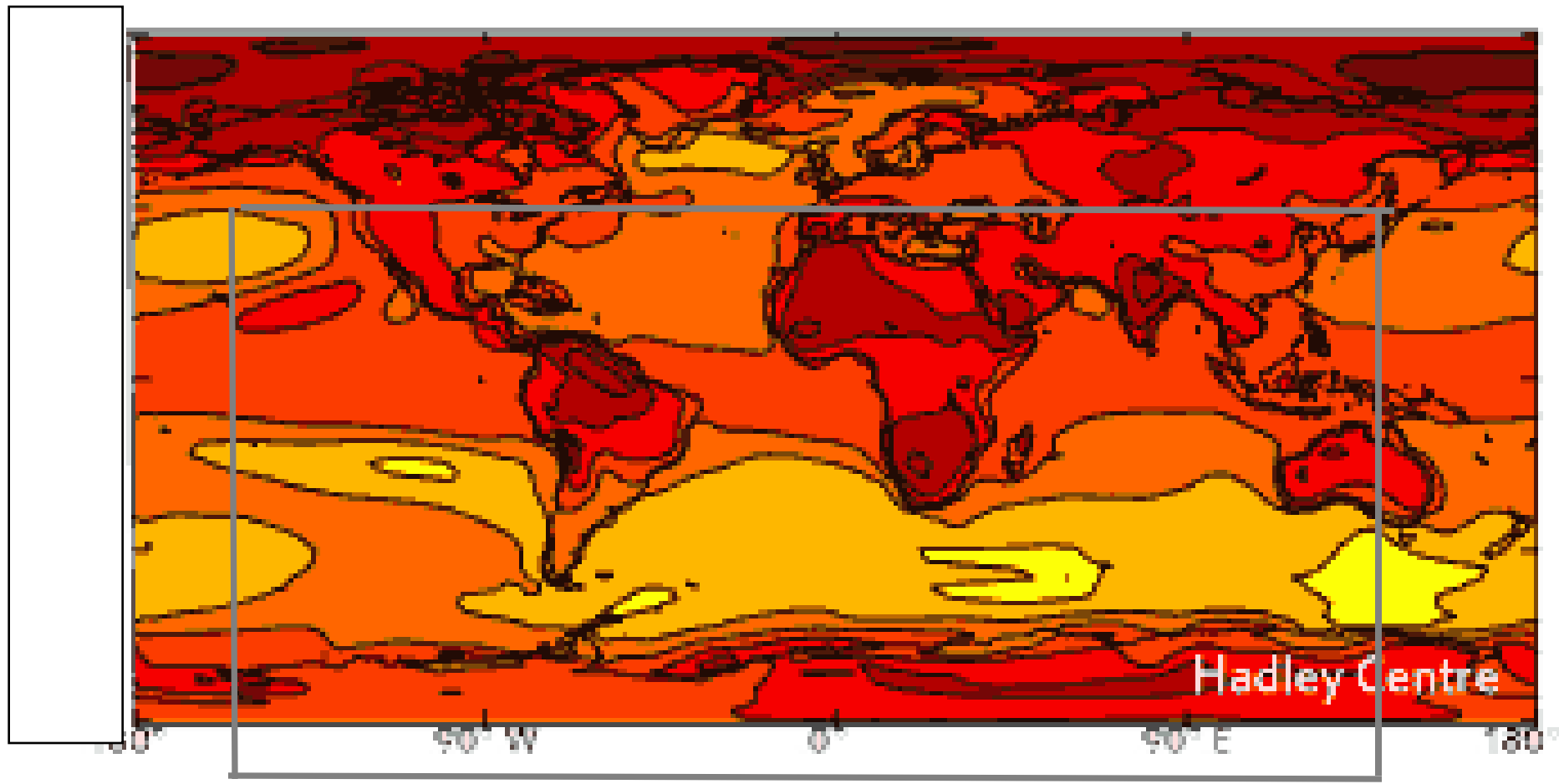


Zero Carbon Building : Approaches and cases

Insun Ree – ZEDfactory Ltd



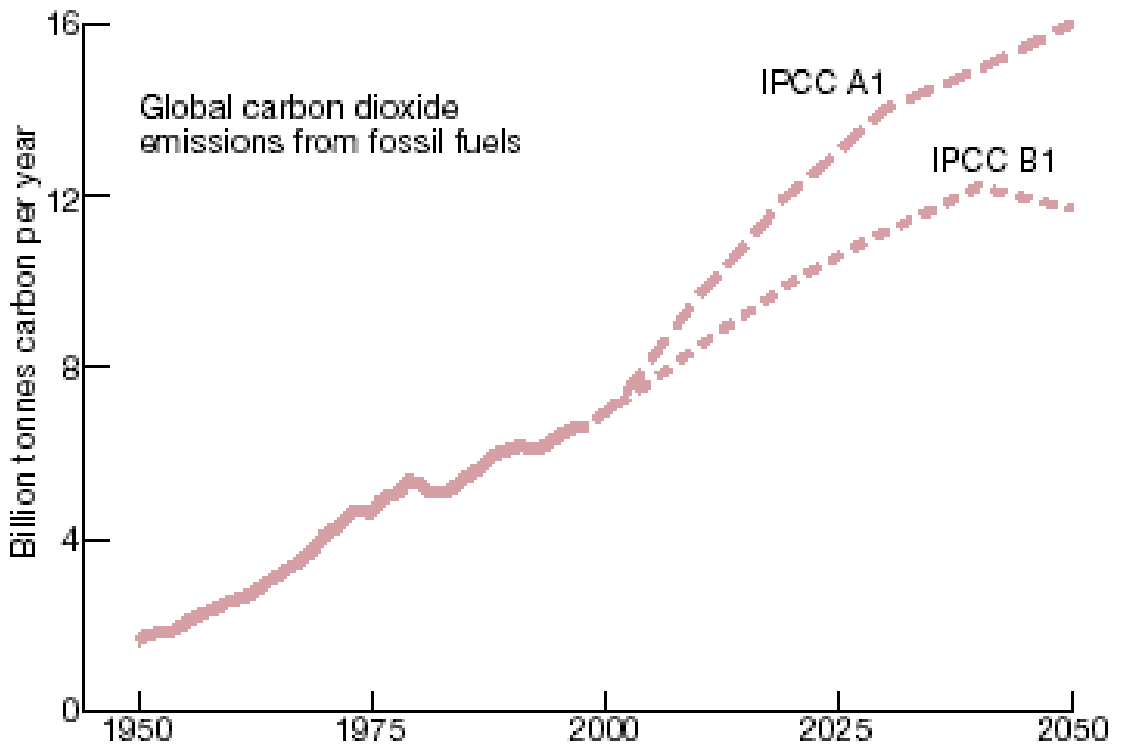
Hadley Centre



Predicted 2080 Temperature rise (°C)

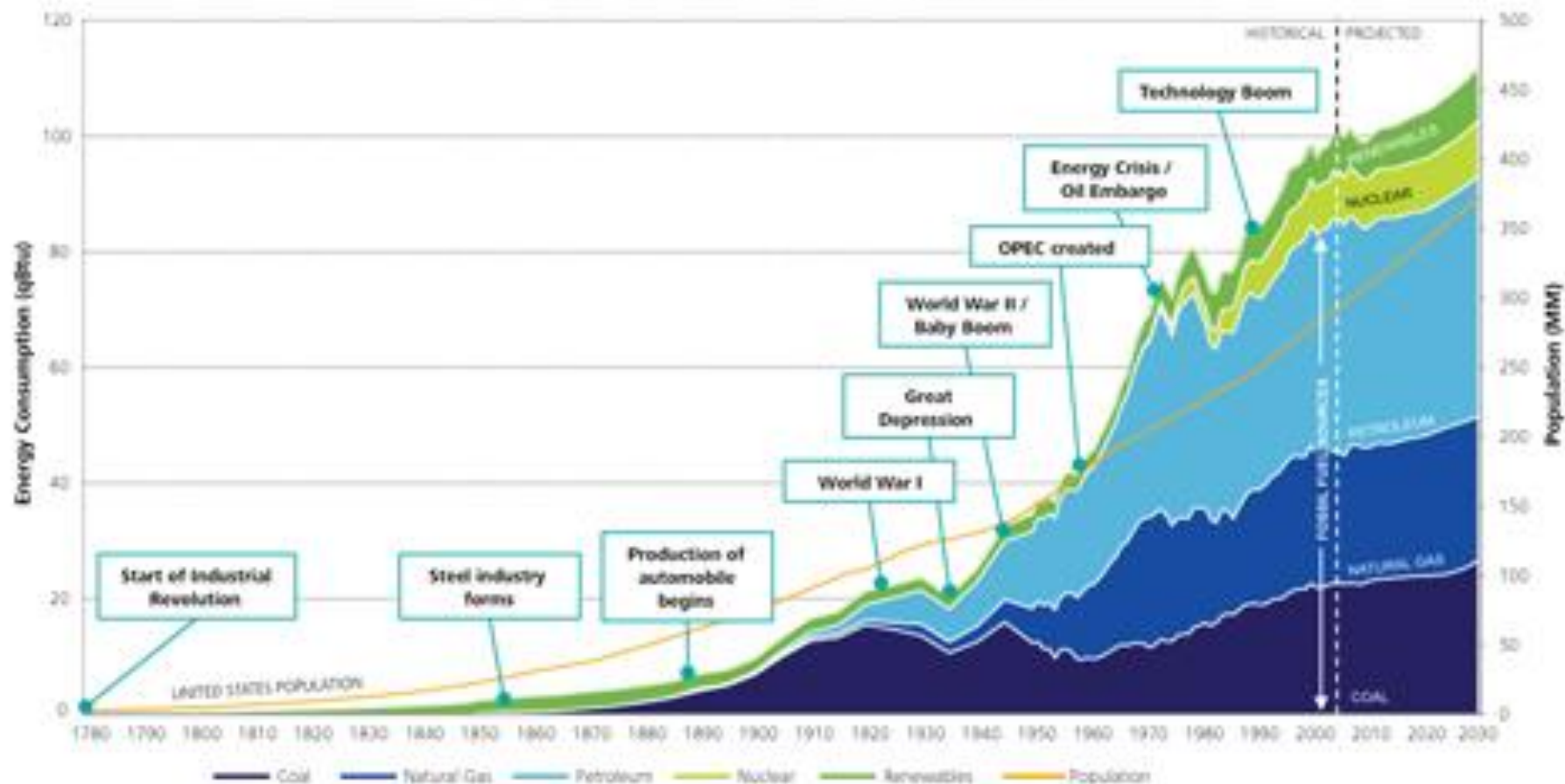


IPCC CO₂ EMISSIONS SCENARIOS, 1950-2050





How will we meet rising demand for energy?



U.S. demand for energy is expected to increase 14-28% from 2005 to 2030

Source: Energy Information Administration, Annual Energy Outlook (2008)

THE
FUTURE IS
NUCLEAR



THE
FUTURE IS
CLEAR



THE
FUTURE IS
UNCLEAR



17 iii 11
Peter Brooks

The future is renewable energy at all scales in both city, countryside, wilderness and sea





If the UK's average lifestyle were applied globally we would need 3 planets to sustain the current levels of resource consumption

How do we reduce our environmental impact whilst increasing our quality of life



ZED
Emissions Development
Zero (less)

1/3 Heating & Powering Homes

1/3 Food Miles From Farm to Plate

1/3 Transport, Car Use & Commuting



- ZED built homes are desirable & robust
- ZED Team can supply an EPC or Mortgage
- ZEP's are built with high specification to keep bills low
- Healthy, sunny, affordable housing
- Build with new materials rather than replace
- Nobody need ever build a business park again
- On yer bike !!!
- Car pools powered by the sun
- Nobody need ever build a housing estate again
- Lives, work and play on a ZED
- Most residents on ZED's have private outdoor space
- Helping to build the compact city
- Internet deliveries are made at ZED's
- Re-forging urban / rural links
- Promoting farm shops on ZED sites

Transport strategy

TRANSPORT

The green transport strategy is of paramount importance as we reduce our dependence on fossil fuels. The minimal on-site parking provision of both schemes is a welcome feature of both compliant and non compliant schemes that will make Zero Carbon Transport alternatives far more feasible to successfully implement.

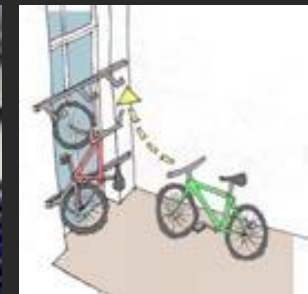
Private Vehicles:

Restricted to 1 parking spaces per dwelling, all of which will be offered half price vegetable oil conversions (on diesel vehicles only, paid for by developer) or electric vehicle charging point.

Green Transport Hub

The strategy revolves around a joint venture operated by 3 primary partners that could be replicated for other similar housing schemes. Two of them would be remote partners, one managing the Car Club and the other managing and maintaining the fleet and the Vegetable Oil supply.

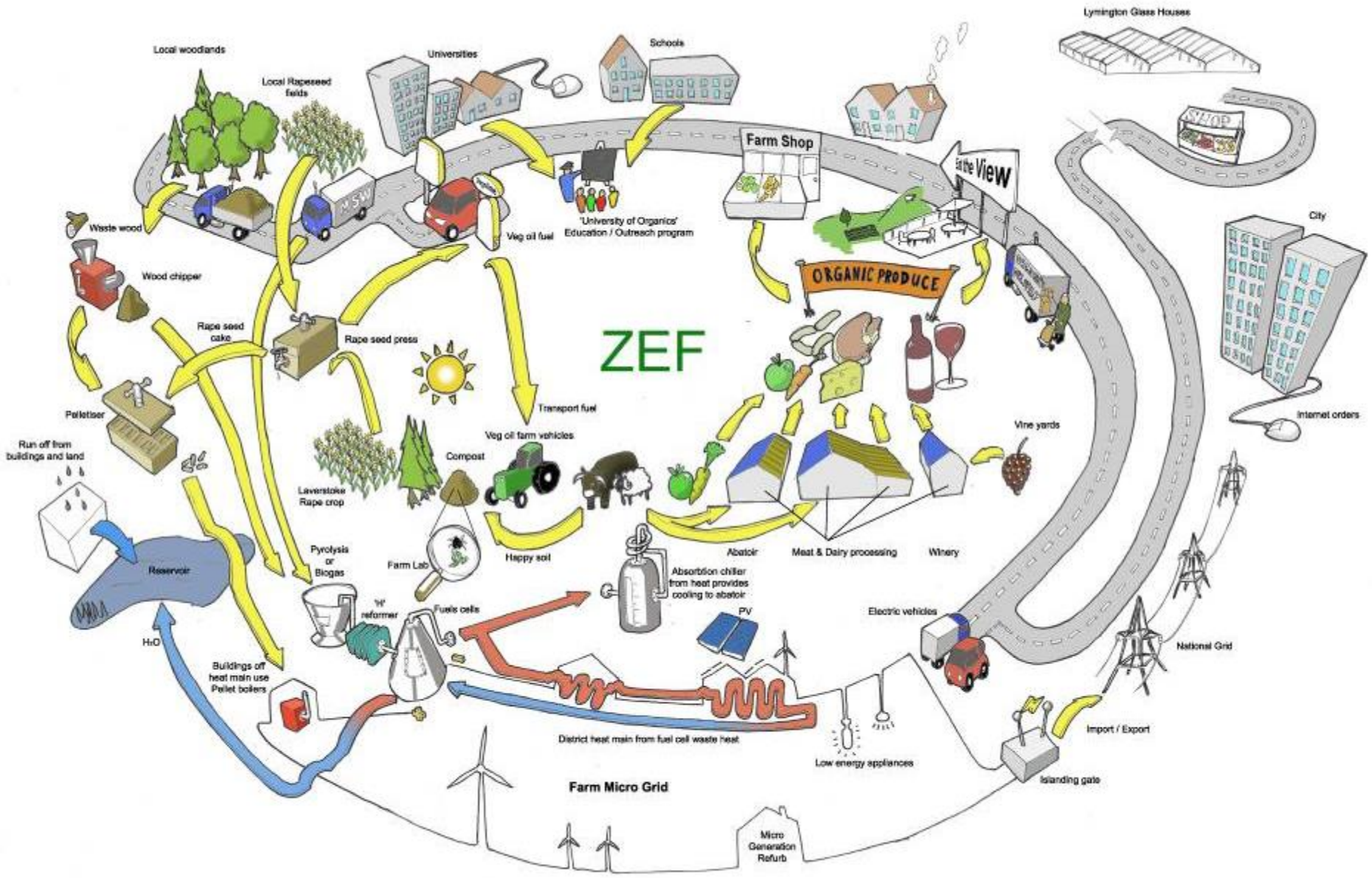
The third partner would act as the on site "Hub- shopfront"; part bike shop, part transport resource centre. They would manage the day to day running of the Hub, from cycle pool rentals and electric trike charging to filling the vegetable oil vehicles. They would also sell bikes and accessories and carry out cycle repairs and servicing. This would preferably work as a not-for-profit social enterprise and could also attract funding.

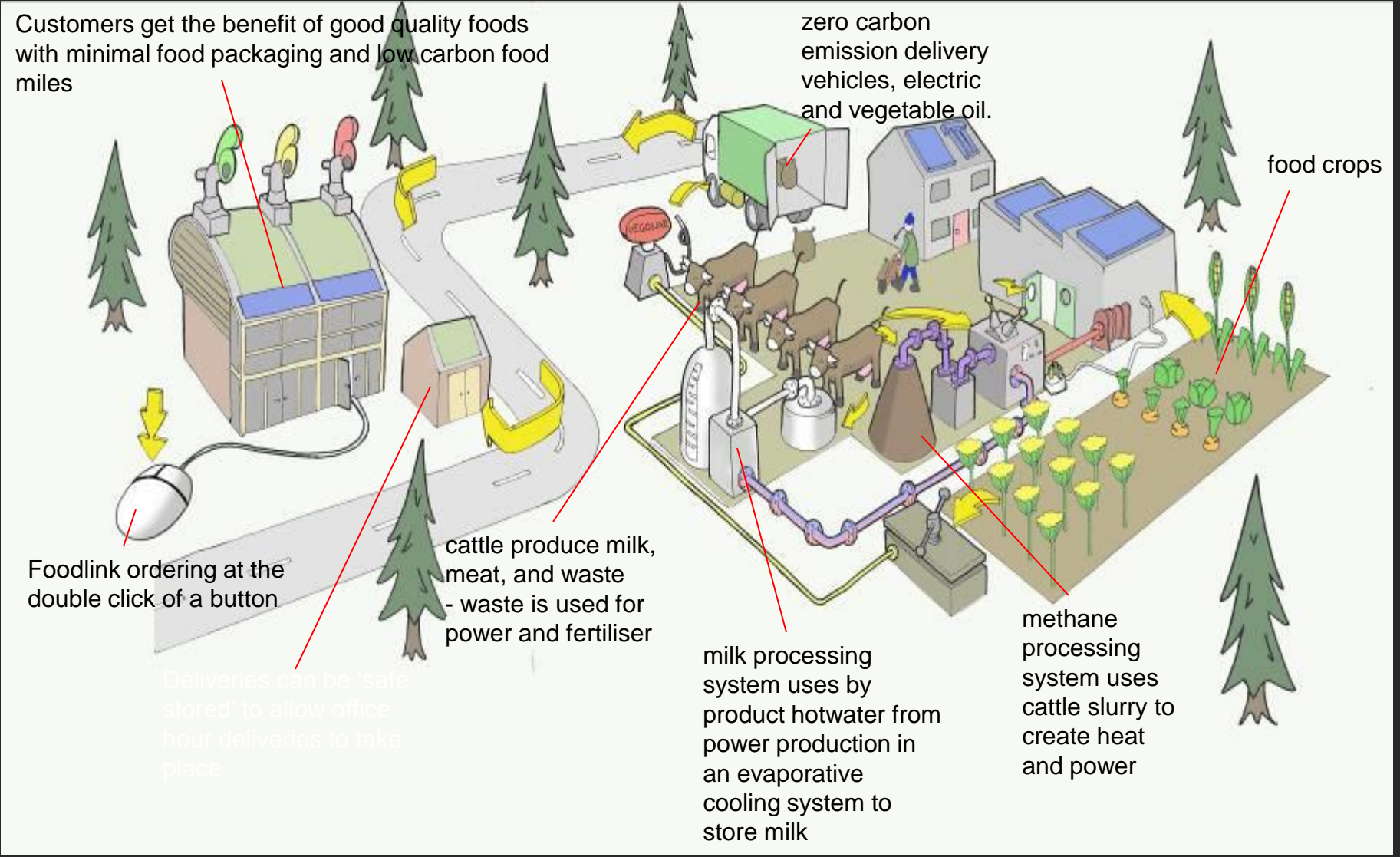


Partner	Roles	Funding
Vegetable Oil Car Club Co.	<ul style="list-style-type: none"> Provide vehicles Manage club remotely 	Funded by vehicle hire as per usual.
Vegetable Oil Co.	<ul style="list-style-type: none"> Convert Car Club Vehicles Source and Supply Oil (e.g from ZEF) 	Conversions funded partly by initial developers pledge. Maintenance contract with Car Club for the 3 vehicles. Extra private conversions and a % on oil supplies.
Bike Shop Co/ Transport Hub operator	<ul style="list-style-type: none"> Run shop-front (10-7) Manage cycle pool (bikes, electric bikes & trailers) Charging of electric bikes Fuelling car club cycles and private vehicles. 	Subsidised rent (from residents service charge or developer commitment for limited period?); Sales, repairs, rentals. Could operate as a not for profit Social Enterprise and attract funding.



Food strategy





Reducing the need for transport, commuting, and food miles



Bread in brown paper bags from Richmond farmers market - zero waste

The ZED scheme is designed to minimise waste from food packaging and also to minimise CO2 from transportation of food.

This includes the use of local markets, home delivery and the ZEF.



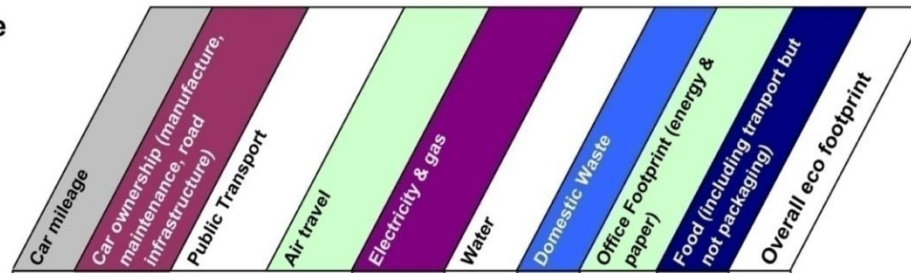
Zero emission cyclists buying zero packaging food

Fresh veg from Kingston market - zero waste





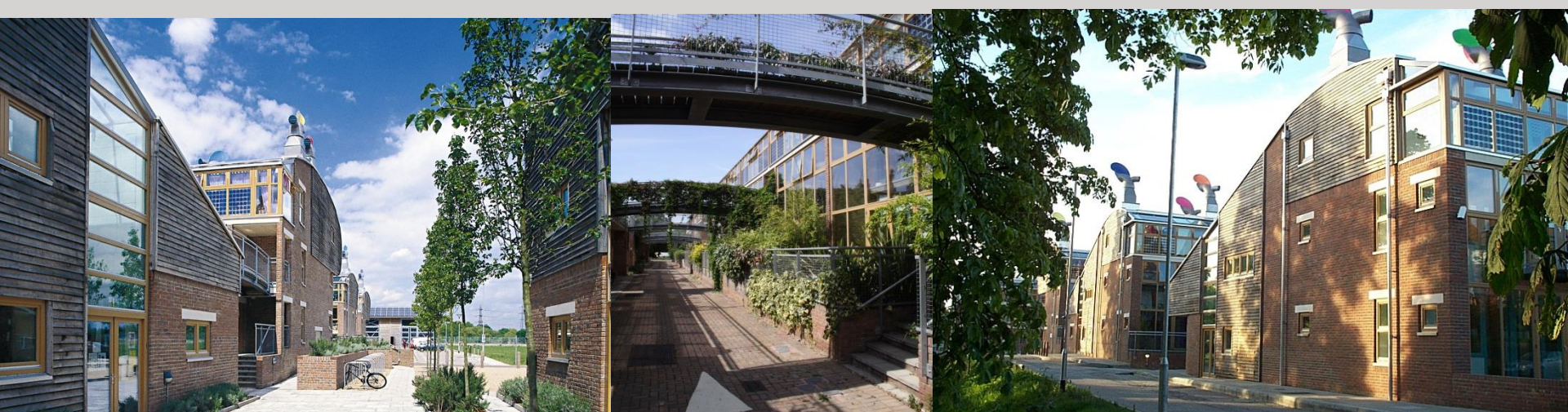
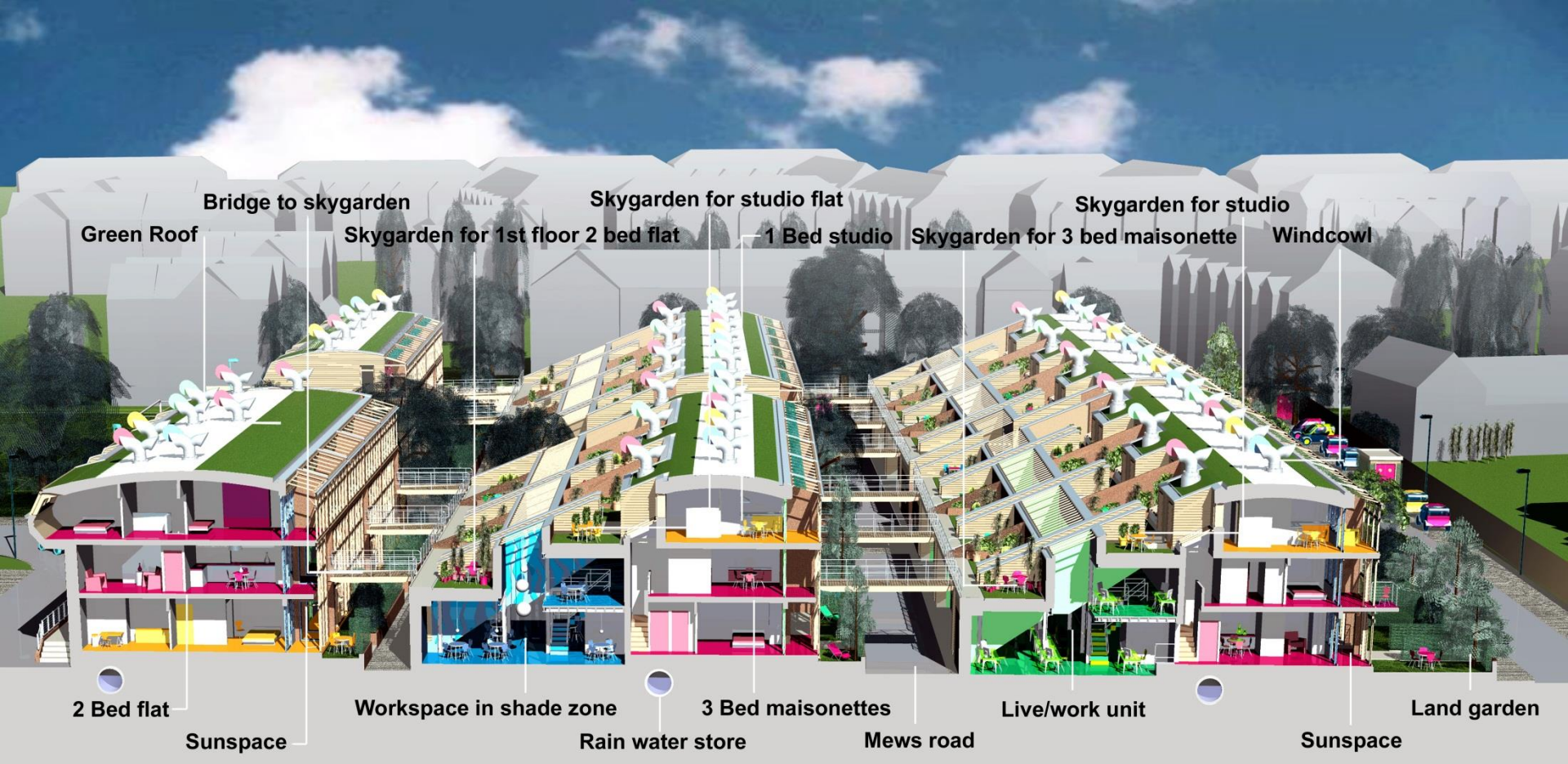
Ecological footprints for UK lifestyle in hectares per person



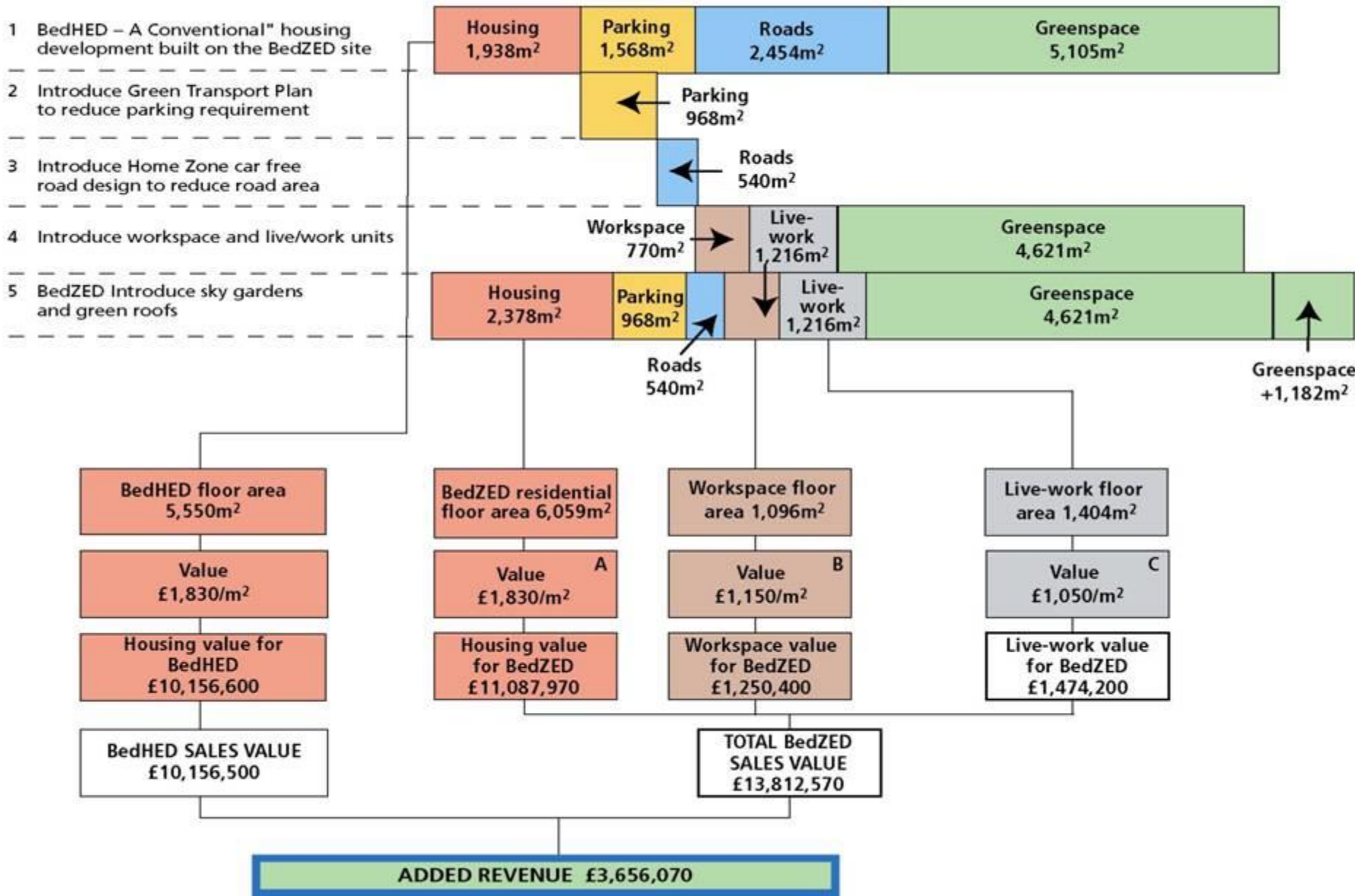
Based on a 4-person household

		Car mileage	Car ownership (manufacture, maintenance, road infrastructure)	Public Transport	Air travel	Electricity & Gas	Water	Domestic Waste	Office Footprint (energy & paper)	Food (including transport but not packaging)	Overall eco footprint		
Typical UK lifestyle	Owns car Holidays by plane every year Recycles 11% Eats out-of-season, highly packaged, imported food	0.90	0.41	0.00	0.30	0.45	0.002	1.70	0.80	1.63	6.19		
		10,000 km/yr				22,500 kWh electric & gas	140 litres/day		non renewable energy and virgin paper				
BedZED with conventional lifestyle	Owns car and commutes to work by public transport Holidays by plane every year Recycles 60% Moderate meat eater & some imported food	0.45	0.32	0.30	0.30	0.10	0.001	1.02	0.80	1.06	4.36		
		5,000 km/yr		4,000 km/yr		waste wood CHP including credit for landfill diversion	91 litres/day		non renewable energy and virgin paper				
BedZED ideal	Lives and works at BedZED Recycles office paper No car (member of ZEDcars club)	0.09	0.04	0.30	0.15	0.10	0.001	0.34	0.16	0.72	1.90		
	Holiday by plane every 2 years Recycles 80% at home Low meat diet with local fresh food	1,000 km/yr	20 people per club car	4,000 km/yr		waste wood CHP including credit for landfill diversion/wood CHP	91 litres/day		joins closed loop office paper scheme				
Global average											2.40		
Global available	Leaving 10% of bioproductive land for wildlife										1.90		

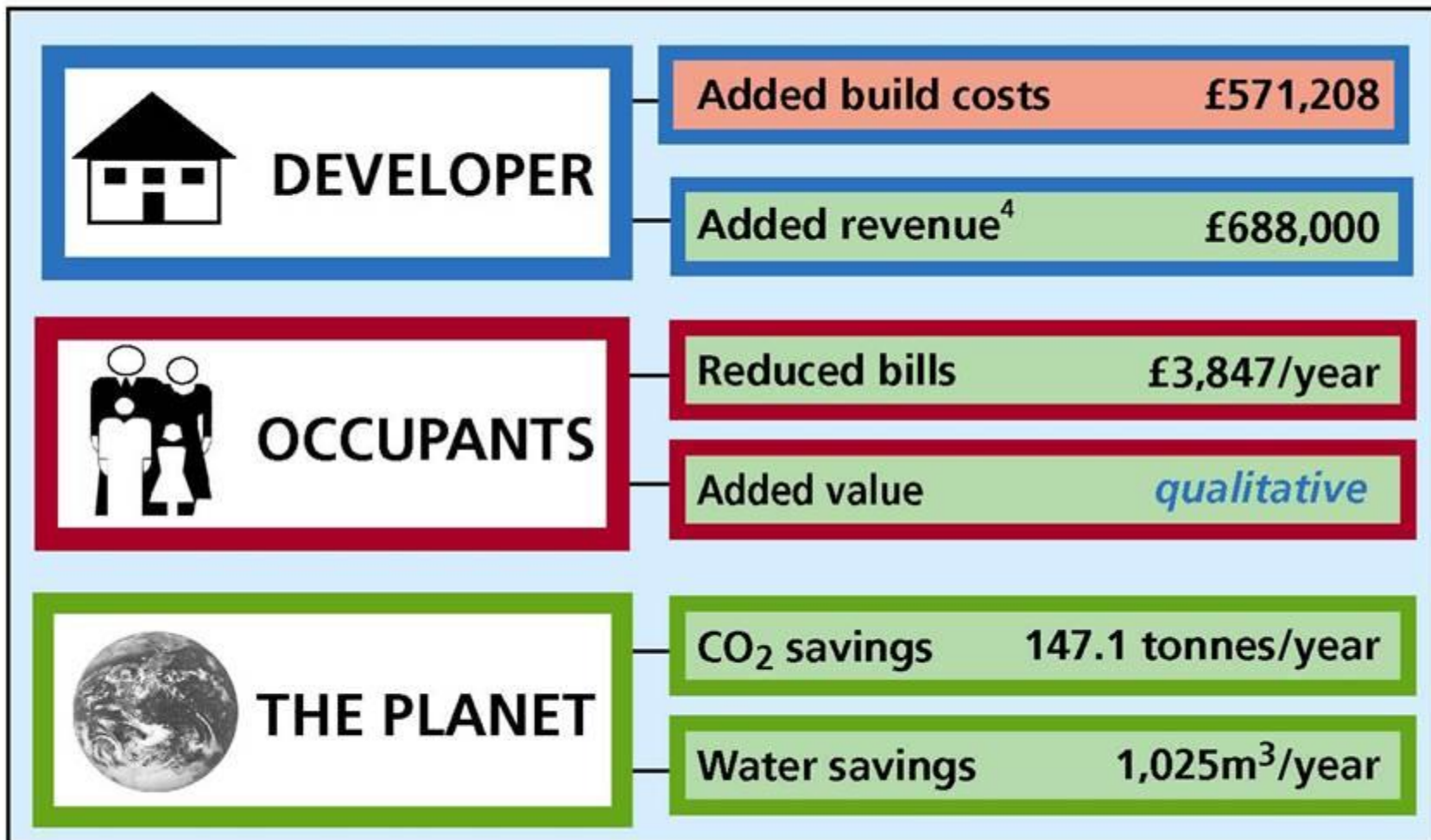
- what right do we have to consume more than our fair share of limited international resource ?



Planning Gain



Project Balance Sheet









copyright 2004

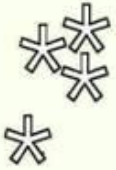
- case studies - BedZED



EXPOSED
THERMAL
MASS



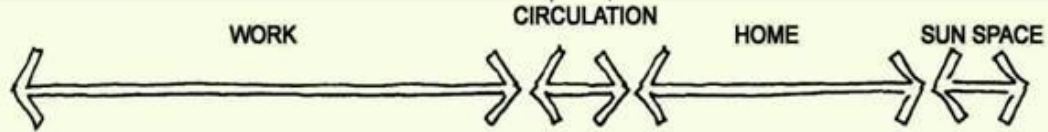
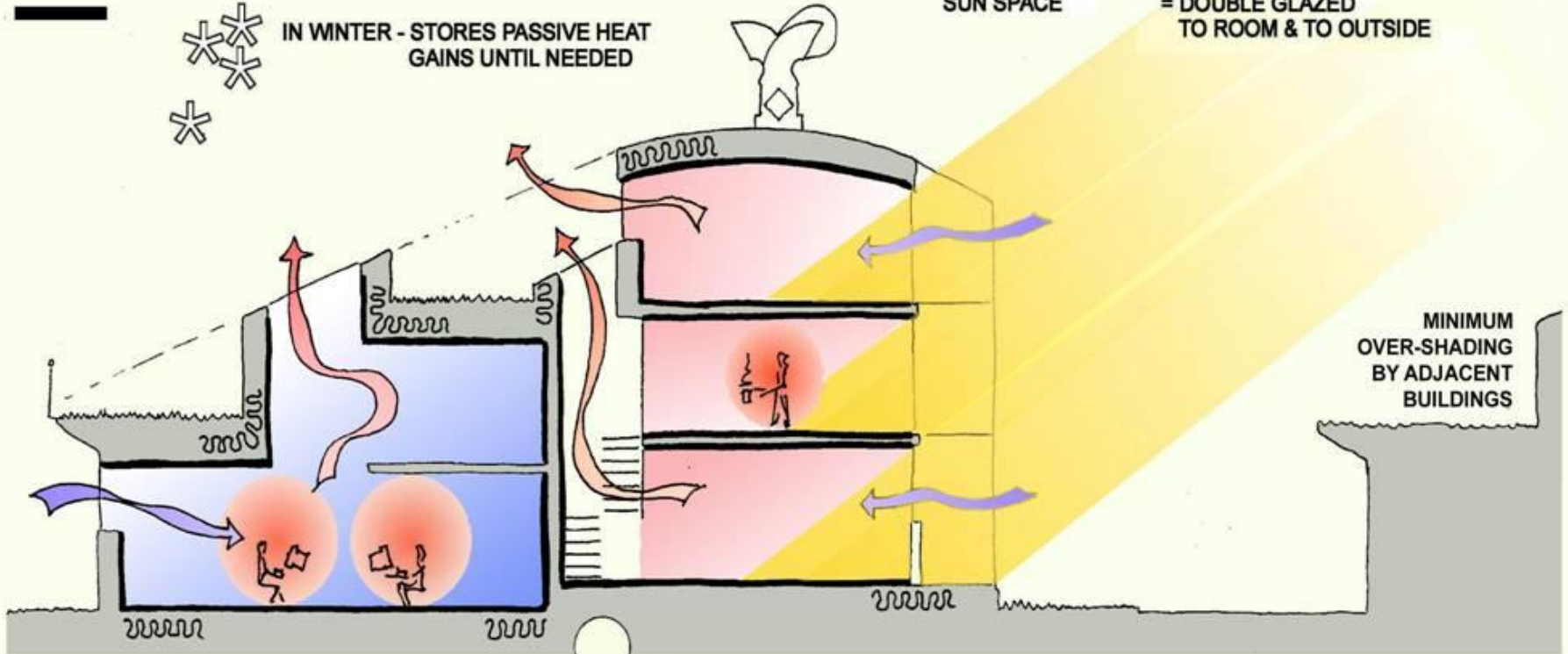
IN SUMMER - PRODUCES COOLING



IN WINTER - STORES PASSIVE HEAT
GAINS UNTIL NEEDED

HIGHLY INSULATED
WINDOWS
AIRTIGHTNESS
SUN SPACE

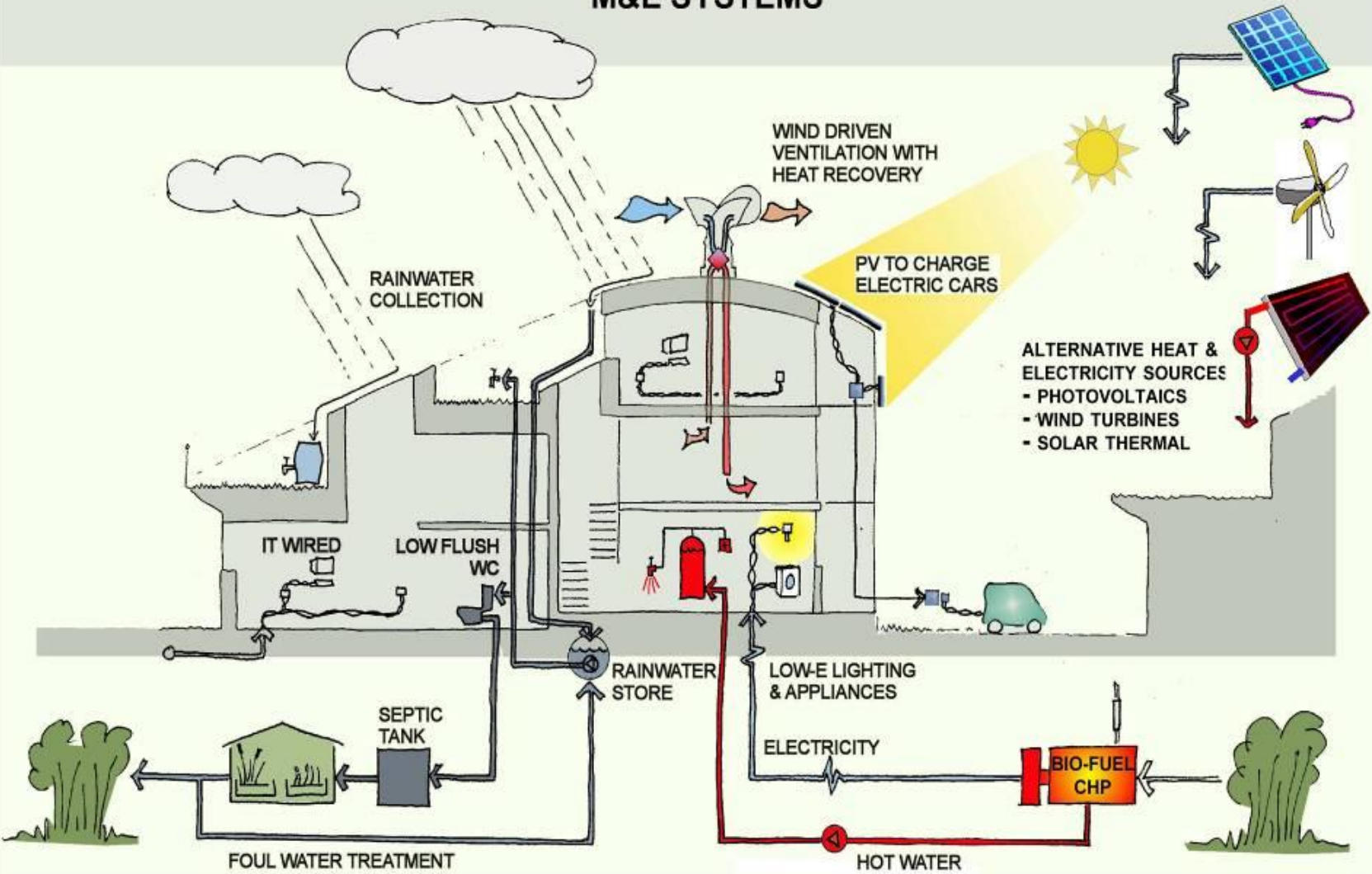
= $0.1 \text{ W/m}^2\text{k}$
= TRIPLE GLAZED
= 2 AC/HR @ 50Pa
= DOUBLE GLAZED
TO ROOM & TO OUTSIDE



NORTH FACING WINDOWS
GOOD DAYLIGHT
MINIMUM SOLAR HEAT GAIN

EXTENSIVE SOUTH FACING GIVING
GOOD, PASSIVE SOLAR HEAT GAIN
GLAZED BUFFER SUN SPACE.
MINIMUM NORTH GLAZING FOR
DAYLIGHT.

M&E SYSTEMS



Reclaimed materials



Reclaimed steel
-previously used for station work in Brighton



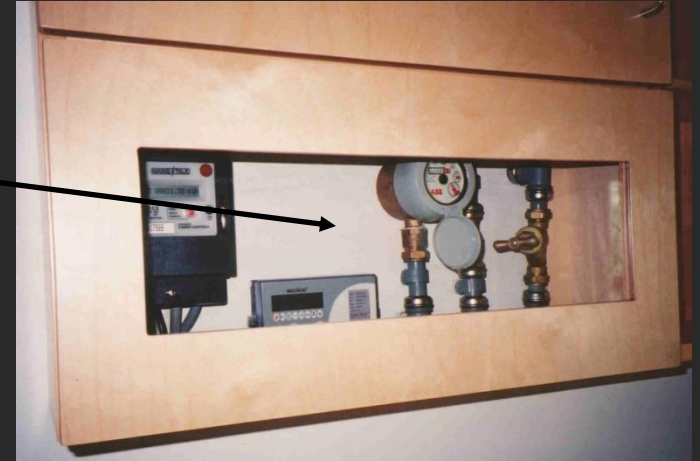
Can we set up on site prefabrication plants using reclaimed and local materials and labour ?

Reclaimed timber
-from local demolition site
-re-cut and used for internal stud work





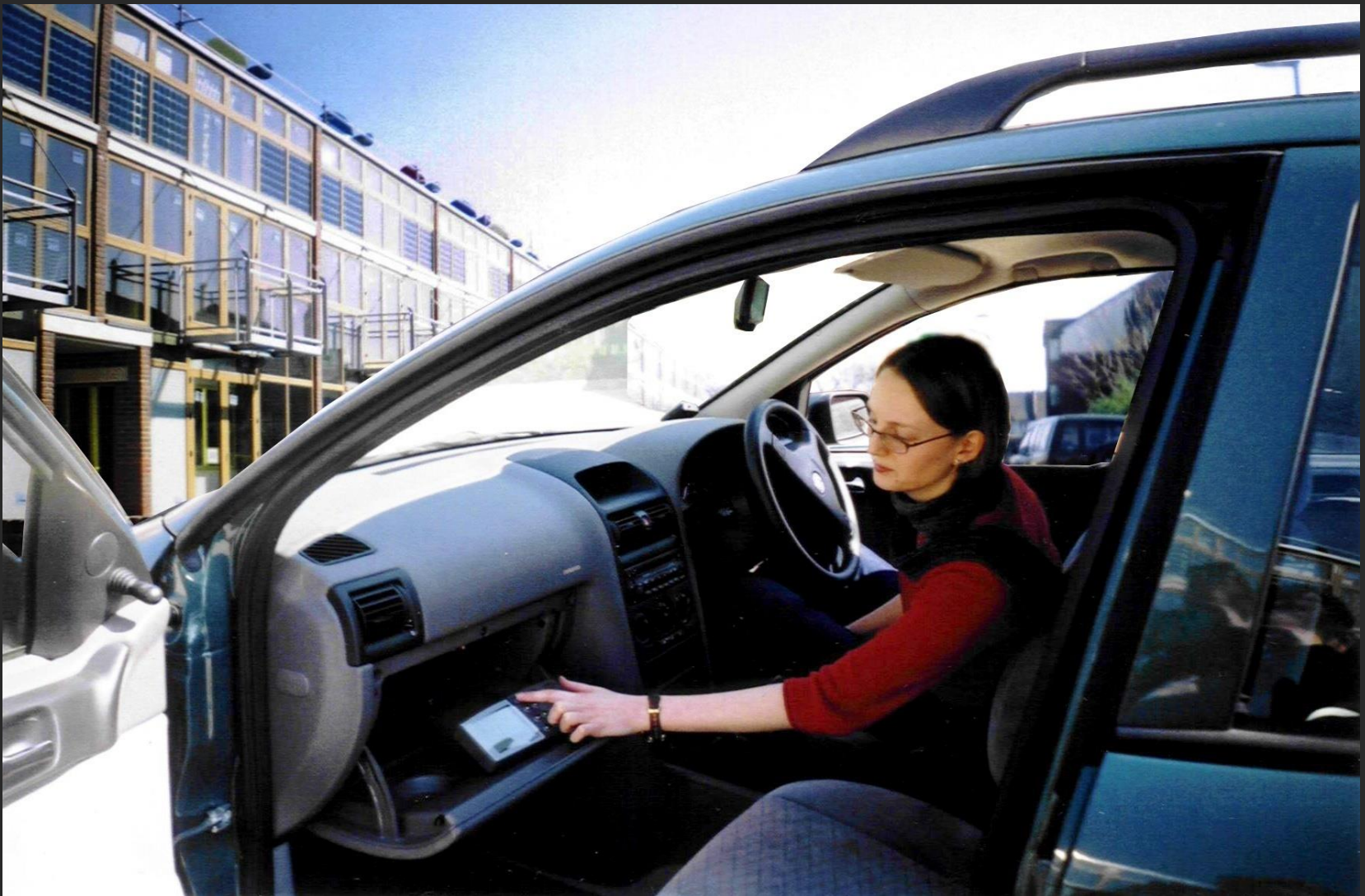
The maisonette kitchen



All energy and water meters



Waste segregation for recycling



Key to ZED strategies is giving residents the opportunity to give up the family car and its associated carbon emissions. ZED residents all have access to a pool of electric cars.

BioRegional

Bill Dunster architects

zerofactory

zero fossil energy developments

Key facts

Energy: 81% reduction in energy use for heating,
45% reduction in electricity use
(compared to local av.).

Transport: 64% reduction in car mileage 2,318km/year
(compared to national av.).

Water: 58% reduction in water use @ 72 litres/person/day
(compared to local av.)

Waste: 60% waste recycled.

Food: 86% of residents buy organic food.

Community: residents know 20 neighbours by name on average











FINAL CERTIFICATE

(Issued at the Post Construction Stage)

ISSUED TO:
19 Mill Pond Drive,
Upton,
Northampton,
Northants NN5 4EW

The sustainability of this home has been independently assessed at the Post Construction Stage and has achieved a Code Rating of 6 out of 6 stars under the April 2007 version



Above
Regulatory
Standards

Current
Best
Practice

Highly
Sustainable
and Zero Carbon

The next page sets out how this home achieved its rating in the nine categories.

Licensed Assessor: **Simon Roberts** | Assessor Organisation: **ARUP**

Client: **Mansell Construction Services Limited** | Developer: **Metropolitan Housing Partnership**

Architect: **Bill Dunster Architects ZEDFactory Ltd** | Certificate Number: **BRE-A-CSH-SR05-1-0002**

Date: **14th May 2009** | Signed for and on behalf of BRE Global Ltd



This certificate remains the property of BRE Global Ltd and is issued subject to terms and conditions. Copies can be made for the purposes of the Home Information Packs. It is produced from data supplied by the licensed Code assessor (a 'certified' competent person under Scheme Document SD123). To check the authenticity of this certificate, please contact BRE Global Ltd.



FINAL CERTIFICATE

(Issued at the Post Construction Stage)

Certificate Number: BRE-A-CSH-SR05-1-0002

Score: 91

What Your Code Star Rating Means

Combined Score Stars	36-47	48-56	57-67	68-83	84-89	90-100
	1	2	3	4	5	6

The Code for Sustainable Homes considers the effects on the environment caused by the development and occupation of a home. To achieve a star rating a home must perform better than a new home built to minimum legal standards, and much better than an average existing home.

How this home scored

Category	Percentage of Category Score attained	What is covered in the category
Energy	100	Energy efficiency and CO ₂ saving measures
Water	100	Internal and external water saving measures
Materials	87	The sourcing and environmental impact of materials used to build the home
Surface Water Run-off	100	Measures to reduce the risk of flooding and surface water run-off, which can pollute rivers
Waste	100	Storage for recyclable waste and compost, and care taken to reduce, reuse and recycle construction materials
Pollution	25	The use of insulation materials and heating systems that do not add to global warming
Health & Wellbeing	100	Provision of good daylight quality, sound insulation, private space, accessibility and adaptability
Management	100	A Home User Guide, designing in security, and reducing the impact of construction
Ecology	55	Protection and enhancement of the ecology of the area and efficient use of building land

Further detailed information regarding The Code for Sustainable Homes can be found at www.communities.gov.uk/sustainable



The CO₂ rating is a measure of a home's Carbon Dioxide (CO₂) emissions. This rating is shown on your Energy Performance Certificate as the Environmental Impact Rating. This Certificate is available from the seller, and also includes information on how you can improve the home's performance.

The Code measures the sustainability of a home as a complete package, and takes into account other aspects of energy use as well as wider sustainability issues, such as water and waste.

The CO₂ Environmental Impact Rating is shown here for information only and does not form part of The Code for Sustainable Homes. Neither BRE Global nor the assessment organisation is responsible for the accuracy of this number.

This certificate remains the property of BRE Global Ltd and is issued subject to terms and conditions. It is produced from data supplied by the licensed Code assessor (a 'certified' competent person under Scheme Document SD123). To check the authenticity of this certificate, please contact BRE Global Ltd.

EPC Number: 9153-2850-6429-0598-8101





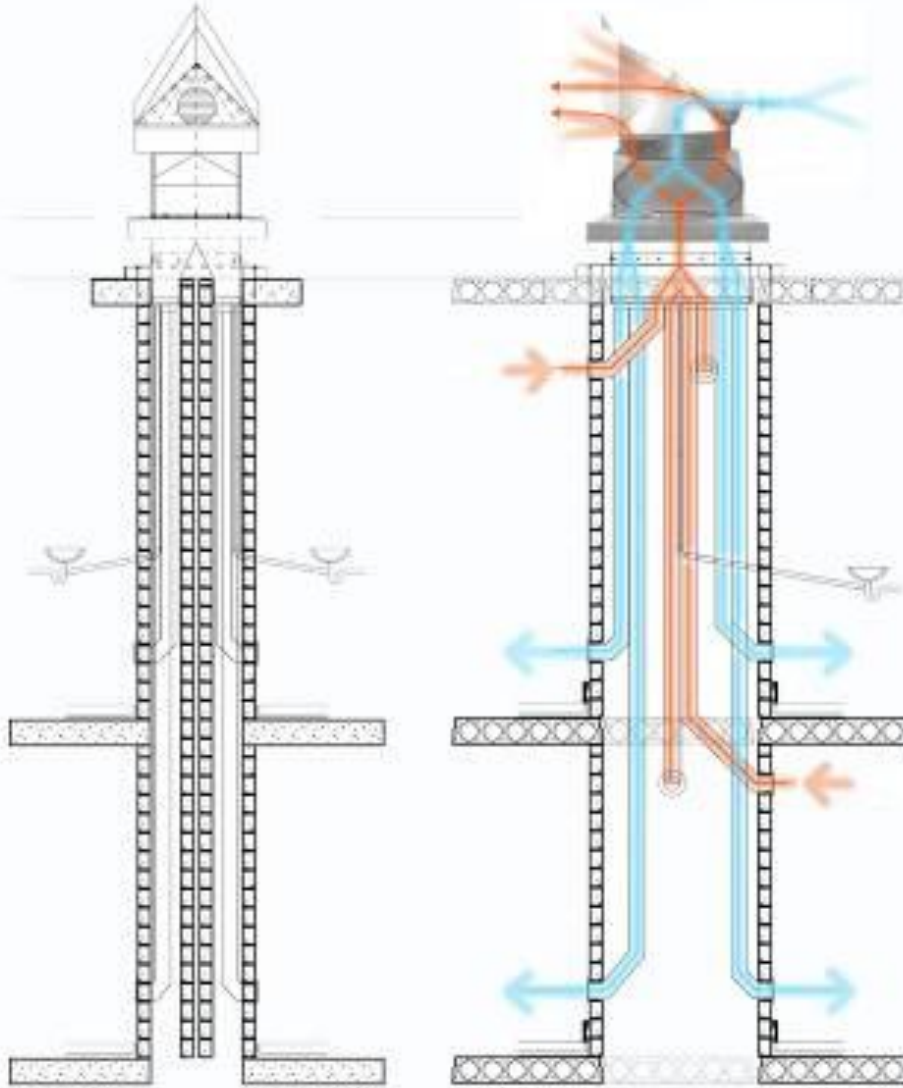
The dry assembly ruralZED 조립형 주택키트- 적층 목재를 사용한 골재와 thermally mass 여름에는 시원하고 겨울에는 따뜻함을 유지.



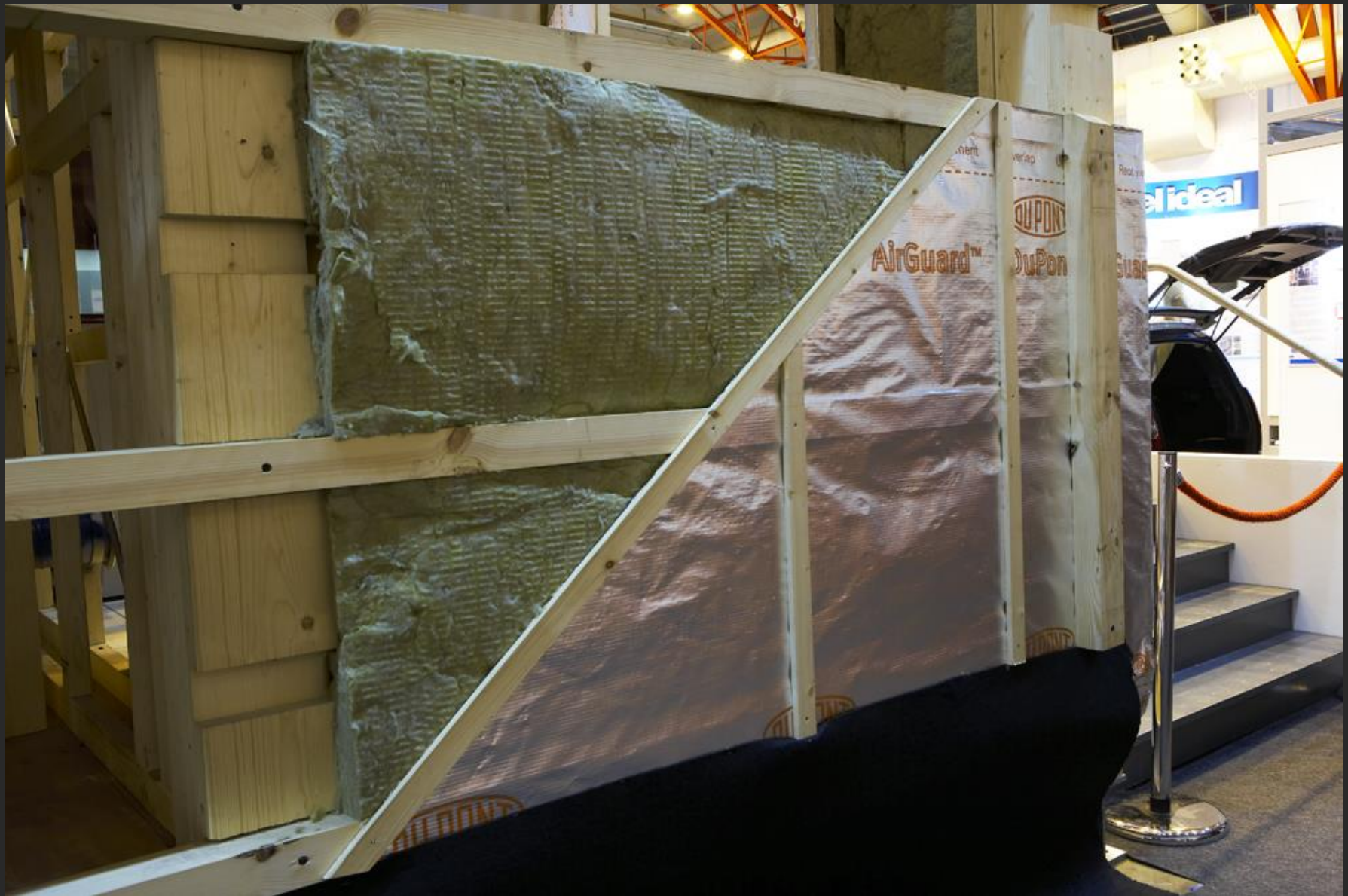




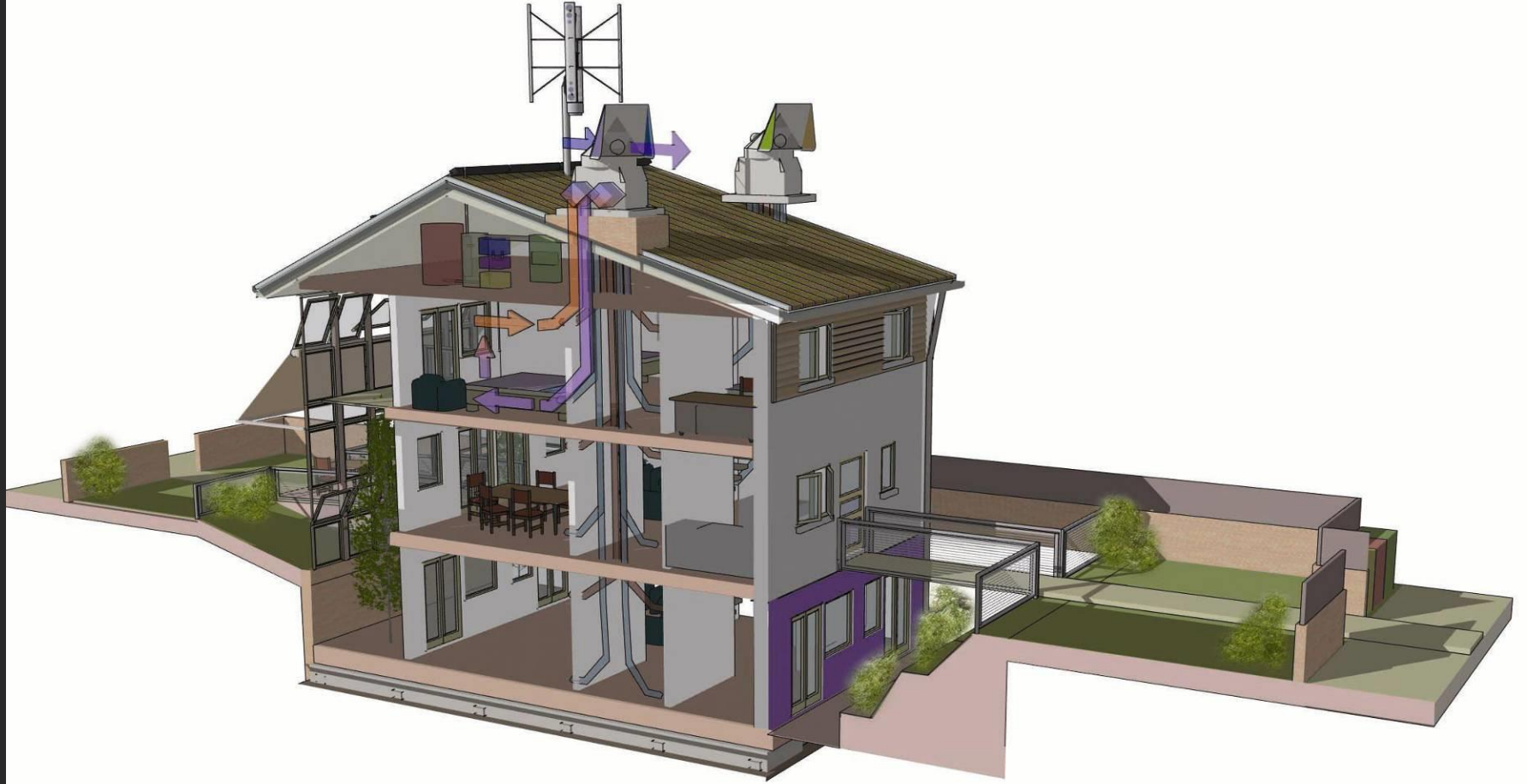
ruralZED™ - using ruralZED™ as an example – cool vault







ruralZED™ - using ruralZED™ as an example – airtight construction











The ZEDspec becomes affordable with economies of scale

- it is only more expensive today because of low throughput through the supply chain

Annual new build homes in UK / year - average 162,000 @ average density 26 homes / ha
requiring 6,230 ha of land

Gov sustainable communities programme calls for 20,000 extra / homes / year

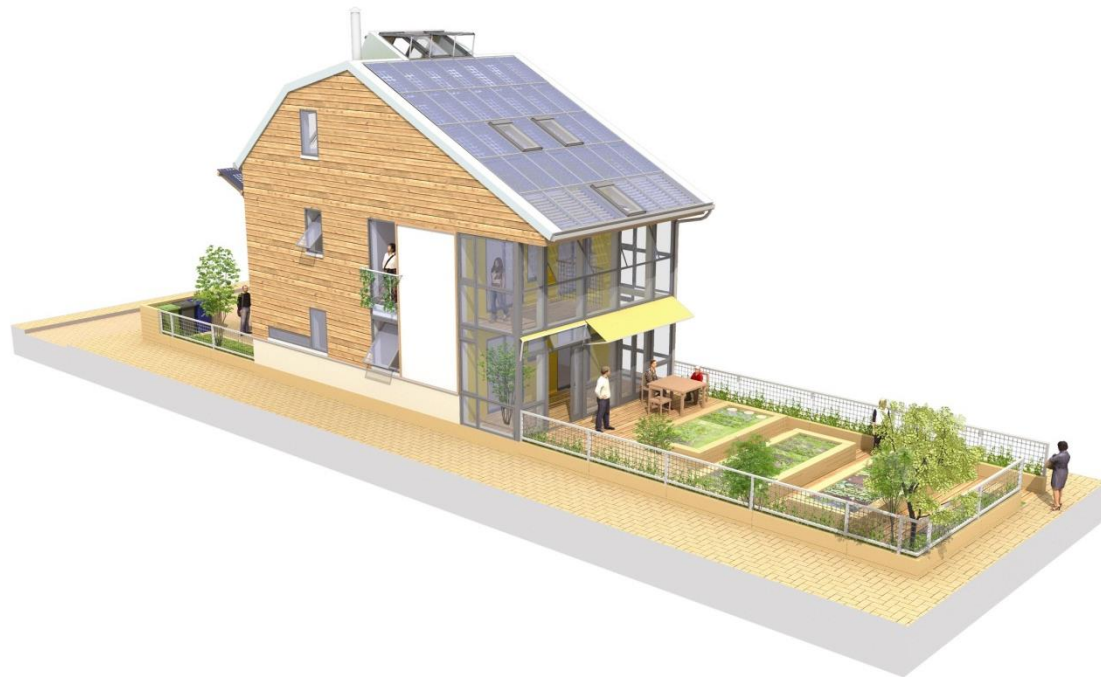
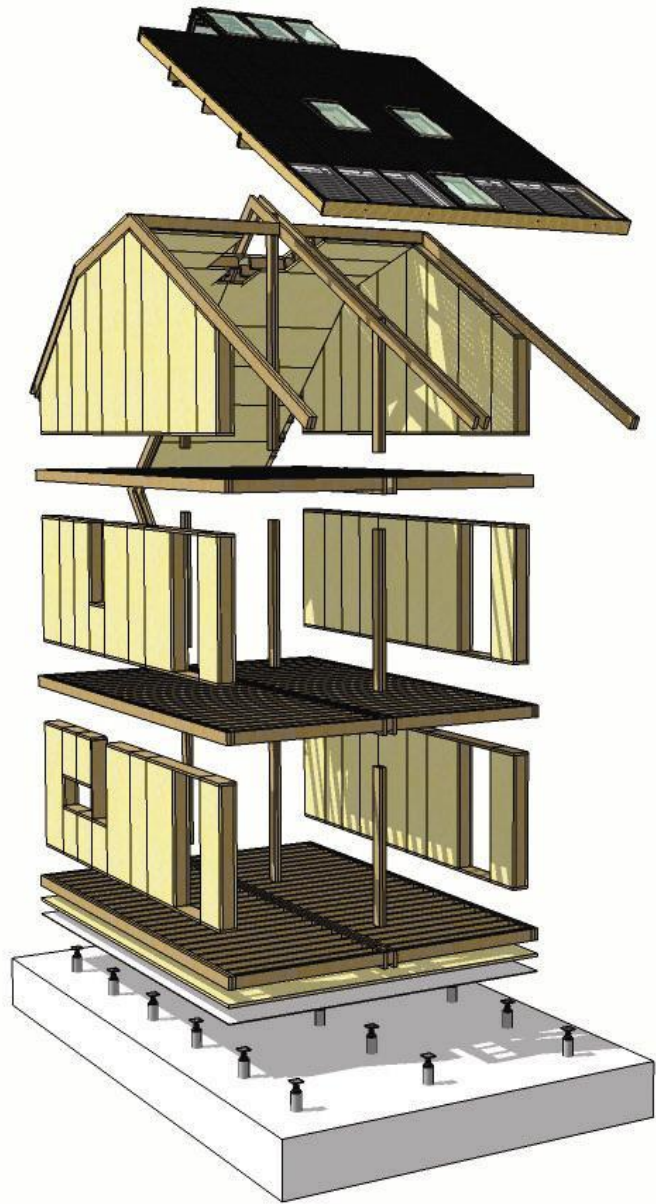
100 units / year ZEDspec = 30 % above building regs
minimum

1000 units / year ZEDspec = 15 % above building regs
minimum

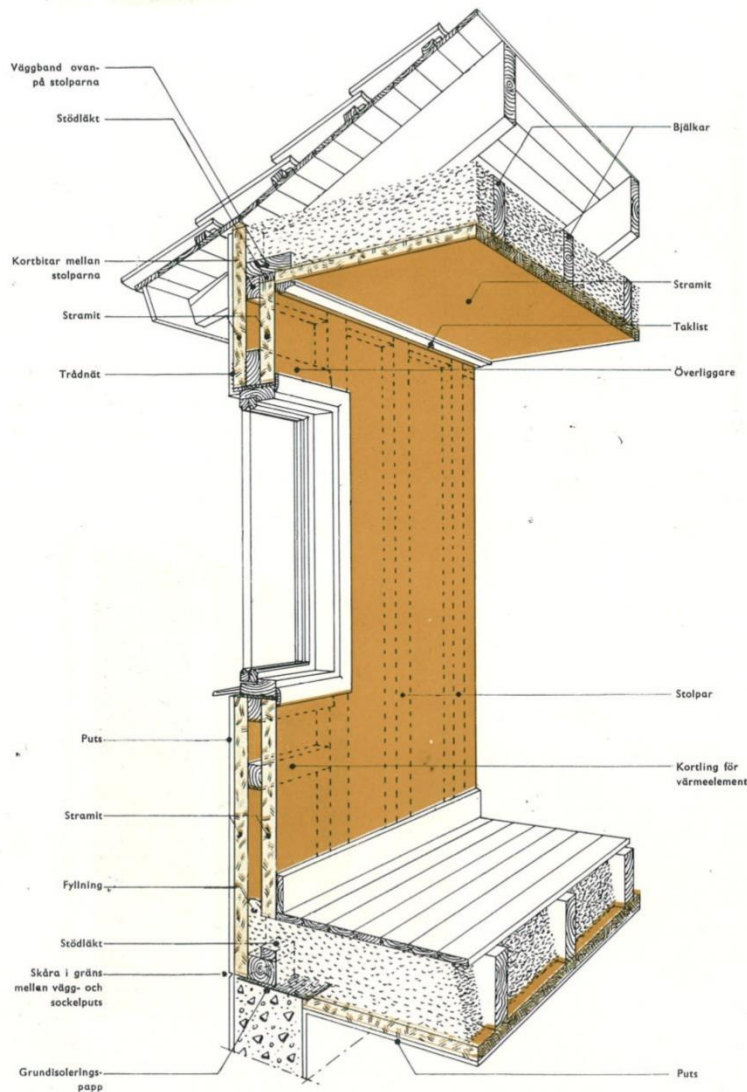
5000 units / year ZEDspec = same price as
building regs minimum

We only need 3% of the UK new homes to be built to the ZEDspec to be cost neutral
with current building regs minimum specification @ average density of 80 homes / ha

If all 162,000 homes were built to ZED spec at ZEDdensities only 2025 ha required, saving two
thirds of the increase in urban sprawl, and still providing every home with a garden



Detalj av väggsektion



Stramit compressed strawboard homes have been built in Sweden for the past 70 years

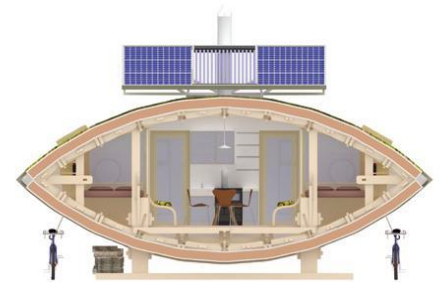
- High resale value
- Low cost
- Low environmental impact construction

All you need is a rubber mallet, a tape measure, screwdrivers, a powerdrive drill, and enough peace to read the manual. If you can build a flat pack sofa, you can probably master your own rural escape pod.



.....LandARK meets your needs.

- Works well as a home or an office
- Sleeps up to 8 people as a shorter stay cabin
- Is cosy in winter and cool in summer
- Is made from healthy natural materials such as FSC timber, superinsulation and draughtproofing
- Perches on the land without needing expensive foundations or concrete
- Runs off logs in winter or uses the summer sun to provide a hot shower
- Is powered from sunlight for most of the year, or mid winter wind
- Doesn't need a connection to the drains or the meter unless you do
- Includes water tanks with options to connect to a standpipe
- Blends into the landscape with weatherboarding and a sedum roof
- Will last many generations if it is loved



Zero carbon holiday resort

the zedfactory ltd[®]

www.zedfactory.com and www.zedstandards.com



Sea level rise – London

Central Estimate

2050

+ 22 cm



2080

+ 36 cm

Worst Case

High++ scenario:

2100

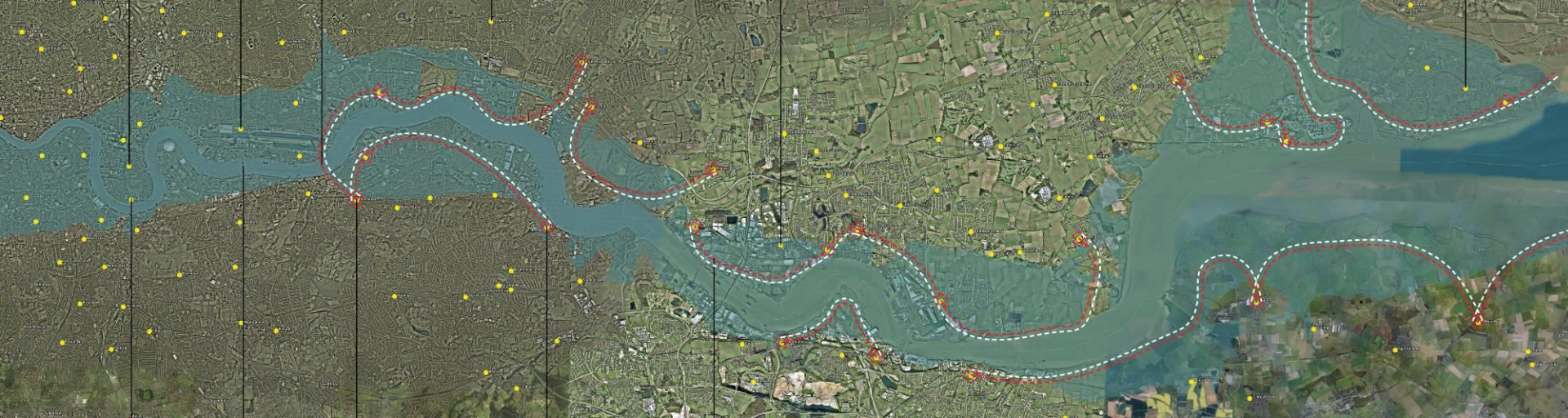
Rises up to 1.9 m





line of defence

protected area













Earth centre



Gary Jackson, Isywood project manager

As project manager for Isywood, Jackson is responsible for the design and build aspects of the 100,000-sq-ft facility at the University of North Carolina. He has worked on-site, the contractor had completed the building of the apartment and construction of a new building addition. The fact is, as responsible for the construction of the building, Jackson is not a member of the design team. He is responsible for the construction of the building and the building's structure, but not for the design of the building.

When Jackson first saw the design, he was not a member of the design team. He was responsible for the construction of the building and the building's structure, but not for the design of the building. He was responsible for the construction of the building and the building's structure, but not for the design of the building.



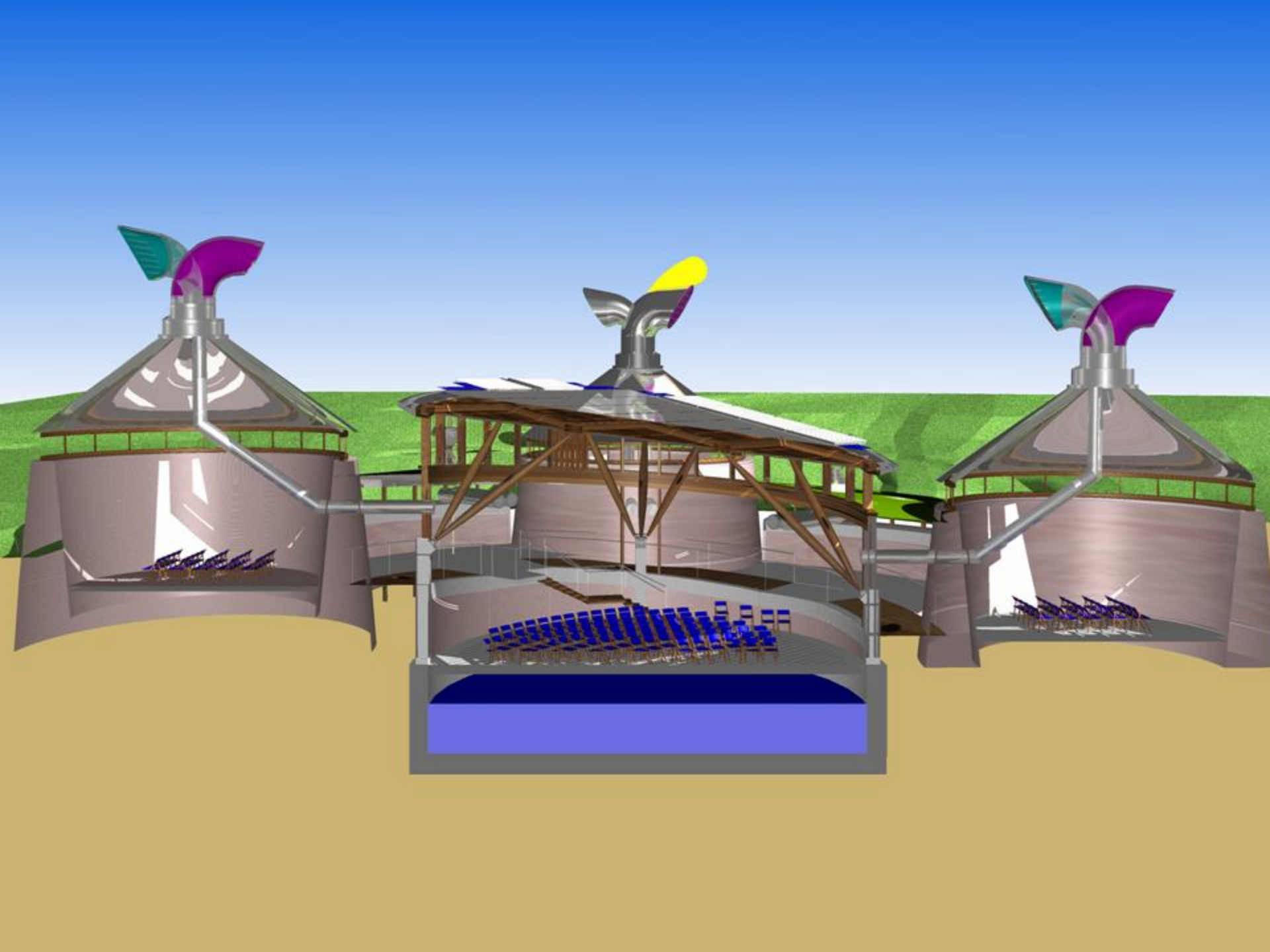
Big-tilt cast-in-place concrete forms allowed them to build the building's unique structure. These materials are shown on-site ready to be recycled.

When Jackson first saw the design, he was not a member of the design team. He was responsible for the construction of the building and the building's structure, but not for the design of the building. He was responsible for the construction of the building and the building's structure, but not for the design of the building.

When Jackson first saw the design, he was not a member of the design team. He was responsible for the construction of the building and the building's structure, but not for the design of the building. He was responsible for the construction of the building and the building's structure, but not for the design of the building.

These buildings are
rubbish









HininZED

A joint venture between the ZEDfactory and Hinin Solar

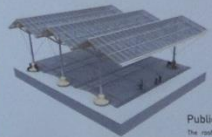
The ZEDroof has a variety of different applications...



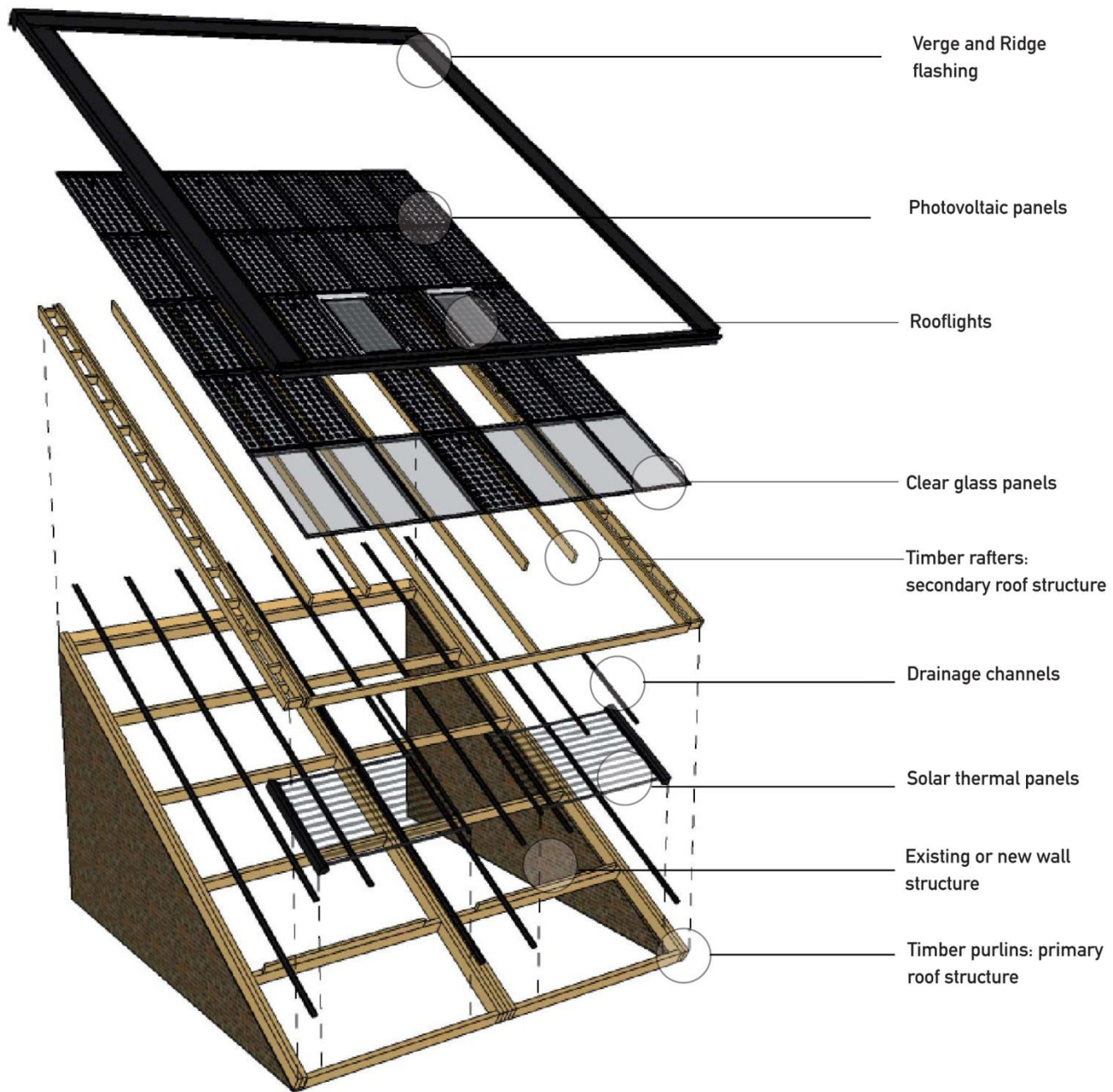
New build
Create a sustainable shared community at the top of a residential building

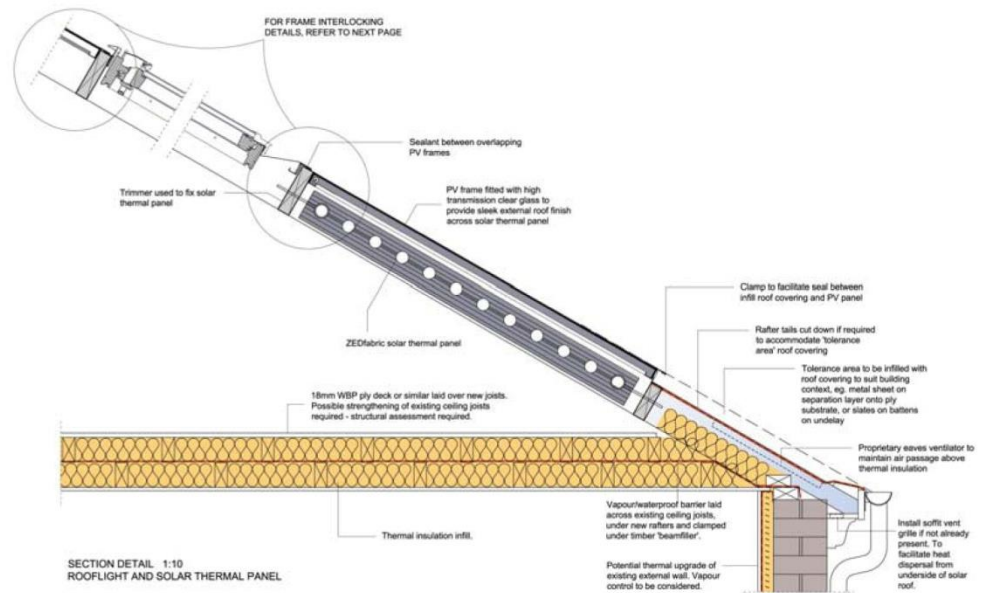
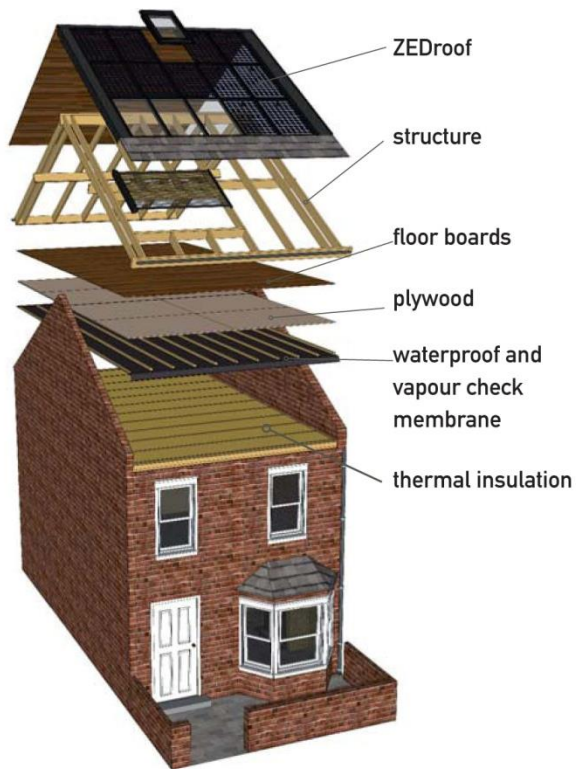


Retrofit
Generate over 100% of annual electricity needs and around 60% of annual hot water requirements

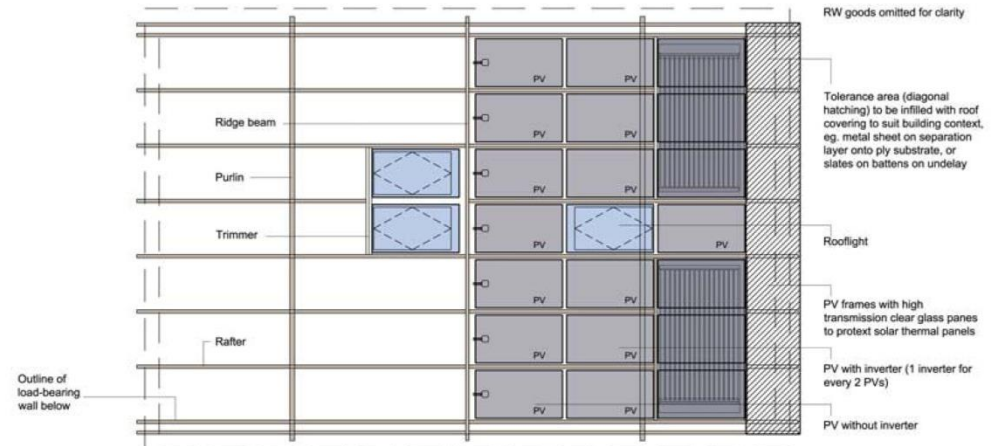


Public spaces
The roof panels are best retaining until can be installed on any roof with a pitch steeper than 15 degrees





Plan of a ZEDroof refurbishment of a victorian house



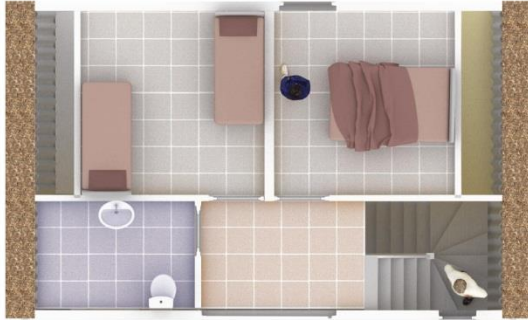


Solar carport

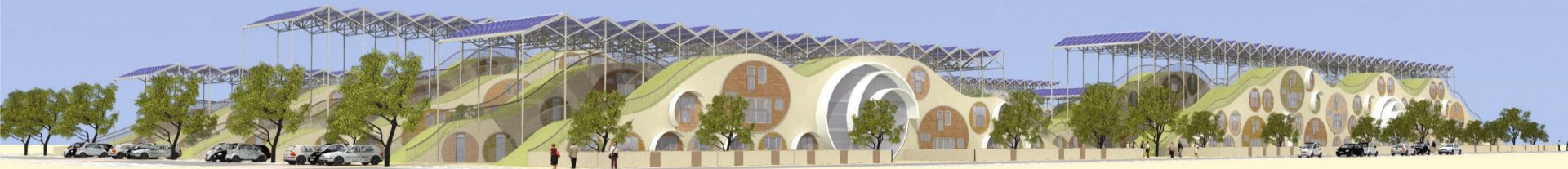


Solar bikeport







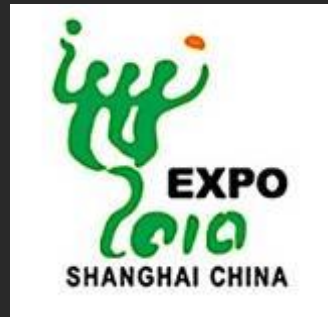




ZEDfactory

Urban Best Practice Demonstration Area
Shanghai EXPO exhibition

- permanent and replicable ZED pavilion

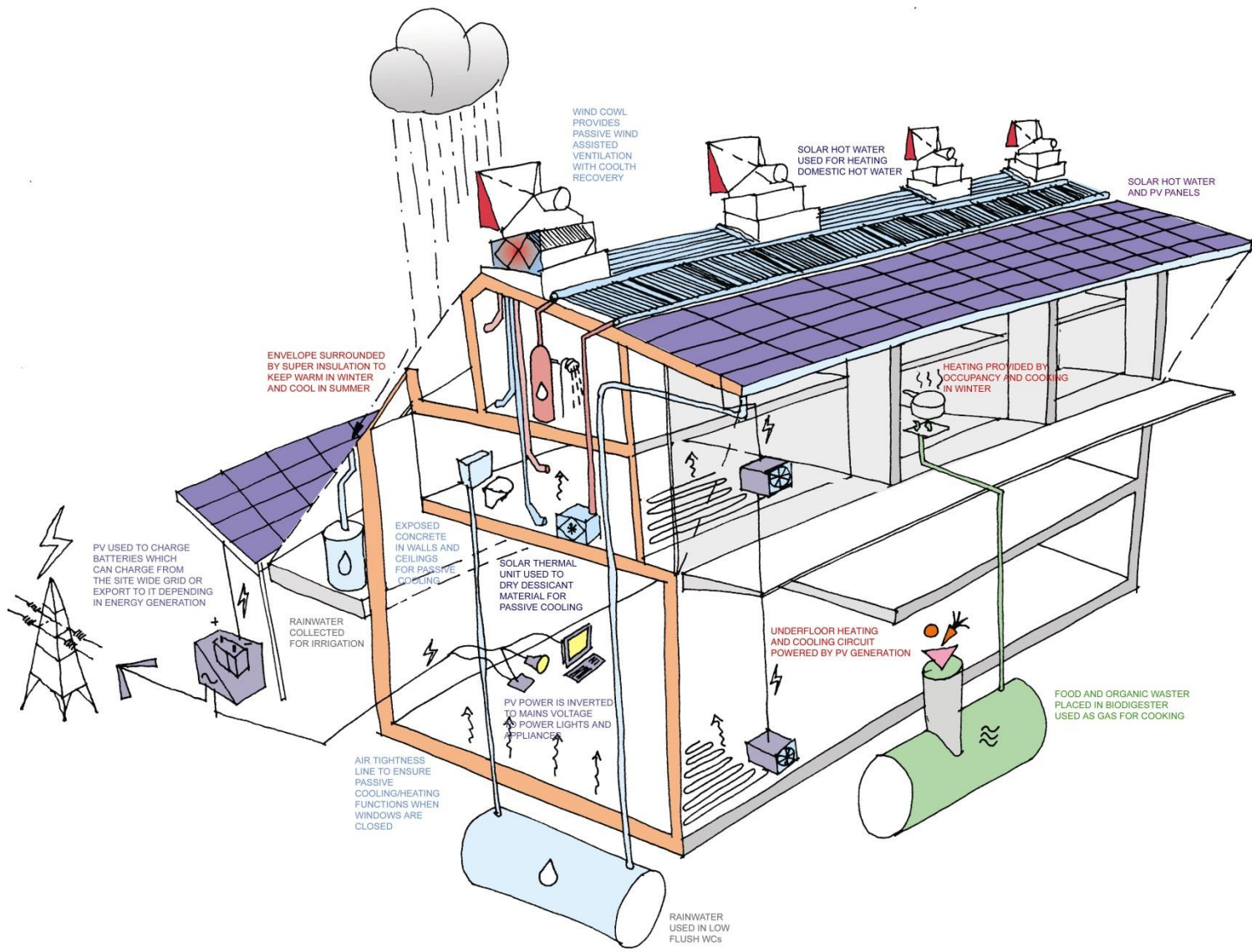
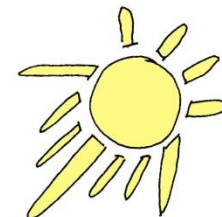




SHANGHAI EXPO- ZEDPAVILLION LOW DENSITY







WIND COWL PROVIDES PASSIVE WIND ASSISTED VENTILATION WITH COOLTH RECOVERY

SOLAR HOT WATER USED FOR HEATING DOMESTIC HOT WATER

SOLAR HOT WATER AND PV PANELS

SUMMER SUN SHADED WARMING WINTER SUN USED FOR PASSIVE HEATING

ENVELOPE SURROUNDED BY SUPER INSULATION TO KEEP WARM IN WINTER AND COOL IN SUMMER

HEATING PROVIDED BY OCCUPANCY AND COOKING IN WINTER

PV USED TO CHARGE BATTERIES WHICH CAN CHARGE FROM THE SITE WIDE GRID OR EXPORT TO IT DEPENDING IN ENERGY GENERATION

RAINWATER COLLECTED FOR IRRIGATION

EXPOSED CONCRETE IN WALLS AND CEILINGS FOR PASSIVE COOLING

SOLAR THERMAL UNIT USED TO DRY DESSICANT MATERIAL FOR PASSIVE COOLING

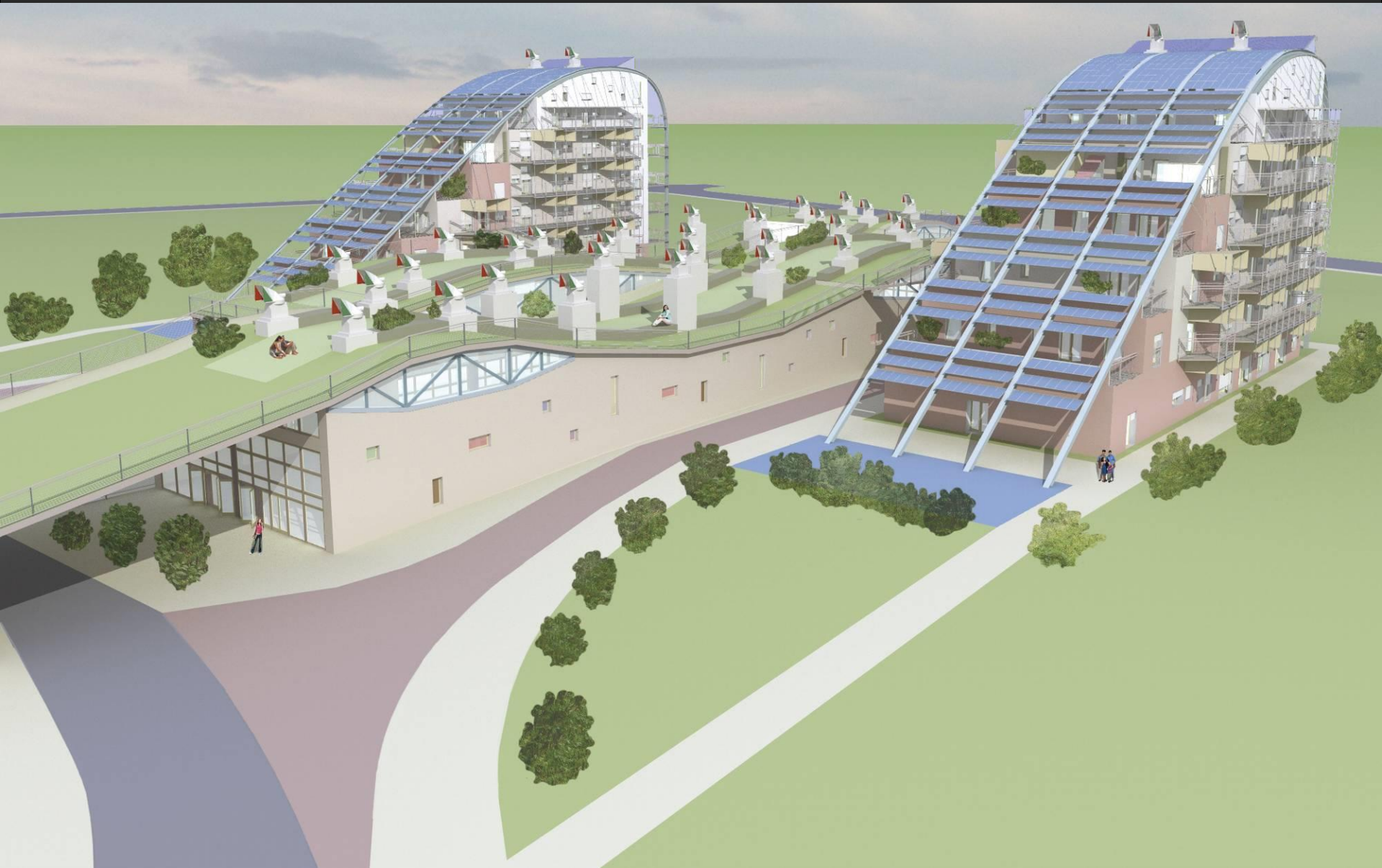
UNDERFLOOR HEATING AND COOLING CIRCUIT POWERED BY PV GENERATION

PV POWER IS INVERTED TO MAINS VOLTAGE TO POWER LIGHTS AND APPLIANCES

FOOD AND ORGANIC WASTER PLACED IN BIODIGESTER USED AS GAS FOR COOKING

AIR TIGHTNESS LINE TO ENSURE PASSIVE COOLING/HEATING FUNCTIONS WHEN WINDOWS ARE CLOSED

RAINWATER USED IN LOW FLUSH WCs



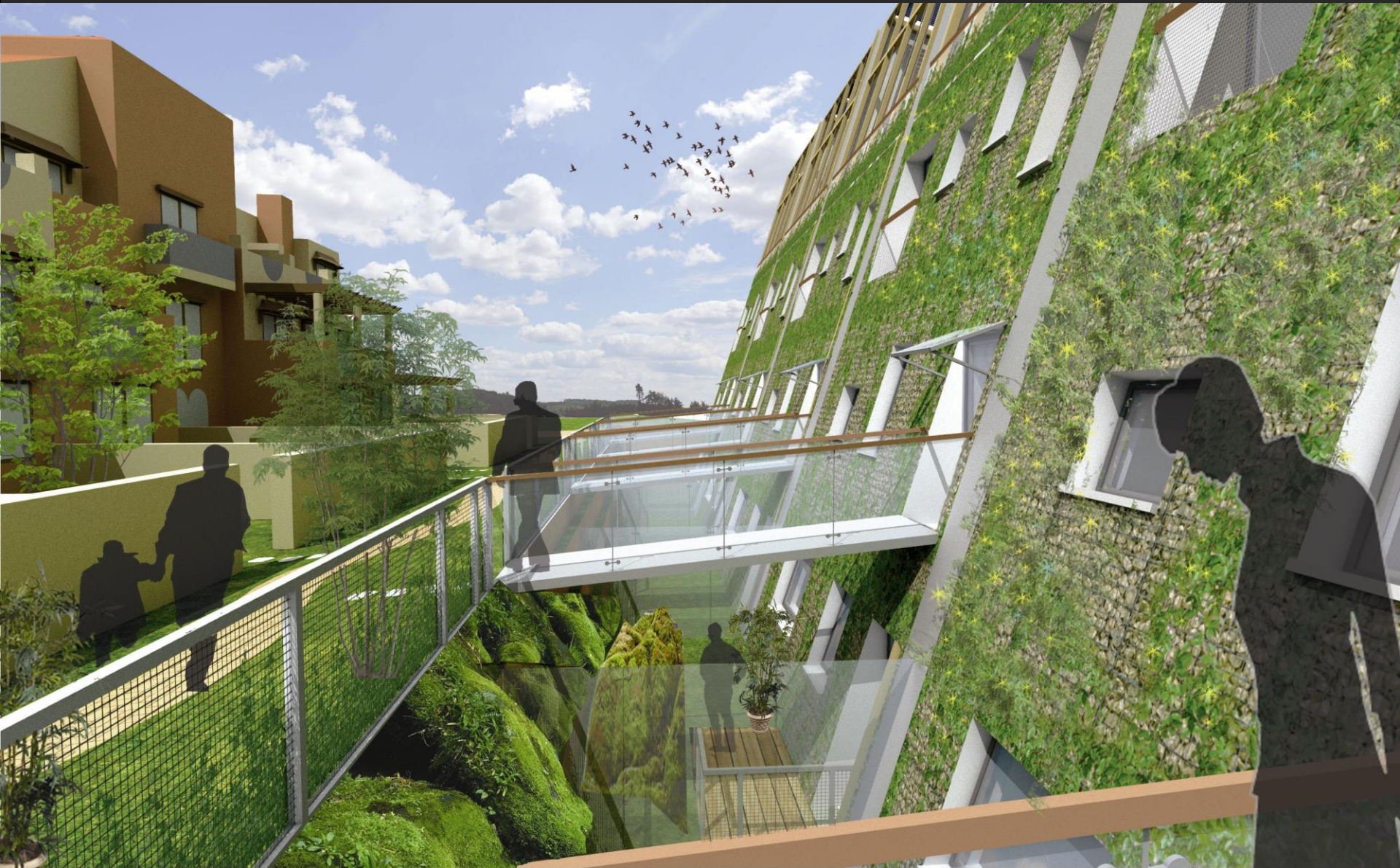
Chansha ZEDquarter



Changsha





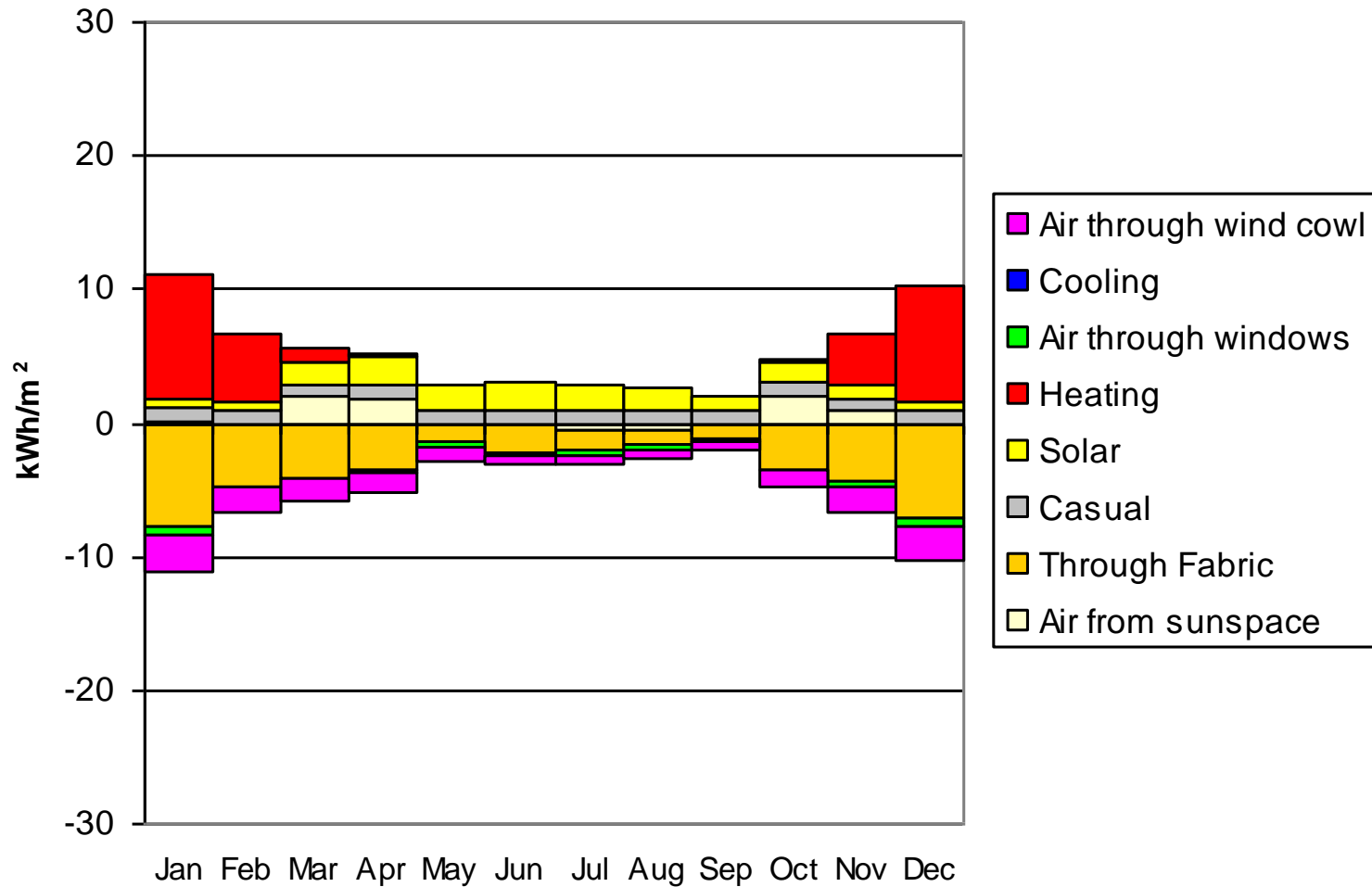




Korean Institute of Construction Technology - KICT
Namyangju - Zero Carbon City Energy masterplan

Heat Energy Characteristic

heating 18, cooling 25 (not needed)



ZED fabric standards

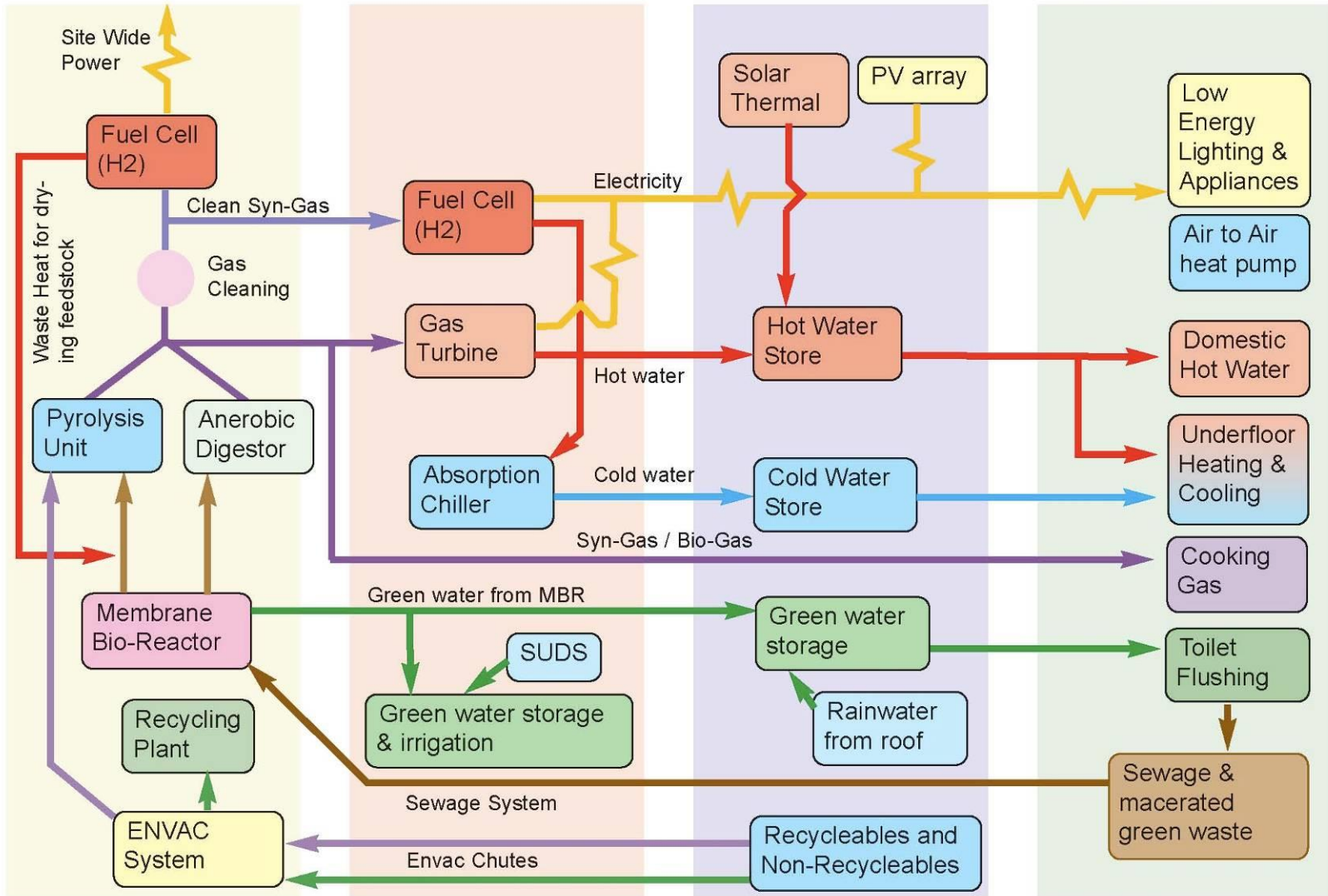
- south facing unit
- ruralZED typology
- sunspace provides heating for two months either side of heating season
- heat load reduced to 1.5 kw

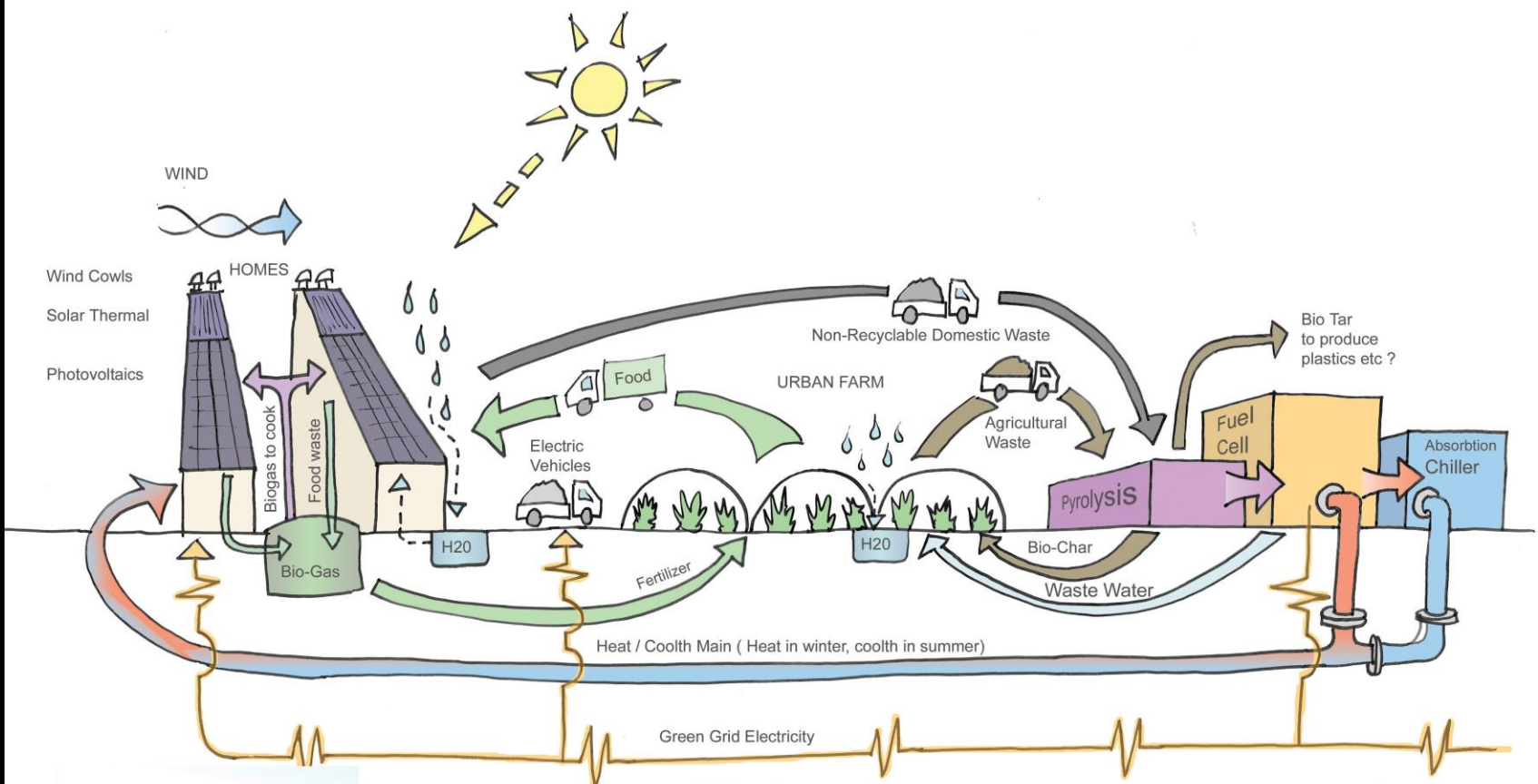
OVERALL

ZONE

BLOCK

DWELLING





URBAN FARM

An integral component of the schemes waste strategy, with the waste from the Anaerobic Digestion and the Pyrolysis units enriching the soil and improving the food production.



ANAEROBIC DIGESTION

Processing waste food and sewage to bio gas and fertilizer. This would provide cooking gas to residents and fertilizer for the farm



PYROLYSIS

Non-recycleable domestic waste and agricultural waste can be processed to a Syn-Gas by pyrolysis, also producing a Bio-char and a Bio-tar as by-products

HYDROGEN FUEL CELL

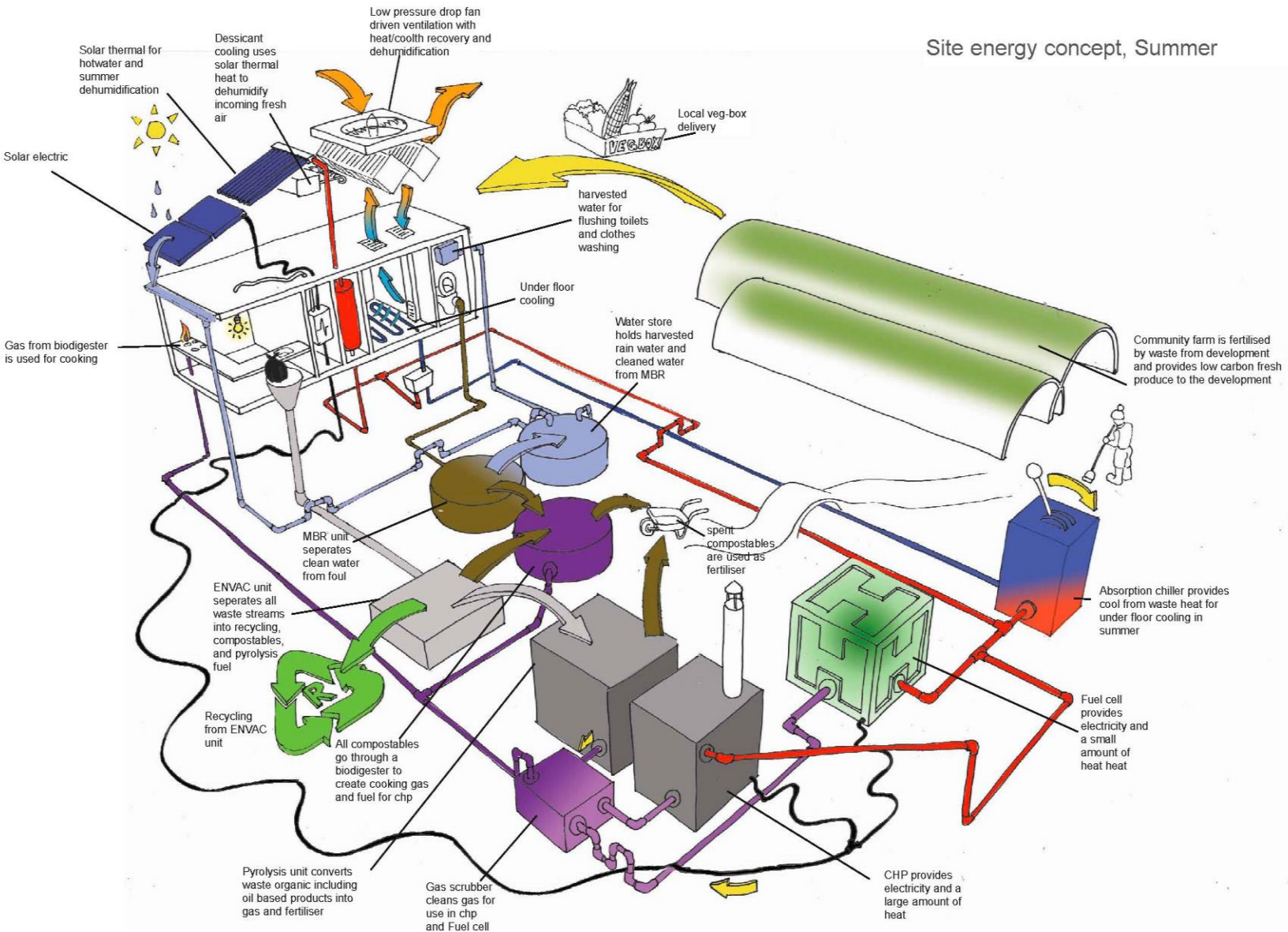
Extracts Hydrogen from natural, bio or syn gas and converts to heat and power at a ratio of approximately 3:4



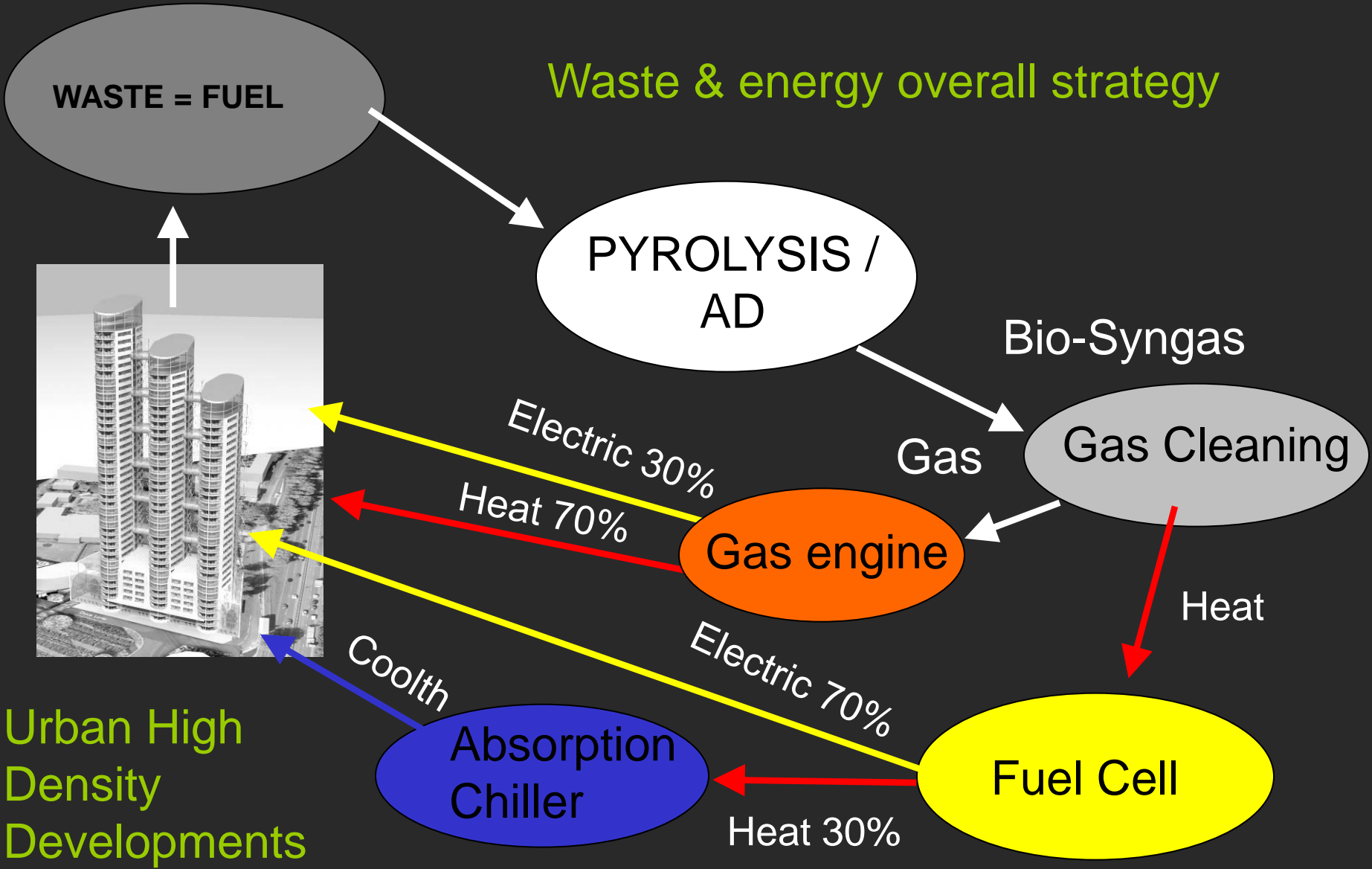
ABSORPTION CHILLER

Waste heat from Fuel Cell drives Absorption Chiller, creating cold water for distribution through heat / coolth main.

Site energy concept, Summer



Waste & energy overall strategy



Urban High Density Developments

a 5 tonne / hour unit pyrolysis unit produces 5 MW continuous electric output enough for 10,000 homes

Hydrogen Fuel Cell Module

Existing unit on the market with proven track record

- Natural Gas
- 50% electrical efficiency
- 230kW electric
- 180kW thermal

Excellent electric / thermal ratio means no heat dumping and better financial returns



Problem: Hydrogen production?

- Solution : Bio-Syngas
(gas produced from biomass)



1: Anaerobic Digestion



2: Pyrolysis /
Gasification

Pyrolysis gas content

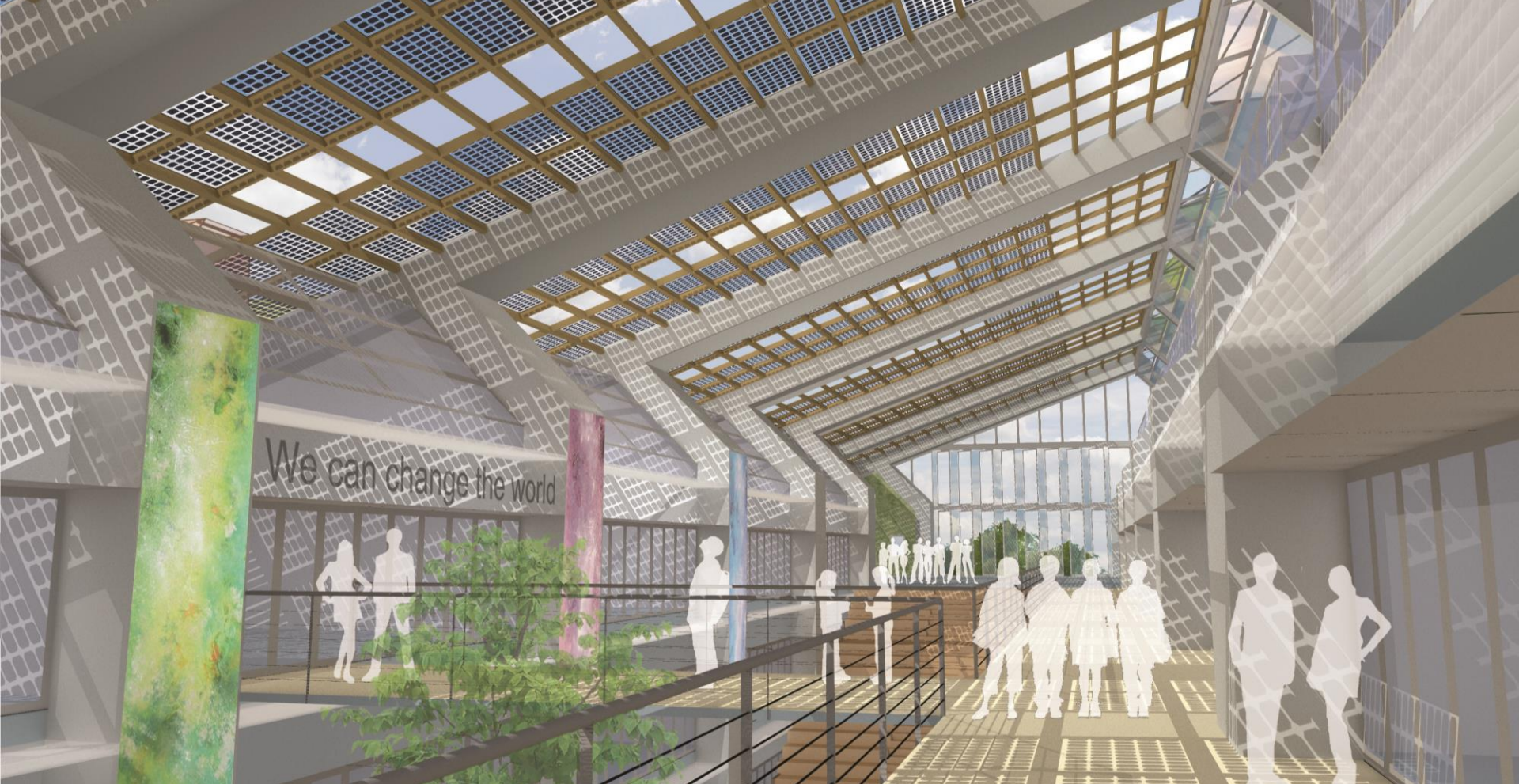
- 4.8 kWh / m³
- High Hydrogen content



Parameter	Sample 1	Sample 2	Sample 3	Sample 4	Average
	woodchip	mixed construction	sudge pellets		
Gas Analysis (Vol %)	Vol %				
Carbon Dioxide	12.2	15.0	13.6		13.6
Oxygen	0.7	1.1	0.7		0.8
Nitrogen	2.0	3.0	2.0		2.3
Hydrogen	17.0	23.1	13.5		17.9
Carbon Monoxide	43.0	34.0	42.0		39.7
Methane (CH ₄)	17.5	16.1	17.5		17.0
Ethane (C ₂ H ₆)	0.54	0.46	1.21		0.7
Propane (C ₃ H ₈)	0.02	0.02	0.04		0.0
Butane (n-C ₄ H ₁₀)	0.05	0.03	0.12		0.1
Pentane (n-C ₅ H ₁₂)	0.04	0.02	0.05		0.0
Hexane (n-C ₆ H ₁₄)	0.0015	0.0122	0.0272		0.0
Heptane (n-C ₇ H ₁₆)	0.0032	0.0044	0.0147		0.0
Octane (n-C ₈ H ₁₈)	0.0030	0.0034	0.0064		0.0
Ethylene (C ₂ H ₄)	4.50	3.90	5.10		4.5
Cyclopropane (Propene) (C ₃ H ₆)			0.59		0.6
Acetylene (ethyne) C ₂ H ₂	0.00	0.00	0.00		0.0
Hydrogen Sulfide	0.00	0.00	0.00		0.0
Carbonyl Sulfide	0.00	0.00	0.00		0.0
Total Vol %	97.51	96.70	96.46	0.00	97.3
Molar Mass					
Ideal Gas Density					
Heating Value (Btu/ft ³)					493

Zero carbon school for Korea- for KICT/RIST/ EDUMAC
Jincheon, Chungchugbookdo





ZED SCHOOL KOREA

Concept Design Report November 2010

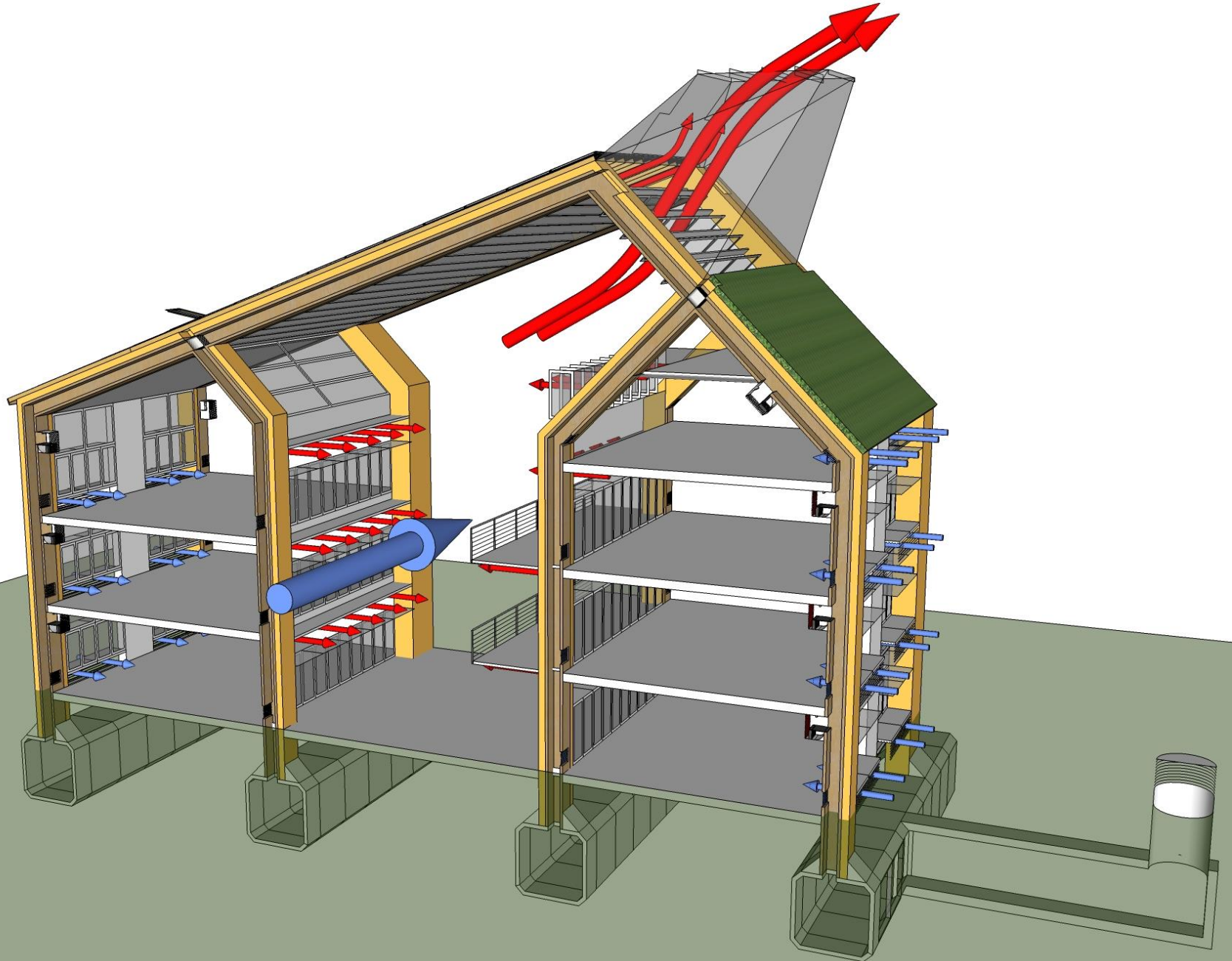
Korea have the opportunity to build **the true zero carbon school** in the world both in operational and embodied energy – and demonstrate practical leadership in this climate critical field.

Conceptual Design – ATRIUM



The atrium is an unheated winter garden. The atrium floor has permanent tables, allowing for prompt meeting places and semi-outdoor but sheltered study space when climatic conditions are low.

MID SEASON







THANK YOU

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