridge's Article 22 requirement of "LEED Certifiability".
2. On site renewables (Photovoltaic) will be required at a significant scale to meet PHIUS+2018. PHIUS+Core is likely a more suitable program as it is intended for multi-family projects (PHIUS recognizes that the PHIUS+2018 source energy targets are virtually impossible to meet with high density occupancies and created PHIUS+Core to make certification attainable).
3. Individual tenant metering for heating and cooling would be preferred but is not required.
4. Individual air source heat pumps with individual outdoor units on the roof for each apartment would be the recommended system for 100% tenant metering of heating and cooling but this concept was ruled out to allow ample roof space for PV.
5. All electric HVAC and Domestic Hot water System approaches are not required but will be considered.

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Typical Project – Report Feasibility Results

Look for a go/no go decision

Generate reference and proposed models and summarize findings

- Report must be concise and clear
- Propose options to meet PH threshold
  - Select ECMs based on cost
  - Select ECMs based on impact
    - Windows vs ground
- Schedule min 1-hour meeting to review findings
- Re-run model as needed

EXPERIENCED MODELER IS CRITICAL FOR THIS PHASE TO BE IMPACTFUL

Reference building

Proposed building

Missed threshold

Proposed ECM

NEW ECOLOGY Community-Based Sustainable Development	Project Name:		Rindge Commons Building B (Residential)	
	Climate		Boston Logan International Airport	
	Case		Reference Building (VRF Option)	PHIUS+ Core
Change from the Reference Building / Meets PHIUS Target / Misses PHIUS Target	Notes		Baseline envelope provided in drawings, VRF Heating & Cooling, Central Gas-Fired DHW	Upgraded envelope from reference building with added Solar PV to meet PHIUS+ Core requirements. VRF Heating & Cooling, Central Gas-Fired DHW
WUFI PASSIVE RESULTS	**Units**	**Target**		
Heating Demand	kBtu/ft2.yr	4.00	7.07	1.99
Cooling Demand	kBtu/ft2.yr	7.20	2.43	3.17
Heating Load	Btu/hr.ft2	3.80	6.82	2.46
Cooling Load	Btu/hr.ft2	2.50	2.67	2.41
SITE ENERGY RESULTS	**Units**	**Target**		
Source Energy	kWh/person.yr	5,500	5,378	4,905
Site Energy Use Index	kBtu/ft2.yr	-	21	20
Site Energy Consumption	kWh/yr	-	545,505	507,698
Geometry	**Units**			
Interior Conditioned Floor Area (iCFA)	ft2		87,754	87,754
Net Volume	ft3		799,891	799,891
Envelope Area	ft2		74,848	74,848
Average Window-to-Wall Ratio	%		19%	19%
Exterior Envelope	**Units**			
Roof	R		50	50
Exterior Wall (1F)	R (effective)		21	21
Exterior Wall (2-6F)	R (effective)		28	28
Slab	R		15.0	15.0
Window	U		0.27	0.18
	SHGC		0.3	0.3
Glazed Door	U		0.33	0.33
	SHGC		0.4	0.4
Opaque Door	R		4	4
Airtightness	**Units**			
Air changes per hour at 50 Pa	ACH50		3.00	0.34
Lighting Assumptions	**Units**			
Lighting	kWh/yr		85,426	85,426
Plug Loads	**Units**			
Miscellaneous Electric Loads	kWh/yr		84,695	84,695
Occupancy	**Units**			
Bedrooms	#		160	160
Average Occupancy	# Bedrooms + 1		237	237
Appliances	**Units**			
Refrigerator	kWh/year/unit		423	423
Dishwasher	kWh/year/unit		260	260
Clothes Washer	kWh/year/unit		116	116
Clothes Dryer	Energy Factor		3.4	3.4
Electric Cooktop	kWh/use		0.2	0.2
Ventilation	**Units**			
Dryer Exhaust	cfm		125	125
ERV Ventilation	cfm		5,500	5,500
ERV Power	W/cfm		1.0	0.8
ERV Recovery Efficiency	%		80%	80%
Mechanical Systems	**Units**			

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Typical Project – Design Progress

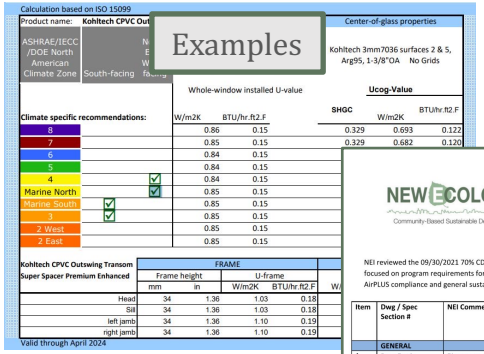
Minimize changes later

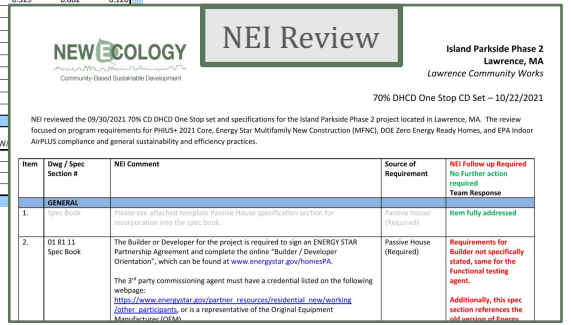
Early Design

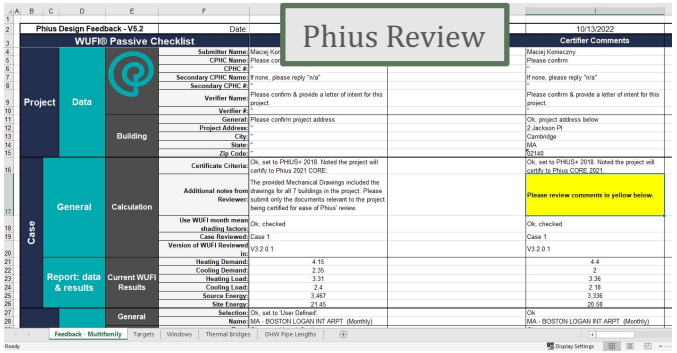
- Participate in regular meetings
- Provide examples and input
- Recommend materials/windows
- Register project with Phius

Mid Design

- Request a ~50% DD set; review and comment
- Submit project into queue and request changes from team
- Upload documentation for 1st round Phius review (earlier if complex)
- Review Phius comments – do **NOT** send feedback form to client







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From Concept to Pre-Certification

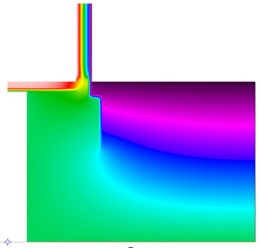
Typical Project – Design Progress

Minor changes with quick turnaround

Construction Documents

- Use ~50% CD set for Round 2 review
- Time to focus on the minutia
- Use submittals from previous projects
- Model or mitigate TBs or CRs identified by Phius (hopefully only few)
- Submit for Pre-certification

REPEAT AS NEEDED → DESIGN PRE-CERTIFICATION → CONSTRUCTION



THERM Model

2D model

	U (btu/hr.sf.F)	dT (F)	L (in)	ULdT (btu/hr.ft)	error (%)
Interior	0.0559	54.00	89.38	22.48	7.33%
Exterior	0.0103	54.00	486.625	22.56	7.33%

Component

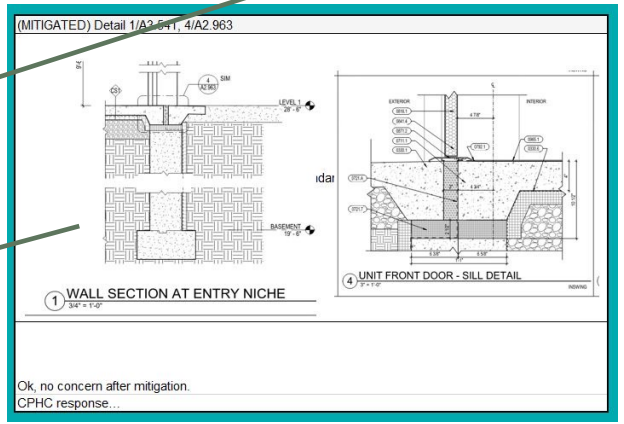
		U (btu/hr.sf.F)	dT (F)	L (in)	ULdT (btu/hr.ft)	error (%)
Component A	Interior	0.0303	54.00	54.0	7.36	0.00%
Wall	Exterior	0.030	54.00	54.00	7.36	0.00%
Component B	Interior	0.0889	27.00	50.6	10.13	0.00%
Slab	Exterior	0.0889	27.00	50.63	10.13	0.00%

Psi

	PsidT (btu/hr.ft)	dT (F)	Psi (btu/hr.ft.F)	Psi for WUFI (btu/hr.ft.F)
Interior	4.99	54.00	0.09	0.093
Exterior	5.07	54.00	0.09	

Calculated TB

Mitigated TB



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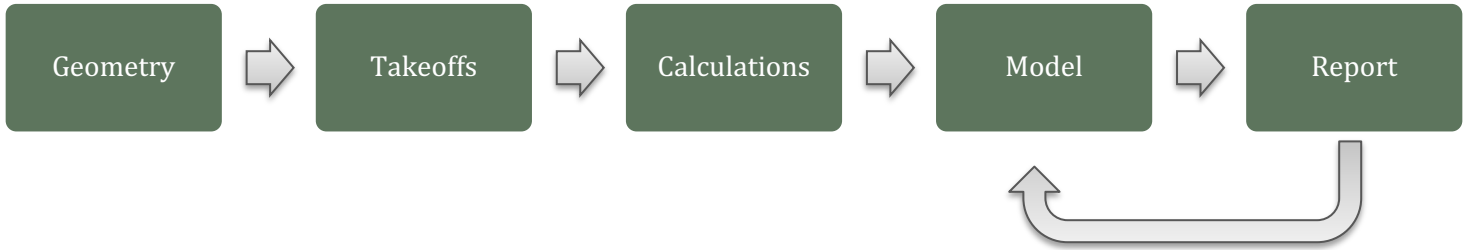
From Concept to Pre-Certification

Feasibility Study Workflow



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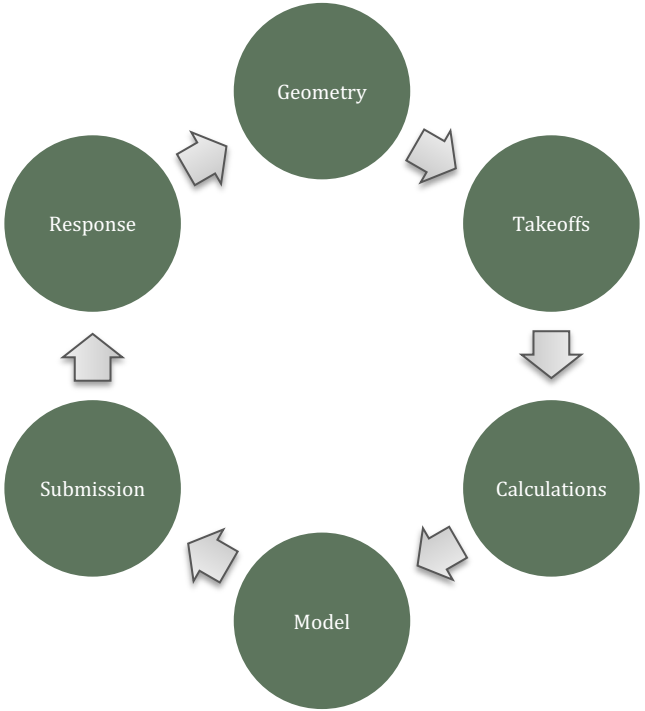
Pre-Certification Workflow



From Concept to Pre-Certification

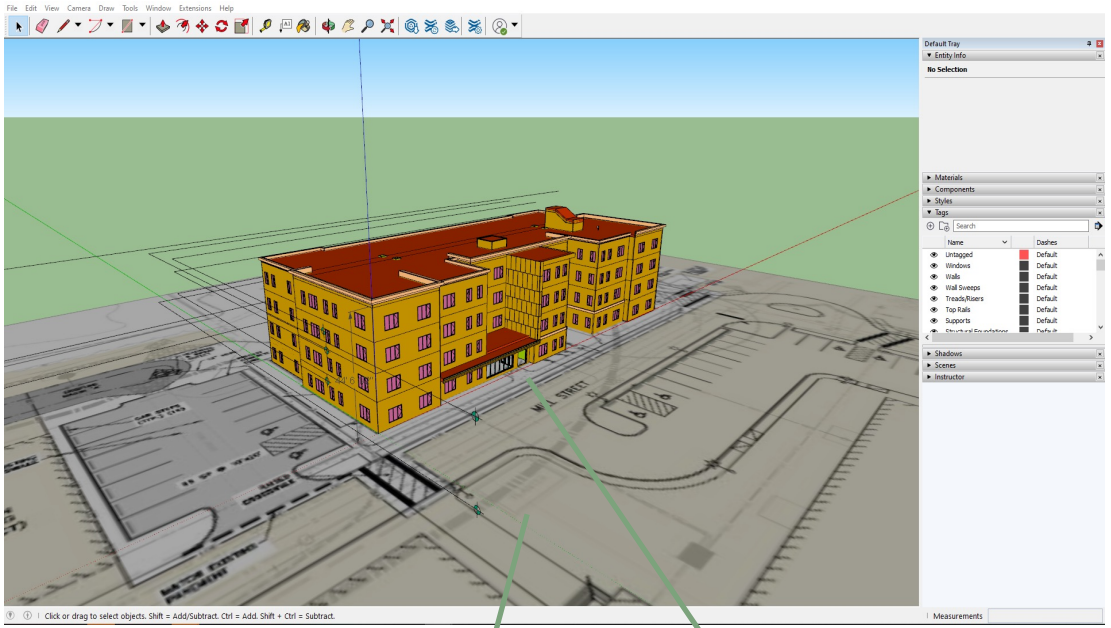
Building the Geometry

Use Sketchup

- Software to be used in conjunction with WUFI
- Simple and user-friendly
- Many useful extensions
  - Extension Warehouse
- Can import multiple file types
  - .dwg, .dxf, .rvt, .jpeg, .png
- Streamlined process of creating geometry

How do we create the geometry quickly and efficiently?

- Become familiar with all SketchUp tools
- Utilize extensions
- Shell first, then glazing, then shading
- Quality check at each stage



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Building the Geometry – Feasibility

Don’t over simplify

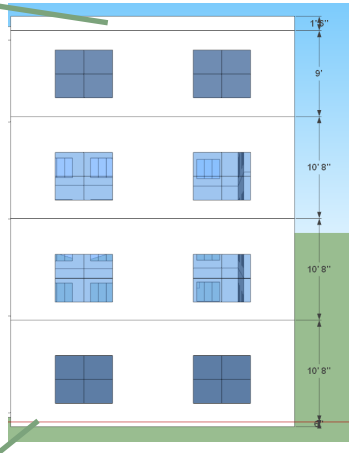
- Use shortcuts to draw, not to design
- Draw the items that show up in later drawings
  - Elevator pit, bulkheads, site shading (use google earth)

Make realistic assumptions

- 10’ floor to floor
- 6” from first floor to bottom of slab insulation
- 1.5’ from top floor ceiling to the top of roof insulation
- 15-20% WWR, possibly 25-30% if large market rate

Top of roof insulation assumed 1.5’ from ceiling

Progress drawing



Feasibility model

Bottom of slab insulation assumed 6” from floor

From Concept to Pre-Certification

Building the Geometry – Pre-Certification

Start from scratch for the first submission

- Typically many changes from early stage
- More details required
- Reuse and update geometry thereafter

Make use of the REVIT model

- Can import directly into Sketchup and trace
- Reference floor plans and elevations while tracing
- Draw doors/glazing according to schedule

Feasibility model

Revit model at pre-certification

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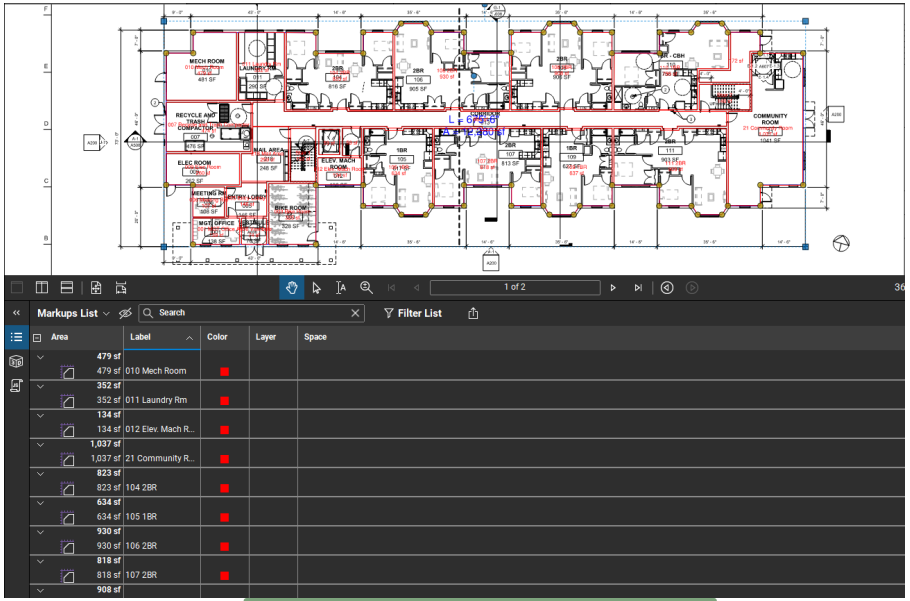
Performing Takeoffs

Many different tools can work

- Aim for familiarity, accuracy, and clarity

Save as individual files

- Measurements are there as soon as the file is opened
- Avoids cluttering the list of markups with irrelevant measurements



Can use markups to clearly label each measurement in Bluebeam

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Performing Takeoffs – Feasibility

iCFA/net volume takeoff

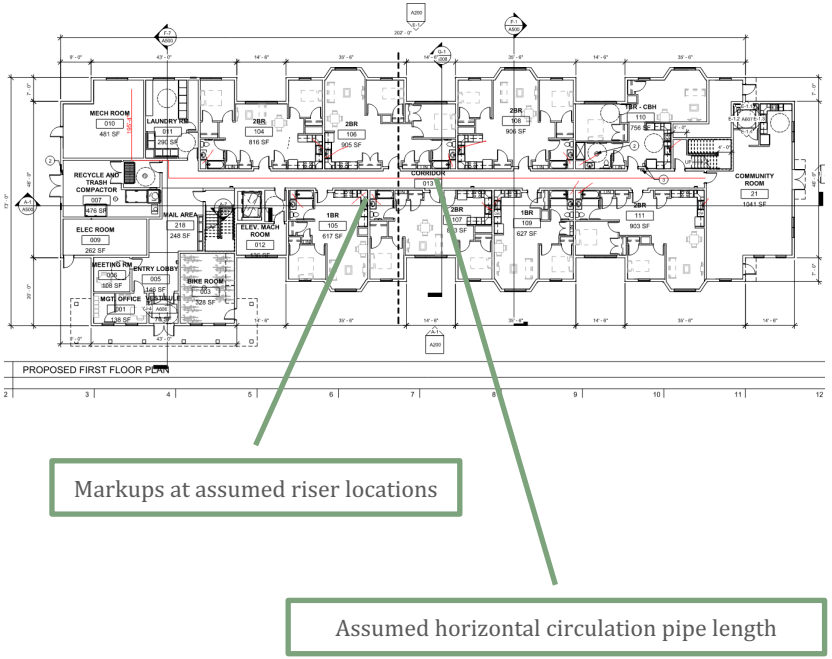
- Strongly recommended to at least have measurable floor plans
- WUFI can estimate the floor area and net volume, but tends to overestimate

DHW pipe takeoff

- Measure length of corridor for horizontal length of circulation pipe
- Assume 2 risers per unit and 10 ft. per riser per floor
- Average diameter 1 in. and K value of 0.023 Btu/hr.ft.F
- 35 ft. per unit for individual pipe
- Average diameter 0.625 in.

Duct takeoff

- Rooftop ERV: 10 ft. per duct, 18x18 in., 3 in. insulation @ R-4/in
- In-unit ERV: 20 ft. per duct, 8 in. diameter, 3 in. insulation @ R-4/in.



From Concept to Pre-Certification

Performing Takeoffs – Pre-Certification

Start all takeoffs from scratch

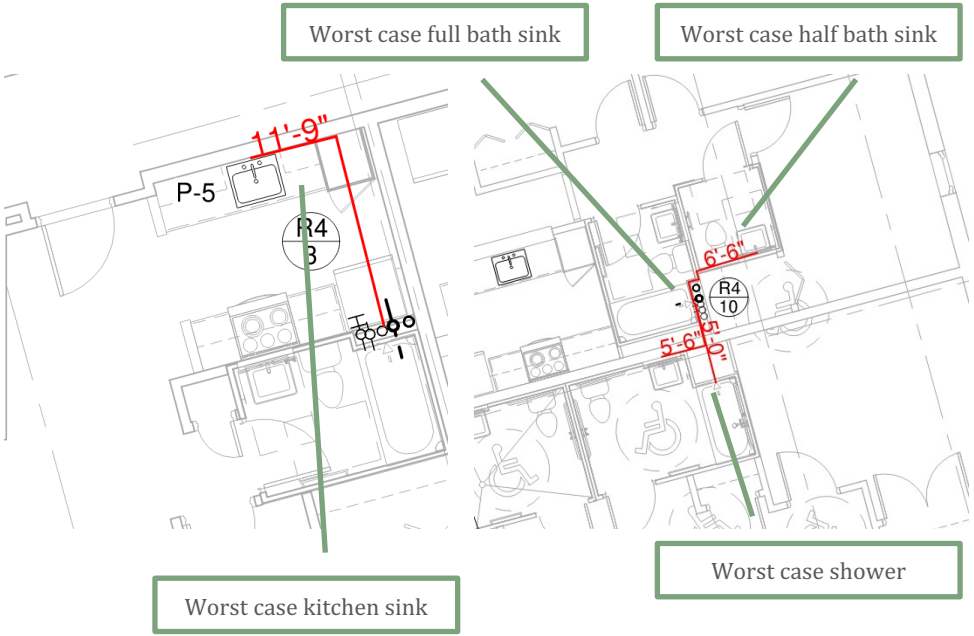
- If the drawings were available at early stage, likely major changes

Can be conservative to cut down on time

- Pick out worst case unit/fixture for the individual pipe takeoff
- If in-unit ERV, can pick out worst case duct length
- Not recommended if extreme outlier
  - Use average

Keep clear and concise

- Makes it easier on you during the calculations
- Makes it easier on Phius to verify



From Concept to Pre-Certification

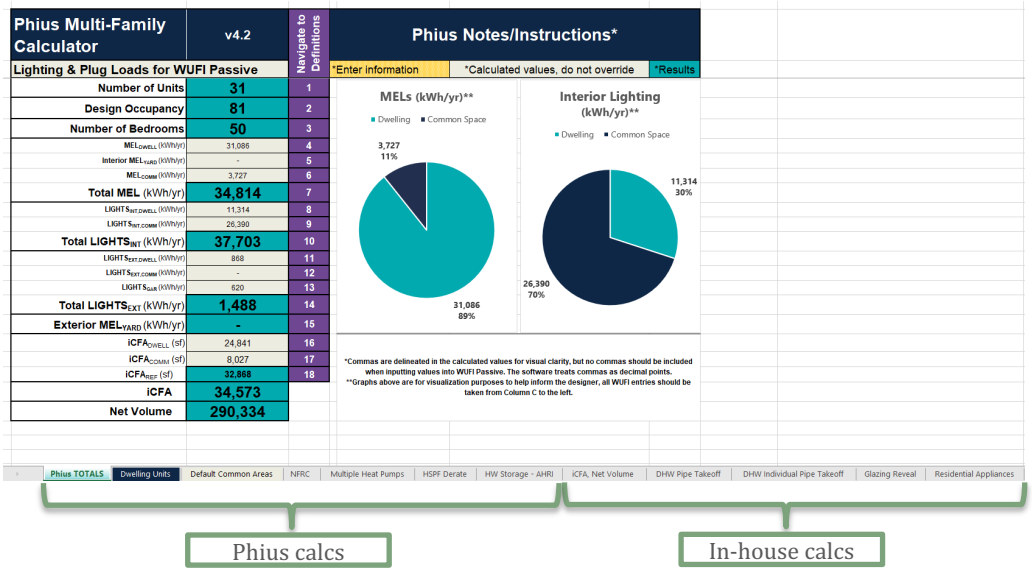
Running the Calculations

Have a template file

- Easily adjust inputs from project to project

Keep Phius and in-house spreadsheets in one file

- Many inputs are cross-referenced
- Streamlines data entry into WUFI
- Autofill report



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Running the Calculations – Feasibility

Lighting, plug loads, and ventilation

- Use Phius worksheet to calculate
- Can enter each unique unit type or every unit
- Enter every common area space
- Assume conservative ventilation rates for dwelling units
  - 35 cfm per kitchen and 25 cfm per bathroom or 18 cfm per person
- Assume 62.1 or similar ventilation rates for common area
  - Balance to highest between supply and exhaust

iCFA and Net Volume

- No Phius spreadsheet but can easily be put together
- Cross reference space areas in the dwelling unit and common area tabs to calculate net volume
  - Multiply areas by the floor to ceiling height. Can assume 8’

Supply ventilation assumptions

Space Type	People/1000 ft^2	Cfm/person	Cfm/ft^2
Common Laundry	10	5	0.12
Common Mail	7	7.5	0.12
Common Office	5	5	0.06
Multipurpose	50	5	0.06
Indoor Corridor	-	-	0.06
Workout Room	10	20	0.06

Exhaust ventilation assumptions

Space Type	Cfm/unit	Cfm/ft^2
Central Restroom	50	-
Storage/Equip (Trash, Janitor)	-	1.0

From Concept to Pre-Certification

Running the Calculations – Pre-Certification

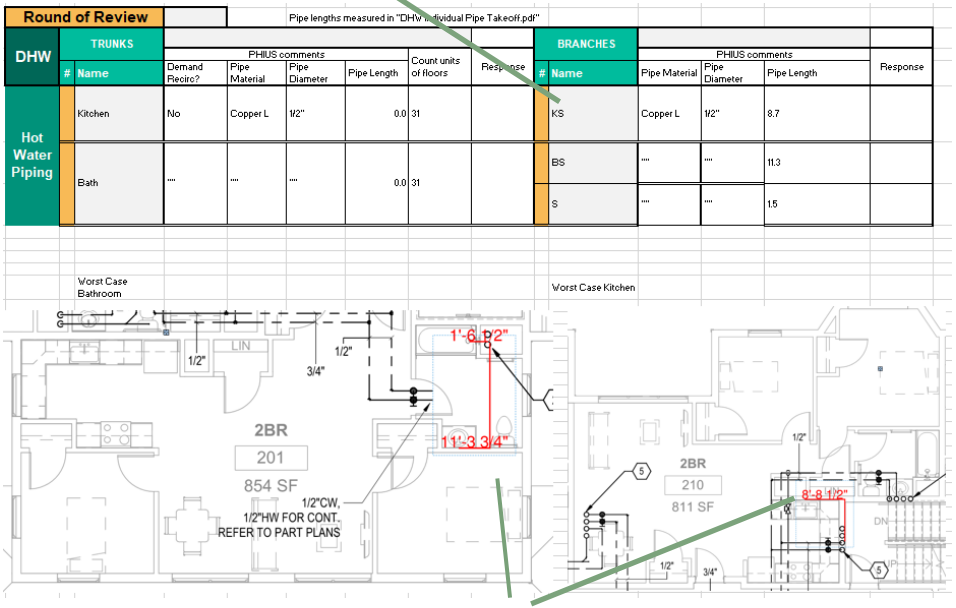
Recycle calculation file used at feasibility

- Can easily make updates to outdated sheets
- Keep future calculations in the Phius feedback file

Stay Organized

- Note down the takeoff file names used to complete calculations
- Save submittals and certifications as you use them
  - Note down these as well

Takeoff file name called out



Screenshots included for quick reference

From Concept to Pre-Certification

WUFI Modeling

Have a completed model as a template

- Can import new geometry to replace old
- Ensure default inputs are correct
- Note which inputs need to be changed

Don't overcomplicate the model

- One component per each unique envelope type
- Input ventilation per device not room
- Only typically need one system
- Keep devices to a minimum

Appliances can be left as defaults

Occupant quantity [-]	128
Number of bedrooms [-]	88
Humidity sources [lb/(ft²hr)]	0.00041

Device list — Set standard dataset

Device/end use	Reference quantity	Quantity	In conditioned space
Kitchen refrigerator	PH case Units	40	☑
Kitchen dishwasher	PH case occupants		☑
Kitchen cooking	PH case occupants		☑
Laundry - washer	PH case occupants		☑
Laundry - dryer	PH case occupants		☑
User defined - lighting	User defined	1	☑
User defined - lighting	User defined	1	☑
User defined - lighting	User defined	1	☐
User defined - Misc electric loads	User defined	1	☑

New / Delete / Copy / Insert / New/Insert: after

Lighting and plug loads need to be updated for each project

From Concept to Pre-Certification

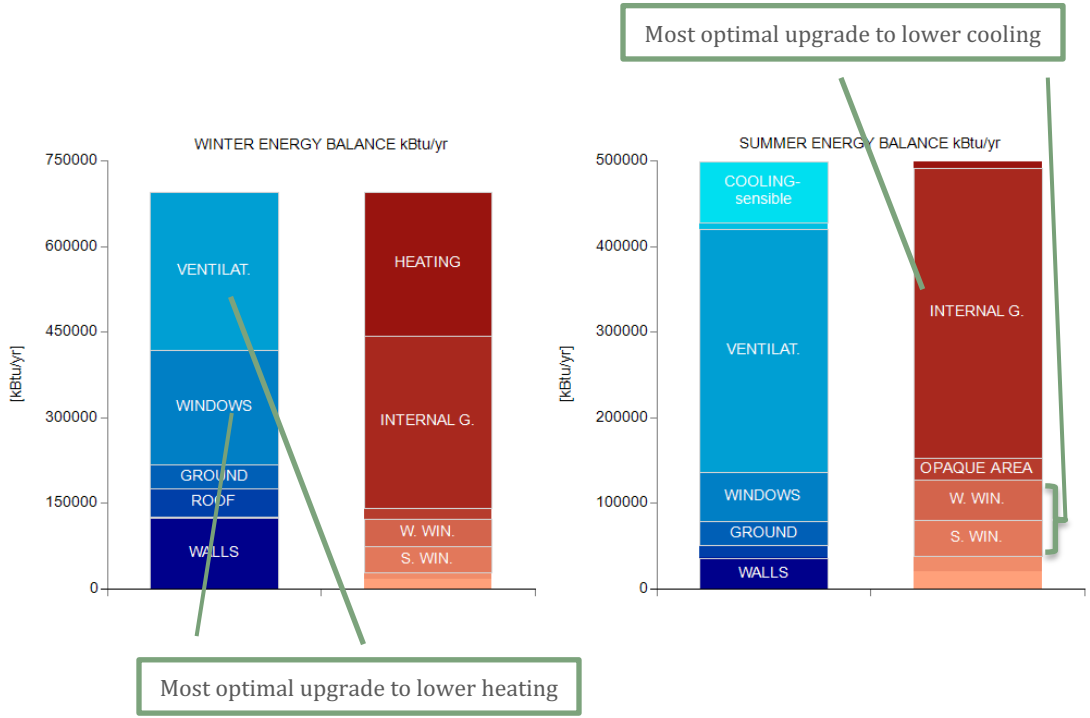
WUFI Modeling – Feasibility

How to take advantage of WUFI in early design?

- Default inputs
- Multiple iterations
- Real time simulation
- Comprehensive report

How to produce reliable results?

- Learn the impacts of each input
- Make the right assumptions
  - Not too optimistic
  - Not too conservative



From Concept to Pre-Certification

WUFI Modeling – Feasibility, continued…

General Assumptions

- Perimeter insulation set to “Not defined”
- Windows: 4” depth of reveal, 4” glazing to reveal
- Storefront/Glass Doors: 2” depth of reveal, 2” glazing to reveal
- Median Energy Star Rated Appliances
- Dryer exhaust 220 cfm
  - Remove if ventless dryer
- ERV: 75% SRE, 40% HRE, 1.2 w/cfm for central, 0.8 w/cfm for in-unit
- Heat Pump COP (Heating): 2.5 @ 17F, 3.5 @ 47F
- Heat Pump COP (Cooling) : 4.0
- Heat Pump Water Heater COP: 2.5
- Gas Heat/DHW: 88% thermal efficiency

Typical envelope performance used at feasibility

Opaque Assemblies	R Value (IP)
Exterior Wall	24 - 30
Roof	40 - 50
Exterior Floor	30
Slab	8 - 10
Door	2

Fenestration	U Value (IP)	SHGC
Fixed Window	0.15 – 0.18	0.30
Operable Window	0.18 – 0.22	0.30
Storefront	0.40	0.40
Glass Door	0.55	0.40

From Concept to Pre-Certification

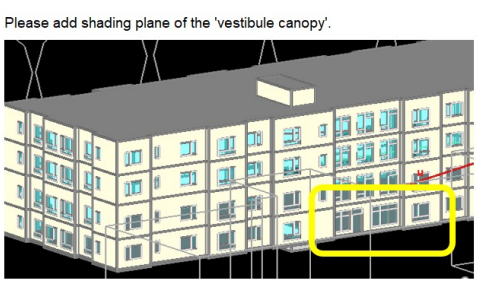
WUFI Modeling – Pre-Certification

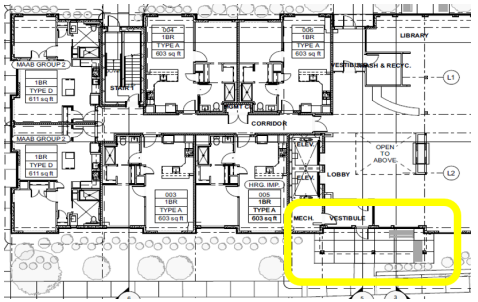
Use each previous model as a template

- Narrow down on assumptions
- Make updates to the model using both Phius' Feedback and the latest drawing set in unison
  - Avoids backtracking
- Try and make small geometry updates in WUFI before going to Sketchup

Have a database of typical product datasheets for quick retrieval

- Heat pump/ERV AHRI certifications, Window/Storefront product data, etc.
- Can pick from this database to use as a placeholder while the actual product is still pending





From Concept to Pre-Certification

Lessons Learned – Energy Modeler

Experienced with Phius protocols

- Expect a steep learning curve

How to make the ‘right’ assumptions

- Too conservative is as dangerous as too optimistic

Previous project experience is critical

- Uses previous projects’ BOD for envelope and MEP systems
- Responses to Phius comments

Create template files

From Concept to Pre-Certification

Lessons Learned – Project

Define objectives and building performance **early**

Feasibility study is **critical** to client buy-in and project success

Review complex projects with Phius **early** if

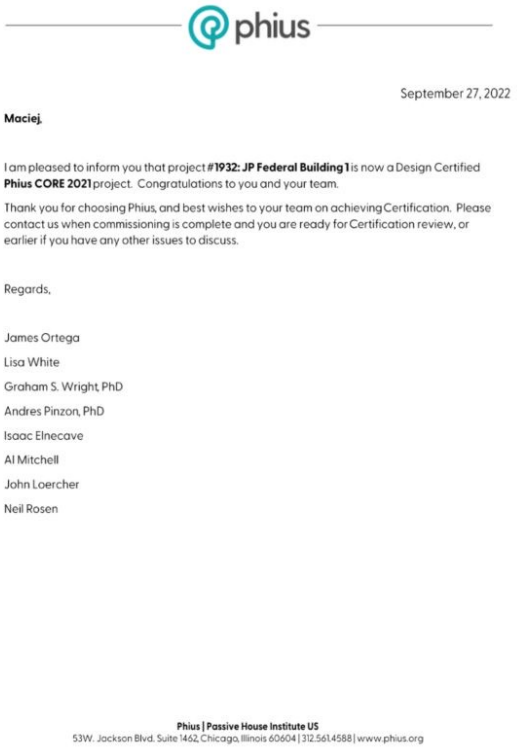
- Multiple use groups in a single building
- Complex Phasing

Plan Phius review schedule **early**

Pre-certification letter is acceptable for code compliance but difficult to time correctly

Using PH at building permit eliminates additional compliance pathways:

- RESNET, ASHRAE 90.1, REScheck, COMcheck, Prescriptive



phius

September 27, 2022

Maciej,

I am pleased to inform you that project **#1932: JP Federal Building 1** is now a Design Certified **Phius CORE 2021** project. Congratulations to you and your team.

Thank you for choosing Phius, and best wishes to your team on achieving Certification. Please contact us when commissioning is complete and you are ready for Certification review, or earlier if you have any other issues to discuss.

Regards,

James Ortega
Lisa White
Graham S. Wright, PhD
Andres Pinzon, PhD
Isaac Elnecave
Al Mitchell
John Loercher
Neil Rosen

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From Concept to Pre-Certification

Lessons Learned – Project Manager

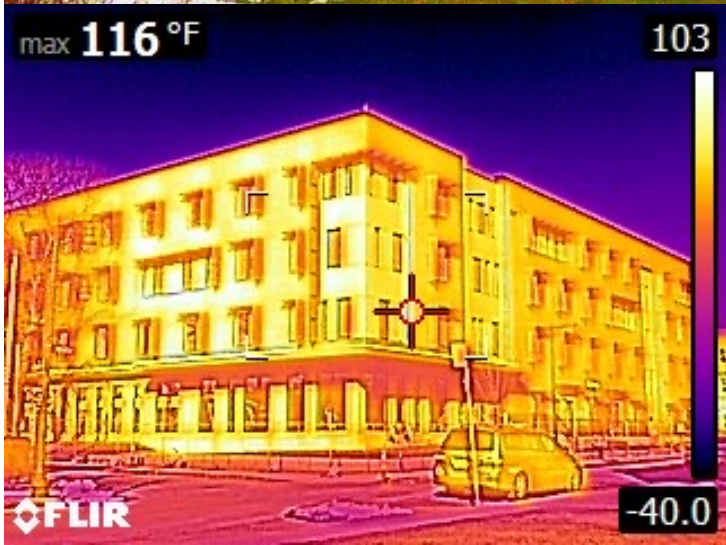
Experience with building systems (CPHC)

Experience with Phius protocols and modeling

Makes design decisions without model

Coordinates flow of information – reduces design ‘noise’

- Only critical decisions need input from modeler
- Client does not need to know how to make the sausage
- Architect/MEP (first PH) need significant input and education early in the process
- Supports architect and MEP engineers throughout



NEW ECOLOGY
Community-Based Sustainable Development

From Concept to Pre-Certification

QUESTIONS?

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NEW ECOLOGY
Community-Based Sustainable Development

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NEW ECOLOGY
Community-Based Sustainable Development

THANK YOU!