The Riverside Cities

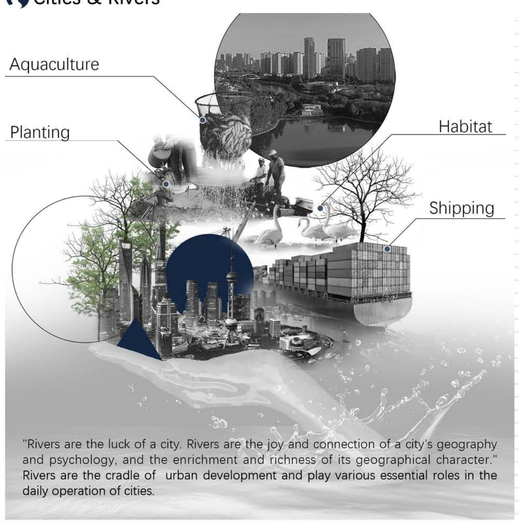
Rivers, which were the cradle of ancient human civilizations in the past, are the arteries of urban towns today. Rivers carry out people's food, clothing, housing and transportation, and play an important role in industrial and agricultural production and landscape ecology shaping in particular. They carry sediments and emotions, reviving land and ideas, connecting places and times.

All built-up cities have a mother river of their own. The rivers in the cities, whose duties are more reflected in traffic and industrial sewage, and the industrialized urban development, weaken its value of irrigation in agricultural production. The project hopes to use the river to think about improving the shortcomings of today's industrialized cities - the property of material production - and to revive the river's original mission and role.

The project explores a methodology to design standardized modules for production, domestic services, transportation, energy, and purification through a geological typology analysis of different river basins and a generalization of urban functions, using complementary design strategies, combined with customized ratios and installation guidance for site attributes. Borrowing from the river to extend the productive functions of the city. The project design can consider nesting the original bridge for functional placement, and can also use the module to complete the traffic connection between the two sides of the river according to the needs of the site.

The project folds traditional agriculture into the river landscape and bridge structure into a more efficient mechanical production system with a more complete planting and trade chain to fully exploit the production value of the urban river and meet the expanding daily needs of urban residents.

Cities & Rivers



"Rivers are the luck of a city. Rivers are the joy and connection of a city's geography and psychology, and the enrichment and richness of its geographical character." Rivers are the cradle of urban development and play various essential roles in the daily operation of cities.

From typical highly-developed cities around the world,it is not difficult to see that the birth and expansion of cities largely depend on the main rivers in each city,and rivers feed inhabitants in these cities.

In China, cities located in the lower reaches of rivers are more developed than cities in other parts of the country.

7 Major rivers — There are 7 major rivers in China.

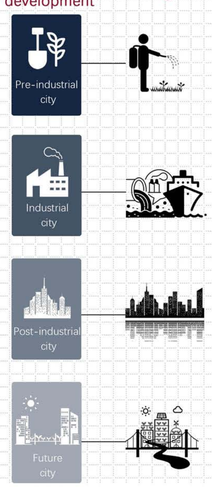
1/2 Population — Cities located in the lower reaches of the 7 rivers are home to 1/2 of the whole country's population.

1/3 Arable land — Cities located in the lower reaches of the 7 rivers own 1/3 arable land of the whole country's

70% Output value — Cities located in the lower reaches of the 7 rivers create 70% of the output value of industry and agriculture of the country.

Development

Stages of urban development / Changes in the function of the river



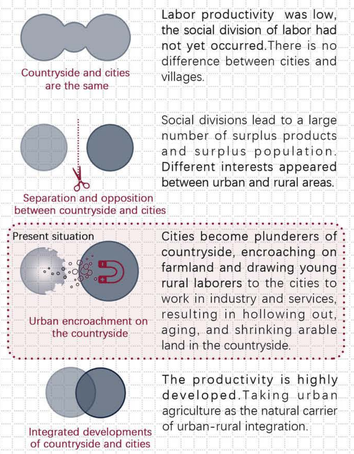
Rivers serve people's daily lives, provide fresh water for people and livestock, and facilitate irrigation of farmland.

Rivers provide water resources for industrial production and convenience for the water transport .

The role of rivers in industrial production is weakened. Rivers not only shoulder the function of improving the quality of urban life, but also undertakesthe mission of marketing.

Urban agriculture relying on rivers is folded on bridges and become a natural carrier of the integration of urban and rural areas.

Evolution of urban-rural relations



Reasons

Labor productivity was low, the social division of labor had not yet occurred.There is no difference between cities and villages.

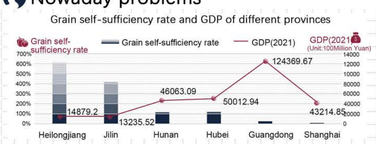
Social divisions lead to a large number of surplus products and surplus population. Different interests appeared between urban and rural areas.

Cities become plunderers of countryside, encroaching on farmland and drawing young rural laborers to the cities to work in industry and services, resulting in hollowing out, aging, and shrinking arable land in the countryside.

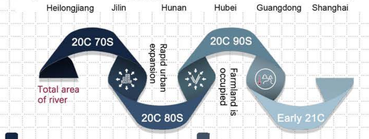
The productivity is highly developed.Taking urban agriculture as the natural carrier of urban-rural integration.

Nowaday problems

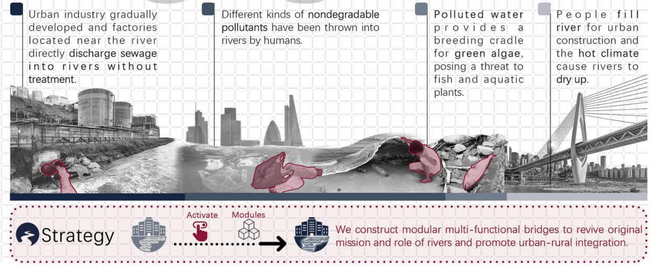
Grain self-sufficiency rate and GDP of different provinces



Rural arable land has to give way to urban construction, which leads to food production struggling to meet inhabitants' demand in developed cities.So these cities need to importe food from other provinces.



Due to the urban expansion, the water surface ratio of the river network and the complexity of the river network decrease, which gradually separates the relationship between people and water



Urban industry gradually developed and factories located near the river directly discharge sewage into rivers without treatment.

Different kinds of nondegradable pollutants have been thrown into rivers by humans.

Polluted water provides a breeding cradle for green algae, posing a threat to fish and aquatic plants.

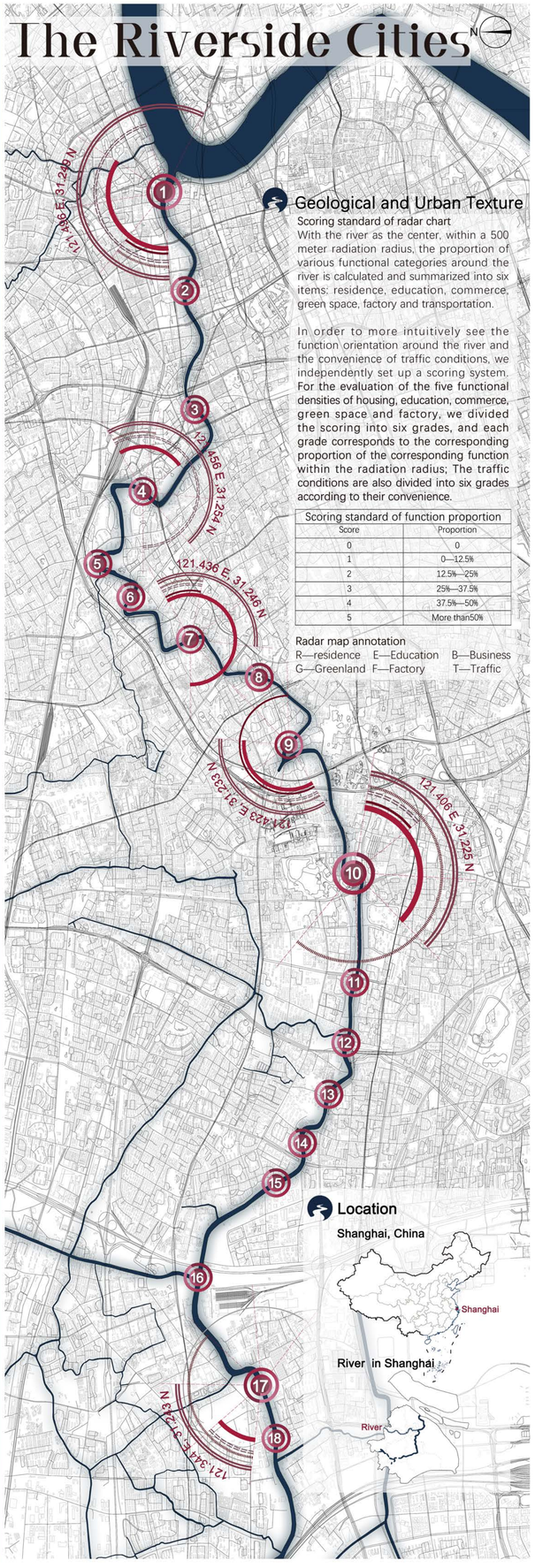
People fill river for urban construction and the hot climate cause rivers to dry up.

Strategy

We construct modular multi-functional bridges to revive original mission and role of rivers and promote urban-rural integration.

5000 M

The Riverside Cities



Geological and Urban Texture

Scoring standard of radar chart

With the river as the center, within a 500 meter radiation radius, the proportion of various functional categories around the river is calculated and summarized into six items: residence, education, commerce, green space, factory and transportation.

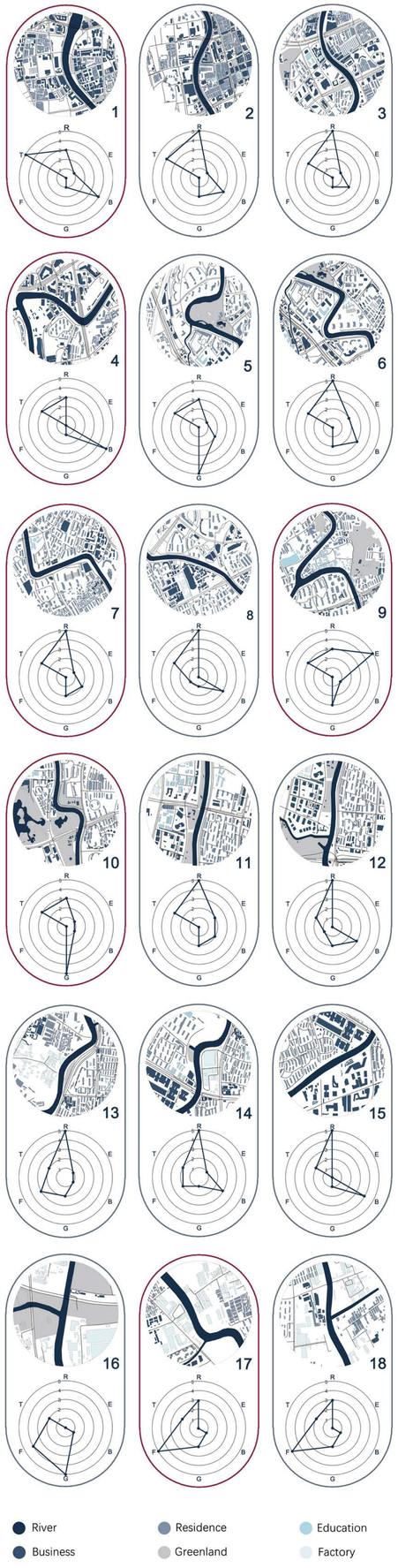
In order to more intuitively see the function orientation around the river and the convenience of traffic conditions, we independently set up a scoring system. For the evaluation of the five functional densities of housing, education, commerce, green space and factory, we divided the scoring into six grades, and each grade corresponds to the corresponding proportion of the corresponding function within the radiation radius; The traffic conditions are also divided into six grades according to their convenience.

Scoring standard of function proportion

Score	Proportion
0	0
1	0—12.5%
2	12.5%—25%
3	25%—37.5%
4	37.5%—50%
5	More than50%

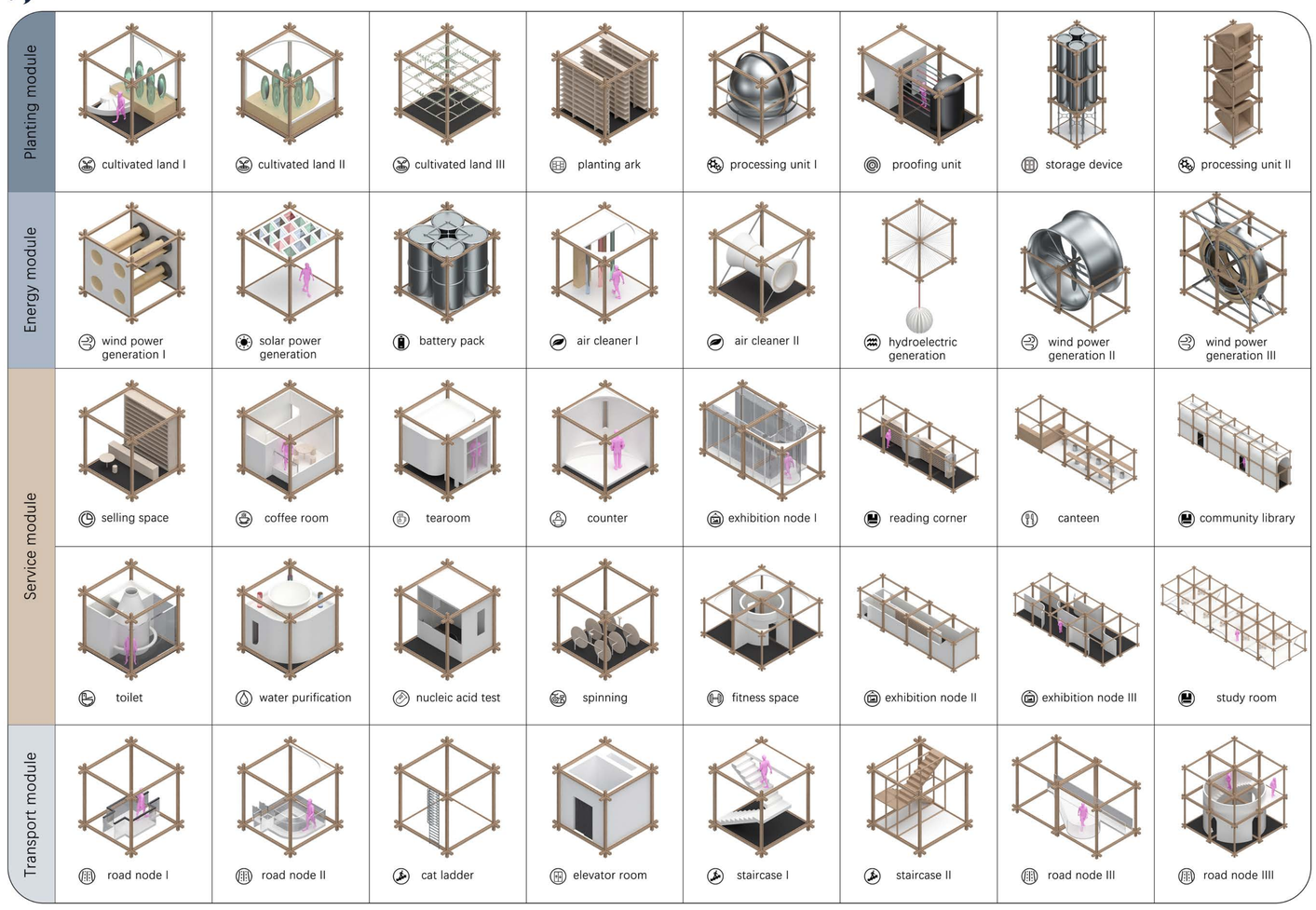
Radar map annotation

R—residence E—Education B—Business
G—Greenland F—Factory T—Traffic



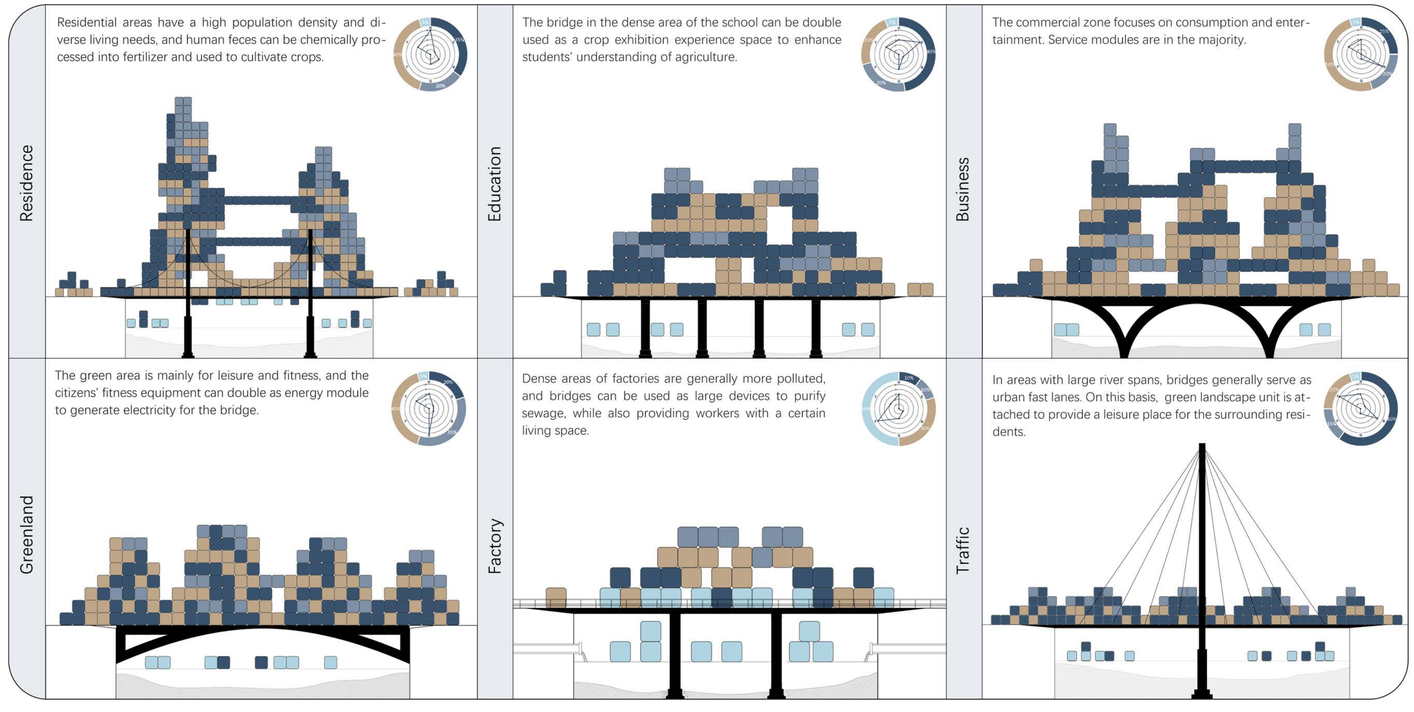
River
Residence
Education
Business
Greenland
Factory

Functional Block



Adaptive Designs of Six Sites

Planting module Energy module Service module Purification module



The Riverside Manufacturer

① Food Processing Modules

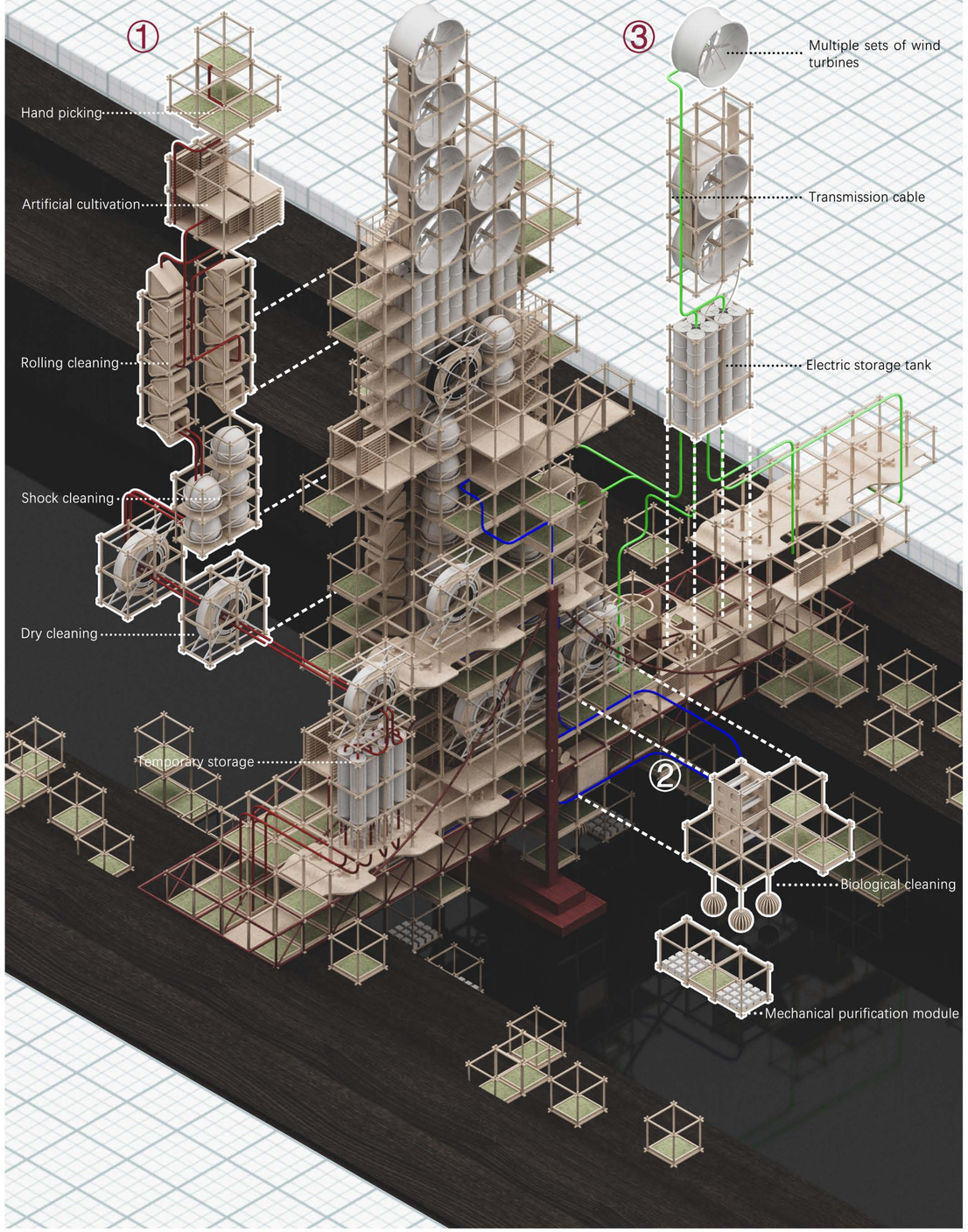
The vertical food processing module system includes the whole process of crop planting, manual selection, cutting, tumbling cleaning, shock cleaning, air drying cleaning, packaging and transportation. Compared with conventional agriculture, the time from picking crops to being sent to the table is significantly reduced, even less than half a day.

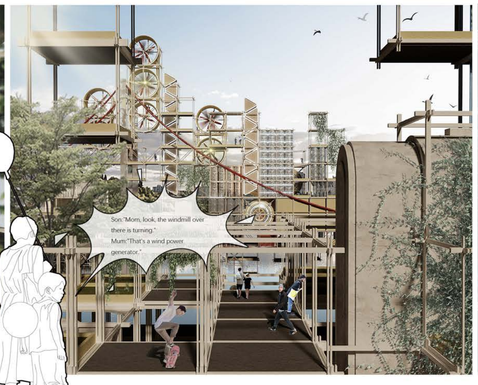
② Purification Modules

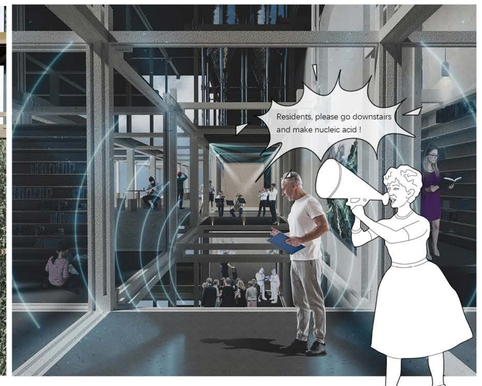
The purification device is an indispensable part of the whole bridge system, which has the function of purifying industrial and domestic sewage and reducing the pollution to the river. In addition, the purification module can reversely pump the river water, and after the initial chemical purification, it can be transmitted through the pipeline to each production and planting module to complete the irrigation of crops.

③ Energy Modules

The energy module is mainly composed of fan, electric storage box and transmission cable. The high-power generation module can meet the daily production electricity consumption of the whole bridge, and achieve zero carbon emission of production capacity in a real sense. In addition, the residents' fitness power generation module accounts for a small part, which is used to generate power on the bridge landscape to achieve the dual goals of sports and production capacity.

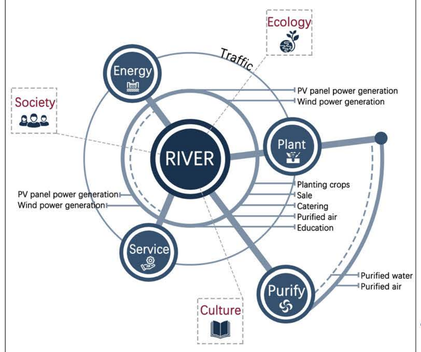






System & Evaluation

Functional composition and interaction of bridges



Taking the river as the starting point, the bridge is built to alleviate the contradiction between urban and rural areas by giving it five functions of **planting, living services, transportation, energy production and purification**. These five functions promote each other, making the bridge constructed operate efficiently, and having a positive and far-reaching impact on the **social, ecological** and **cultural** environment of the region where it is located.

Social impact

Take Shanghai, a high-density city, as an example

- Average caloric intake per person per day——2000cal
- The grain output of the six types of bridges are (unit-cal):

grain yield 5.64%

Residential oriented —— 2.15×10^9
Business oriented —— 1.25×10^9
Factory oriented —— 1.08×10^9
Education oriented —— 1.86×10^9
Greenland oriented —— 3.76×10^9
Traffic oriented —— 1.66×10^9

- The number of six bridges erected in Shanghai—— 512
  Residential oriented—— 203 Education oriented—— 54
  Business oriented—— 101 Greenland oriented—— 63
  Factory oriented—— 42 Traffic oriented—— 49
- Total output of all bridges erected in Shanghai——1.03×10^{12}cal
- Total output/Average caloric intake per person per day=5.15×10^8
- Number of people satisfied by the total grain output of the bridge/Total number of people in Shanghai=**5.64%**

Daily travel
Life radius ——20min (before) → 10min (now)
Percentage decrease in driving frequency——7.24%

Ecological impact

Take Shanghai, a high-density city, as an example

Air Purification

2.826×10^5

- Air purification capacity of one module——2759.4L
- The number of six bridges erected in Shanghai—— 512
- Annual average purification amount——2.826×10^8L

Energy

- Per capita capacity of human power generation ——0.35kw
- Annual average number of people using power generating bicycles ——1×10^8
- Total electric energy generated by human power generation ——3.5×10^7
- Total electric energy generated by wind power generation ——2.4×10^8
- Total electric energy generated by hydropower ——5×10^7
- Total electric energy generated ——3.2×10^8
- The number of households that the bridge generates electricity for/Total number of households in Shanghai=**1.41%**

1.41%

Cultural impact

Take Shanghai, a high-density city, as an example

- percentage increase in reading books ——1.3%
- Percentage increase in walking frequency ——2%
- Percentage increase in motion frequency ——2%
- Percentage increase in watching performance frequency ——3.5%
- Percentage increase in viewing outdoor cinema frequency ——2.5%

In order to more intuitively see the fitness between the bridge and the city, we quantize various indicators of the bridge and attach corresponding coefficients according to the city attributes to obtain the quantitative fitness value.

$$S_n = M_1(K_1R_1 + K_2R_2) + M_2(K_3R_3 + K_4R_4) + M_3\sum_{i=1}^{n} a_iQ_i$$ (S_n——Adaptability index of the bridge to the city)

M1——Social attribute weight
M2——Ecological attribute weight
M3——Cultural attribute weight
Kn,an——each item attribute weight

R1——Number of people satisfied by the total grain output of the bridge per year/total number of people in the city
R2——Percentage decrease in average annual driving frequency
R3——Annual average purification capacity
R4——Number of households satisfied by bridge power generation per year/total urban households
Qn——Percentage increase of residents' cultural behavior frequency per year

Reference standards for bridge adaptability
$0 \leqslant S_n \leqslant 400$——Low adaptation
$400 < S_n \leqslant 600$——Moderate adaptation
$S_n > 600$——High adaptability

The following is the S_n numerical calculation of six selected high-density cities $S_{n\ Shabghai}=700$ $S_{n\ Changsha}=560$ $S_{n\ Wuhan}=635$ $S_{n\ Guangzhou}=656$ $S_{n\ London}=605$ $S_{n\ New\ York}=663$