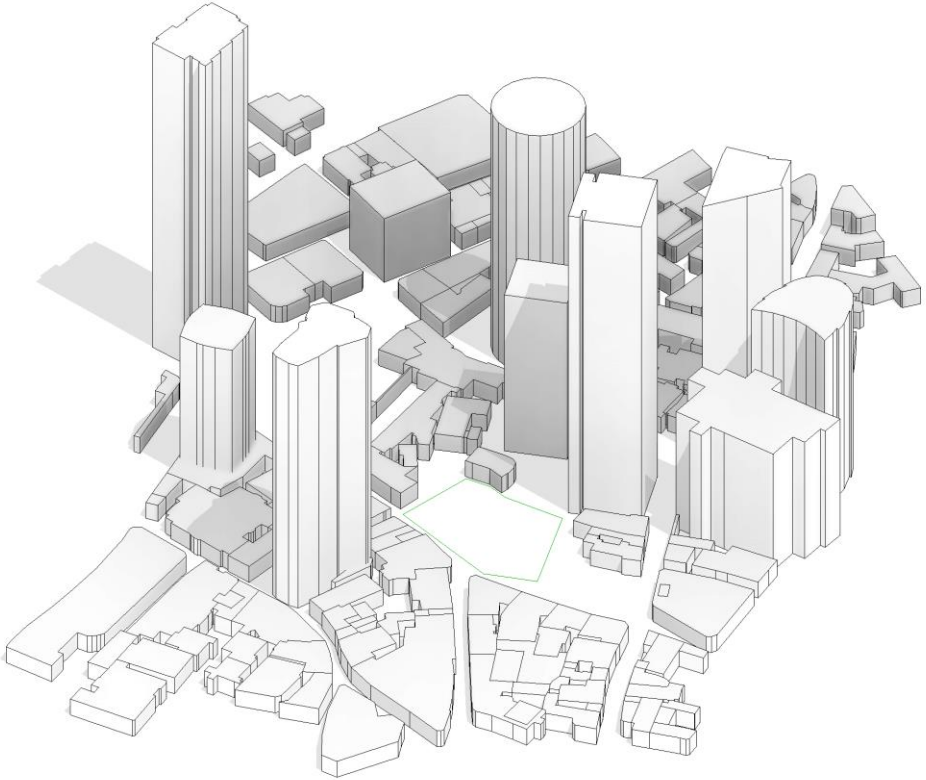
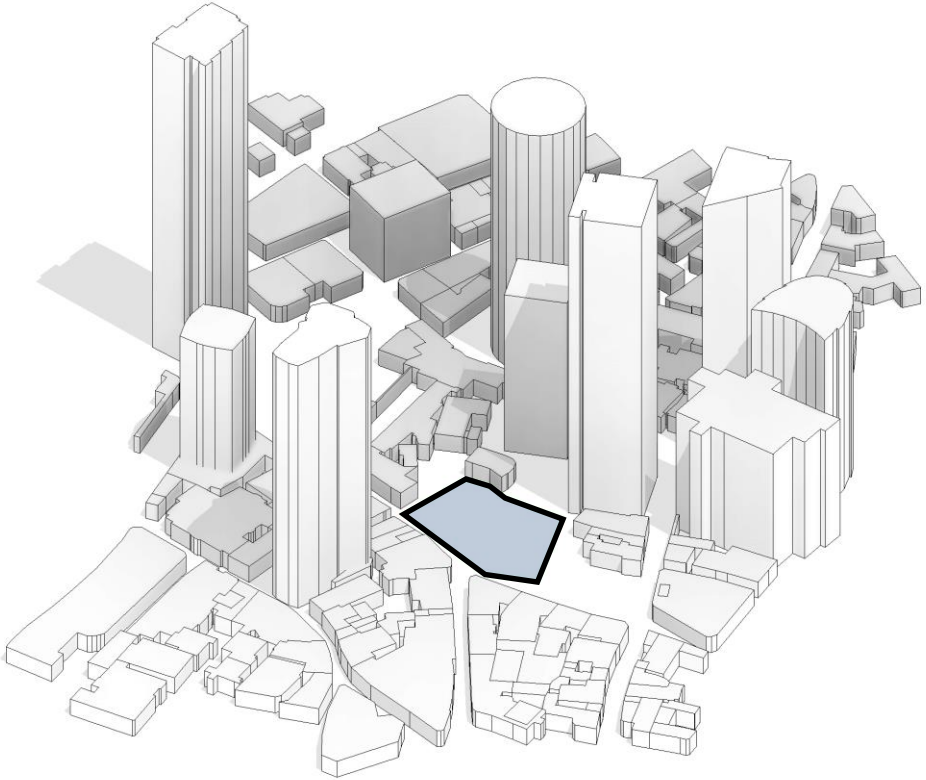
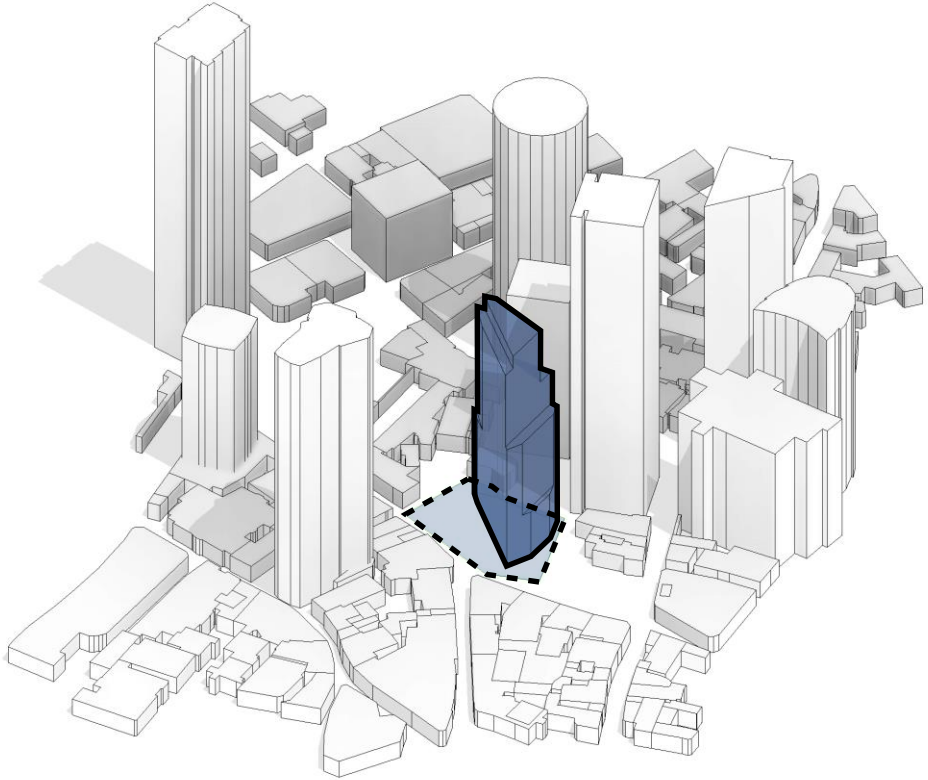
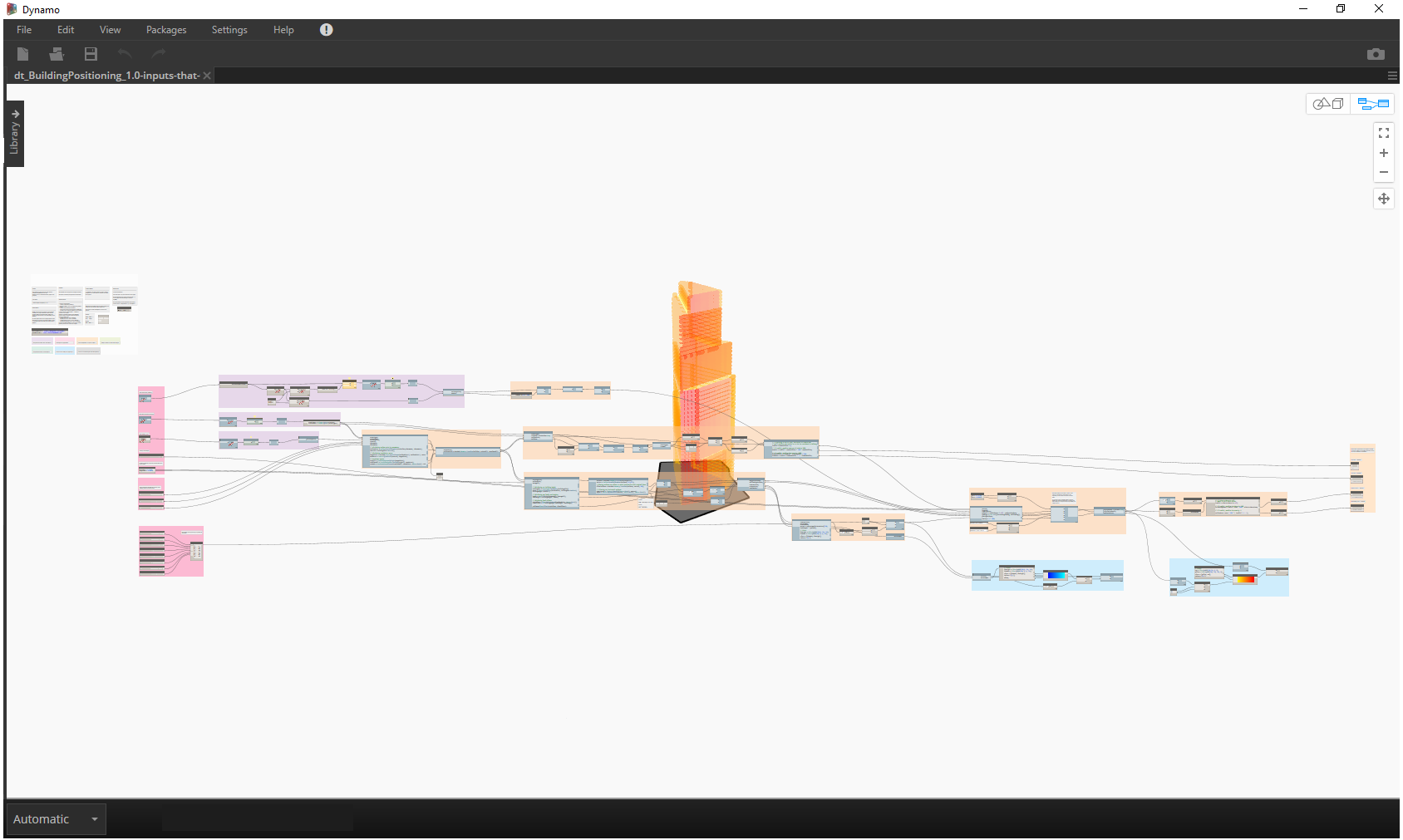
Example

Solar Analysis, Building Placement








Dynamo
File
Edit
View
Packages
Settings
Help
dt_BuildingPositioning_1.0-inputs-that-
Library
Automatic

Variable design inputs

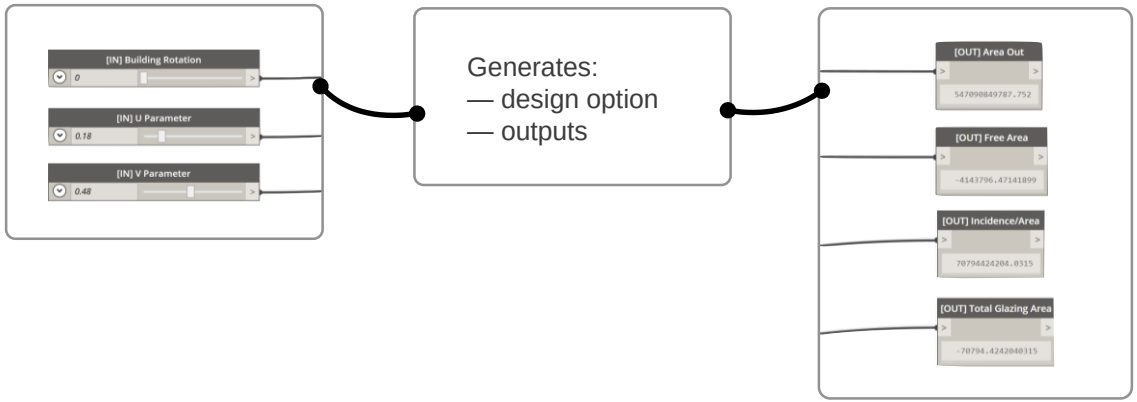
Inputs

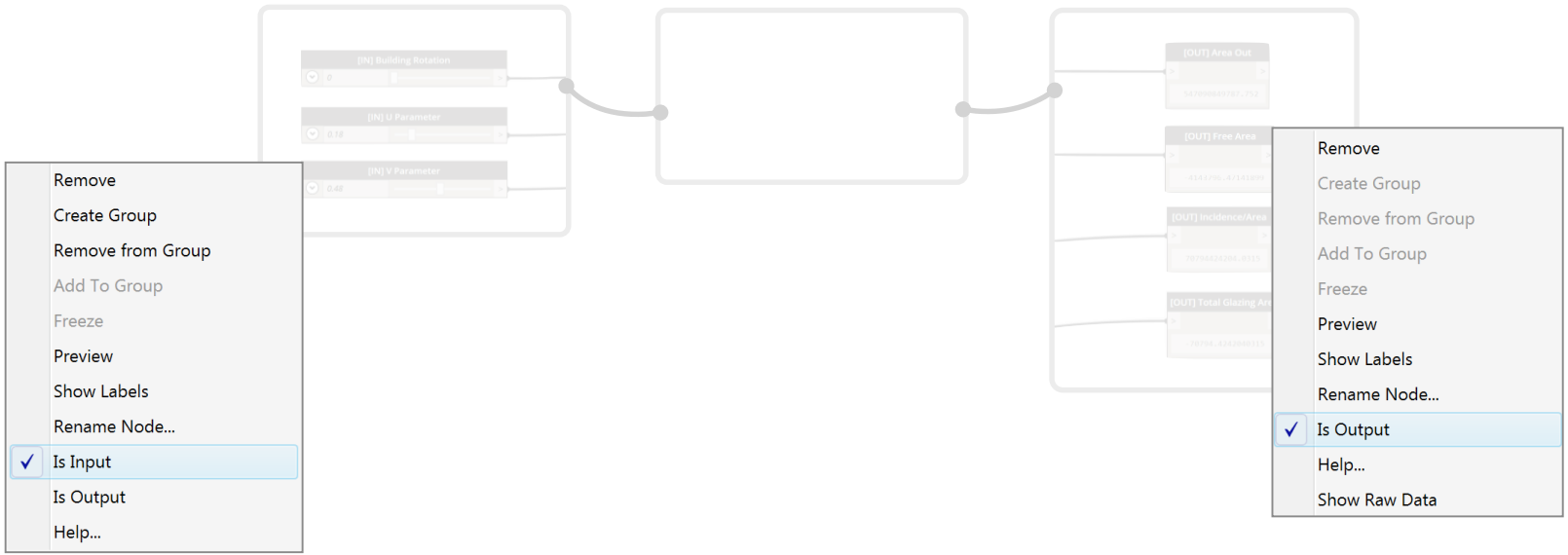
Computational design logic

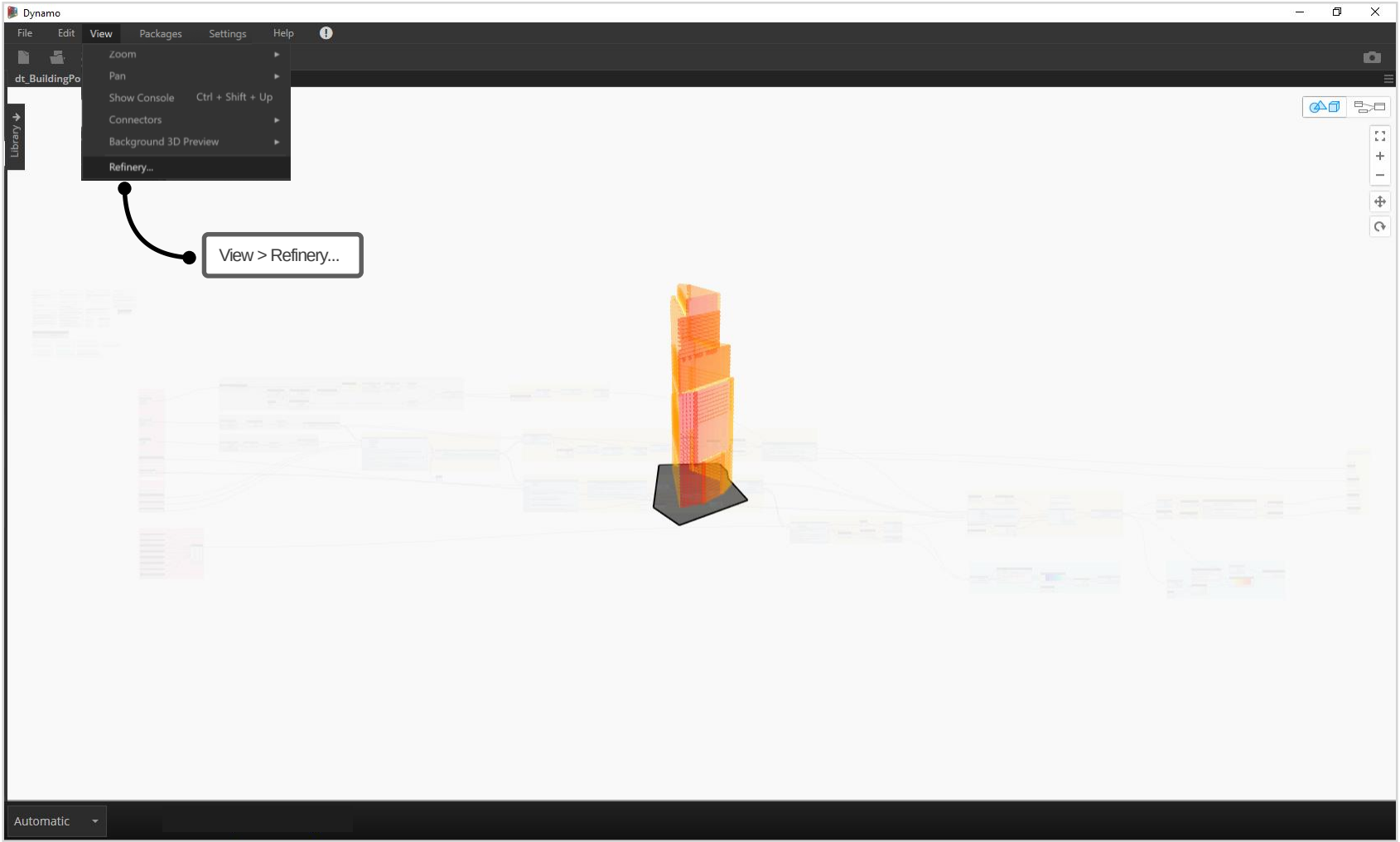
Function

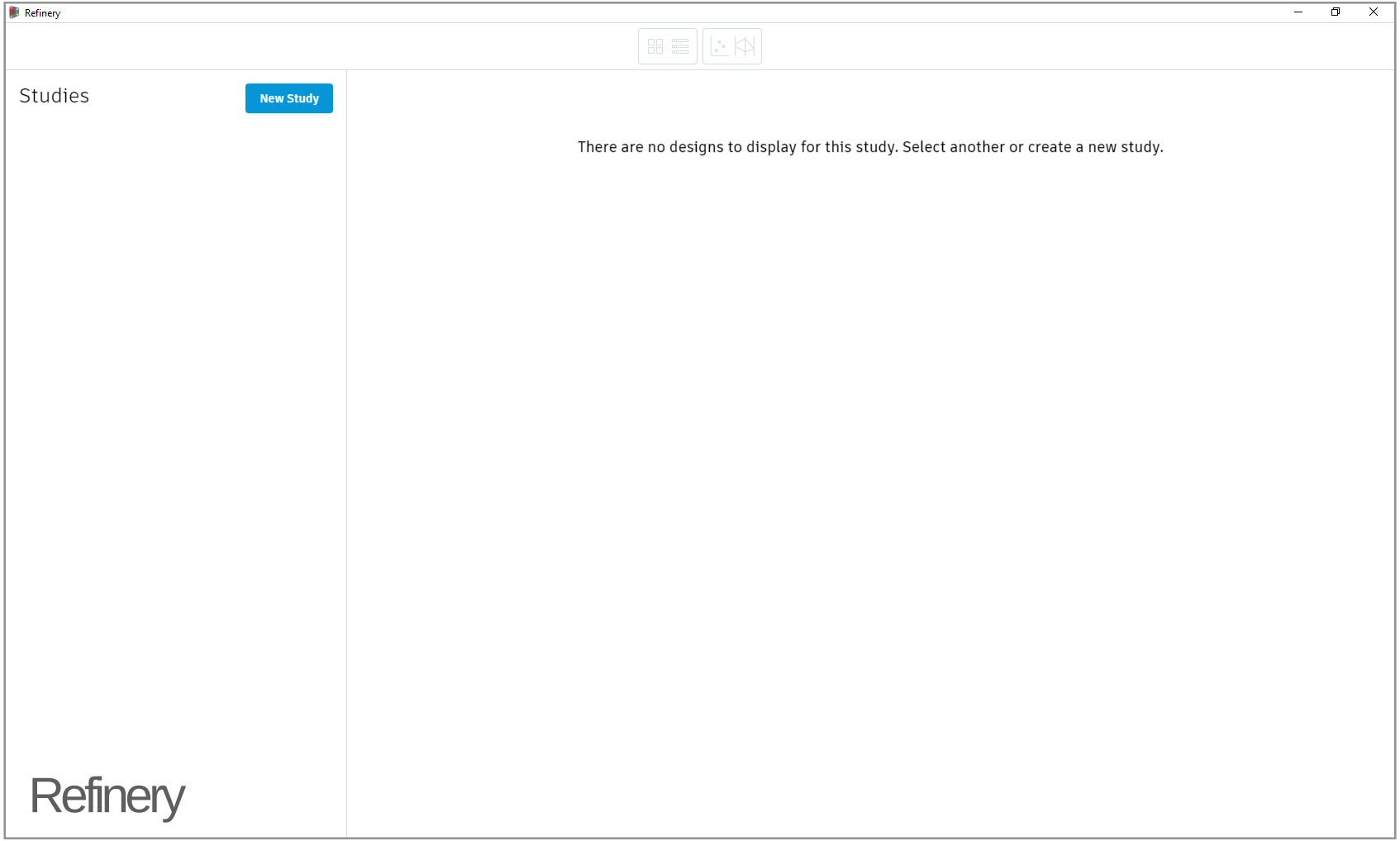
Design goals and metrics

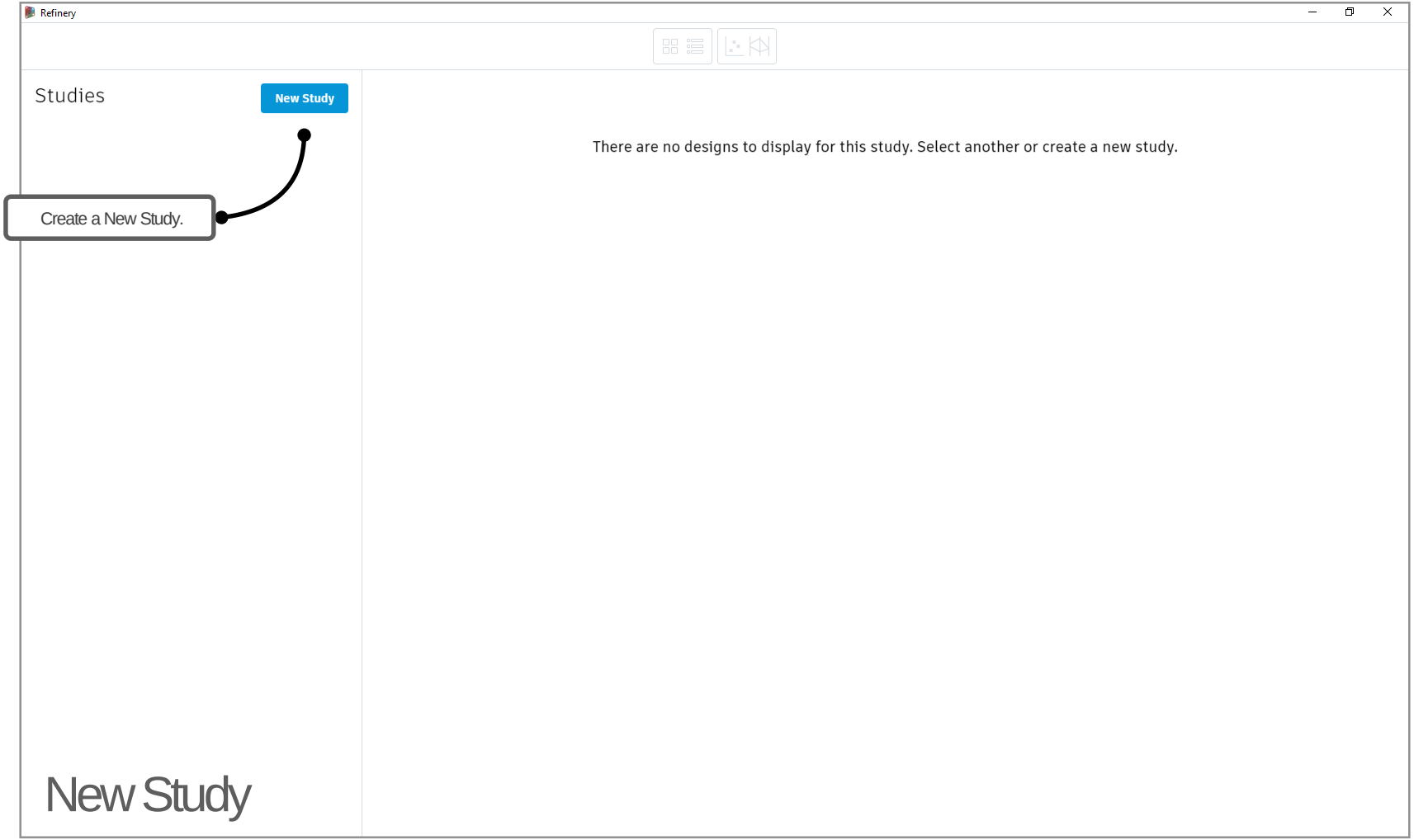
Outputs

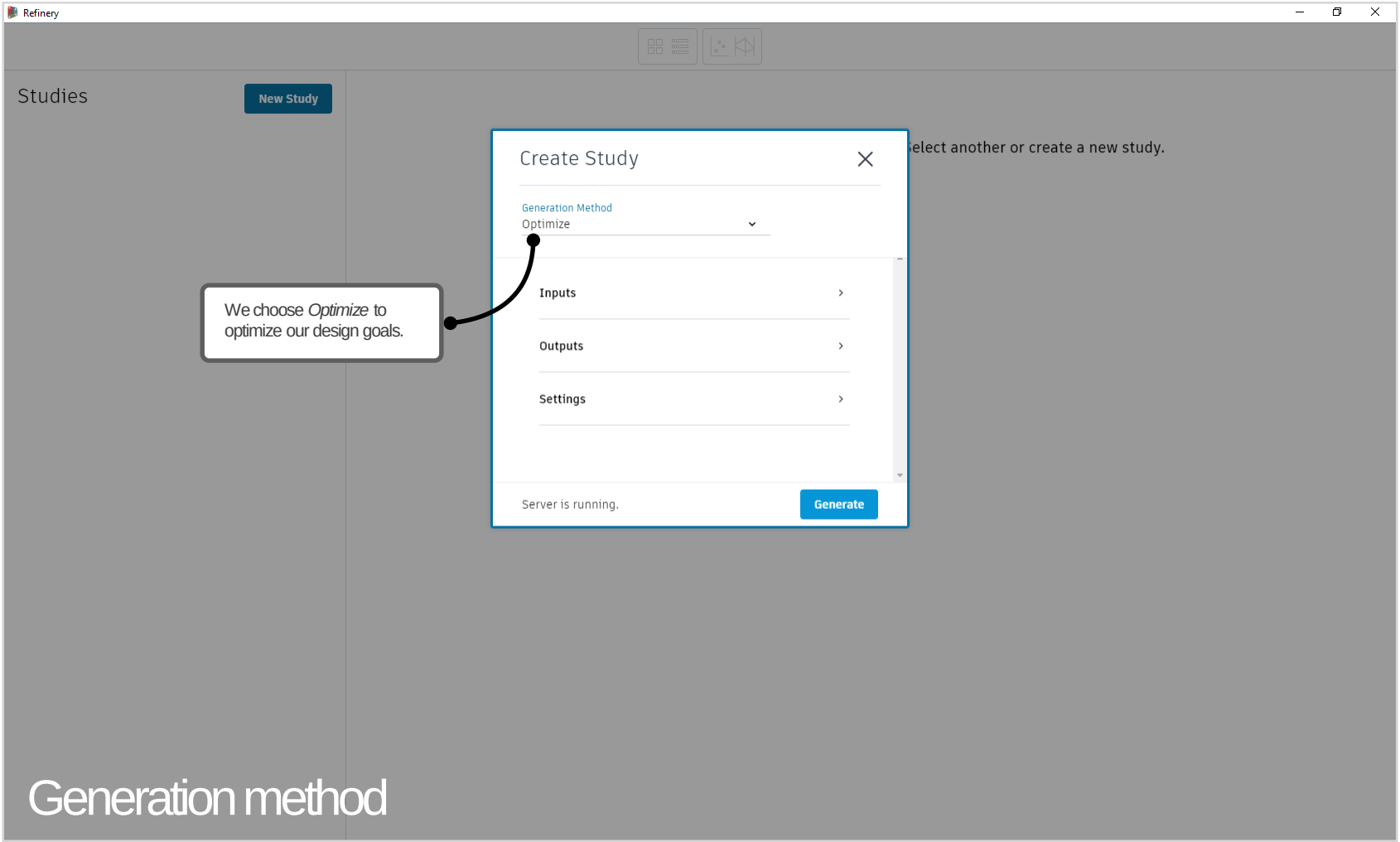



[IN] Building Rotation
[IN] U Parameter
[IN] V Parameter
[OUT] Area Out
[OUT] Free Area
[OUT] Incidence/Area
[OUT] Total Glazing Ar
Remove
Create Group
Remove from Group
Add To Group
Freeze
Preview
Show Labels
Rename Node...
Is Input
Is Output
Help...
Remove
Create Group
Remove from Group
Add To Group
Freeze
Preview
Show Labels
Rename Node...
Is Output
Help...
Show Raw Data

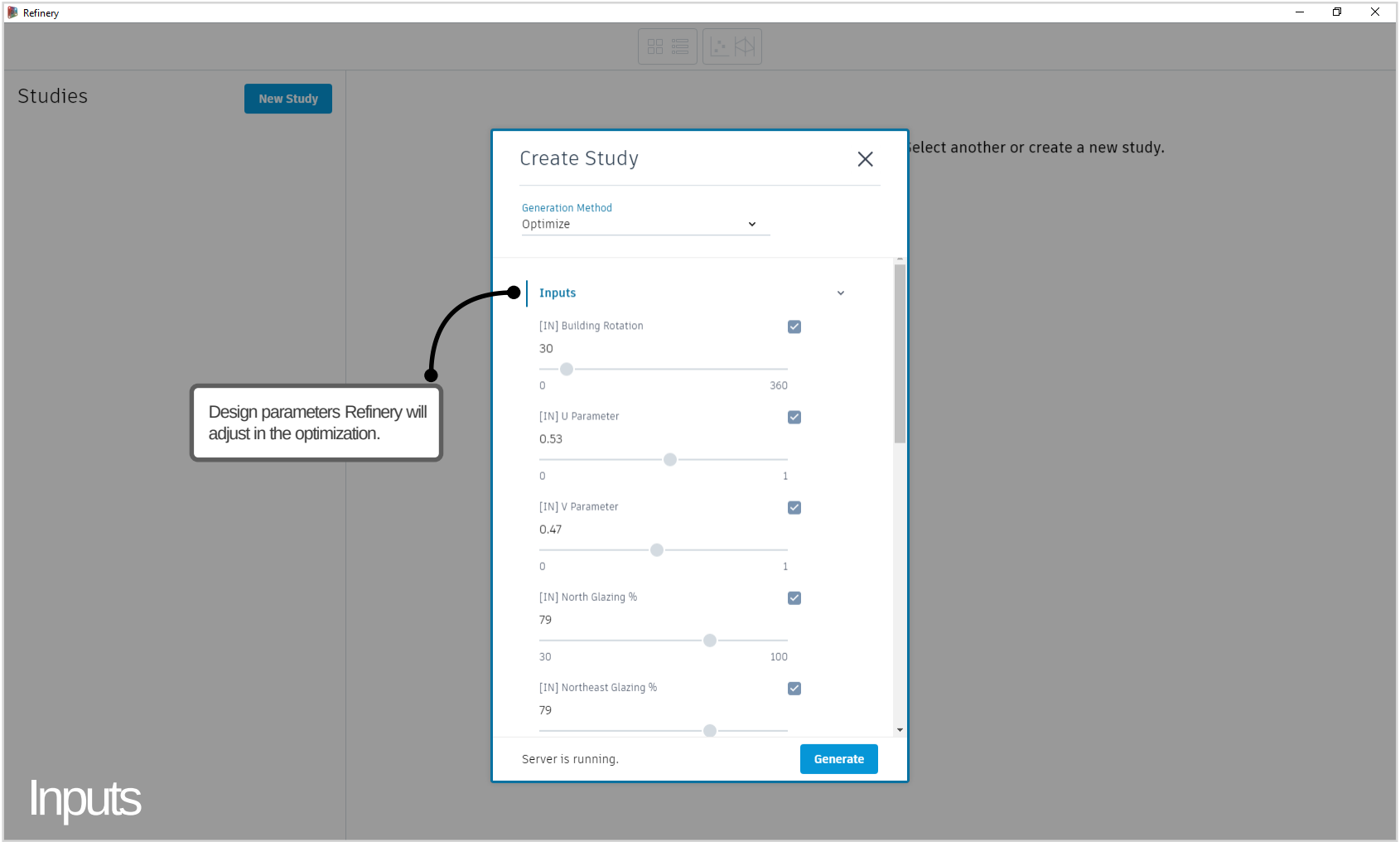

Dynamo
File
Edit
View
Packages
Settings
Help
Zoom
Pan
Show Console
Ctrl + Shift + Up
Connectors
Background 3D Preview
Refinery...
View > Refinery...
Library
Automatic

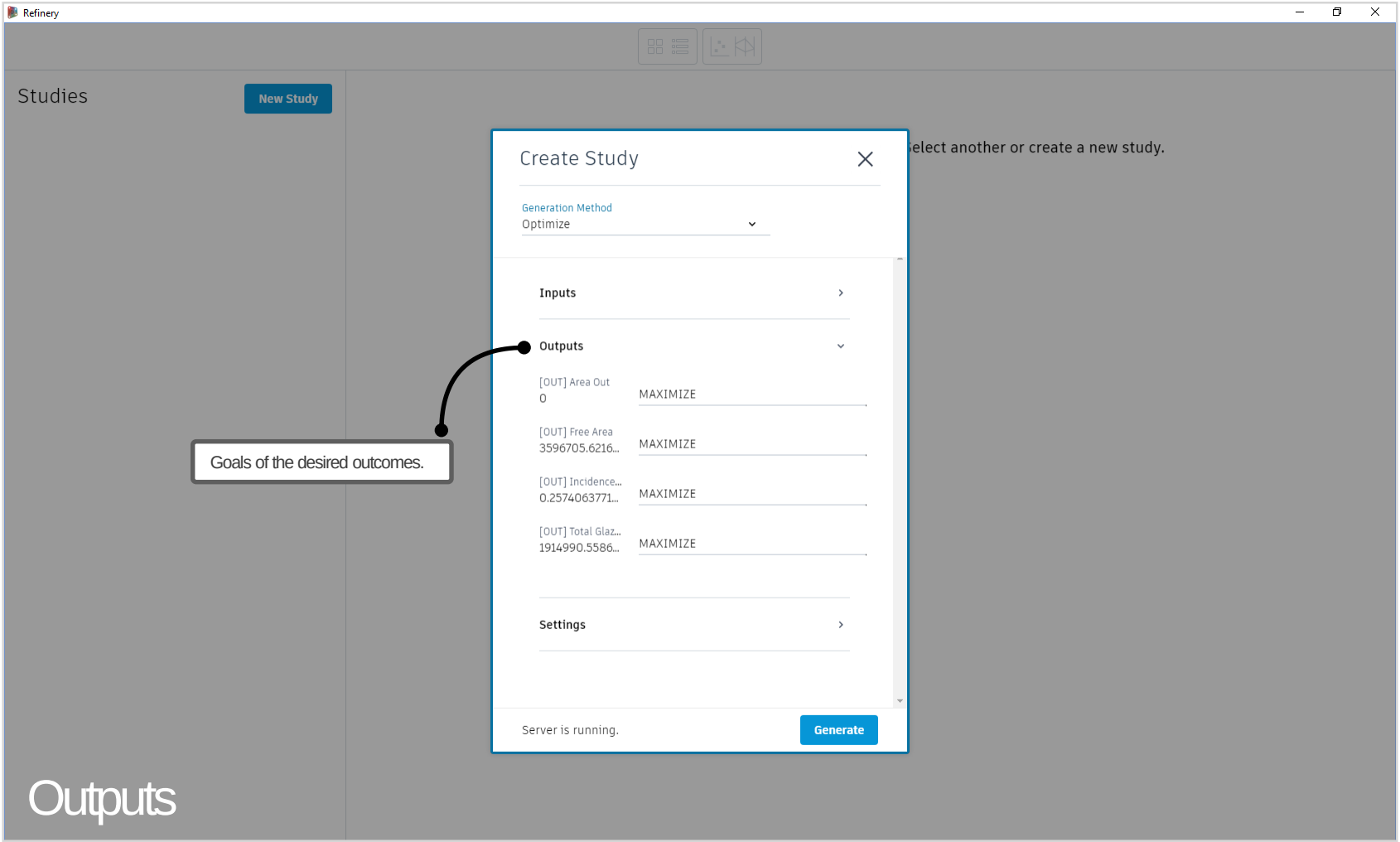

Refinery
Studies
New Study
There are no designs to display for this study. Select another or create a new study.
Refinery

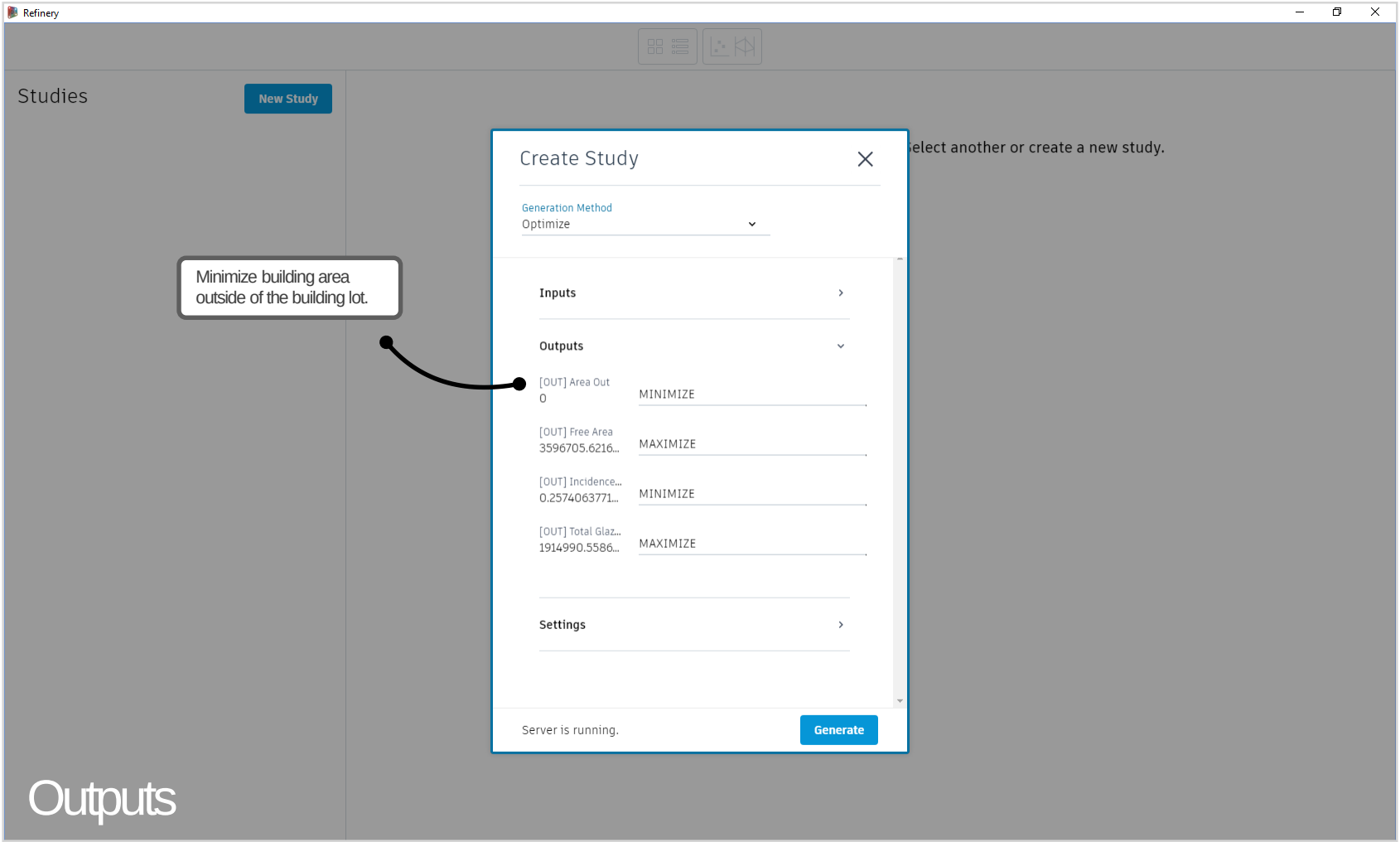

Refinery
Studies
New Study
There are no designs to display for this study. Select another or create a new study.
Create a New Study.
New Study

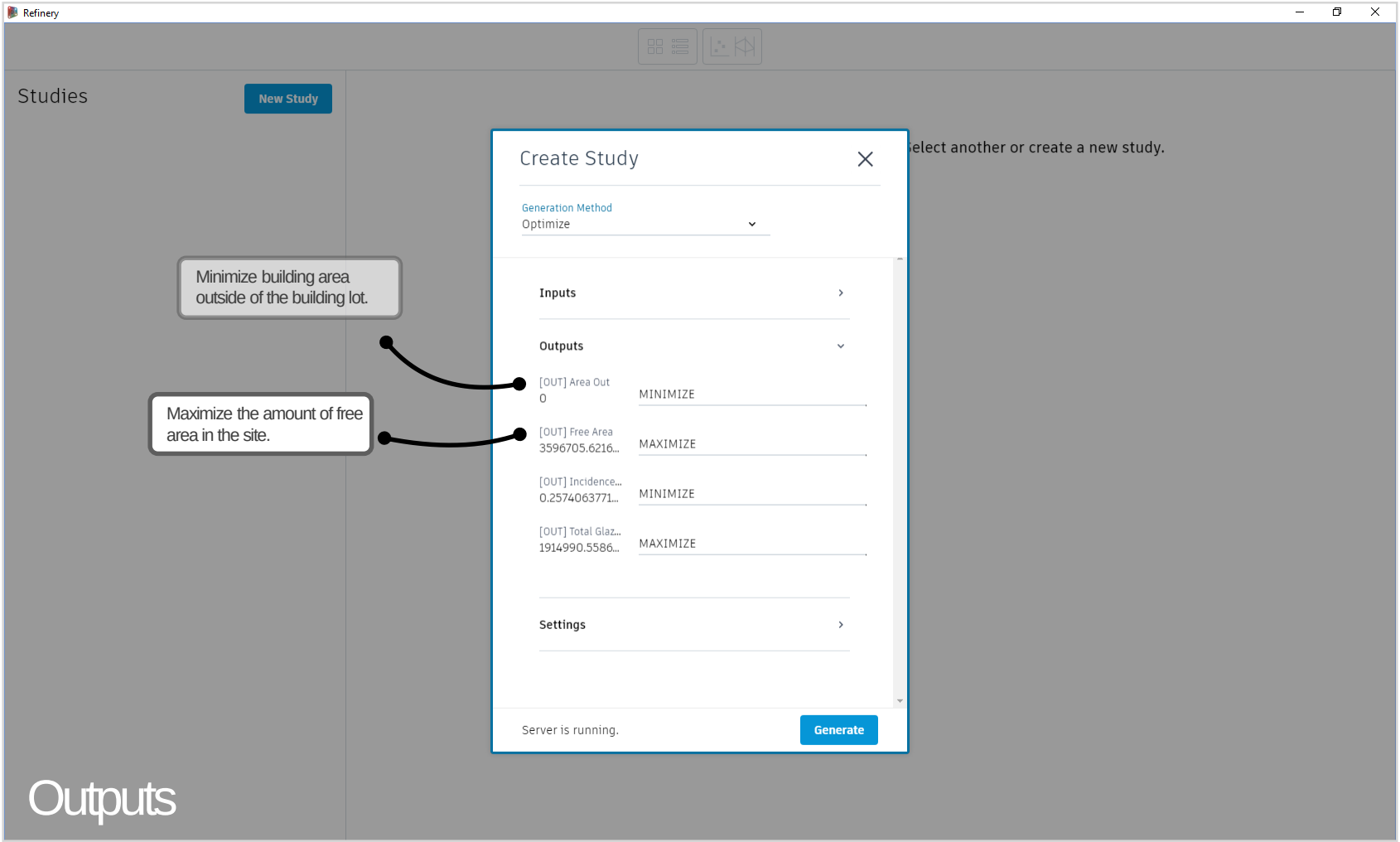


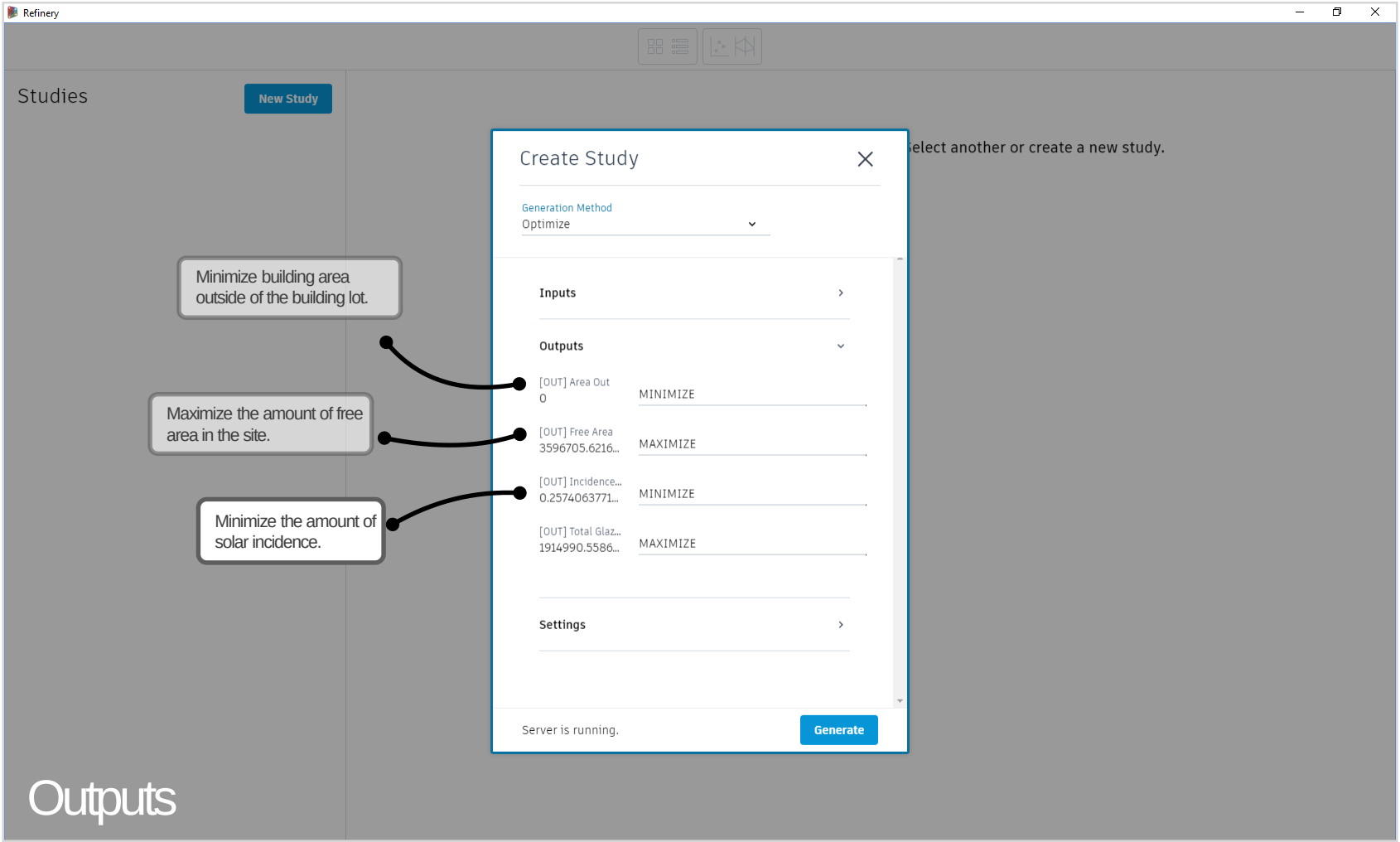
Generation method

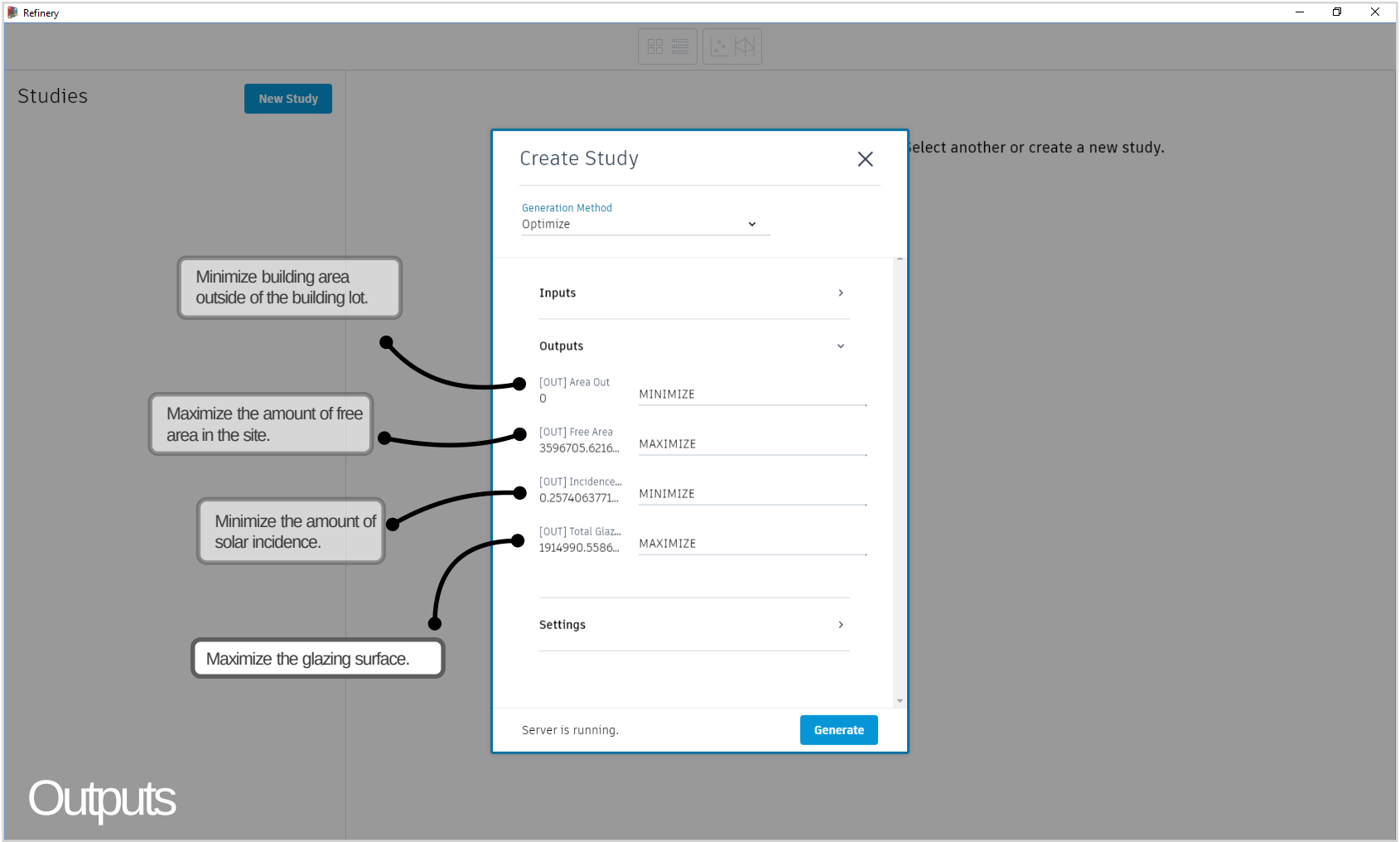

Refinery
Studies
New Study
elect another or create a new study.
Create Study
Generation Method
Optimize
Inputs
[IN] Building Rotation
30
0
360
[IN] U Parameter
0.53
0
1
[IN] V Parameter
0.47
0
1
[IN] North Glazing %
79
30
100
[IN] Northeast Glazing %
79
Server is running.
Generate
Design parameters Refinery will adjust in the optimization.
Inputs

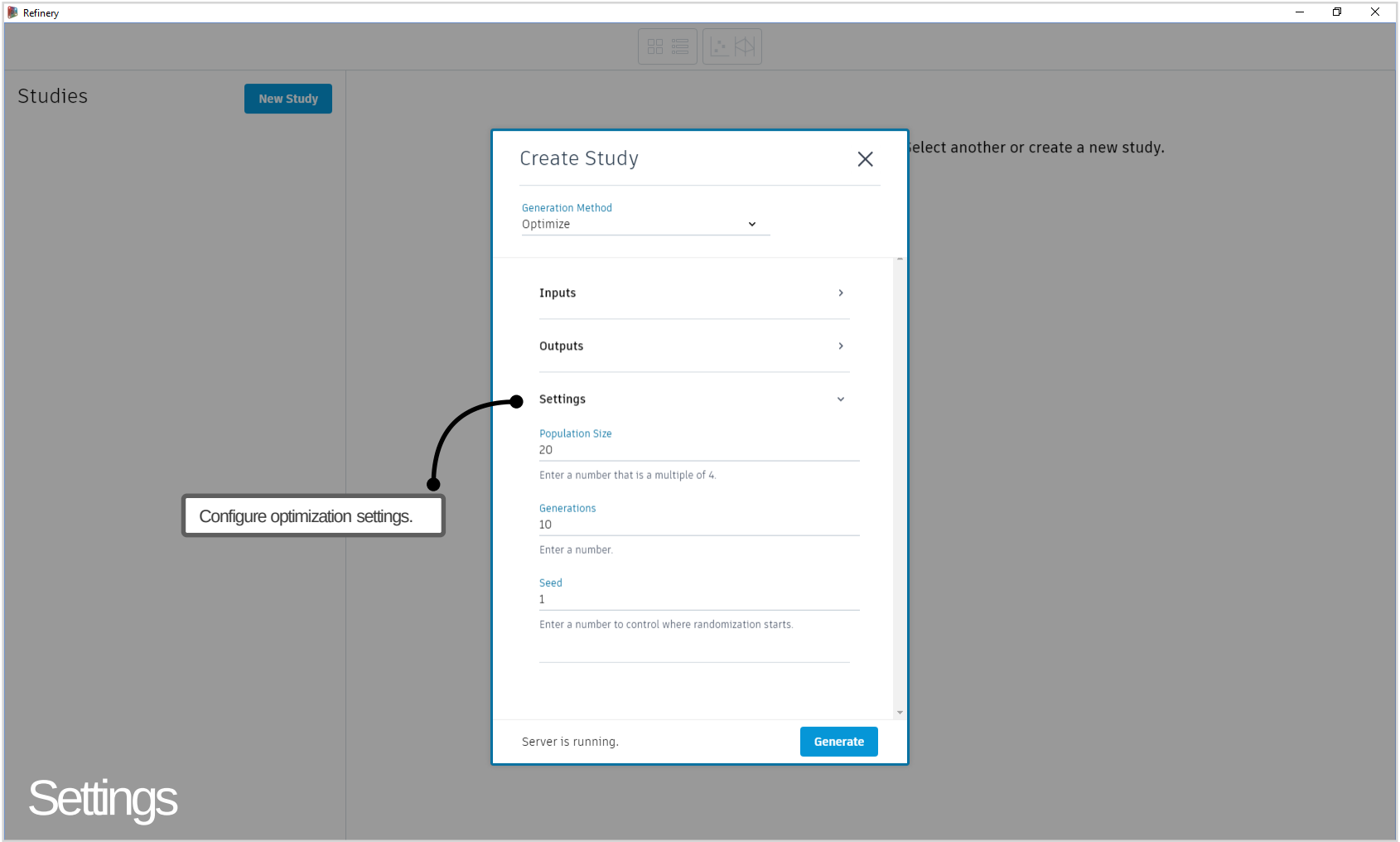

Refinery
Studies
New Study
elect another or create a new study.
Create Study
Generation Method
Optimize
Inputs
Outputs
[OUT] Area Out
0
MAXIMIZE
[OUT] Free Area
3596705.6216...
MAXIMIZE
[OUT] Incidence...
0.2574063771...
MAXIMIZE
[OUT] Total Glaz...
1914990.5586...
MAXIMIZE
Settings
Server is running.
Generate
Goals of the desired outcomes.
Outputs

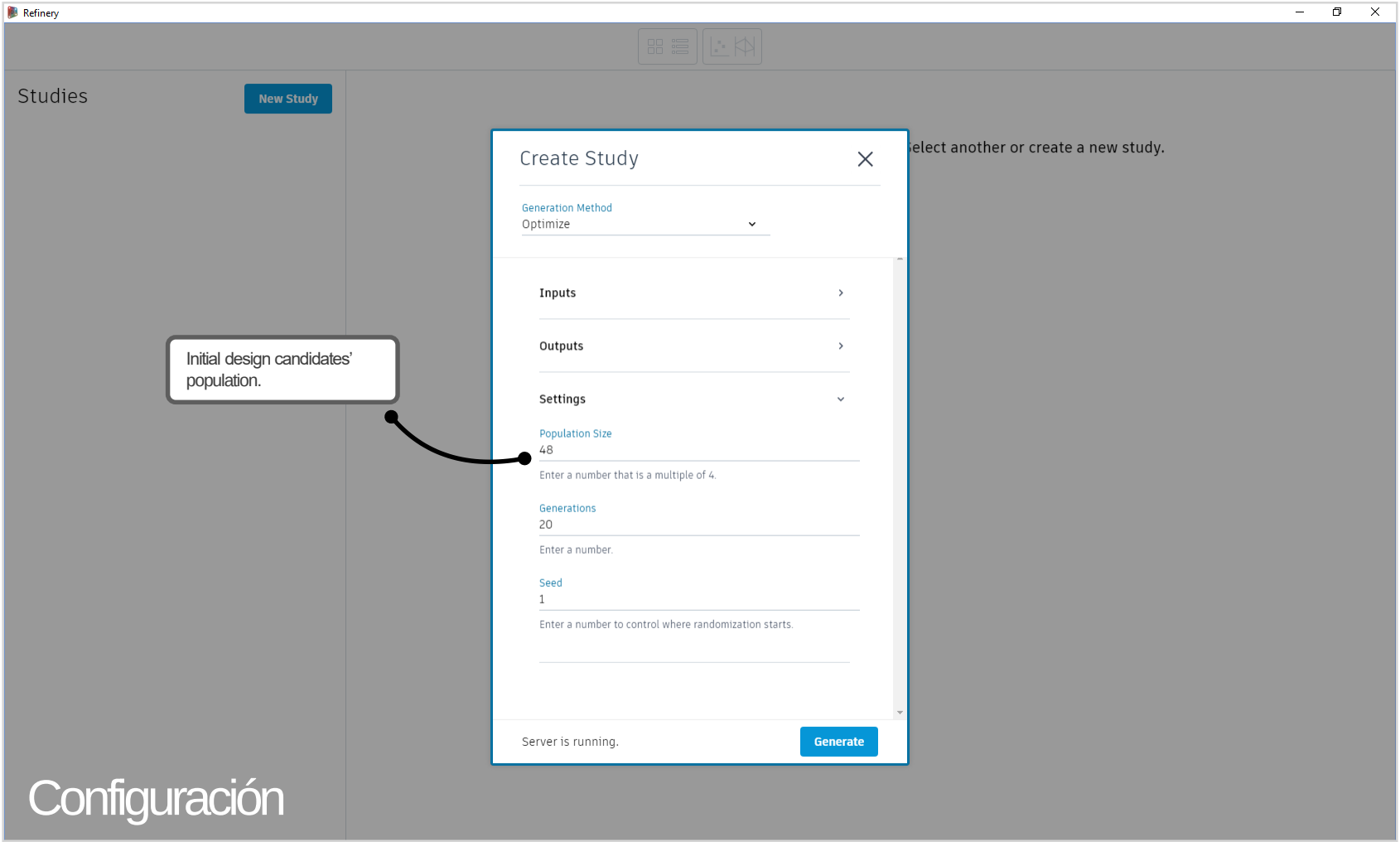

Refinery
Studies
New Study
elect another or create a new study.
Minimize building area outside of the building lot.
Create Study
Generation Method
Optimize
Inputs
Outputs
[OUT] Area Out
0
MINIMIZE
[OUT] Free Area
3596705.6216...
MAXIMIZE
[OUT] Incidence...
0.2574063771...
MINIMIZE
[OUT] Total Glaz...
1914990.5586...
MAXIMIZE
Settings
Server is running.
Generate
Outputs

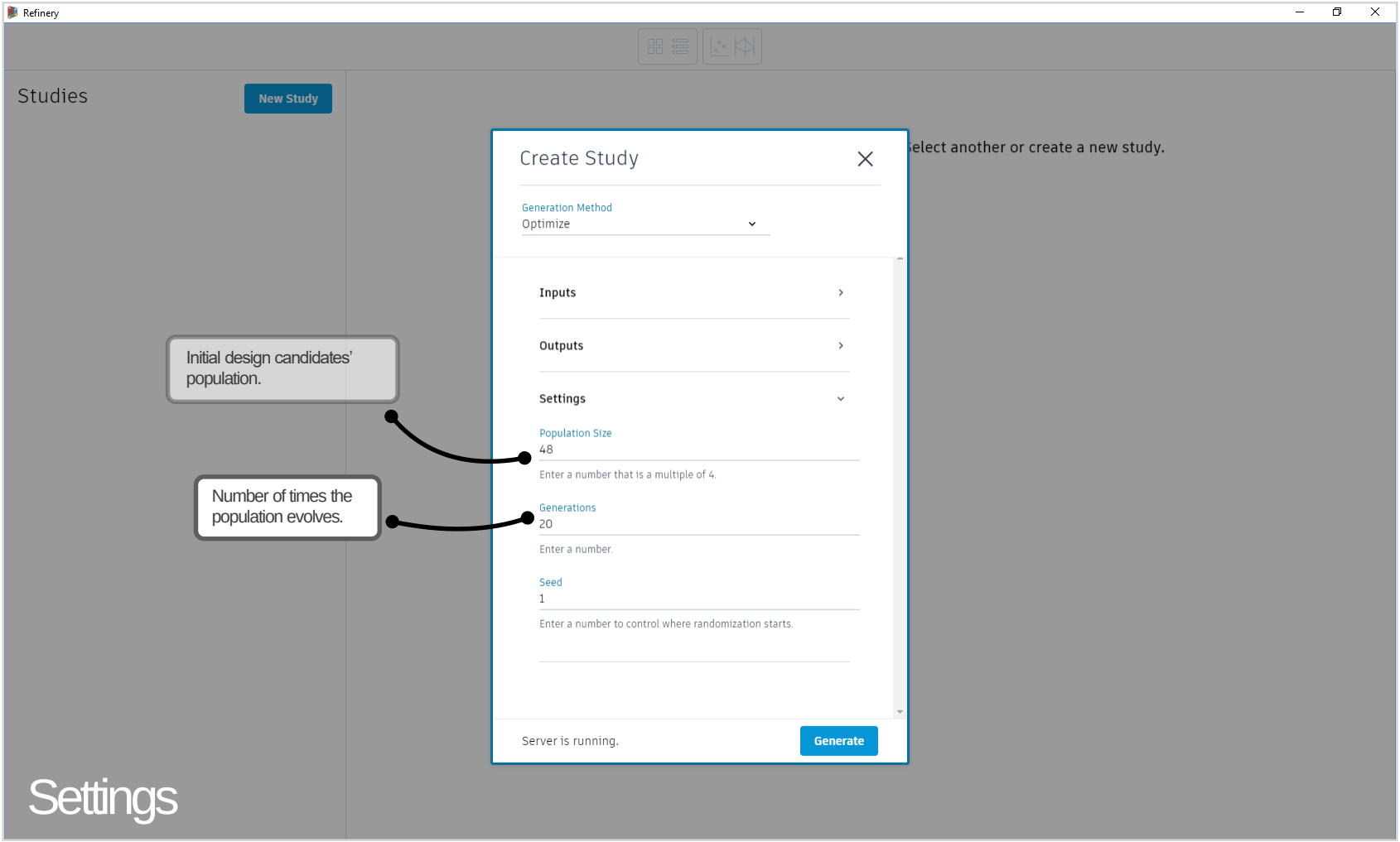

Refinery
Studies
New Study
elect another or create a new study.
Minimize building area outside of the building lot.
Maximize the amount of free area in the site.
Create Study
Generation Method
Optimize
Inputs
Outputs
[OUT] Area Out
0
MINIMIZE
[OUT] Free Area
3596705.6216...
MAXIMIZE
[OUT] Incidence...
0.2574063771...
MINIMIZE
[OUT] Total Glaz...
1914990.5586...
MAXIMIZE
Settings
Server is running.
Generate
Outputs

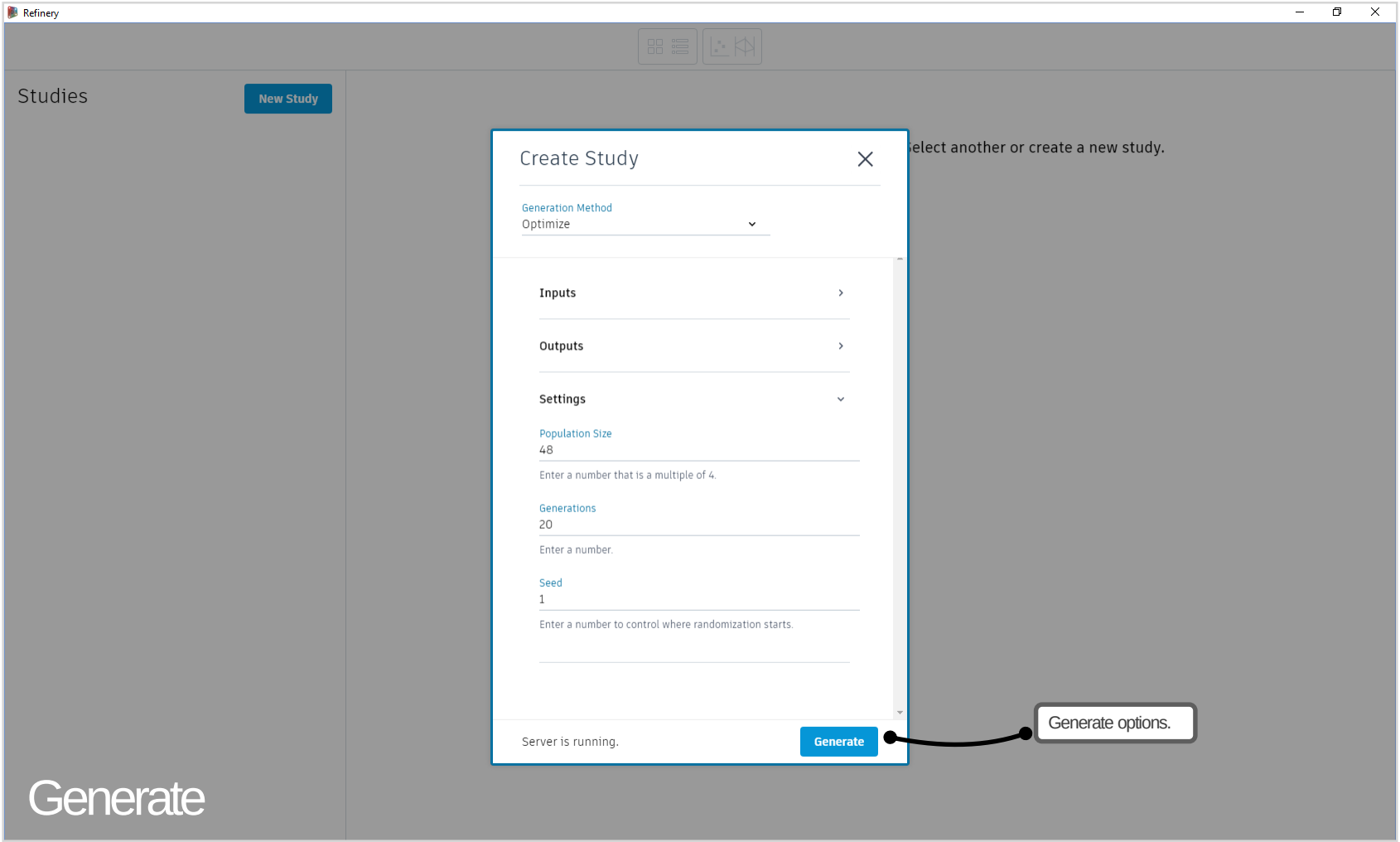

Refinery
Studies
New Study
elect another or create a new study.
Create Study
Generation Method
Optimize
Inputs
Outputs
[OUT] Area Out
0
MINIMIZE
[OUT] Free Area
3596705.6216...
MAXIMIZE
[OUT] Incidence...
0.2574063771...
MINIMIZE
[OUT] Total Glaz...
1914990.5586...
MAXIMIZE
Settings
Server is running.
Generate
Minimize building area outside of the building lot.
Maximize the amount of free area in the site.
Minimize the amount of solar incidence.
Outputs


Refinery
Studies
New Study
elect another or create a new study.
Create Study
Generation Method
Optimize
Inputs
Outputs
[OUT] Area Out
0
MINIMIZE
[OUT] Free Area
3596705.6216...
MAXIMIZE
[OUT] Incidence...
0.2574063771...
MINIMIZE
[OUT] Total Glaz...
1914990.5586...
MAXIMIZE
Settings
Server is running.
Generate
Minimize building area outside of the building lot.
Maximize the amount of free area in the site.
Minimize the amount of solar incidence.
Maximize the glazing surface.
Outputs


Refinery
Studies
New Study
elect another or create a new study.
Create Study
Generation Method
Optimize
Inputs
Outputs
Settings
Population Size
20
Enter a number that is a multiple of 4.
Generations
10
Enter a number.
Seed
1
Enter a number to control where randomization starts.
Server is running.
Generate
Configure optimization settings.
Settings


Refinery
Studies
New Study
elect another or create a new study.
Create Study
Generation Method
Optimize
Inputs
Outputs
Settings
Population Size
48
Enter a number that is a multiple of 4.
Generations
20
Enter a number.
Seed
1
Enter a number to control where randomization starts.
Server is running.
Generate
Initial design candidates' population.
Configuración


Refinery
Studies
New Study
elect another or create a new study.
Create Study
Generation Method
Optimize
Inputs
Outputs
Settings
Population Size
48
Enter a number that is a multiple of 4.
Generations
20
Enter a number.
Seed
1
Enter a number to control where randomization starts.
Server is running.
Generate
Initial design candidates' population.
Number of times the population evolves.
Settings


Refinery
Studies
New Study
elect another or create a new study.
Create Study
Generation Method
Optimize
Inputs
Outputs
Settings
Population Size
48
Enter a number that is a multiple of 4.
Generations
20
Enter a number.
Seed
1
Enter a number to control where randomization starts.
Server is running.
Generate
Generate options.
Generate

Refinery

Studies

New Study

Study		
a25018e7-6576-45ee-a69a-6	20/20	✓

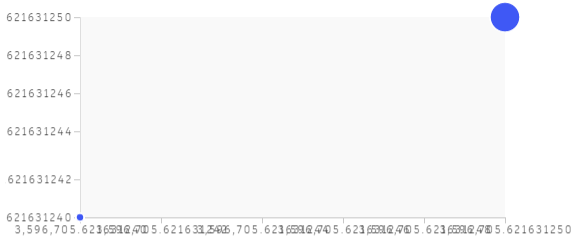
Filter

Y-Axis
[OUT] Free Area

X-Axis
[OUT] Free Area

Size
[OUT] Free Area

Color
[OUT] Incidence/Area



Sort by [OUT] Area Out

1

Solar Analysis, Building Placement

Two remarks

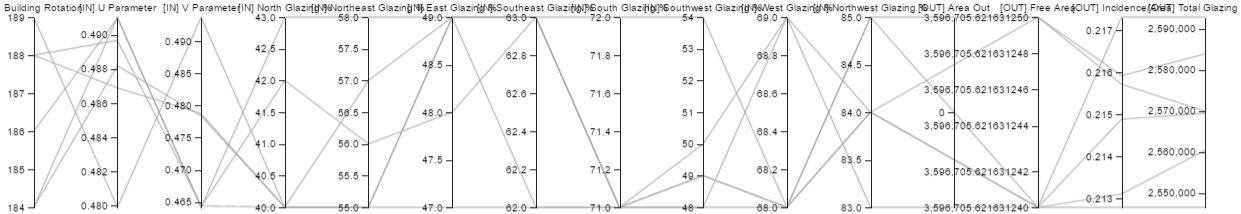
Refinery

Studies

New Study

Study		
a25018e7-6576-45ee-a69a-6	20/20	✓

Filter



[OUT] Area Out	[OUT] Free Area	[OUT] Incidence/Area	[OUT] Total Glazing Area	[IN] Building Rotation	[IN] U Parameter	[IN] V Parameter	[IN] North Glazing %
0.0	3596705.622	0.216	2583840.578	188	0.490	0.464	40
0.0	3596705.622	0.216	2569927.094	188	0.487	0.479	40
0.0	3596705.622	0.213	2546503.657	184	0.491	0.464	43
0.0	3596705.622	0.213	2560417.140	184	0.488	0.478	40
0.0	3596705.622	0.217	2592811.987	189	0.480	0.494	40
0.0	3596705.622	0.215	2569388.549	186	0.491	0.464	42

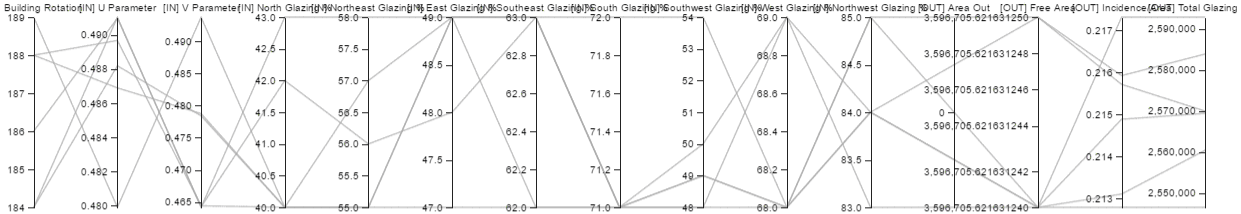
Refinery

Studies

New Study

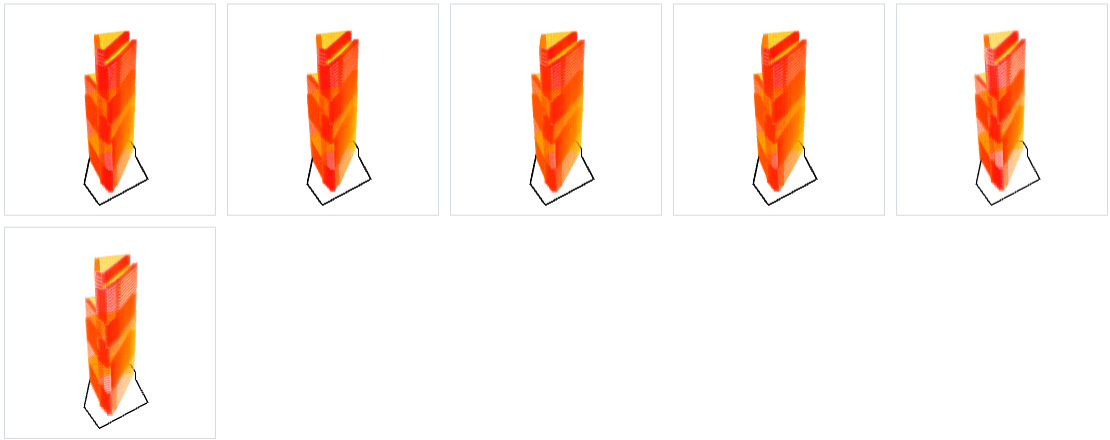
Study		
a25018e7-6576-45ee-a69a-6	20/20	✓

Filter



Sort by [OUT] Area Out

1



Refinery

Studies

New Study

Study		
a25018e7-6576-45ee-a69a-6	20/20	✓

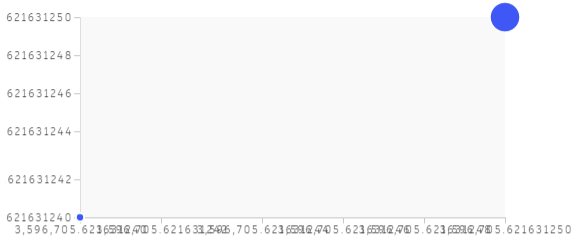
Filter

Y-Axis
[OUT] Free Area

X-Axis
[OUT] Free Area

Size
[OUT] Free Area

Color
[OUT] Incidence/Area

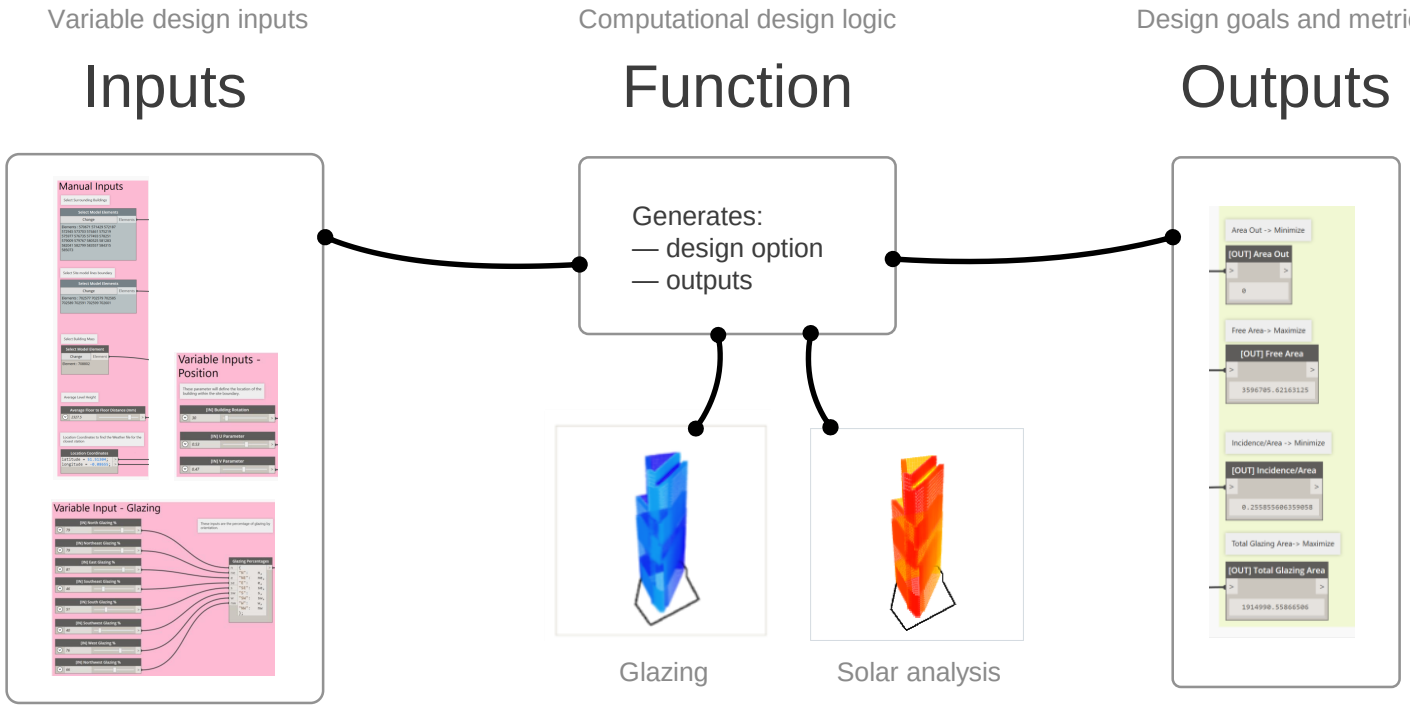


Sort by [OUT] Area Out

1

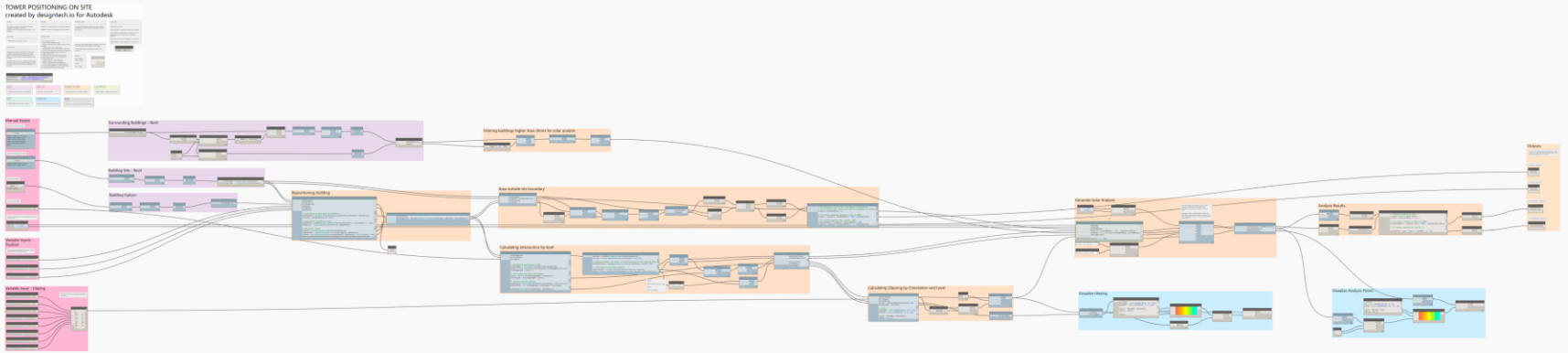
Solar Analysis, Building Placement

Graph diagram



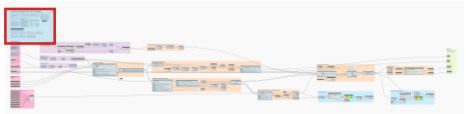
Solar Analysis, Building Placement

Overall View



Solar Analysis, Building Placement

Dynamo graph notes and color key



TOWER POSITIONING ON SITE
created by designtech.io for Autodesk

NOTES

This graph in meant to be used with Dynamo Refinery in "Optimize" mode only.
Internet access is REQUIRED for this graph to run properly.

AUTHOR

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COMPANY: created by designtech.io for Autodesk

KNOWN ISSUES

1) Performing the Solar Analysis can take a while as it depends on a web service to calculate and return the response.

GUIDELINES

Read the instructions.

Add Notes (Ctrl + W) and Comments to the graph.

Use the Cleanup Node Layout command (Ctrl + L) on the graph and inside Groups to enhance legibility.

Use Node Groups and the Standard Color Coding.

Rename Nodes: <OriginalName> || <Description>.

PACKAGES

- Solar Analysis for Dynamo, v1.2.2

INSTRUCTIONS

1) Set the Manual Inputs:
   a) Select surrounding buildings.
   b) Select building mass to analyze from previous workflow.
   c) Select site boundary model lines.
   d) Set average floor to floor height in millimeters.
   e) Define site coordinates (latitude and longitude).
2) Open Dynamo Refinery (View > Refinery...)
3) Create a New Study
4) Under generation method select Optimize
5) Under Inputs, all inputs should be selected.
6) On the outputs tab:
   a) [OUT] Area Out - Set to Minimize
   b) [OUT] Free Area - Set to Maximize
   c) [OUT] Incidence/Area - Set to Minimize.
   d) [OUT] Total Glazing Area - Set to Maximize.
7) Fix any possible problems on the issues section
8) Click generate and wait for the outputs

DESCRIPTION

Starting from the Tower selected on the previous workflow, the graph will iterate to find the best position within the site boundaries, taking into acount the Solar Incidence and total Glazing of the building.

To avoid options that don't comply (outside of site boundary), the results are heavily penalized, saving computational time by making the analysis fail on purpose.

Write Input and Output Notes for Python Scripts and group the note with the Python Scipt node.

Note: Node contains boilerplate code for use in projects.

Boolean | | Toggle On/Off
True False

INPUTS

IN[0] = Walls
IN[1] = Height

OUPUT

OUT = Data

Python Script
IN[0] IN[1] + - OUT

Useful Links | CTRL + Click the link below

```
authorWebsite = "https://designtech.io/contact/";
dynamoForums = "http://forum.dynamobim.com";
```

GET — Get parameter values from Revit objects

INPUT — Data input and preparation

FUNCTION — Data manipulation on dynamo objects

OUTPUT — Object creation in Revit or final output

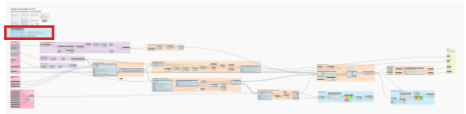
SET — Set parameter values of Revit objects

DEBUG — Nodes used to debug the graph logic

WIP — Notes not considered part of the final package

Solar Analysis, Building Placement

Dynamo graph color key



GET
Get parameter values from Revit objects

INPUT
Data input and preparation

FUNCTION
Data manipulation on dynamo objects

OUTPUT
Object creation in Revit or final output

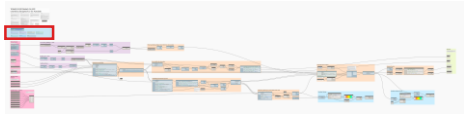
SET
Set parameter values of Revit objects

DEBUG
Nodes used to debug the graph logic

WIP
Notes not considered part of the final package

Solar Analysis, Building Placement

Graph nodes · INPUT · Data input and preparation

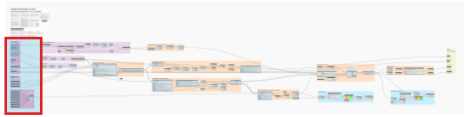


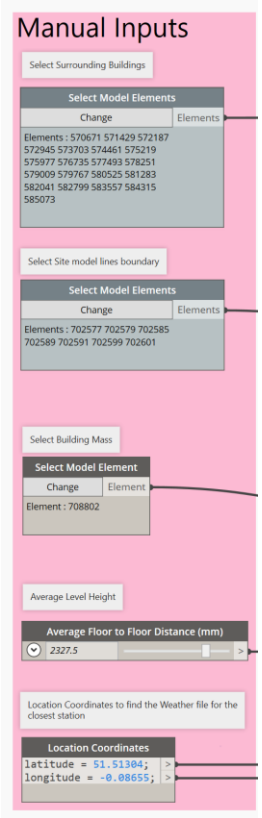
INPUT

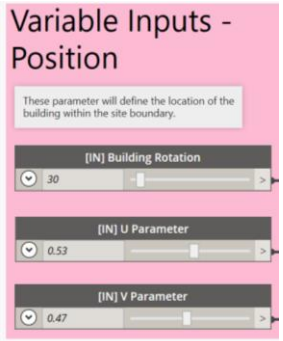
Data input and preparation

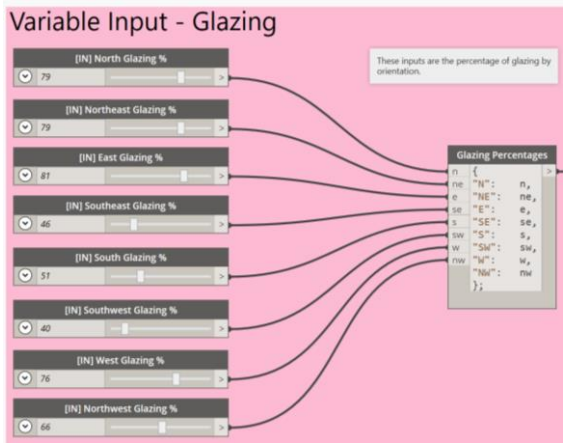
Solar Analysis, Building Placement

INPUT · Revit manual inputs + Refinery variable inputs)



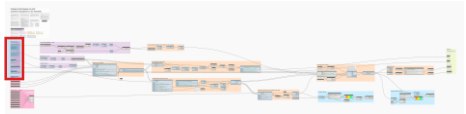


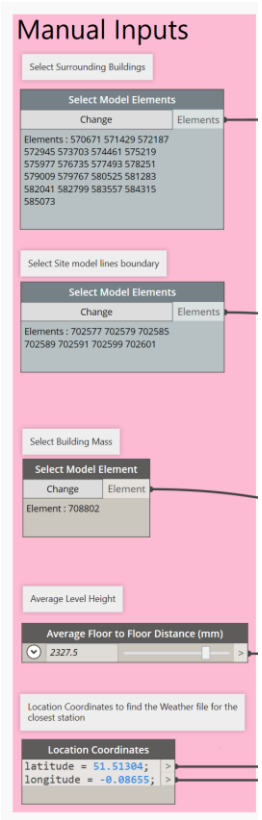


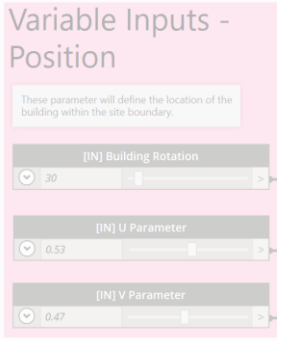


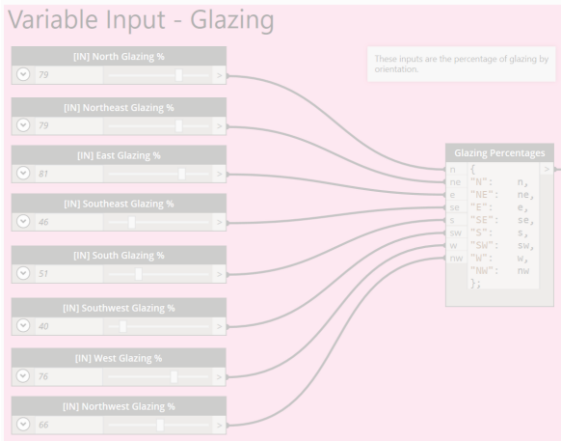
Solar Analysis, Building Placement

INPUT · Revit manual inputs



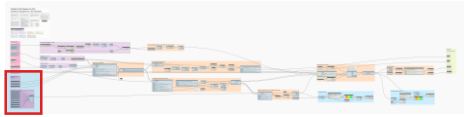


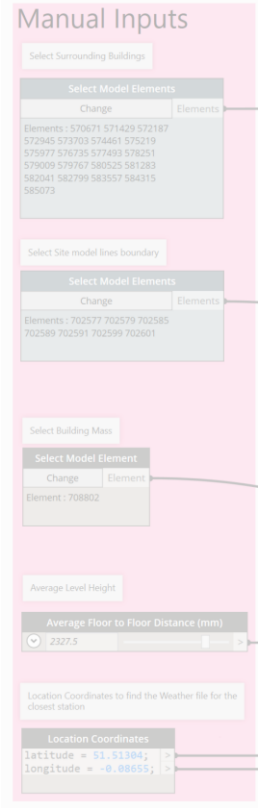


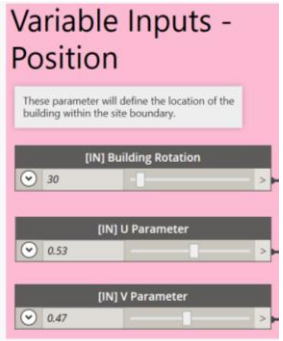


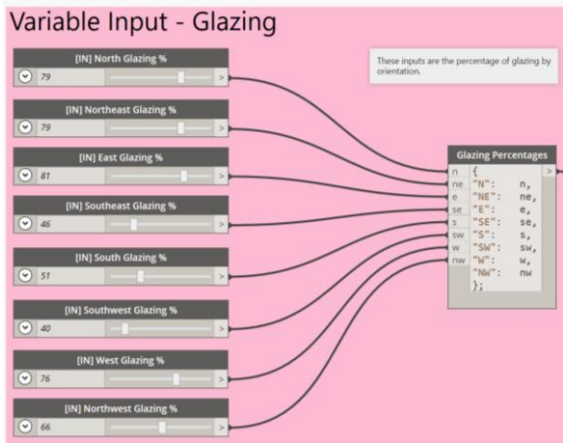
Solar Analysis, Building Placement

INPUT · Refinery variable inputs



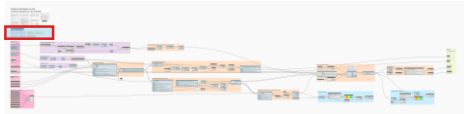


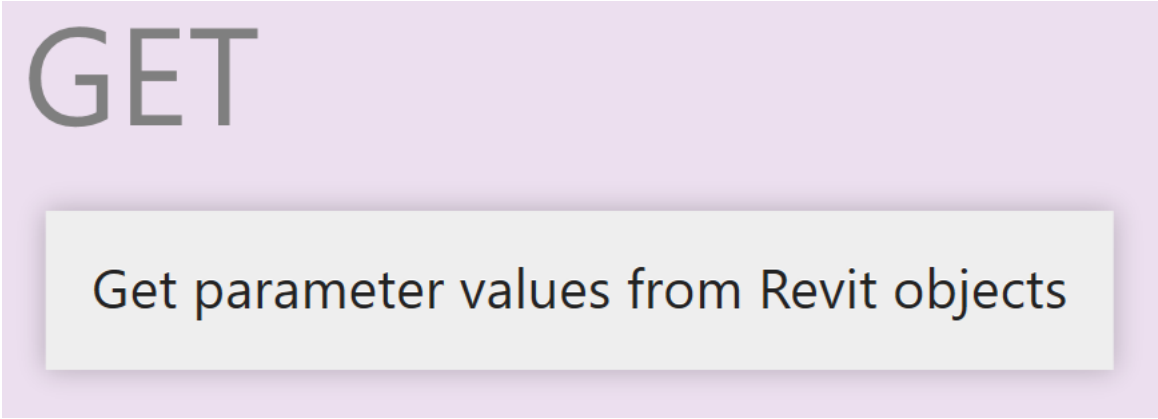




Solar Analysis, Building Placement

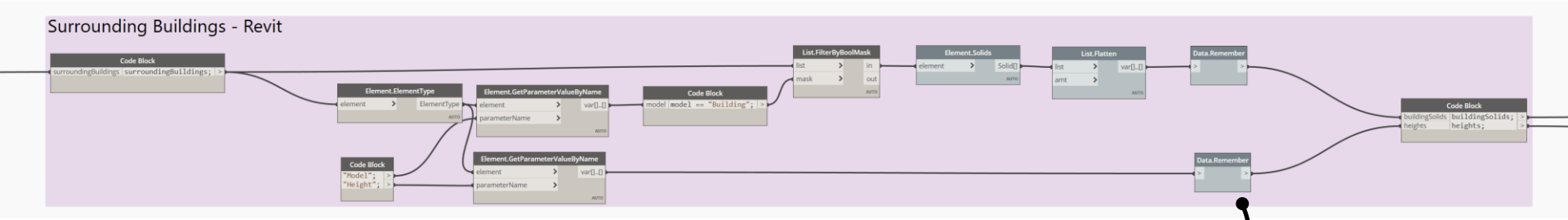
Graph nodes · GET · Get parameter values from Revit objects

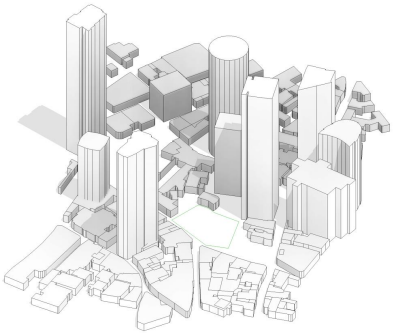




Solar Analysis, Building Placement

GET · Revit surrounding buildings



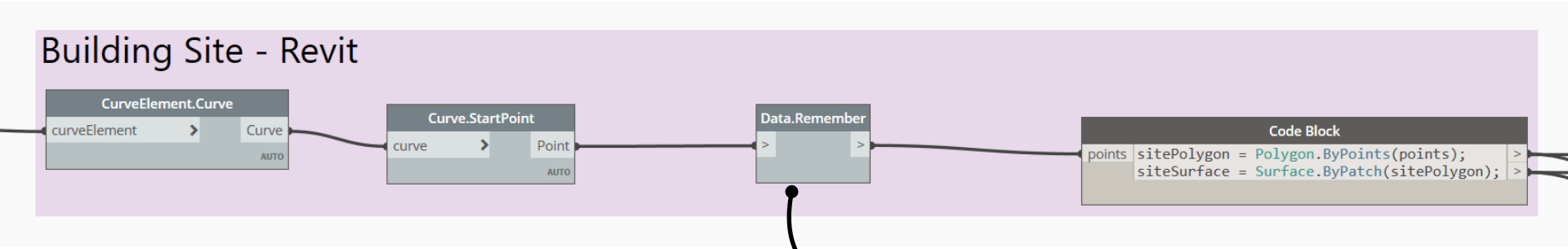


Data.Remember to cache Revit data.

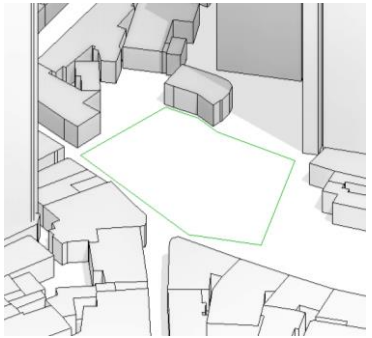
Cache after operations to Revit data.

Solar Analysis, Building Placement

GET · Revit building site

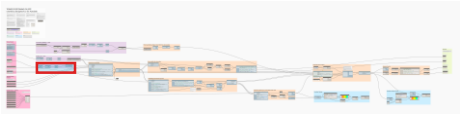


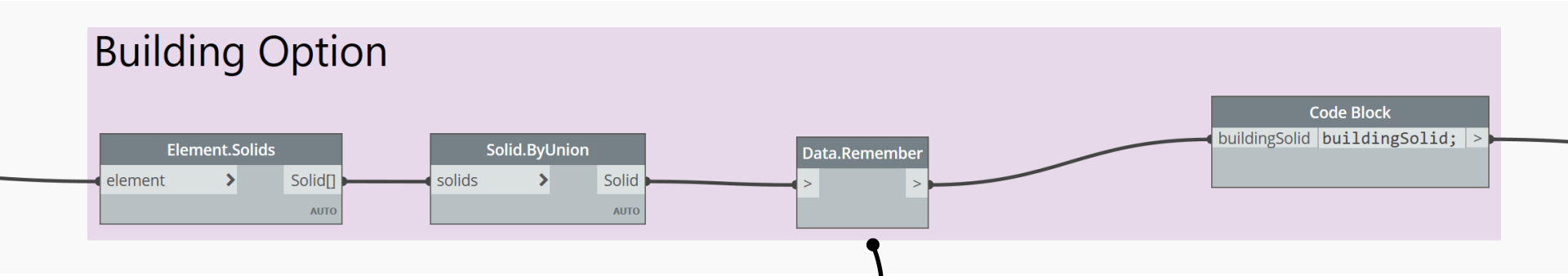
Data.Remember to cache Revit data.

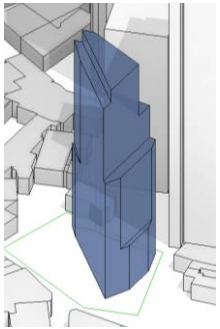


Solar Analysis, Building Placement

GET · Building option





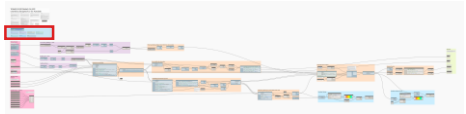


Data.Remember to cache Revit data.

Cache after operations to Revit data.

Solar Analysis, Building Placement

Graph nodes · Data manipulation on Dynamo objects

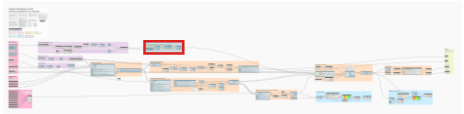


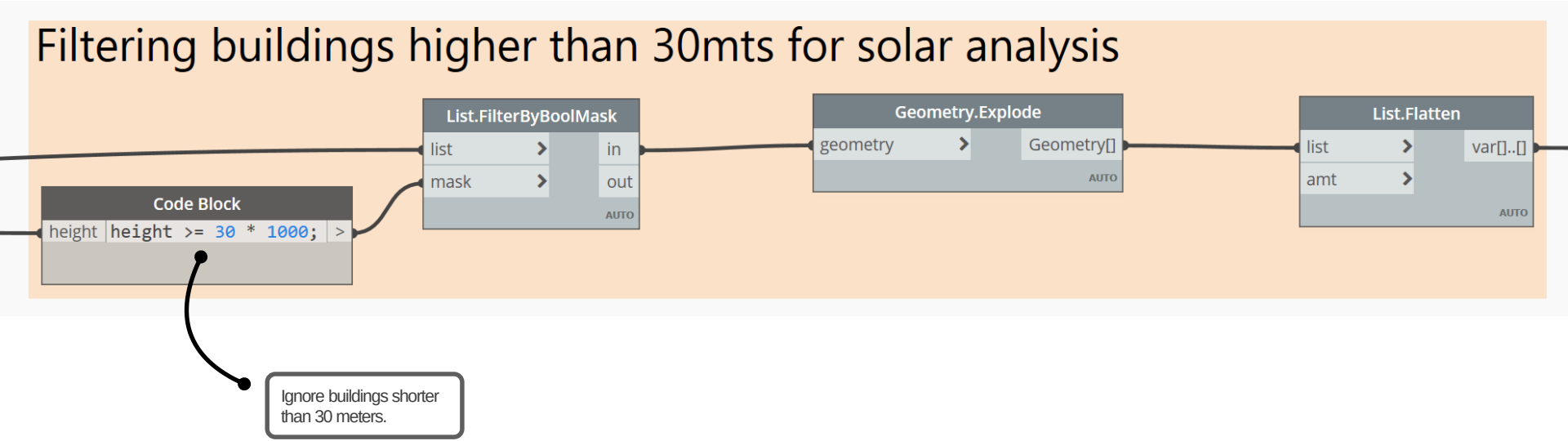
FUNCTION

Data manipulation on dynamo objects

Solar Analysis, Building Placement

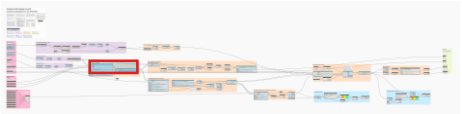
FUNCTION · Filter buildings by height





Solar Analysis, Building Placement

FUNCTION · Reposition building



Repositioning building

Code Block

Inputs: sitePolygon, siteSurface, buildingSolid, rotation, uParameter, vParameter

```
sitePolygon;
siteSurface;
buildingSolid;
rotation;
uParameter;
vParameter;

// Calculating surface point by parameters
surfacePoint = Surface.PointAtParameter(siteSurface,uParameter, vParameter);
centroid = buildingSolid.Centroid();

// Calculating translation vector
targetPoint = Autodesk.Point.ByCoordinates(surfacePoint.X, surfacePoint.Y, centro:
moveVector = Vector.ByTwoPoints(centroid, targetPoint);

// Coordinate System
originCS = CoordinateSystem.ByOrigin(targetPoint);
translatedCS = CoordinateSystem.Translate(originCS, moveVector);
rotated = CoordinateSystem.Rotate(translatedCS, targetPoint, Vector.ZAxis(), rota
```

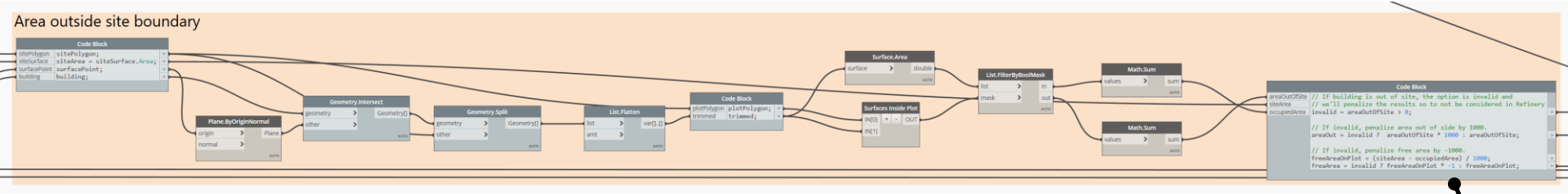
Code Block

Inputs: surfacePoint, building, originalCS, translatedCS

```
surfacePoint;
buildingSolid = Autodesk.Geometry.Transform(building, originalCS, translatedCS);
```

Solar Analysis, Building Placement

FUNCTION · Calculate area outside of the site boundary

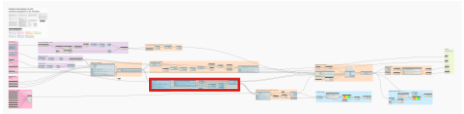


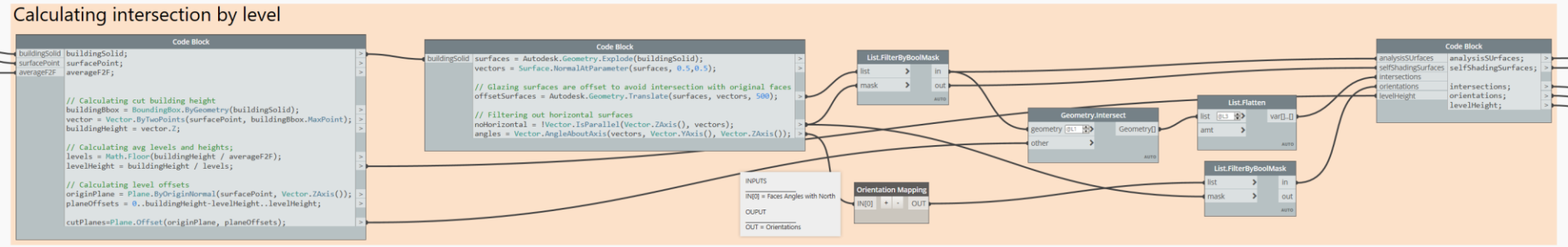
Ignore buildings placed out of bounds.

invalid = areaOutOfSite > 0;

Solar Analysis, Building Placement

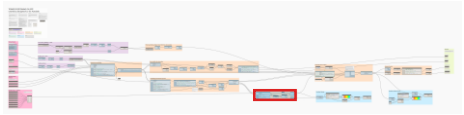
FUNCTION · Calculate intersection by level

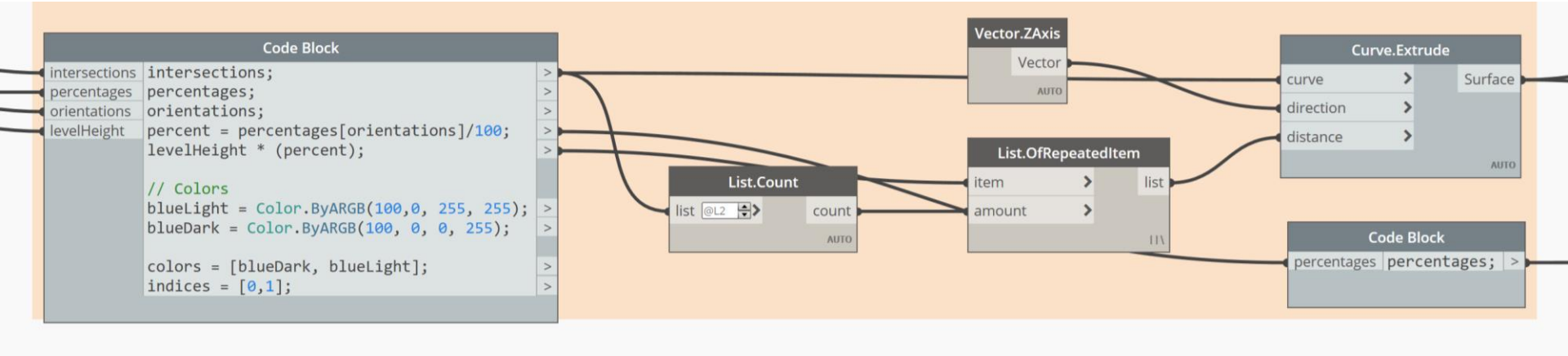




Solar Analysis, Building Placement

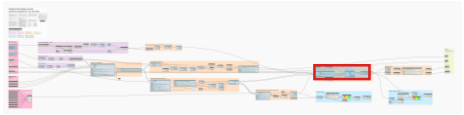
FUNCTION · Calculate glazing by orientation and level

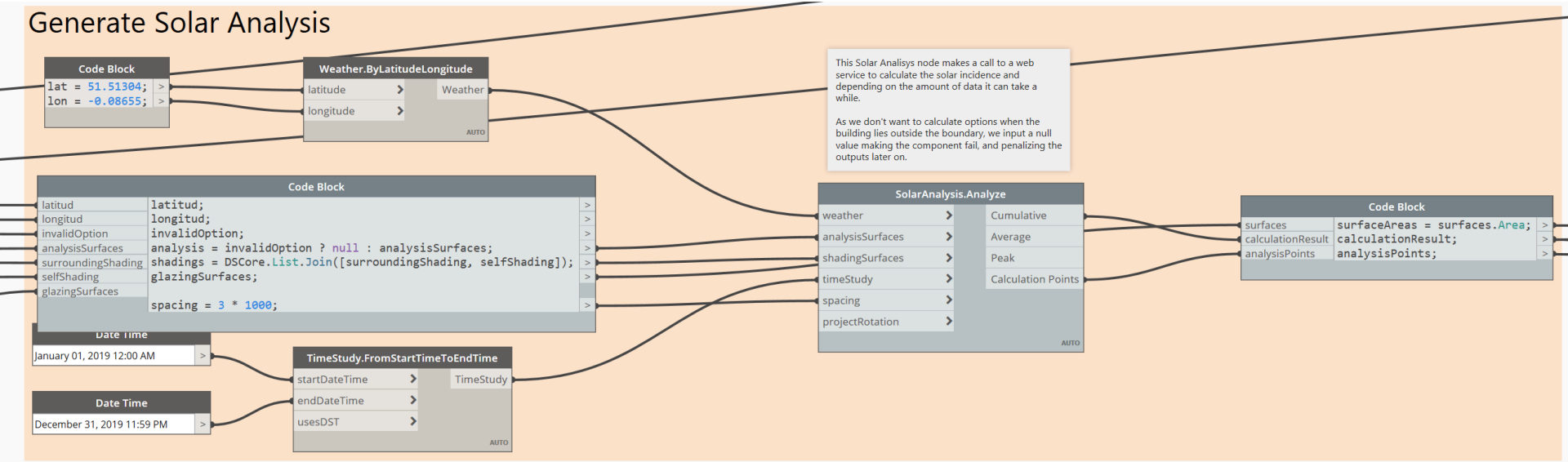




Solar Analysis, Building Placement

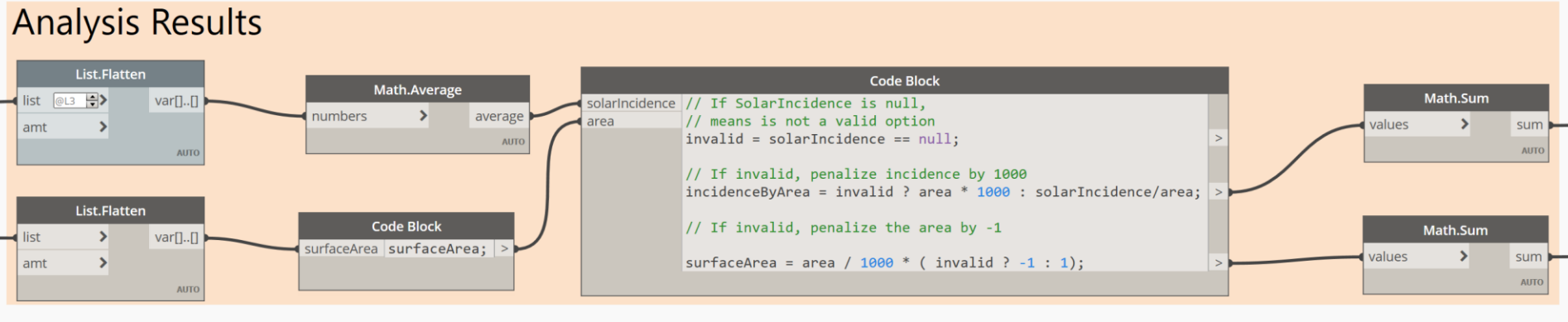
FUNCTION · Generate and run solar analysis





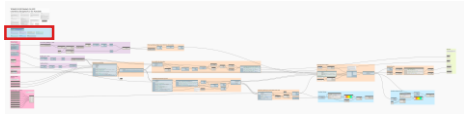
Solar Analysis, Building Placement

FUNCTION · Analyze results



Solar Analysis, Building Placement

Graph nodes · OUTPUT · Object creation in Revit (or final output)

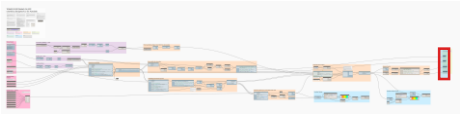


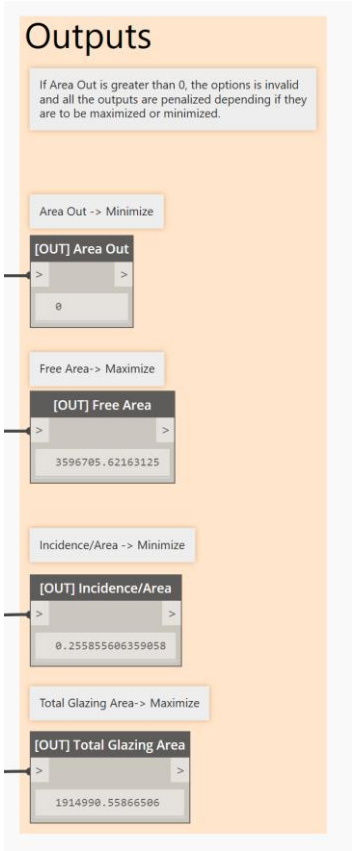
OUTPUT

Object creation in Revit or final output

Solar Analysis, Building Placement

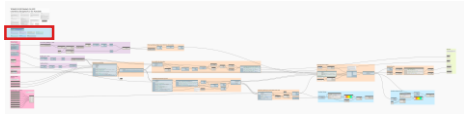
OUTPUT · Goals (or metrics) of our design





Solar Analysis, Building Placement

Graph nodes · DEBUG · Nodes used to debug the graph logic

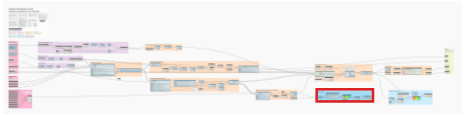


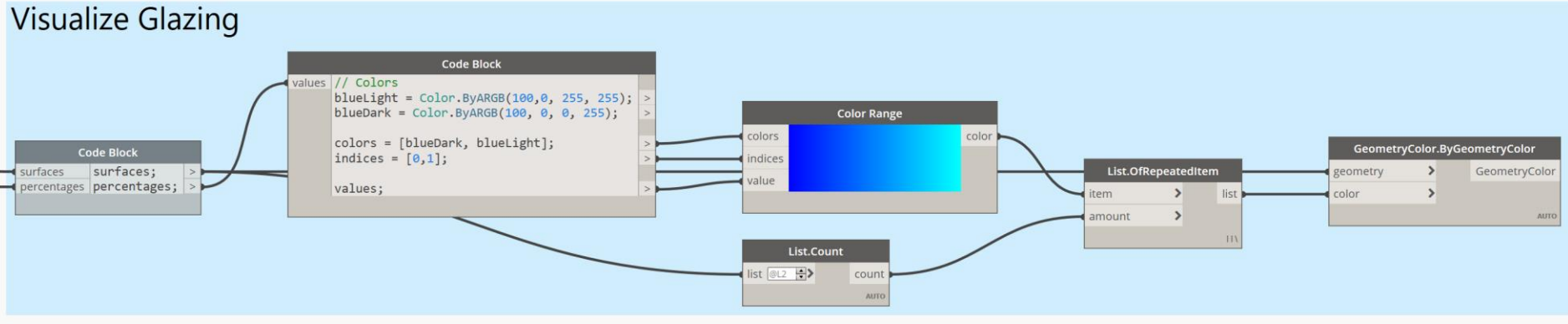
DEBUG

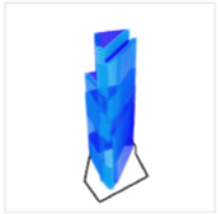
Nodes used to debug the graph logic

Solar Analysis, Building Placement

DEBUG · Preview glazing geometry



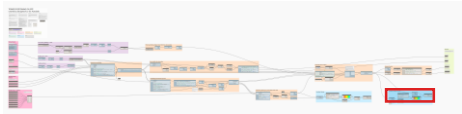




Glazing

Solar Analysis, Building Placement

DEBUG · Preview solar analysis results



Visualize Analysis Points

Code Block

```
// Colors
red = Color.ByARGB(100,255, 0, 0);
yellow = Color.ByARGB(100, 255, 255, 0);

colors = [yellow, red];
indices = [0,1];
```

List.Flatten

list
amt
var[]..[]
AUTO

List.Flatten

list
amt
var[]..[]
AUTO

Code Block

```
0;
1;
```

Math.RemapRange

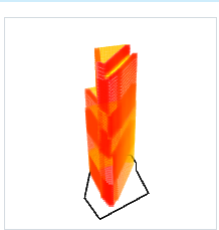
numbers
newMin
newMax
list
AUTO

Color Range

colors
indices
value
color

GeometryColor.ByGeometryColor

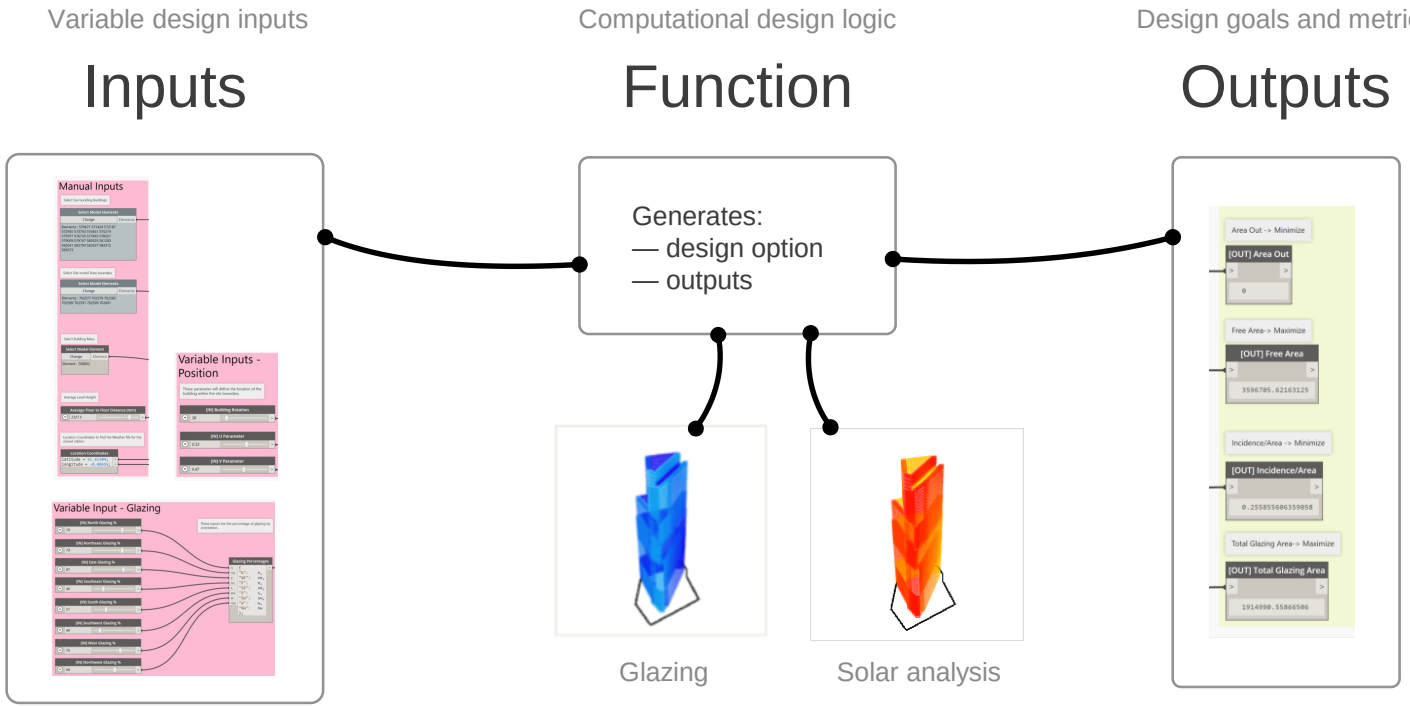
geometry
color
GeometryColor
AUTO



Solar analysis

Solar Analysis, Building Placement

Graph diagram



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