Pathways towards a community inspired city for the future...now!

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Outline

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- Aim and objectives
- Baseline Condition
- Key design actions
- Community inspired “clean” city
- Conclusions

Aim

Develop the energy system for community based sustainable future cities.

Objectives

To design an ideal city that can be a global example for regional resources management

To propose an energy mix and green technologies to achieve a carbon neutral society

To Recognize the risks and limitations when going "all renewable "

Motivation

- Better city
- Problems of cities
- Case study of new and existing
- Opportunities
- Act now to build community and sustainability
- Set the global example

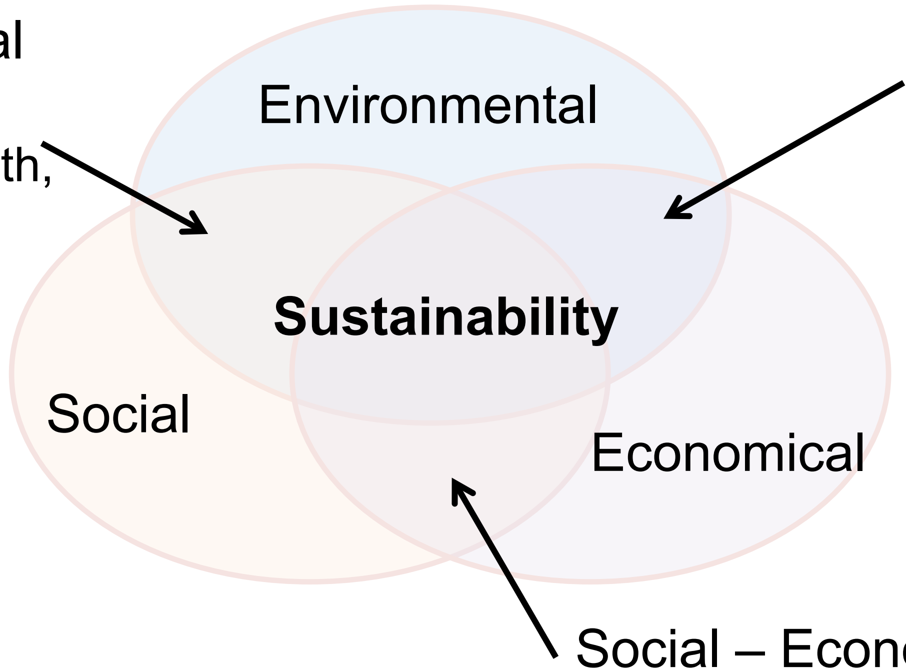
Urban Sustainability

Social – Environmental

wellbeing, health, community engagement

Environmental – Economical

Public transport, regional energy generation, urban agriculture, waste management



Social – Economical

Job opportunities, co-operations, training and support

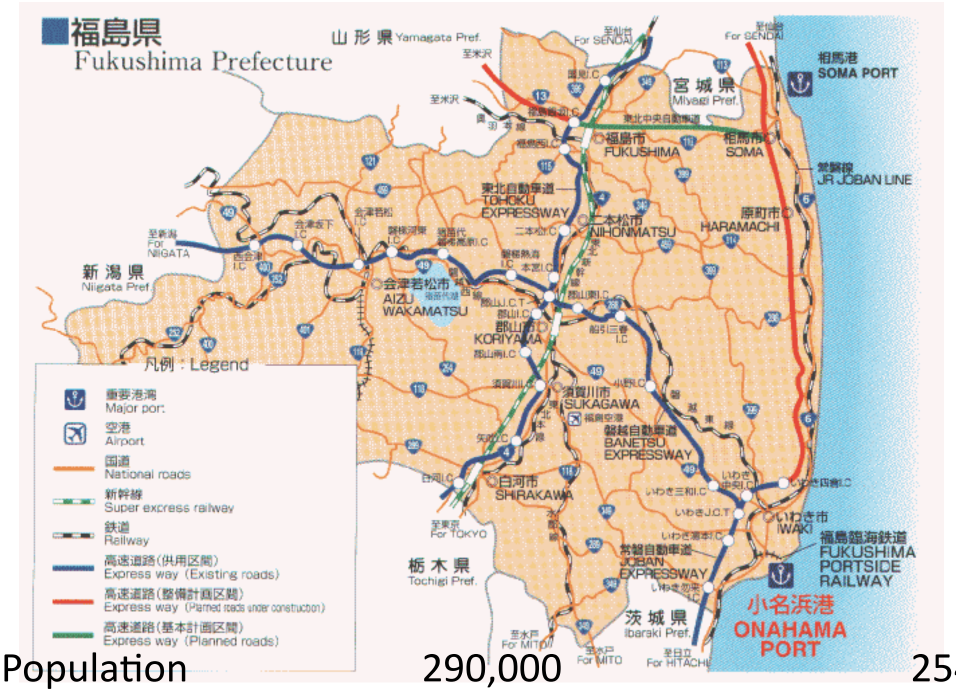
Adapted from : Teli D & James P.A.B. 2013 *Urban Space,* MSc Energy and Sustainability ,University of Southampton

Key design actions

- ✓ Describe the current conditions
- ✓ Assess technological community-based solutions
- ✓ Evaluate different policy initiatives to attract private investment
- ✓ Build a framework for innovation and collaboration between universities, stakeholders and industry
- ✓ International paradigms
- ✓ Future plans : Fukuhampton

Fukushima and Southampton

Two cities looking forward to go “green”



Population	290,000	254,000
Area	747 km²	73 km²
Climate	Warm Temperate- Hot summer	Warm Temperate- Warm summer

Fukuhampton – closer to heaven

Population 270,000

Area 400 km²

Annual Electricity demand:
2,200 kWh/person

Annual Total Electricity demand:
594 GWh

Fukuhampton – closer to heaven

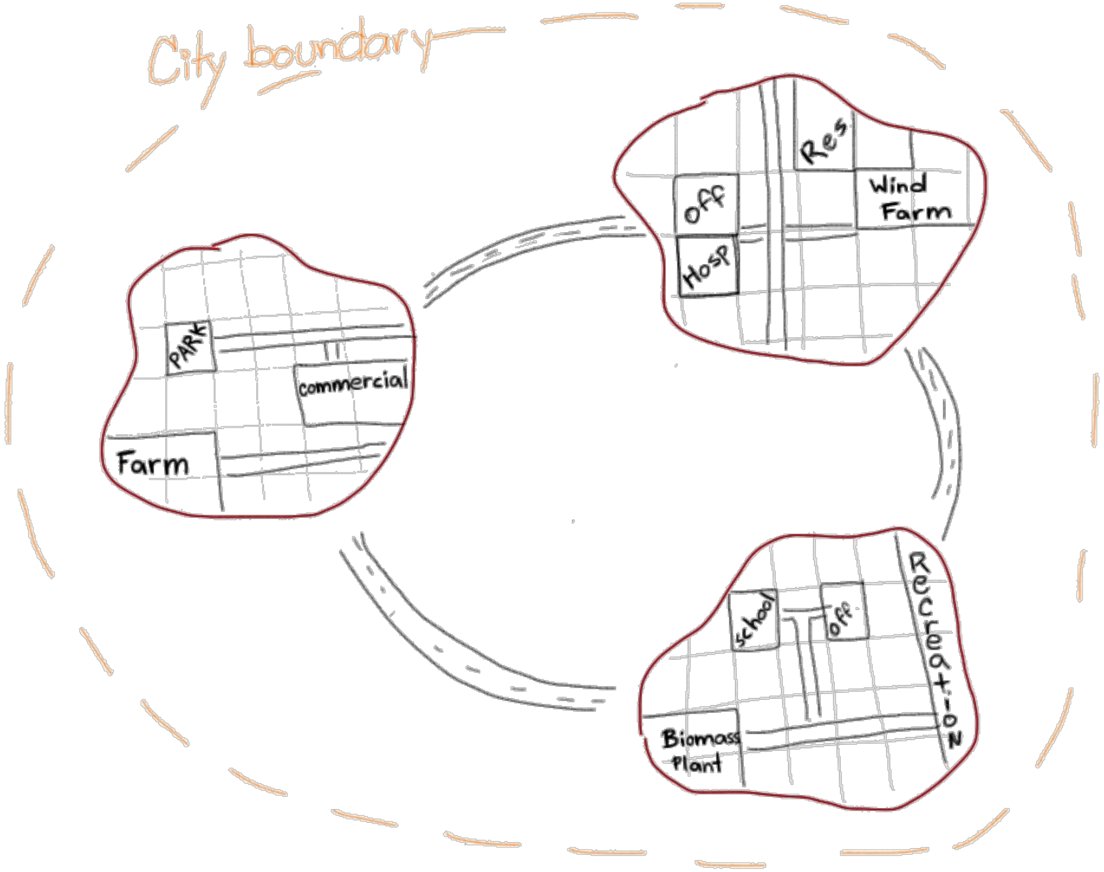
Population	270,000
Area	400 km²
Climate	Warm Temperate

Baseline mix – Business as usual

Technology	e^-	Heat	Japan Energy fuel mix (2012)*	UK Energy fuel mix (2012)*
Hydro	O	X	3%	2%
Solar	O	O	2%	
Wind	O	X		
Geothermal	O	O		
Ocean energy (tidal and wave)	O	X		
Biomass	O	O		
Oil			47%	37%
Natural Gas	O	O	24%	33%
Coal	O	O	23%	16%
Nuclear	O	O	1%	12%

•US Energy Information Administration (2012) Independent statistic analysis for Japan and UK

Urban planning – A place to call home



✓ Protect and support biodiversity

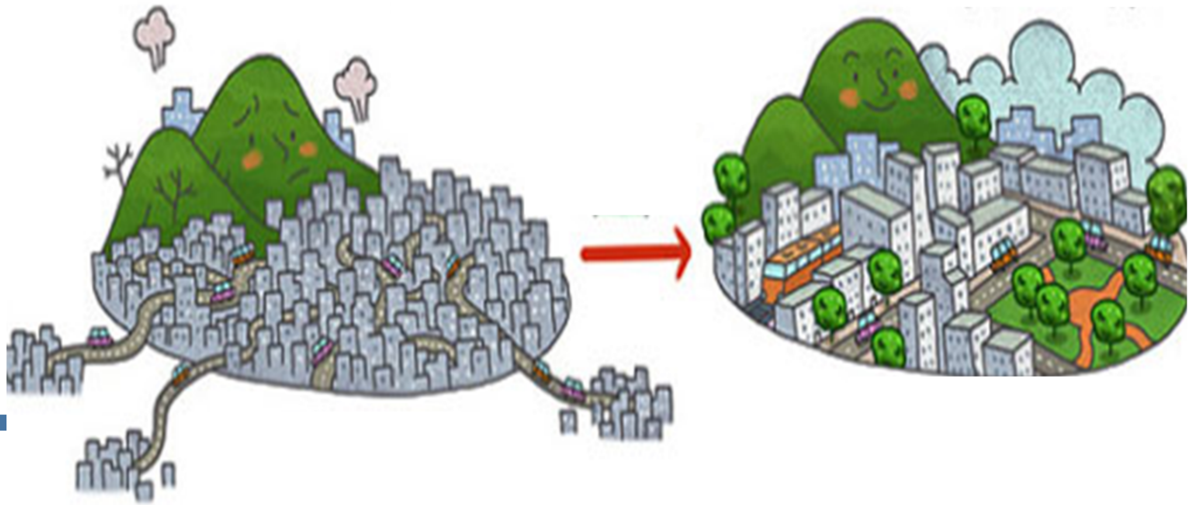
✓ Optimise density and enhance mixed-use

✓ Reassure Economic security for citizens

✓ Support cooperative networks

✓ Preserve local ecosystems and promote sustainable food production

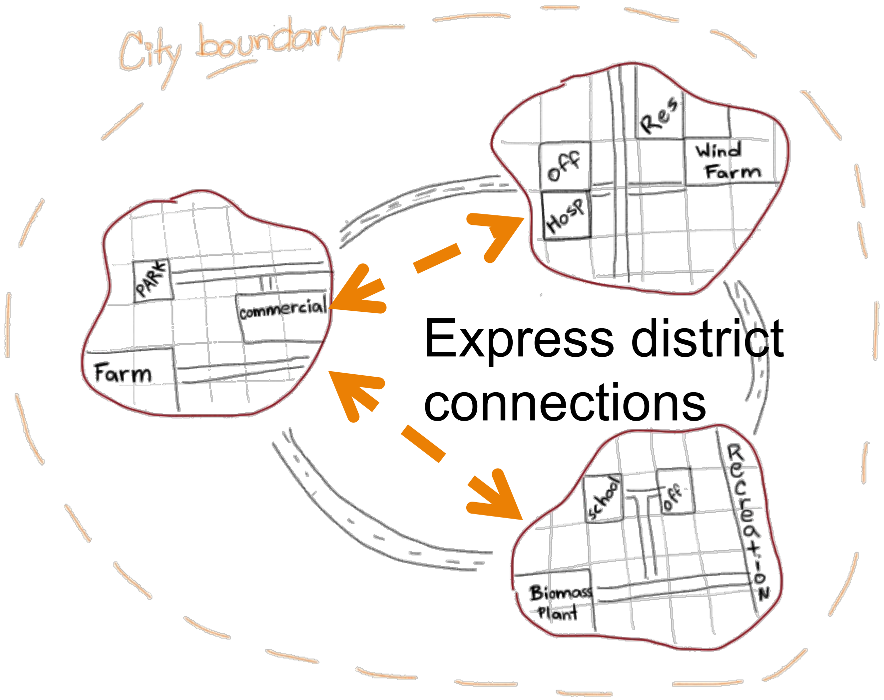
Urban planning - Land use



- Compact, walkable or cycle distance
- Mixed land use (agricultural, housing, green space and recreation),
- Preserve green space and critical habitat for biodiversity
- Total housing area < 60%

Source: theenvironmentalblog.com

Urban planning - Transport in the city



Express district connections

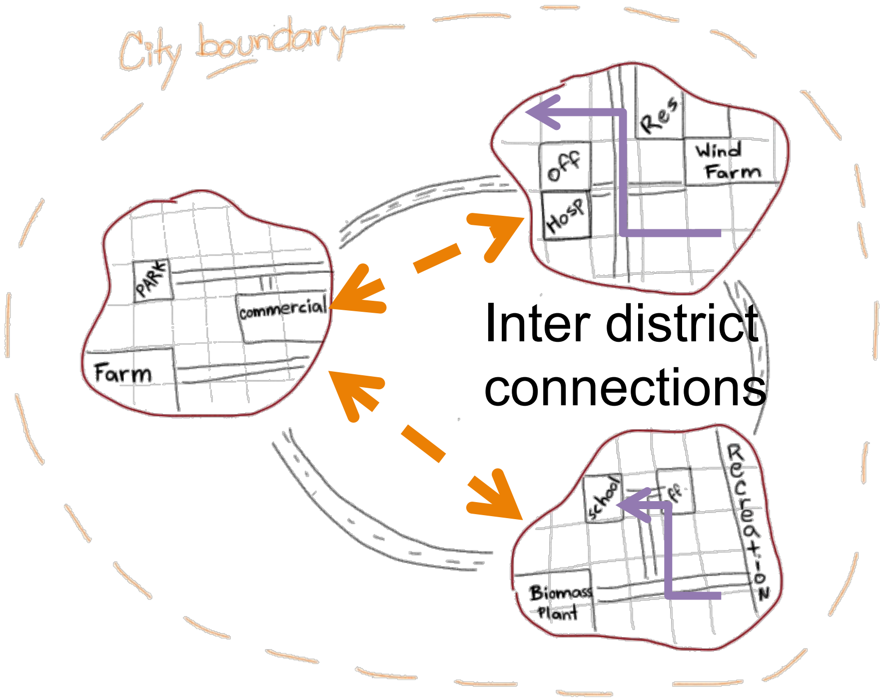
Primary roads – arteries (4 – 6 lanes with planted central reservation and side “green” verges.

Electric, H_2 fuel cell buses, tram

Catchment area the district/ community ~5,000 to 10,000 persons

Non local travel

Urban planning - Transport in the city



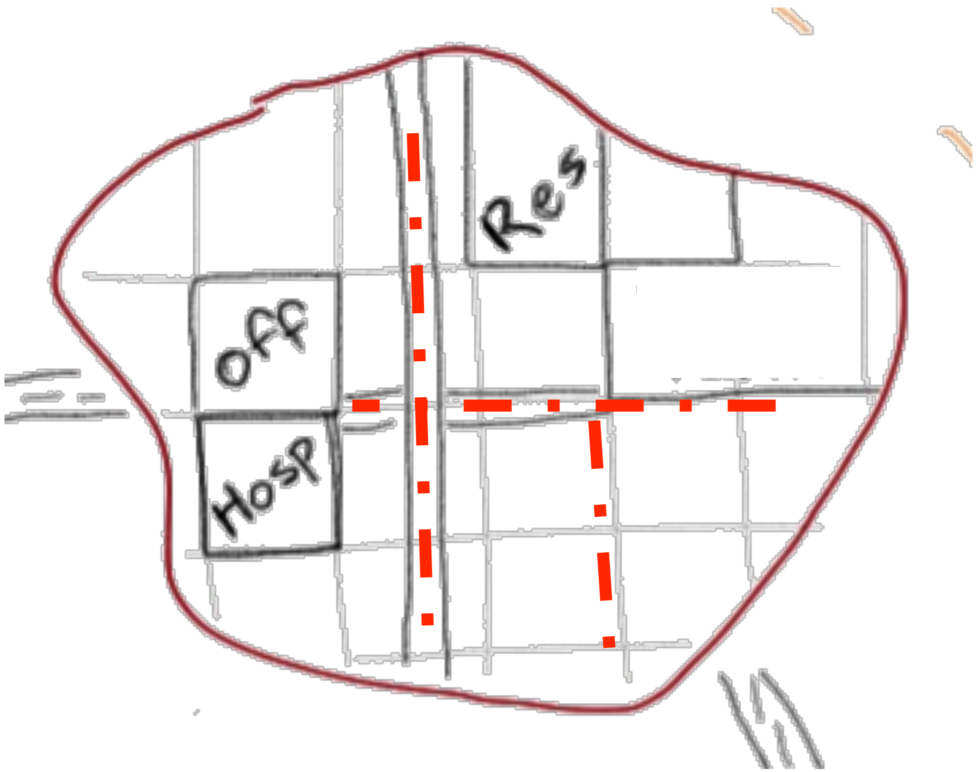
Fast Inter district connections - Electric buses

Secondary roads (2 – 3 lanes with side planted pedestrian walks (increased permeable surfaces with rain run off collection)

Catchment area parts of the district ~2,000 to 3,000 persons

Travel to schools, local commercial centre

Urban planning - Transport in the city



Bicycle lanes/ walkable distances (~800m to main local facilities such as grocery, post office etc)

Secondary and tertiary roads (1-2 lanes with pedestrian walks, public open space, local parking

Catchment area parts of the neighbourhood ~500 to 2,000 persons

Travel to shops, food supplies, entertainment

Urban design - Principles

Places with character and identity

Continuity and enclosure – Private space is distinguished from public

Quality of public places – attractive, well used space

Ease of movement – accessibility and safe connection with surroundings

Adapted from CABE “Commission for Architecture and the Built Environment

Urban design - Principles

Legibility – Easy to find and navigate around

Adaptability – Easy to change according to use needs

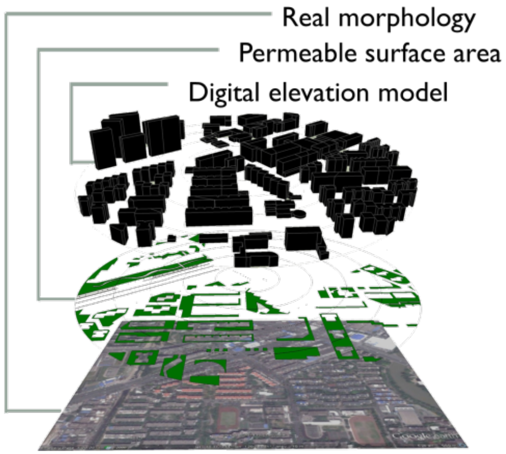
Diversity – Variety and choices

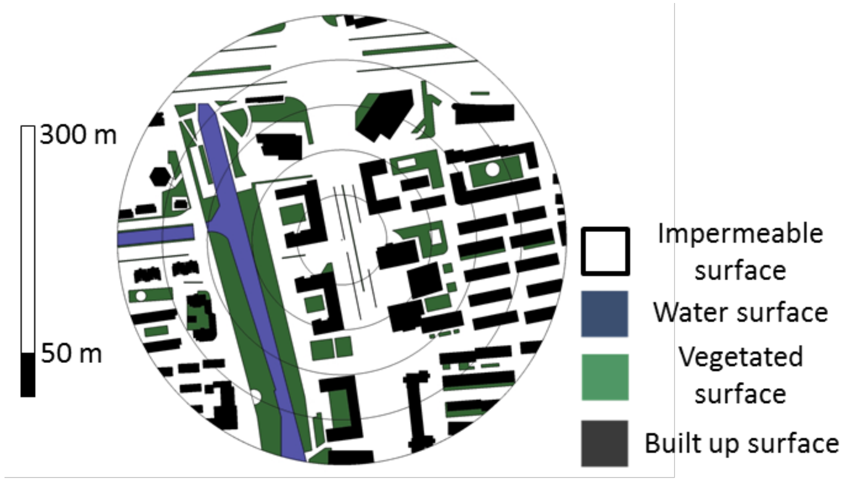
Resilient to climate change and extreme events

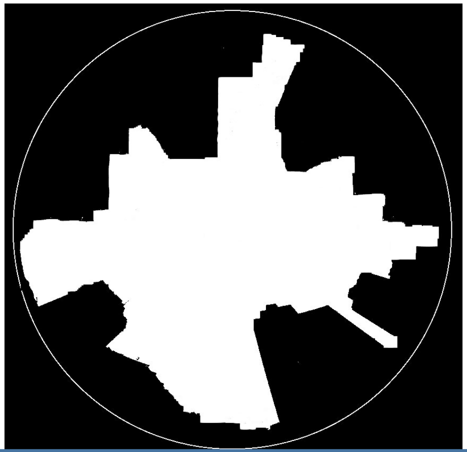
Promoting air quality, thermal comfort and energy savings

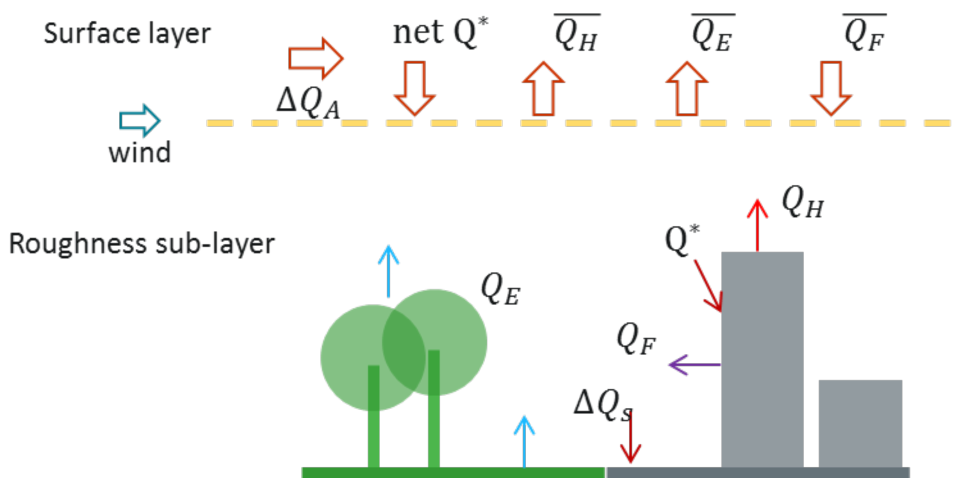
Adapted from CABE “Commission for Architecture and the Built Environment

Urban design – Microclimate





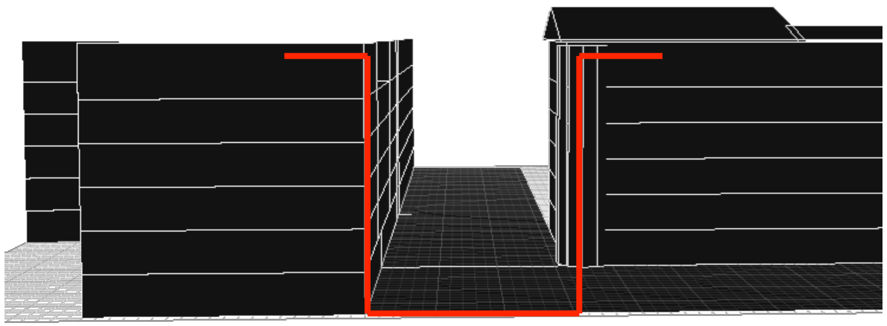




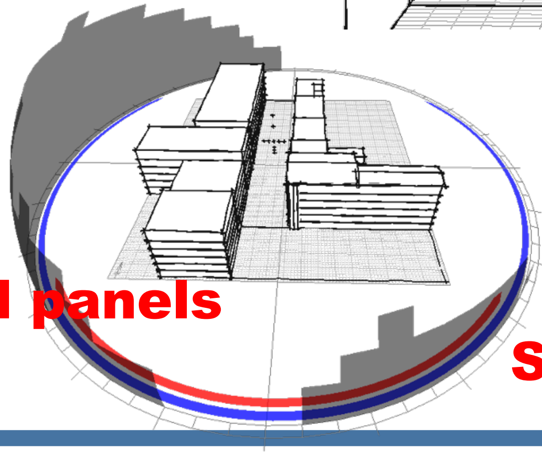
Adapted from CABE “Commission for Architecture and the Built Environment

Urban design – Building layout

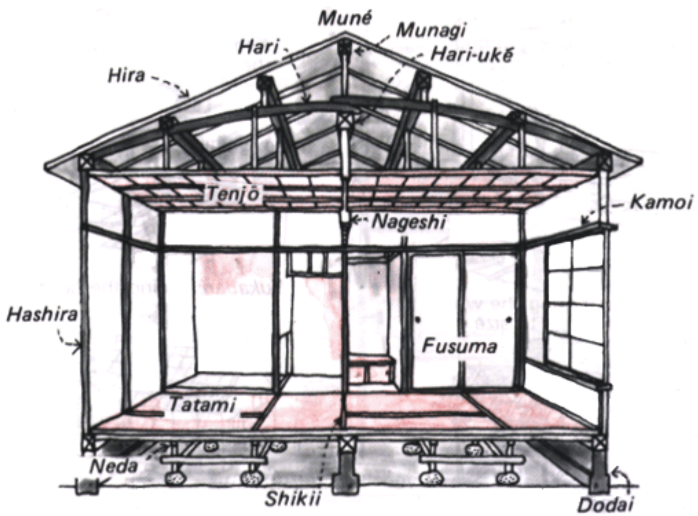
Optimum AR = ?



Consider ....
Daylight levels
Air quality
Pedestrian comfort
Integrated PV and solar thermal panels



Urban design – Building layout



Construction of a small wooden house in the traditional style

Lessons taught from **traditional architecture**

Openings to South (solar gains)

Cold air recession – secondary use spaces to North

Daylight access

Change in the use of space

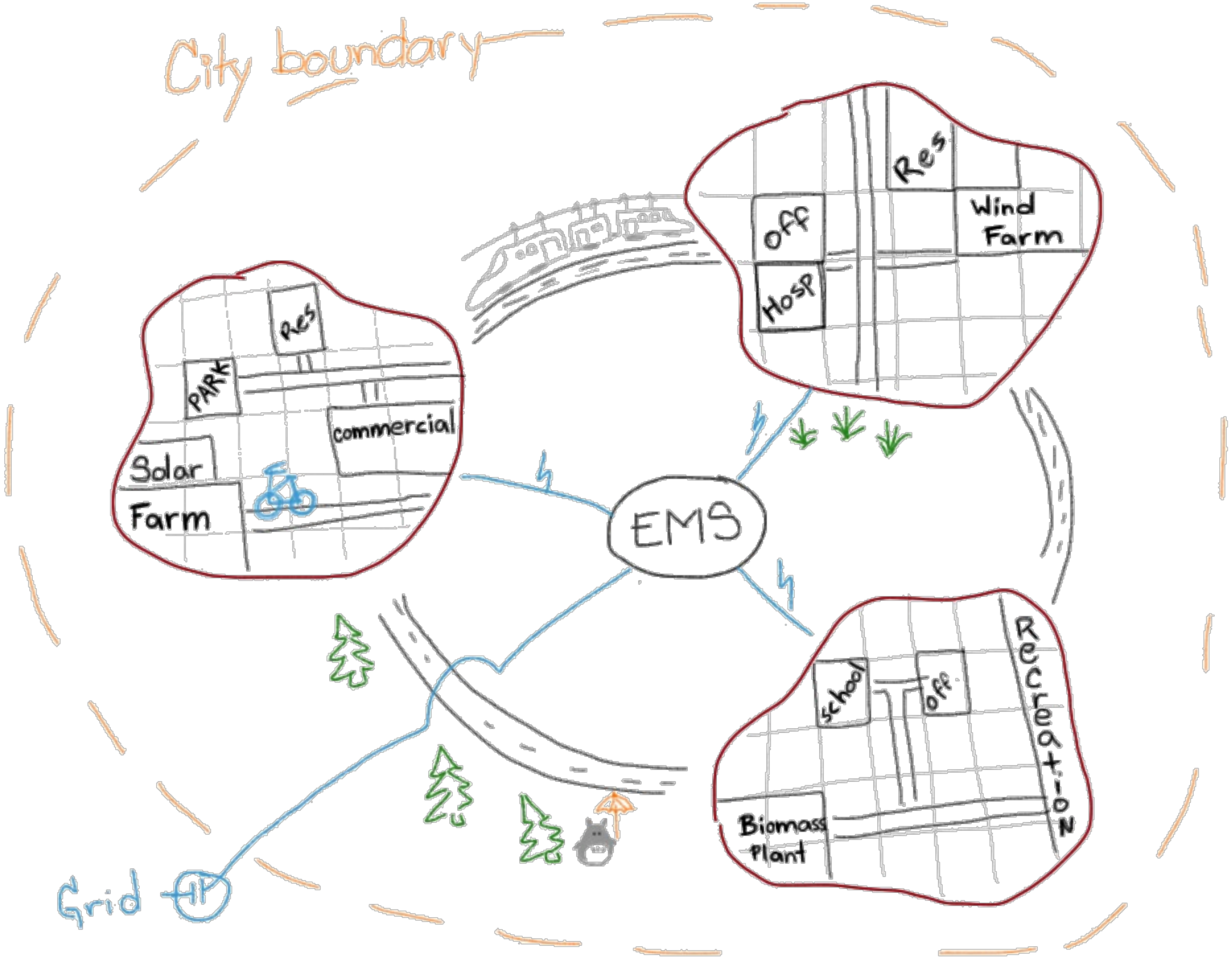
Cross ventilation

Urban design – Building layout

Regional – responsive to climate design

Use of local materials and recycling at the end of life – Life Cycle Assessment

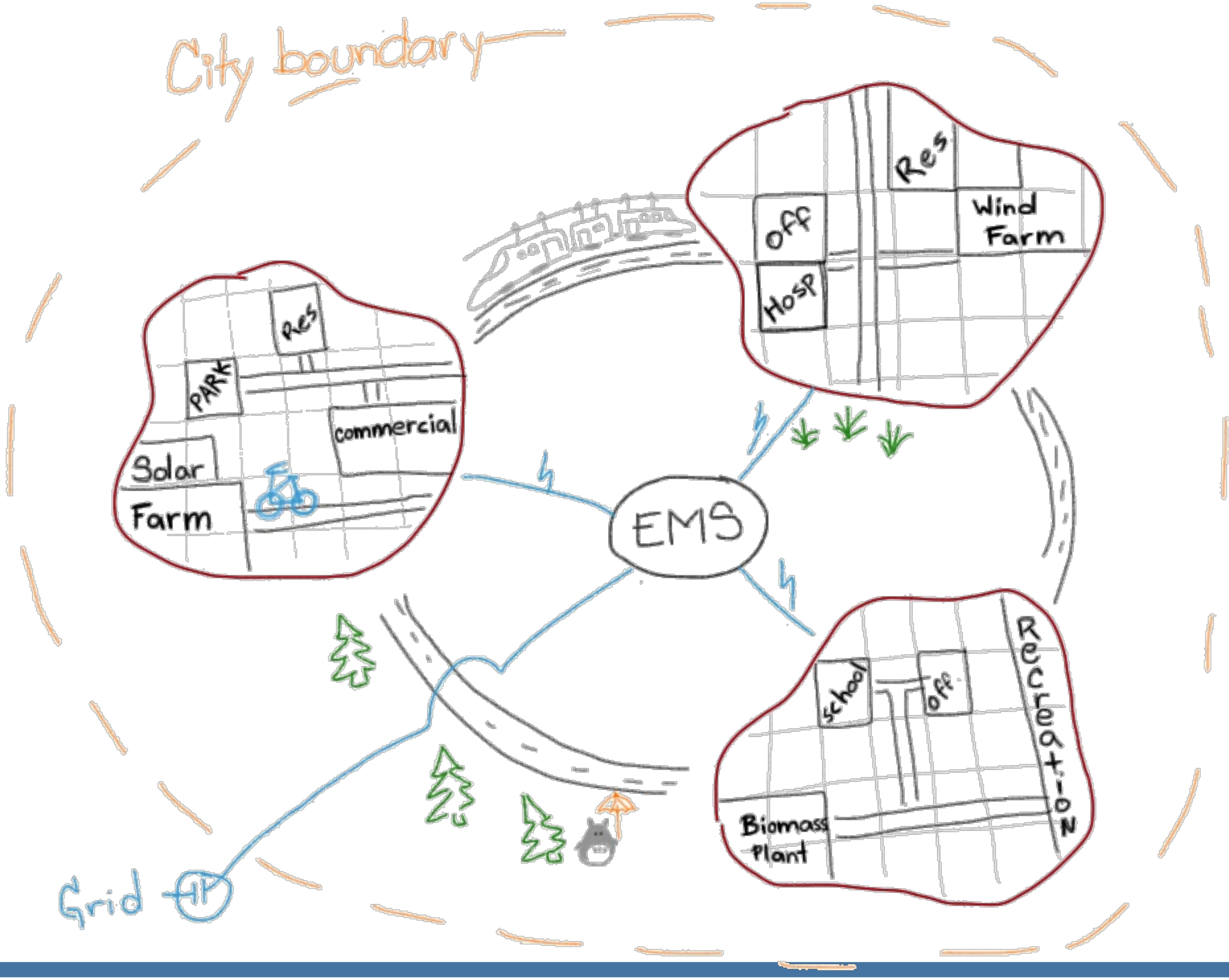
Energy – Management



Annual Total
Electricity
demand:
594 GWh

Energy management system for Fukuhampton

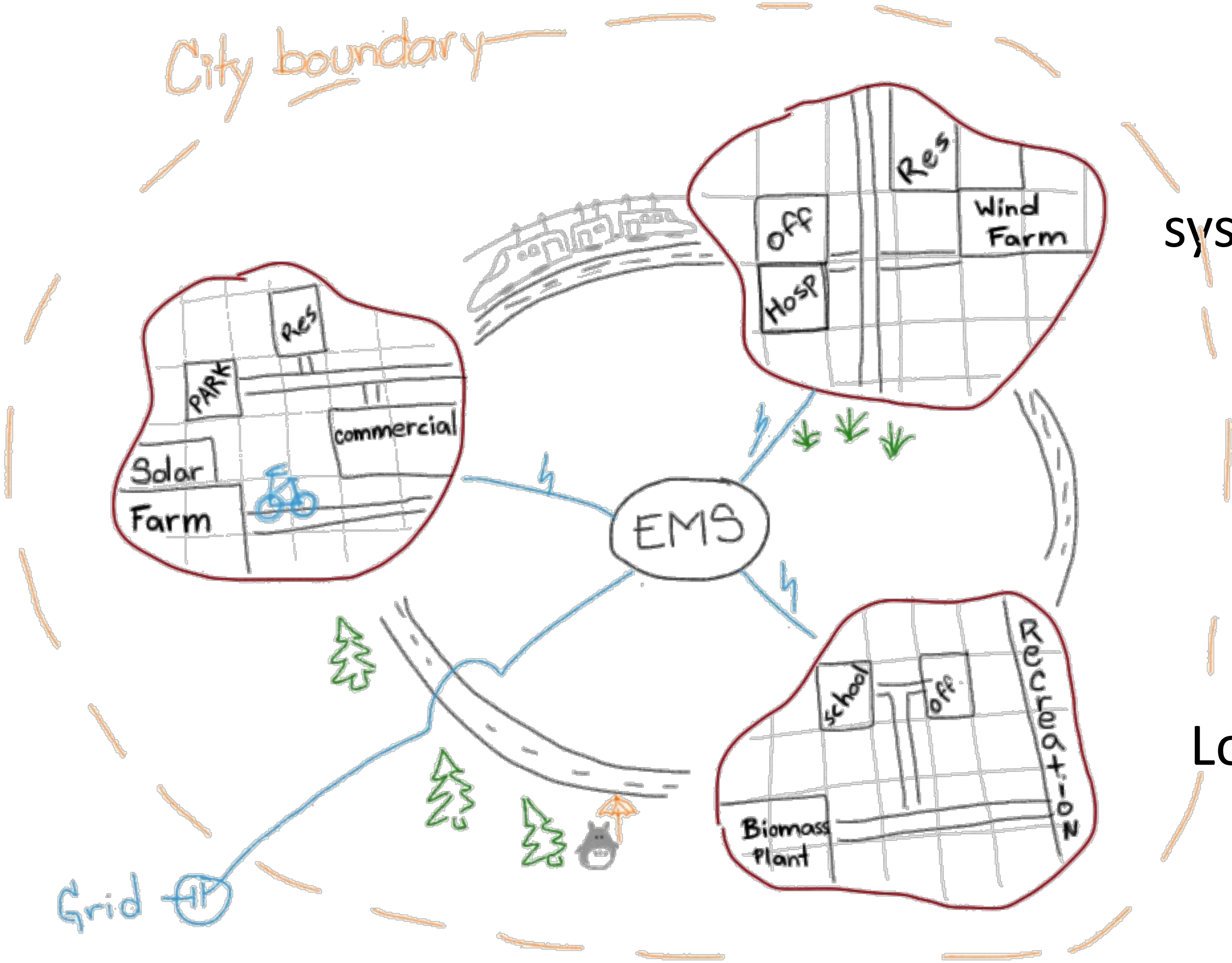
Energy – Hybrid approach



Annual Total Electricity demand: 742.5 GWh

Target: 125% net cover of energy demand

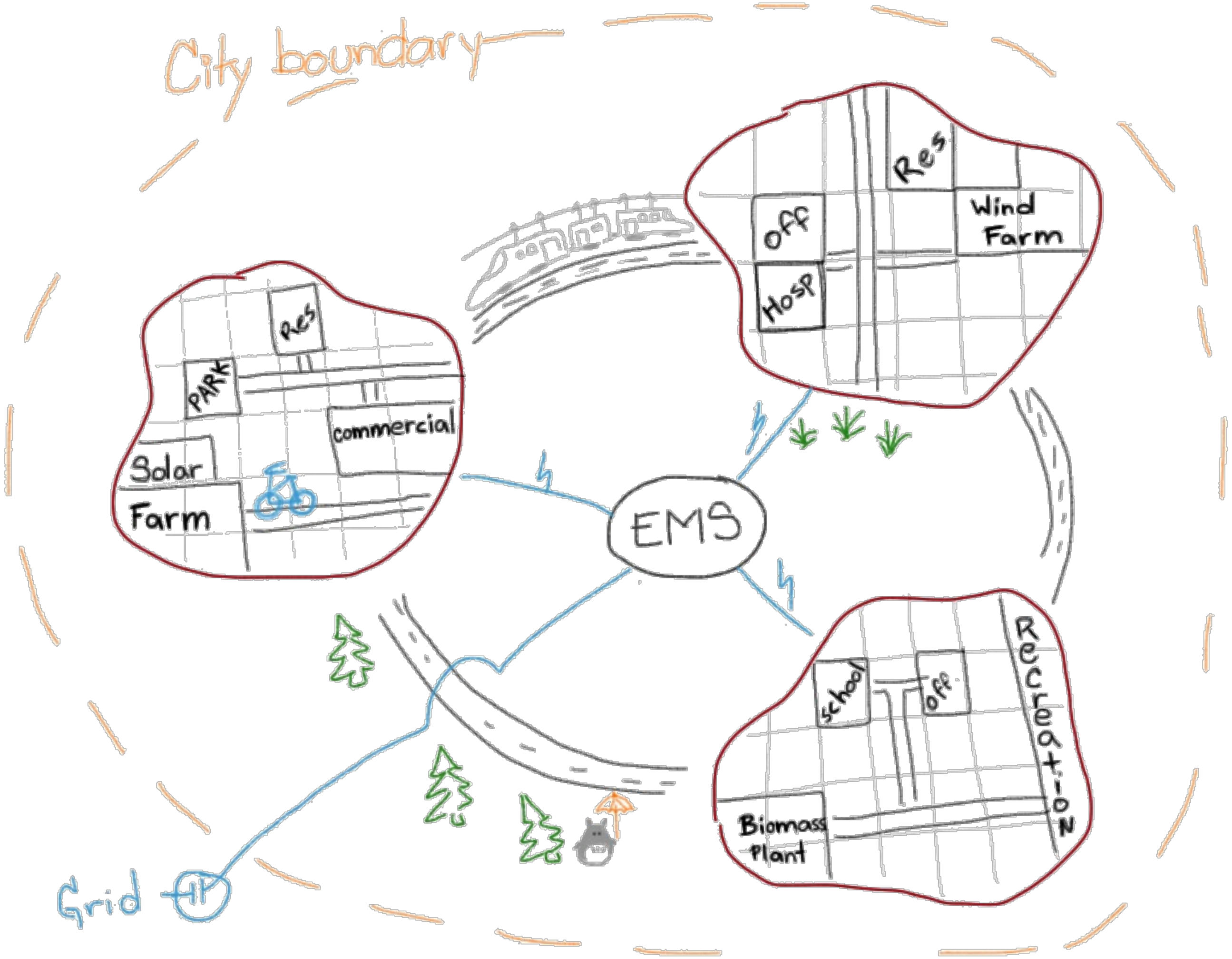
Energy – Management



Community owned energy management system controls the local power distribution between the districts

Local decentralised grid is connected to the national grid

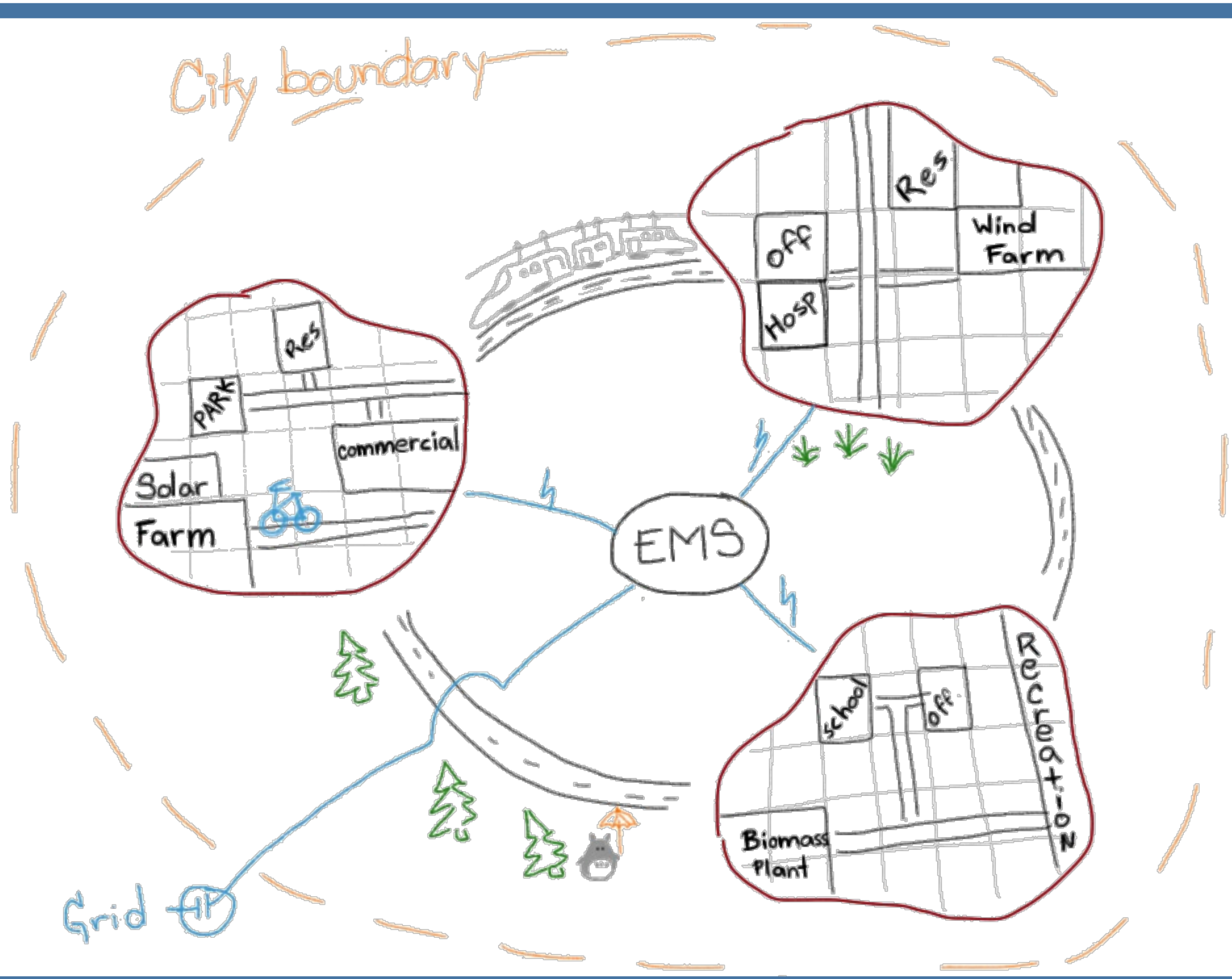
Energy – Hybrid approach



Surplus is exported to the grid.
Carbon offset for the CO_2 emitted by private vehicles and conventional energy generation.

At mature stage of the development average per capita demand does not exceed 2,200 kWh

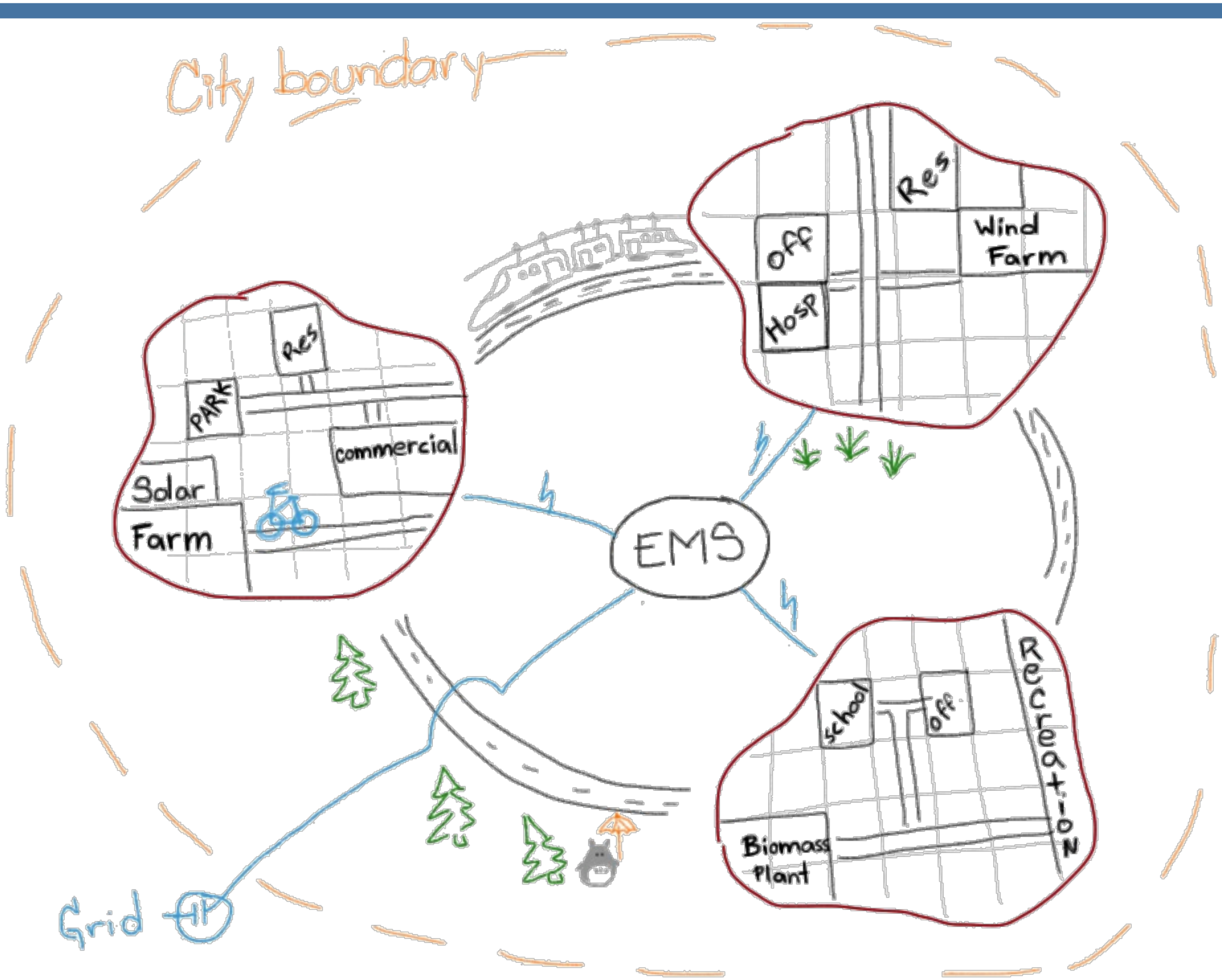
Energy – Hybrid approach



Solar PV potential...

Total A=400 10^6 m^2

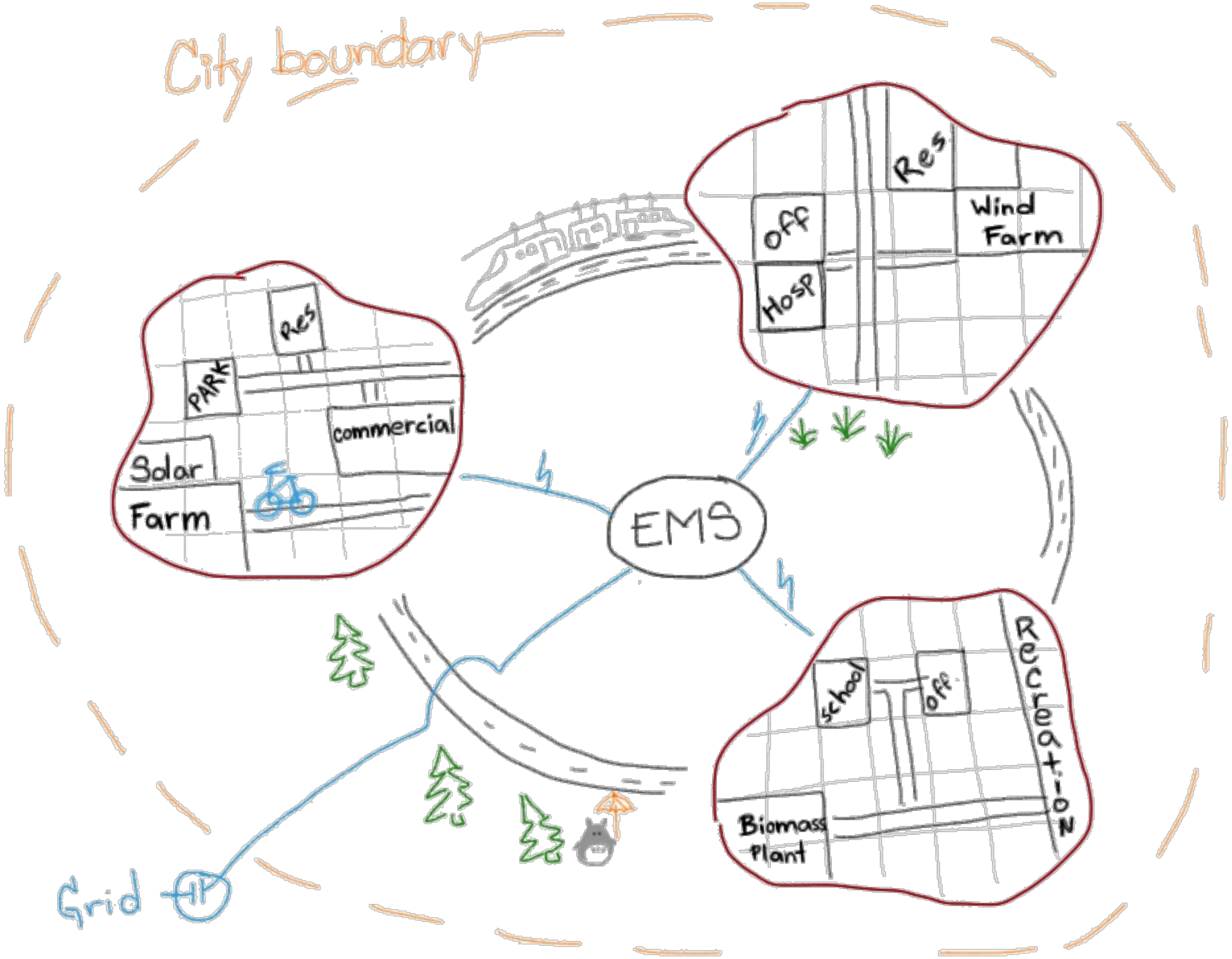
Energy – Hybrid approach



Annual Total Electricity demand: 742.5 GWh

50% Built x 400 10^6 m^2 x 5% suitable roofs x 800 kWh / kWp x 0.1 kWp/m^2 = 800 GWh!

Energy – Hybrid approach

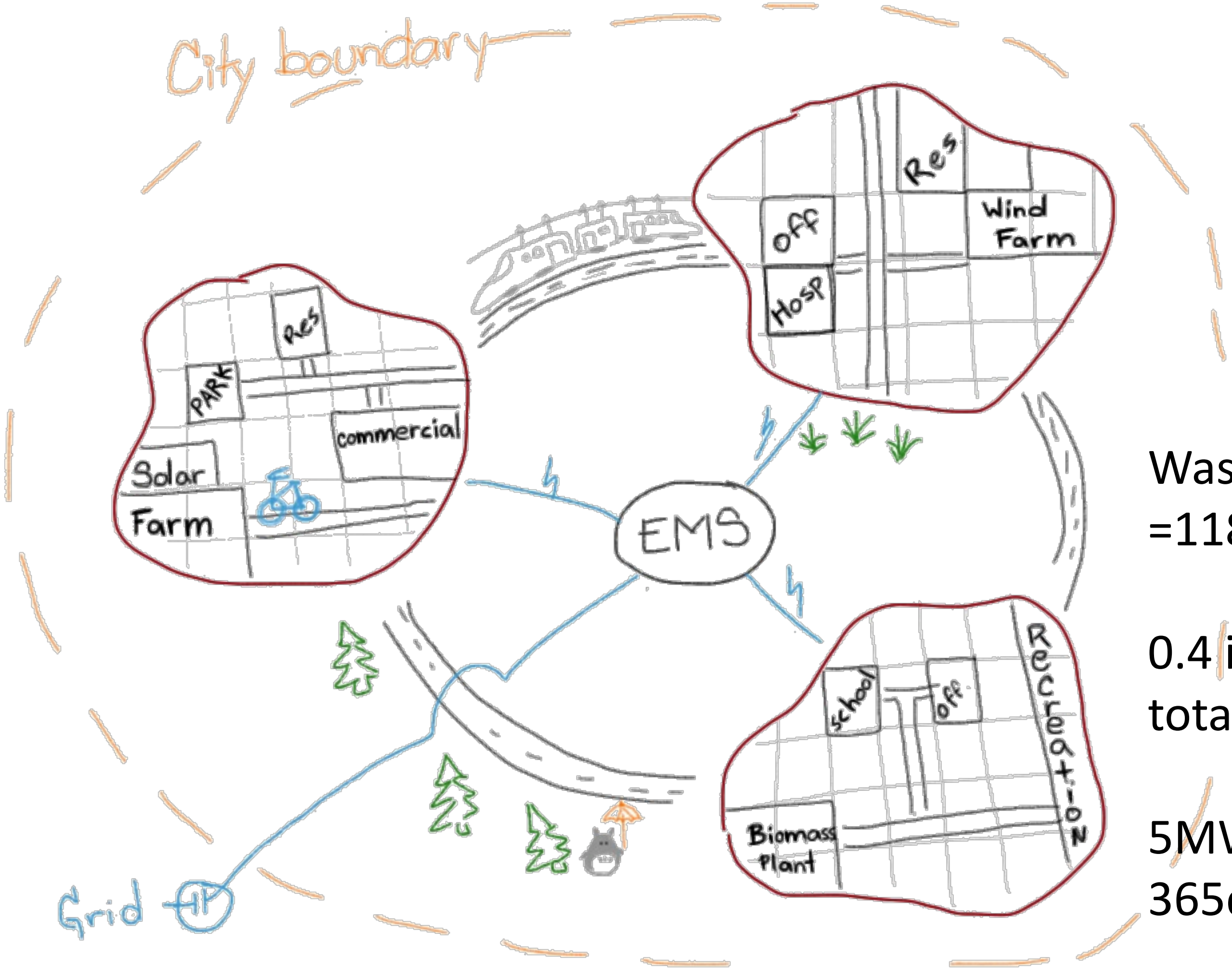


Annual Total Electricity demand: 742.5 GWh

Wind 10 MW onshore -> 15 GWh*

* World View. Wind Energy opportunities in Japan. www.worldview.co.nz

Energy – Hybrid approach



Annual Total Electricity demand: 742.5 GWh

Waste 1.2 kg /person/daily =118,000 tons annually

0.4 incinerated in 5MW e^- total plants.

5MW x 0.2 effic. x 12hr/day x 365days = 22 GWh

Energy – Hybrid approach

FUKUHAMPTON	Energy	Cost
Biomass - waste incineration - CHP	0	0
Geothermal	627GWh/year	0.1070MM$
Hydropower - large-scale	0	0
Hydropower - small-scale	0	0
Solar photovoltaics - Large scale	0	0
Solar photovoltaics - Buildings	0	0
Marine	0	0
Wind onshore	0	0
Wind offshore	0	0

FUKUHAMPTON	Energy	Cost
Biomass - waste incineration - CHP	0	0
Geothermal	97.2	0.0166
Hydropower - large-scale	0	0
Hydropower - small-scale	0	0
Solar photovoltaics - Large scale	0	0
Solar photovoltaics - Buildings	0	0
Marine	0	0
Wind onshore	530.65	0.2423
Wind offshore	0	0

Energy– risks and limitations

- Low community engagement - Not in my back yard syndrome
- Cost and initial capital stock
- Natural disasters
- Unpredicted climate conditions
- Finite primary energy resources
- Low rate of technological learning

Sustainable infrastructure

- Water management infrastructure

Drinking water supply(save water usage)

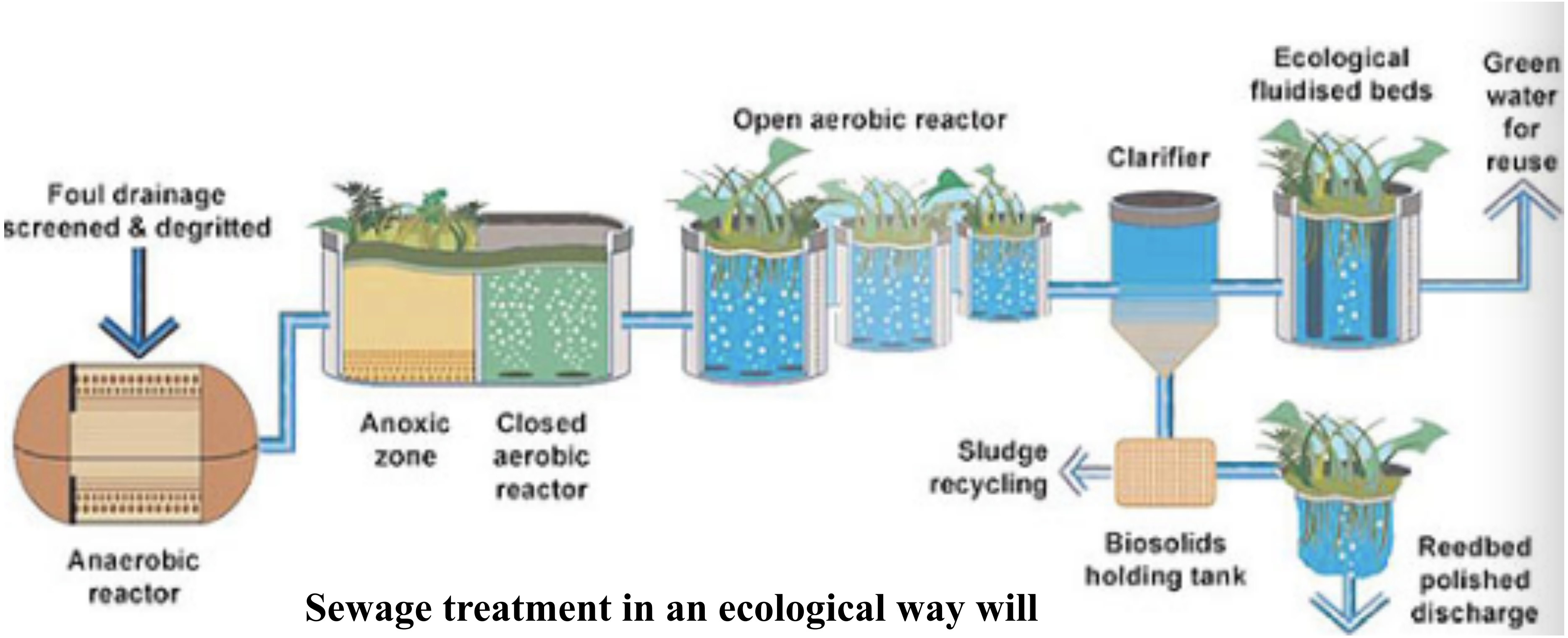
Sewage treatment-Ecological treatment

- Solid waste management

Solid waste gasification facilities

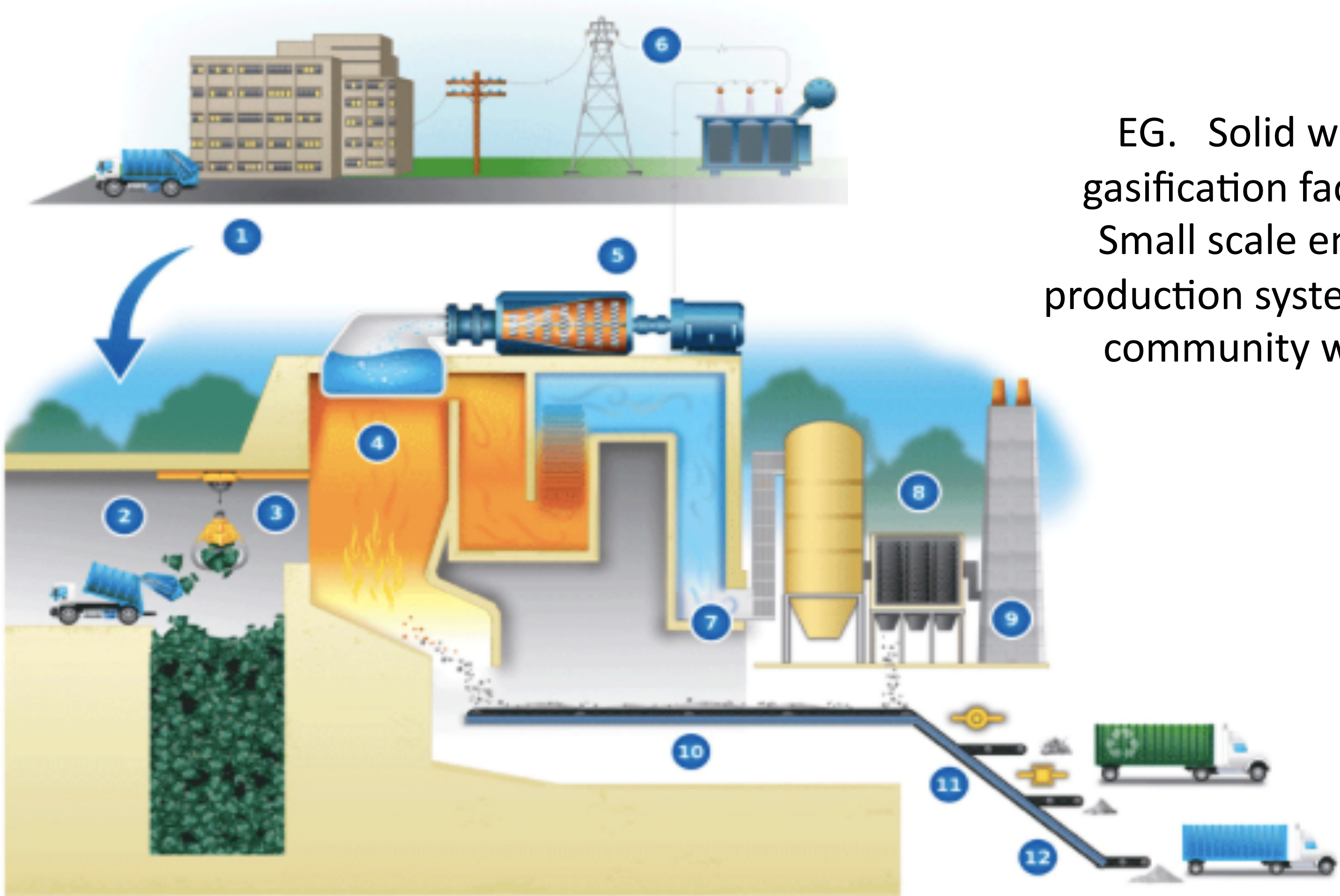
- Green infrastructure

Water management (water-energy nexus)



Sewage treatment in an ecological way will save energy compared to traditional treatment methods.

Solid waste management（energy production from waste)



EG. Solid waste gasification facilities
Small scale energy production system using community waste

Green infrastructure

Green belt in the city: early drainage of rainwater the rainwater, and at the same time, can be used to facilitate CO2 sequestration

Green roof: if there is some roof top space left, green roof can be used to save energy by increasing the insulation of the buildings.

Conclusion

- Energy demand reduction through behaviour shift and efficient city design.
- Emissions from Gas/Biomass CHP and grid carbon intensity are offset by energy export to the grid.
- Community cooperation networks have shares on the energy generation plants.
- Fukuhampton can set as a global example for community based generation according to regional resources.

Thank you very much
Q&A