Exploring Energy Modeling Workflows within Dynamo and Grasshopper

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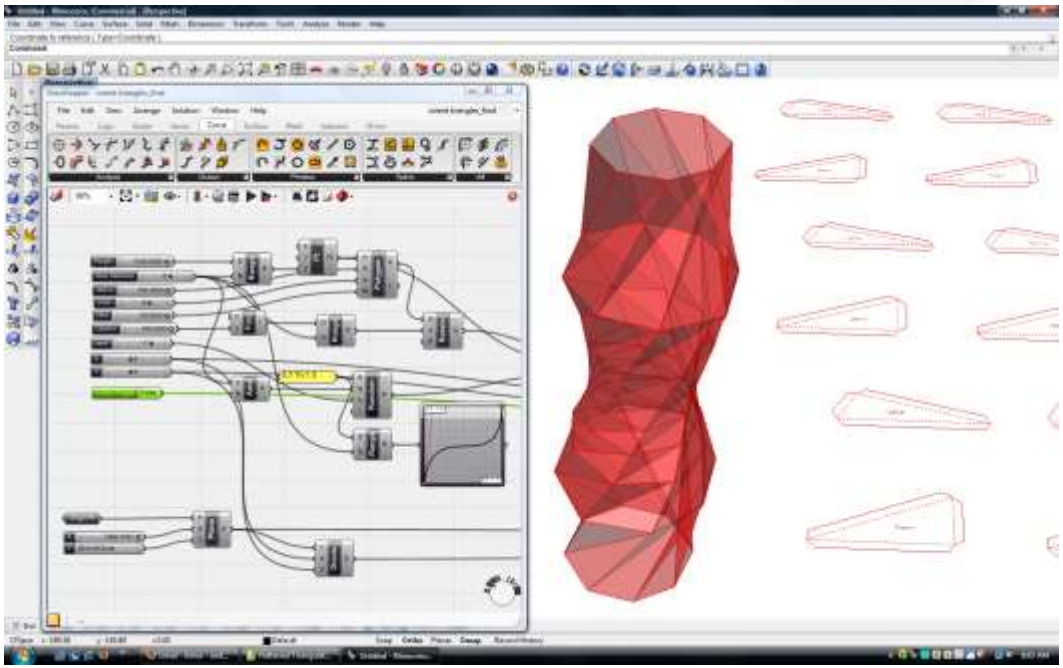
Associate Principal
06/21/2017

What Are We Talking About Today

Visual programming languages

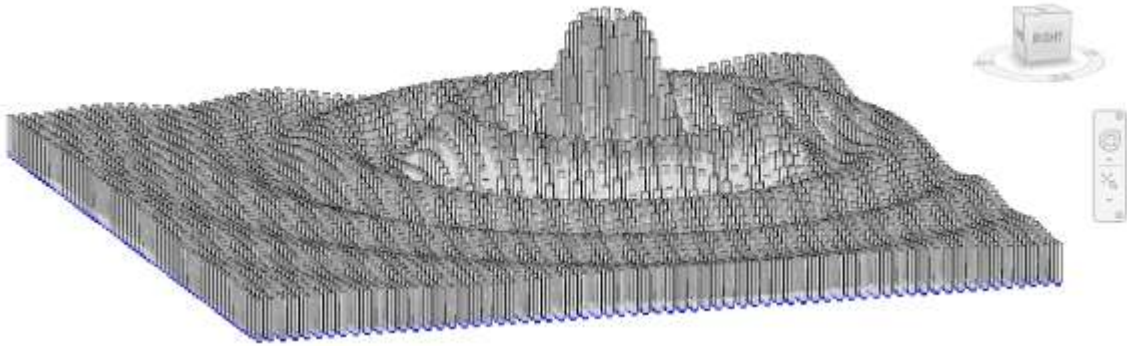
Generative algorithms

Open source programs

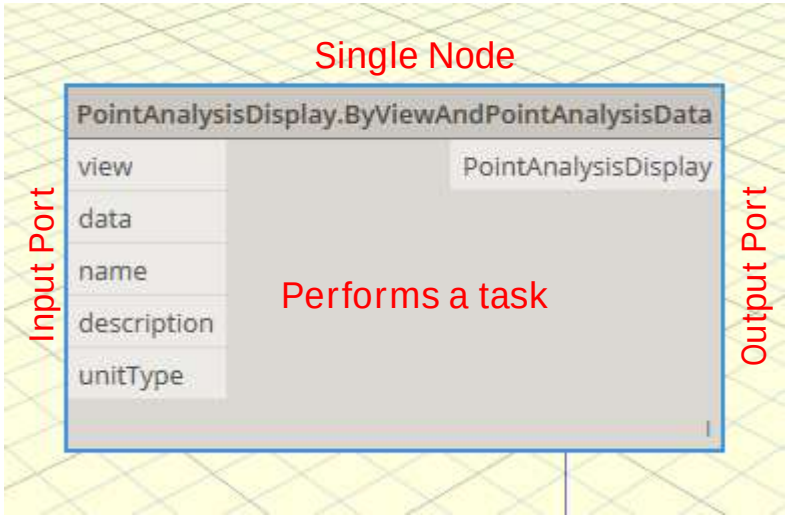


Visual Programming Origin in A/E

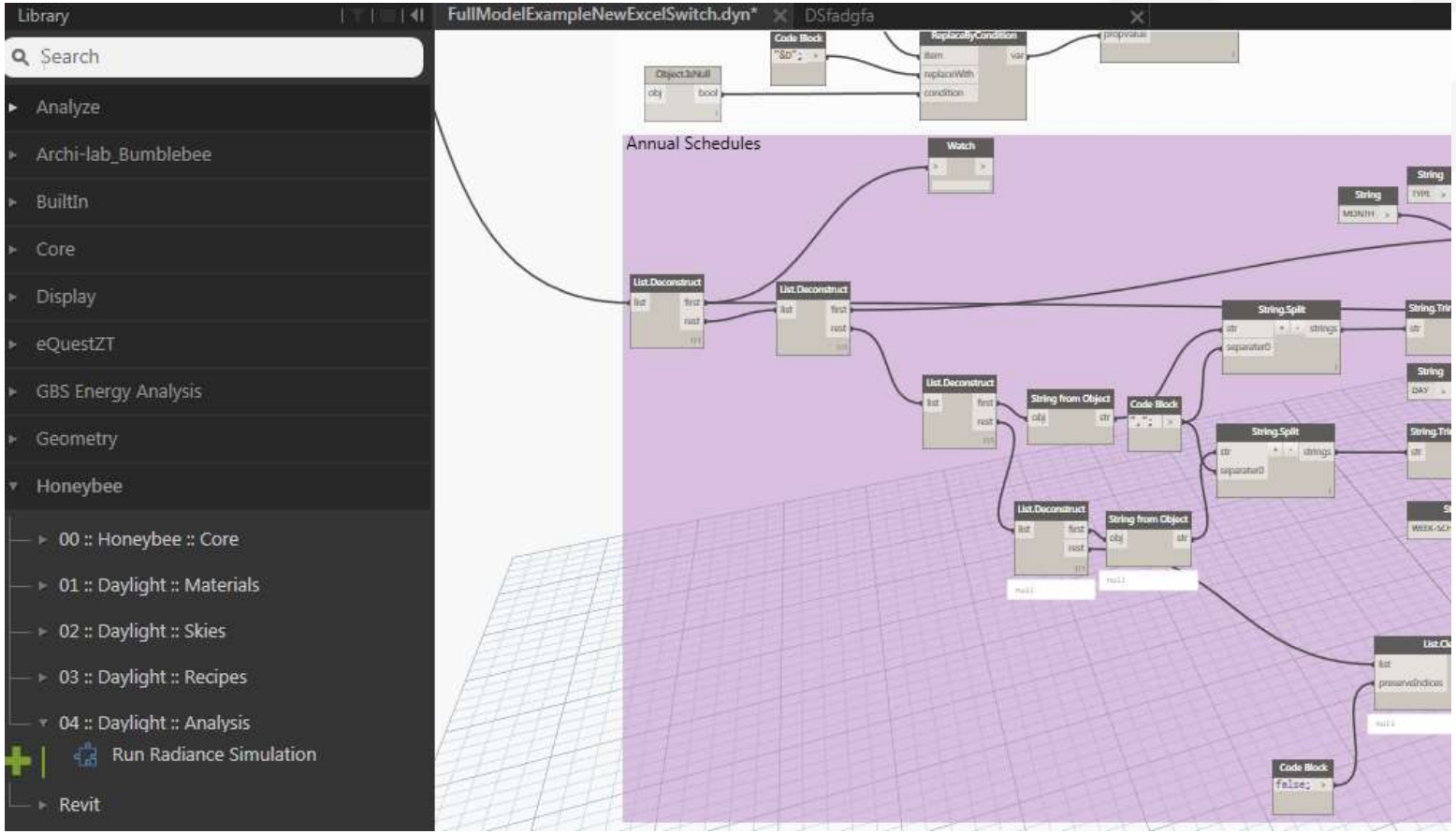
Created to help architects explore new shapes



Visual Programming



Visual Programming



Visual Programming Interfaces

Dynamo ⇄ REVIT

 ⇄ Rhinoceros

Clarification

Dynamo and Grasshopper are not energy modeling programs. They have the ability to send information to nodes or programs capable of energy analysis and more

Energy Analysis in Dynamo & Grasshopper

Visual vs Textual Programming

Visual

- Allows you to create programs without learning special syntax in an intuitive visual interface.
- Visual programs can become cluttered, and can at times fall short in functionality.

Textual

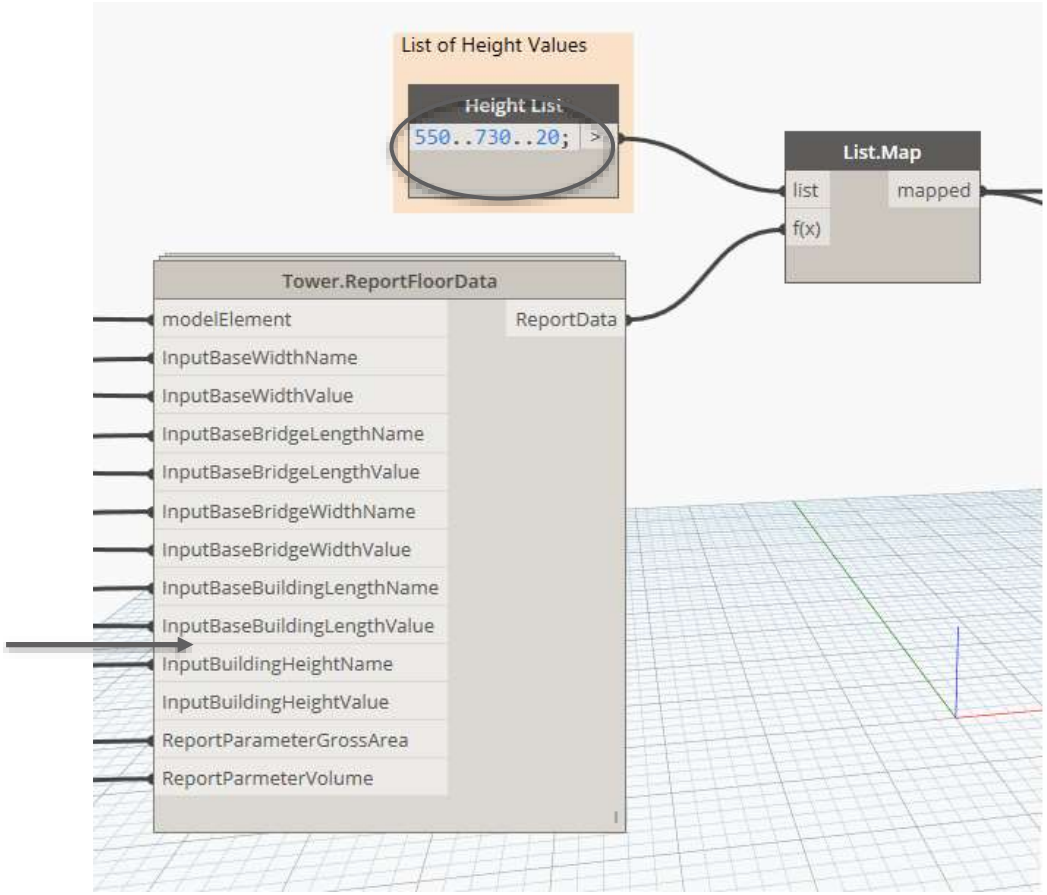
- Textual offers much more achievable methods for writing conditional statements (if/then) and looping.
- Extends the capabilities of Dynamo/Grasshopper and allow you to replace many nodes with a few concise lines of code.
- C#, Python, Visual Basic

Glumac Energy Group

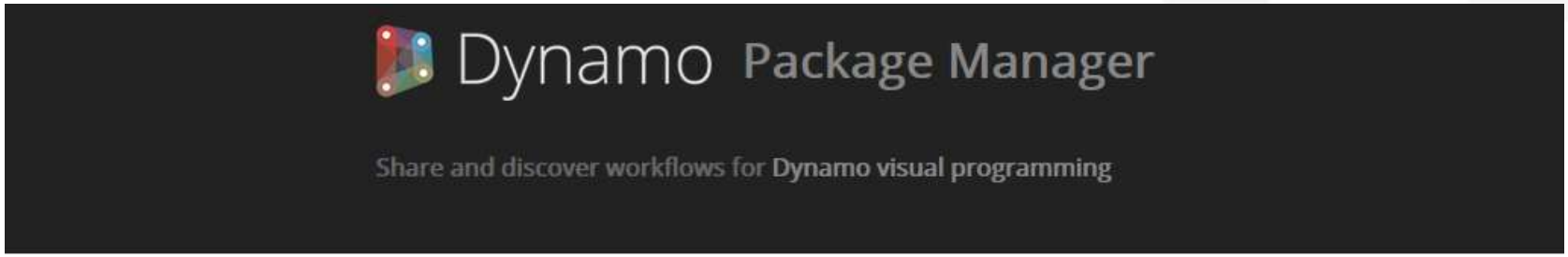
Visual – 80%

Textual – 20%

Generative Design



Open Source



603156 INSTALLS

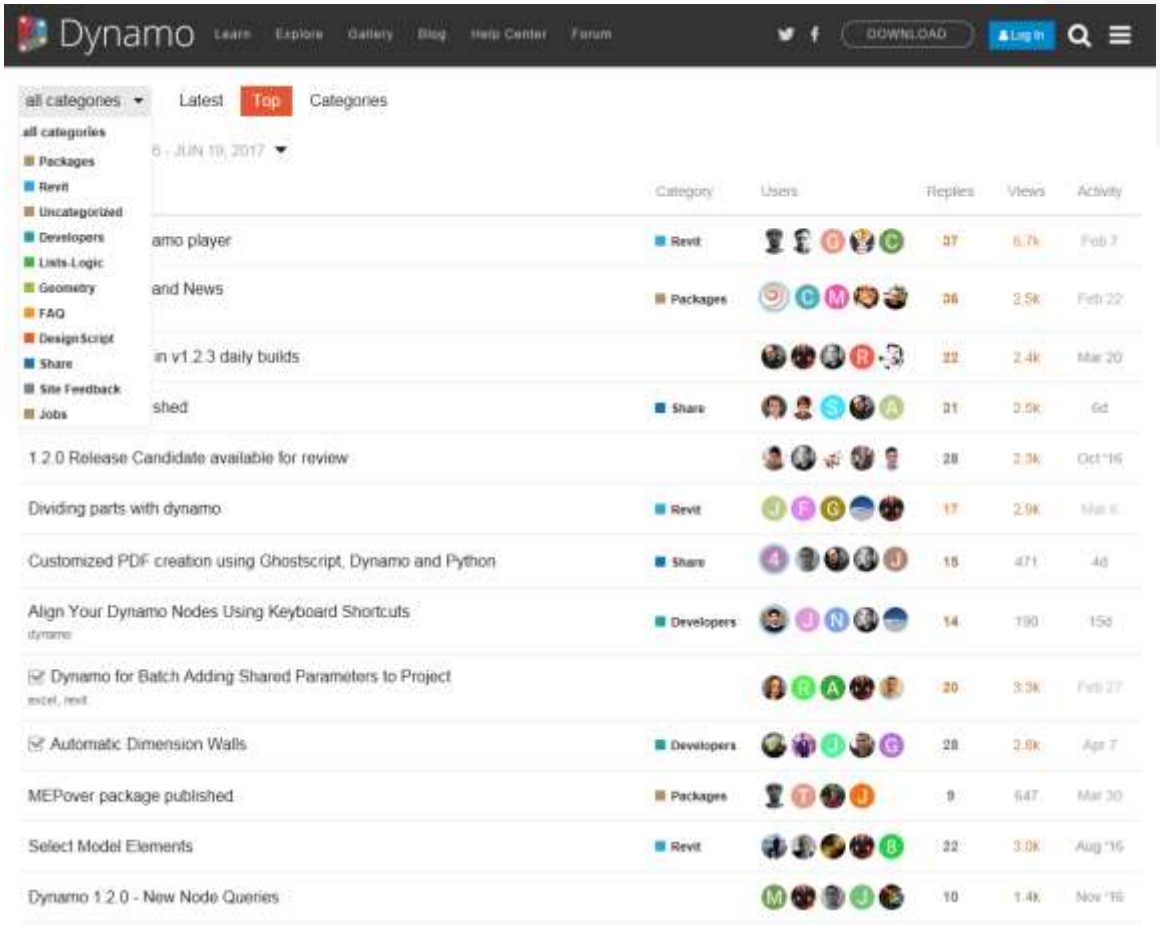
1085 PACKAGES

356 AUTHORS

Packages

Newest	Most Recently Updated	Most Installed		Most Depended Upon	
NET_package	spring nodes	LunchBox for Dynamo	60680	LunchBox for Dynamo	30
WombatDynamo	Zhukoven.com	archi-lab.net	45342	archi-lab.net	27
Corso Dynamo One Tea...	RPT_DynamoZTNs	spring nodes	23568	Clockwork for Dynamo 1.x	19
MyBIMtheque	Data-Shapes	Clockwork for Dynamo 1.x	22127	Quads from Rectangular ...	18
CubeSid	SoFresh	Rhythm	20273	SteamNodes	17
OT_writeValueOnSurroun...	WhiteHorse	SteamNodes	19121	Rhythm	14
TestSid	NET_package	Rhynamo	17579	Evaluate Sun Directness -...	13
ztest	BIM4Struc.Productivity	BumbleBee	12124	spring nodes	13

Open Source


Dynamo
Learn
Explore
Gallery
Blog
Help Center
Forum
DOWNLOAD
Log In
all categories
Latest
Top
Categories
all categories
Packages
Revit
Uncategorized
Developers
Lists-Logic
Geometry
FAQ
DesignScript
Share
Site Feedback
Jobs
Category
Users
Replies
Views
Activity
amo player
Revit
and News
Packages
in v1.2.3 daily builds
shed
Share
1.2.0 Release Candidate available for review
Dividing parts with dynamo
Revit
Customized PDF creation using Ghostscript, Dynamo and Python
Share
Align Your Dynamo Nodes Using Keyboard Shortcuts
Developers
Dynamo for Batch Adding Shared Parameters to Project
Automatic Dimension Walls
Developers
MEPover package published
Packages
Select Model Elements
Revit
Dynamo 1.2.0 - New Node Queries

ENERGY AT GLUMAC

Our Goal

BIM Workflow – Glumac Energy 2012

Google Sketchup Pro

BIM Workflow – Glumac Energy 2012

Google Sketchup Pro

Limited to passing information available in gbXML

eQUEST

EnergyPlus

Additional tools & practices needed to pass/clean data

Autodesk Green Building Studio

Bottle Neck – GBS servers experience downtime

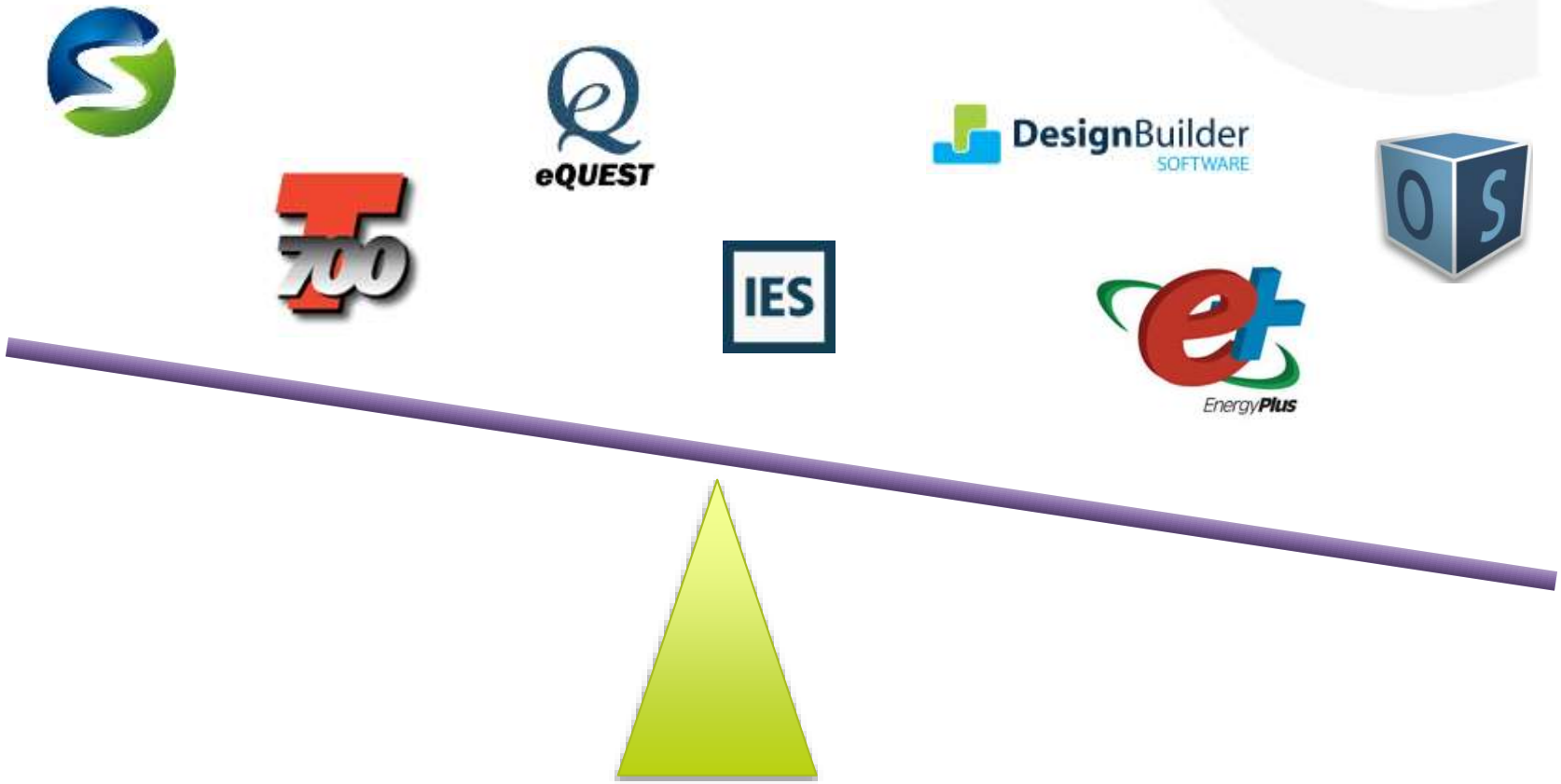
Business Case

For every 1 hour we spend on software and tool development we have seen a 3:1 return on high volume tasks

Lessons Learnt

Treat software and tool development like a project – Set budgets, schedules, and deliverables

Software Options

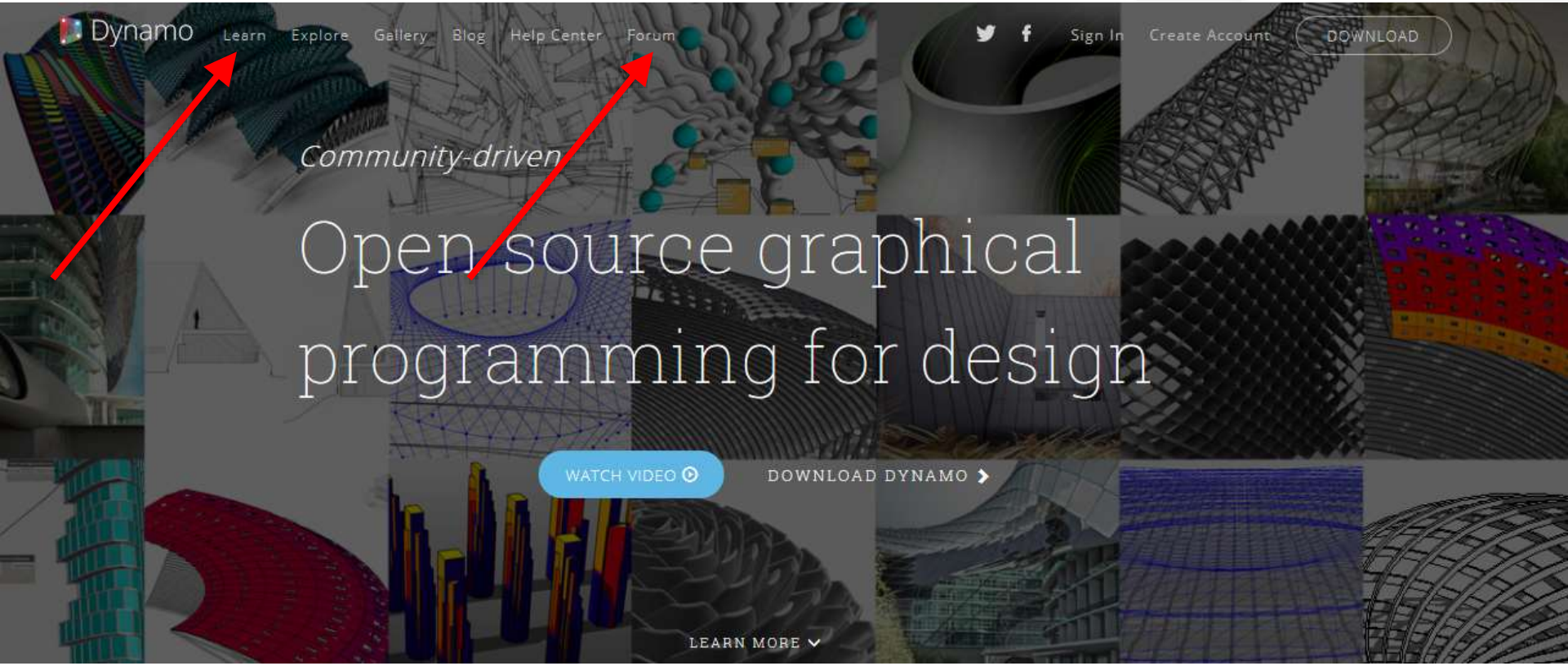


Dynamo Decision Drivers

- Grasshopper has a larger more developed community however Dynamo has a direct interface with Revit which is ultimately the tool used for production.
- Opportunity to leverage a single analytical model built within Revit and used by multiple disciplines for Design & Energy.
- Challenges with California's CBECC-COM energy compliance software.
- Not limited by a Graphical User Interface (GUI) – Direct access to all simulation engine features.
- Iterative analysis and optimizing multiple variables simultaneously.
- Open Source Community.

GETTING STARTED WITH DYNAMO

Getting Started with Dynamo



Getting Started With Dynamo

Video Tutorial

Introductory Videos

DATASET

GETTING SITUATED WITH DYNAMO

Launch Dynamo for the first time. Take a tour of the Dynamo user interface. Learn how to open and interact with Dynamo files.

THE ANATOMY OF A DEFINITION

A closer look at the program elements used to interface and connect a Dynamo definition to a Revit Document.

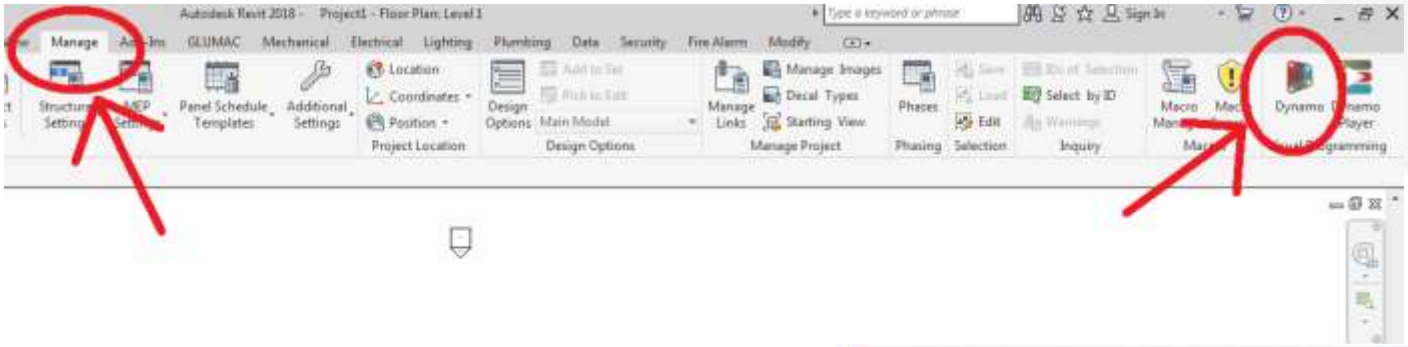
DATA MANAGEMENT

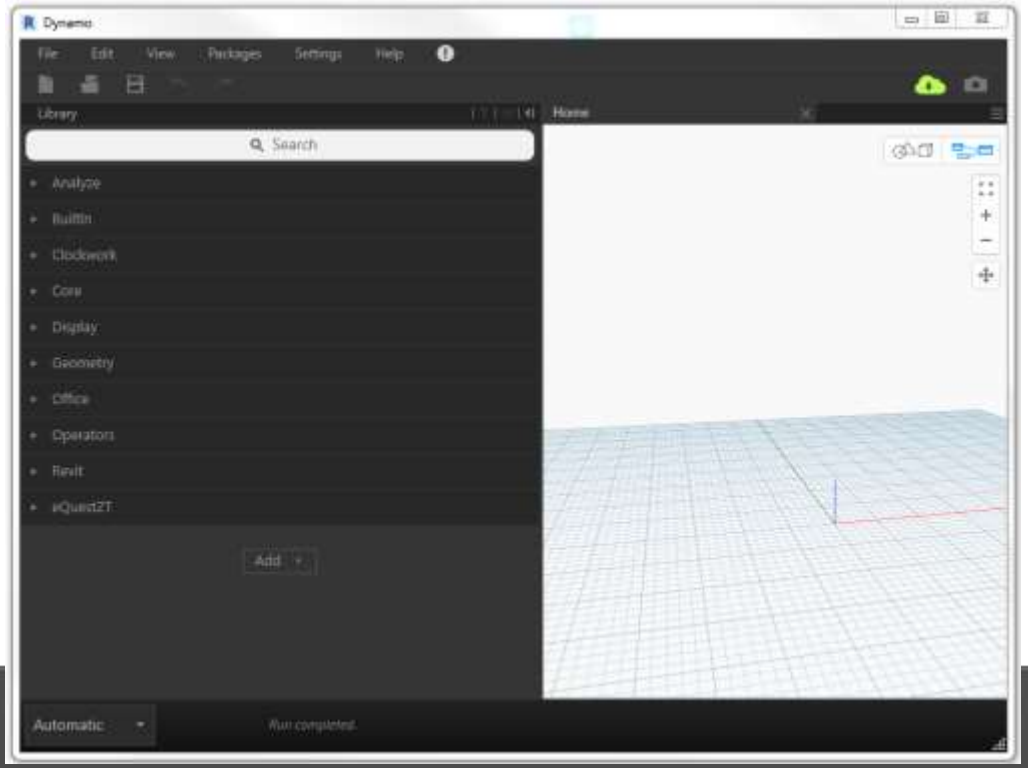
Basic concepts for working with lists

NESTED LIST MANAGEMENT

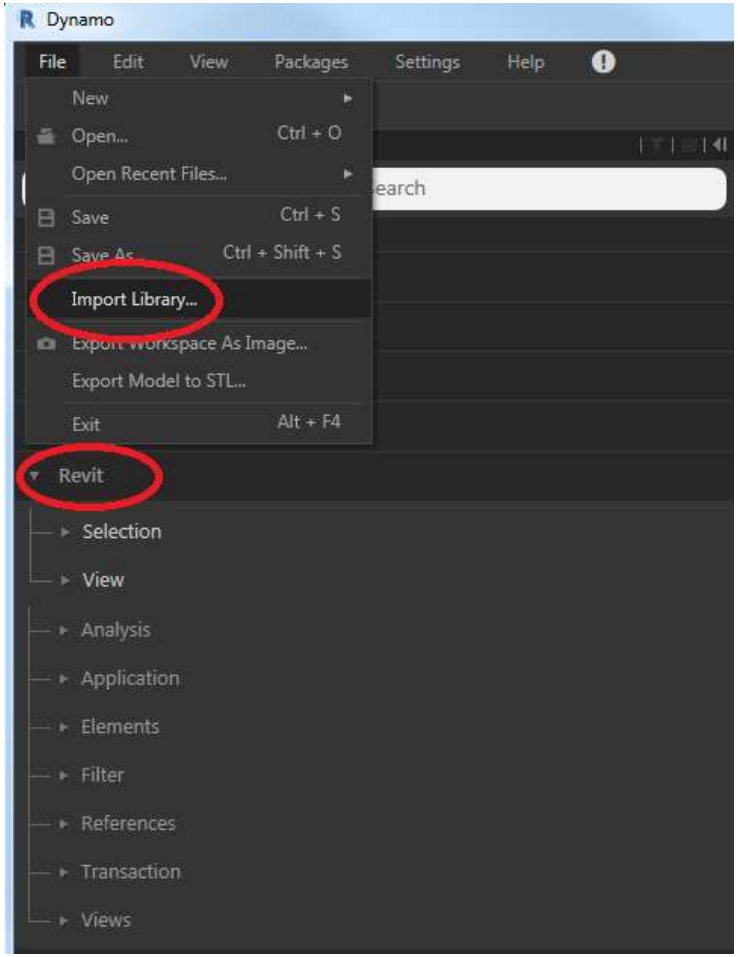
Basic concepts for working with lists and nested lists

Getting Started With Dynamo





Connection to Revit - Libraries



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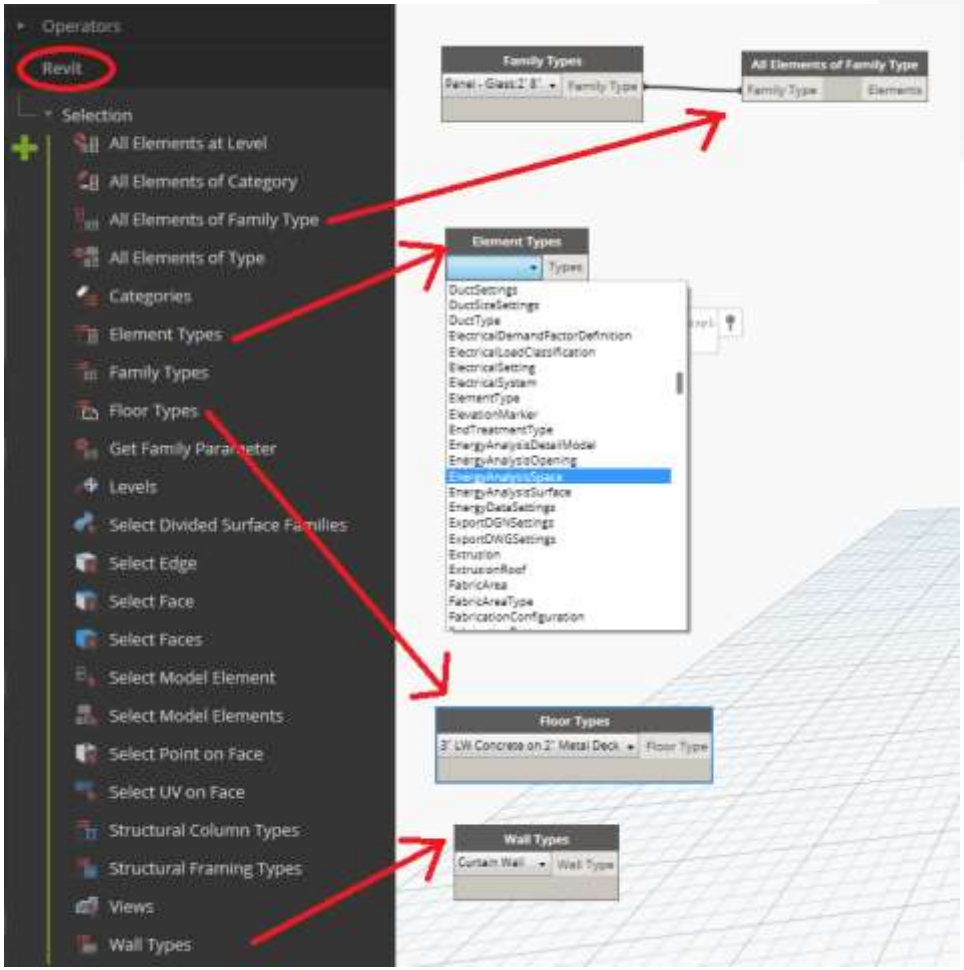
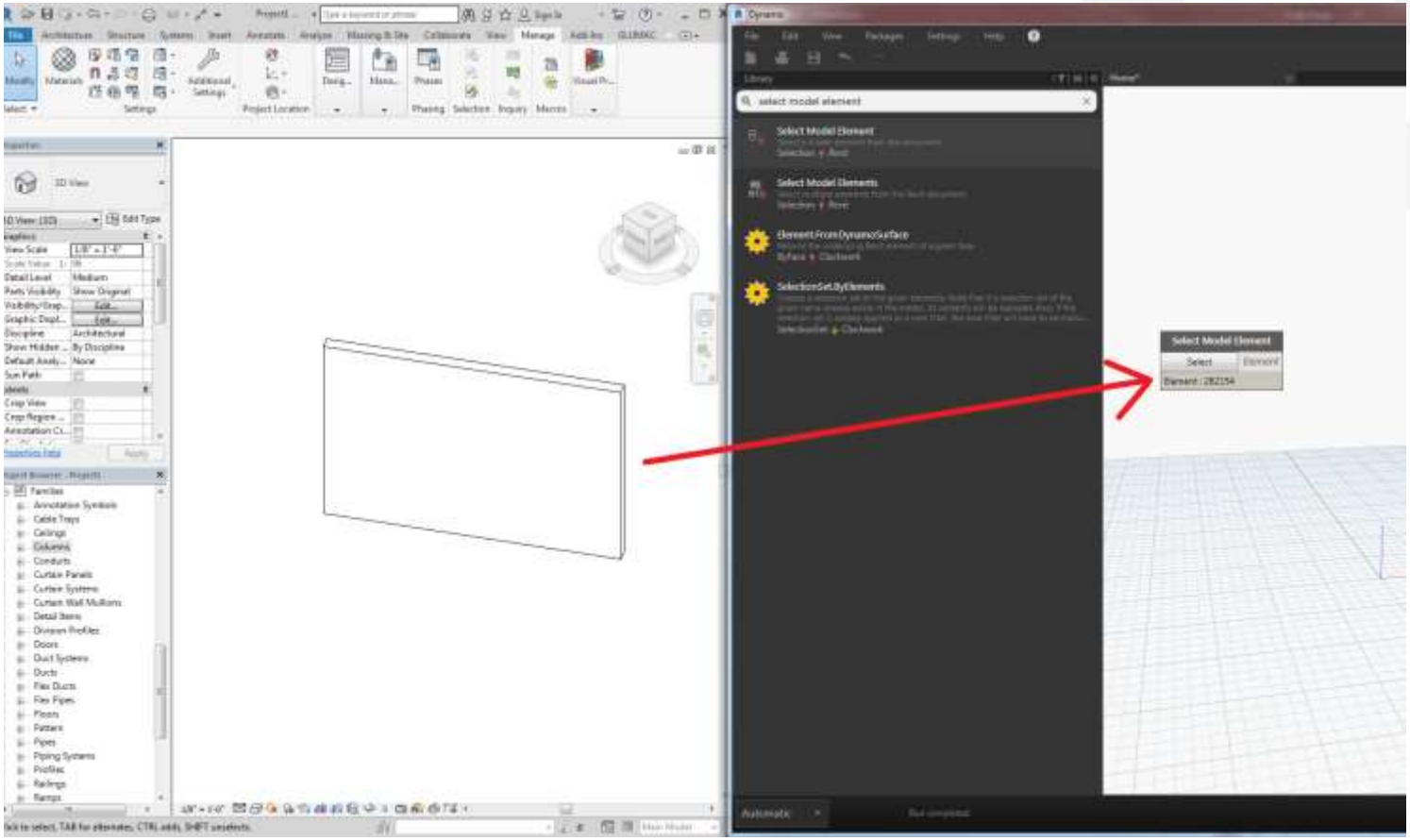


Basic Workflow



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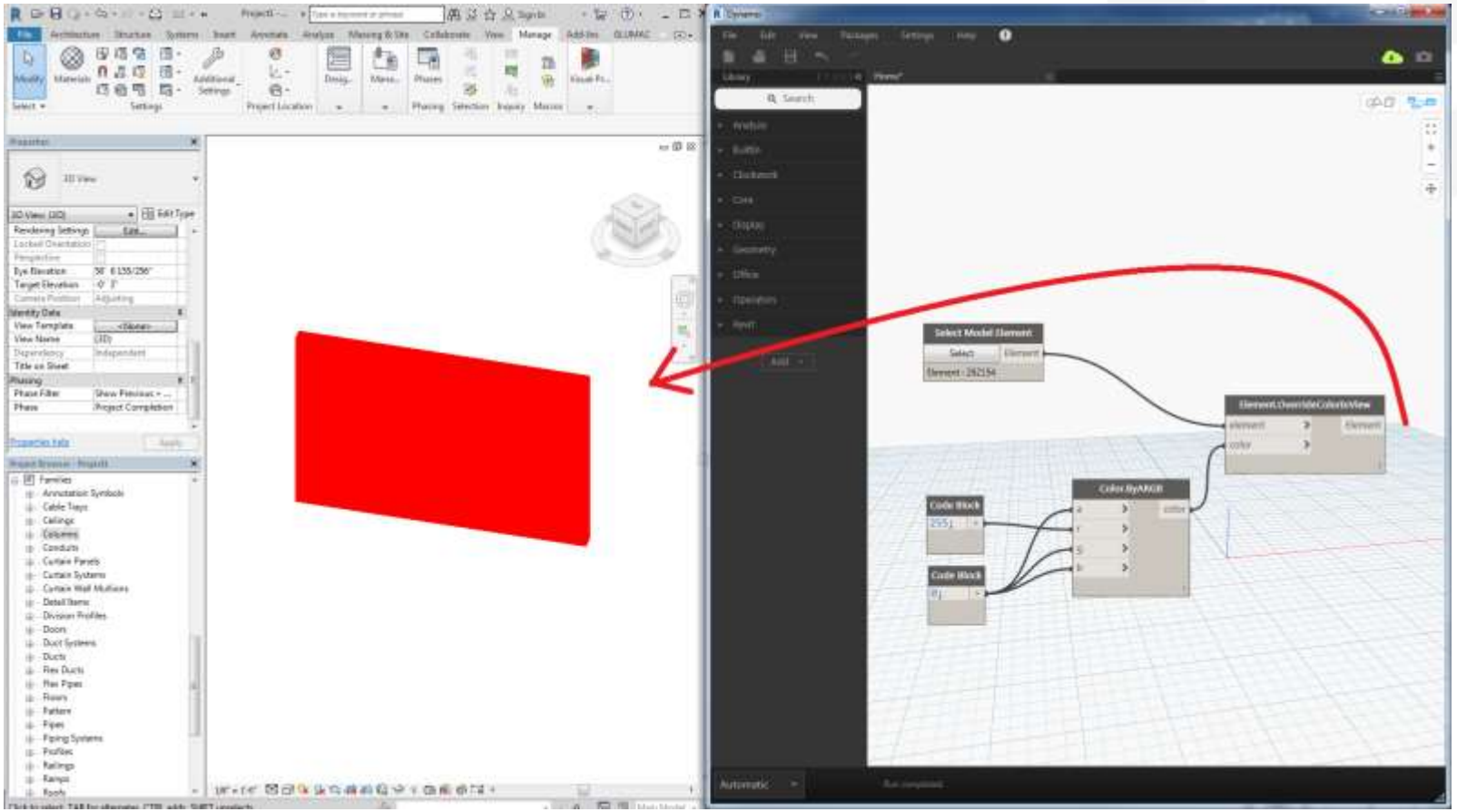
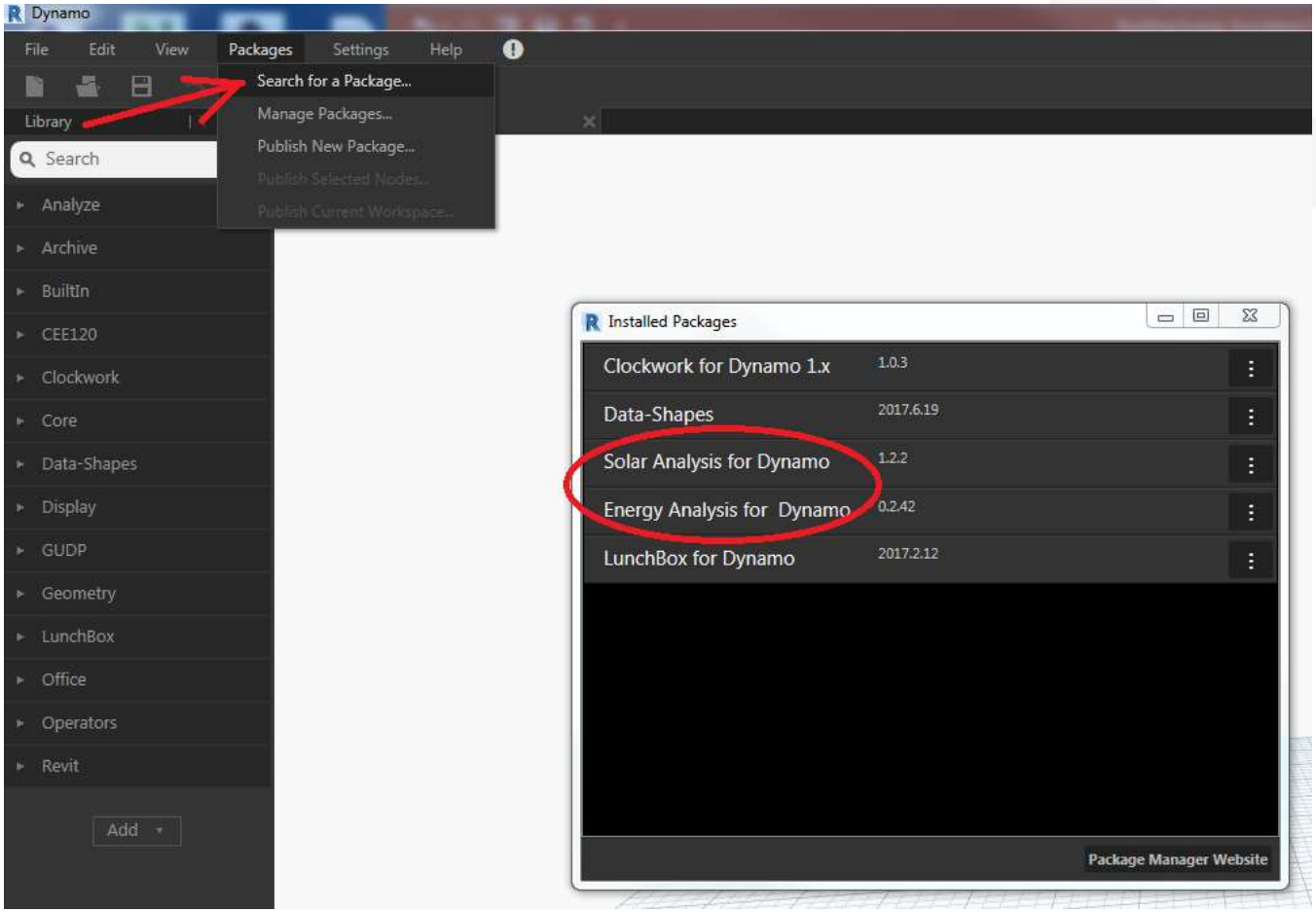
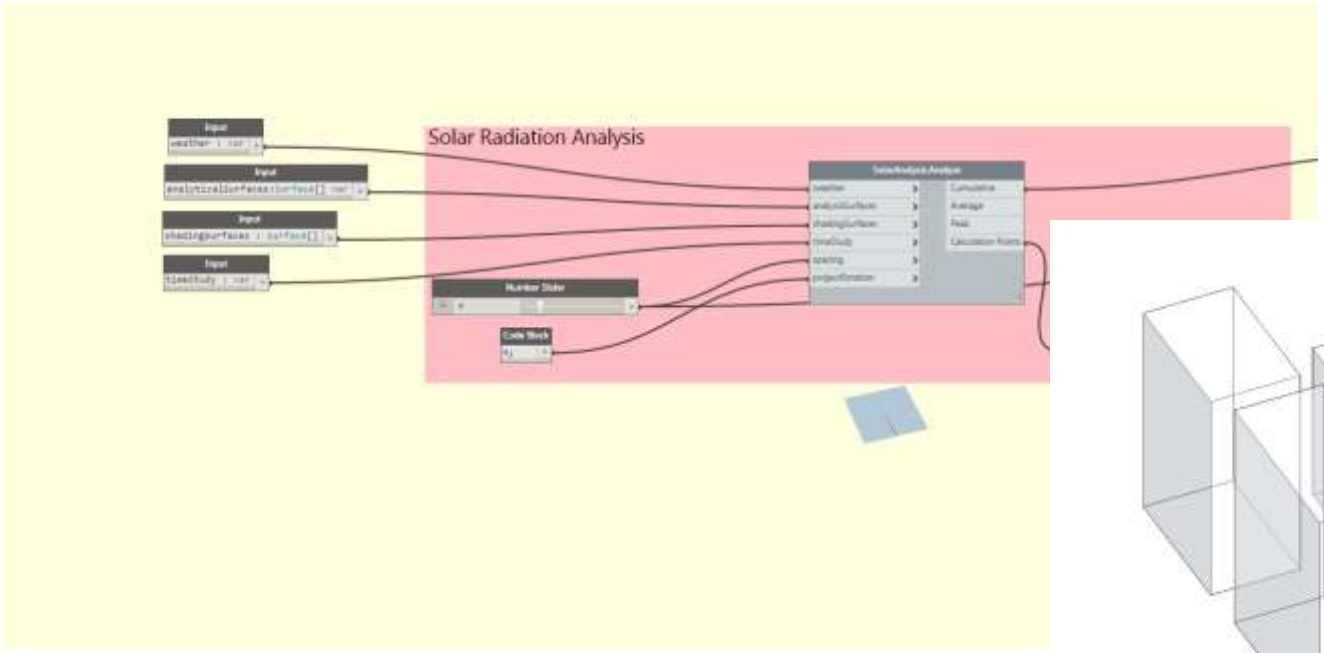
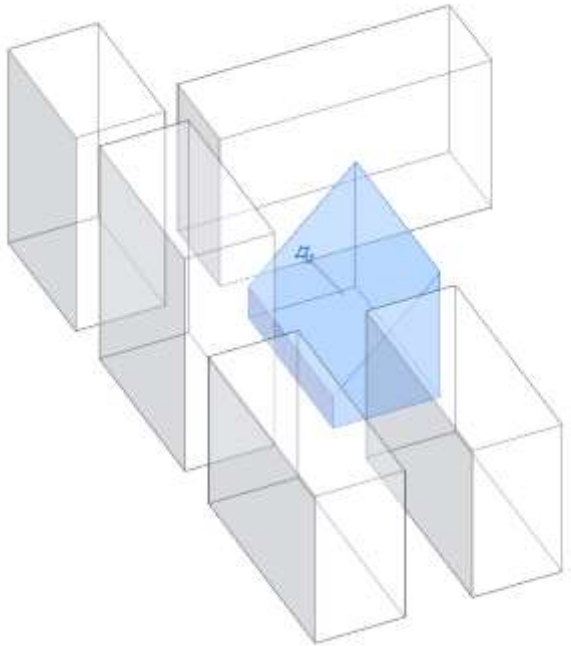


Connection to Revit - Packages



Solar Analysis for Dynamo Package

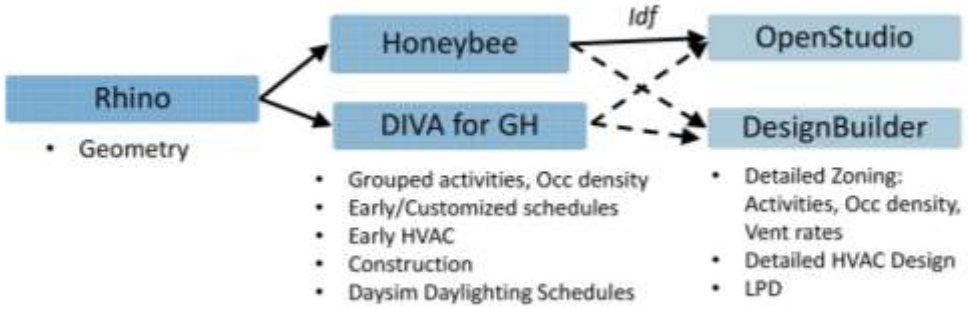




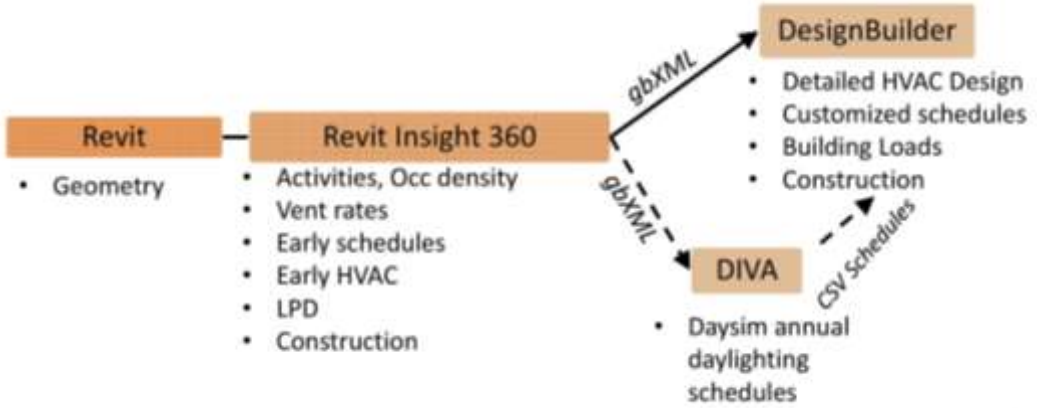
LADYBUG / HONEY BEE

Design Workflow

1.

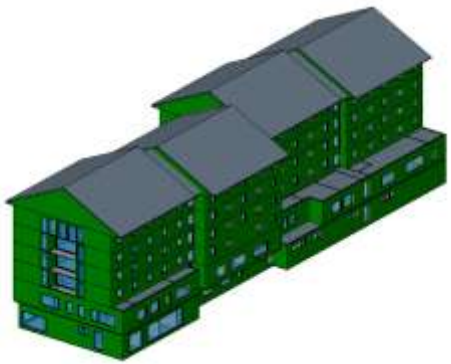


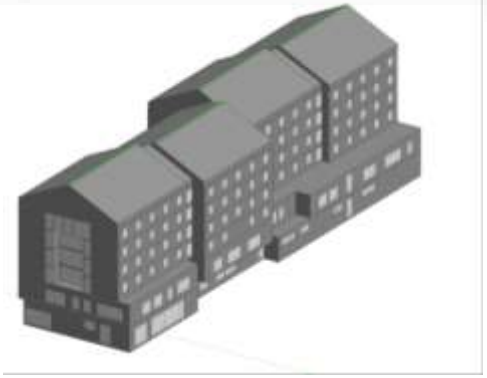
2.



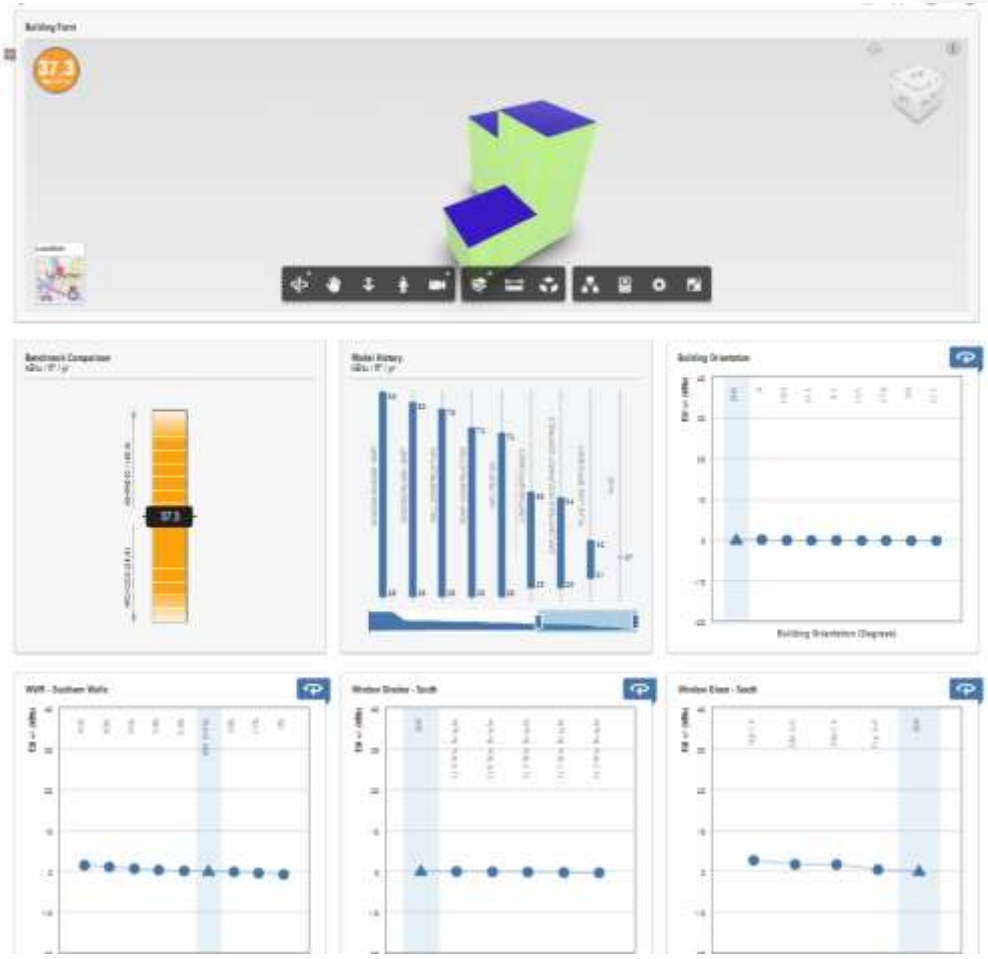
Possible Transition
Missing connection

Schematic to Detailed Analysis



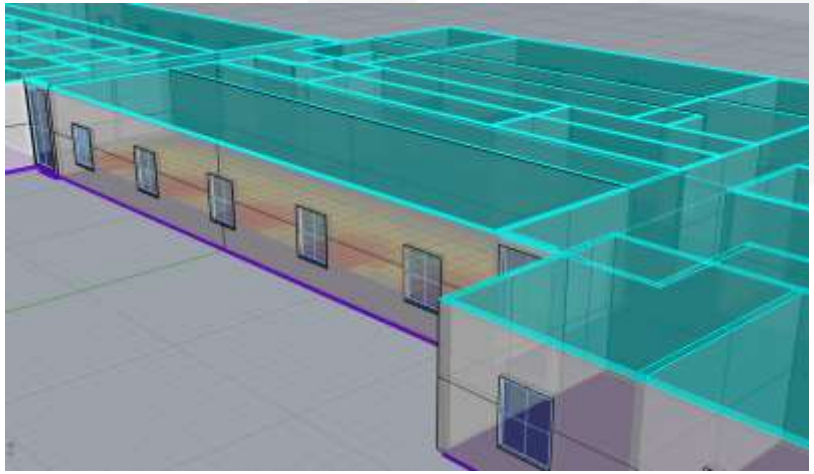


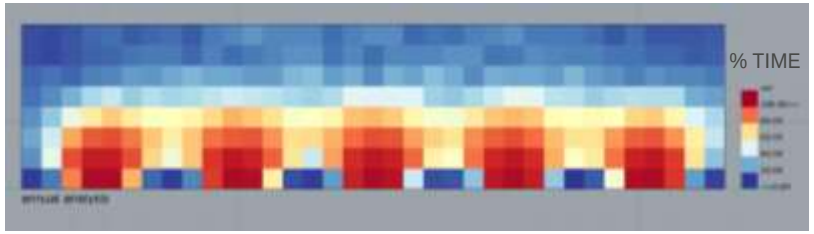
Insight 360 / Dynamo



Energy and Daylight Analysis- Grasshopper/ Honeybee

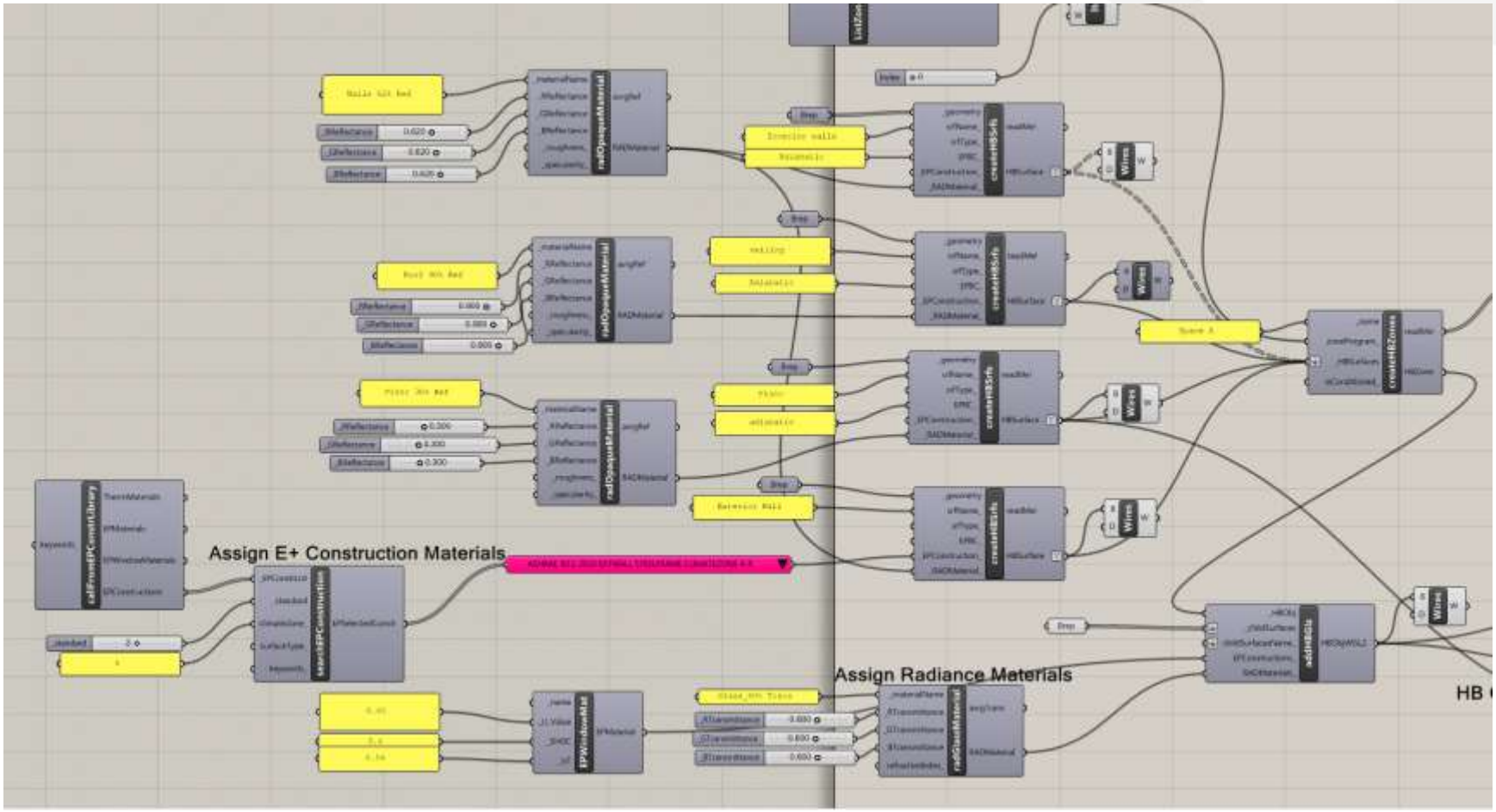
- Honeybee (HB) is a free plug-in for Grasshopper and Rhino.
- HB brings environmental analysis tools to Grasshopper:
  - EnergyPlus (Energy Modeling)
  - Radiance (Daylight Modeling)
  - Daysim (Climate-based Annual Daylight Modeling)



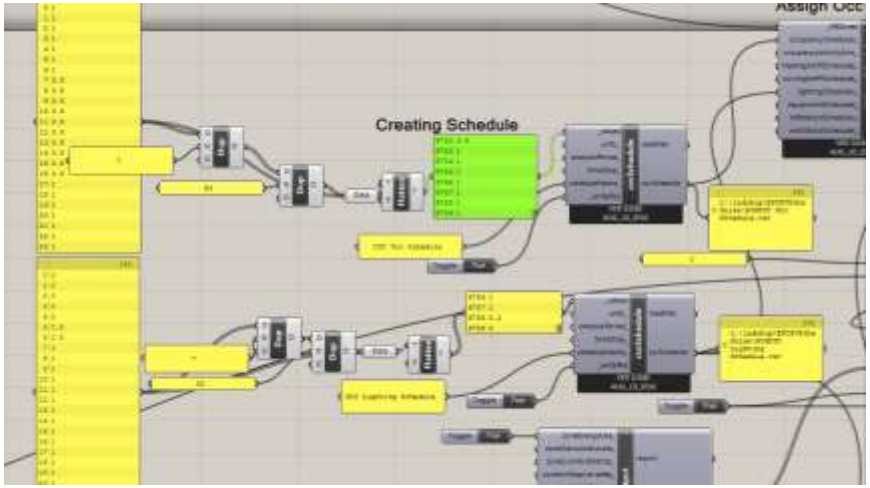


Daylight Autonomy Map (annual daylighting metric) shows the percentage of annual daytime hours that a given point is above 300 lux.

Integrated Energy and Daylight Modeling- HONEYBEE



Lighting Schedules- HONEYBEE

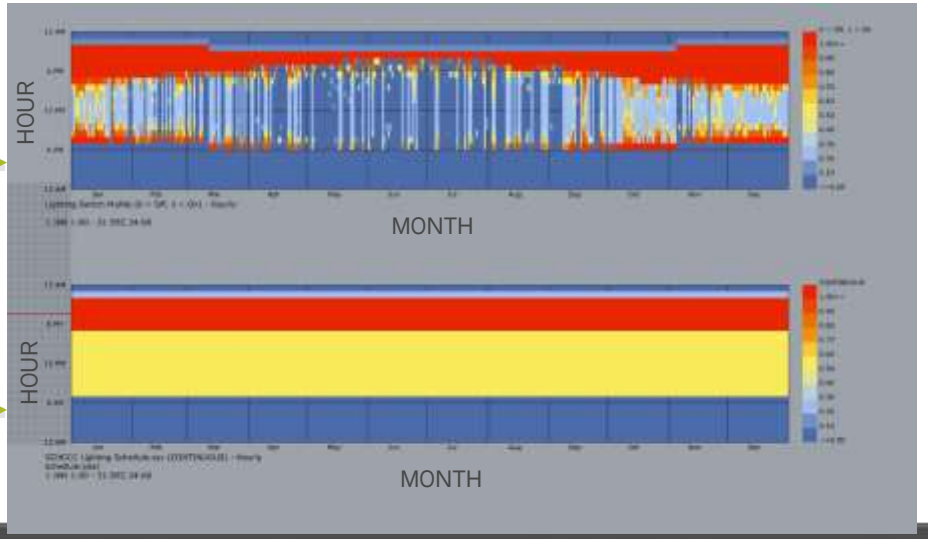


Flexibility to define any lighting **schedule by the use of "MATH"** commands in Grasshopper.

DAYSIM- generated schedule that includes annual climate-based daylighting outputs

Typical baseline schedule for a residential building

Annual Lighting Schedules



Monthly Energy Use- Honeybee

With Daylighting

Without Daylighting

Lighting energy has significantly reduced

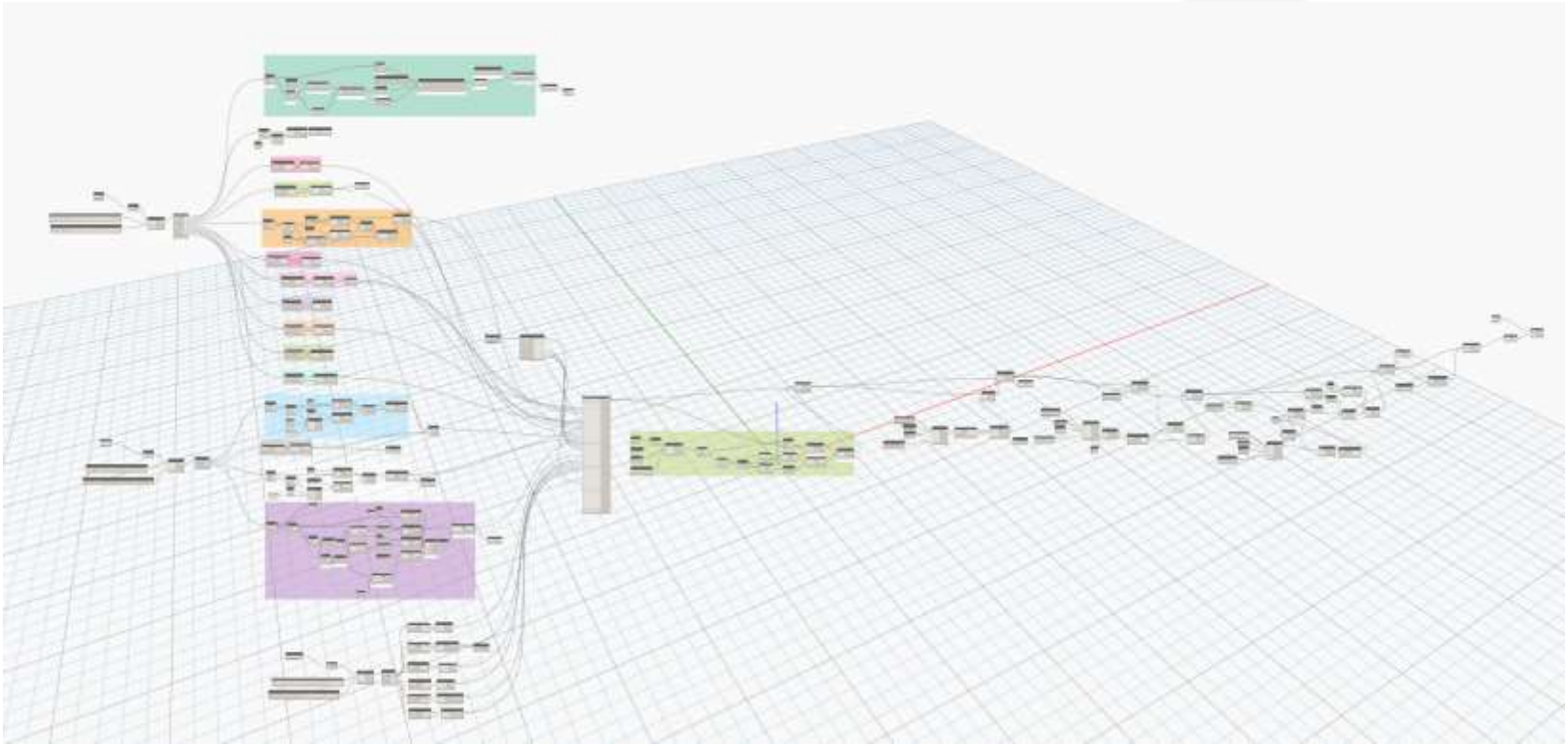
Cooling energy reduced

WHERE WE ARE TODAY

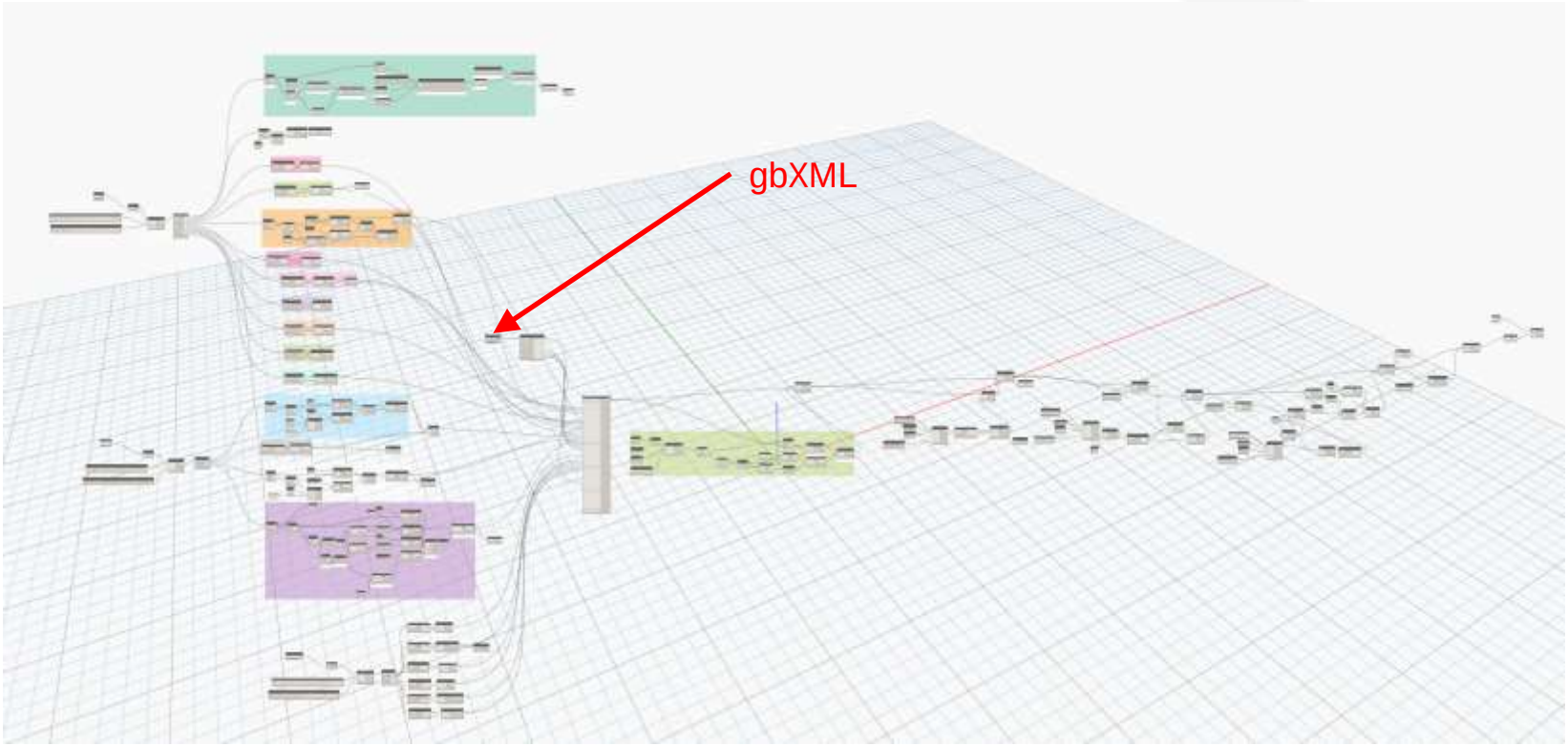
BIM Workflow – Glumac Energy 2012

Google Sketchup Pro

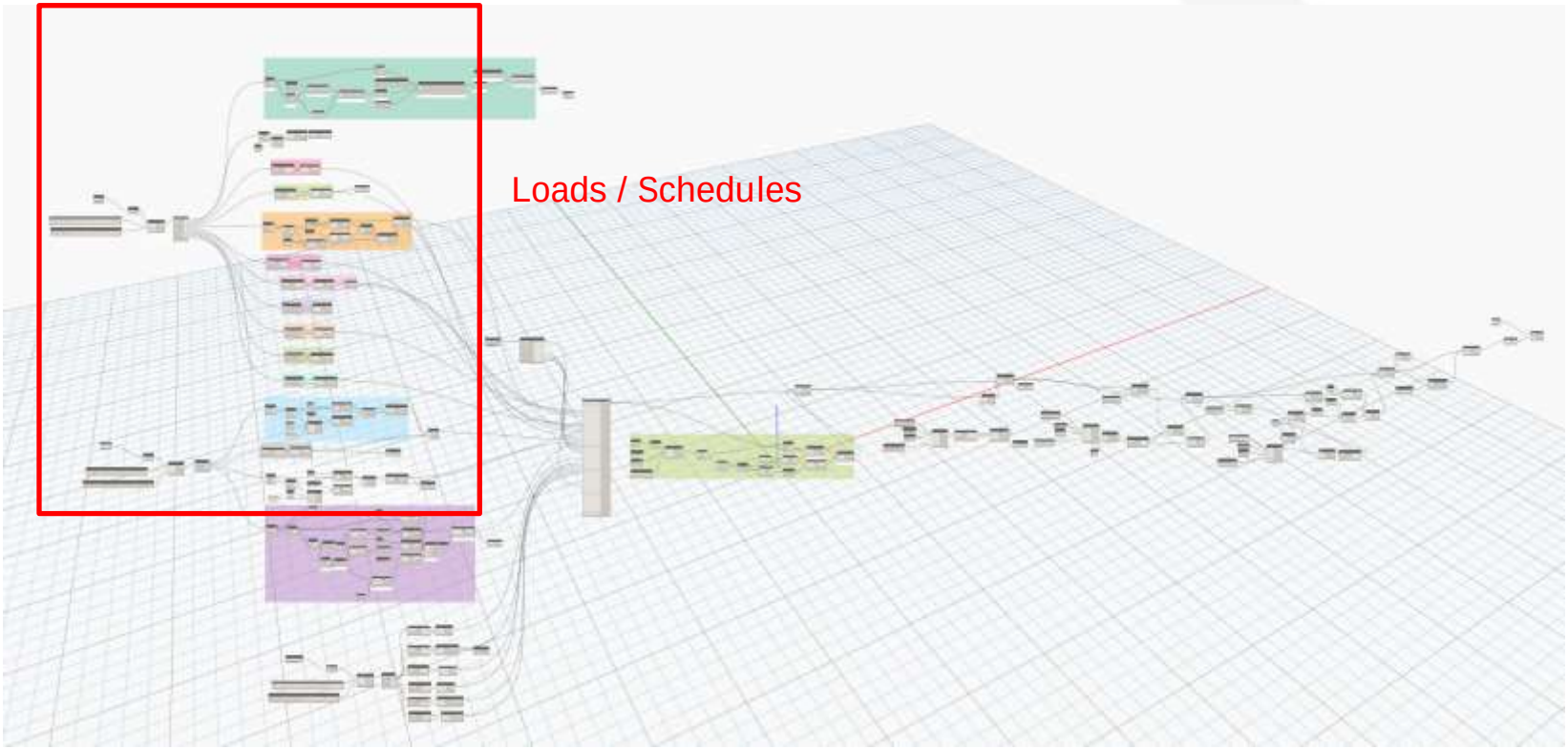
BIM Workflow – Glumac Energy 2017



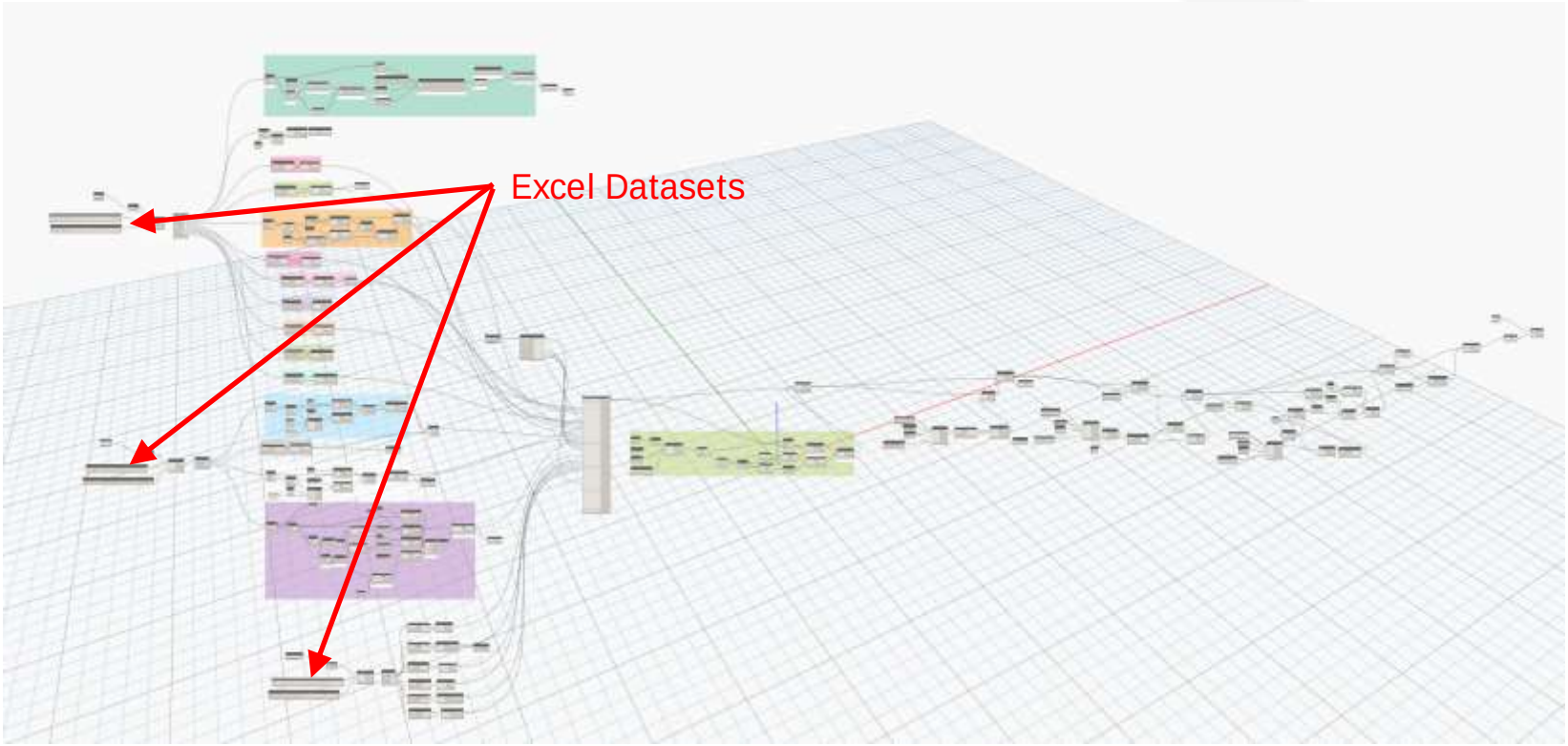
BIM Workflow – Glumac Energy 2017



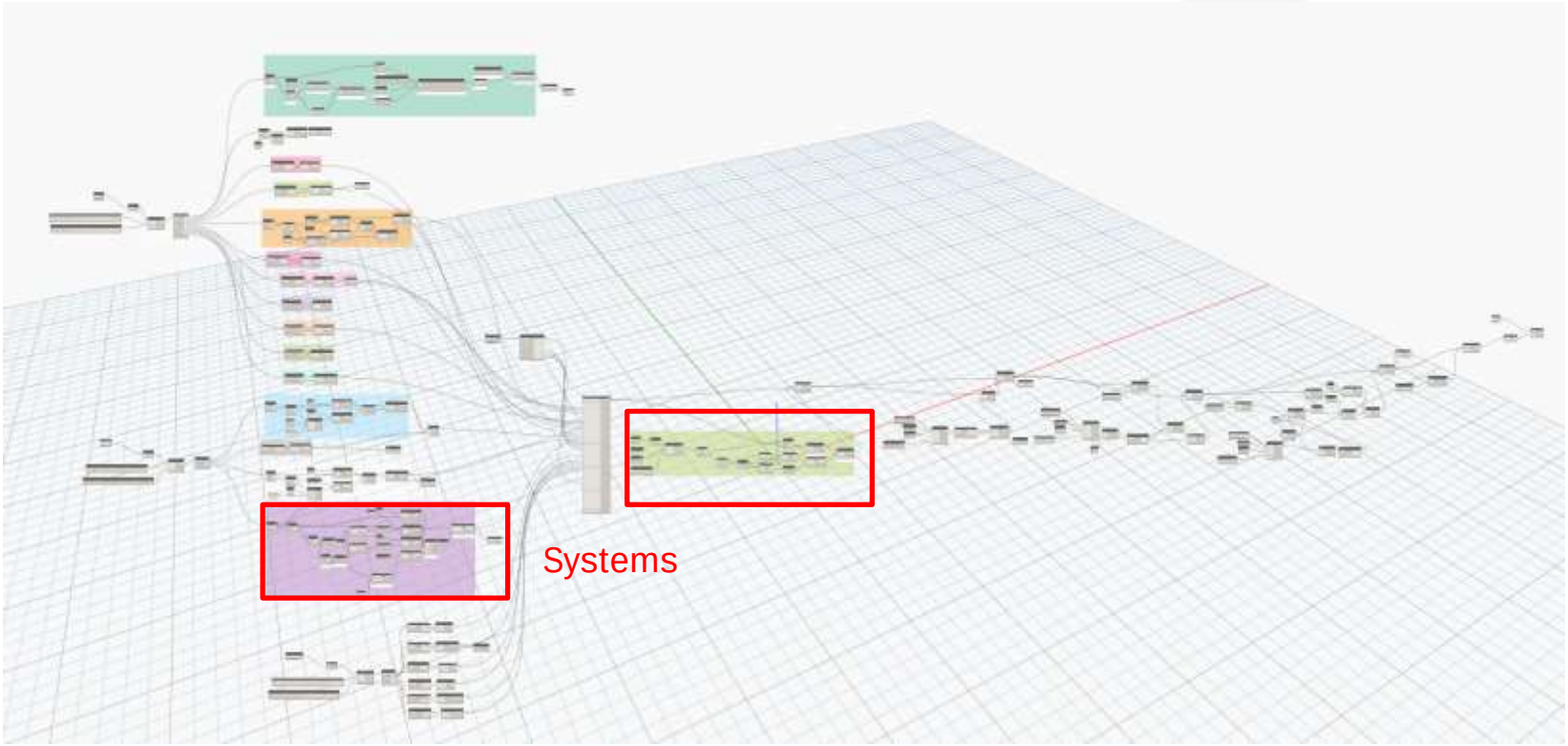
BIM Workflow – Glumac Energy 2017



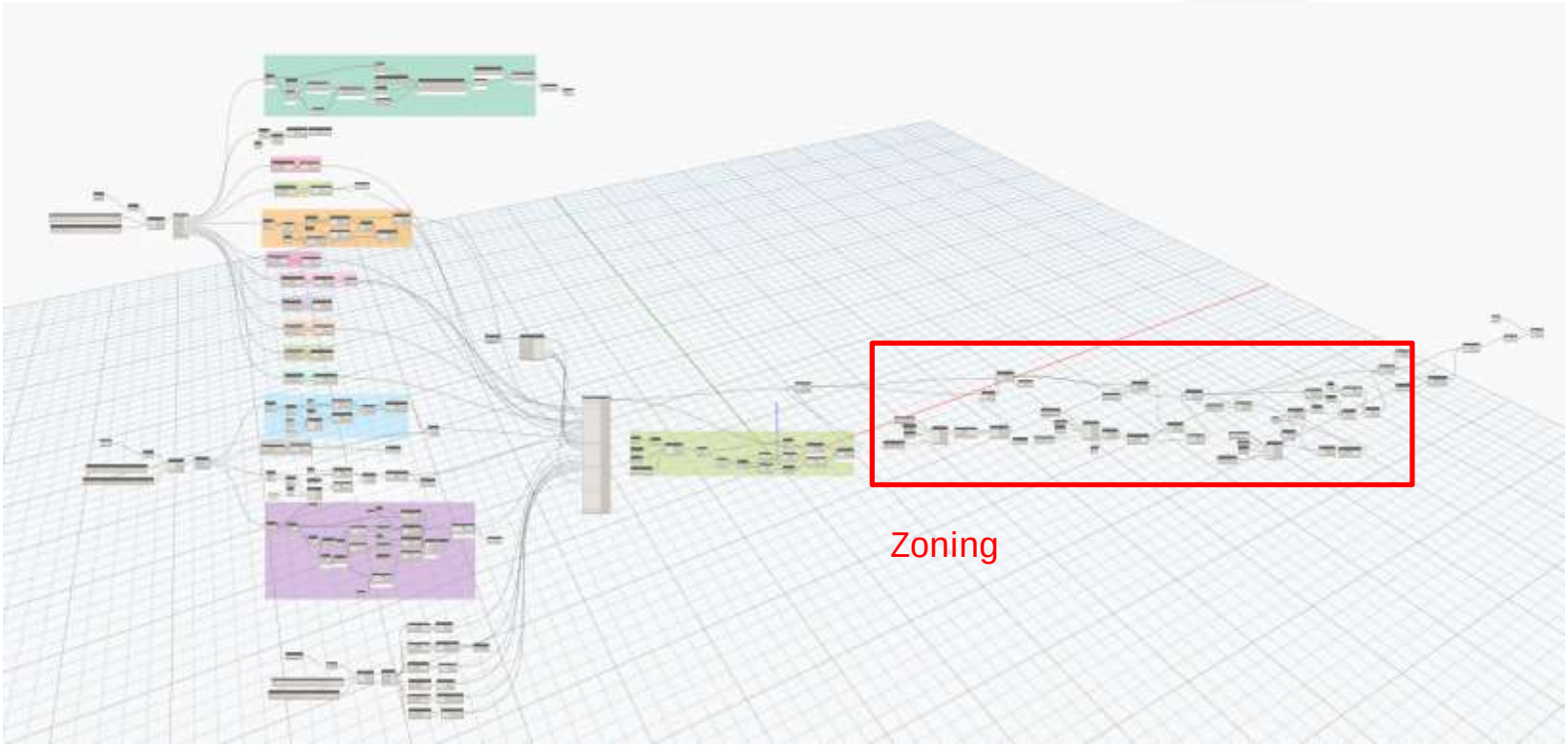
BIM Workflow – Glumac Energy 2017



BIM Workflow – Glumac Energy 2017



BIM Workflow – Glumac Energy 2017



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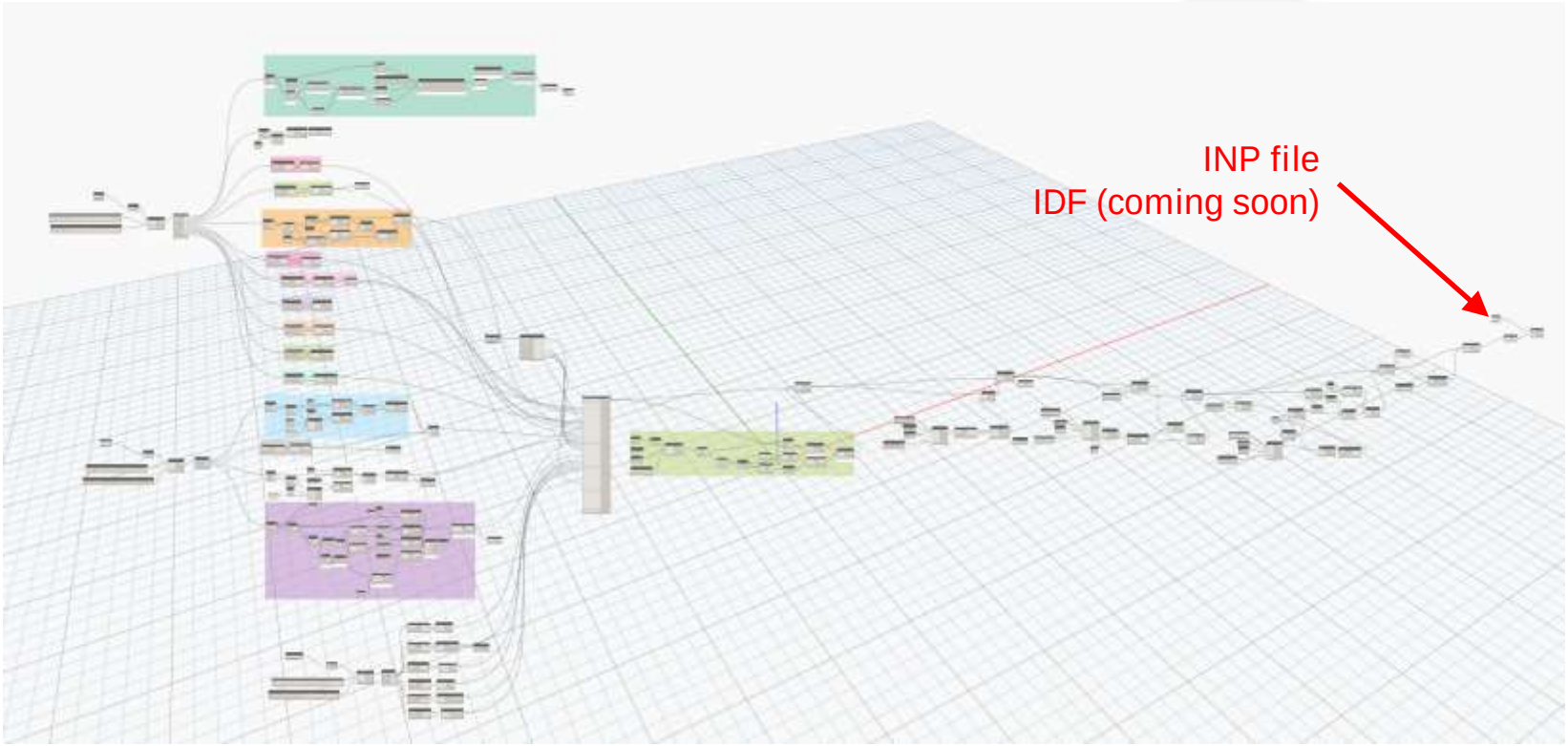
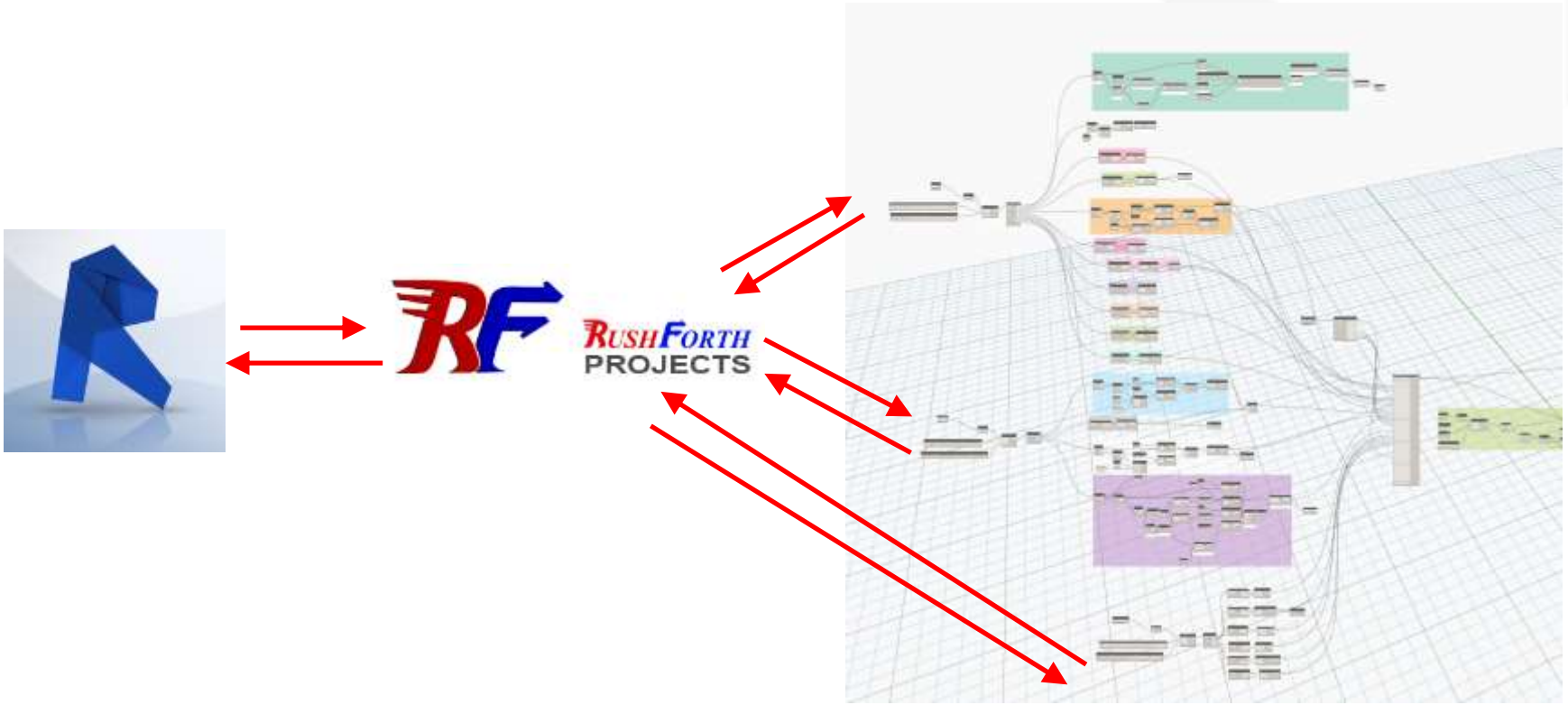


Our Goal

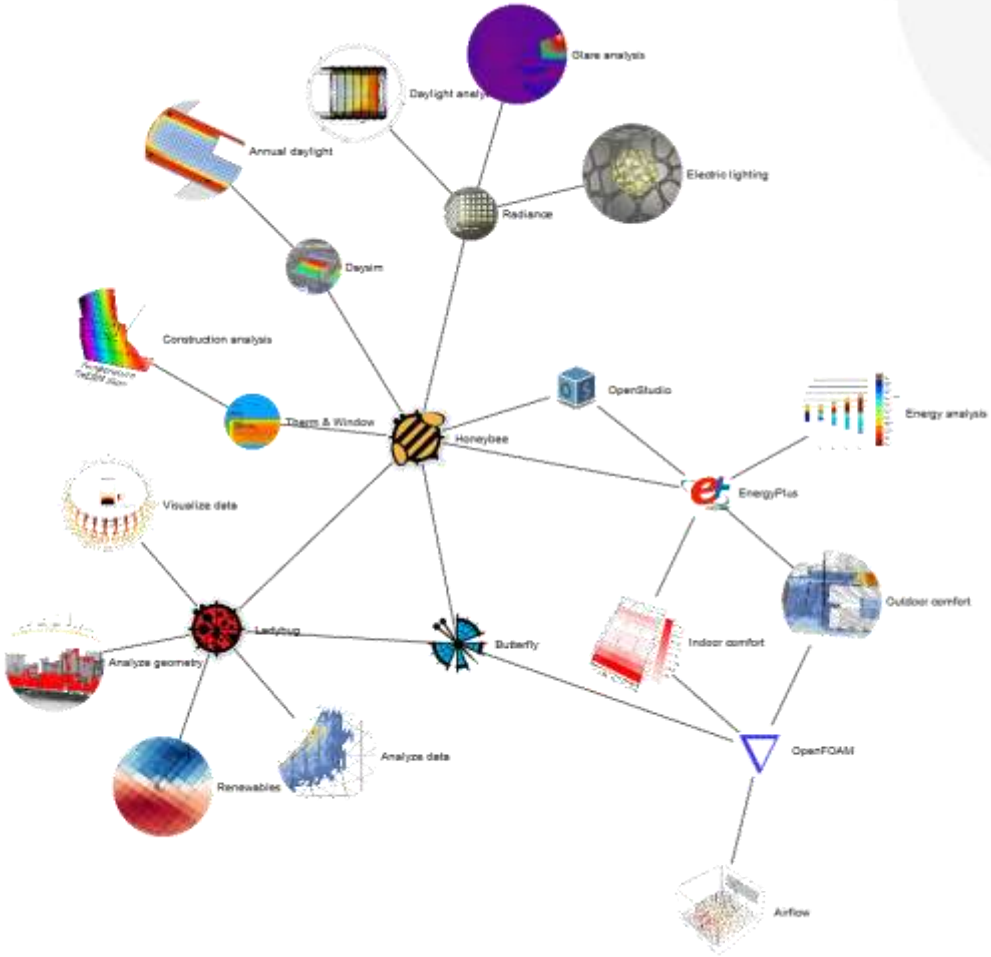
Rushforth Project & Revit



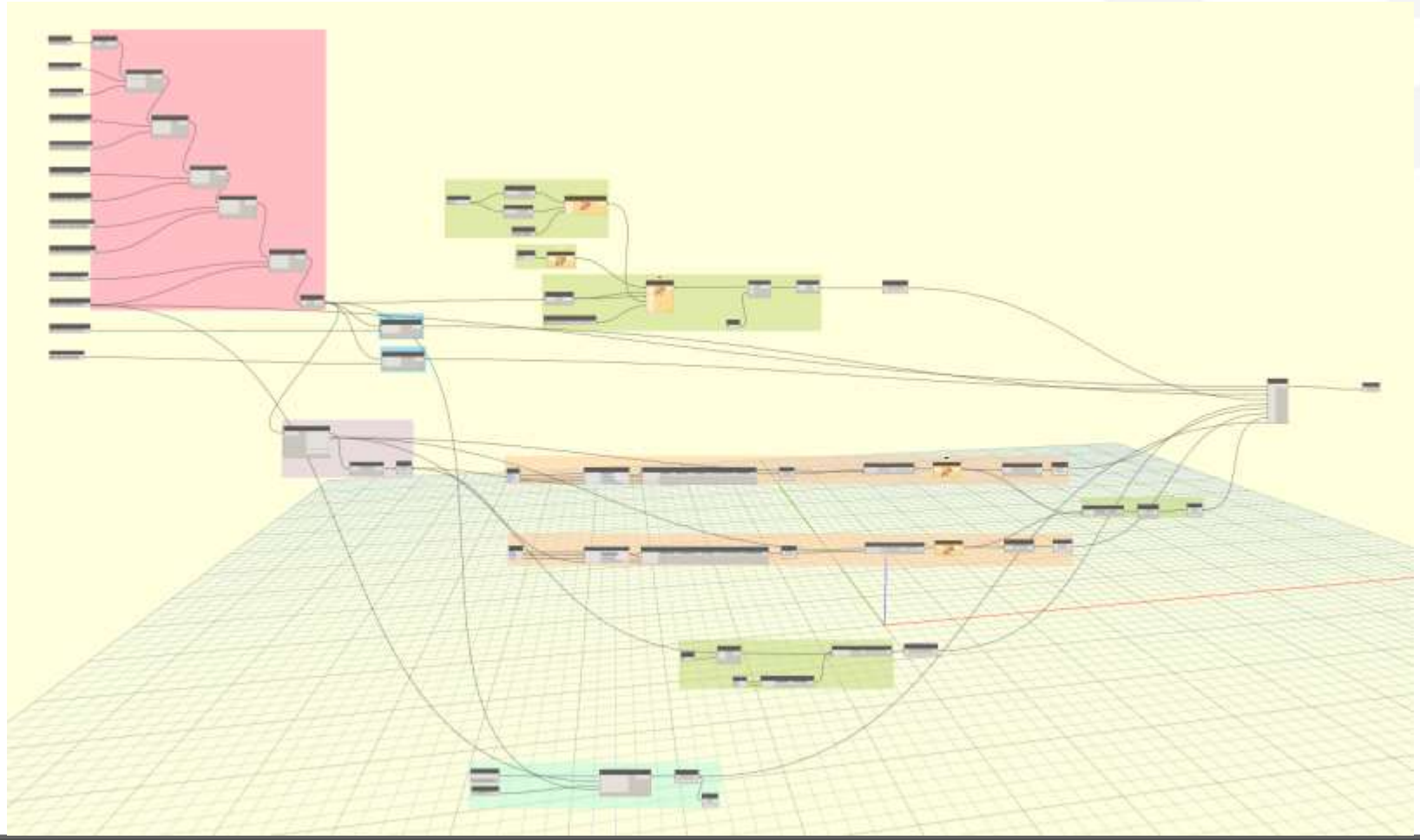
What's Next

- Tool is currently one-directional, develop conduit for analysis to inform design within Revit
- Integrate with other workflows;
  - CFD
  - Daylight
  - Comfort
  - Behavior
- Visualization of results

Integration



Generative Energy & Cost Workflow



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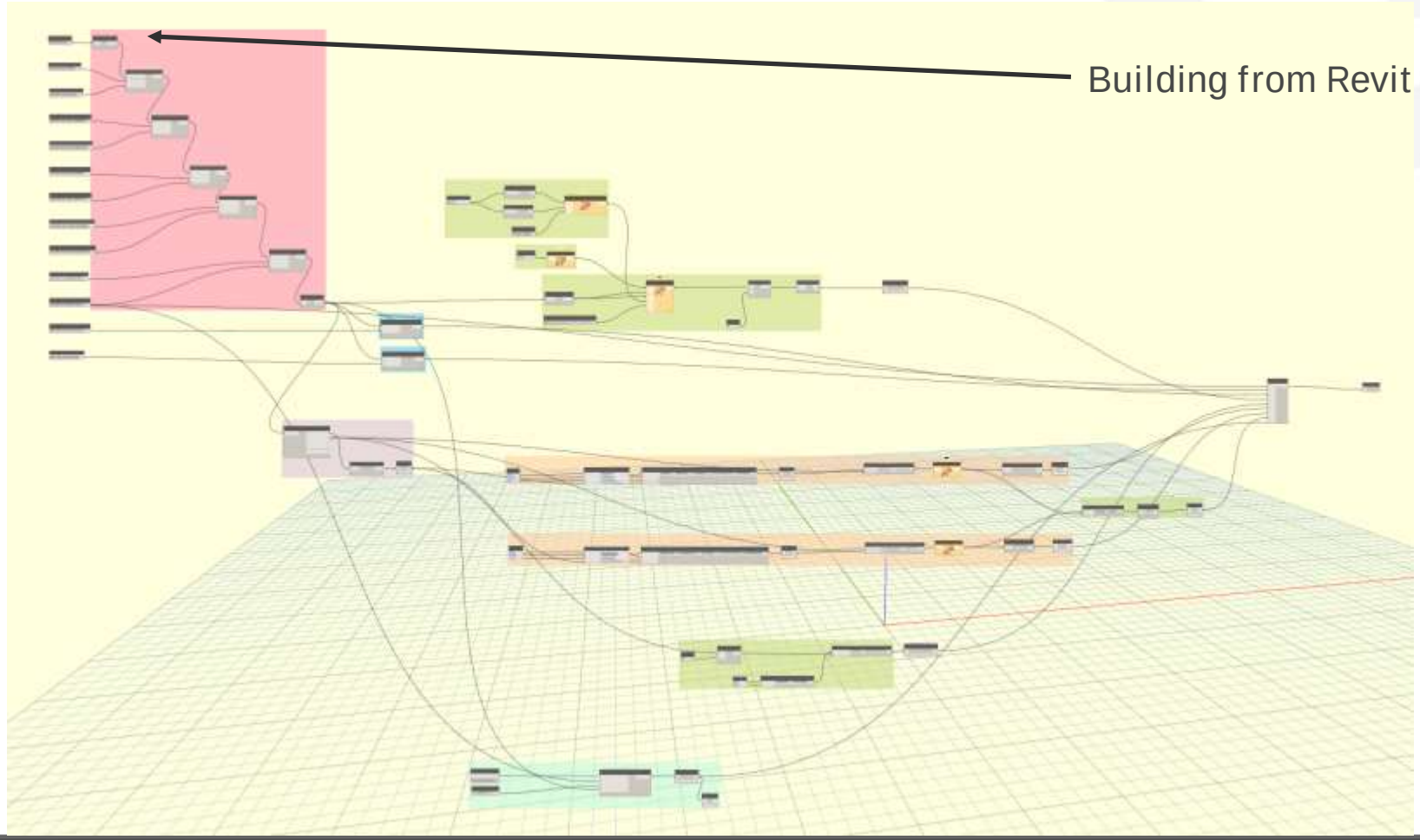

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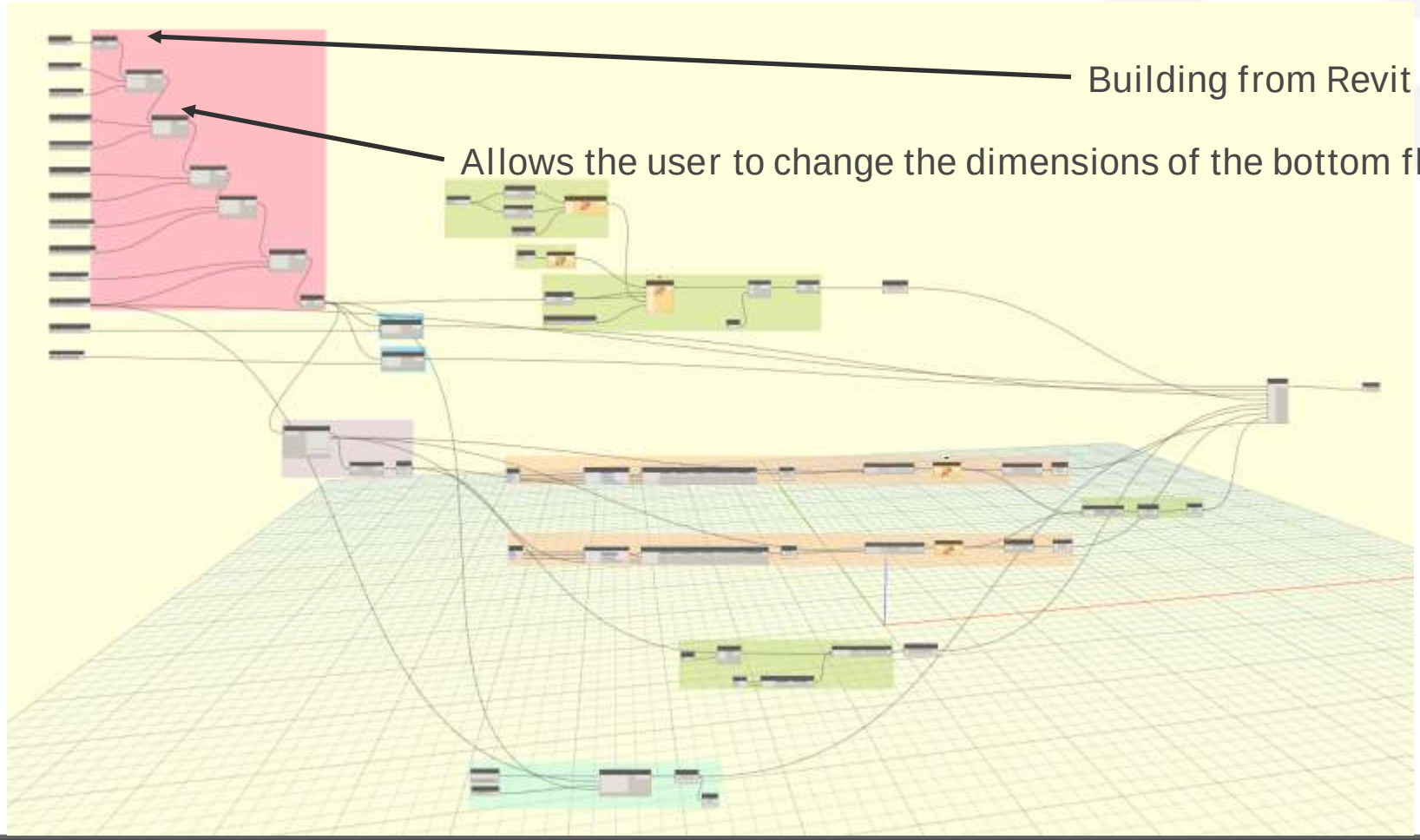
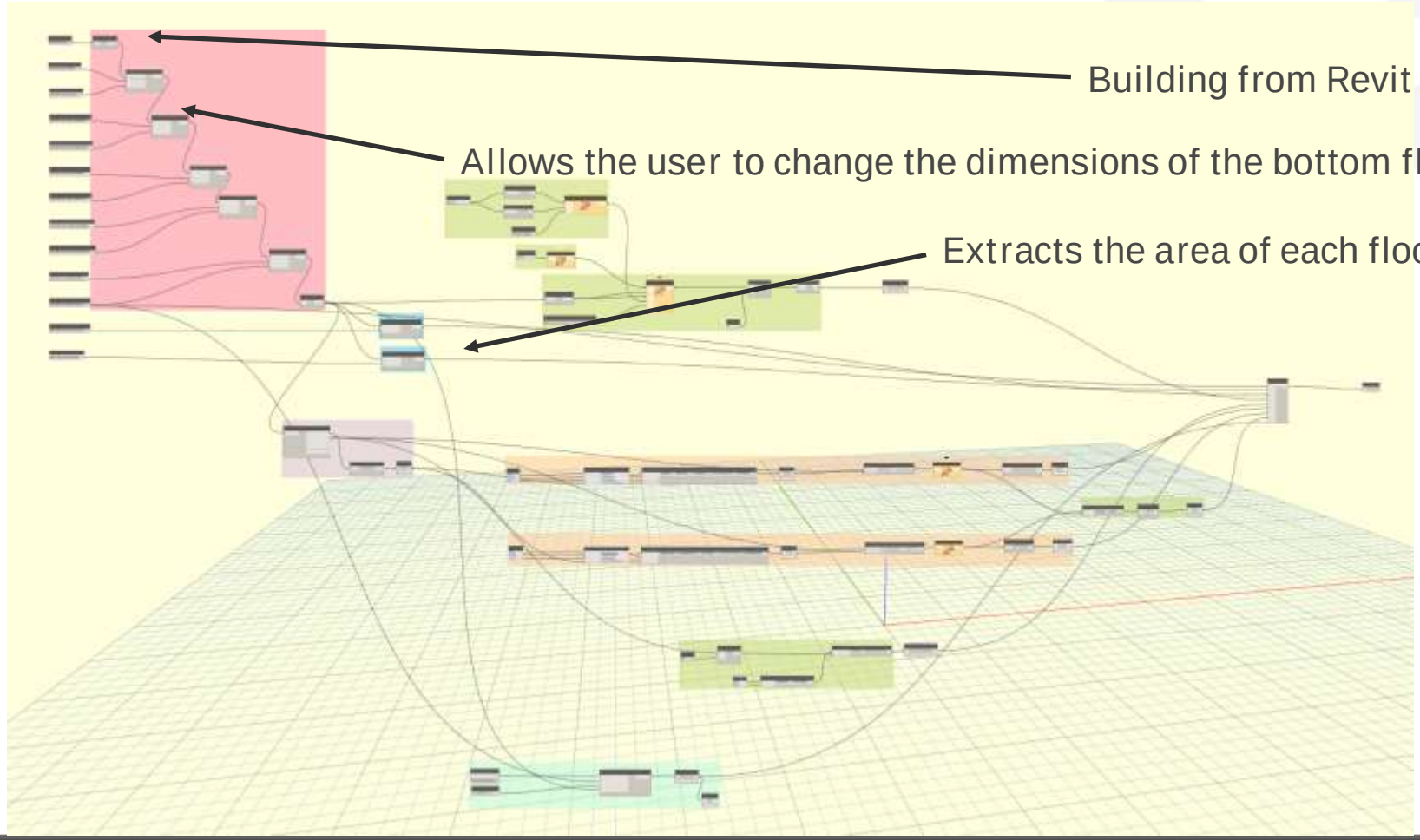
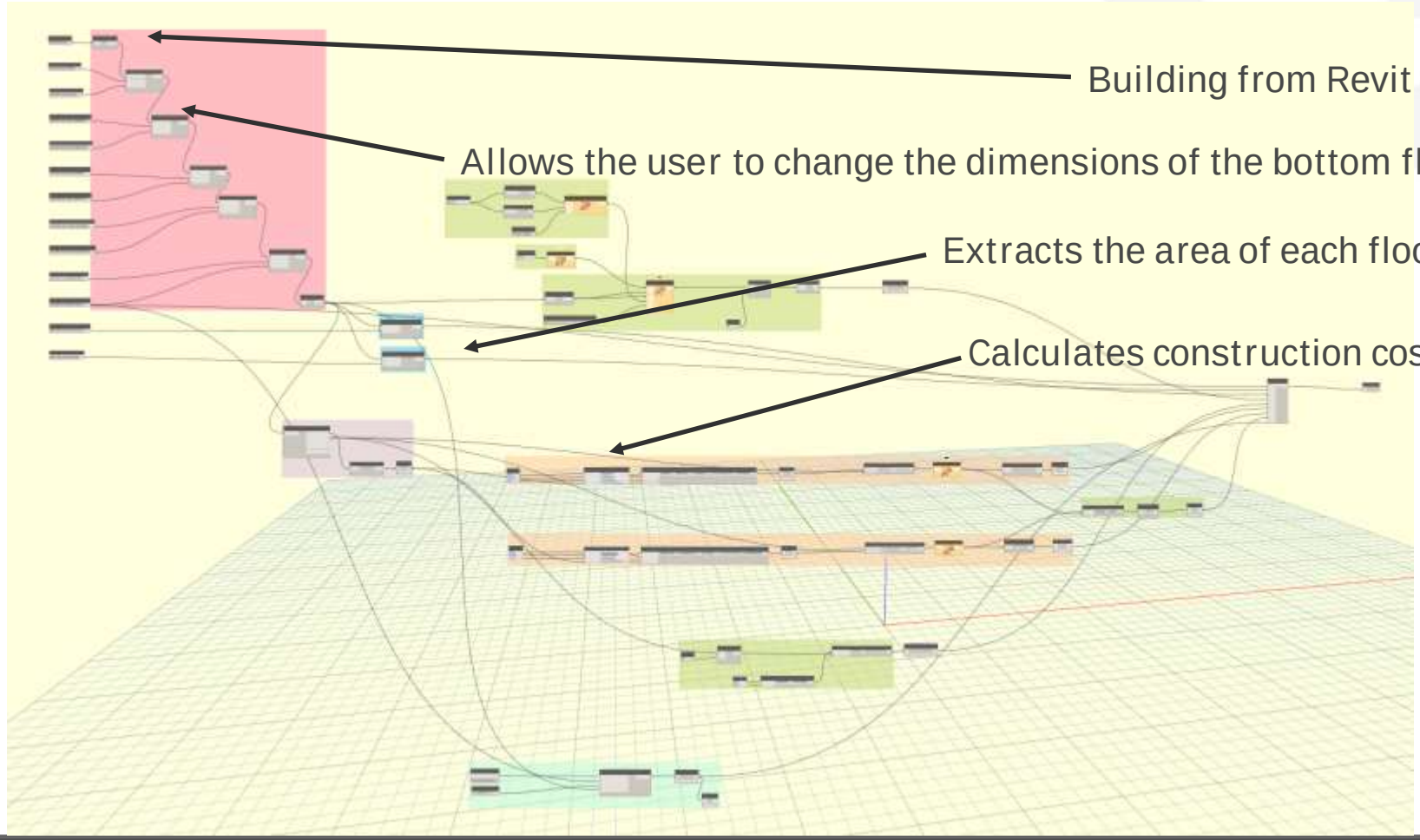


Generative Energy & Cost Workflow



Generative Energy & Cost Workflow



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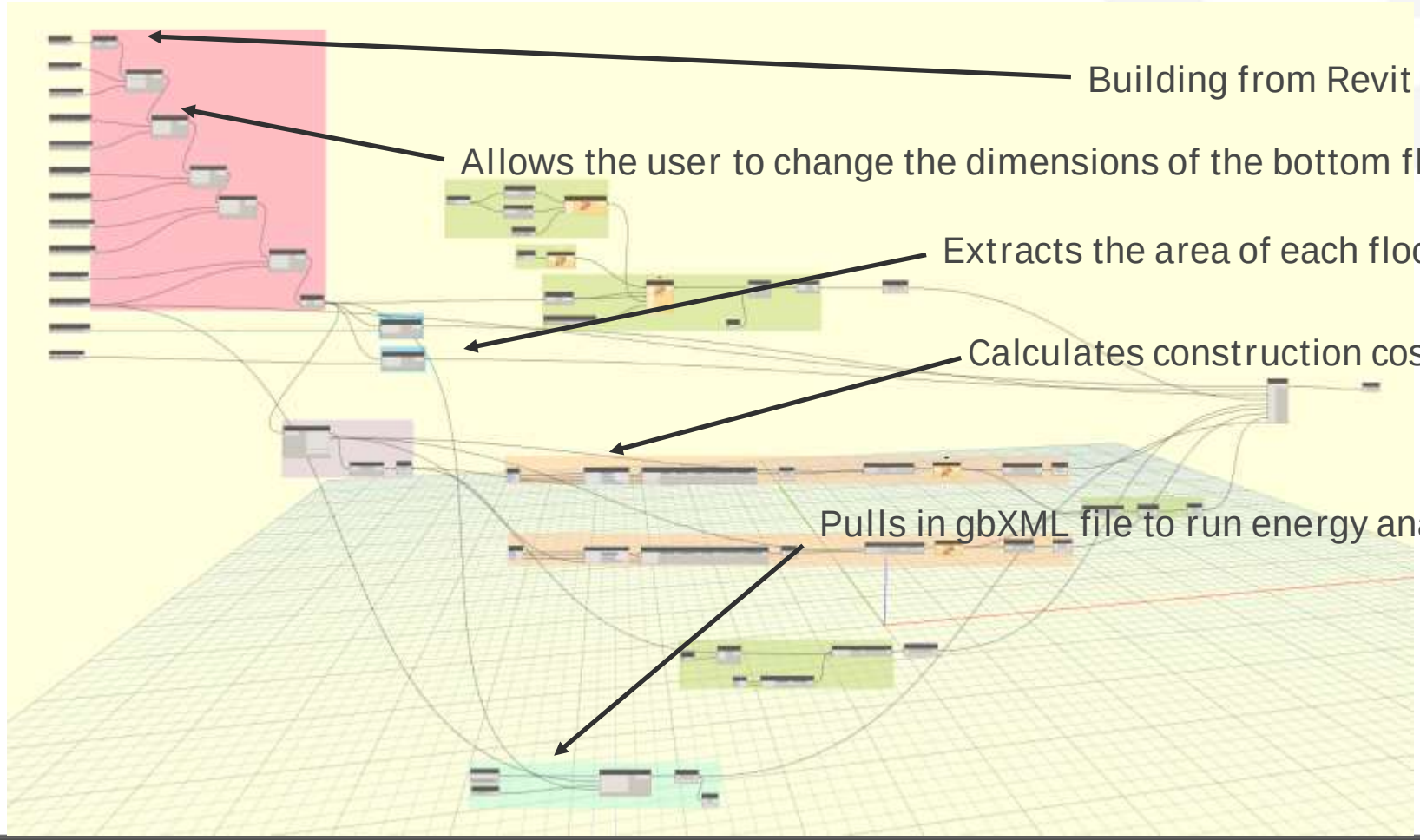
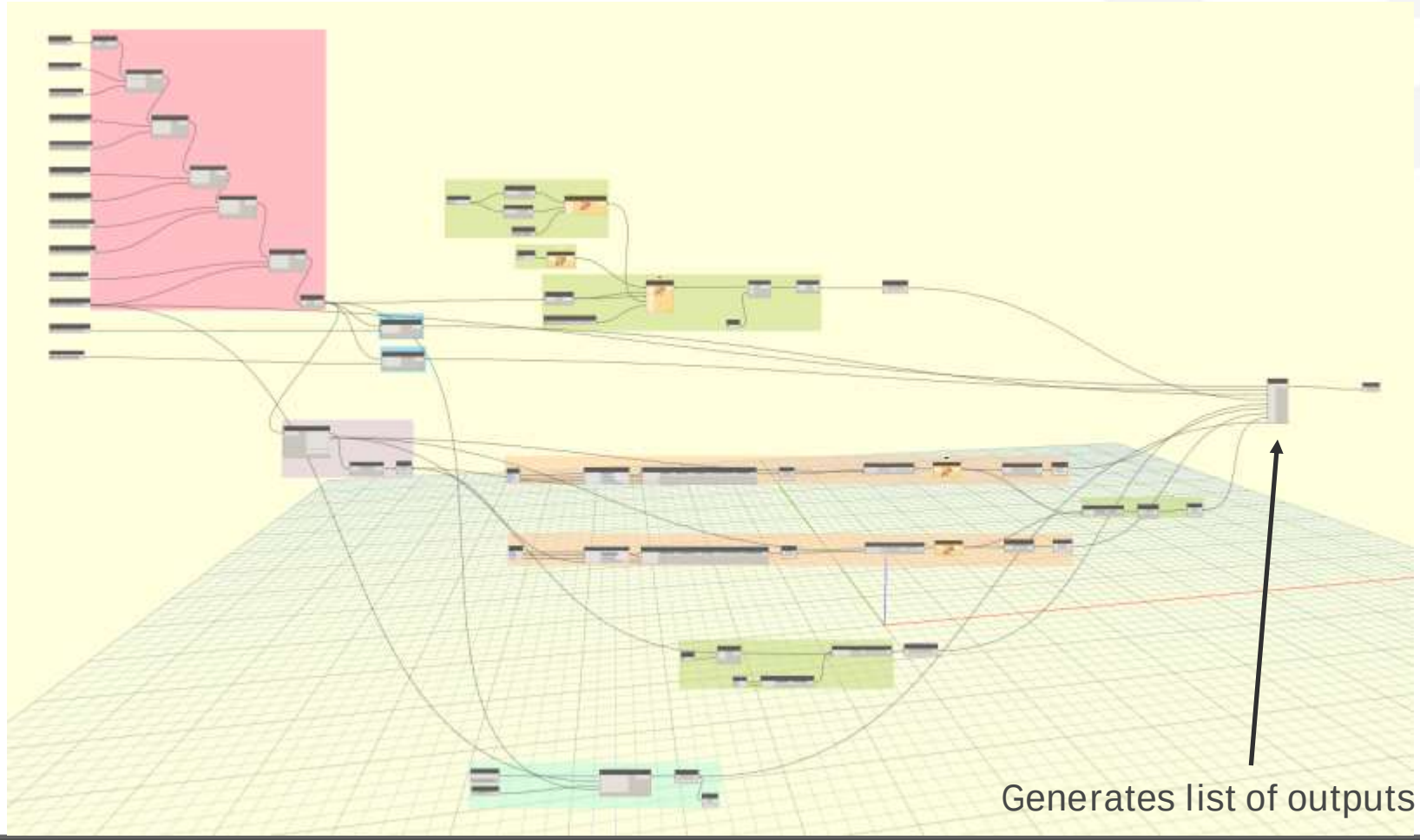
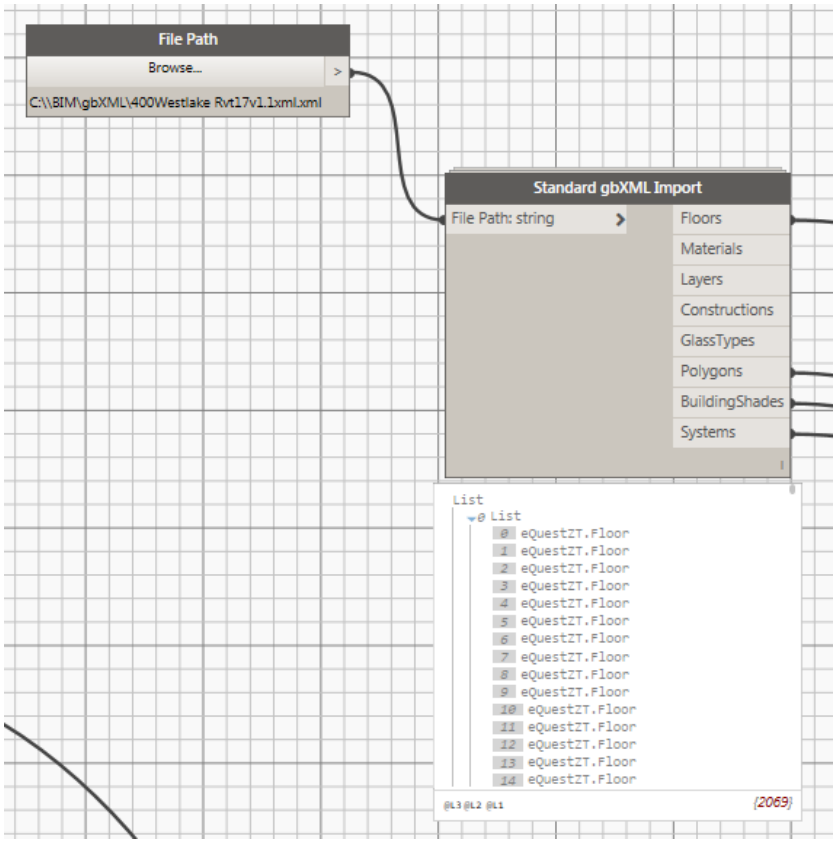


Generative Energy & Cost Workflow



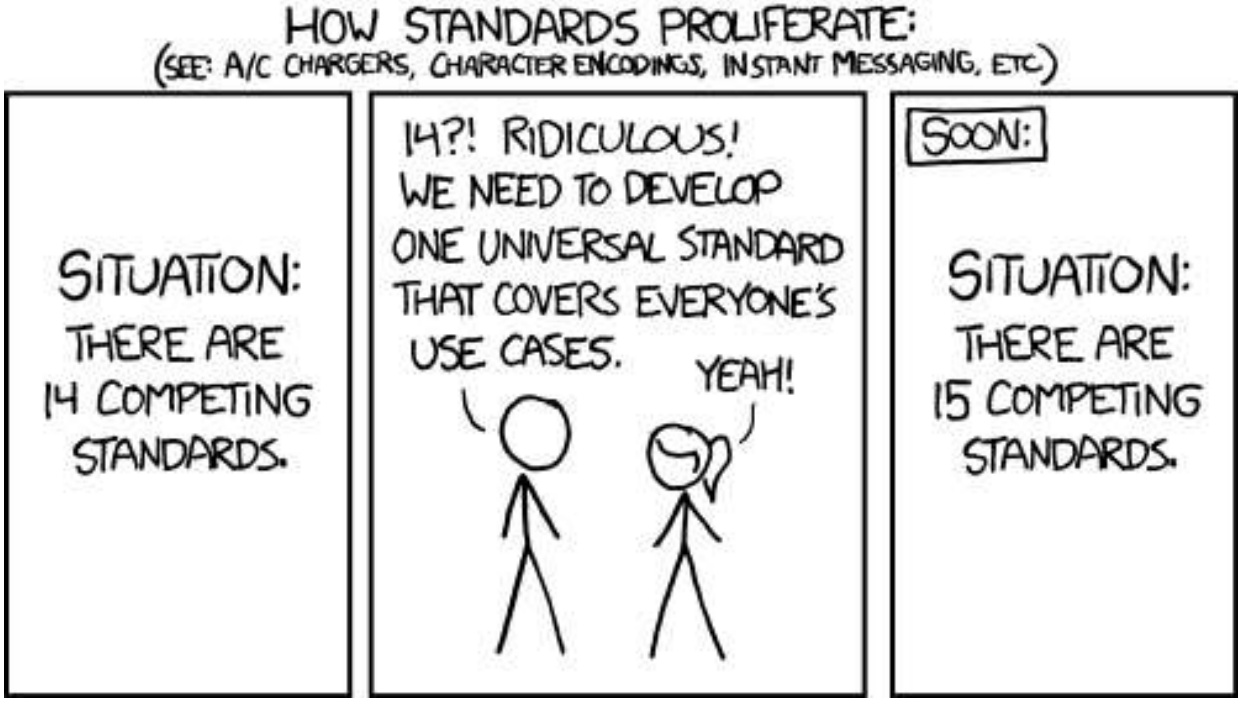
WHAT'S ON THE HORIZON

Architectural Integration



Full Automation

Full or nearly full automation could be achievable at some point but would probably require some sort standard and no one likes standards.



Resources

- Downloads
  - http://www.grasshopper3d.com/
  - http://dynamobim.org/
- Community Resources
  - http://www.grasshopper3d.com/forum
  - https://forum.dynamobim.com/
  - http://www.ladybug.tools/
  - https://www.python.org/
  - https://docs.microsoft.com/en-us/dotnet/visual-basic/
  - https://docs.microsoft.com/en-us/dotnet/csharp/csharp
  - https://github.com/

THANK YOU

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