

## **Densifying Istanbul**

Final Review 12|16|2011

Team:

Anne Schmidt

Bing Wang

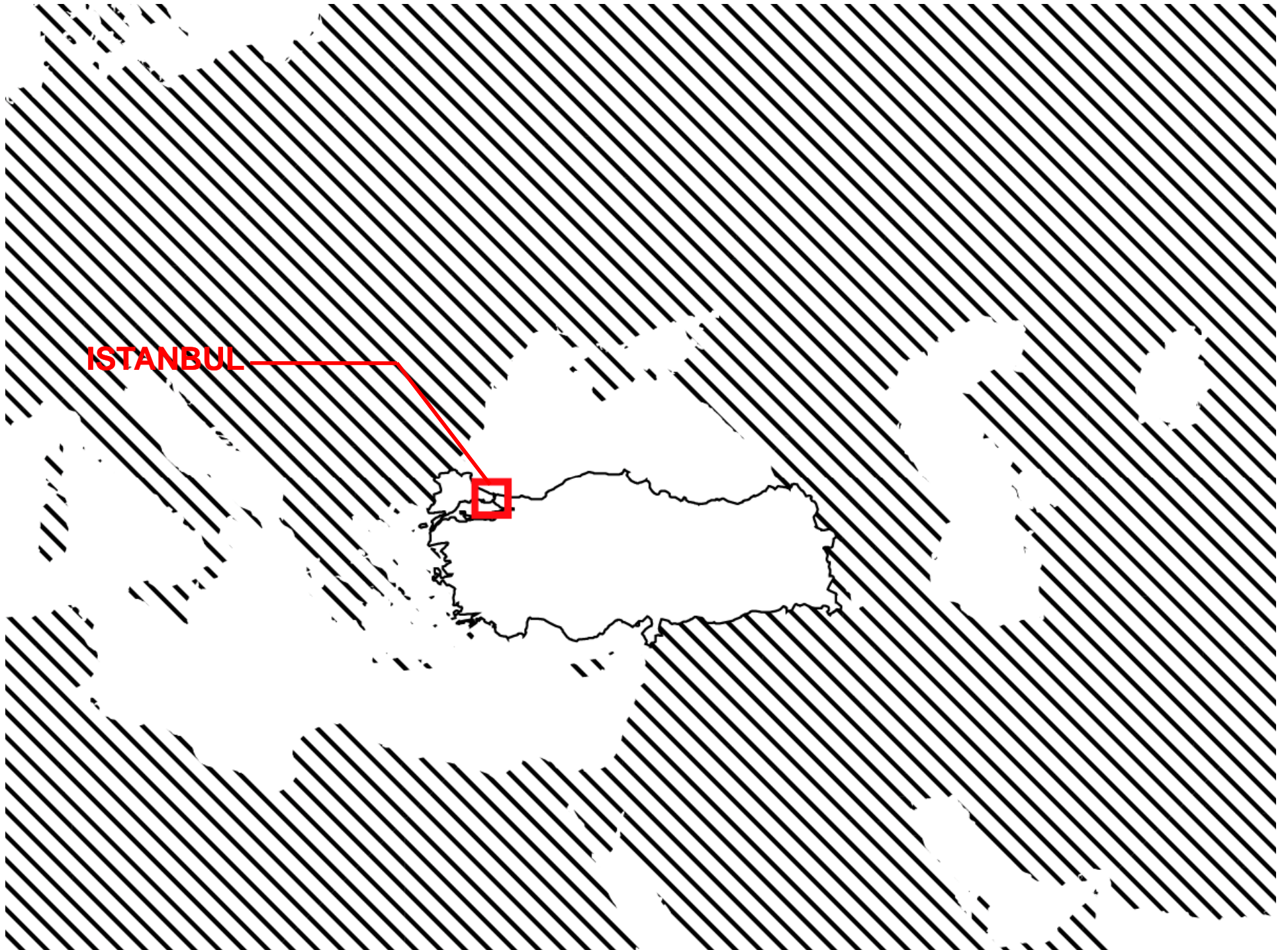
Nari Yoon

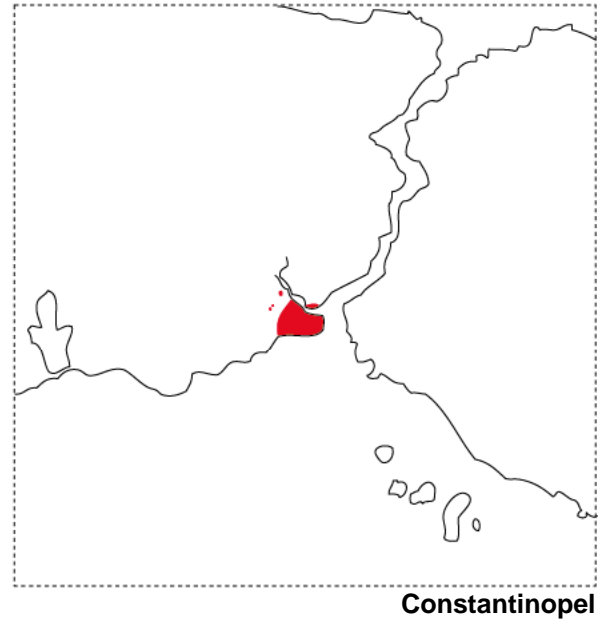
Timur Dogan

**TURKEY**







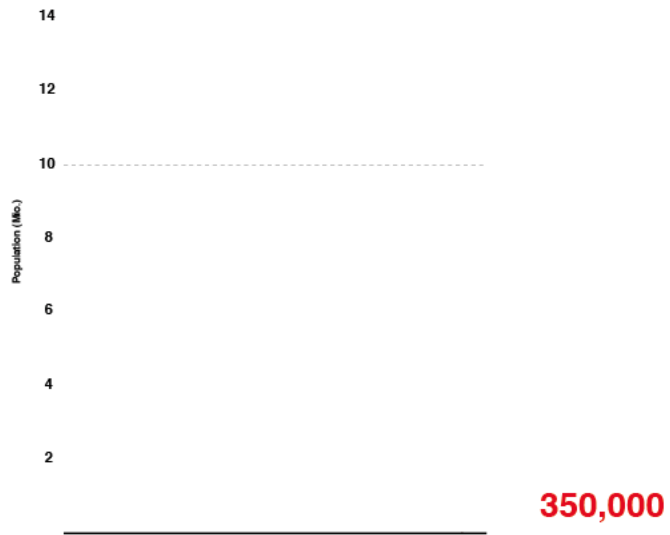


4th Century

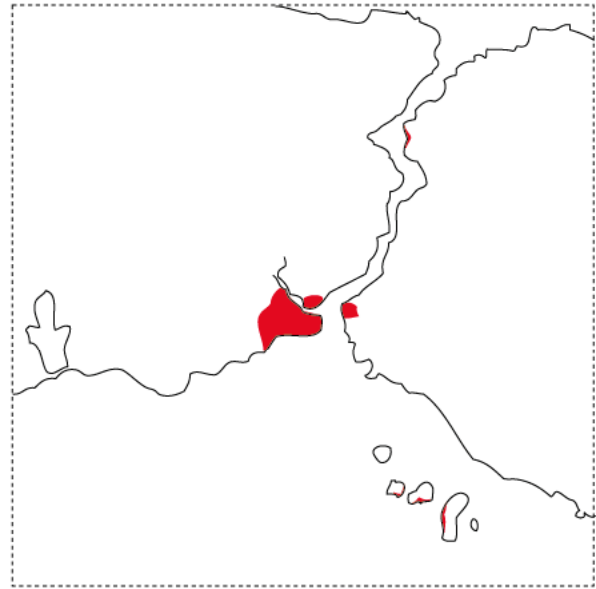


Population Development & Urban Growth



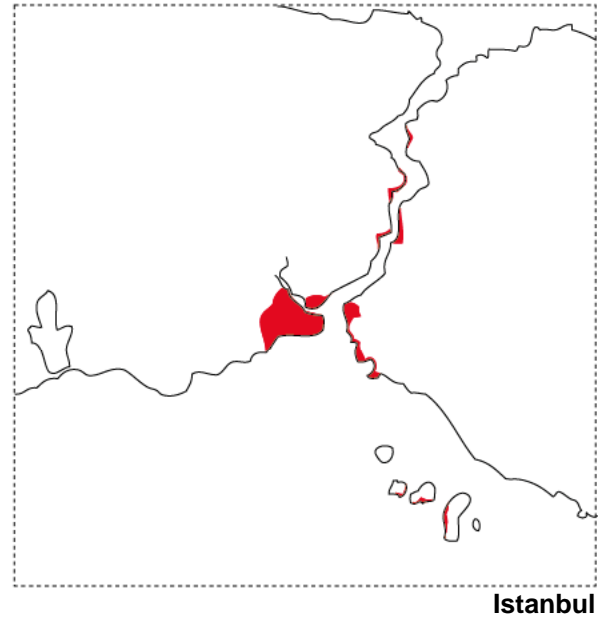
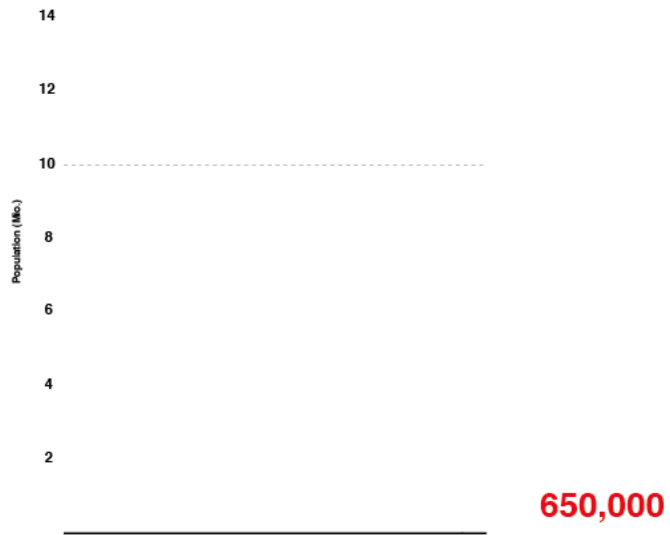


6th Century

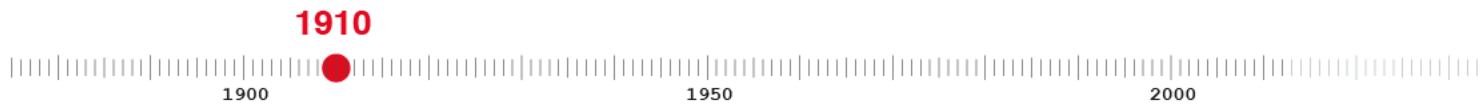
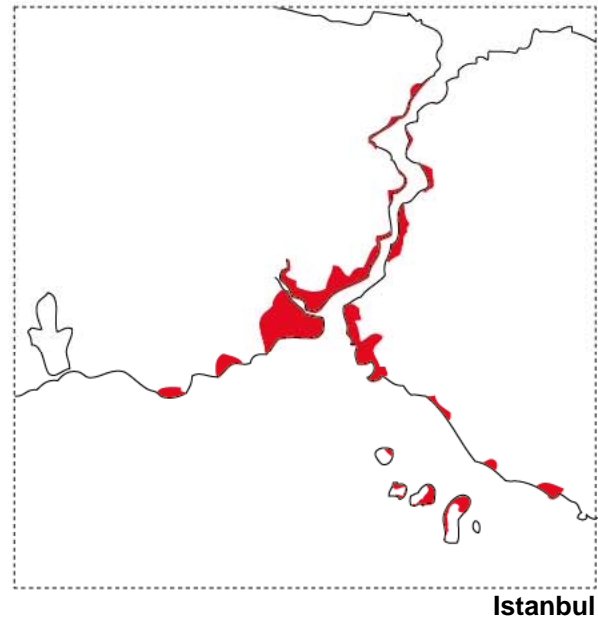
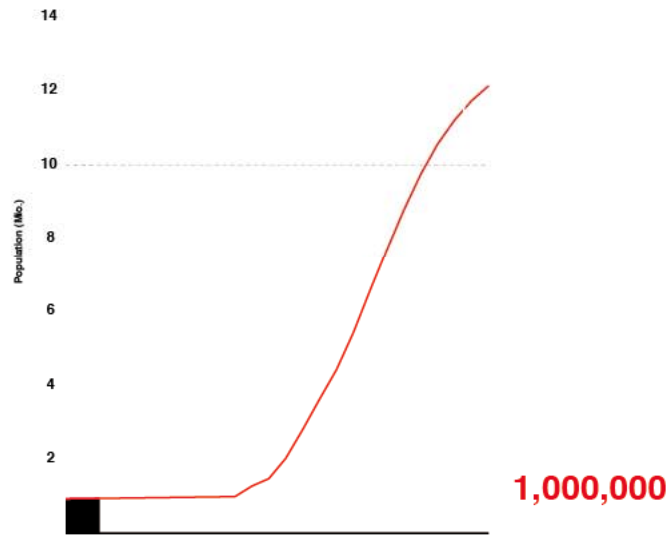


Constantinopel

Population Development & Urban Growth

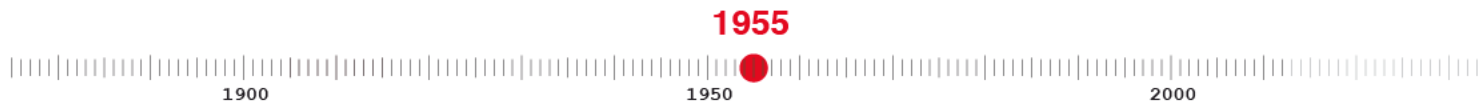
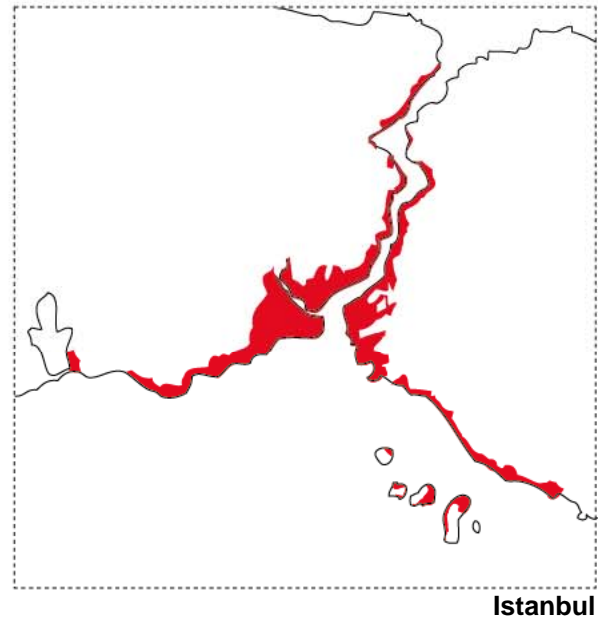
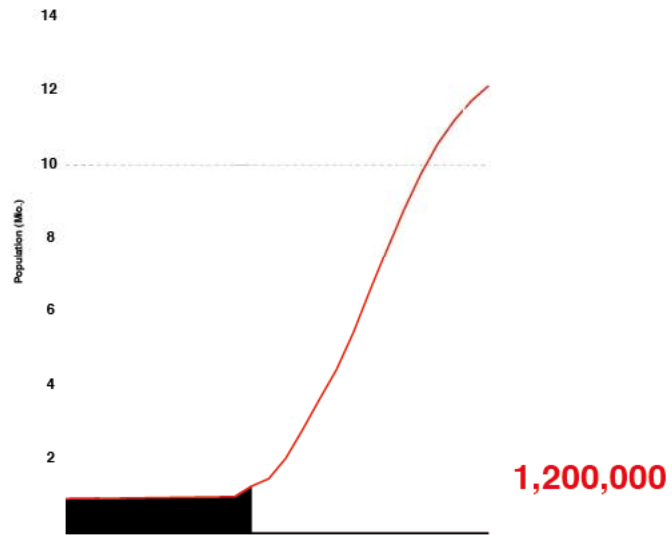


Population Development & Urban Growth

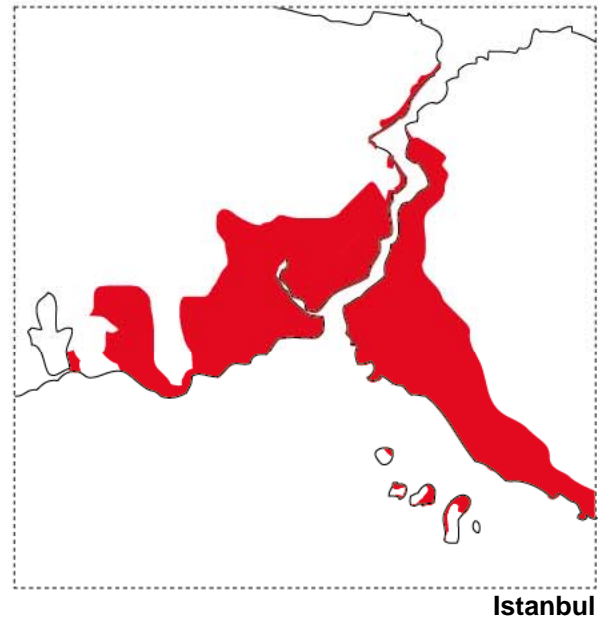
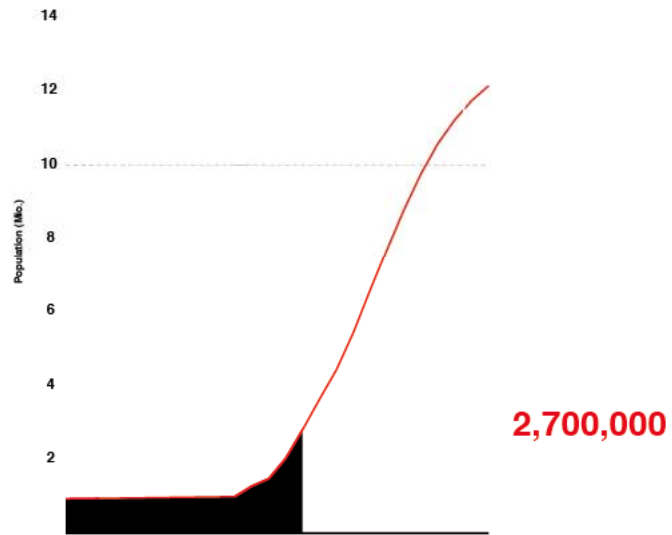


Population Development & Urban Growth





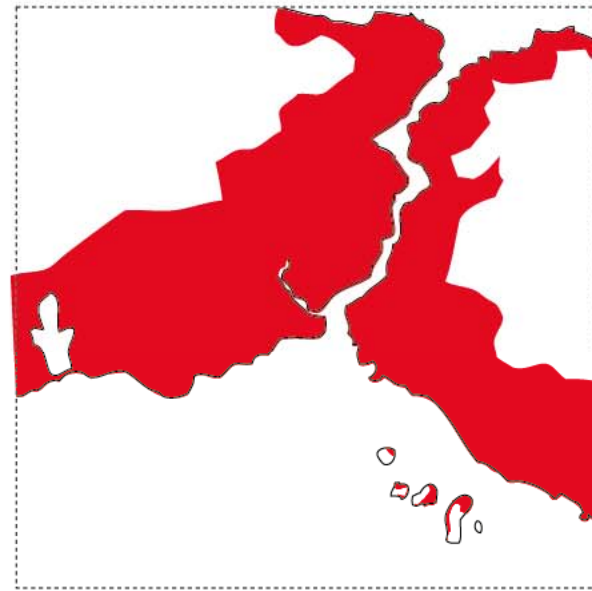
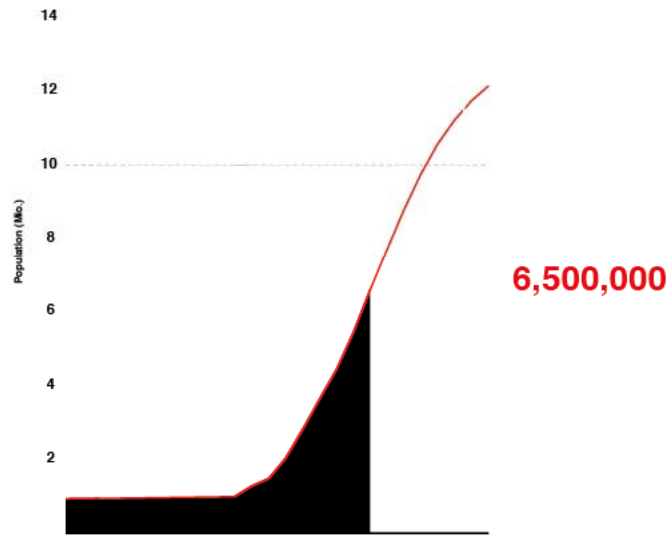
Population Development & Urban Growth



1970



Population Development & Urban Growth



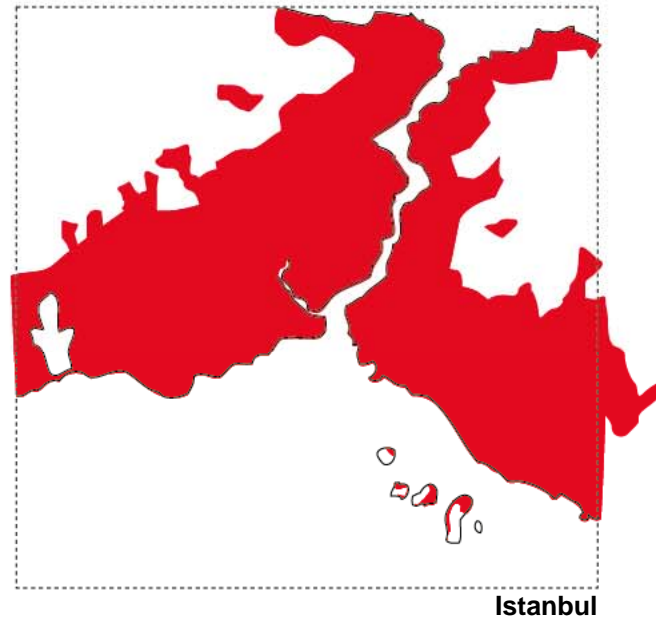
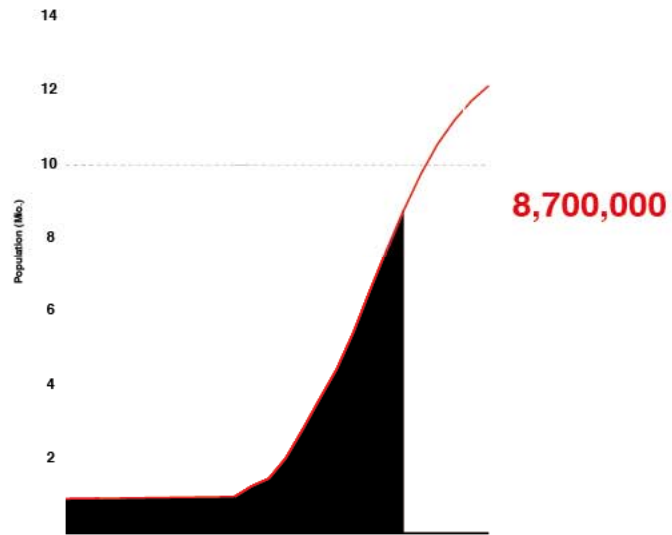
Istanbul

1990

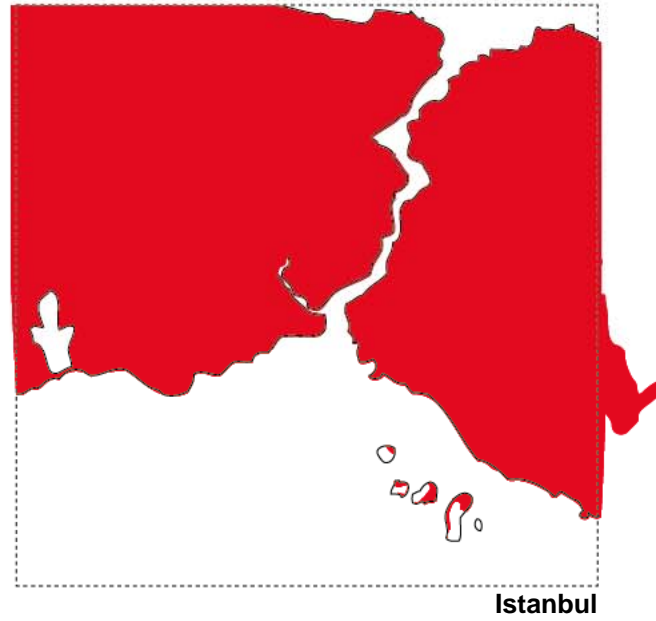
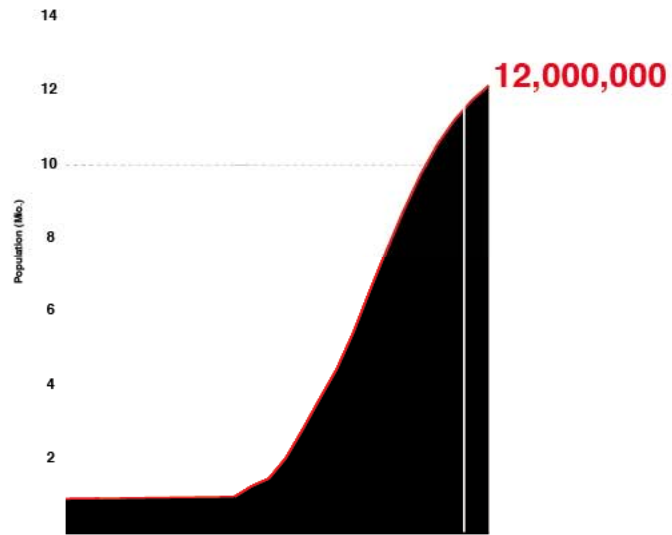


Population Development & Urban Growth





Population Development & Urban Growth



Population Development & Urban Growth





Bostanci Pier 2009





TOKI Tower Blocks in Atasehir





Çekmeköy, 2007





New Mass Housing

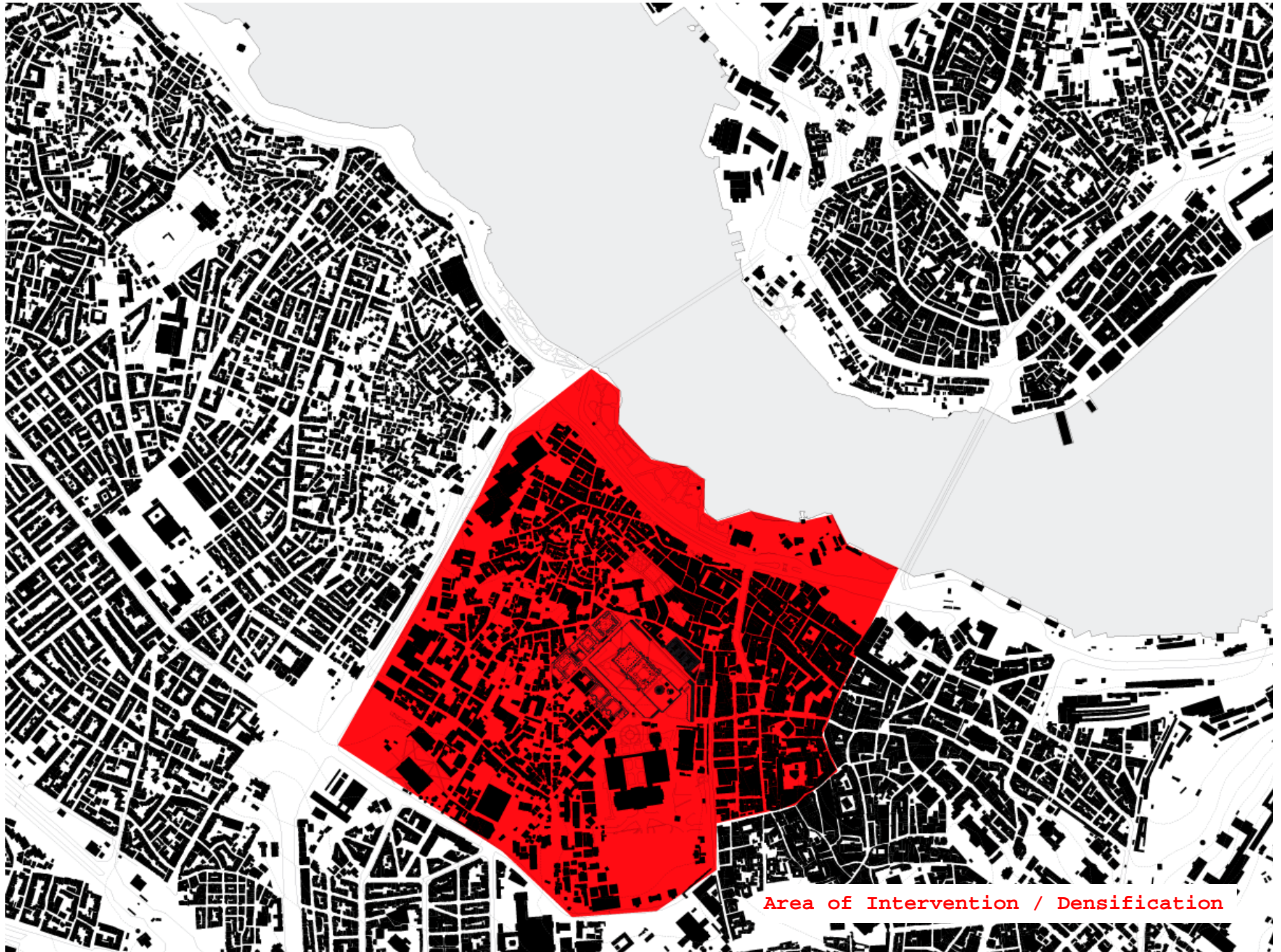


Gated Communities



Fabric of Old Peninsula





Area of Intervention / Densification





Area of Intervention / Densification



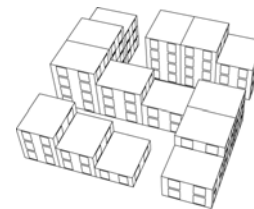
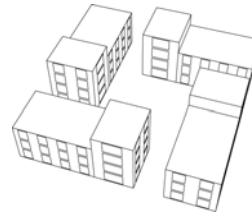
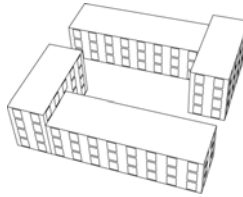
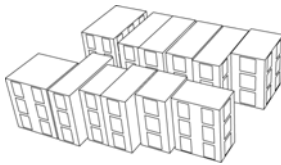


"Loose teeth" in the Urban Fabric



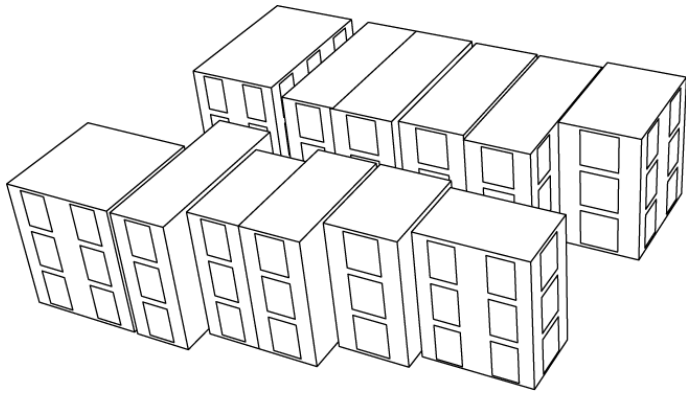
"Loose teeth" in the Urban Fabric

## Weave the Fabric



## Existing Fabric

- Old construction
- Little open spaces
- Ventilation issue
- Daylighting issue



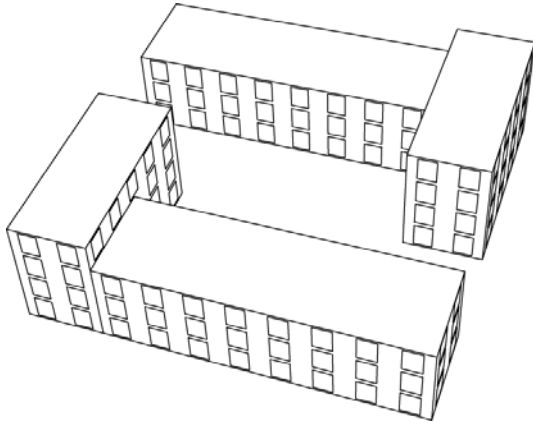
\*Individual units are simplified/refined as show boxes for the sake of simulation.

### Guidelines

- Not high-rise apartments
- Less than 5 stories
- Providing public spaces for better communication of the neighborhood
- Preserve the existing urban scale



## Fabric 1



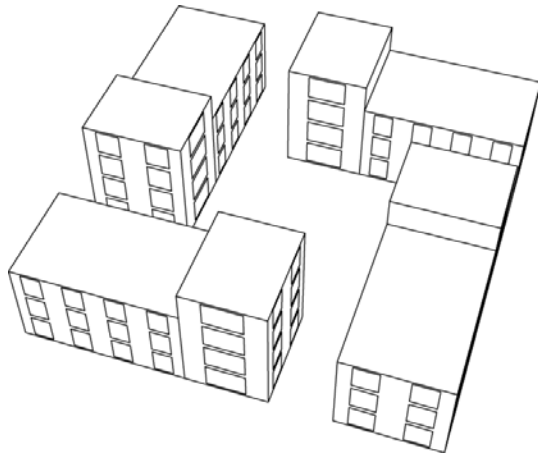
\*Individual units are simplified/refined as show boxes for the sake of simulation.

- Ample open spaces
- Creating
- Improved ventilation and daylighting situation
- Higher building heights to make the same density as before
- Open to two facades
- Less flexible to be adjusted to the existing fabric





## Fabric 2

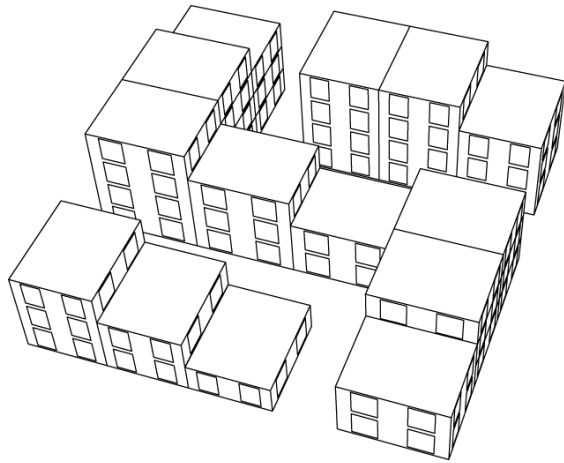


\*Individual units are simplified/refined as show boxes for the sake of simulation.

- Open spaces
- Improved ventilation and daylighting situation
- Accessible by four sides
- Flexible to arrange



## Fabric 3



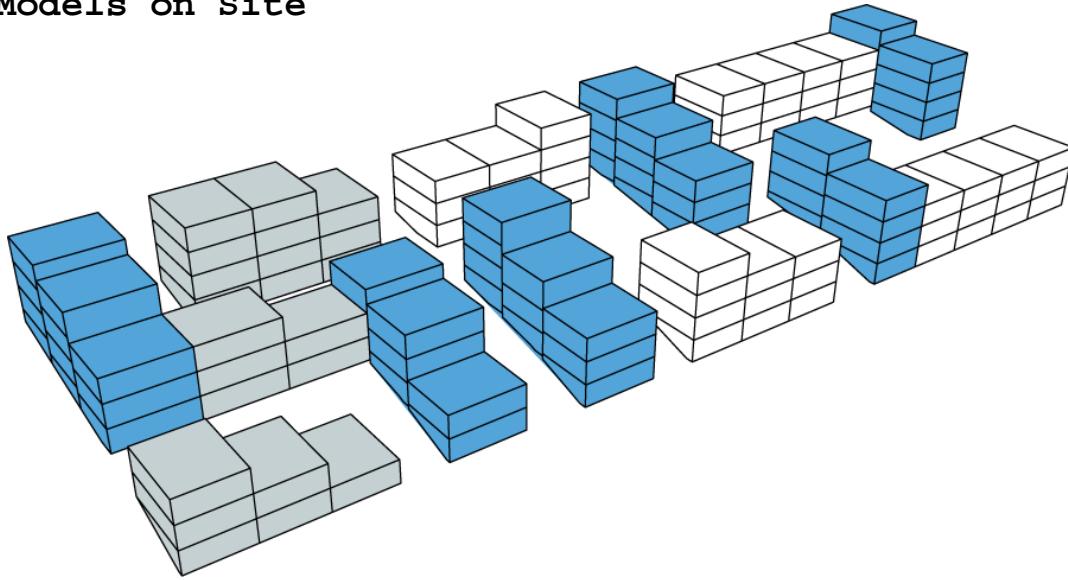
\*Individual units are simplified/refined as show boxes for the sake of simulation.

- Improved Ventilation
- Improved Daylighting Condition
- Use of the terrace/natural ventilation

- Less open spaces (but can be compensated by the roof terrace)

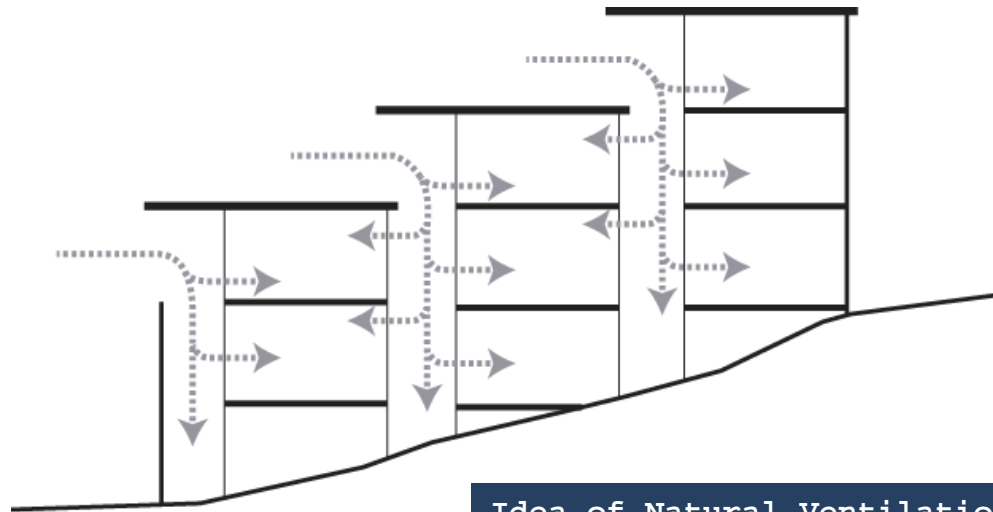
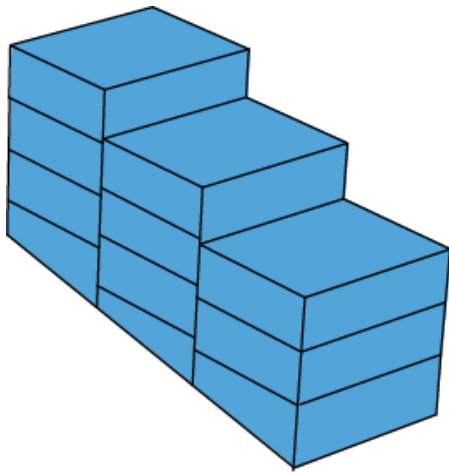


## Models on Site



## Daylighting

## Natural Ventilation



Idea of Natural Ventilation

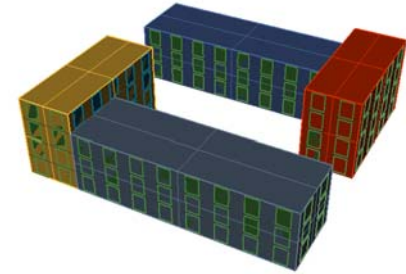
## UMI Simulation

### Existing Fabric



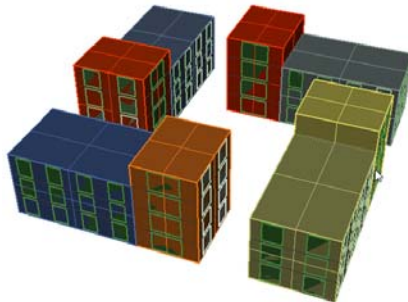
Total Urban Heating Loads: **29652.6 kWh**  
Total Urban Cooling Loads: **51181.8 kWh**  
Total Urban Lighting Loads: **39423.1 kWh**

### Fabric 1



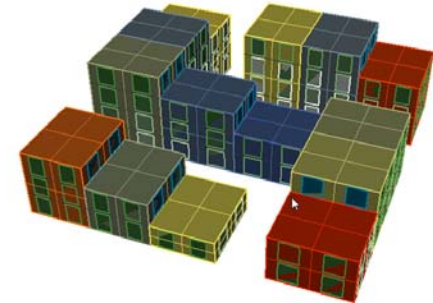
Total Urban Heating Loads: **13556.3 kWh**  
Total Urban Cooling Loads: **36611.6 kWh**  
Total Urban Lighting Loads: **39863.8 kWh**

### Fabric 2



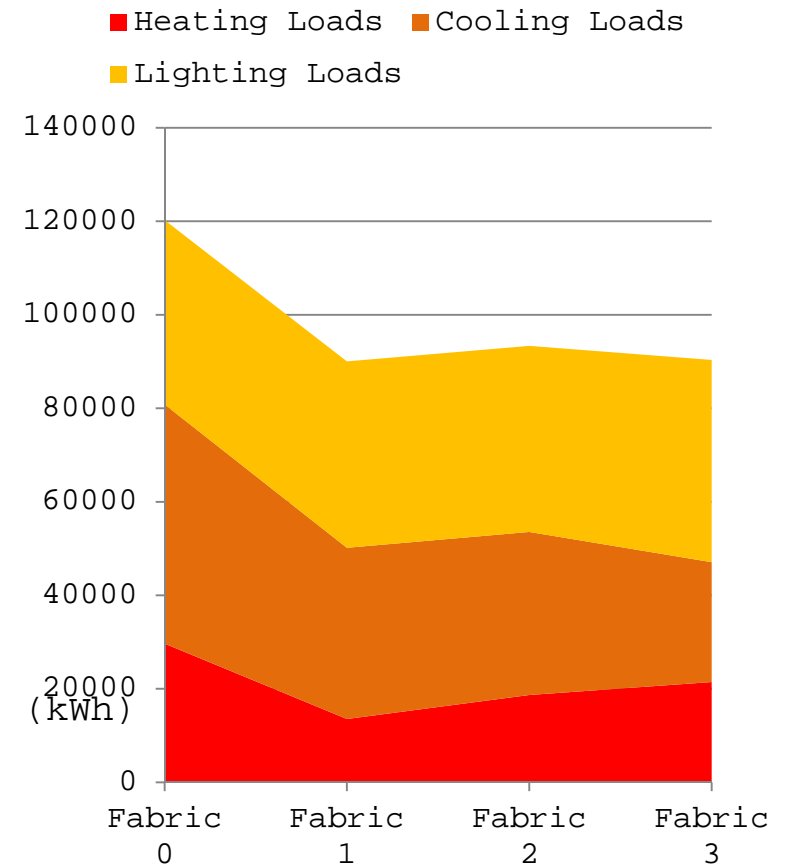
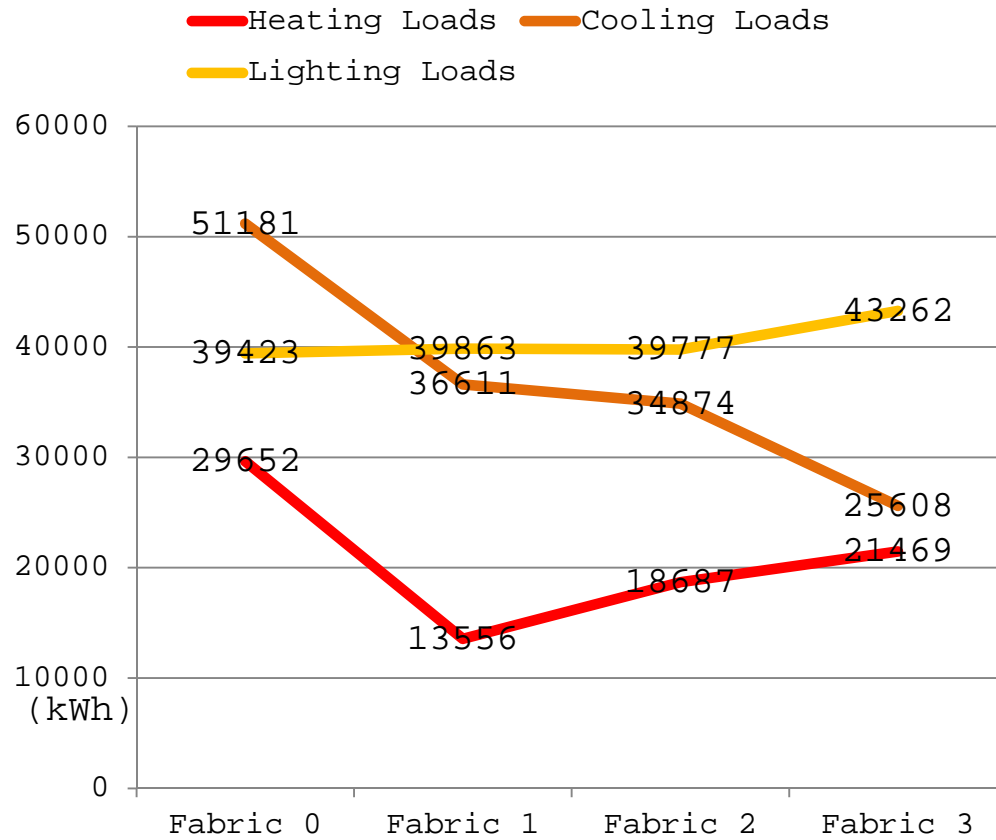
Total Urban Heating Loads: **18687.0 kWh**  
Total Urban Cooling Loads: **34874.7 kWh**  
Total Urban Lighting Loads: **39777.3 kWh**

### Fabric 3



Total Urban Heating Loads: **21469.3 kWh**  
Total Urban Cooling Loads: **25608.0 kWh**  
Total Urban Lighting Loads: **43262.6 kWh**

## UMI Simulation



## UMI Simulation

There are some **missing** factors in UMI Simulation

- **Daylighting Simulation**

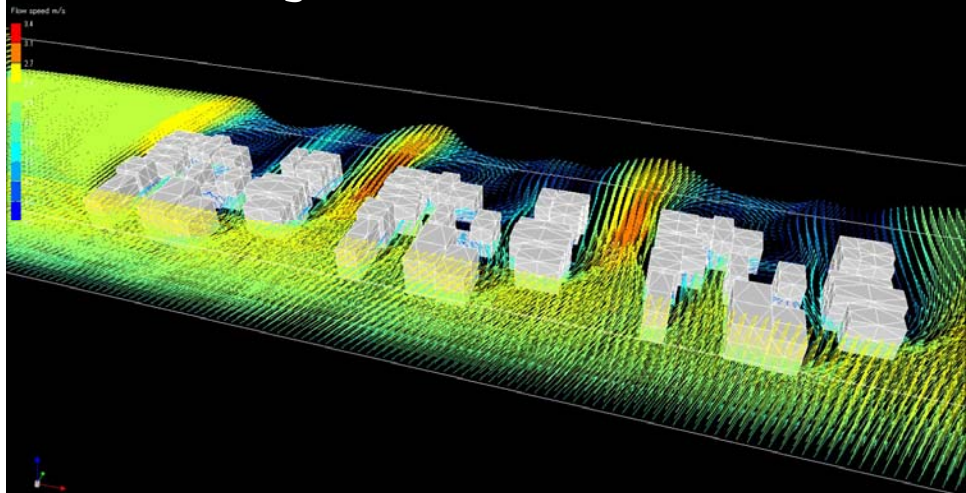
- UMI works with lighting schedule that we have made in DesignBuilder.
- If letting UMI calculate lighting loads according to the sun position, it will take forever.

- **Ventilation Simulation**

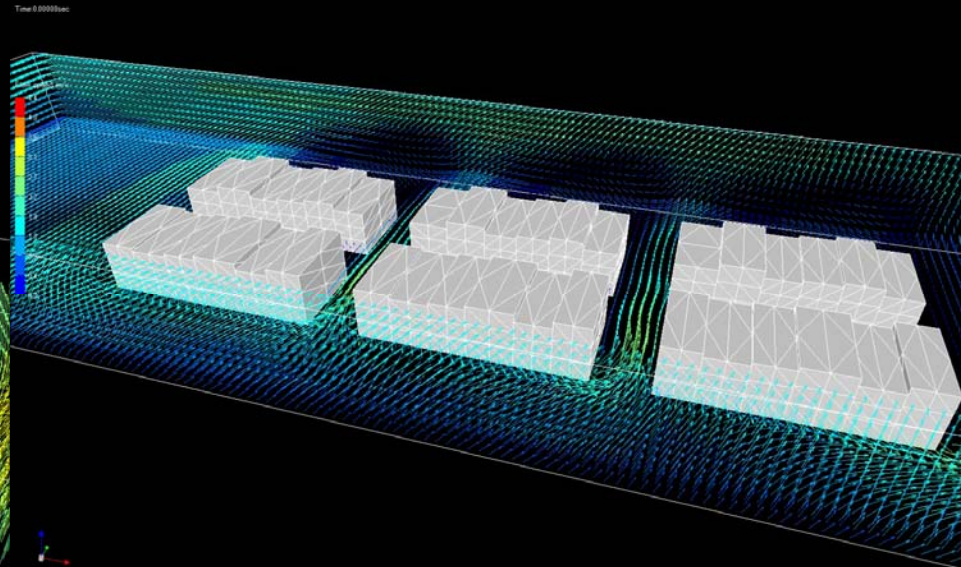
- UMI does not calculate ventilation values.
- So we tried FlowDesigner8 as an alternative.



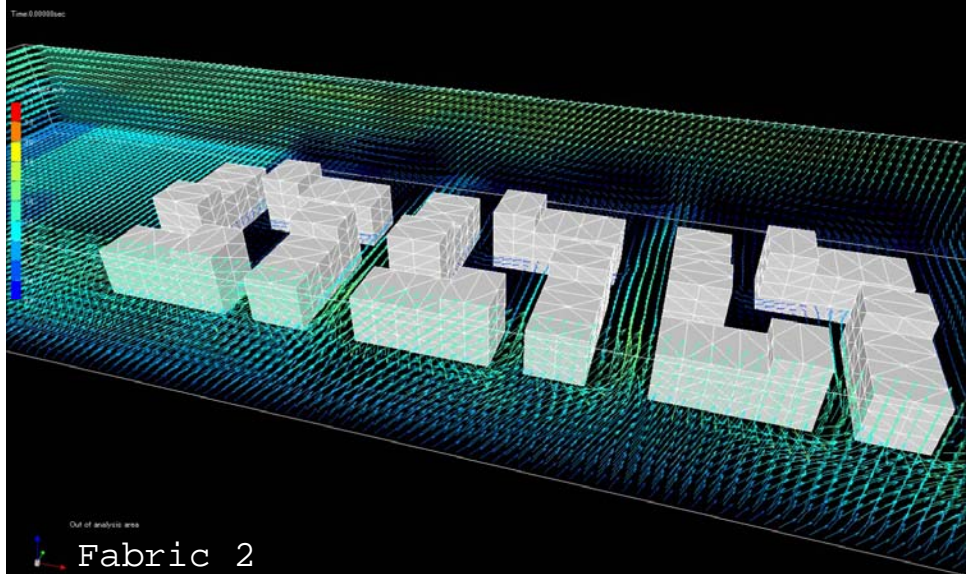
# FlowDesigner Simulation



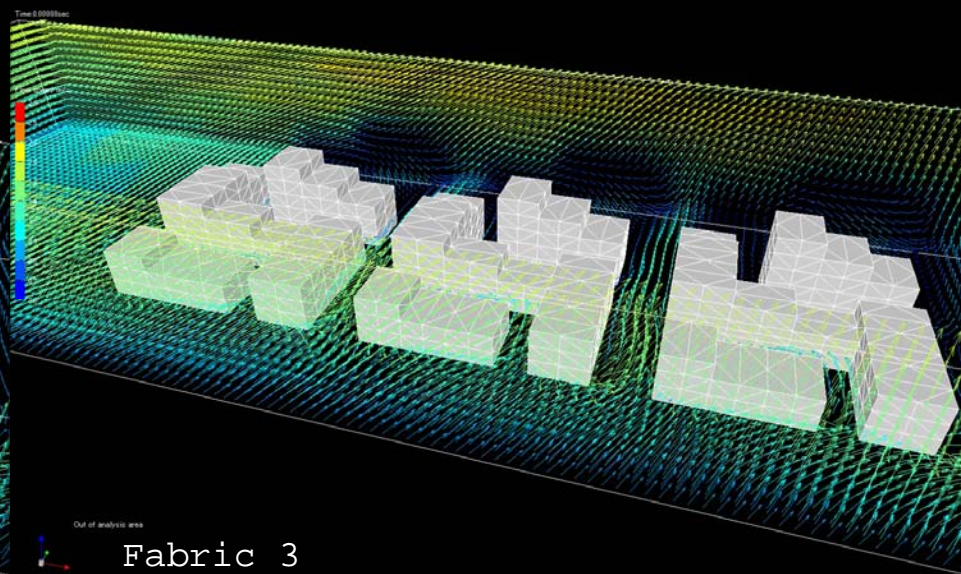
Olden Fabric



Existing Fabric



Fabric 2



Fabric 3

## **FlowDesigner Simulation**

What we could find out from FlowDesigner Simulation are,

- Wind speed, wind pressure, and wind direction
- Sketchy idea how forms affect ventilation, thus how to design buildings according to different seasons, climates, etc.
- Neither evaluate thermal comfort nor energy

What we wanted to know more is,

- Quantitative Analysis
  - Energy Calculation

**Therefore,** we will introduce our new software that can explain daylighting and ventilation!

- **UrbanDaylighting** (UD) for Daylighting Simulation
- **CFD Simulation** for Natural Ventilation Simulation

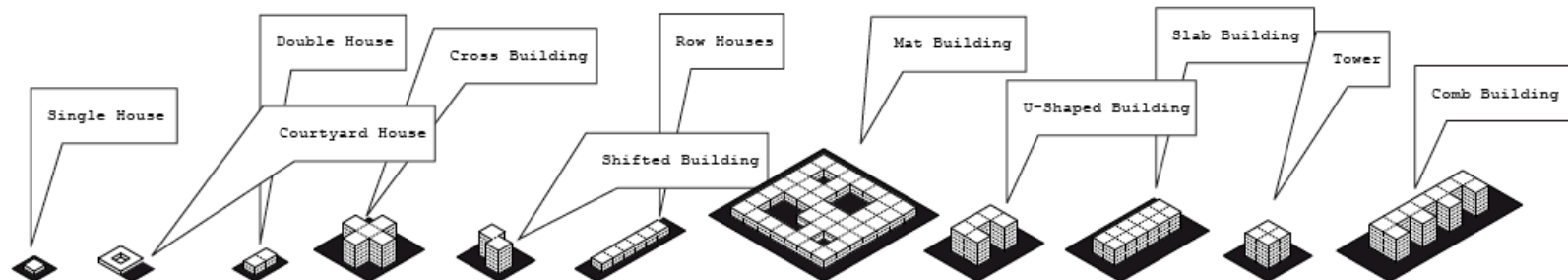
GENERIC STUDY

# WHAT IS THE RIGHT TYPOLOGY?

## Parameters of Comparison:

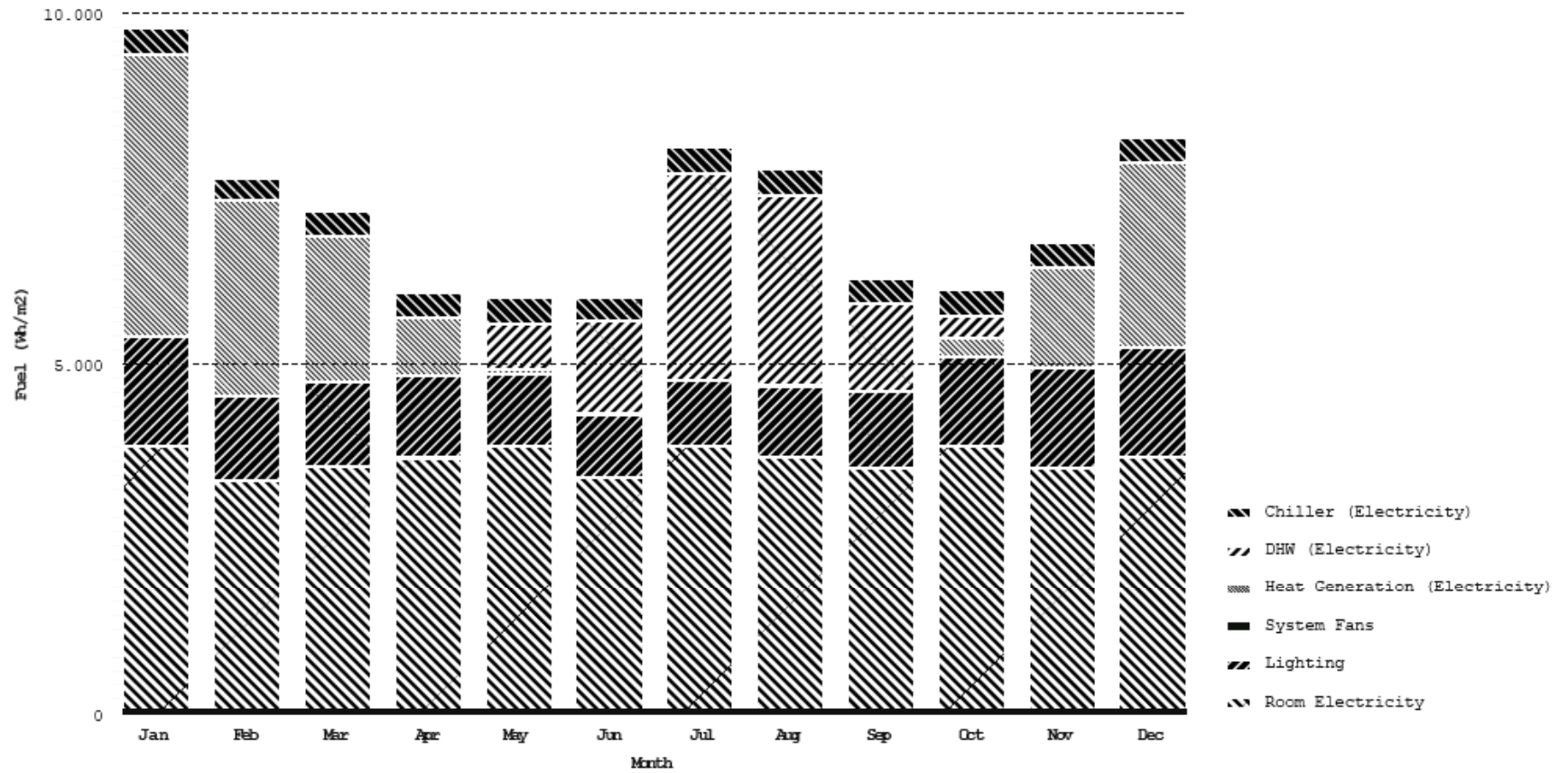
FAR (Floor-Area-Ratio: Plot soze/Total floor area)

Energy Use:     Heat Balance  
                  Fuel Breakdown



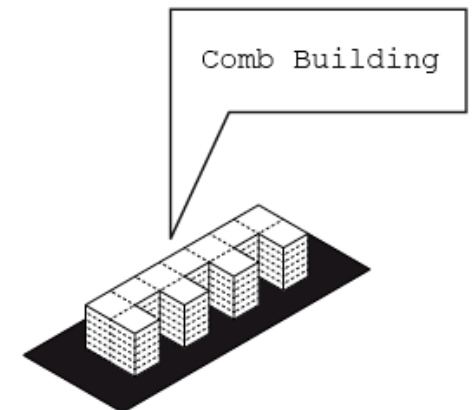
Form matters?

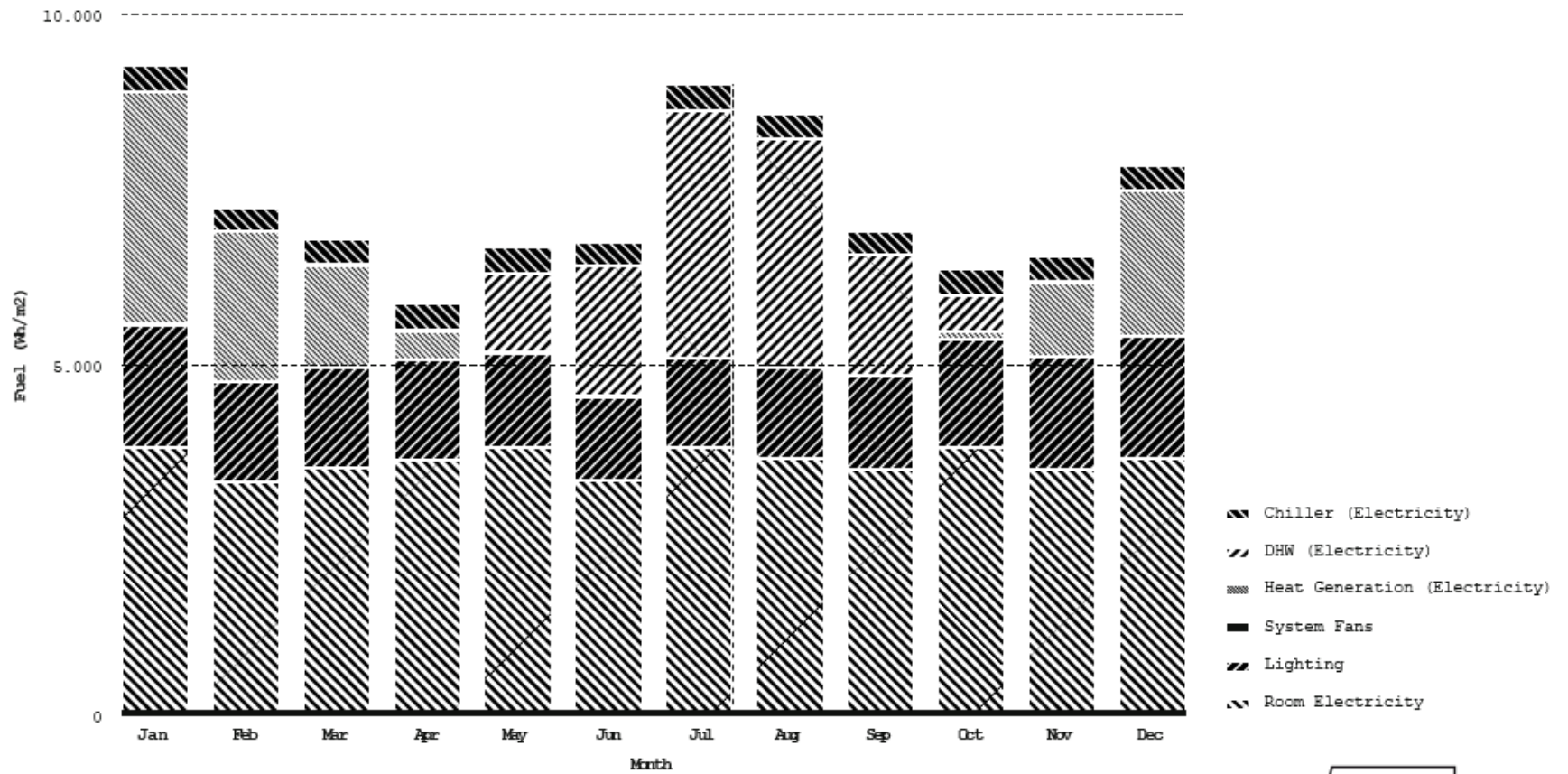




Fuel Breakdown - Comb Building, 6 stories  
1 Jan - 31 Dec, Monthly

FAR: 1.65  
EUI: 85,473 Wh/sqm

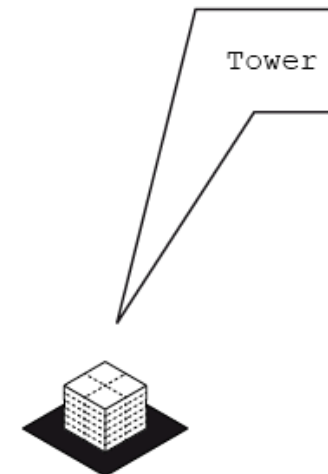


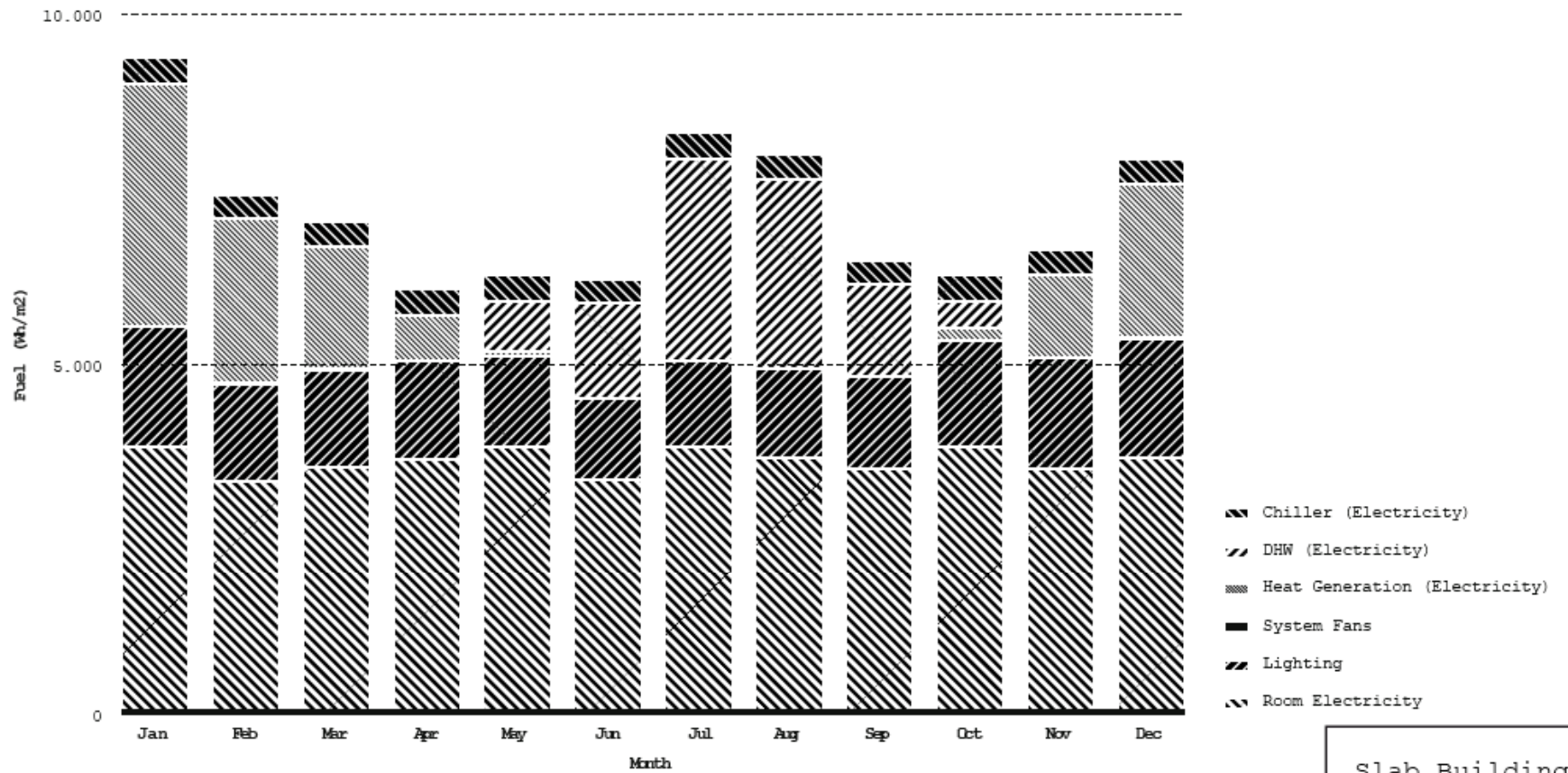


Fuel Breakdown - Tower, 6 stories  
1 Jan - 31 Dec, Monthly

FAR: 2.16

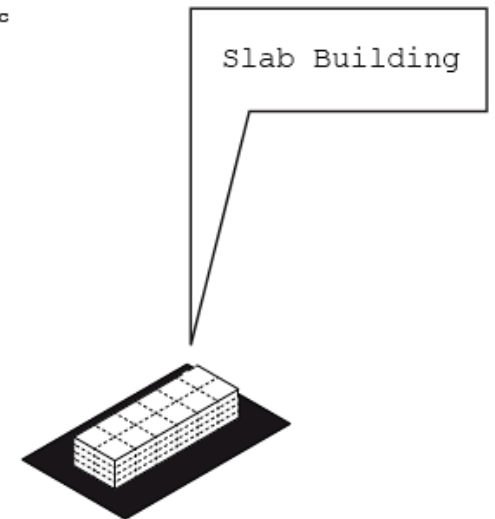
EUI: 87,728 Wh/sqm



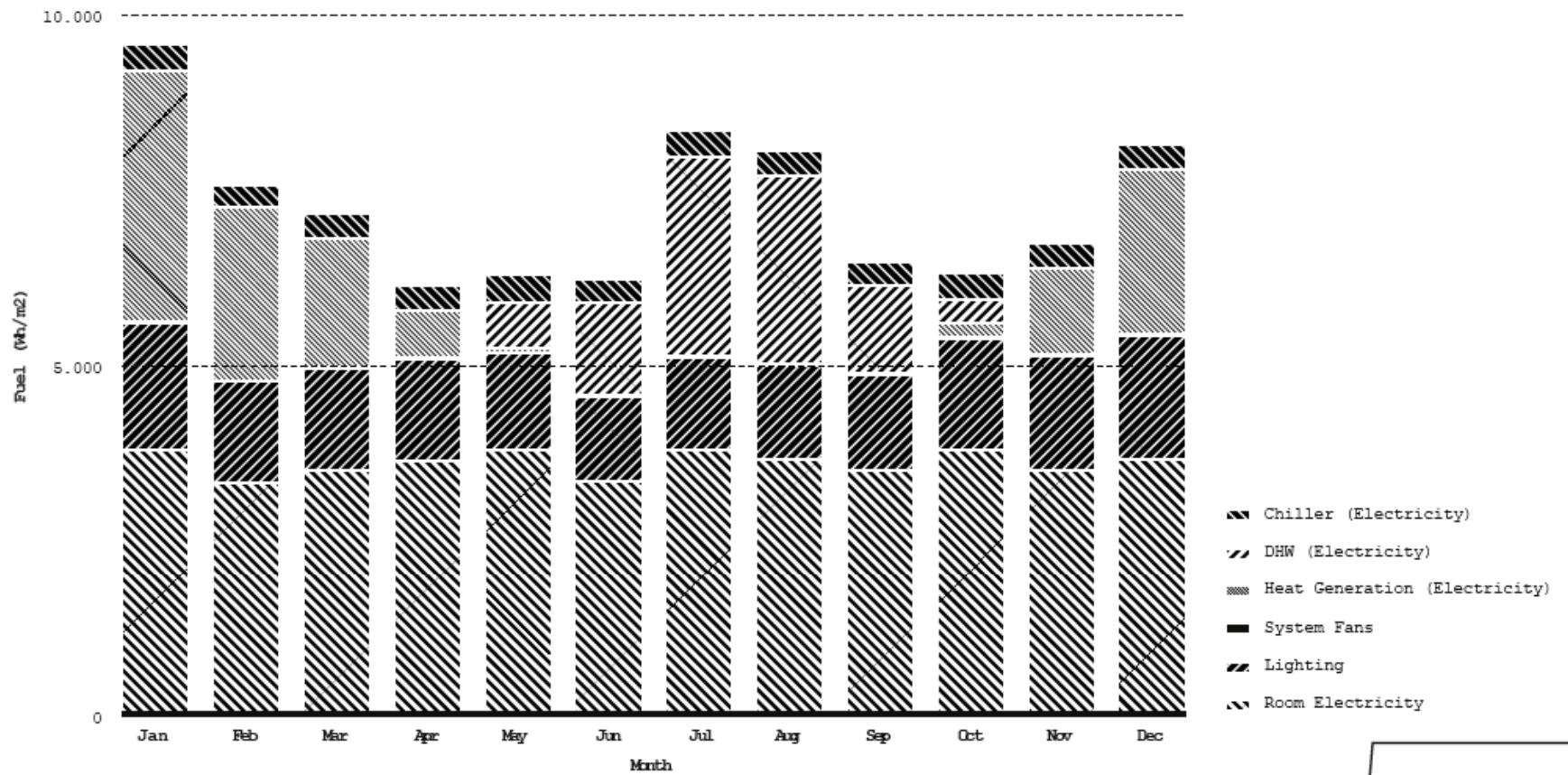


Fuel Breakdown - Slab Building, 6 stories  
1 Jan - 31 Dec, Monthly

FAR: 1.80  
EUI: 85,952 Wh/sqm



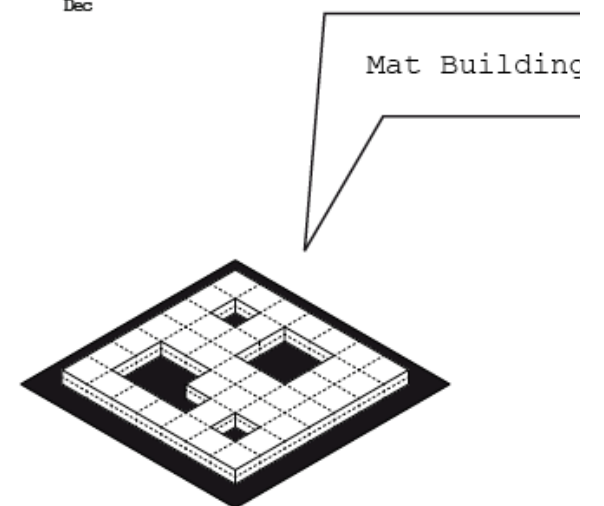




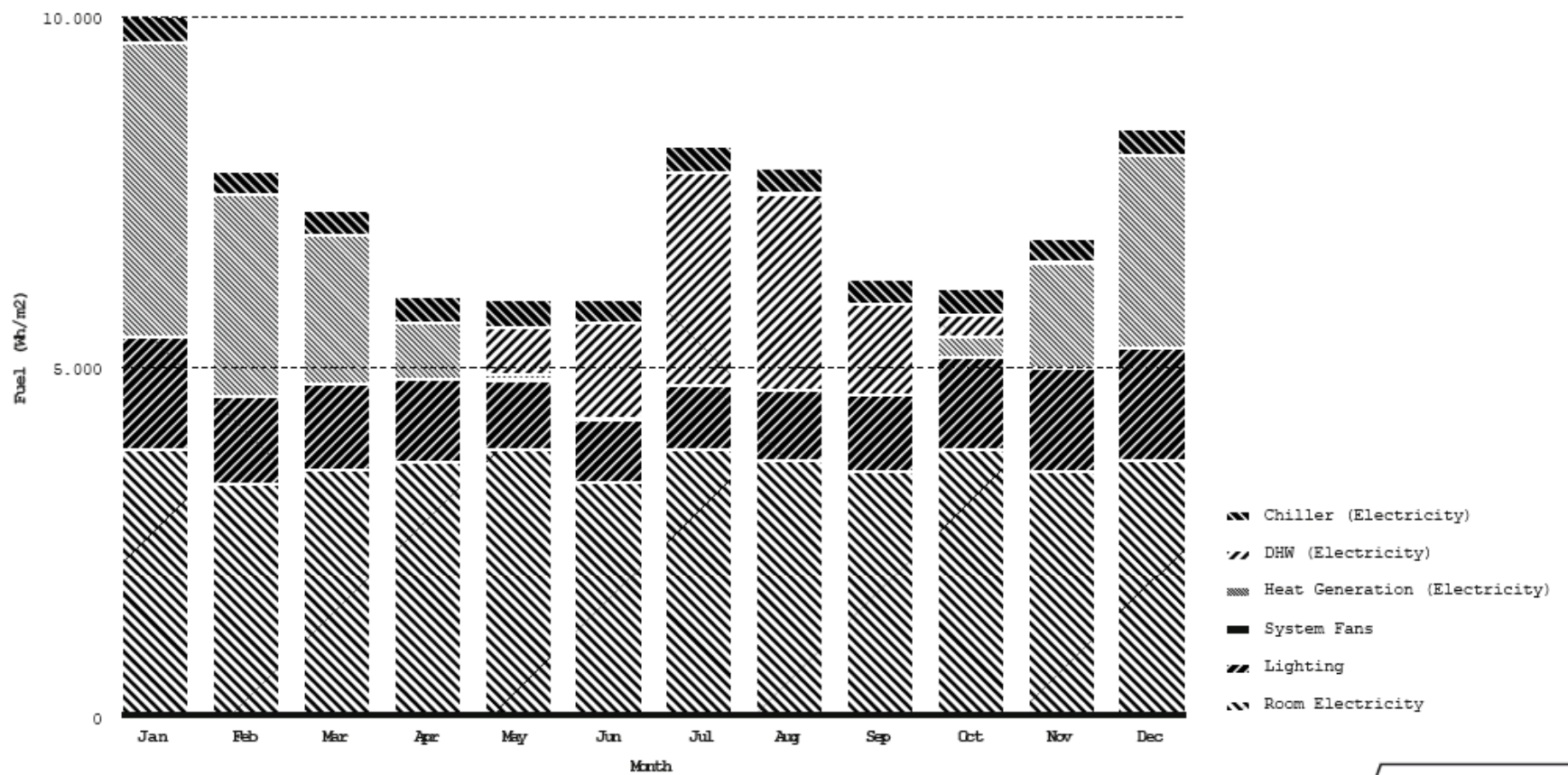
Fuel Breakdown - Mat Building  
1 Jan - 31 Dec, Monthly

FAR: 1.56

EUI: 87,063 Wh/sqm



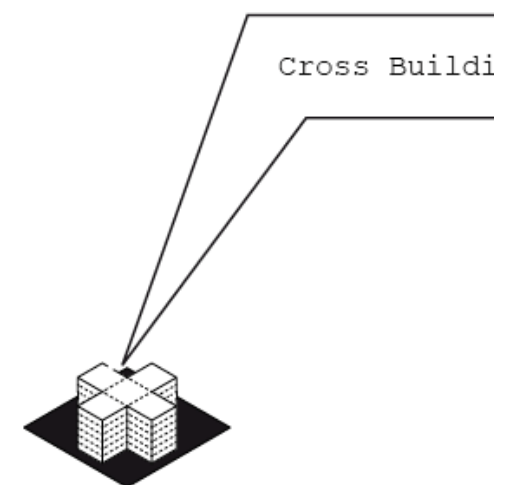




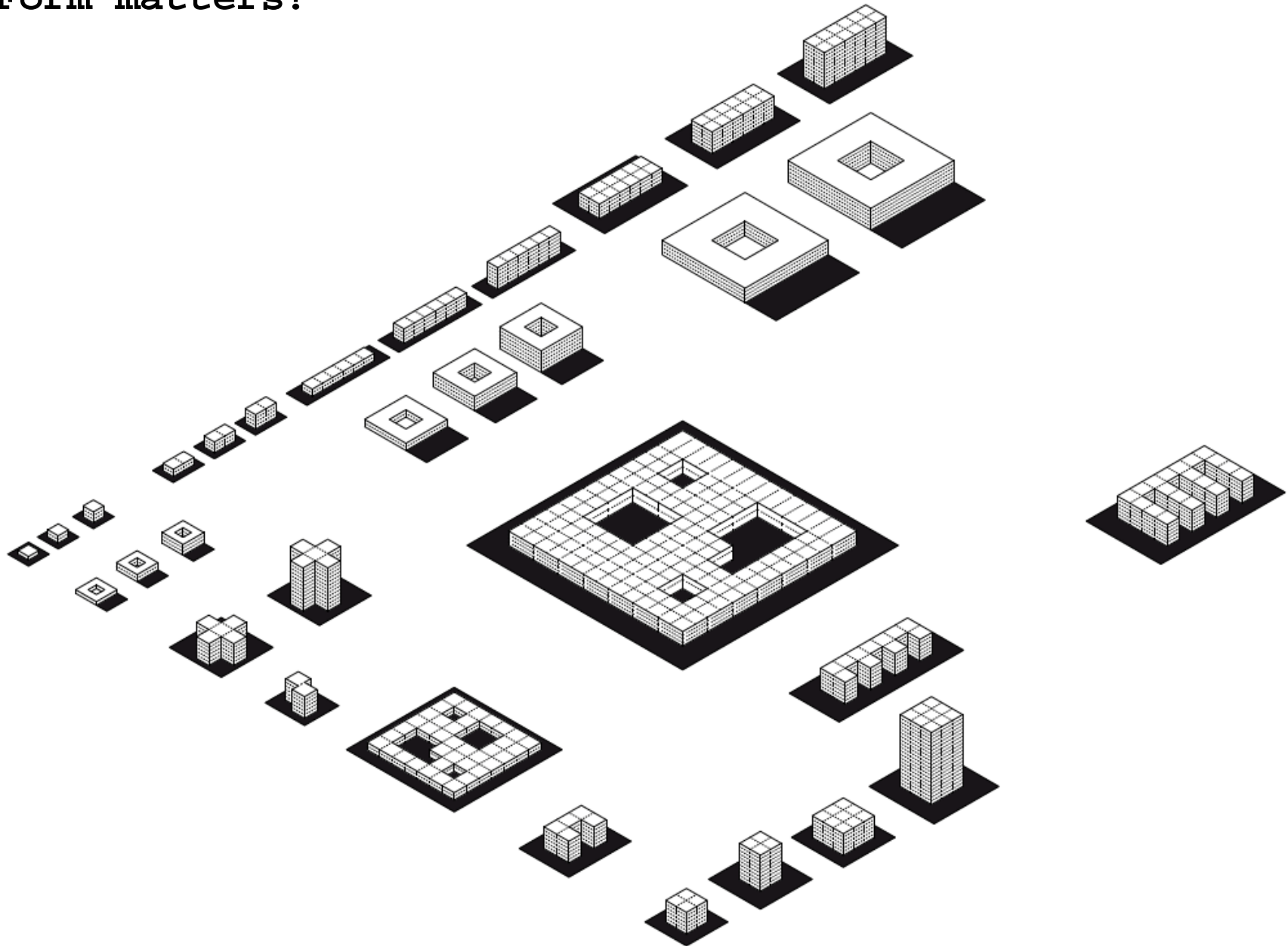
Fuel Breakdown - Cross Building, 6 stories  
1 Jan - 31 Dec, Monthly

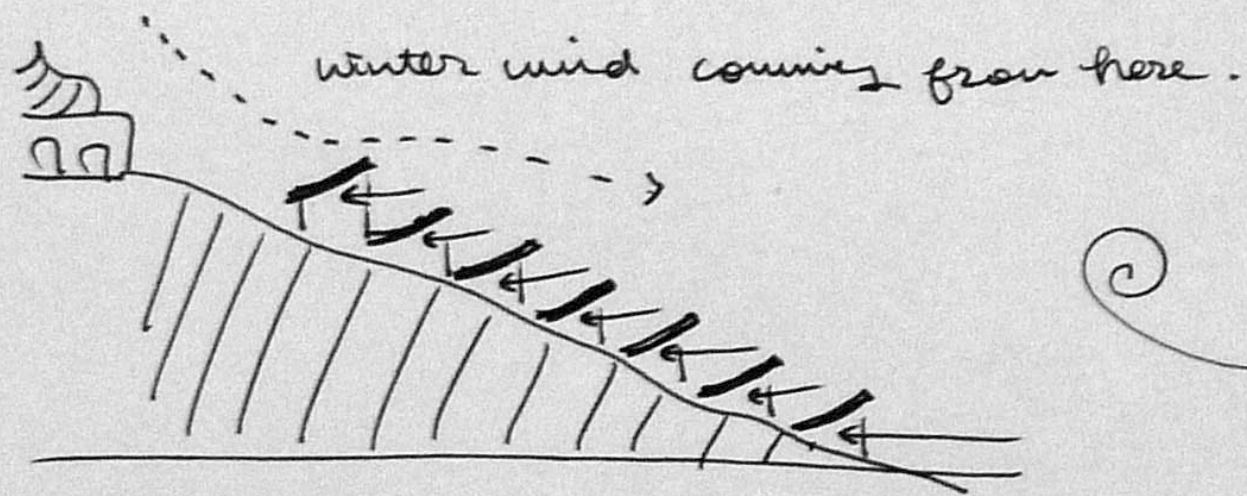
FAR: 1.73

EUI: 86,479 Wh/sqm



Form matters?





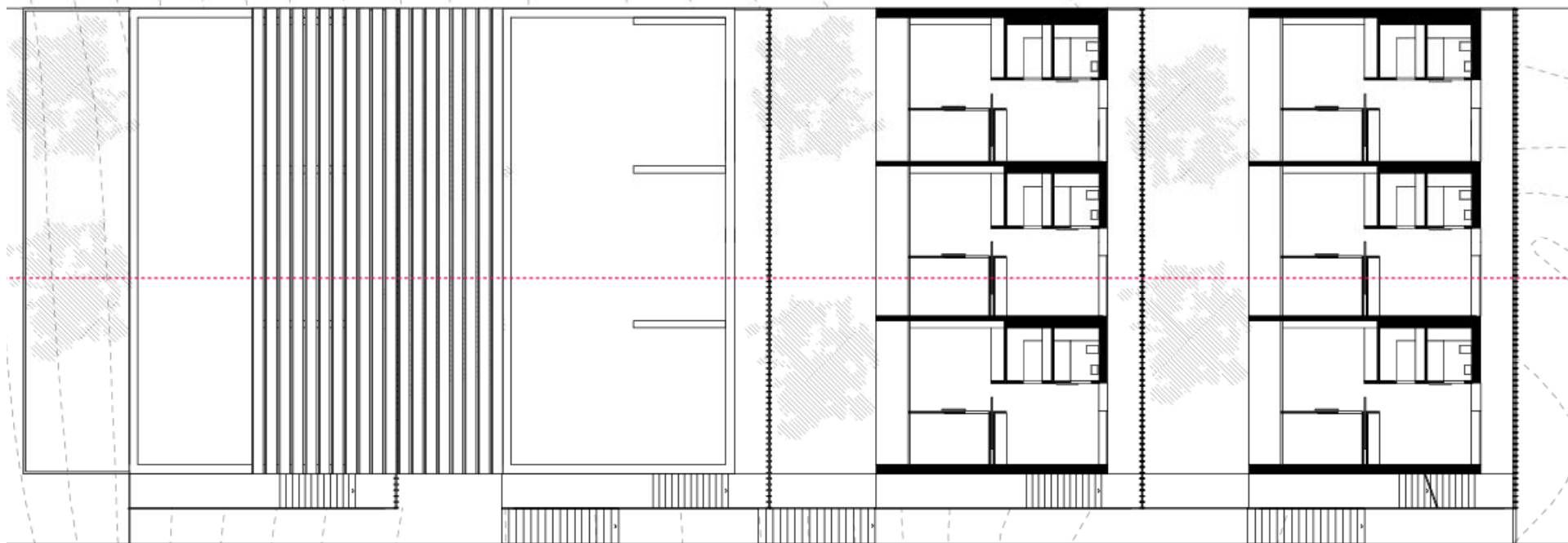
summer wind  
coming from  
here!







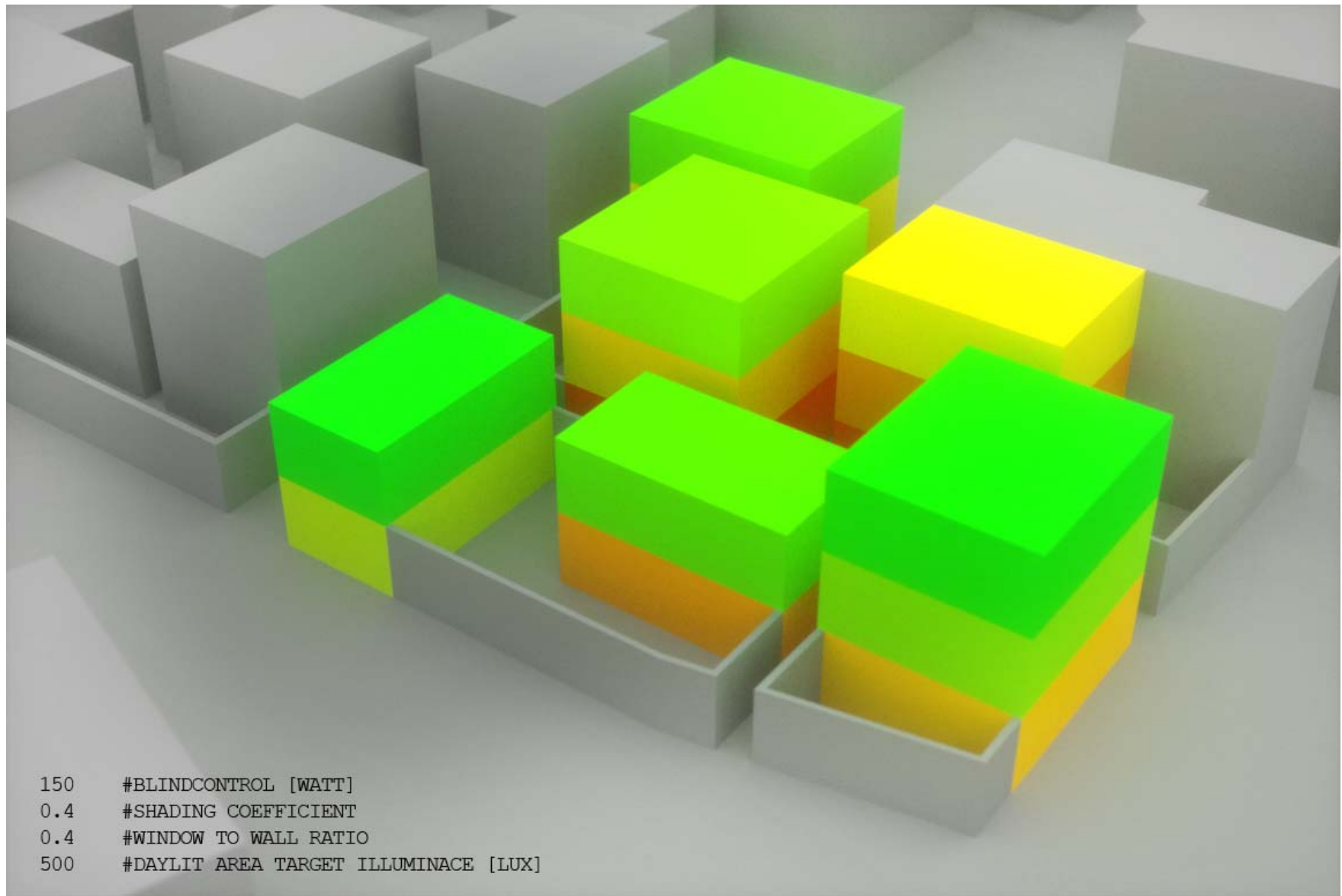




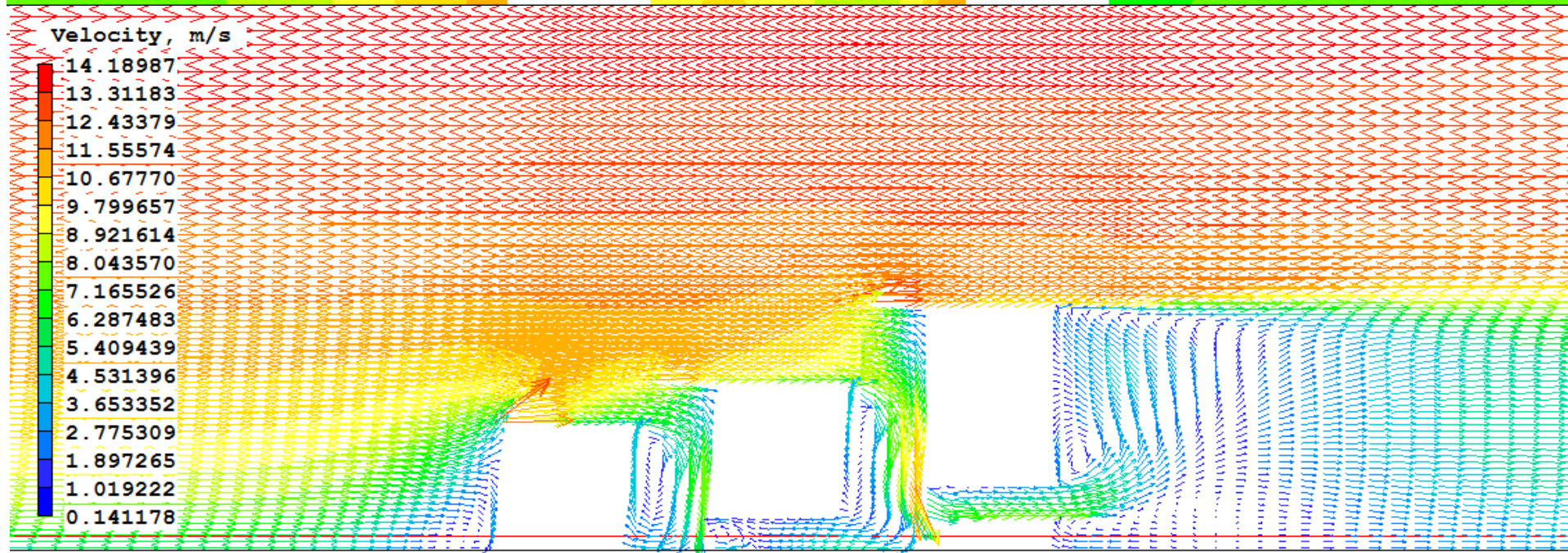
Typical Floorplan

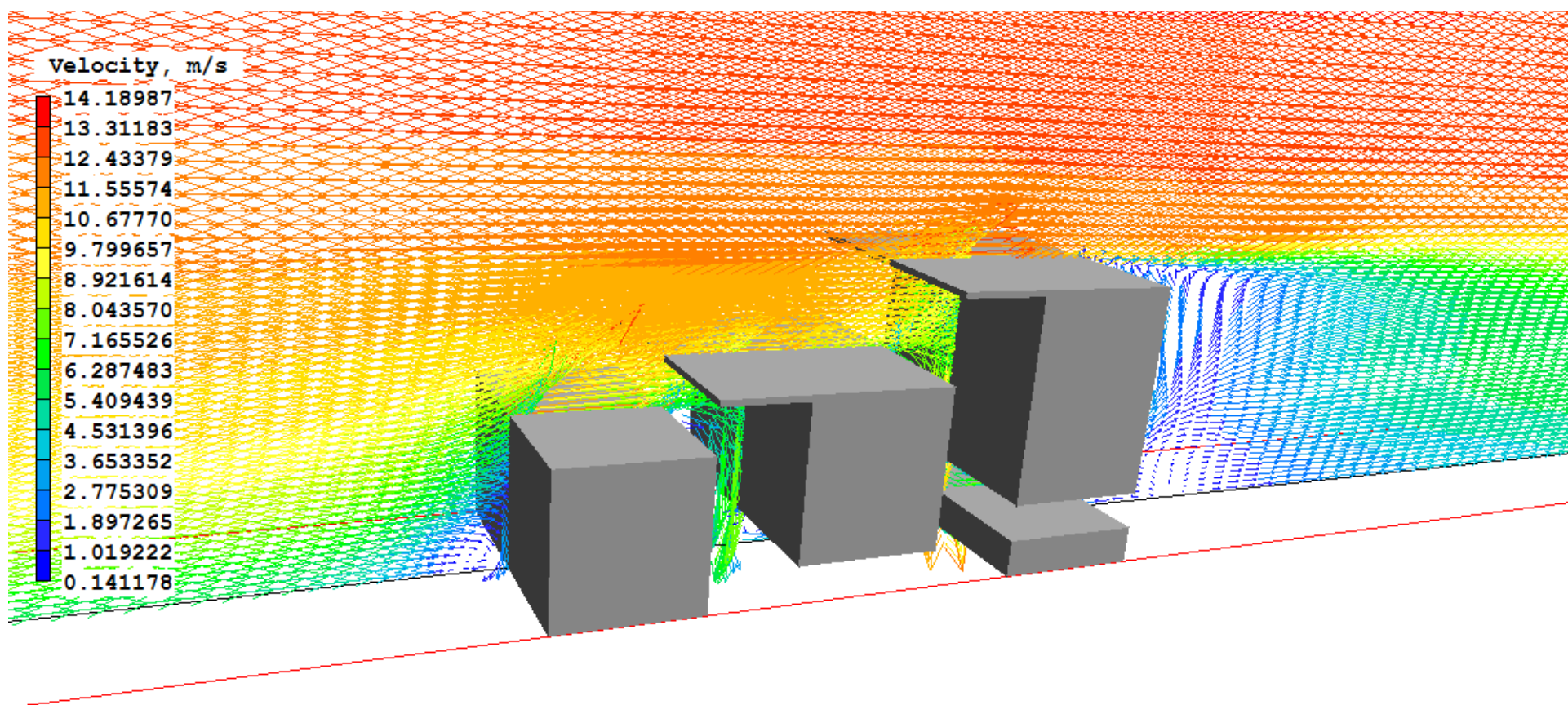
HOW TO EVALUATE?





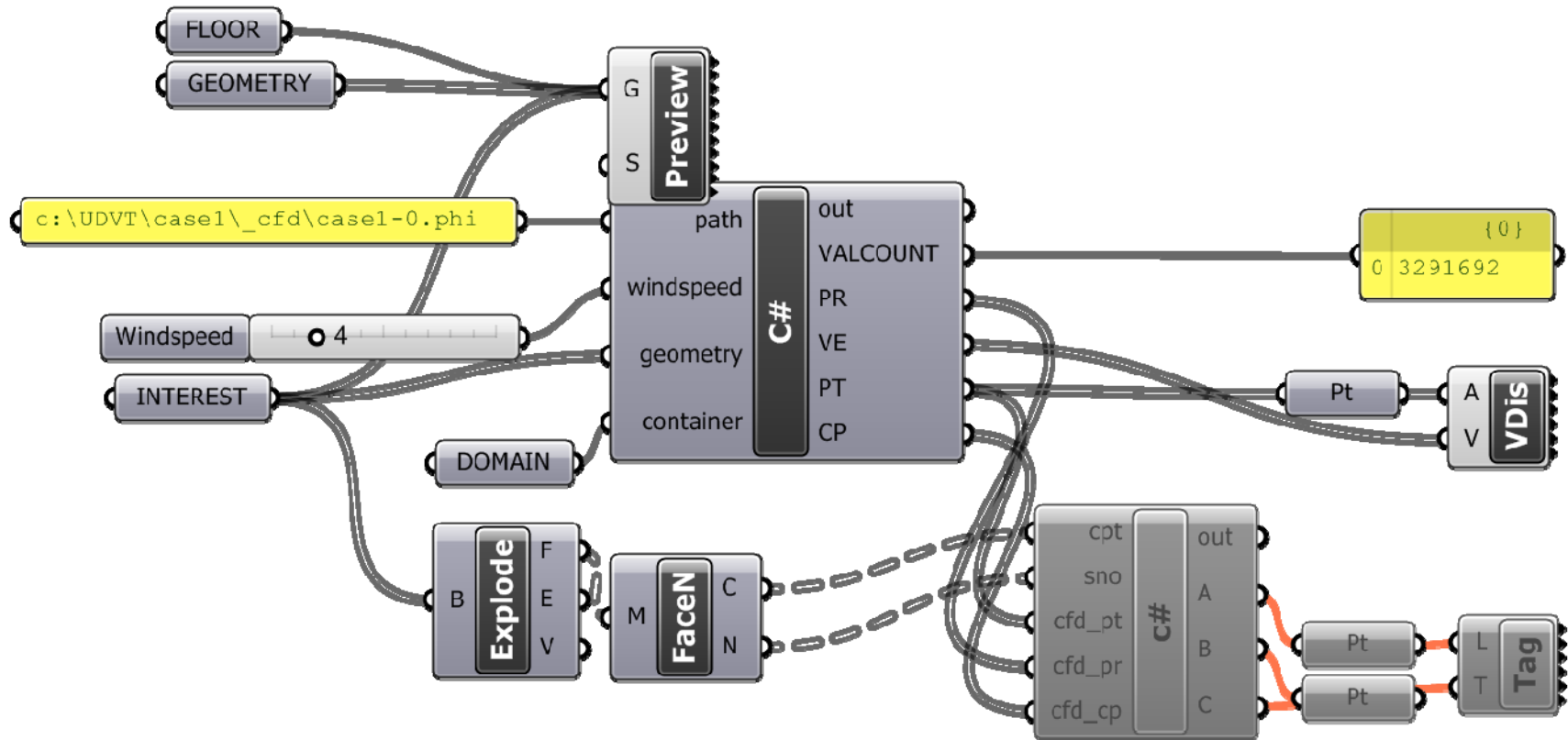
## DAYLIGHT TOOL DEVELOPMENT

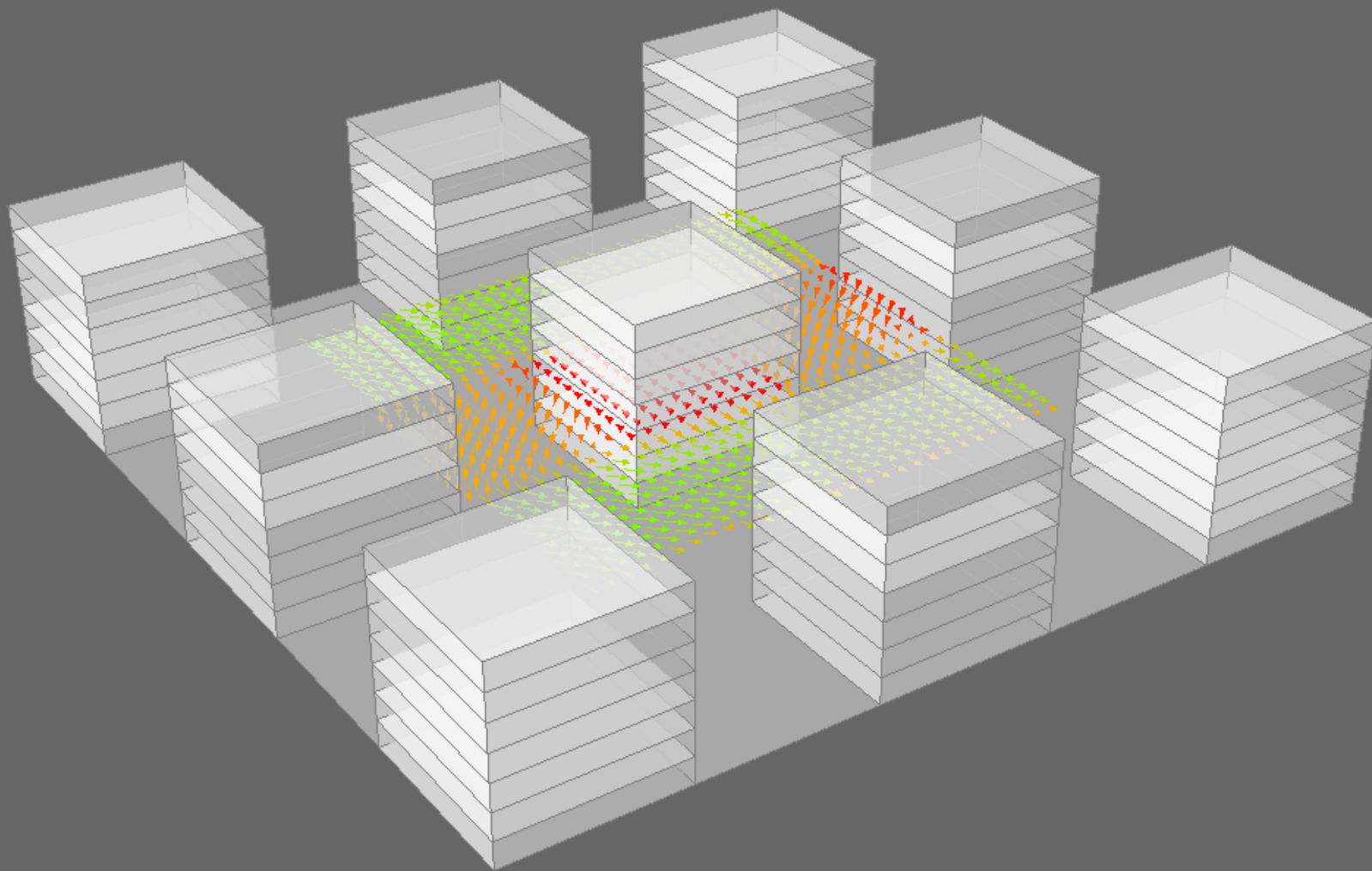




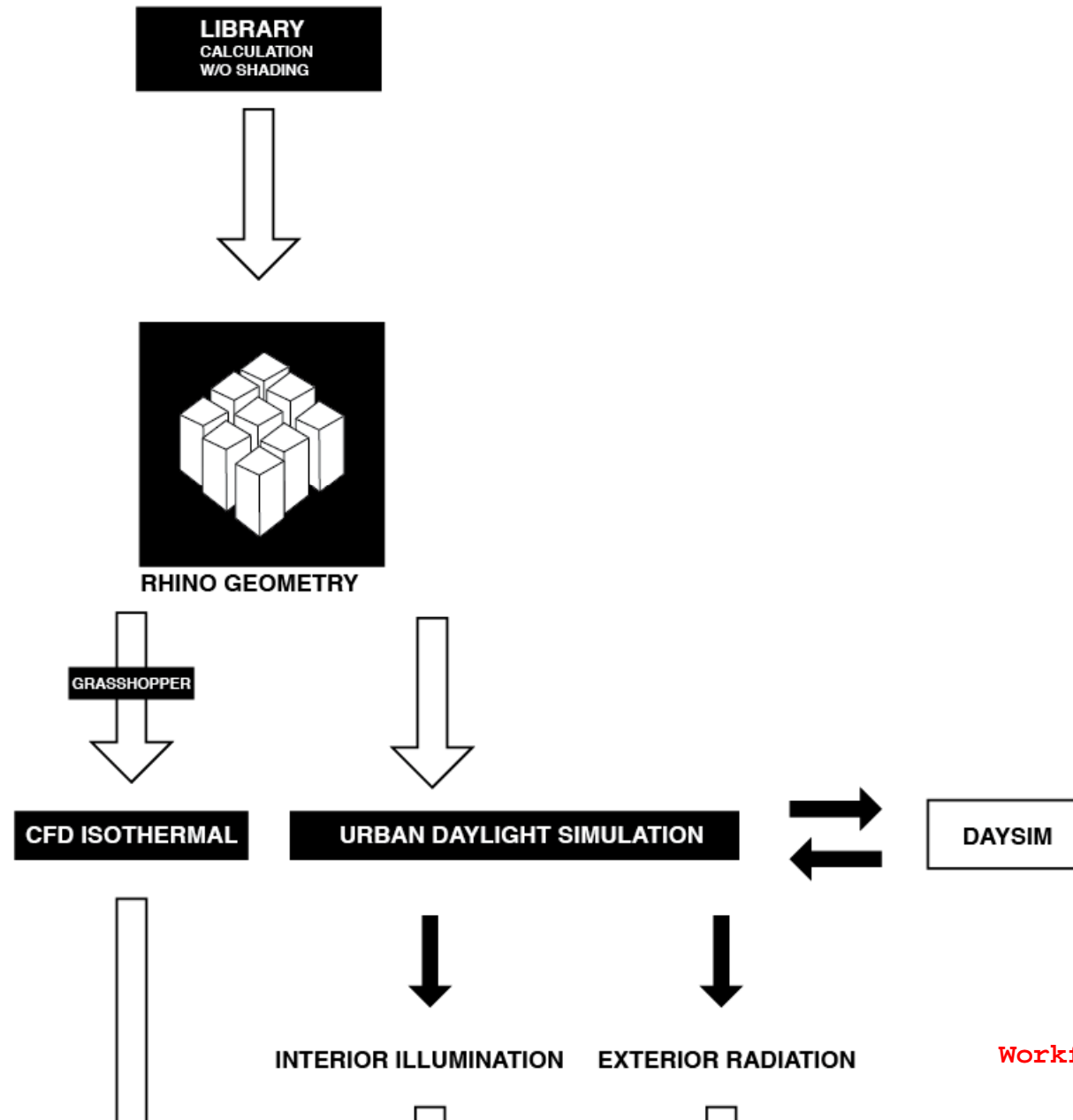
HOW DOES THIS TRANSLATE TO ENERGY?



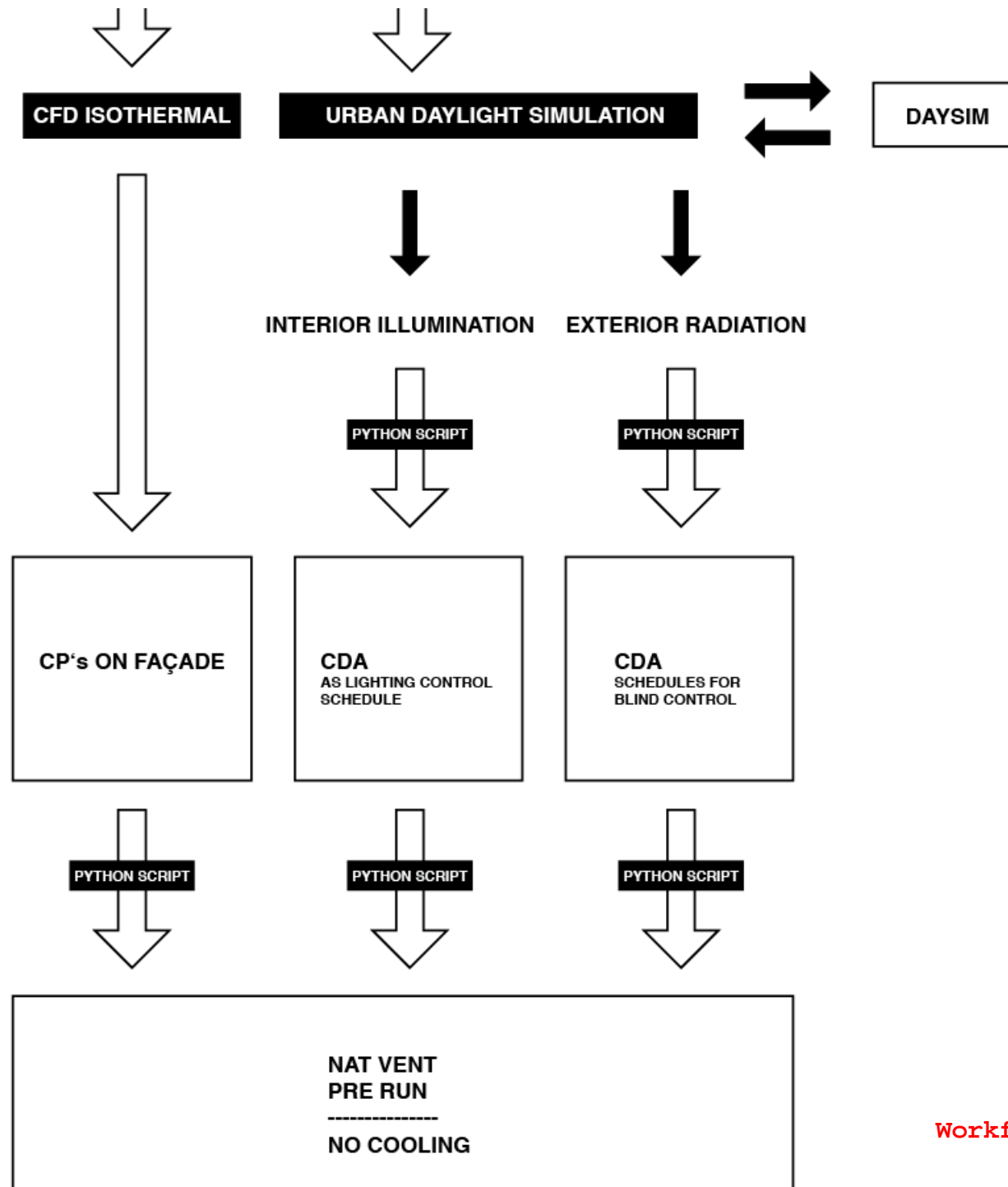




READ CFD RESULTS

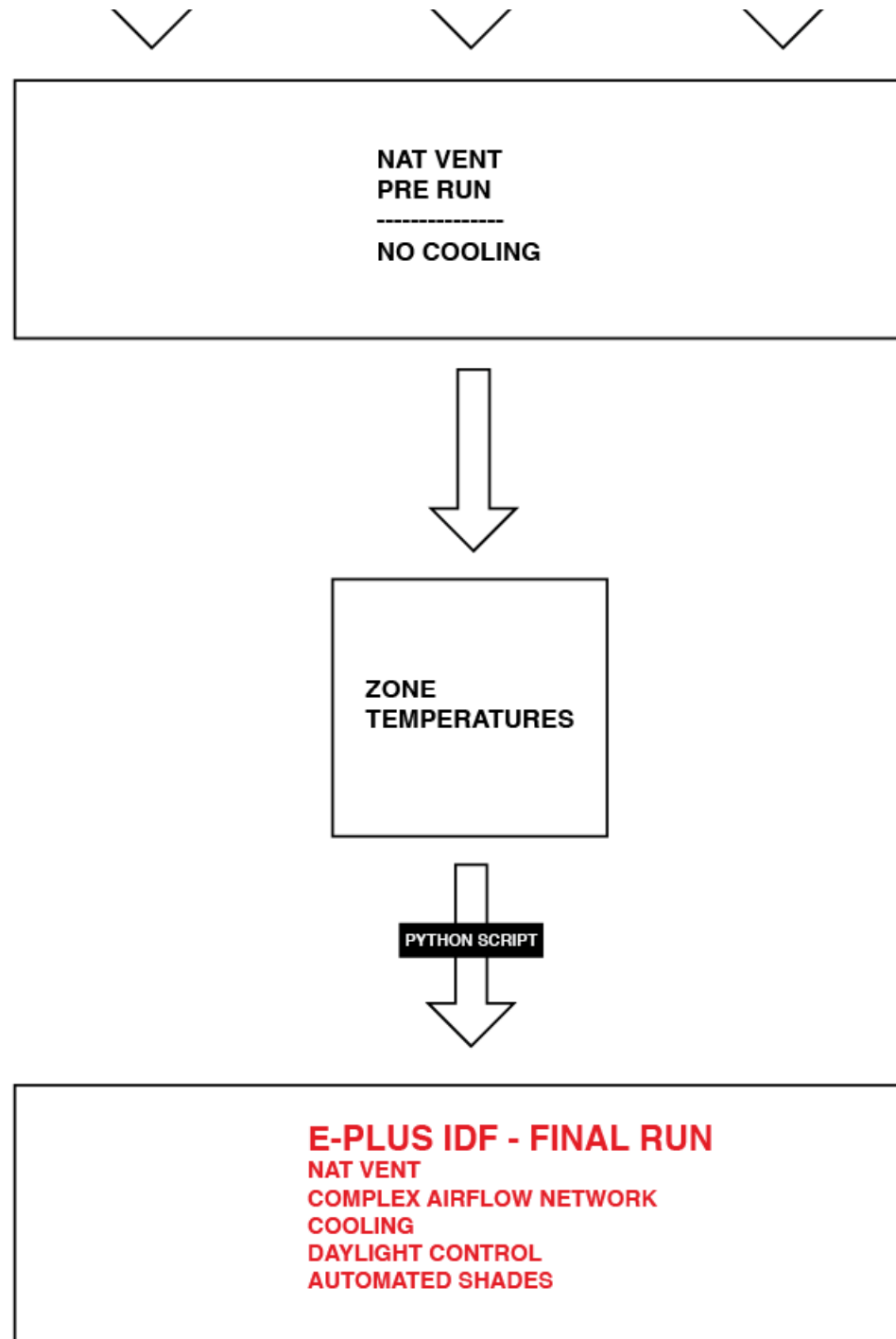


Workflow Diagram



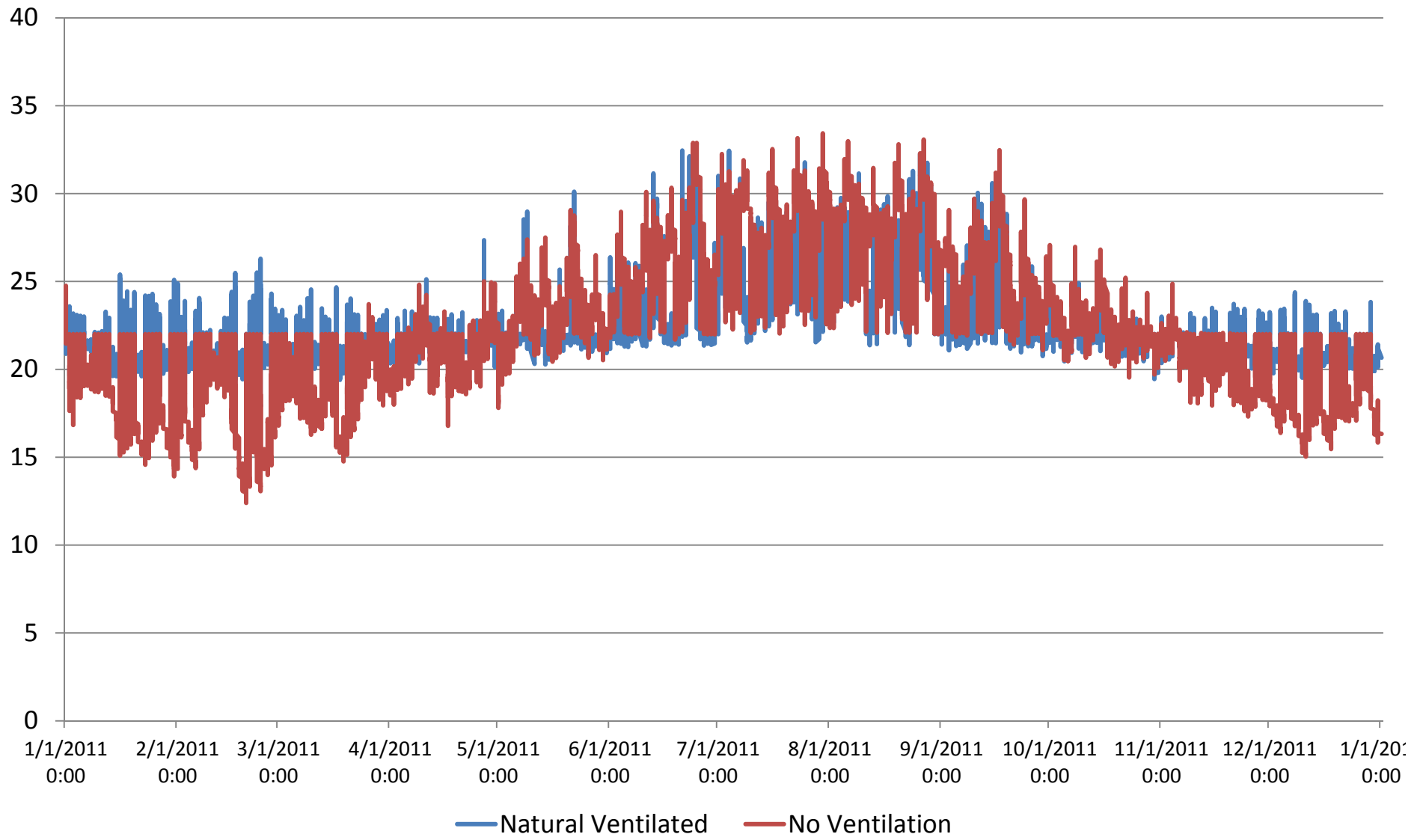
Workflow Diagram



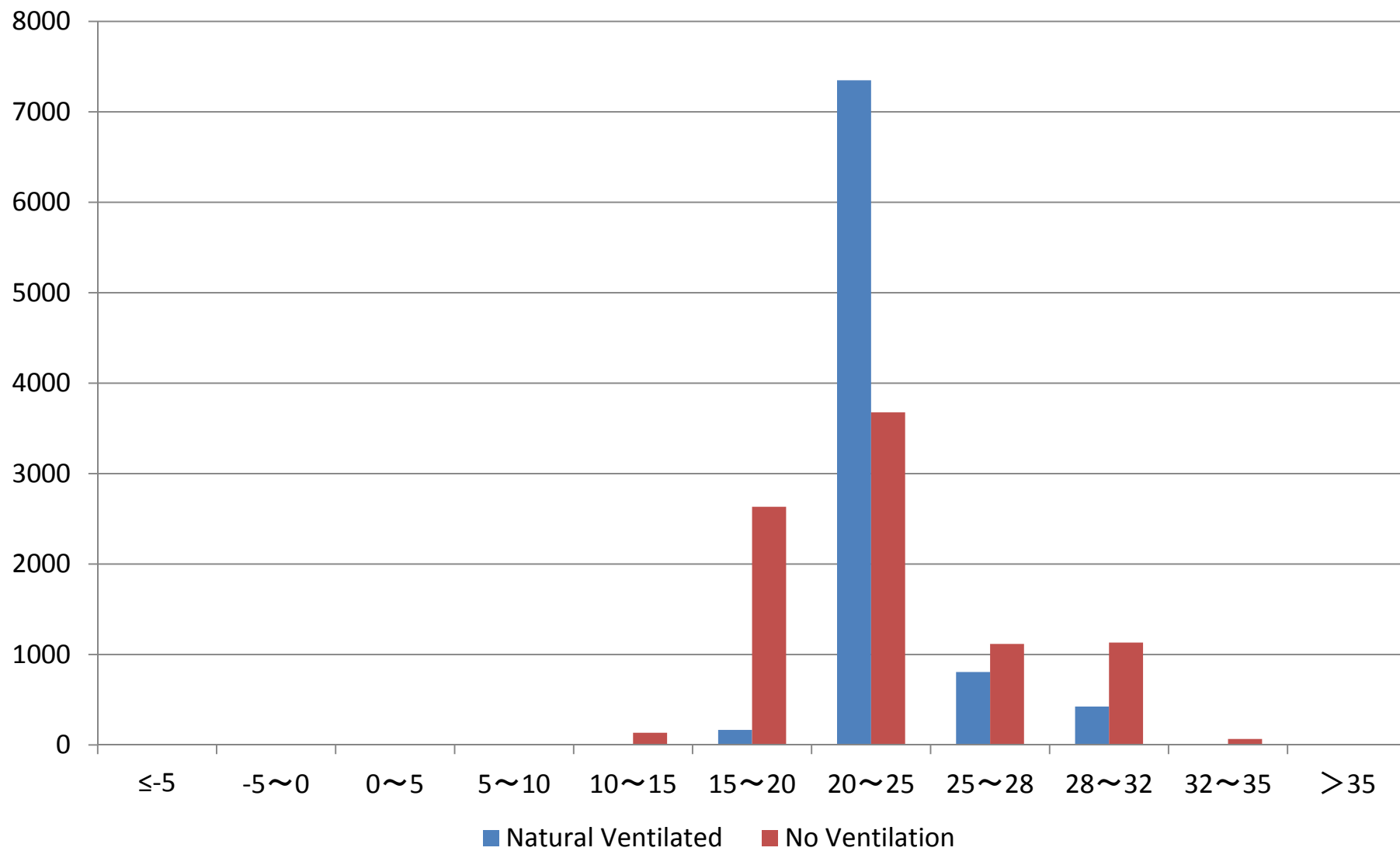


Workflow Diagram

**Air Temperature With and Without Natural Ventilation**



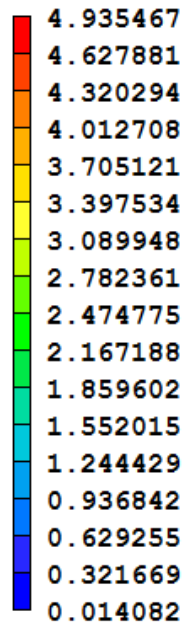
**Air Temperature Distribution With and Without Natural Ventilation**



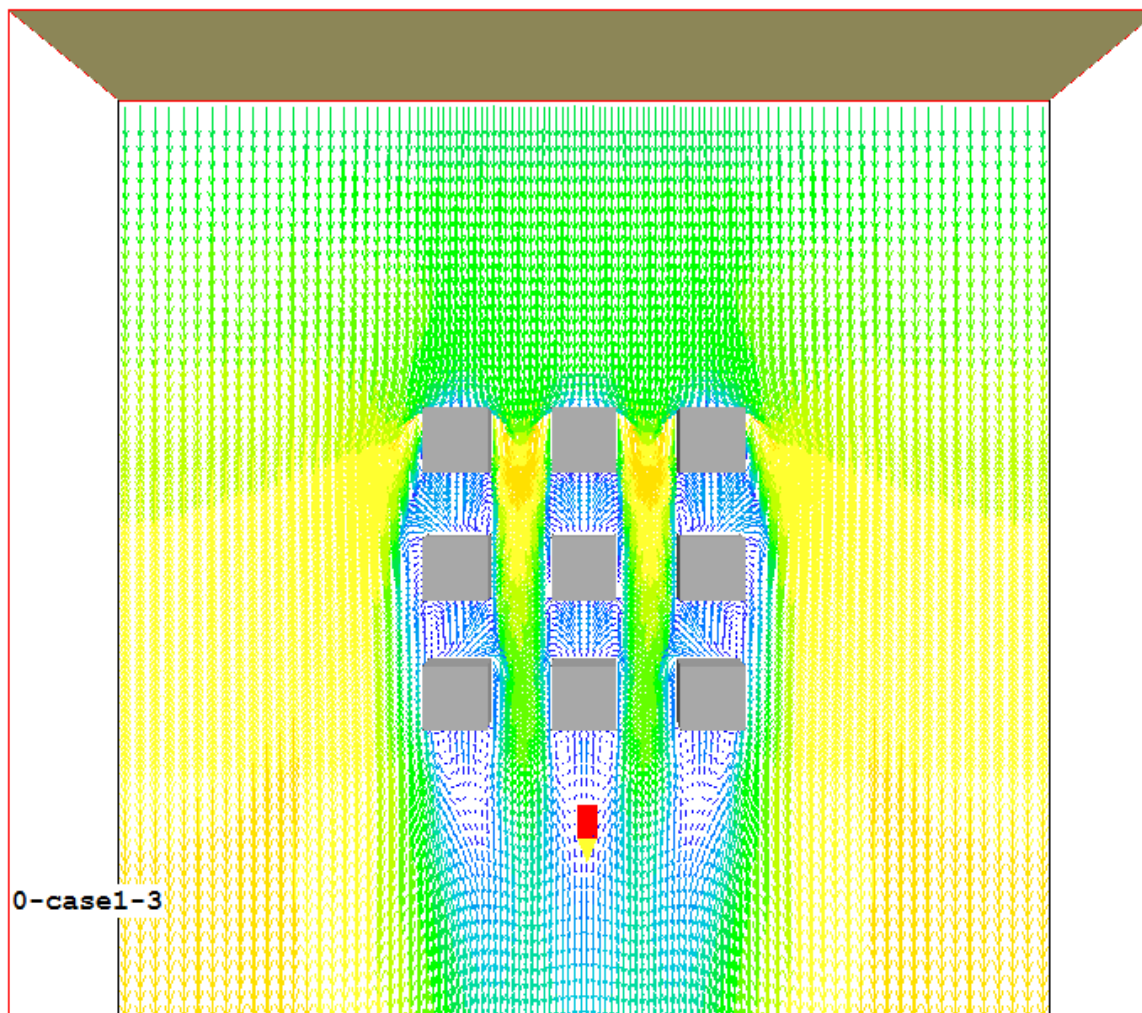
## Ventilation Simulation



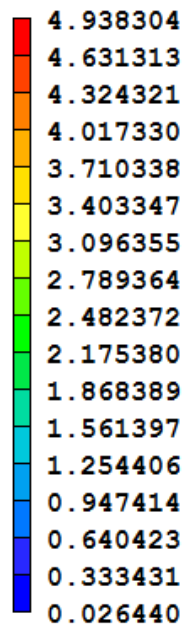
Velocity, m/s



Probe value  
0.566586



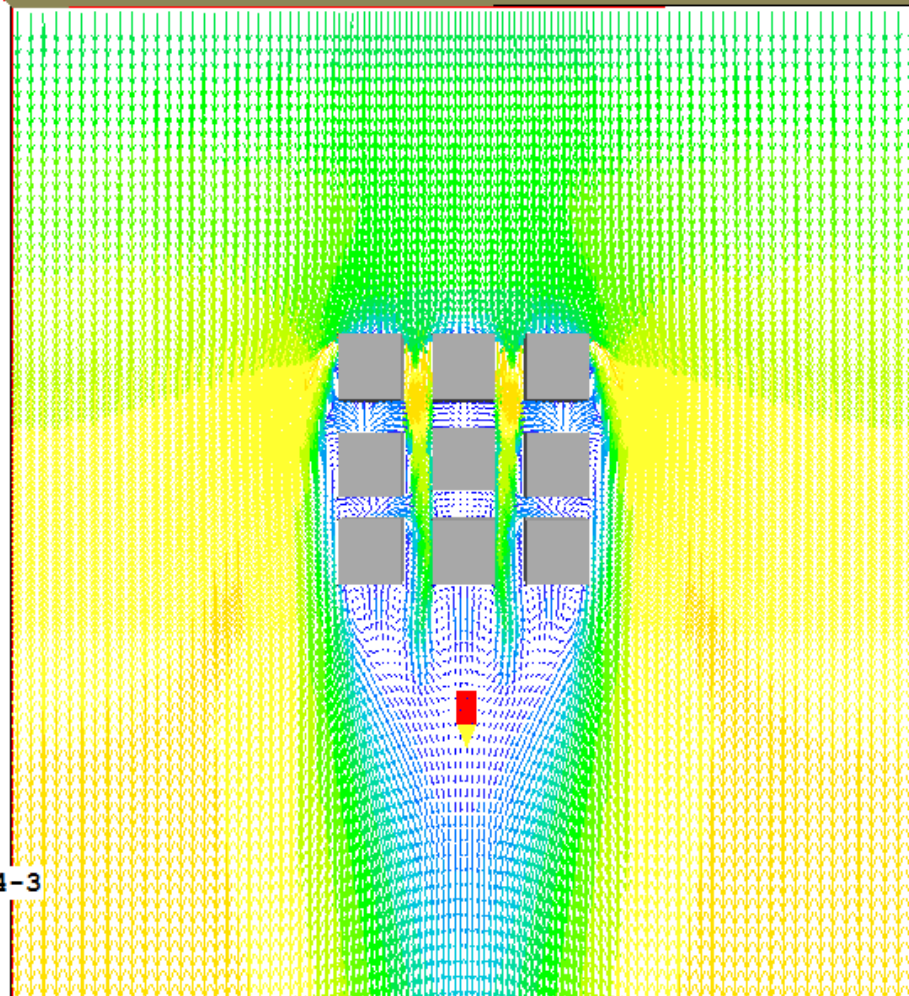
Velocity, m/s



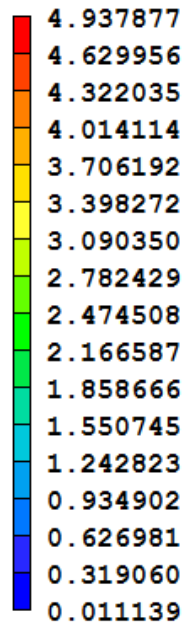
Probe value

0.312386

0-case4-3

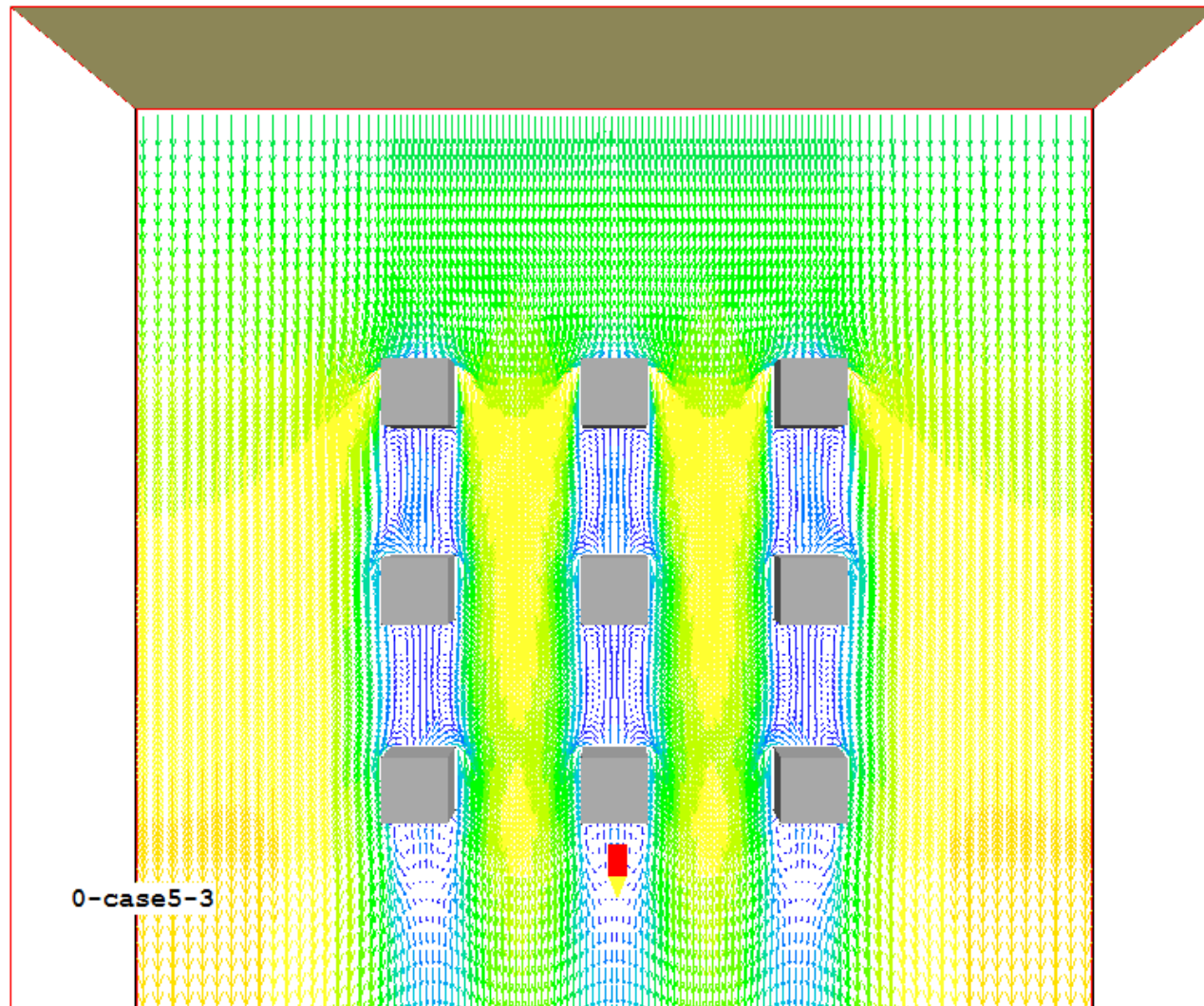


Velocity, m/s

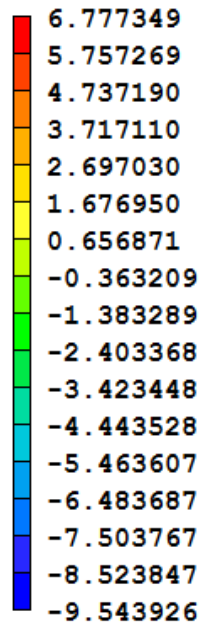


Probe value  
0.191329

0-case5-3



Pressure, Pa



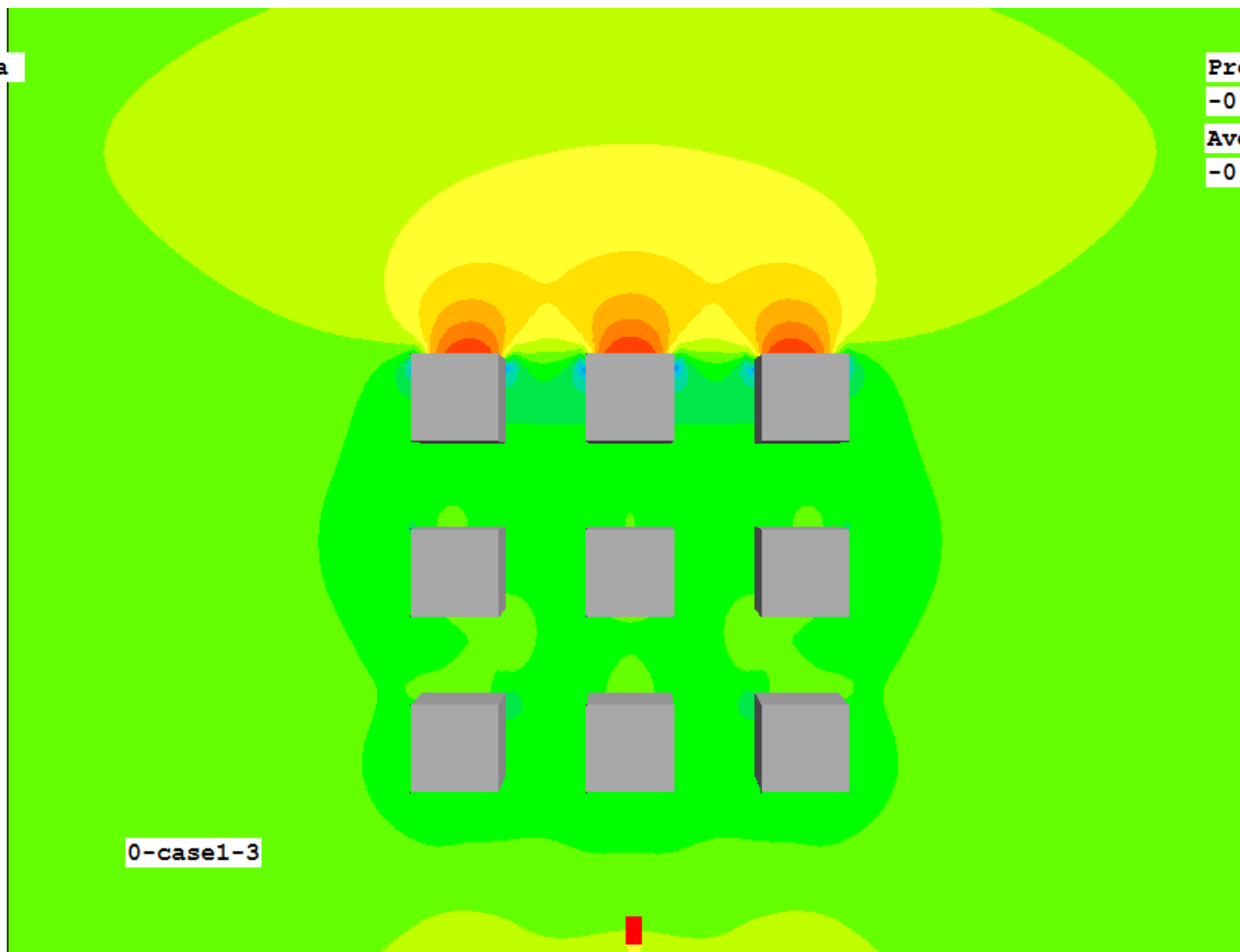
Probe value

-0.193276

Average value

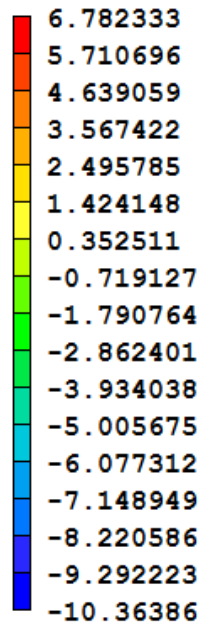
-0.342464

0-case1-3





Pressure, Pa



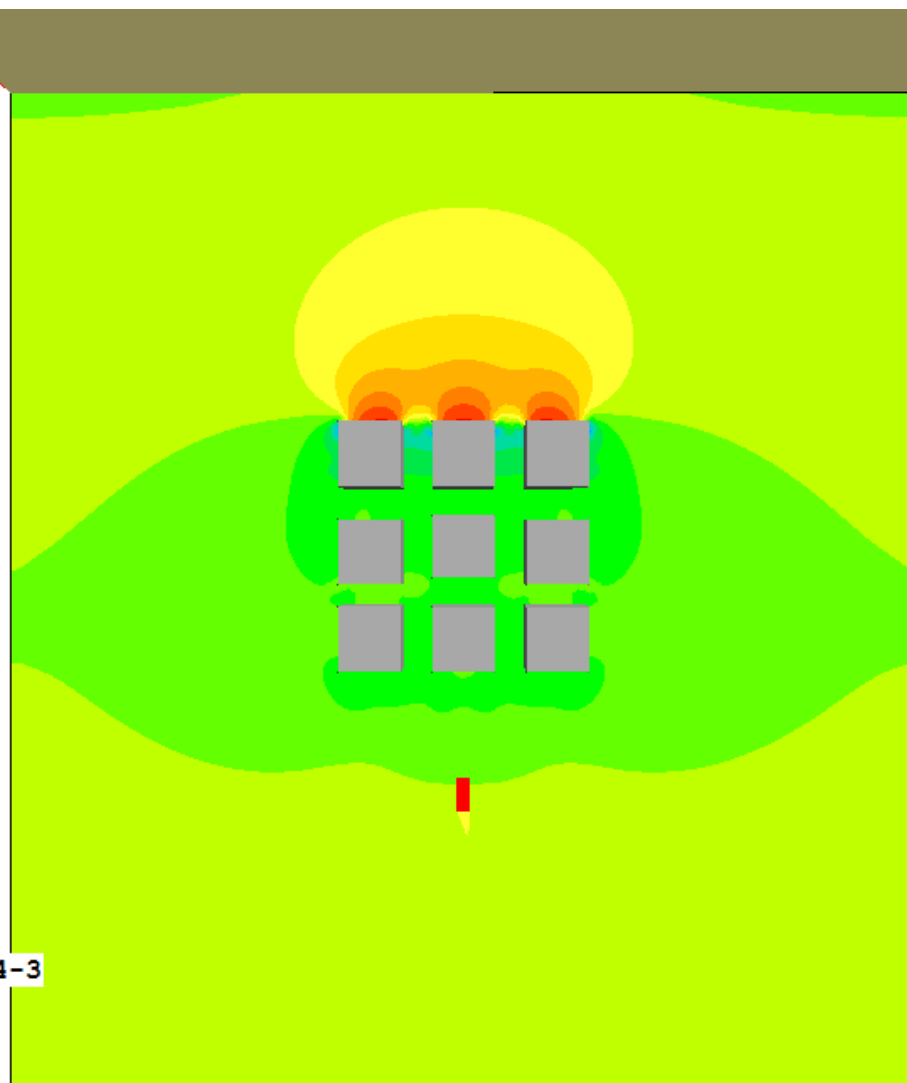
Probe value

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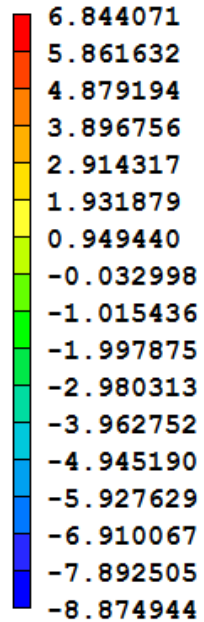
Average value

-0.325226

0-case4-3



Pressure, Pa



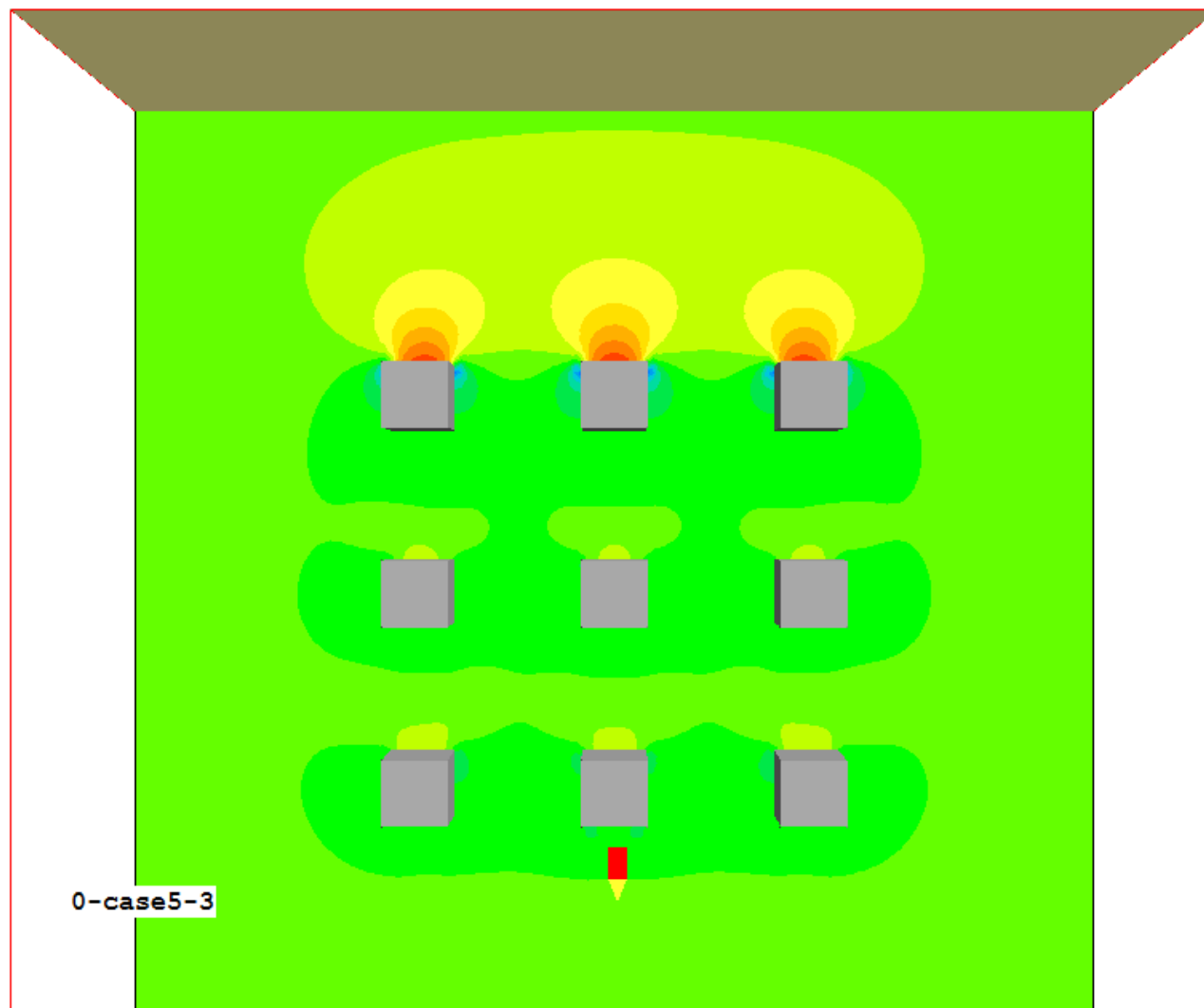
Probe value

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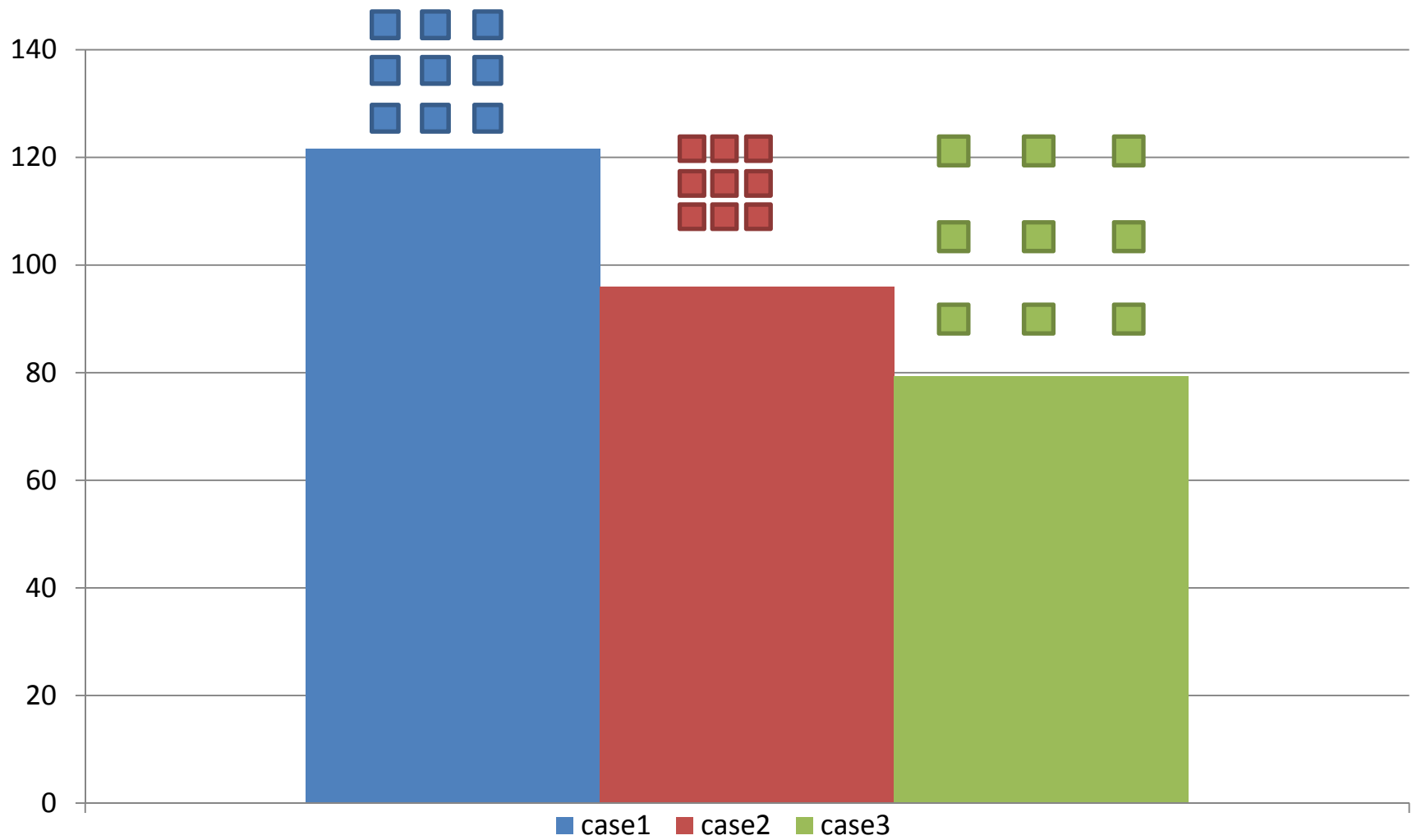
Average value

-0.367854

0-case5-3



**Total Site Energy Per Total Building Area [kWh/m2]**



Thank you for your attention