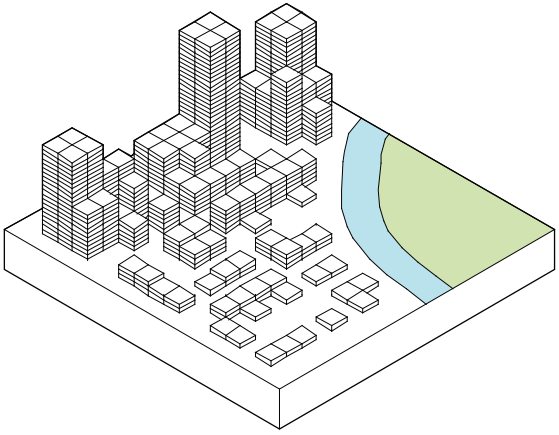
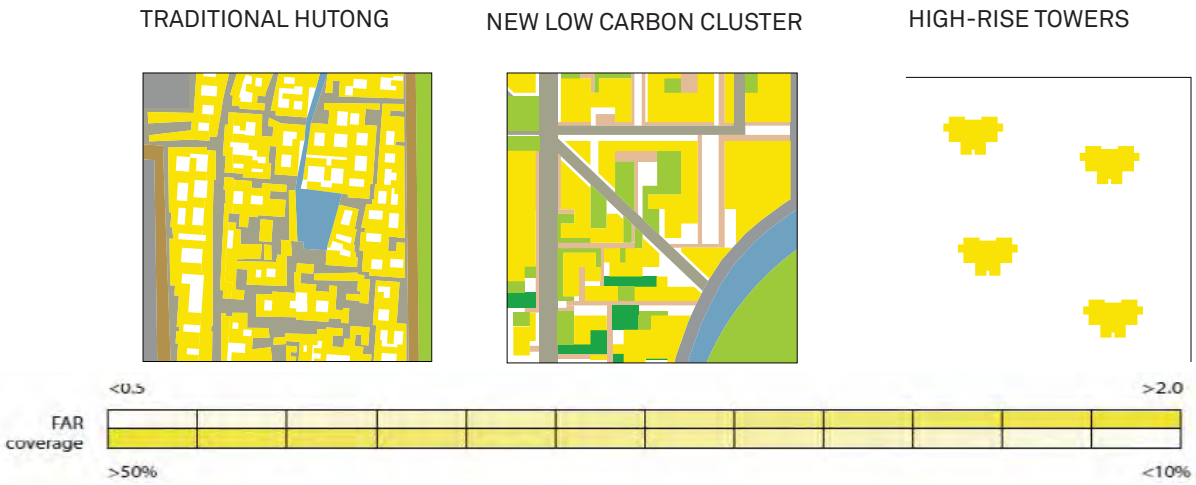
URBAN SPONGE 5

This project, designed to overcome liabilities of the "tower-in-park" typology, proposes a modern eco-city characterized by higher density, integrated residential and commercial opportunities, and reduced energy consumption. The Urban Sponge prototype represents a departure from the conventional height–coverage relationship, where height and land coverage are inversely proportional. By carefully crafting heights and sun exposure it achieves both high FAR and high coverage with a mix of high-rise and low-rise structures, in turn freeing up large areas of land for recreation and open space. The sensitive modeling of sunlight exposure and other environmental requirements results in a highly articulated form and relationship to space: the Urban Sponge.

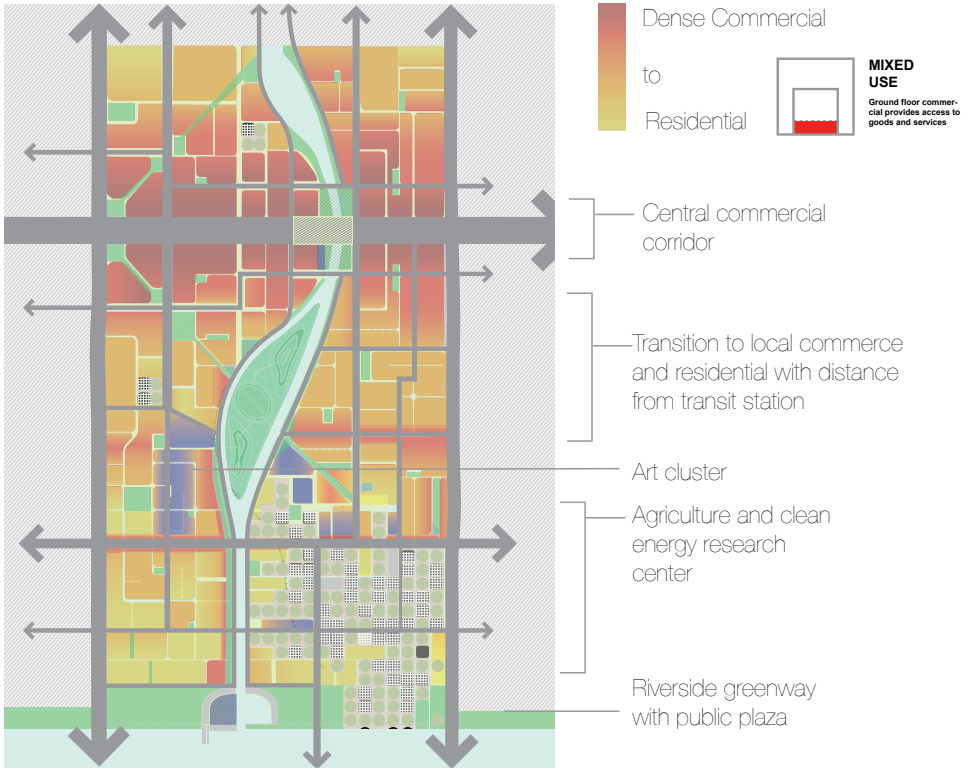


The project focuses on an urban waterfront, island, and park that are carved out of the center of the neighborhood. A network of activity nodes located

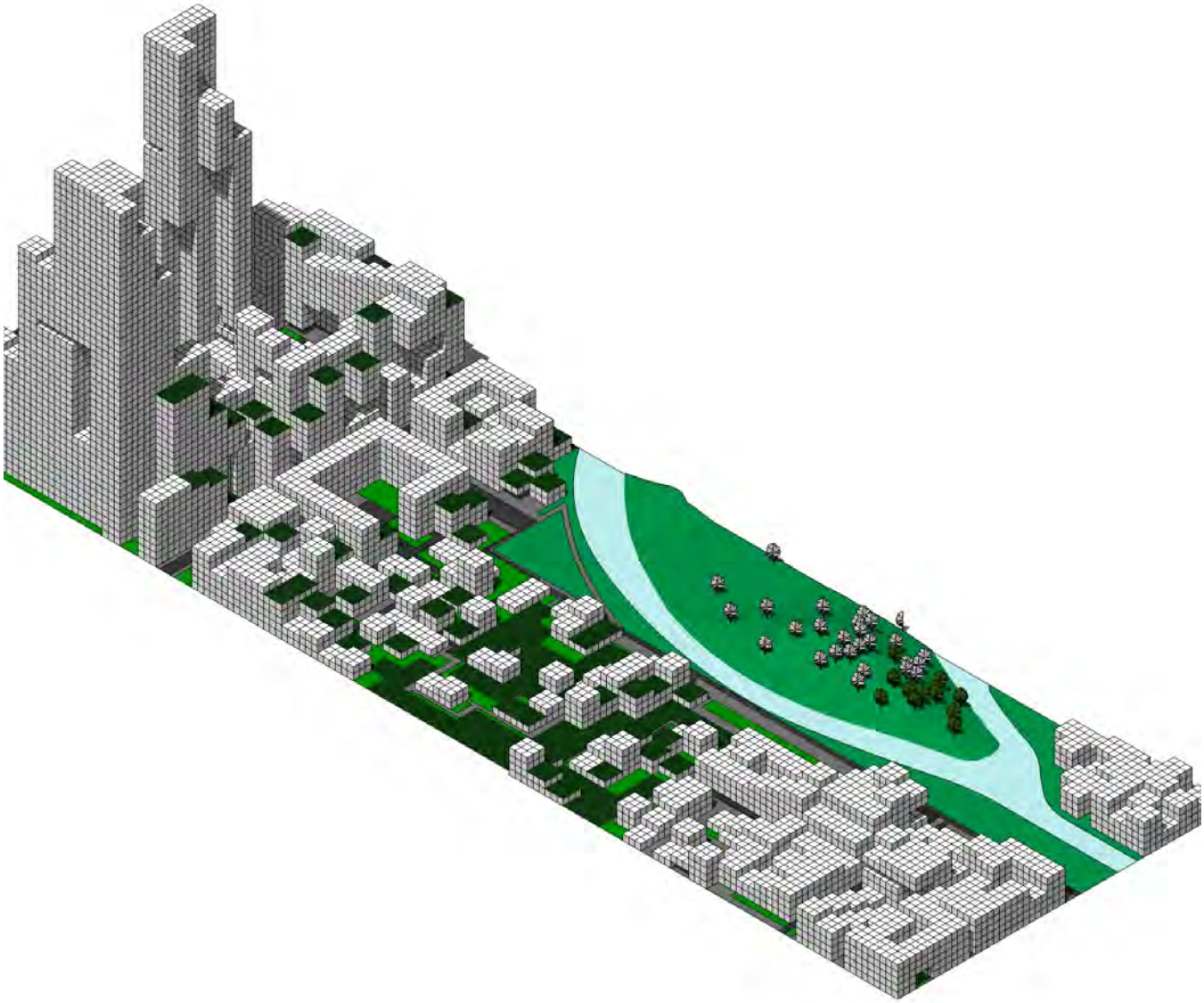
3.55. Rendering showing the typological gradient and the contrast between the built and the landscaped



3.56. Diagram presenting middle scheme as the decoupling of FAR and site coverage



3.57 Site plan showing land use as intensity of use gradients, general zones and circulation hierarchy.



3.58. Isometric view showing sectional variation in height and coverage variation in plan

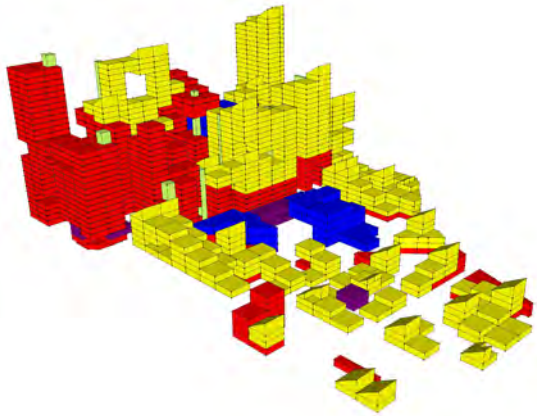
around transit stations, small squares, and connecting pathways binds the community together. The network also disperses activity across the entire site. Both the overall urban form and individual building systems incorporate renewable energy forms.

ORGANIZING CONCEPTS

As shown in the site plan, the densest development is clustered to the north, around the intersection of a major transit station, arterial roadway and the canal —an area of tall buildings and commercial intensity. Building heights decrease moving south, where residential becomes the predominant use. Finally, major cultural, educational and research institutions are clustered at the bottom of the site, which opens onto a major natural preserve.

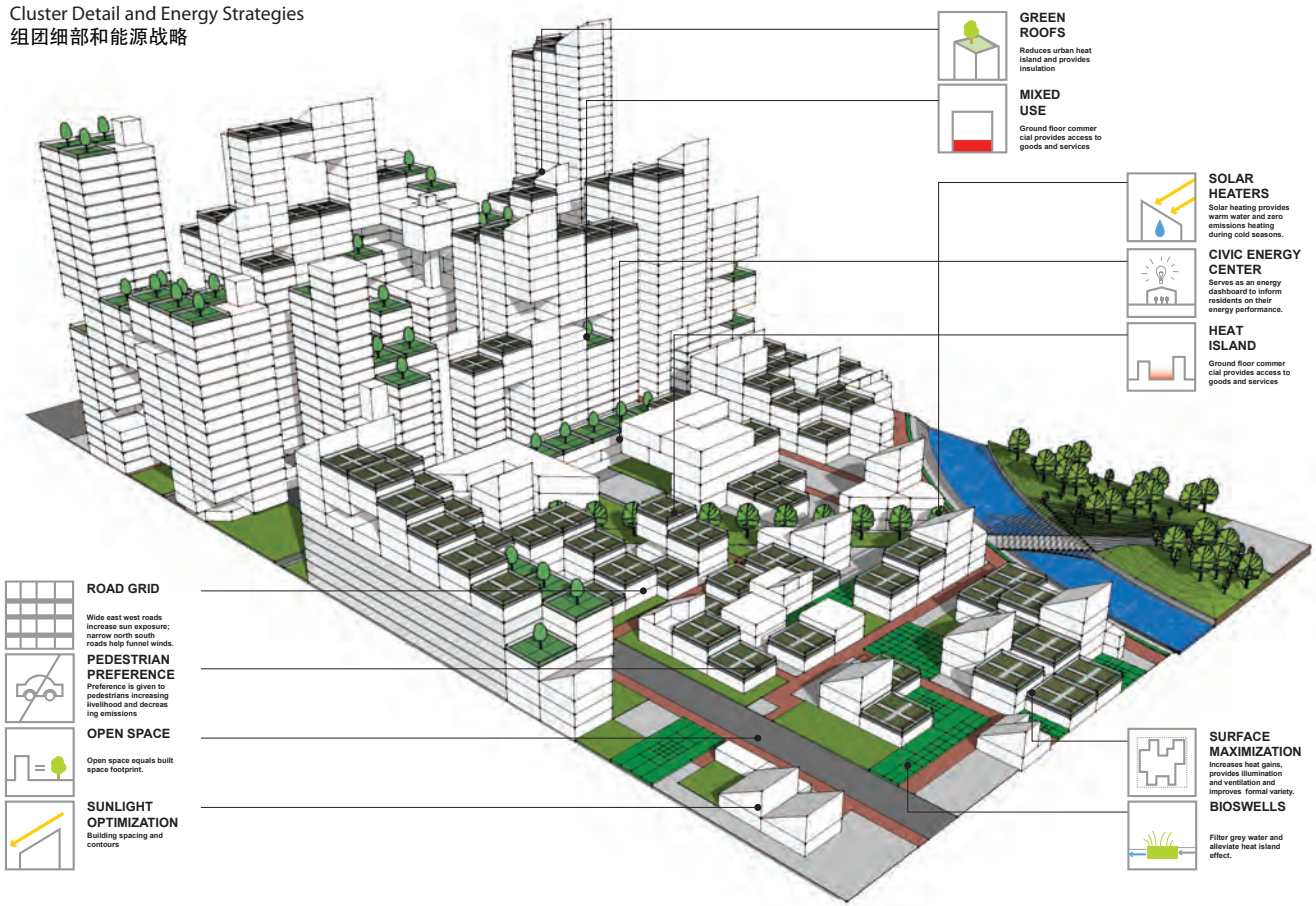
The fabric is composed of a polycentric system of hubs and connectors. Inserted natural features contribute to livability and reduce the urban heat island effect. These natural areas also include geothermal, wind, and solar energy production. Greenways throughout the area support pedestrian and bike circulation, accommodate for the geothermal system needs and mitigate air pollution. Ultimately, the master plan suggests a transit-oriented development by concentrating activity along the transit lines, and multiple means of circulation, including a bike or car sharing program, and a public electric bike charging scheme powered by solar energy.

At the center, the canal splits to create an island (to the north it expand to create a lake). Commercial uses activate the banks with an artist gallery emphasis on



3.59. Cluster detail showing mix of uses

3.60. Bird's eye view of deck over transportation hub



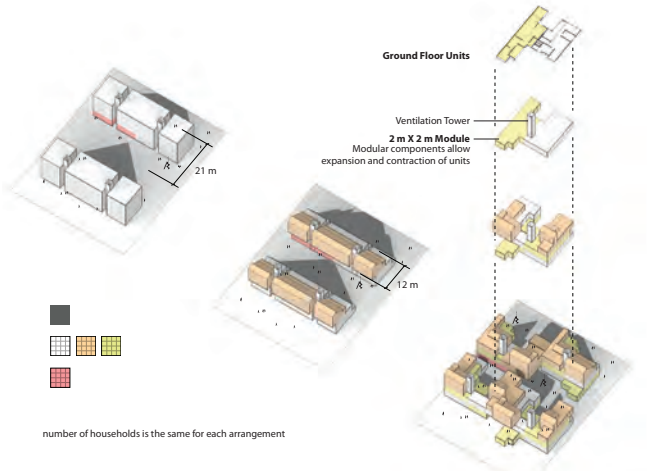
3.61. 3D model showing form - energy components

the western shore and an agricultural and alternative energy research institution on the east. The waterfront edge becomes a unifying green space for the entire neighborhood.

CLUSTER SCALE DEVELOPMENT

The vertical diversity creates a variety of spaces from clustered tall office buildings to quiet residential streets and public spaces. The uses and forms are carefully balanced to enable sunlight penetration but still achieve density and diversity of form. This is possible by careful digital analysis of all the elements of the system during the process of design. The drawings illustrate the quality of permeable form that results from maximizing these complex interrelationships. The form is not only more energy efficient but also more livable than simple tower-in-park schemes, because it increases the opportunity to accommodate mixed uses and individual lifestyles. This approach can be translated to an entire city, where dense high-rise areas surround transit nodes or hubs of activity. Streets and pedestrian ways merge to transition to lower-rise environments farther away from the light rail stops. The variation of building types also allows for a high percentage of open space and public plazas as well as for the integration of geothermal wells and bio swales.

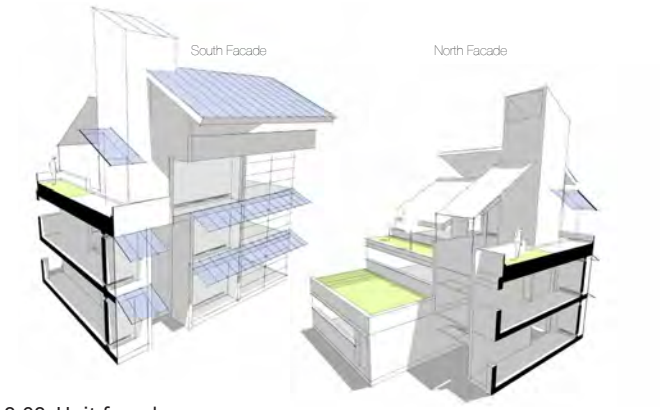
Residential units are aggregated into a range of types, including low-rise (1-3 stories), mid-rise (4-6 stories), and higher-rise (over 6 stories) configurations. In each case, residential units are combined in a way that allows them to share vertical ventilation towers and wet walls. The stacking is such that these vertical elements are



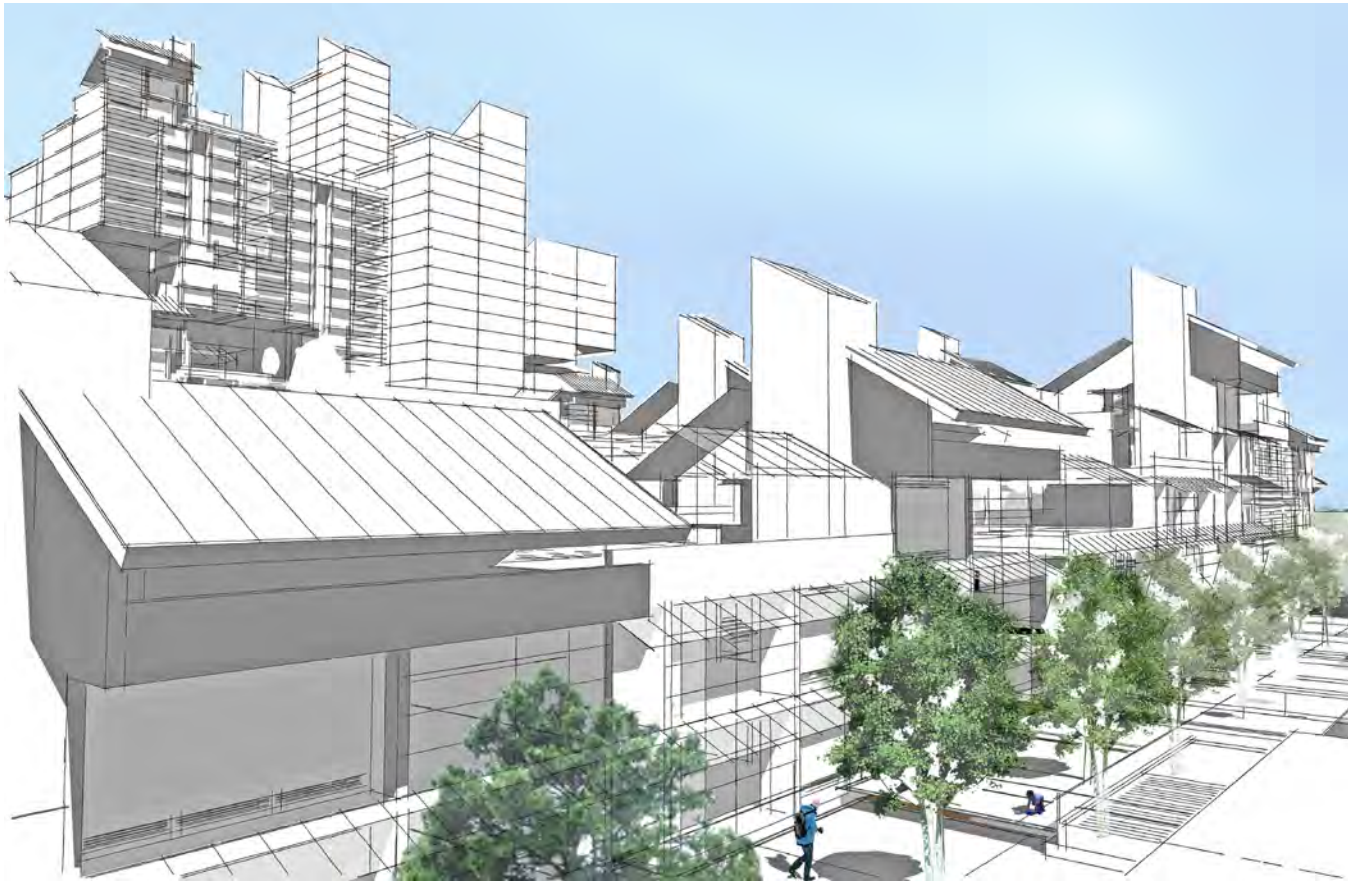
3.62. Individual unit components

continuous. Unit plans vary greatly in shape, creating an array of spaces designed to expand and contract over time and still meet sunlight requirements. Passive solar heating and adequate daylight are achieved through Trombe walls and south facing windows. An efficient unit size of approximately 100 square meters further contributes to decreased operational costs.

This new prototype achieves an energy performance comparable to that of a traditional Hutong with five times the density and twice as much open space allocation. The energy strategies contributing to this outcome emphasize natural ventilation, sunlight optimization, using roofs and un-built areas of the overall area for energy production, and a highly pedestrian environment. The Urban Sponge prototype proposes a new model of increased livability and energy efficiency that, although formed in this instance around a unique feature created by the canal island, can be abstracted and replicated elsewhere.



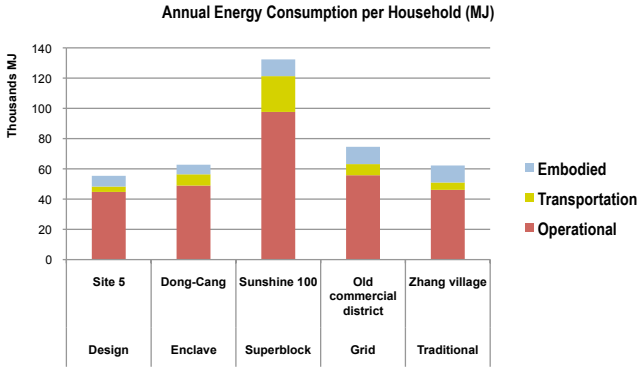
3.63. Unit facades



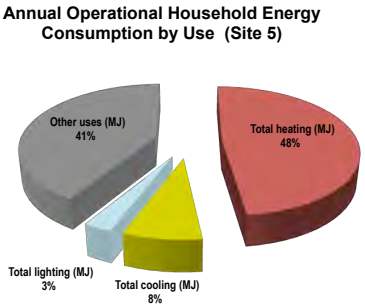
3.64. A pedestrian street in a majorly residential area overlooking mixed use highrises in the background

KEY FORM-ENERGY CONCPTS: URBAN SPONGE

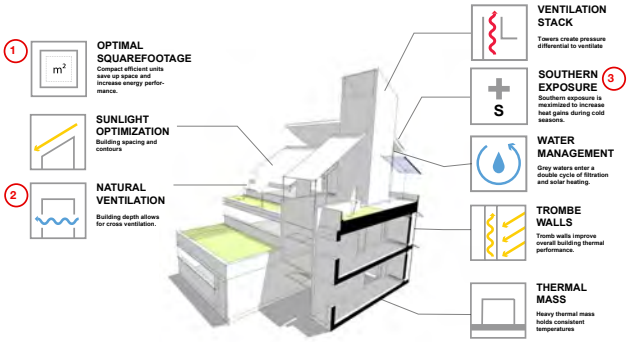
- The building height gradient and careful sunlight calculations that characterize this approach enables both high density and high site coverage and for clusters of high-rise structures and low-rise structures to be developed in appropriate areas of the site.
- The concentration of building frees up a high percentage of open space for major site features and public plazas as well as for the integration of geothermal wells and bioswales.
- The fabric across the site is composed of a system of open spaces, green pathways that link them, and activity nodes located around transit stations.
- Greenways and spaces also support pedestrian and bike circulation, accommodate for the geothermal system needs, and contribute towards the clean sky effect.
- Renewable energy forms are incorporated in both the overall urban form and in individual building systems. These are complemented by passive solar heating and daylighting achieved through trombe walls and south facing windows.
- A very efficient unit size design of approximately 100 square meters further contributes to decreased operational and embodied energy consumption.



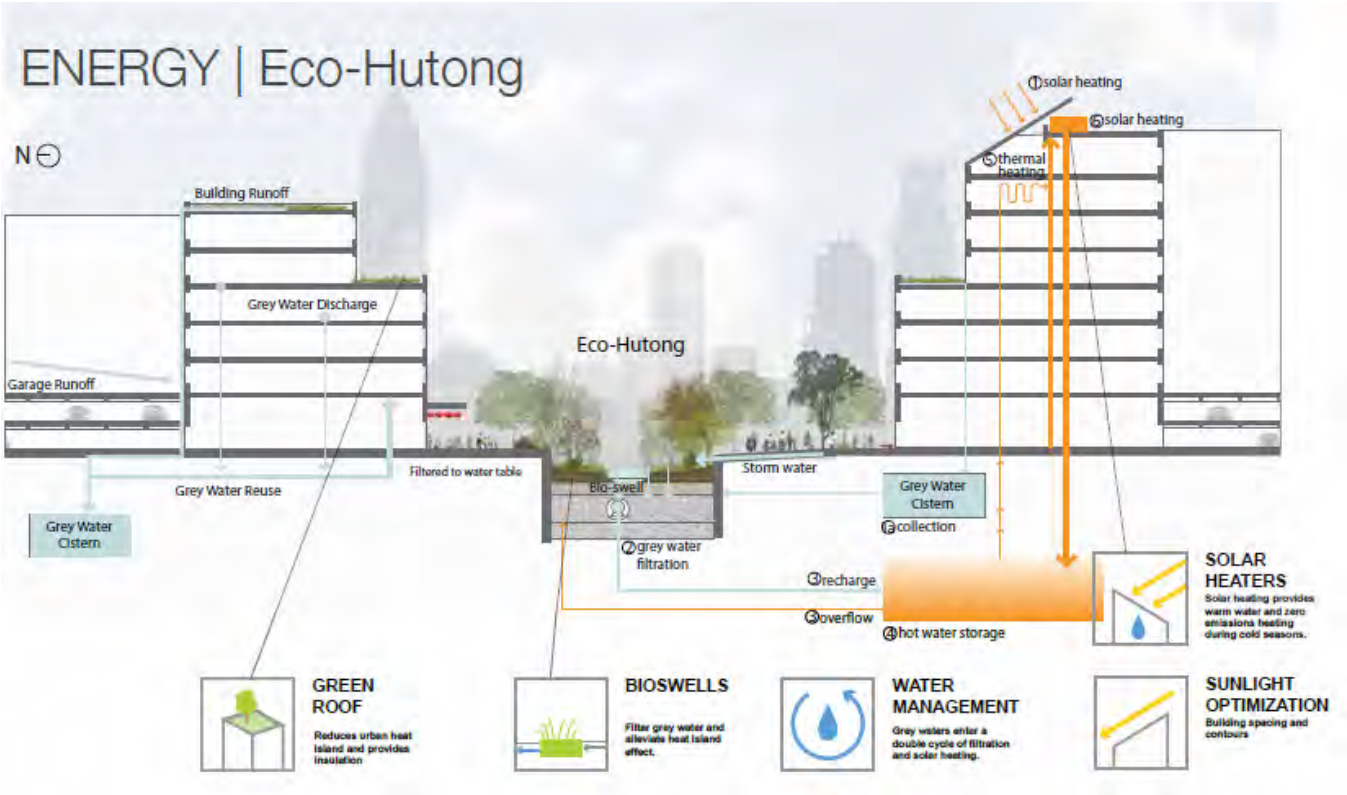
3.65. Annual energy consumption per Household (MJ)



3.66. Annual operational household energy consumption by use



3.67. Energy strategies on the unit level



3.68. Section showing the bio swale as the heart of gray-water management strategy