

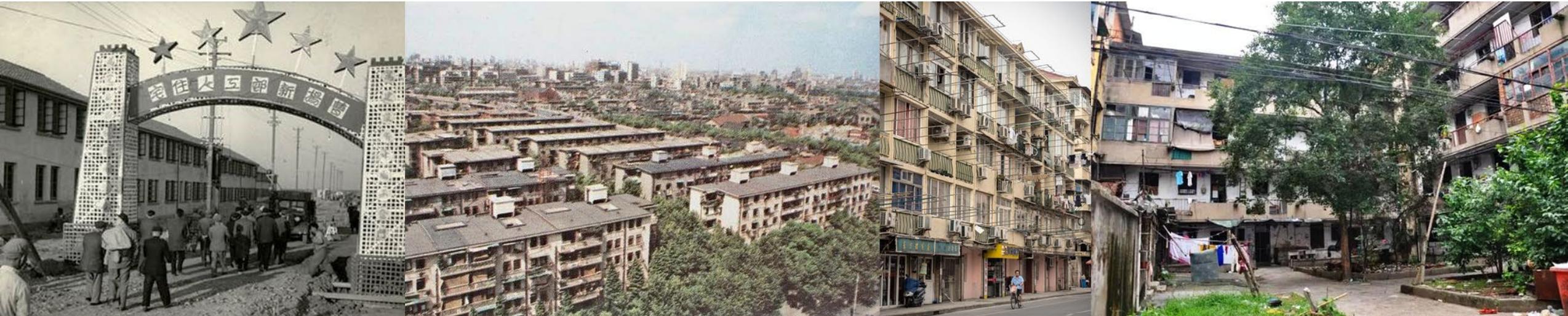
How does the

“Flat to Slope Project”

affect building energy performance in urban regeneration

“Flat to Slope Project”

- “From Flat to Slope Roof” Project
- A governmental project in Shanghai, China
- Workers’ villages
 - Account 31% of the total area of residential buildings
 - Built 30 years ago & Dwelling environment is deteriorating
 - More than 250,000 Worker village buildings are to be renovated



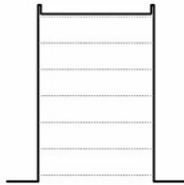
“Flat to Slope Project”

- **3** main purposes
 - Changes monotonous appearance of the urban roofscape
 - Helps to improve waterproofing
 - Aims to achieve higher energy performance



Renovation modes

- **5** modes based on roof variations
 - **B0** – Baseline case – flat roof without insulation



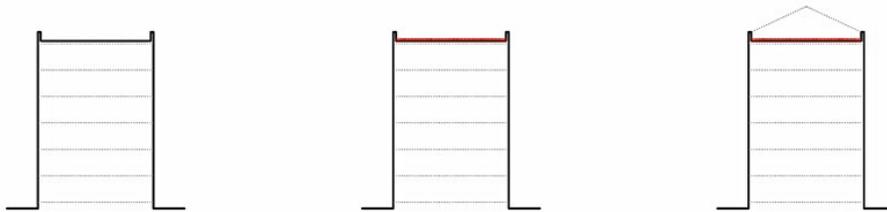
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 - **F1** – Flat roofing 1 – flat roof with insulation & no slope roof



Renovation modes

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 - **F2** – Flat roofing 2 – flat roof with insulation & slope roof without insulation



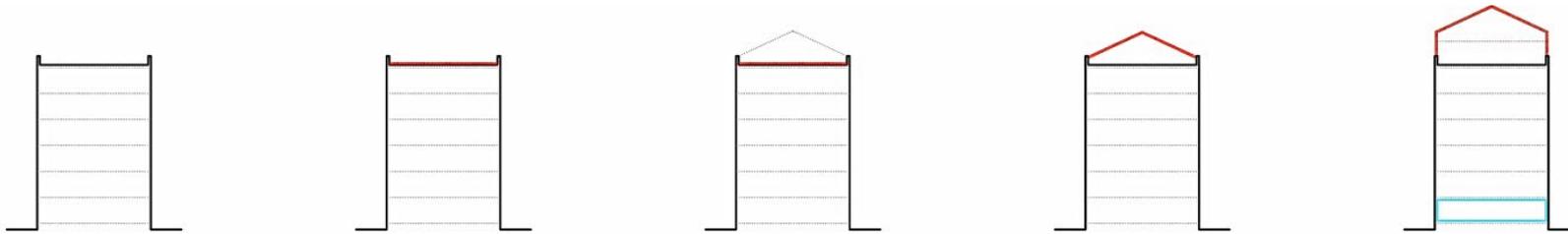
Renovation modes

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 - **F1** – Flat roofing 1 – flat roof with insulation & no slope roof
 - **F2** – Flat roofing 2 – flat roof with insulation & slope roof without insulation
 - **S1** – Slope roofing 1 – flat roof without insulation & slope roof with insulation



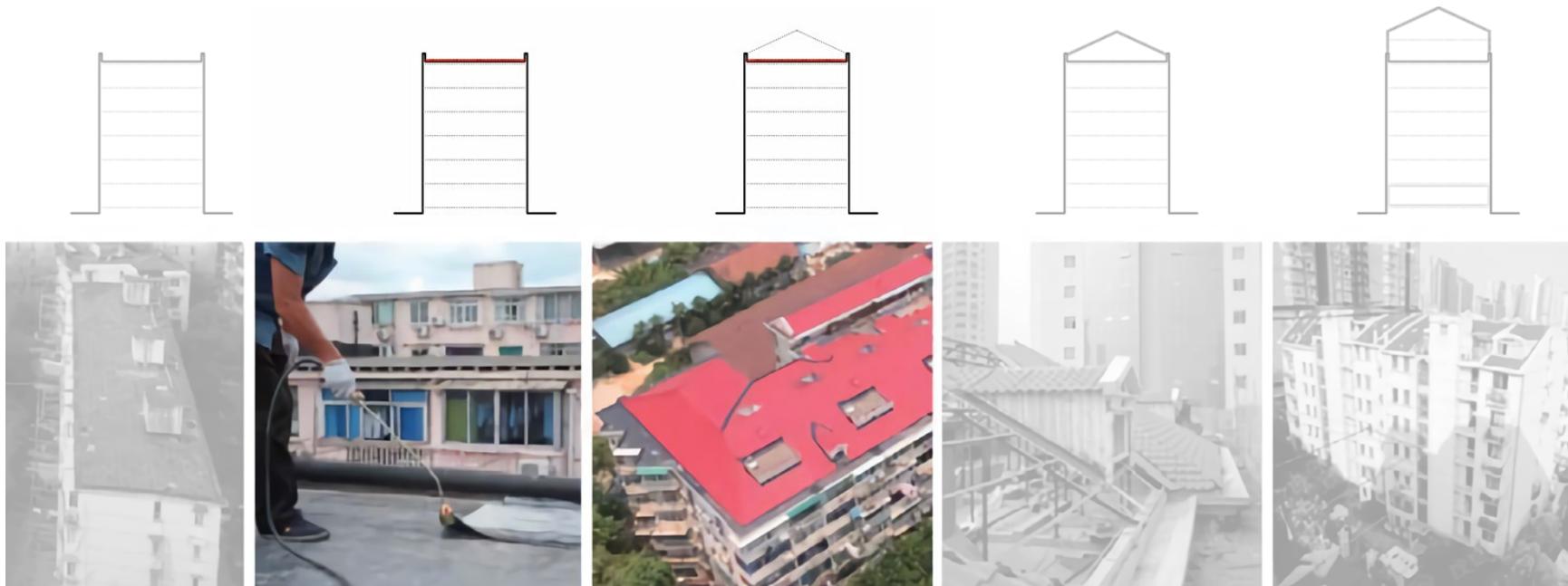
Renovation modes

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 - **F2** – Flat roofing 2 – flat roof with insulation & slope roof without insulation
 - **S1** – Slope roofing 1 – flat roof without insulation & slope roof with insulation
 - **S2** – Slope roofing 2 – flat roof without insulation & slope roof with insulation & extra floor



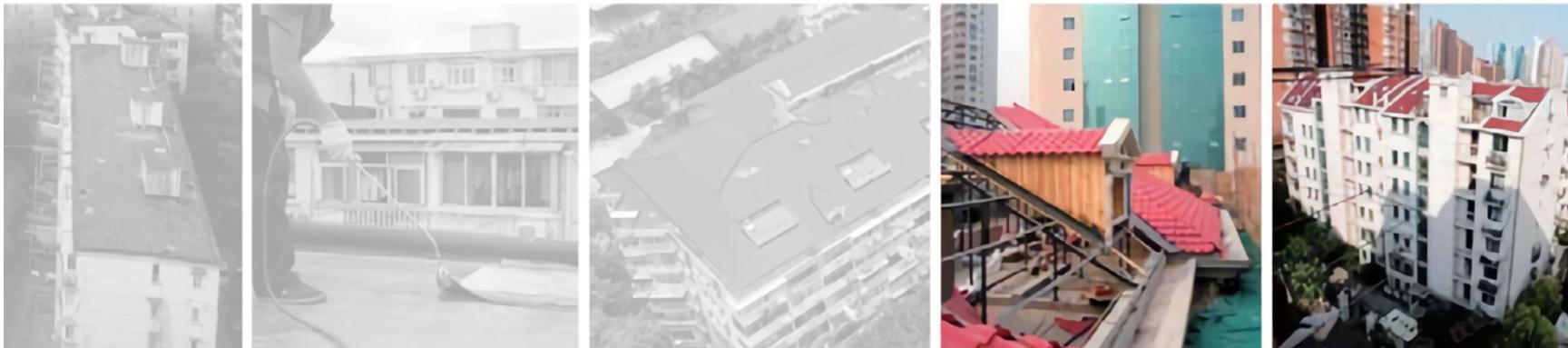
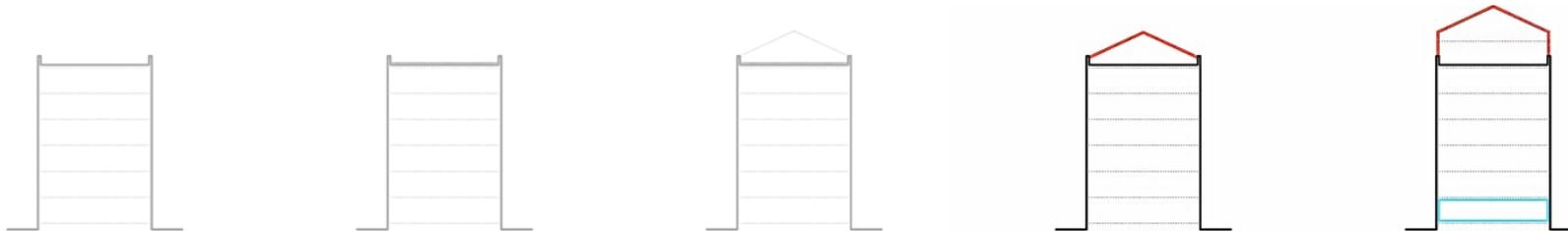
Renovation modes

- **5** modes based on roof variations – Basic renovation typologies
 - **B0** – Baseline case
 - **F1** – Flat roofing
 - **F2** – Inaccessible slope roofing
 - **S1** – Accessible slope roofing
 - **S2** – Converted slope roofing



Renovation modes

- **5** modes based on roof variations – Optimized renovation typologies
 - **B0** – Baseline case
 - **F1** – Flat roofing
 - **F2** – Inaccessible slope roofing
 - **S1** – Accessible slope roofing
 - **S2** – Converted slope roofing



Renovation modes

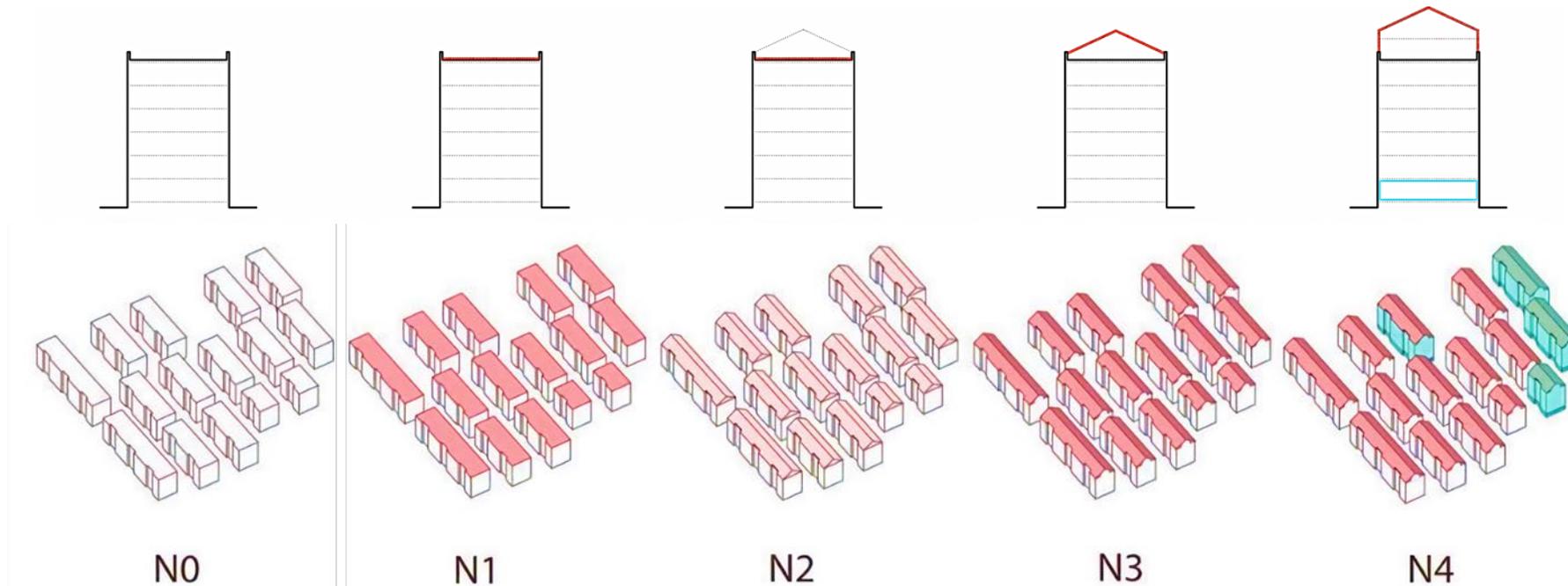
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 - **Building-level** to **Neighborhood-level**
 - Building spacing
 - Building height
 - Building layout
- Affect**
- Mutual shading
 - Sunlight duration
 - Outdoor micro-climate
 - Indoor thermal environment



Renovation modes

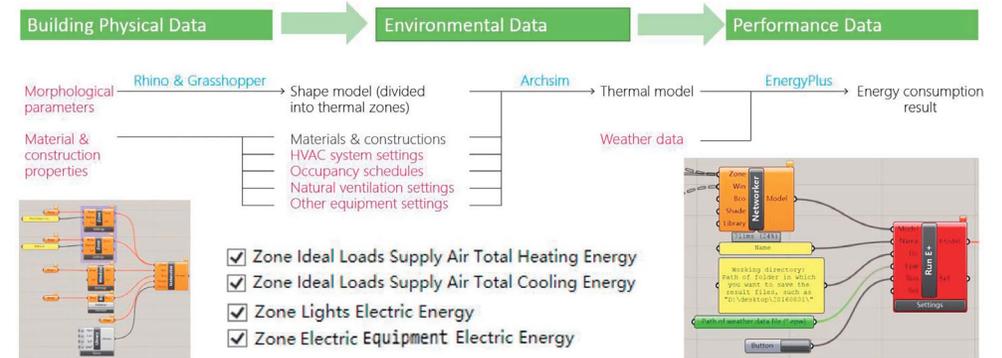
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- **N0**
- **N1**
- **N2**
- **N3**
- **N4**



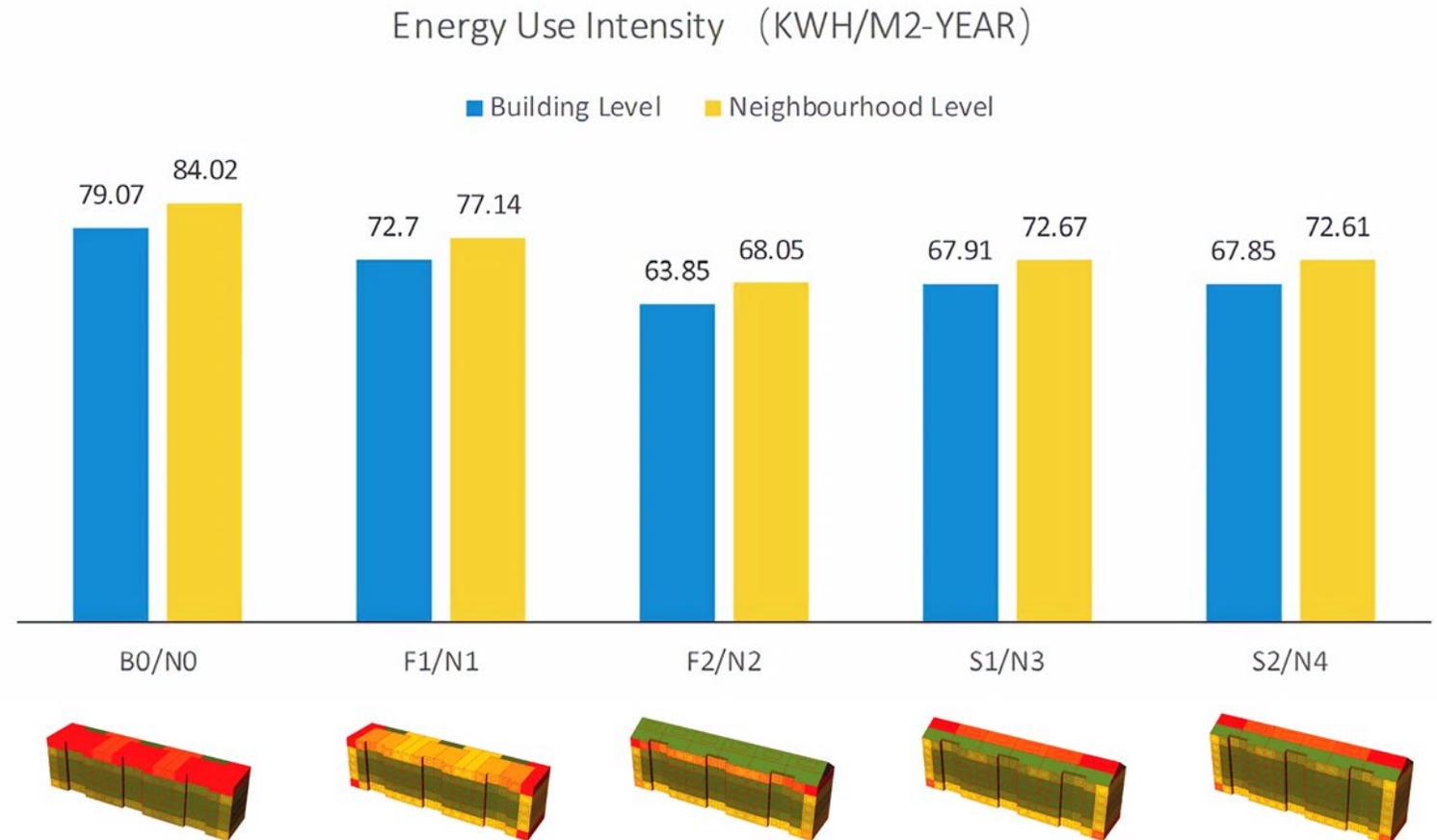
Results & Findings

- **2** scales & **5** scenarios
- Energy simulation
 - Parametric design and simulation software



Results & Findings

- Comparison between **2** scales and **5** scenarios
 - Neighborhood-level higher
 - F1/N1 highest (except B0/N0)
 - F2/N2 lowest
 - Extra space → more energy



Results & Findings

- Comparison between **2** scales and **5** scenarios
 - The set of F2/N2 is more effective in terms of energy-saving

Table 1 Energy Consumption Percentage to baseline case – Building level

Types	B0	F1	F2	S1	S2
Building Level	100%	91.94%	80.75%	85.89%	85.81%

Table 2 Energy Consumption Percentage to baseline case – neighborhood level

Types	N0	N1	N2	N3	N4
Neighborhood Level	100%	91.81%	80.99%	86.49%	86.42%

Results & Findings

- Comparison between **2** scales and **5** scenarios
 - The set of F2/N2 is more effective in terms of energy-saving
 - Larger scale has less energy saving potentials

Table 1 Energy Consumption Percentage to baseline case – Building level

Types	B0	F1	F2	S1	S2
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Table 2 Energy Consumption Percentage to baseline case – neighborhood level

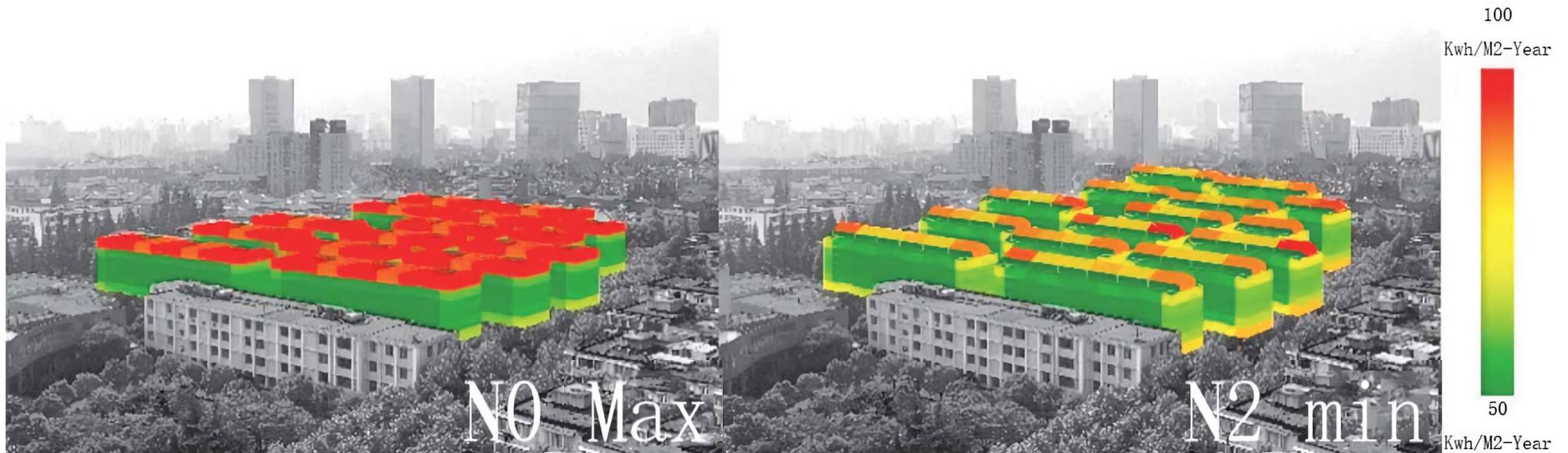
Types	N0	N1	N2	N3	N4
Neighborhood Level	100%	91.81%	80.99%	86.49%	86.42%

Table 3 Comparing the results from building level to neighborhood level

Types	B0/N0	F1/N1	F2/N2	S1/N3	S2/N4
B – level to N – level	1:1.06	1:1.06	1:1.06	1:1.07	1:1.07

Results & Findings

- Comparison between **2** scales and **5** scenarios
 - The set of F2/N2 is more effective in terms of energy-saving
 - Larger scale has less energy saving potentials
 - Buildings with slope roof have better living quality



Summary

- By implementing “**Flat to Slope Project**”
 1. Neighborhood energy consumption would save from 14% up to 19%;
 2. Neighborhood-scale renovation consumes 6% more than the single building;
 3. An extra roof top layer **would not help** to optimize energy performance, but **would help** to create more comfortable living spaces.
- **Building morphology** has a considerable influence on energy performance
- In **early building design stage**, energy performance should be equally valued like function, structure, aesthetics, cost, etc.

THANK YOU

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