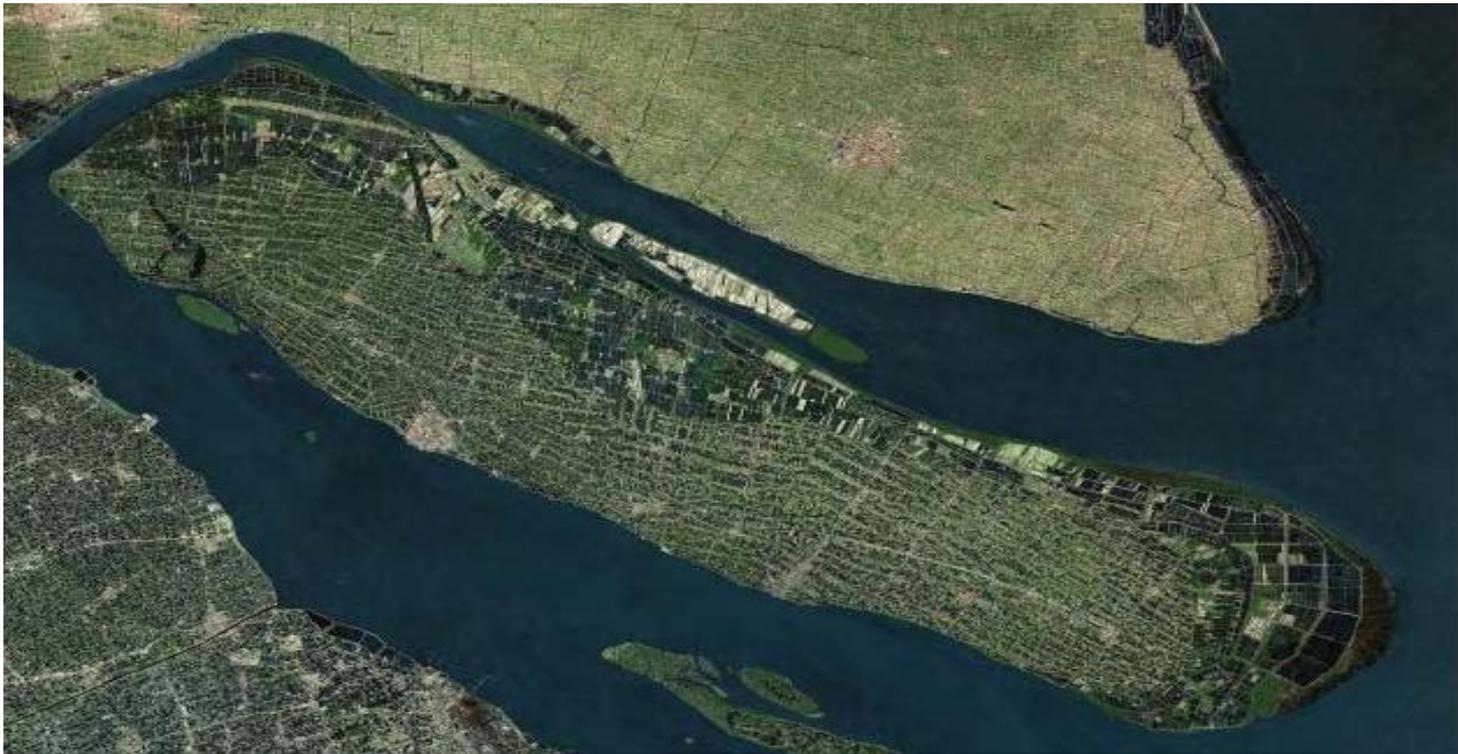


Developing A Sustainable City In China

IPRO 316

The Challenge

- The challenge for our IPRO team was to design a sustainable city for 200,000 on the westerly portion



The Project: Chongming Island

- Sustainable urban planning strategy for a city of 200,000 people.
- Issues: Mitigation of urban sprawl as evident in Shanghai, while organizing compact transit orientated settlement patterns to accommodate growth. (i.e. modules)
- Focus: Sustainability in urban planning strategies, architectural design, transportation, economic planning, tourism, agriculture, and ecology.

The Vision: Designing a Sustainable High-Tech City for Chongming Island

- Goals for Pearl City
 - Sustainability in:
 - Urban Planning Strategies
 - Architectural Design
 - Transportation
 - Power Generation
 - Waste Management
 - Economic Viability
 - Preservation of Cultural Identity
 - Enticing Creativity
 - Conservation of Agriculture and Ecology

The Problem

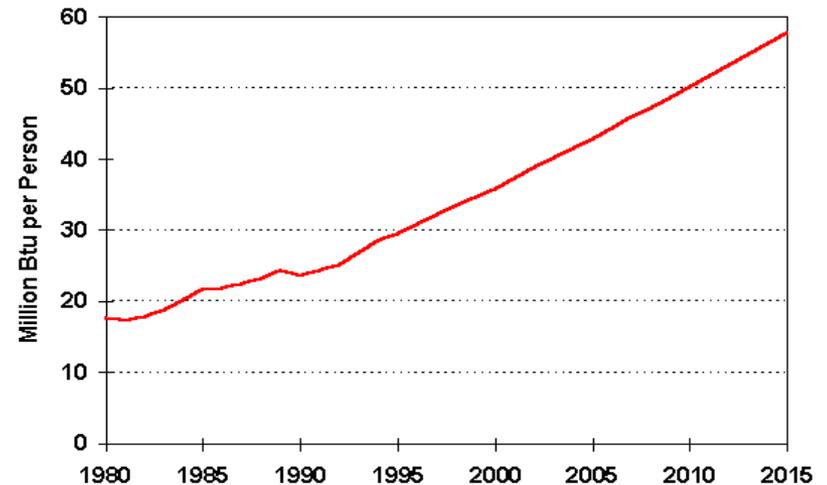
- China is currently experiencing one of the most massive rural to urban migrations to date.
- Bringing the ever looming problems of pollution, productivity, and progress to the forefront of China's plan for the future.
- This drastic change makes the necessity of a viable solution glaringly salient.



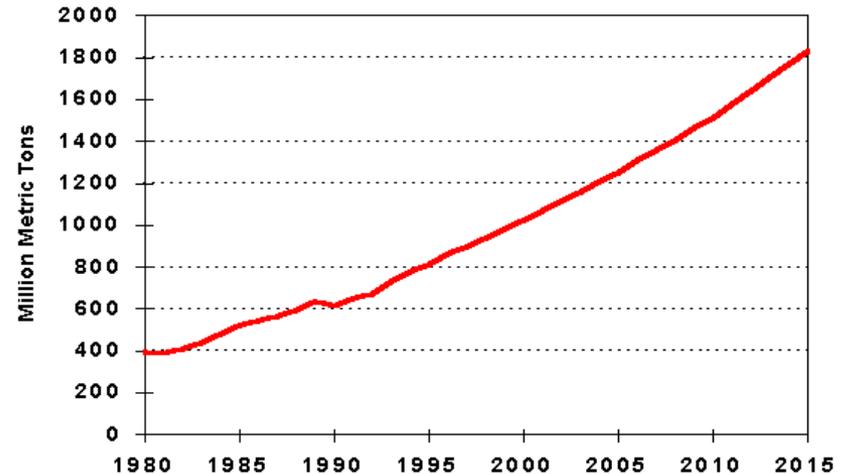
Problem: Impending Energy Crisis

- China consumes three times as much energy per dollar of gross domestic product (GDP) as the world average, and twice the average for all developing countries.
- China's per capita energy consumption has grown from less than 18 million Btu in 1980 to about 31 million Btu in 1996. It is projected to reach 58 million Btu by 2015.
- A consequence of China's rapid economic growth has been severe environmental pollution, including acid rain, thick smog, toxic waste, water pollution, and carbon emissions. China accounts for about 13% of world carbon emissions, ranking second behind the United States.

Energy Consumption per Capita



Carbon Emissions, 1980-2015



Unsustainable Situations



- An "unsustainable situation" occurs when natural capital (the sum total of nature's resources) is used up faster than it can be replenished.
- Sustainability requires that human activity only uses nature's resources at a rate at which they can be replenished naturally.
- The concept of sustainable development is linked with the concept of carrying capacity. The long-term result of environmental degradation is the inability to sustain human life.
- Such degradation on a global scale could imply extinction for humanity.

What is Sustainability?

- **Sustainability** is a characteristic of a process or state that can be maintained at a certain level indefinitely.
 - The term, in its environmental usage, refers to the potential longevity of vital human ecological support systems such as:
 - the planet's climatic system, systems of agriculture, industry, forestry, and fisheries, and human communities in general and the various systems on which they depend in balance with the impacts of our unsustainable or sustainable design.

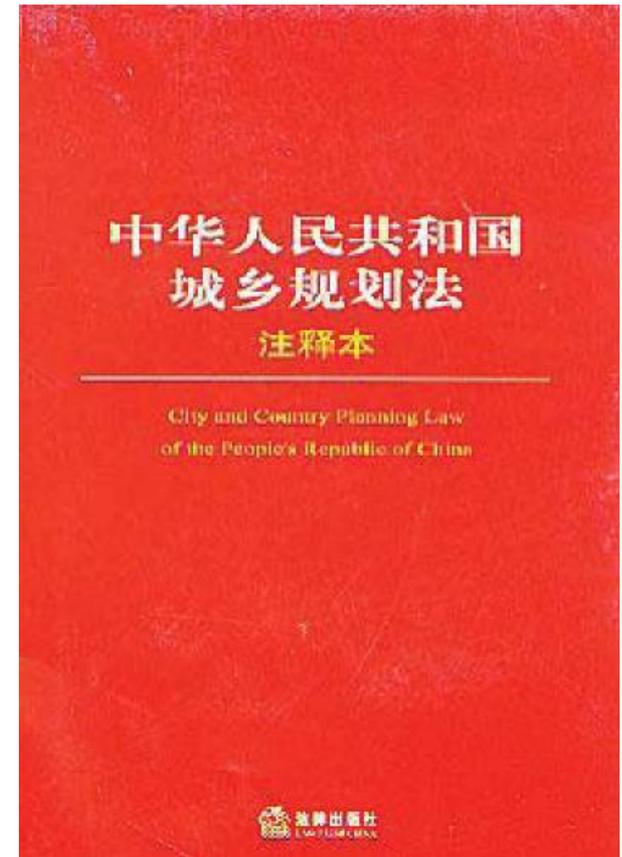
The concept of “sustainable city”

- A sustainable city, is an entire city dedicated to minimizing the required inputs:
 - Energy, water, and food
 - Waste output of heat, air pollution as co2, methane, and water pollution.
- A sustainable city region can feed and power itself with minimal reliance on outside sources
 - Creates the smallest possible eco-footprint for its residents
 - This results in a city that is friendly to the surrounding environment, in terms of pollution, land use, and conservation
- Over half of the world’s population now lives in urban areas and that number is growing everyday
- This provides both challenges and opportunities for environmentally-conscious developers

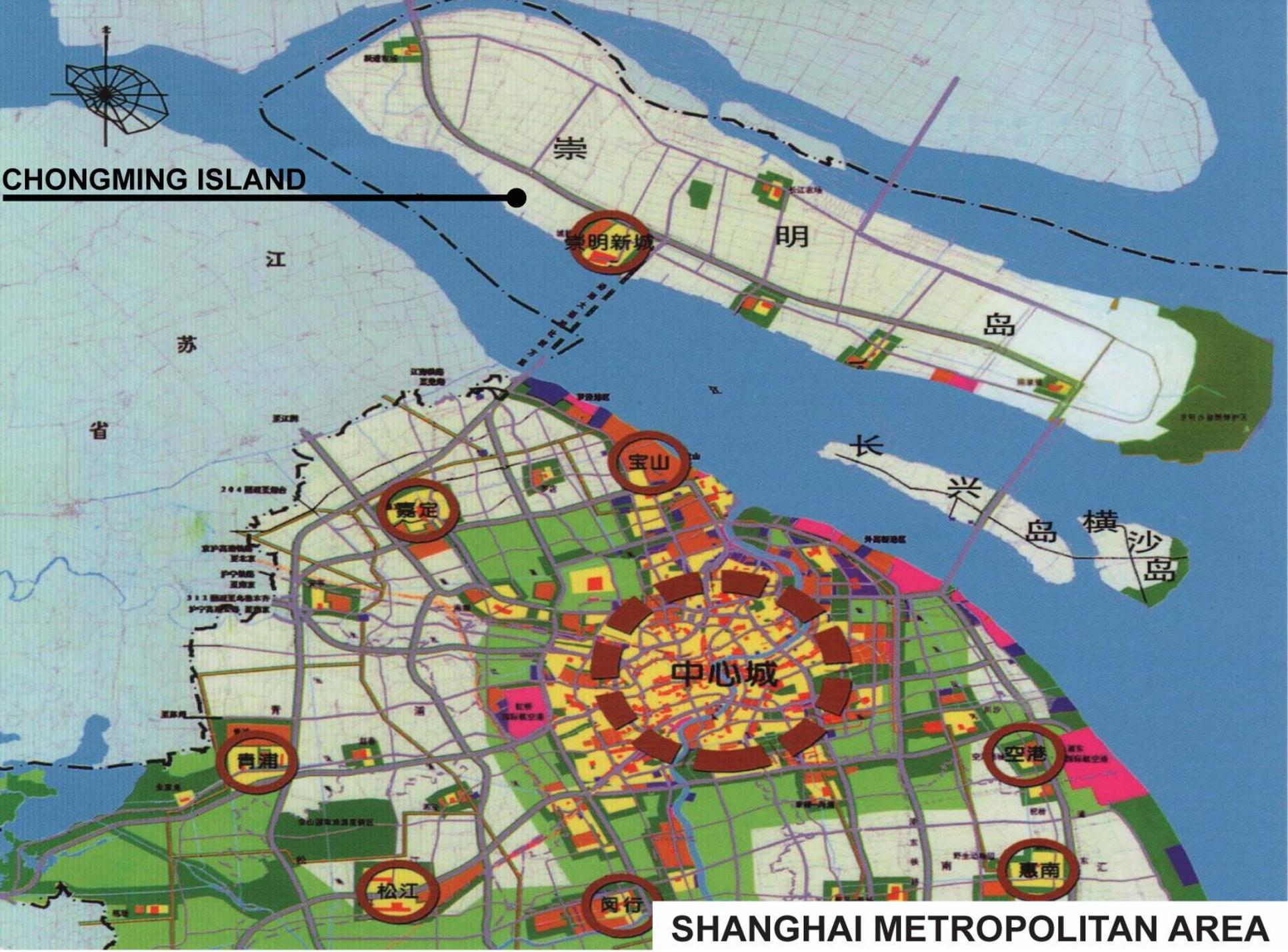
City Planning In China

Legal Constraints

- Land Use
- Infrastructure
- Power Generation
- Waste Management
- Environmental and ecological considerations
- Cultural considerations



CHONGMING ISLAND



SHANGHAI METROPOLITAN AREA

Transportation

Connecting To The Mainland



- Transportation networks

- Bridge

- Cars

- Trucks

- Hydrofoil ferries

- Increased speed

- Reduced emissions



SOM plan for Chongming Island



- SOM plan focused on 6 main concepts for sustainable development on the island:

- Wilderness and ecosystems
- Organic farming
- Green systems
- Transportation
- Green villages
- Coastal cities

Site Analysis





PEARL LAKE CITY SITE LOCATION
AREA: 1.5 MILES BY 4.5 MILES
ELEV: +/- 10 FT
CURRENT LAND USE: WETLAND AGRICULTURE (RICE)



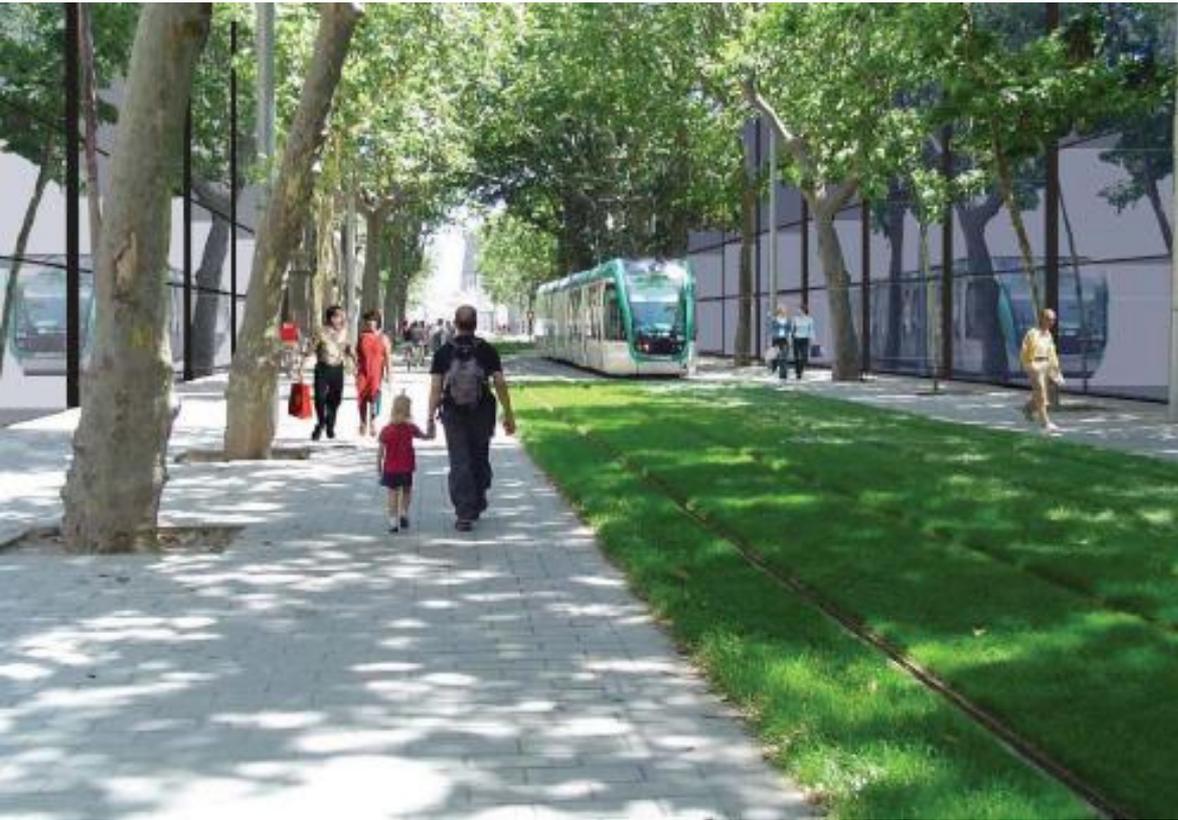
1.5 miles

Transportation

- Efficient transportation is critical to the functioning and development of a sustainable city



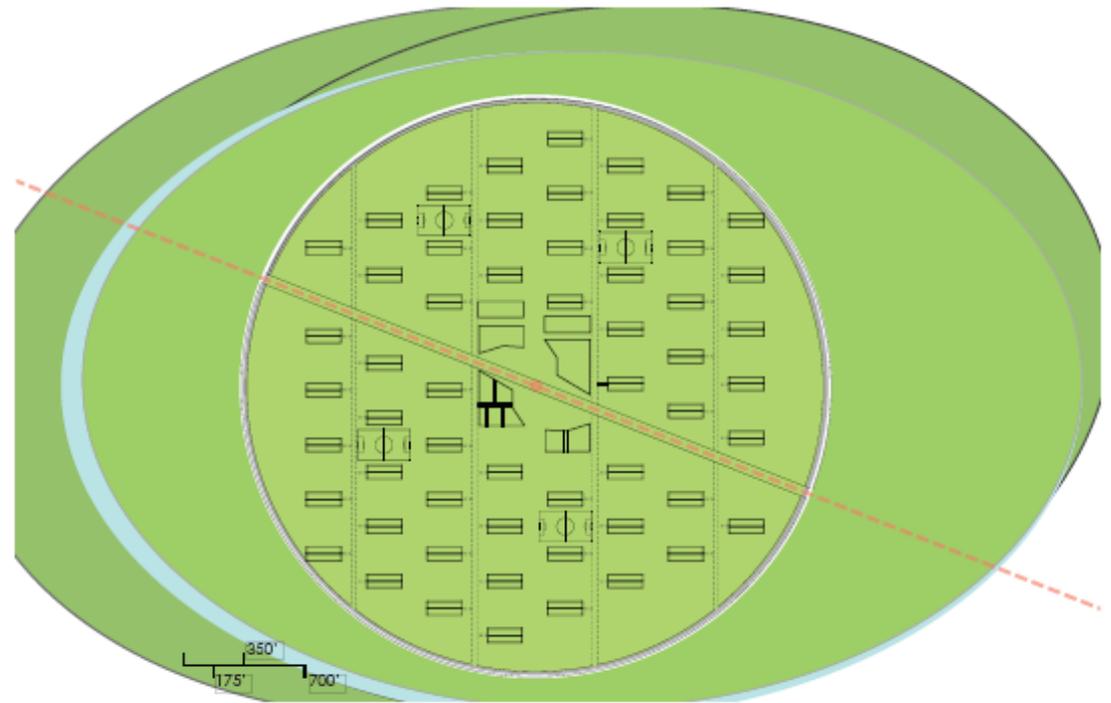
Transportation



- Light Rail
- Bike network
- Pedestrian walking distances

The Urban Village

- A pedestrian community
- Access to facilities and services needed on a daily basis
- Estimated around 30,000 people per module



TYPICAL URBAN VILLAGE SITE PLAN

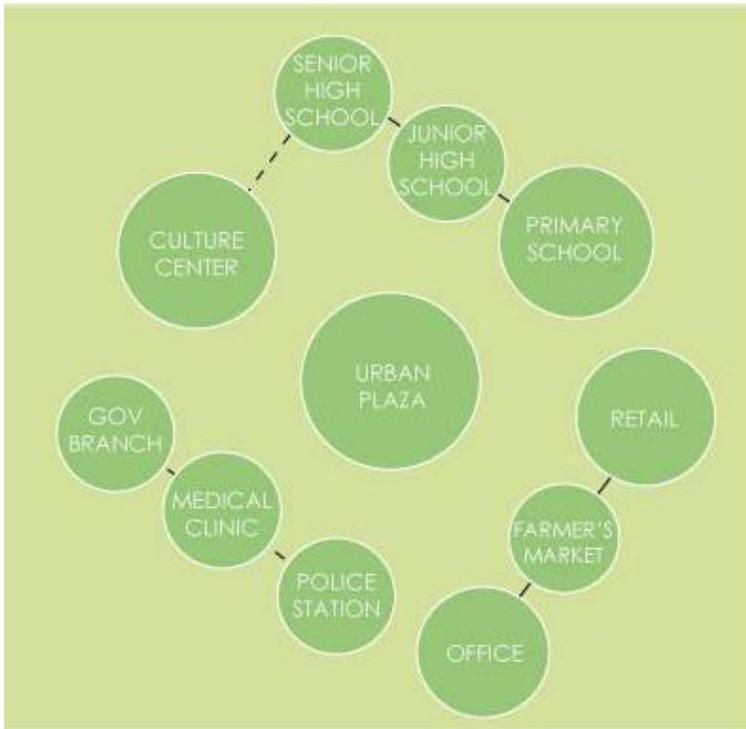
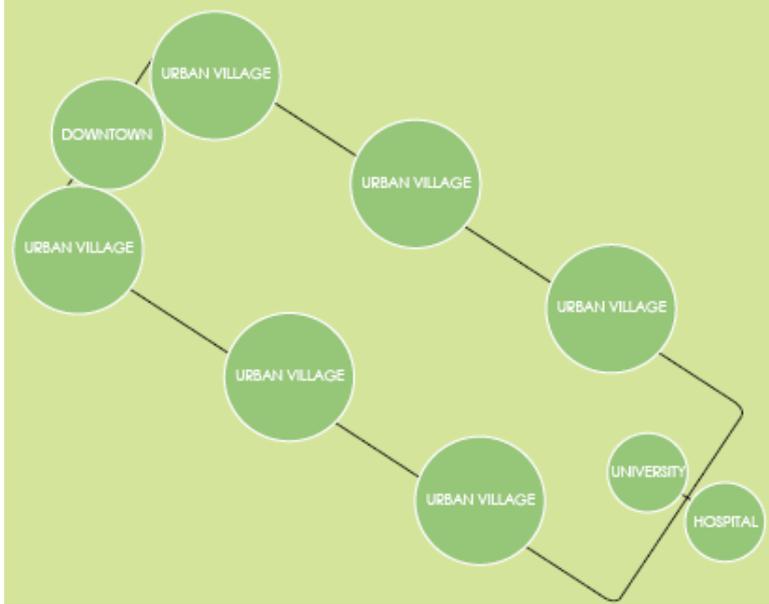
Pearl City Conceptual Diagram



PEARL CITY SITE LOCATION
AREA: 1.5 MILES BY 4.5 MILES
ELEV: +/- 10 FT
CURRENT LAND USE: WETLAND AGRICULTURE (RICE)



1.5 miles



Typical Urban Village Center

City Program

- Governmental
 - Administrative
 - Medical
 - Emergency
- Commercial
- Cultural Center

Housing

CITY POPULATION: 200,000

AVG. DENSITY: 2.7 RESIDENT/UNIT
60% OF RESIDENTS ARE IN A FAMILY

UNIT TYPE	NUMBER (%)	UNITS	AVG SIZE (SF)
3 BEDROOM UNIT	15	9,990	1,000
2 BEDROOM UNIT	70	46,620	900
1 BEDROOM UNIT	10	6,660	700
STUDIO UNIT	5	3,360	400





Distribution of Students



Schools

TYPE	AGE	NUMBER	POPULATION	AREA/CHILD (SF)	GROSS AREA (SF)
KINDERGARTEN	3 - 6	60	100	16	1,600
PRIMARY	6 - 12	6	2,000	22	44,000
JUNIOR HIGH	12 - 15	6	1,000	22	22,000
SENIOR HIGH	16 - 19	6	1,000	22	22,000

Principles of Planning

Chongming Island

- Feng Shui
- Water table control
- High density buildings
- Green space
- Parking



Residential

Schematic Design

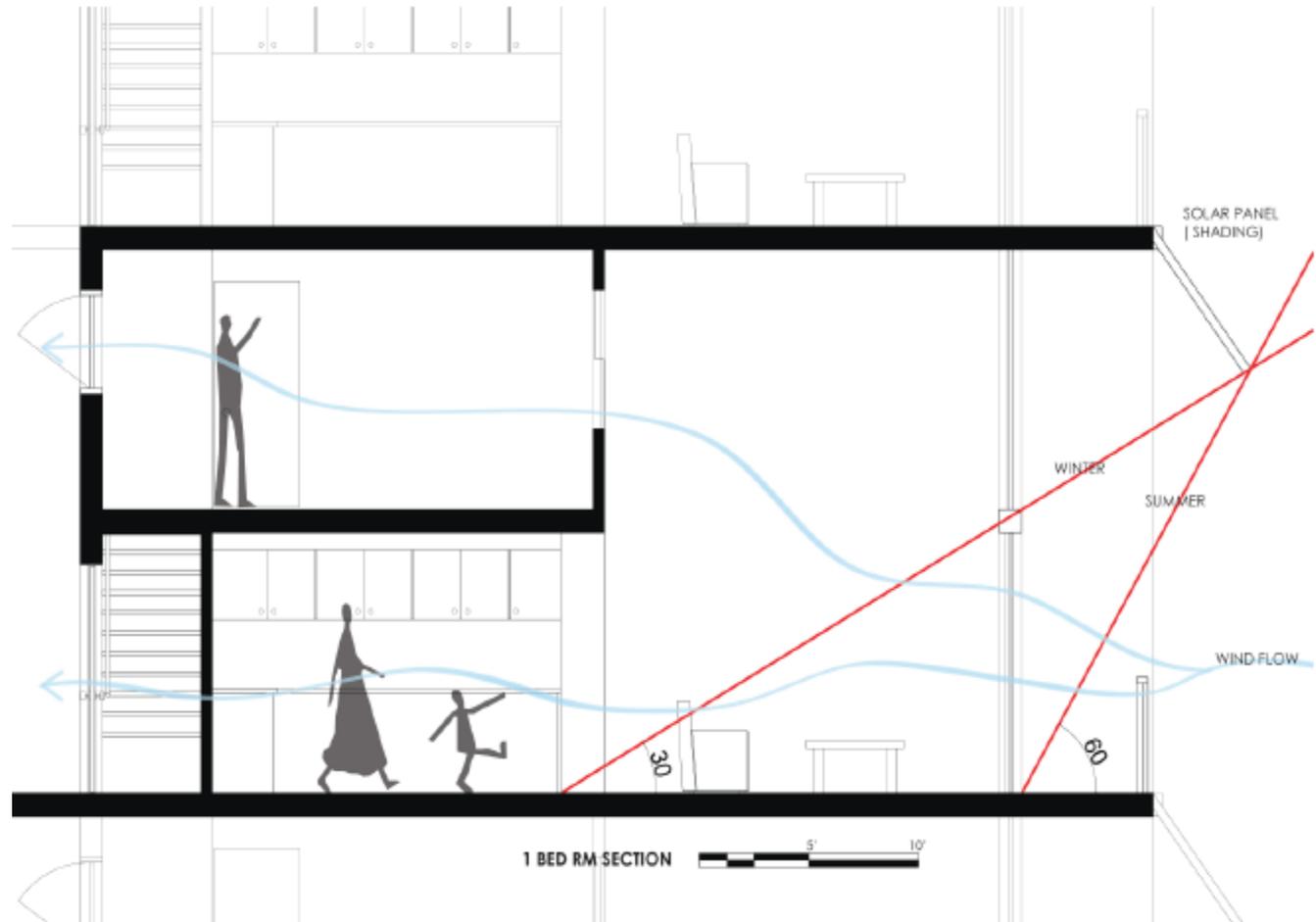


- High-Density residential buildings
- Building foot-print reduced to minimize environmental impact
- Includes sustainable features such as:
 - Solar Panels
 - Grey Water Systems
 - Green Building Materials
 - Spatial separation to promote heat regulation
 - Green Roofs
 - Green Space

Residential

Schematic Design

- Solar panel shading and through ventilation provide efficient cooling in summer and maximum passive heat in the



Culture



- New Facilities to promote culture and custom
 - Art
 - Music
 - Theatre
 - Opera
 - Sports
 - Architecture

A Rich History





Business and Commercial Plan

- Diversified commercial products
- Convenient transit
- Energy efficient
- Environmentally friendly
- Huge and diverse labor market
- Regulated and well-organized public services





Neighborhood Center

- Centered around each transit node, each module will consist of a unique downtown and commercial complex
 - Commercial markets
 - Retail
 - Office & administrative





City Center

- Main transportation node
- Open square or 'piazza'
- Surrounding retail & commercial district
- Centralized corporate, governmental, and administrative buildings



Convention Center

- Above and beyond the cutting edge:
 - Sustainable design
 - R & D
 - Eco-tourism
 - Advanced science, math, & technology



Teaching and Research Hospital

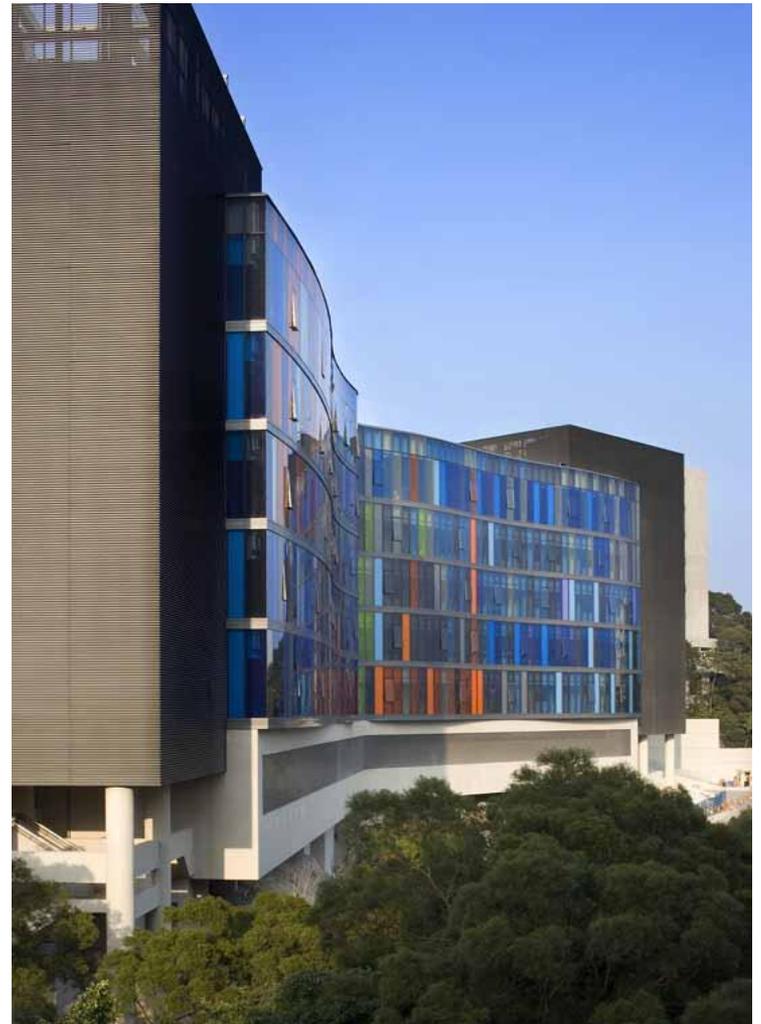
- A regional hospital
 - Planned for service of 300,000+
 - Including Pearl City, Chongming city, and the surrounding rural population





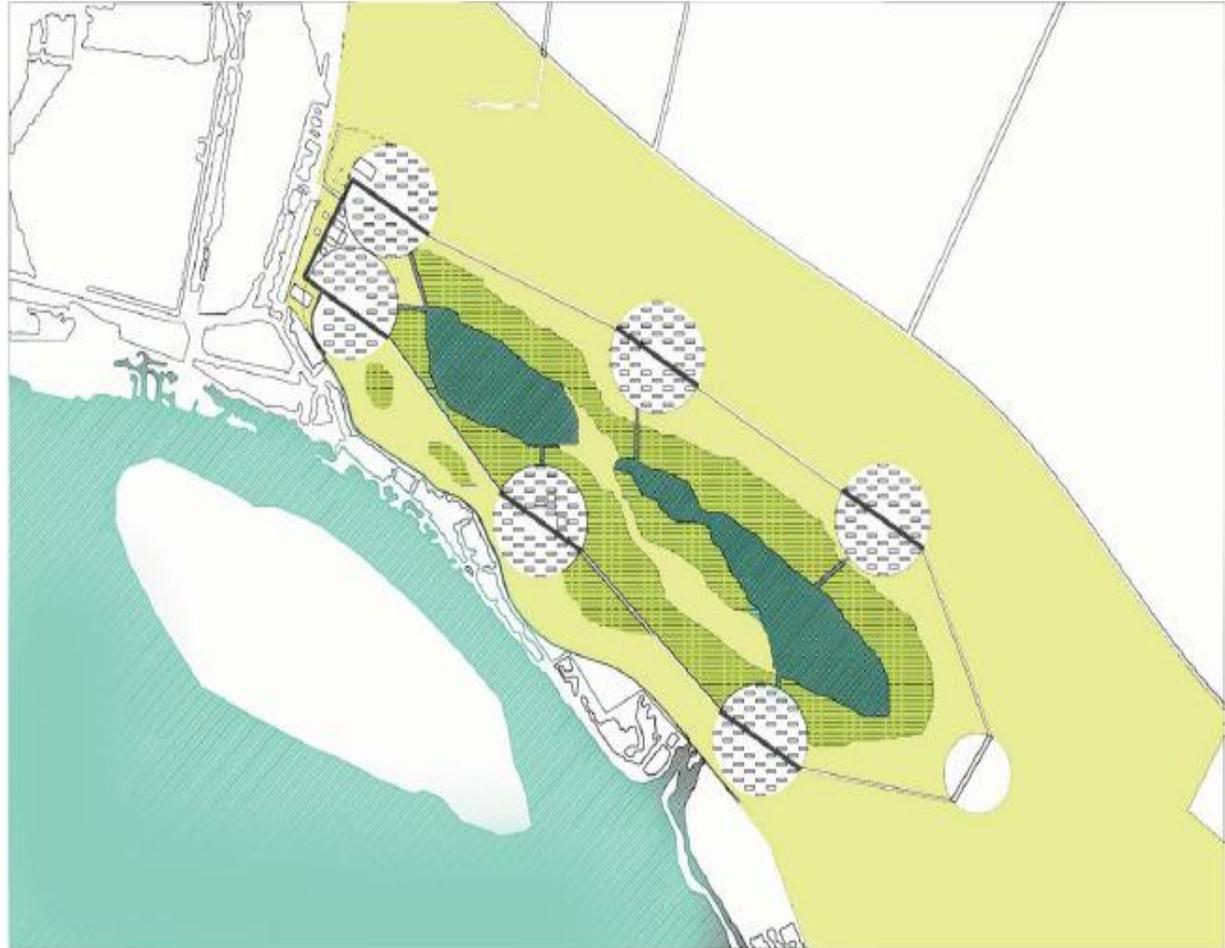
As a leader in research and development as well as high-tech industry, Pearl City will host a satellite campus of a top tier research

Research University



Green Space-Schematic Plan

- Nature preserve
- Ecological corridors
- Wetlands
 - wastewater systems
- Pedestrian trails and bike paths
- Reduced eco-footprint



Power Generation

Small-Scale Solar

- Maximizing efficiency of high-rise buildings
- Dual Use
 - Photovoltaic cells collect energy
 - External solar shading
 - Helps regulate the heating and cooling of units
 - Up to 95% heat reduction



Power Generation

Wind Farming



- Placement is crucial for wind farming
 - Northeastern portion of city
- Estimated energy production
 - 2.5 MW/ Turbine
 - 125 MW for entire farm per year
 - Each turbine can account for around 2,000 residents energy needs



Power Generation

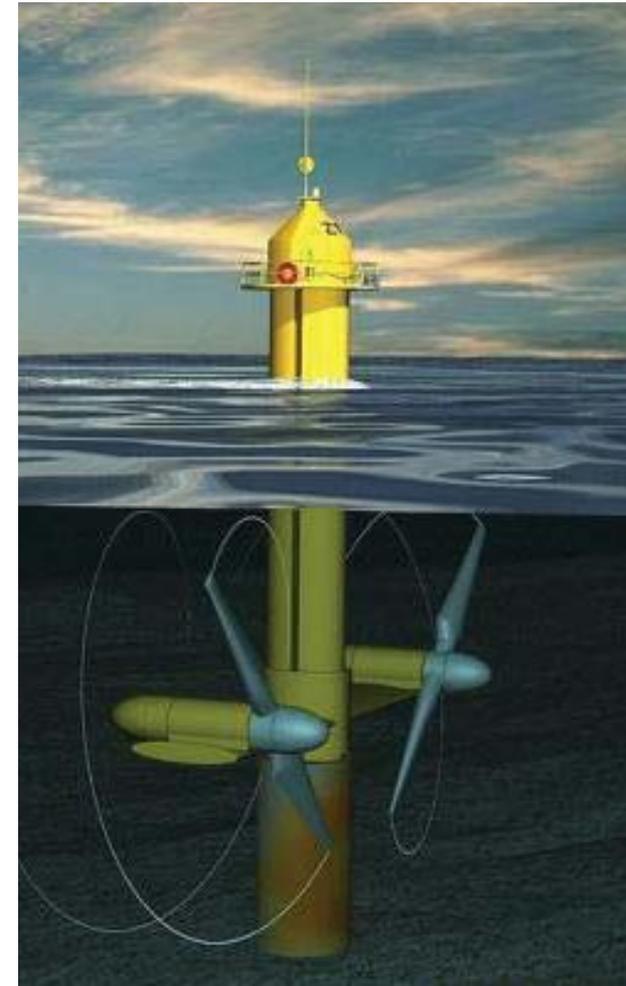
Wind Farming

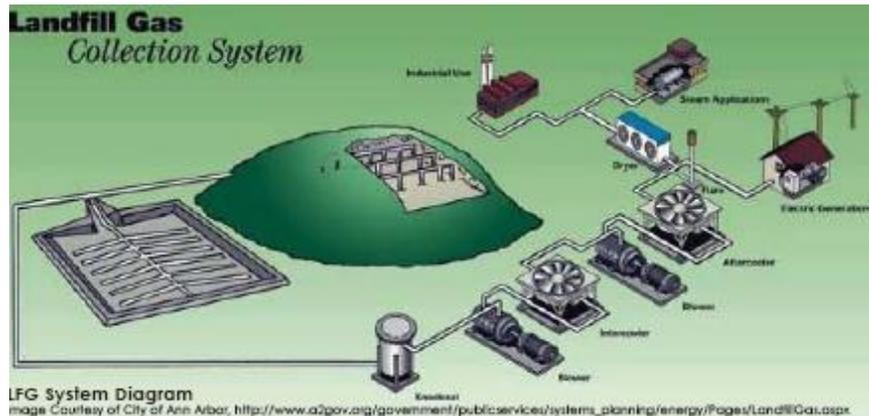




Under Water Current Farming

- Turbines will utilize strong currents from Yangtze River
- Fish Friendly
- 10-20 proposed turbines to supplement energy requirements





Water & Waste Management



- Grey water systems
- Rainwater harvesting
- Water Conservation
- Solid waste cogeneration
- Natural plant and biotic filters
- Bioreactor landfill

Team Credits

Book Team

Martin David Cooper, Editor
Kevin Lerash, Associate Editor

IPRO Leadership

David Durra, IPRO Leader
Anthony Saracino, IPRO Leader
Martin David Cooper, IPRO Leader

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