ZEDlife

Zero Carbon Zero Waste Tool Kit

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ZED Food

ZED Services

ZED Architecture

- Kit House
- Retrofit
- Bespoke
- Non-Residential

ZED Waste

ZED Renewables

ZED Urbanism

- Scale
- Climate

ZED Transport

ZED Fabric

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The debate is now no longer about how to provide the minimum legislative standards - it is how to survive the C21 with an annual fuel price escalator of 8% per annum. Minimum standards are for Losers !

Economies of scale have now made energy positive buildings affordable today, and by building using local, durable and natural materials it is possible to design, build and occupy climate neutral communities that make no net contribution to global CO2 emissions.
This makes it possible to stop competing internationally for dwindling reserves of fossil fuel, or launching headfirst into the 'eco-fascism' inevitable as the existing economic system runs out of natural capital.

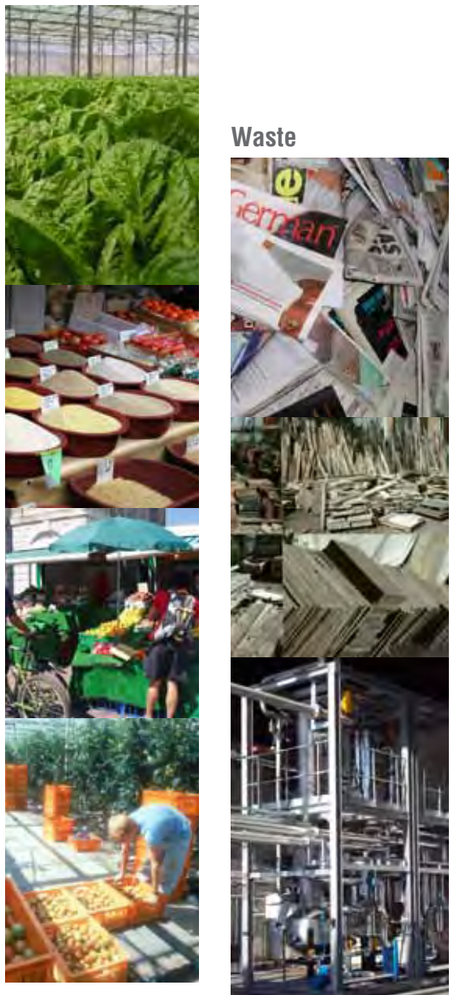
We believe it is possible to plan a stable, equitable future at the same time as increasing our overall collective quality of life and achieving a step change reduction in resource consumption. Endless environmental checklists will not solve real life problems. For this reason ZEDfactory have developed a range of proven tools that can meet the environmental performance targets of what we call the **'ZEDlife'**

ZEDfactory

ZEDfactory's designs for zero carbon building projects are sought out by clients around the world. ZEDfactory began as Bill Dunster Architects in 1998. From day one, the company has been exclusively committed to low carbon design and development, with a unique track record of delivering Zero (fossil) Energy Development (ZED) buildings in the UK. Using tried and tested technologies, ZEDfactory creates designs that are stimulating and practical on a daily basis, yet distinctive, economic and reliable in the long term. Today, ZEDfactory is a leader in the field of zero-carbon design and development, with a unique track record of delivering Zero (fossil) Energy Development (ZED) buildings in the UK. The company offers the full range of architectural services, from master-planning and design of large-scale 'eco villages' to one-off individual building commissions.
ZEDfactory also works closely with leading UK academics and consultants to model predicted energy consumption and production, fluid dynamics and whole life cycle carbon costs of their designs to ensure they achieve the lowest environmental impact possible.
ZEDfactory as a practice demonstrates in its projects a step change reduction in carbon footprint can be achieved at the same time as an increase in overall quality of life . Synchronising a zero carbon, zero waste lifestyle, and work style by the use of urban Zero fossil Energy Developments with Zero fossil Energy Farming and food distribution.

Holistic Approach

ZEDfactory seeks to push the boundaries of contemporary thought on sustainable urbanism and renewables integrated building design. The practice believes that a holistic approach to design is essential to tackling the present and future environmental challenges.
We think of a building as an organism: it eats, drinks, respires, and secretes waste. All the likely 'inputs' and 'outputs' must be planned for. Ways of reducing the carbon footprint of all inputs should be considered. The outputs equally must be ecologically benign, or must not require large amounts of energy to make them so.
For example food for a community is sought as far as possible from local farms, reconnecting the city with the countryside. All food and organic waste can be processed on site using anaerobic digestion (AD) to produce bio-gas which can be used for cooking, and an organic fertilizer by-product that can be sent back to the farm. Any non-recyclable domestic waste is processed by pyrolysis which also produces bio gas, and bio-char, a carbon rich solid which enormously increases soil fertility. The bio-gas produced from both pyrolysis and AD can be fed into a fuel cell which produces electricity at a very high efficiency. In this way, nothing is dumped in landfill, no waste is actually waste but just the input for the next process.



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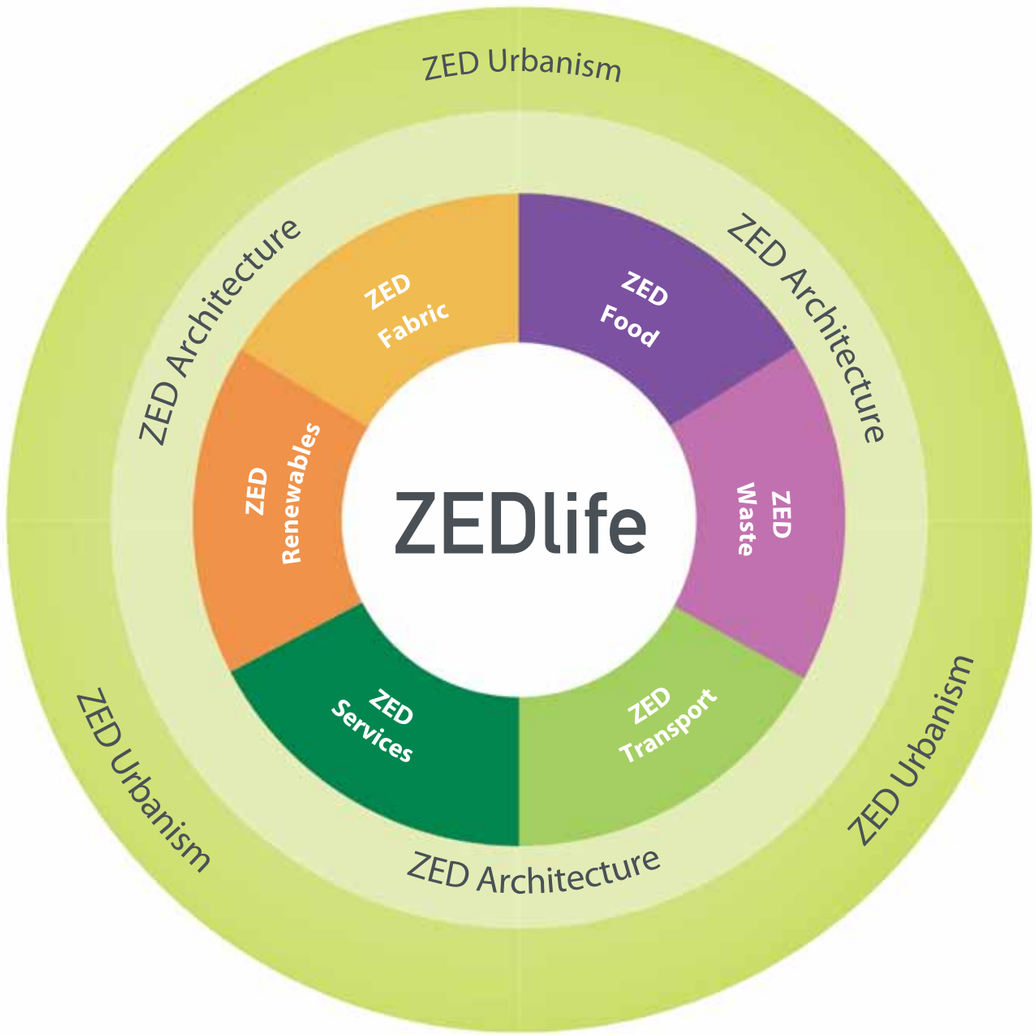
Imagine a Zedlife...



You'd be crazy to continue using that fossil fuelled car...

What is the ZEDlife?

- Zero fossil Energy Developments
- One reworking our urban areas to reduce society's addiction to fossil fuel
- One which reduces our need to fight for oil abroad
- One which doesn't contribute to accelerating climate change
- One which minimises health problems by emitting no fossil-fuelled air pollution
- One which minimises the need for nuclear with associated security risk
- One which seeks to rebalance income and resource inequalities nationally and internationally
- One which minimises its impact on the planet
- One which results in a higher quality of life for all people

What characteristics does it have?

Zero Electric Bills
Zero Heating Bills
Zero Lifecycle Carbon Footprint
Zero Waste To Landfill
Reduced Water Bills
Increased Local Jobs
Reduced Transport Carbon Footprint
Increased Durability
Increased Levels Of Daylight And Ventilation
Increased Sales Value Offseting Increased Construction Cost

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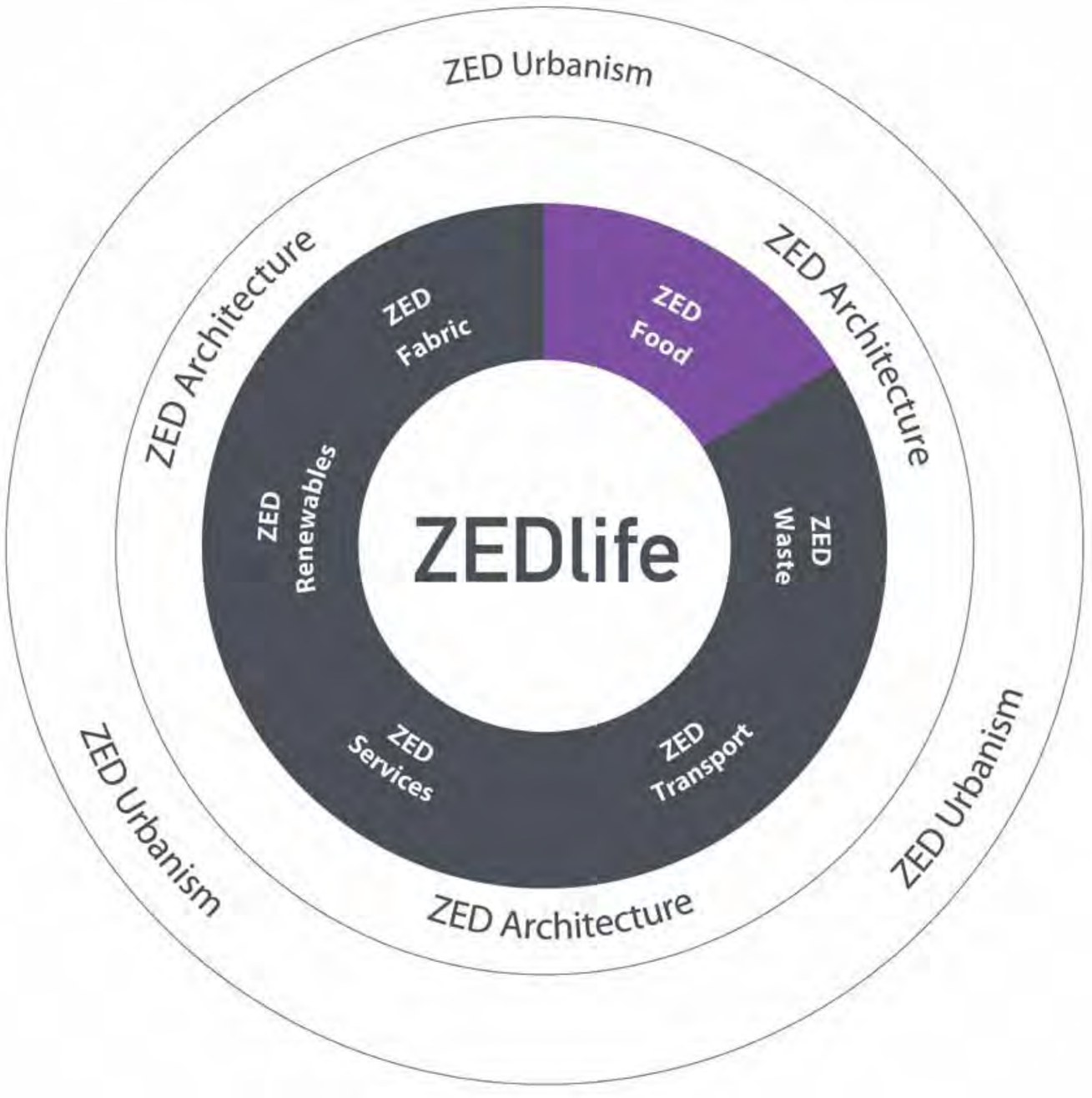
The ZEDwheel

ZEDfactory believe that only a combination of low carbon infrastructure AND low carbon lifestyles can make a viable zero carbon / zero waste society.

Reducing Environmental Footprint

On a finite planet, every human being has a fair share of limited natural resources. Historically transport has restricted human civilisations to the resources contained within their host bioregion, however today access to fossil fuels has facilitated both a global economy and spectacular overconsumption at a depletion rate aggravated by the reproductive success of the species. To move from plague species to planetary curators we must collectively match consumption with available resource levels at the same time as demonstrating a workable and aspirational quality of life. It is difficult to achieve the reductions in environmental footprint proposed by the 'contraction and convergence' models that calculate each human's rights to scarce natural capital. Studies by Best Foot Forward/SEI/Bioregional in 2000 require significant changes to lifestyle and habits. The diagram to the left shows broadly the proportions of CO_2 for one's personal carbon footprint, and that if we want to be truly sustainable, then all segments need reducing.

ZEDfactory believe that a pragmatic way to start the process of contraction and convergence begins by carefully modifying a small part of an existing community, using zero carbon projects to prove that a lower resource footprint is workable, fun and of higher value. By reducing resource demand on a plot by plot basis – it is always possible to reduce the overall demands of the city. We believe that concentrating on behaviour change alone can lead to ecofascism, and it is always better to provide the public with a well considered infrastructure framework that facilitates a low carbon lifestyle – allowing each individual to adapt when and if they see fit. The following calculations examine the range of technologies that would be required to an obtain a fair earthshare ecological and carbon footprint meeting the 'contraction and convergence' model. The footprints are done on a per habitant basis.



A third of our carbon footprints is derived from agriculture and food miles. Here we explain the zero fossil energy farming concept which can be implemented in our rural areas...

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Zero Fossil Energy Farming

The ZEF, zero fossil energy farm, shows how food can be grown and distributed using renewable energy, at the same time as recycling valued nutrients and creating a zero carbon / zero waste community

Home grown

We design in growing space into all ZEDfactory developments. This can be anything from indoor horticulture in sunspaces through gardens and self irrigating raised beds to wintergardens allotments and edible landscaping. Growing your own food is a healthy educational activity for all the family.

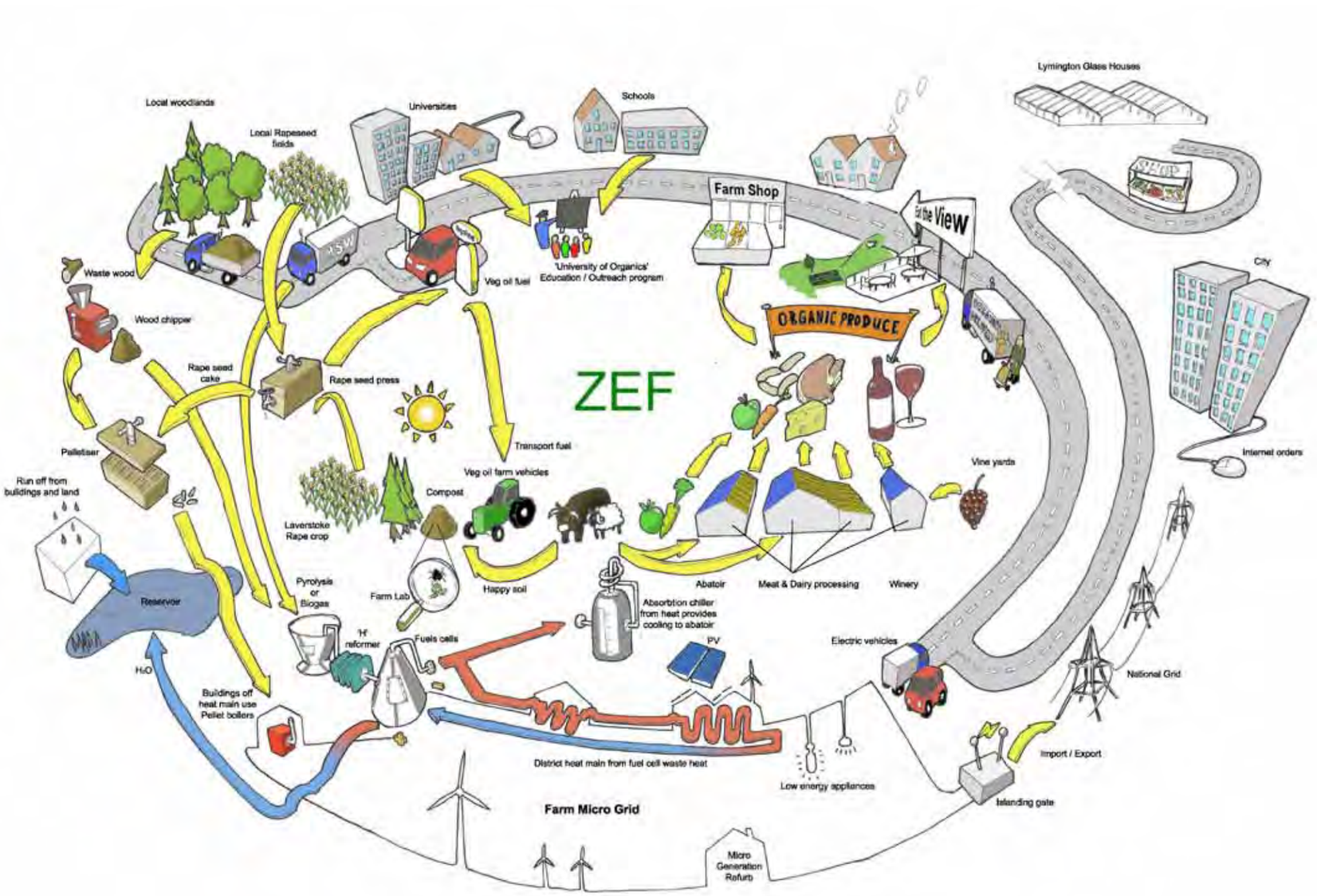
Partnering up with a local farm

In order to reduce the carbon footprint of the buildings' food consumption, it is advised to create a partnership with a local organic farm or group of farms producing organic food.

Food delivery

Residents can be provided with a host of informations on local farms, organic supermarkets and farmers markets.
Free allotment spaces and the green roofs can be arranged to be community gardens with food growing and composting facilities.
Residents can easily be enabled to get organised and get involved in any of the following:

- Bulk discounts for residents arranged with local farms
- Organic supermarket internet delivery
- Coordinate mainstream supermarket internet delivery
- Information pack and free seeds for cultivating sky gardens
- Communal food growing and communal composting land, tools, seeds and equipment provided, residents' group set up
- Farmer's market on site

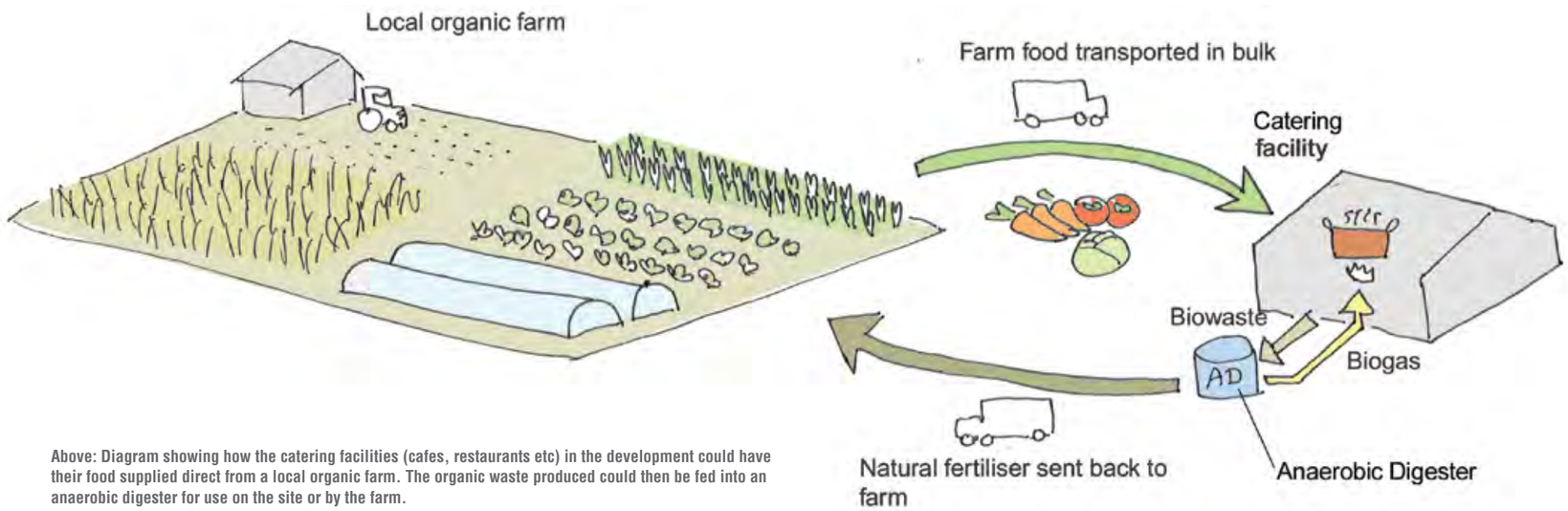


Above: Concept for a zero energy farm (ZEF) using Pyrolysis, Fuel Cells and Absorption chilling for district cooling in hot countries.

Zero Fossil Energy Farming

The production and supply of food is the second largest cause of carbon dioxide emissions per domestic household. This is due to modern farming practices that use large amounts of fossil fuels in the form of fertilizers (natural gas), pesticides (oil), and hydrocarbon power irrigation. The increased use of fertilizers and monoculture farming is reducing soil fertility and not a viable long term strategy.

The industrial miracle that made South Korea into one of the top dozen economies of the world poisoned the people and countryside. In the 2005 Environmental Sustainability Index, South Korea ranked 122 out of 146 nations, the worst showing of any industrialized country. Air and water pollution are notoriously bad. The environmental movement has grown more powerful over the last decade, however, and has sparked ever-growing interest in chemical-free food.



Above: Diagram showing how the catering facilities (cafes, restaurants etc) in the development could have their food supplied direct from a local organic farm. The organic waste produced could then be fed into an anaerobic digester for use on the site or by the farm.

Fresh, local, seasonal and organic

The alternative options for agriculture are: use of natural fertilizers, organic systems, soil fertility, crop rotation and natural pest control, inter-cropping, companion planting and the possibilities of multiple yields, genetic diversity and the benefits of robust and region specific varieties.

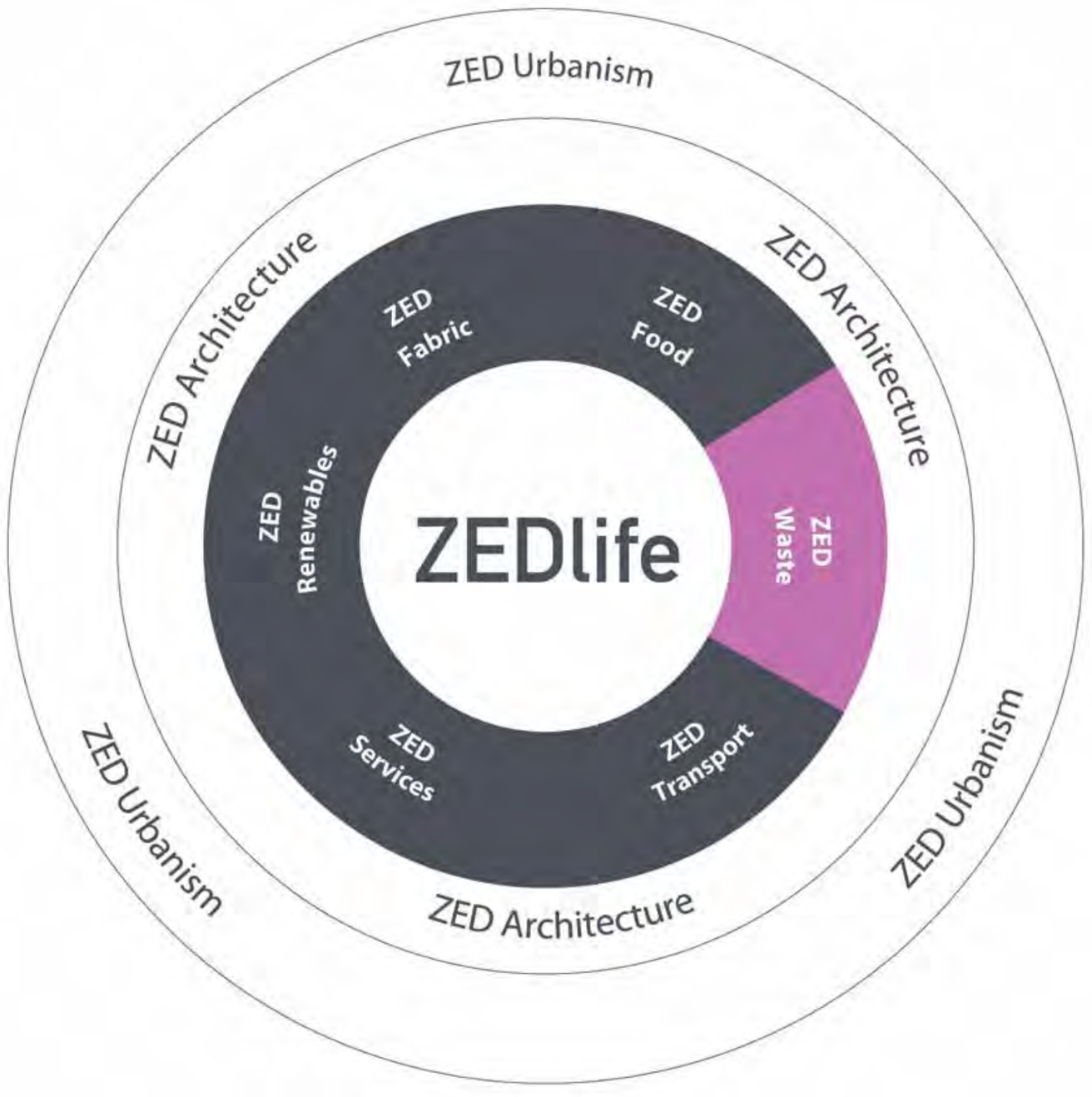
Food miles are another issue, as the further the food must be transported to the plate, the higher the energy consumed. This is due to the transportation fuel burnt and the requirement to keep many foods refrigerated (which uses large amounts of energy). So the closer the farm is to where the food is being eaten, the better.

Eating seasonally also reduces one's carbon footprint, and the food will tend to taste better too, as it has not been picked before ripening, and be vacuum packed for long distance travel.

The U.S. food system consumes 10 times more energy than it produces in food energy. This disparity is made possible by nonrenewable fossil fuel stocks.
We are eating oil.

1kcal food = 10kcal oil

The average American consumes 400 gallons of oil just to feed himself or herself each year (1994). Since then, energy input has continued to increase without a corresponding increase in crop yield. We have reached the point of marginal returns.



After growing all that food, what happens to all the waste straw? How about the decomposing food waste and everything else that we throw away in the city? This section looks at reclaiming energy from that waste…

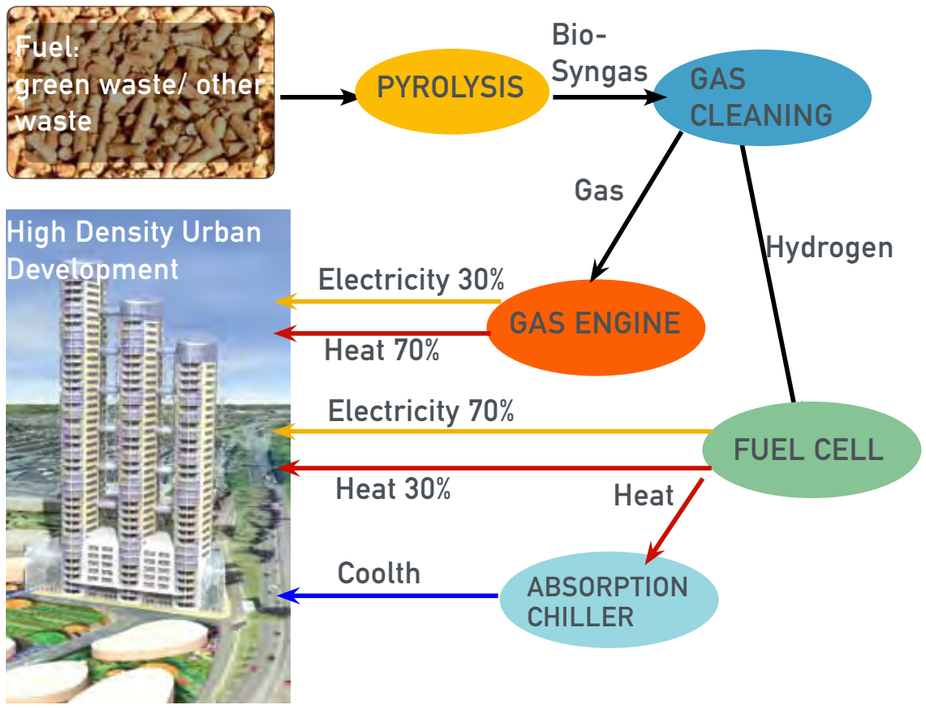
Pyrolysis

In many urban projects about 3/4 of the annual energy demand can be met by solar energy with the remaining 1/4 being met by bio-gas energy produced from both dry urban and agricultural waste in a compact Pyrolysis carbon harvester.

What is Pyrolysis?

Pyrolysis is the process of heating organic or man made carbon based matter in the absence of oxygen. It's essentially a high tech equivalent to traditional charcoal making, only more efficient and controlled.

- under high temperatures and in the absence of oxygen
- matter breaks down into various gasses
- residual oil and solid char
- there is no combustion and no emissions



All CCHP Strategy

Typical installation

A 5 module plant could process 40,000 tonnes of waste a year and generate enough electricity for 10,000 households (based on the DTI's Energy Review 2006).

Urban :
0.88MWh per year

+

Rural :
0.79MWh per year

=

Total :
1.67MWh(e) per year

EPI Pyrolysis prototype Unit, Mitcham Junction, London

Gas Engine

Monitoring room

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Pyrolysis

What contribution can pyrolysis make to a community?

A typical city household produces approximately 0.88 tonnes of MSW per year, which could generate approximately 0.88MWh per year.

The pyrolysis unit can normally produce from the city organic waste :

26% of each homes annual electric demand
9.3% of each homes annual thermal demand

A typical household consumes approximately 2.41 tonnes of agricultural food crop per year

- This quantity of crop creates 21 million tonnes of agricultural waste, or 0.79 tonnes per household.
- This agricultural waste can form the input to a farm based pyrolysis unit, which could generate approximately 0.79MWhper year.

The pyrolysis unit can normally produce from the rural organic waste :

24% of each homes annual electric demand
8.8% of each homes annual thermal demand

What materials can be Pyrolysed?

Anything that is purely organic is absolutely ideal : Wood Chippings, Palm Husks, Any Crop Residues that you can think of… All we have to do is reduce the moisture to a suitable level before we start.

With mixed waste, (Domestic or Commercial) the vast majority of material is either organic : e.g. food, textile, paper, card…. Or organic based products : Such as plastics, film, rubber, or part of a vast range of other materials derived from oil or other fossil fuels.

Animal Waste, Meat & Bonemeal, Sewage Sludge all of these are ideal candidates for treatment with Pyrolysis. In essence, if it isn't metal or mineral (so that includes glass) then assuming it's solid, it's Organic

1 tonne of dry organic waste

Agricultural waste

Bio Methane Gas 65

Oil 50-80 litres

The oil composition will vary dependant upon the material being processed, and this will impact on the likely commercial opportunities for the product. However the calorific value is very high – up to 25% higher than oils produced by similar processes.

Char 150kg

Energy rich, carbon char provides a number of opportunities for the production of additional energy. As a source of heat the char has an energy value better than coal. Better still, any contaminants that might have been present within the original material are destroyed during the process, leaving a clean smokeless product. Char also has various opportunities to be used in the form of activated carbons, and it has the potential to be placed directly on farm land to increase soil fertility.

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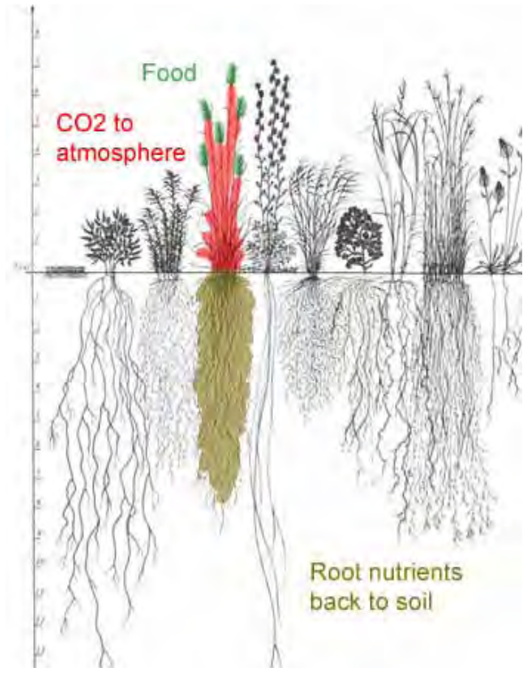
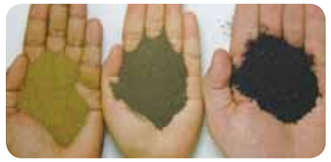
Pyrolysis

Farm based pyrolysis plants produced in volume will be similar in price to a combine harvester, and enables the carbon absorbed from the atmosphere as straw to be removed from the carbon cycle by ploughing back into the soil as biochar fertiliser

ABOVE GROUND - TO ATMOSPHERE

BELOW GROUND - BACK TO SOIL





CHAR & OIL
Both very high calorific value

Bio-Char agricultural applications

Liquid Bio Gas (LBG)

Pyrolysis Gas Content

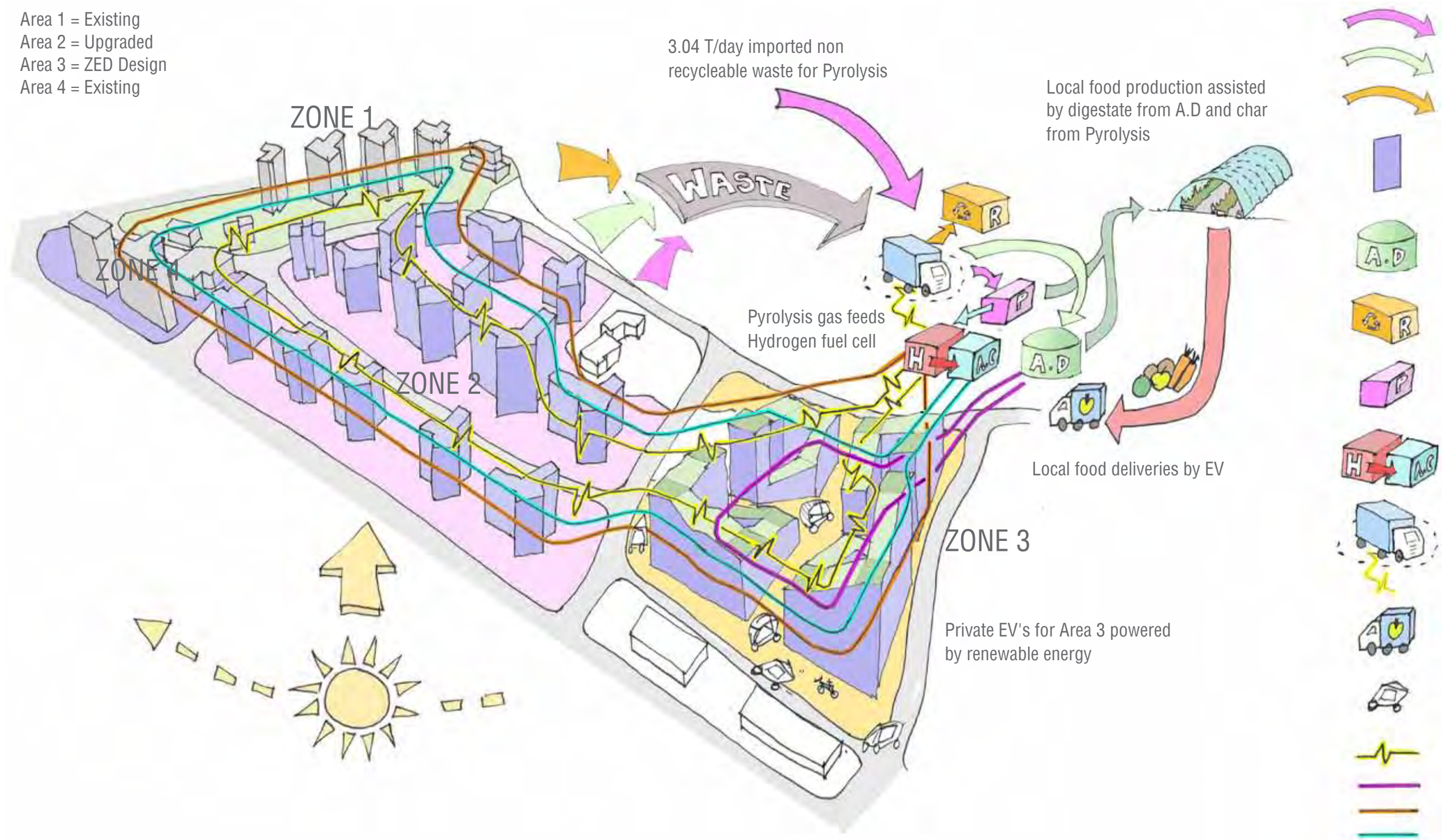
Parameter	Sample 1	Sample 2	Sample 3	Sample 4	Average
	woodchip	mixed construction	sudge pellets		
Gas Analysis (Vol %)	Vol %				
Carbon Dioxide	12.2	15.0	13.6		13.6
Oxygen	0.7	1.1	0.7		0.8
Nitrogen	2.0	3.0	2.0		2.3
Hydrogen	17.0	23.1	13.5		17.9
Carbon Monoxide	43.0	34.0	42.0		39.7
Methane (CH_4)	17.5	16.1	17.5		17.0
Ethane (C_2H_6)	0.54	0.46	1.21		0.7
Propane (C_3H_8)	0.02	0.02	0.04		0.0
Butane (n-C_4H_{10})	0.05	0.03	0.12		0.1
Pentane (n-C_5H_{12})	0.04	0.02	0.05		0.0
Hexane (n-C_6H_{14})	0.0015	0.0122	0.0272		0.0
Heptane (n-C_7H_{16})	0.0032	0.0044	0.0147		0.0
Octane (n-C_8H_{18})	0.0030	0.0034	0.0064		0.0
Ethylene (C_2H_4)	4.50	3.90	5.10		4.5
Cyclopropane (Propene) (C_3H_6)			0.59		0.6
Acetylene (ethyne) C2H2	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/ft3)					493

Pyrolysis

Zero carbon zero waste strategy applied to urban high density masterplan

Summary of Scenario 3 building types:

Area 1 = Existing
Area 2 = Upgraded
Area 3 = ZED Design
Area 4 = Existing



Key

- Non recycleable waste
- Organic waste
- Recyclable waste
- PV panel walls
- Anaerobic Digestion
- Recycling Plant
- Pyrolysis Unit
- 300kW(e) Hydrogen Fuel Cell & Absorption Chiller
- Waste Transfer EV's
- Food Delivery EV's
- Private EV's
- Electricity
- Biogas for Cooking
- Heat Main
- Coolth Main

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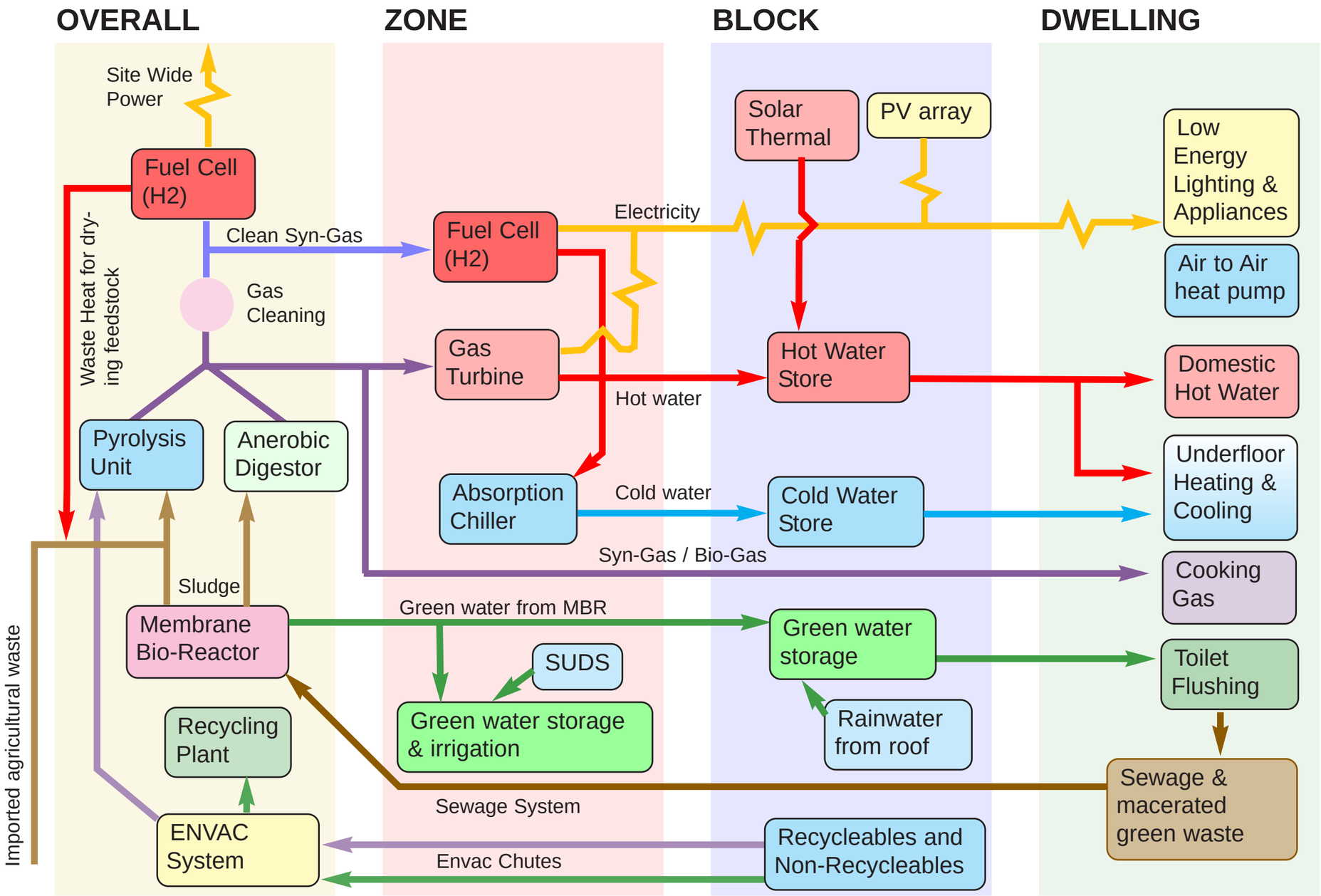
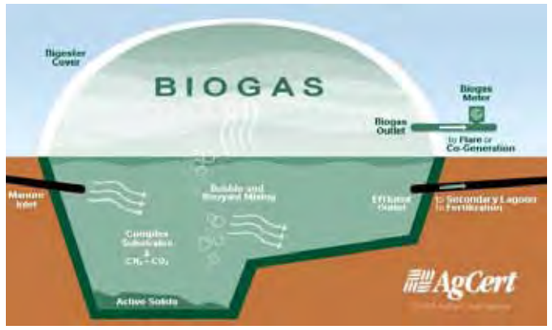
combining all technologies to do the right thing in the right place for the right reason



Pyrolysis



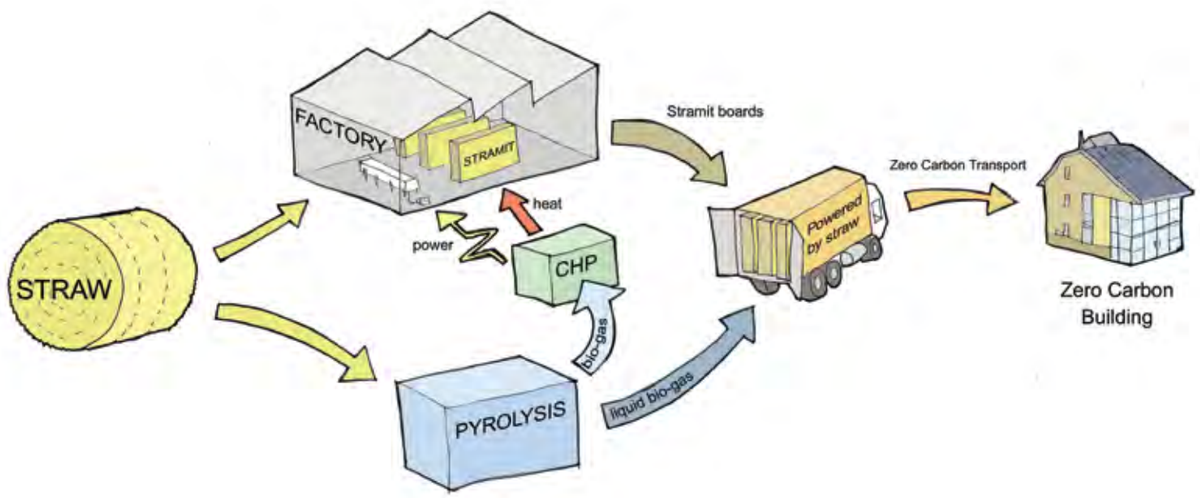
Installation in Turkey

How can the Pyrolysis gas be used?

1: Direct use – on site at point of production, the gas can be cleaned and either fed into a Gas Engine, Hydrogen Fuel Cell, or even used directly for industrial processes or cooking for example. This option requires preferably an electrical and thermal load situated nearby, to approximately match the output of the engine / fuel cell. Installations should be sized for the thermal demand to avoid heat dumping. Electricity, unlike heat, can be exported via the national grid to optimise utilisation of energy generated.

2: Storage and Distribution - Biogas can be compressed and liquefied much in the same way that Petroleum Gas is (LPG), and could be known as LBG, stored and distributed around the country much in the same way as Calor Gas is now. It can also be processed to a transport grade gas which is capable of replacing Petrol in converted vehicle engines.

3: Virtual BioGas – Biogas can be processed, cleaned, 'injected' back into the national gas network and purchased by consumers elsewhere. This is already happening in Austria and Germany, where farmers can benefit from proximity of existing waste streams without being hampered by the distance to the energy end user. This potentially sets up an urban / rural symbiosis, whereby a high density urban development can fund the capital cost of installing a rural waste processing systems. Fuel Cells located in the heart of the city could take the Biogas from the grid, and convert it in a highly efficient process into heat and power where it's most needed.



Straw can be used to make both construction materials and fuel the manufacturing plants and delivery vehicles making the first truly climate neutral construction products such as Stramit board

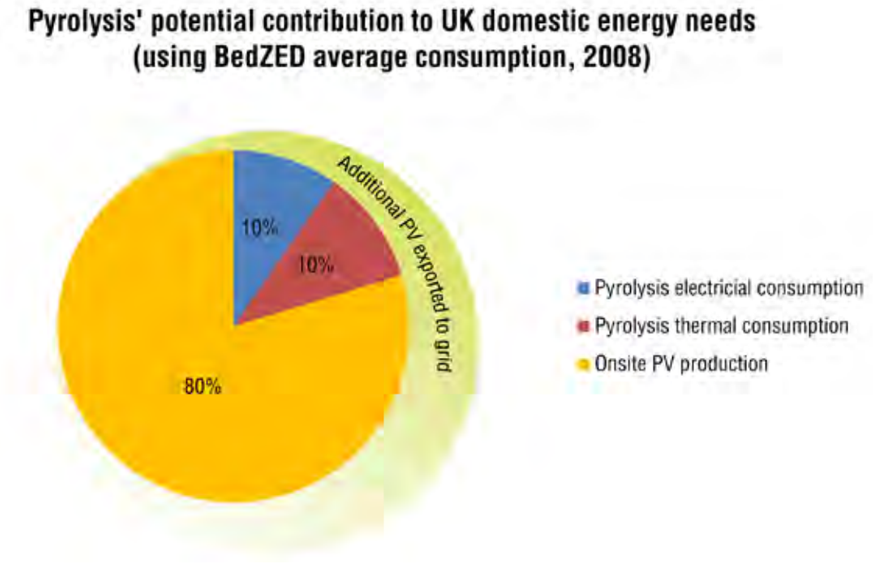
Why Pyrolysis instead of Incineration?

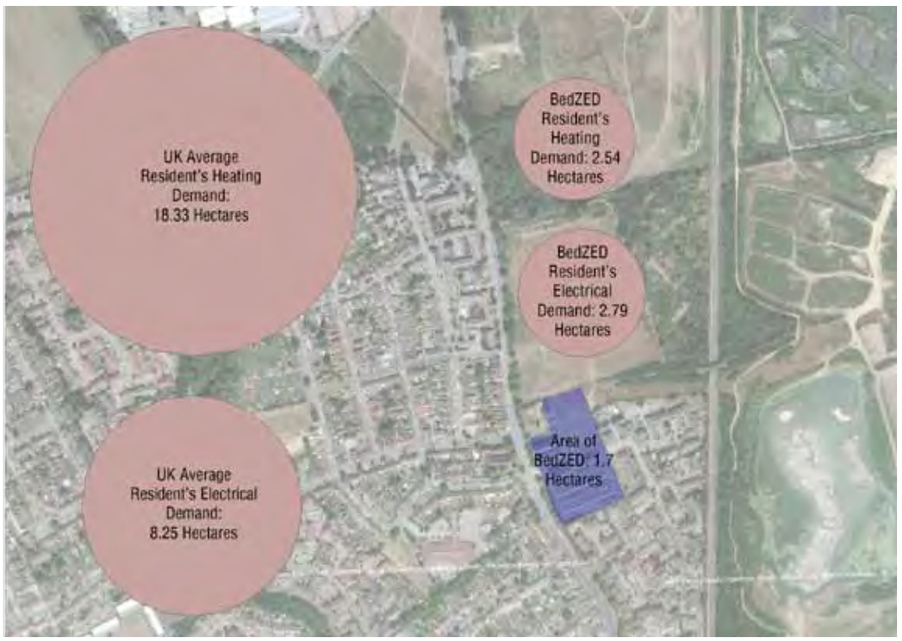
Once we know the calorific value of one tonne of organic waste (this varies with the composition of the waste), and the typical magnitudes of heat and electricity produced per tonne via pyrolysis, we can calculate in orders of magnitude the contribution that pyrolysis could have on our future energy supply.

In 2008 there were just under 5 million tonnes of excess straw waste from the UK farming system[1], equating to just under 80kg per capita given the UK's population. By adding on the average 170kg of organic waste generated per capita per annum[2], we get a total of 250kg of organic waste per capita which could potentially be fed into a district pyrolysis unit.

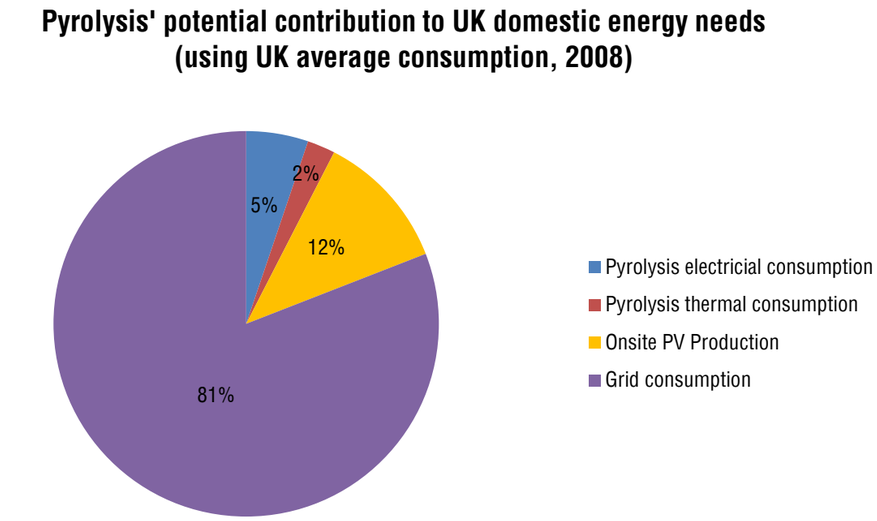
On the assumption that the UK embarks on a national pyrolysis installation program, and using the current stock of UK housing with its high levels energy consumption, the national stock of straw and organic waste would only be able to contribute 5% of the UK domestic electrical consumption and 2% of its thermal consumption, if every houshold was given its fair share (top right pie chart). On the assumption that by 2050, every home in the UK has an average of 3kWp installed PV panels, an additional 12% of electrical/thermal demand could be met from solar sources, leaving 81% of power to be derived from grid gas/electricity. However, this also assumes no improvement in the energy efficiency of the UK housing stock.

A more positive outlook would exist if we upgraded the UK housing stock to ZEDstandards. Using monitored energy consumption data from BedZED, owing to the significantly reduced consumption patterns, pyrolysis would be able to contribute 10% of the domestic electrical supply and 10% of the thermal supply - a significant amount. In addition, the large number of PV panels on currnet ZEDspec housing could generate the remaining 80% of energy, and have some left over to deposit back to the grid.





We can show how important it is to upgrade building fabric using the plan on the left. Here, each circle represents an area of agricultural land required to produce enough excess straw for one person's annual needs. All circles are to scale, superimposed over an aerial image of BedZED's surrounding area. We can see that even a BedZED resident requires a total of 5.33 hectares of land to produce enough straw for pyrolysis to meet 100% of their electrical and thermal requirements. However, a typical UK resident would require nearly 27 hectares each!
If every resident in the UK was allocated an equal amount, we would only have 0.28 hectares each.

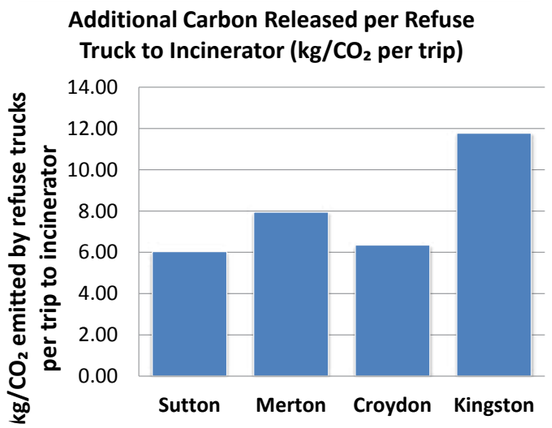


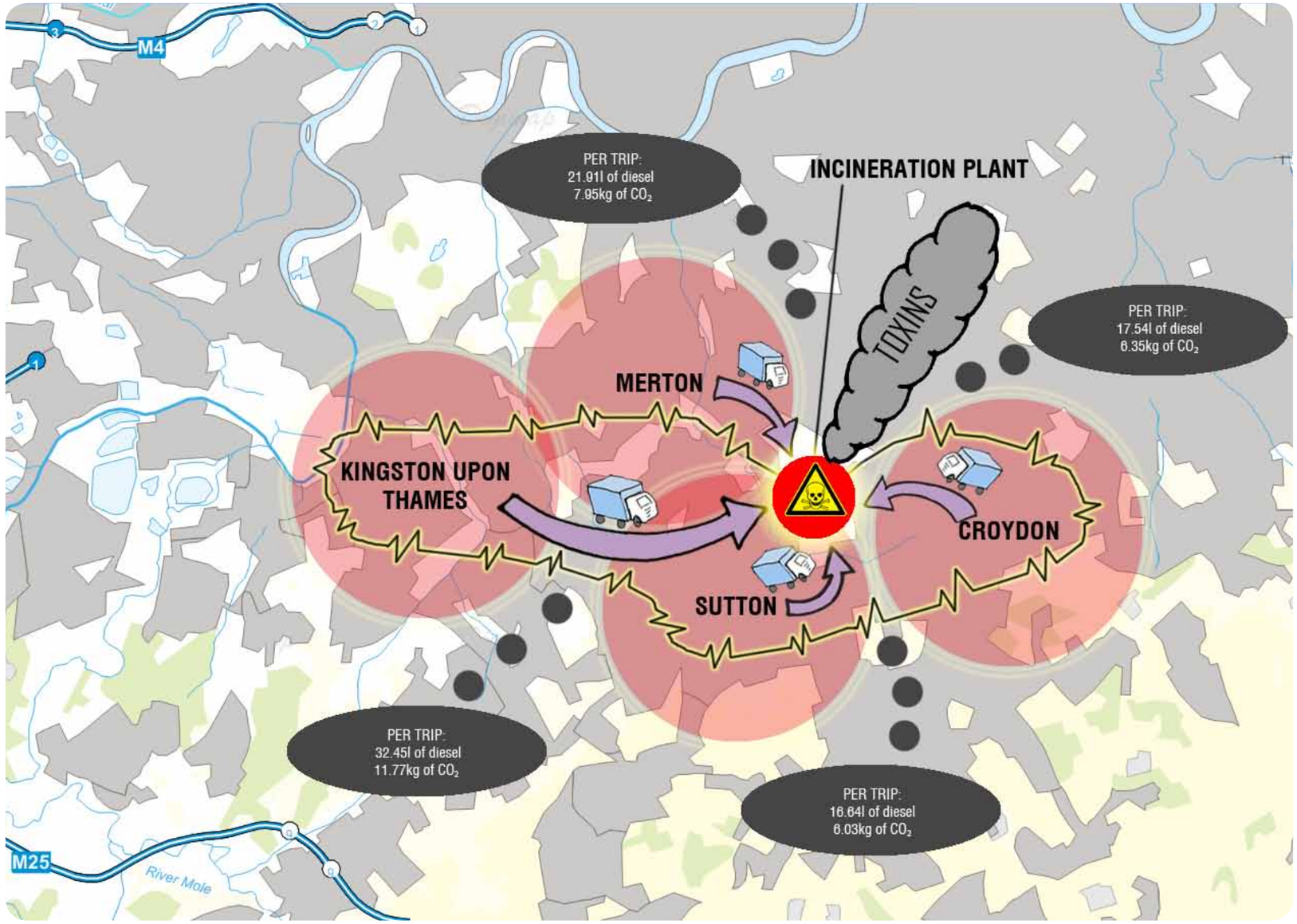
(1) http://www.northwoods.org.uk/files/northwoods/StrawAvailabilityinGreatBritain.pdf
(2) http://www.guardian.co.uk/environment/ethicallivingblog/2008/apr/18/compost organic waste

Why Pyrolysis instead of Incineration?

INCINERATION MODEL:

The four boroughs currently produce around 275,000 tonnes of waste per year.
By utilising incineration, this would produce:
• Enough toxins equivalent to a 50 mile length of the M25 (Heathrow to Dartford) deposited above the airspace of a local park, including PCBs, dioxins, and CO2.
• 101.3GWh of electricity per annum, equivalent to 20,500 homes or 5.3% of the feeder boroughs.
• 376GWh of heat, which can only be economically distributed within a 3km radius. Theoretically, this could heat 47,000 homes which is 12% of the total number of homes within the 4 feeder boroughs. Unfortunately, only 10% of these homes fall within the 3km district heating radius, as the incinerator must be situated so that the toxic waste plume does not fall on nearby homes. Approximately 90% of the heat generated would be dumped into the atmosphere.

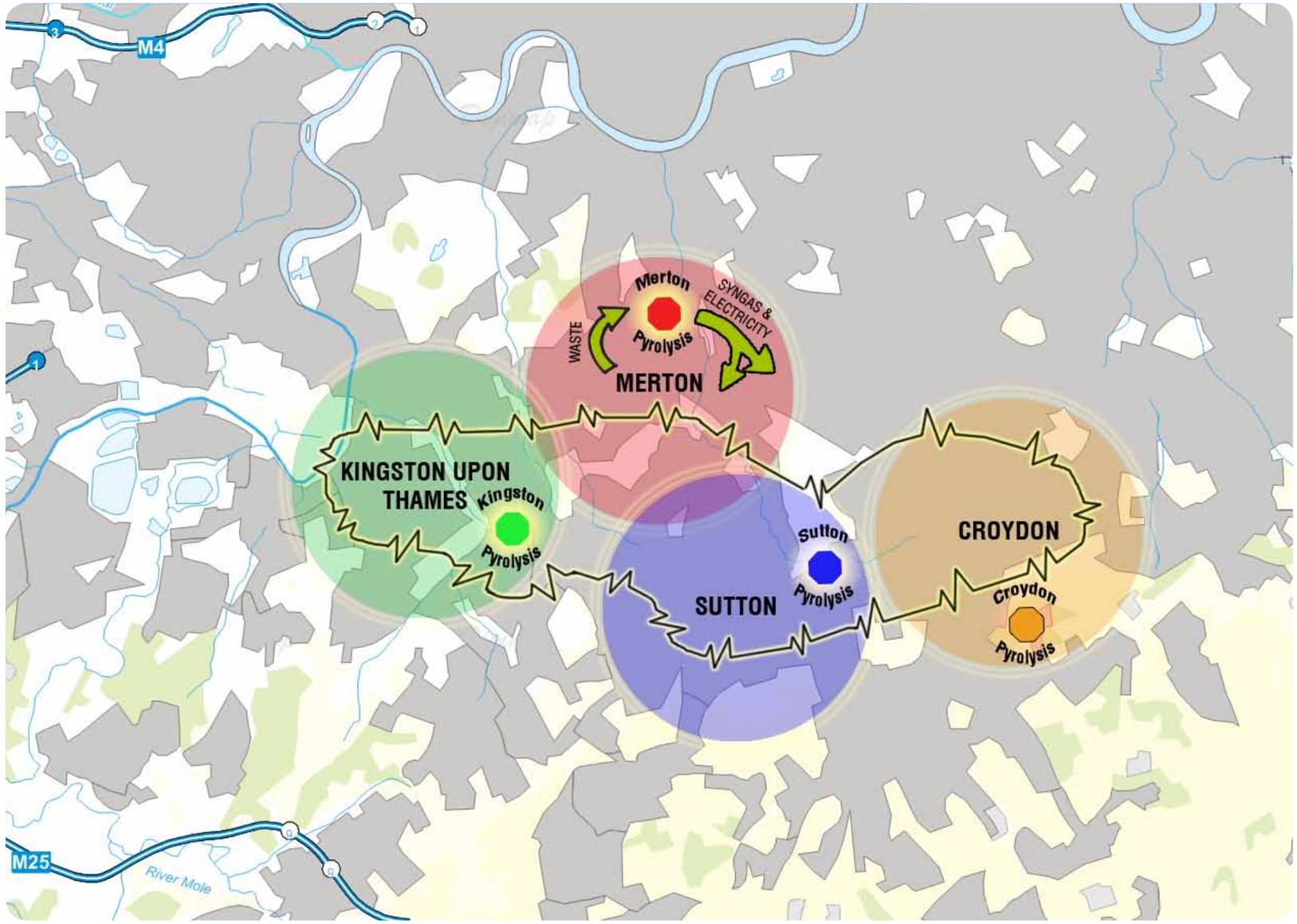




Why Pyrolysis instead of Incineration?

PYROLYSIS MODEL:

The four boroughs currently produce around 275,000 tonnes of waste per year.
By utilising pyrolysis, this would produce:
• 192.5 million cubic metres of syngas
• 41,250 tonnes of biochar for fertilizer
• If syngas is pumped into district CHPs:
• 311.7GWh of electricity, equivalent to 62,300 homes' electrical demand, or 16% of the homes within the feeder boroughs.
• 843GWh of heat, equivalent to 105,500 homes' thermal demand, or 28% of the homes within the feeder boroughs. As the pyrolysis units are decentralised, and can be located next to existing waste transfer stations sites, they have a greater potential to distribute heat within a 3km radius.



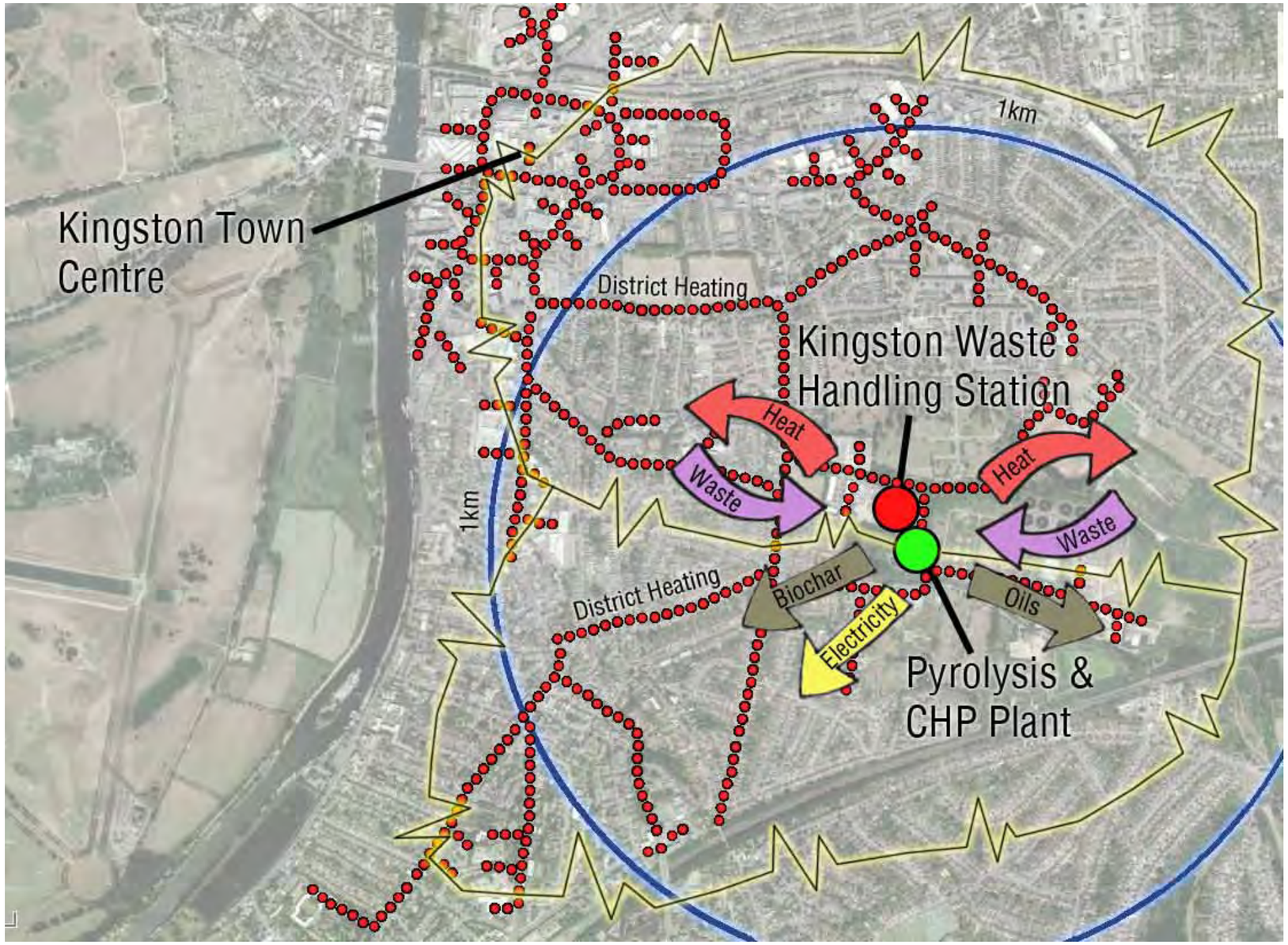
Why Pyrolysis instead of Incineration?

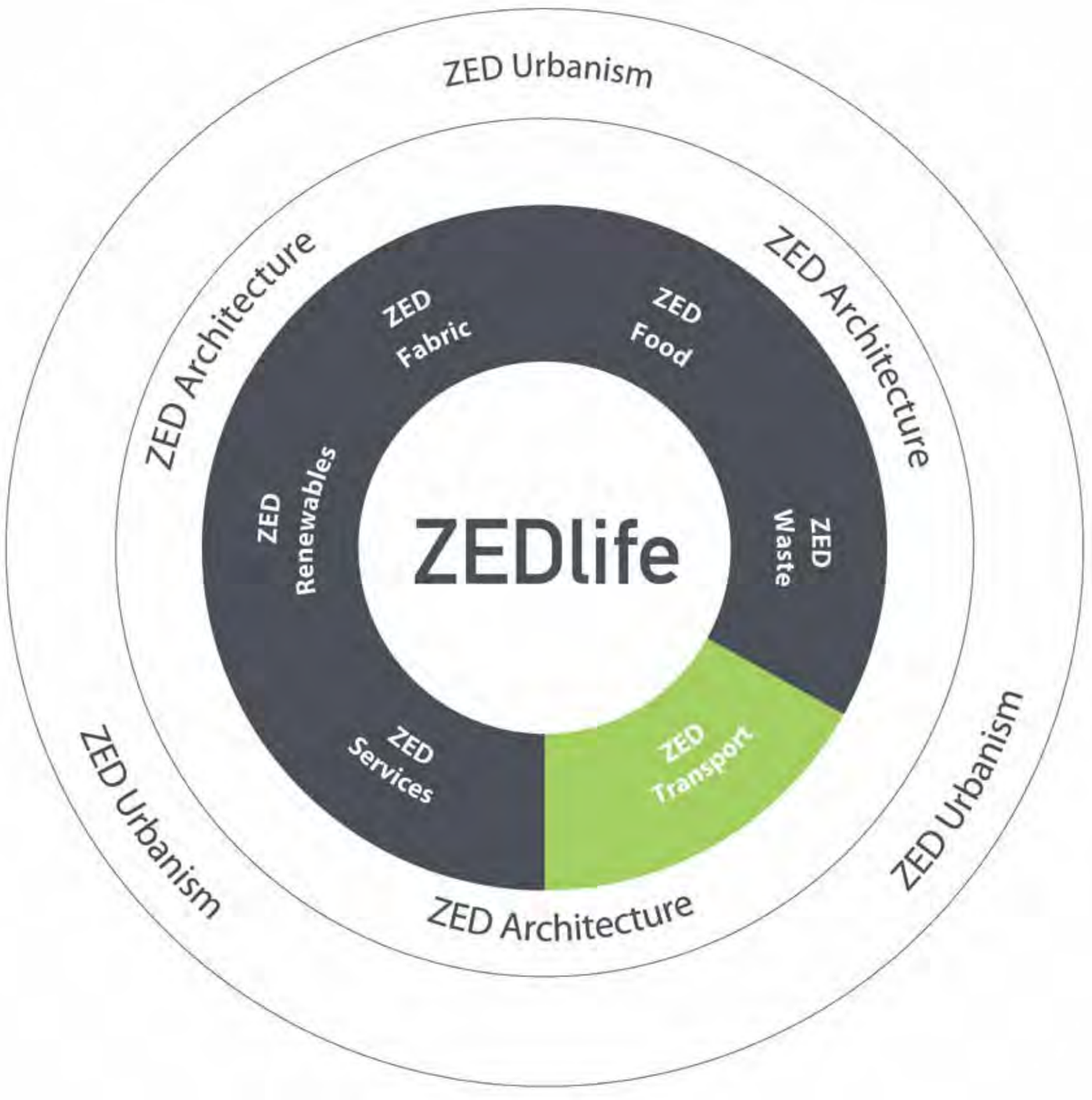
PYROLYSIS MODEL:

This model shows how the pyrolysis unit can be located next to the existing waste transfer station in Kingston Upon Thames.

The pyrolysis unit produces no smells or harmful fumes, and so can be located in an urban area. The district heat pipes can travel up to 3 km from the pyrolysis unit, serving thousands of homes, businesses, and the entirety of Kingston town centre.

Electricty is also exported to the grid. This option gives far more potential for powering and heating buildings within south London than the inceration option.



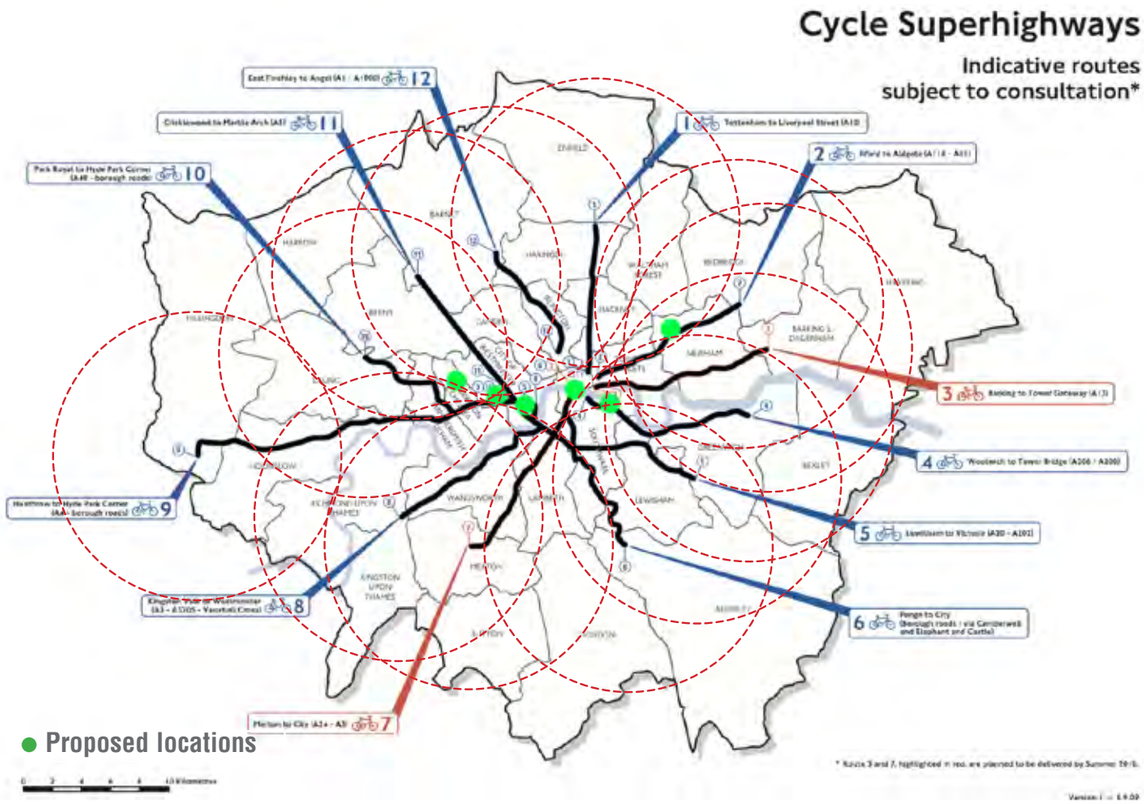


Buildings are only part of the story. We need sustainable transport solutions in place across the city in order to reduce emissions to an acceptable level...

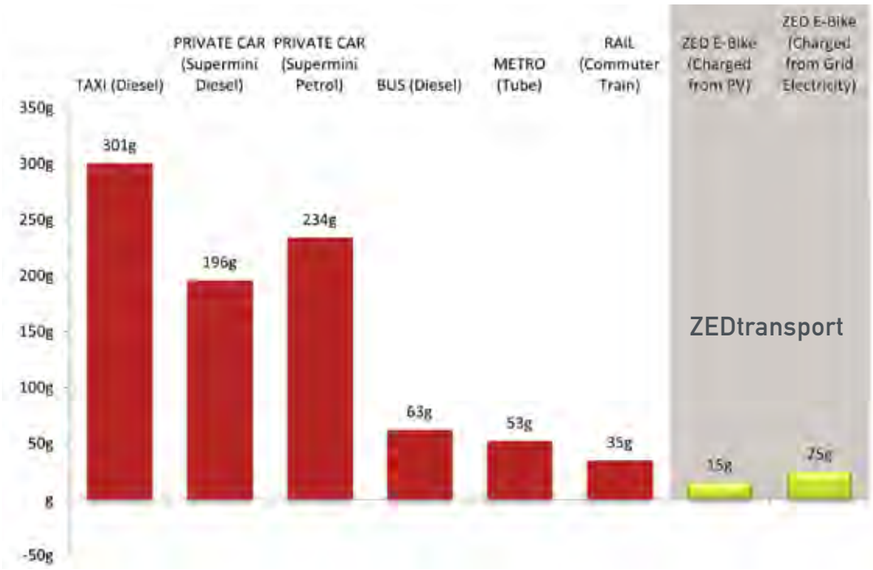
The ZED e-bike

It has now become important to develop low cost personal transportation for urban areas. Pollution and noise from fossil fuel powered vehicles make life in many cities unbearable.
Public transport infrastructure is expensive to build and has a very high embodied carbon footprint. It is also difficult to find the initial capital cost to pay for this investment. Meanwhile in many countries the road building programme has advanced, making walkable urban neighbourhoods difficult to achieve in the short term, however desirable in long term regeneration strategies.

Choose a personal zero carbon travel plan for your business because it's cost effective, more fun and it advertise your corporate values in highly conspicuous public streets.



Lifecycle Carbon Emitted per passenger km (lcg/p/km)



ZEDfactory has analysed the different modes of transport on a life cycle carbon emitted per passenger-kilometre basis, which then takes into account the carbon and energy invested into the manufacture of the vehicle. The average supermini emits more than twice the amount manufacturers are quoting, because of the carbon emitted during the manufacturing process. The ZED E-Bike uses the least amount of carbon per passenger kilometre per unit cost; even less when charged from a ZED PV panel.

Each bike needs 1kw energy to charge them fully, one PV panel can generate 143kwh energy annually, enough to cover 10,000 miles per year. Each solar tree can potentially generate enough energy to power 12 bikes annual power needs or about 10,000 miles for a modern electric car (mitsubishi i-MiEV)

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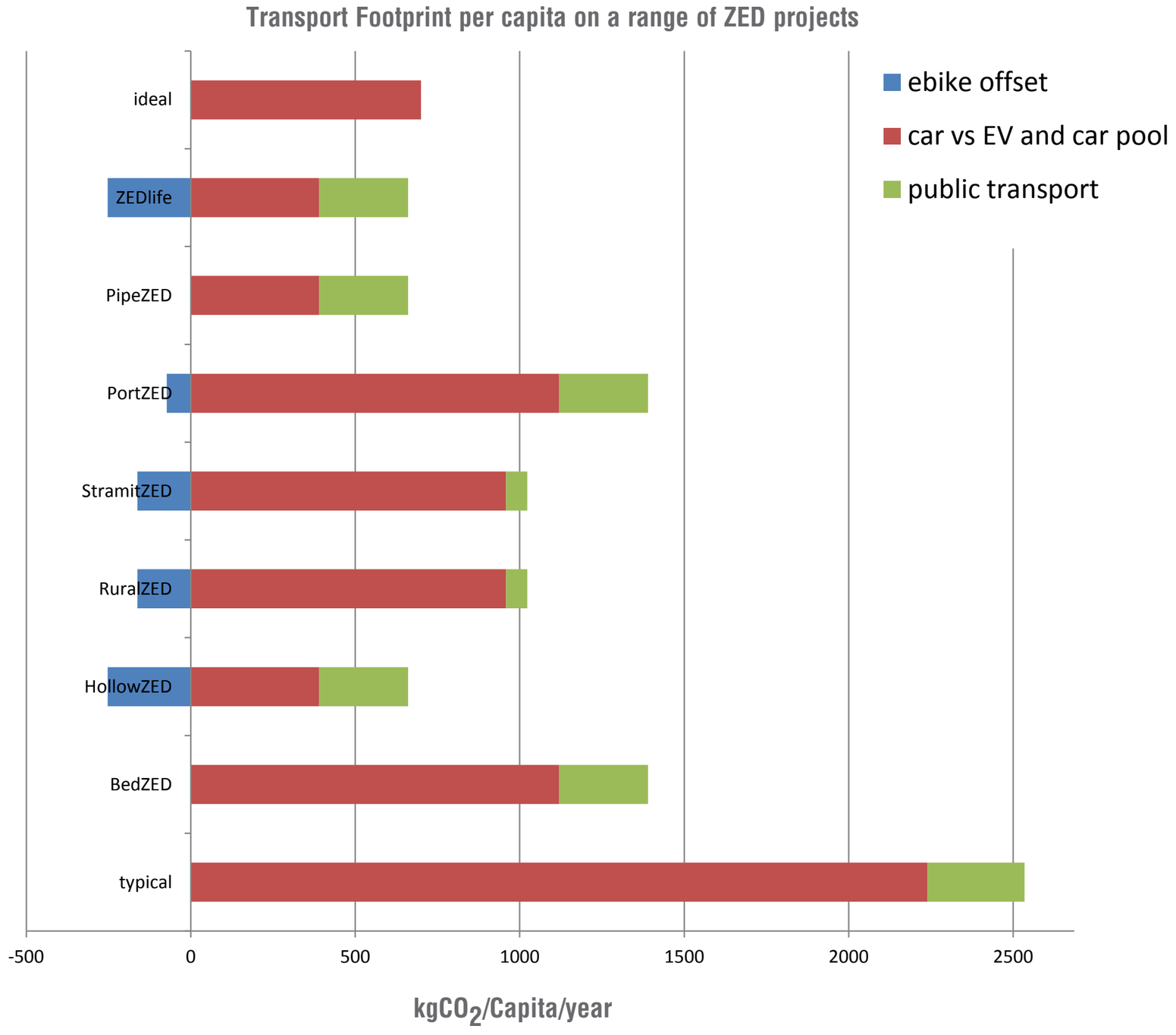
Environmental Footprint

The graph to the right shows the transport footprint (in red on the previous graph) in isolation for different typologies designed.

The e bike can make a major contribution to reducing the carbon footprint of personal travel - effectively displacing car use by encouraging people who wouldn't normally cycle to switch to a low cost renewable energy powered urban and rural transportation system. The E bike enables a 15 to 20 km trip to be easily completed twice a day at speeds comparable or faster than cars in most town and cities.



The ZED e-bike

Each ForeverZED e-bike

- annually saves 1.3, 1.0, 0.2, and 0.1 tonnes of CO2 compared to taxi hire, private car, bus and tube respectively, in London City conditions.
- annually saves £10k and £1.6k compared to hiring a taxi or owning a supermini sized diesel car.
- has a payback period of 33 months for investors without considering additional revenue from e-bike branding and advertising opportunities.
- can cover 48 kilometres with a single charge at speeds from 24 to 40kmph and potentially has 80,000km of battery life.
- has 2 x LiFePO4 batteries capable of 1kwh of storage, giving 3500 full charge cycles; far higher than the 800 charges quoted by most e-bike manufacturers.
- is the first e-bike designed with two batteries, giving higher sustained speeds and range whilst maximizing battery life.

Ebike with optional luggage Pannier

Single motor option for flat terrain

Double motor option for hilly areas

Solar charging integrated canopy

Exchangeable and rechargeable batteries

Potential Users

Academic User- Dock outside accommodation and university campus
Bikes and docks sponsored by universities to provide low cost-low carbon transportation system for students and staff
Business User- Dock outside office and at stations
Bikes and docks sponsored by businesses to provide low cost-low carbon transportation system for employees
Personal desk mounted charger and/or dock at office
Bikes may be purchased by user or subsidized by business with docks in office yard for full advertisement rights
Leisure Users- Docks at strategic public transport nodes
Bikes and docks may be purchased by businesses, where dock may be gifted to the city council with full installation cost in return of full advertisement rights on bike and dock at strategic public transport nodes.

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The ZED e-bike

The ZED e-bike

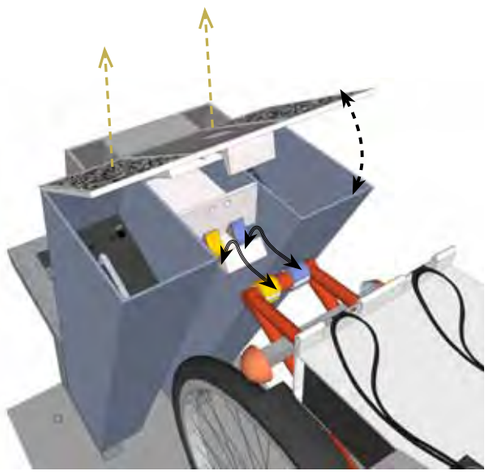
Each ForeverZED dock

- Is the first of its kind to deliver a low-cost zero-carbon transportation system for public use
- Has an optional solar mast which can be rotated for maximum solar gain, allowing the dock to be orientated in any direction.
- Is designed to integrate or enhance the public realm as street furniture, and as an urban landmark with its unique design.
- Is fitted with two accessible batteries to charge other models of e-bike, or other appliances for when an e-bike is not docked.
- Has huge potential to provide valuable advertising space for businesses
- Can be gifted to city councils with zero installation costs in exchange for advertising rights.

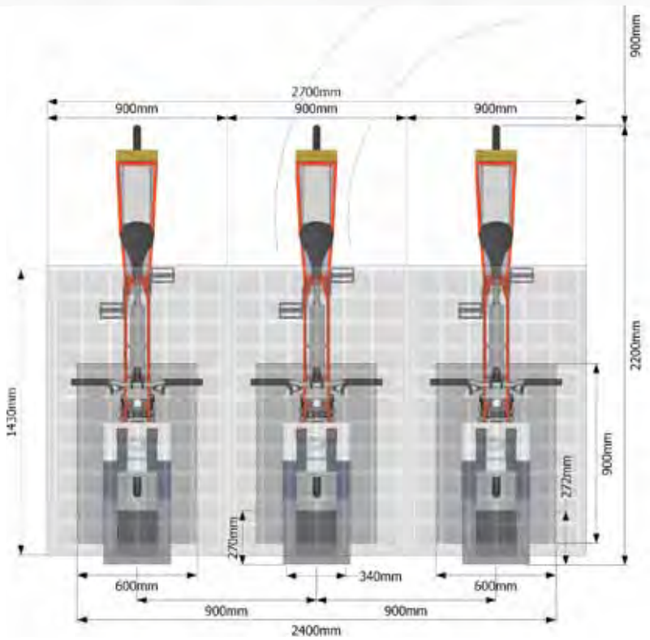
Solar shade canopies with integrated public seating, coffee kiosks and e-bikes docks for both private users and rental - are suitable for any locations with high footfall.

The first public e-bike charging & locking dock integrated with street furniture

Home Charger



Public dock charger with optional solar mast



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The ZED e-bike

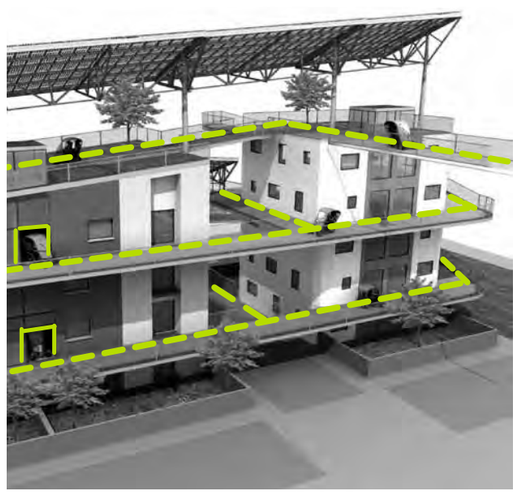
ECOBUILD Exhibition

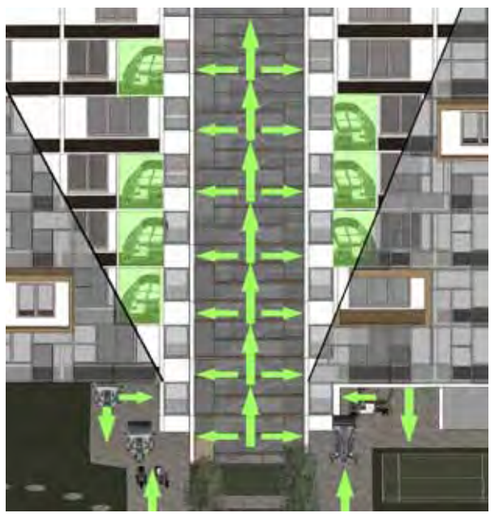
The ZED e-trike

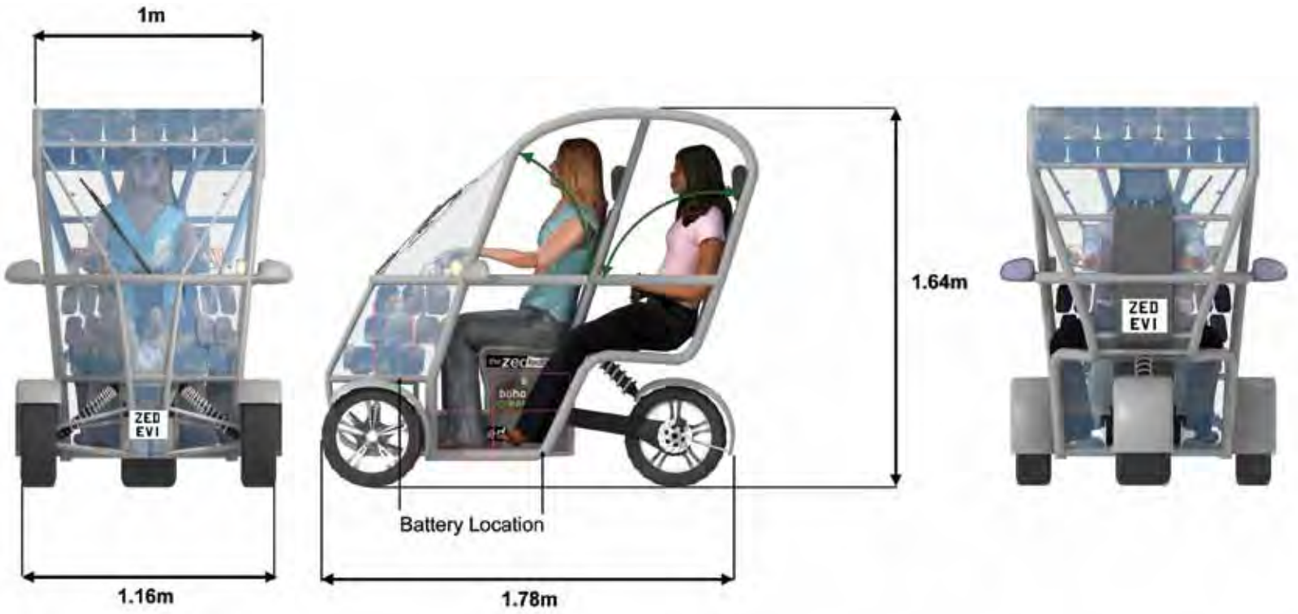
ZED E-Trike ZED

We have also developed a nippy compact electric trike, with two wheels on the front for good road holding, and the electric motor integrated economically into the rear wheel.

With shelter from the rain, optional doors, space for shopping, solar charging with additional grid top up, this space saving E-Trike is more economical and more convenient than a conventional full sized electrical car and, as it has zero tail-pipe emissions is clean enough to be parked in your lobby.







Potential Users

Academic User- Dock outside accommodation and university campus : Bikes, trikes and docks sponsored by universities to provide low cost- low carbon transportation system for students and staff

Business User- Dock outside office and at stations : Bikes, trikes and docks sponsored by businesses to provide low cost- low carbon transportation system for employees

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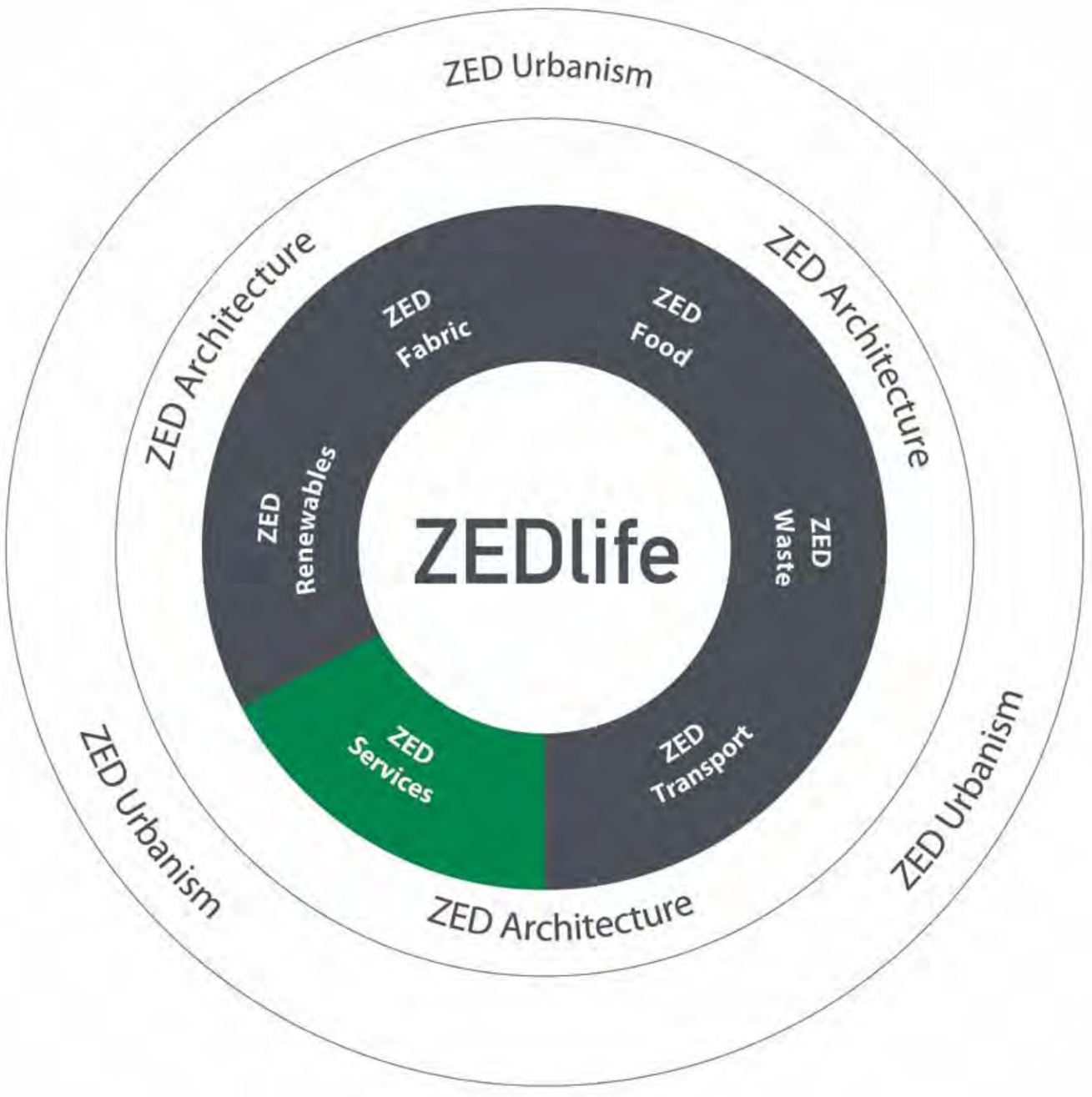


Now that we have our city adjusted to ZEDstandards, we can now reap the benefits that accrue from living a sustainable lifestyle...

Quality of Life

HEALTH

-Low allergy, well ventilated, thermally stable internal environment
-Fresh local produce delivered to the door
-Reduced commuting, excellent bicycle facilities and fewer shopping trips, combined with the quiet, safe streetscape and the neighbourliness has the potential to offer a lifestyle of low stress and more healthy exercise.

MATERIALS
The use of low VOC finishes(like mineral paint and bees wax); non reliance on fitted carpets; omission of heating systems that dry out the internal air in winter; along with the continual ventilation of all spaces together insure a largely dust free, healthy indoor climate which lowers incidence of asthma and other 'sick building' syndromes.

ZED homes rely on solar gain which means large glazed areas in turn give bright airy rooms which alleviate seasonal affective disorder or SAD.

Indoor and outdoor spaces are both crucial for wellbeing and the active use of the site as a place to meet and interact is essential. Indoor and outdoor spaces are connected with light and planting providing buffer zones like balconies and sunspaces - spaces to grow!

SENSE OF COMMUNITY

-ZED Bar
-Neighbourliness

CONVENIENCE
-Car club membership removes the hassle of car ownership and maintenance
-Food deliveries - internet and local farm
-On-site facilities:
-Childcare facilities
-Sports facilities
-ZED Bar
-Ready fitted A-rated white appliances
-Green lifestyle information service
-Community composting service

Above: Shanghai Expo ZEDpavilion

Above: Clean bright interiors with low VOC finishes

Above: Sunspaces link the outside to the inside and vice versa

Above: Each chair made for ZEDfactory by a CAFA art student from reclaimed materials on a budget of 100£ for Shanghai Expo ZEDpavilion auditorium - showing how everyone can be different in a low carbon future

Quality of Life

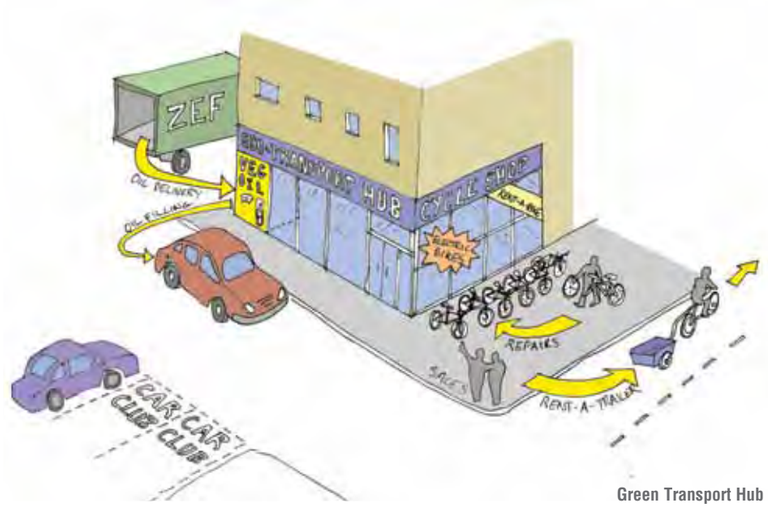
The ZED concept aims to provide sustainable homes without the hair shirts. Occupants can live and work within their fair share of the earth's resources without sacrificing convenience or mobility. In fact, it offers occupants a higher quality of life, increased levels of convenience, healthier lifestyles and cheaper running costs.

The range of ZED features that may enhance quality of life for occupants are catagorised below:

INTERNAL ENVIRONMENT

-Good daylight design
- Conservatory
-Good quality design
-External environment
- Sky gardens and balconies
- Quiet, safe, low car Home Zone design

FINANCIAL SAVINGS
-Bill savings - water, electricity and heating
-Car free living - occupants who drive under 15,000km / year are financially better off as car club members than owning a private car

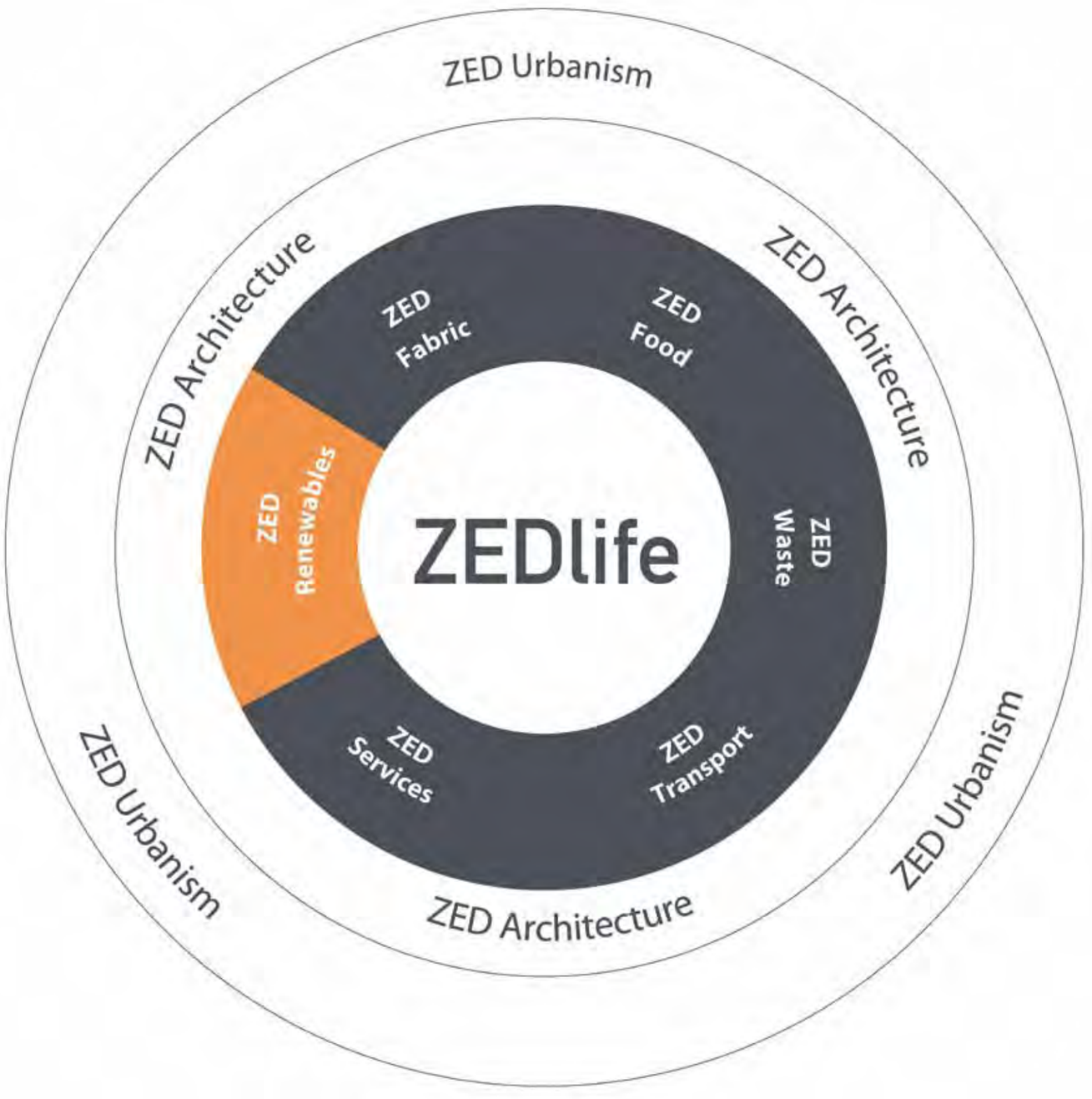


Green Transport Hub

Working with local small scale organic farms, delivering fresh, tasty and organic produce to the site via solar charged electric vehicles - the ZEDcafe & Bar demonstrates how food can be grown without using fossil fuels; delivered to the city without using fossil fuels; and without unnecessary packaging.

An on site bio-digester uses food waste to produce biogas to cook Chinese and International cuisines, and the waste stream nutrients can be returned as fertilizer to the farms.
Evening events and activities can be held, with shows and lectures on site, providing an entertaining and informative atmosphere to share, learn and relax.


Above: ZEF link diagram



Next, we will introduce some of our bespoke solutions for integrating renewable technologies into our buildings...

The ZEDroof

What is the ZEDroof?

The ZEDroof is a new energy roof system which lets daylight into a loft to create a conservatory in your south-facing roof space whilst generating electricity.

The ZEDroof can make you money, while providing free energy.

An integrated energy and roofing system that reduces costs by replacing traditional roofing materials

An universal architectural product the creates a conservatory or atrium in the south-facing roof space

The most cost effective solution to generate high FITS returns wherever there is a new roofing or a re-roofing need

The ZEDroof forms and integral part of our ‘ Net Zero Carbon - Net Zero Energy Bills’ Solution

New build

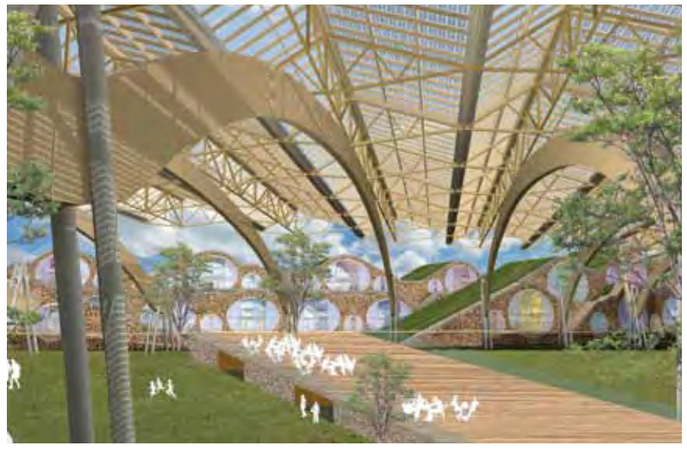
Create a beautiful shaded conservatory at the top of a residential building.

Retrofit

Installing a ZEDroof onto an existing victorian terraced house.
Generate over 100% of annual electricity and around 60% of annual hot water demand.

Public spaces

The roof panels are self cleaning and can be installed on any roof with a pitch steeper than 15 degrees.



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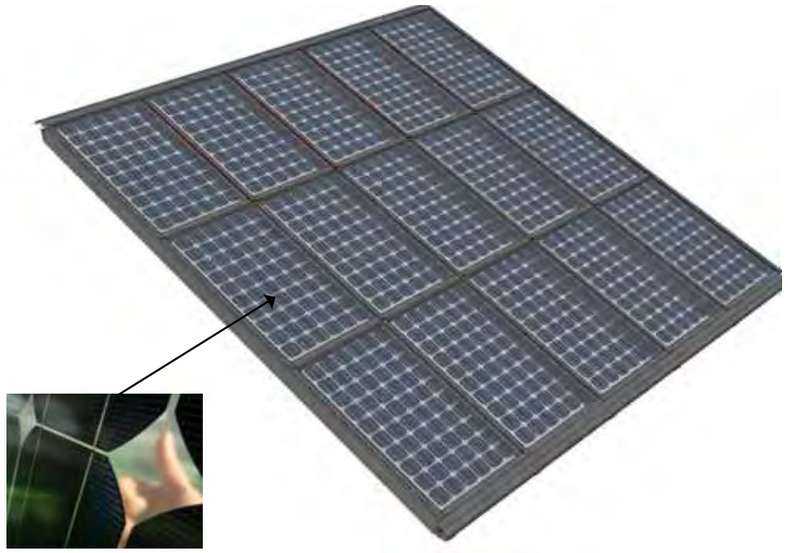
The ZEDroof

The roof becomes a weathering surface that doubles as a micro power producer. It allows for a solarium to be placed behind given the tedlar translucent backing allows light in at the fraction of the cost of glass-glass PV



Supporting Structure

Structural components

Waterproof Membrane & PVs placement

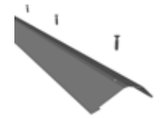
Gutter & Bottom Flashing

H profile

EPDM

Buty tape

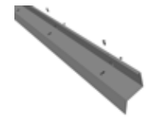
End Cap



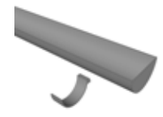
Ridge flashing

Ridge end cap flashing

Left /right verge flashiing



Eaves flashing



Gutter

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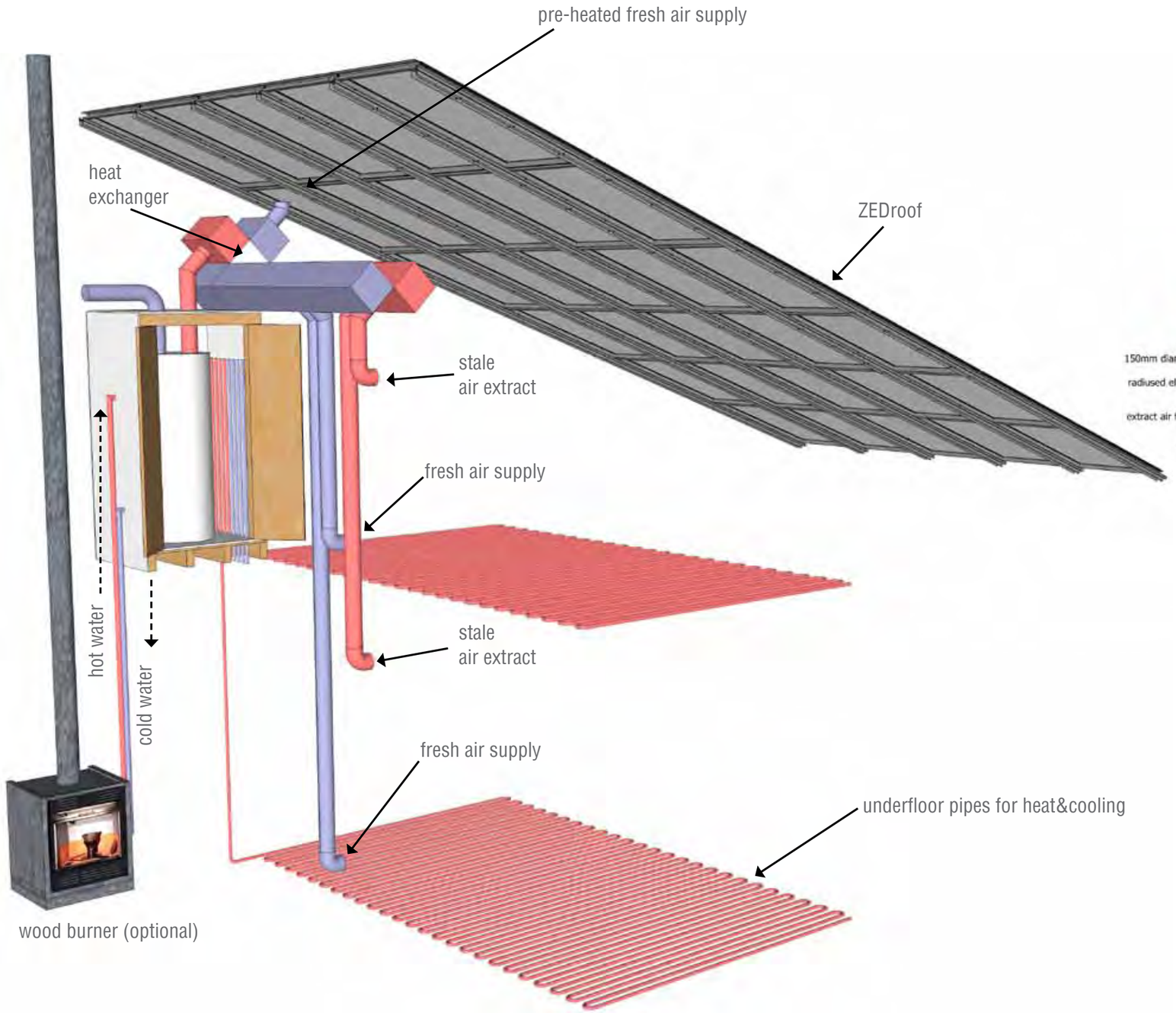
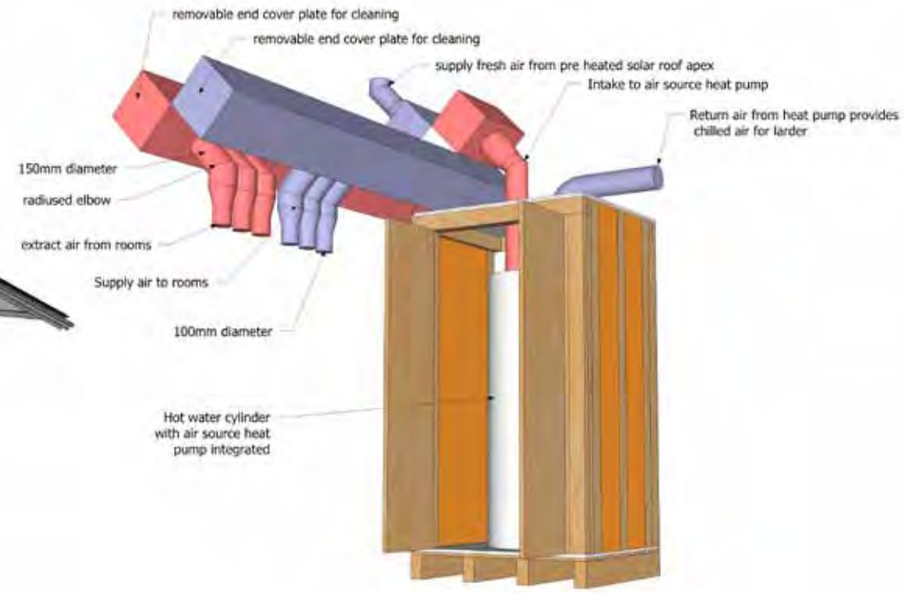
The ZED Heat Hub

ZEDhub has a positive carbon footprint device but delivers a whole house ventilation system with hot water and heating for a dwelling. This is a fraction of the cost of a conventional system without the infrastructure expense of a centralised plant.



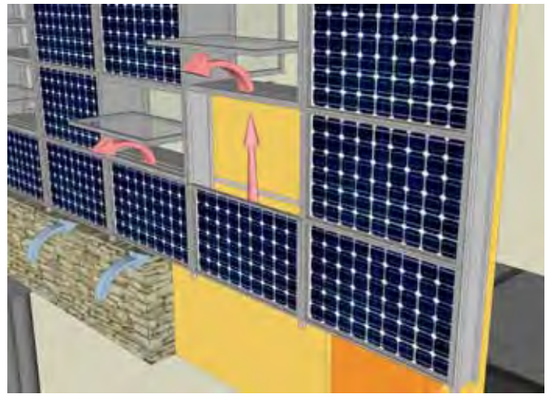


Renewables Application

ENERGY WALL

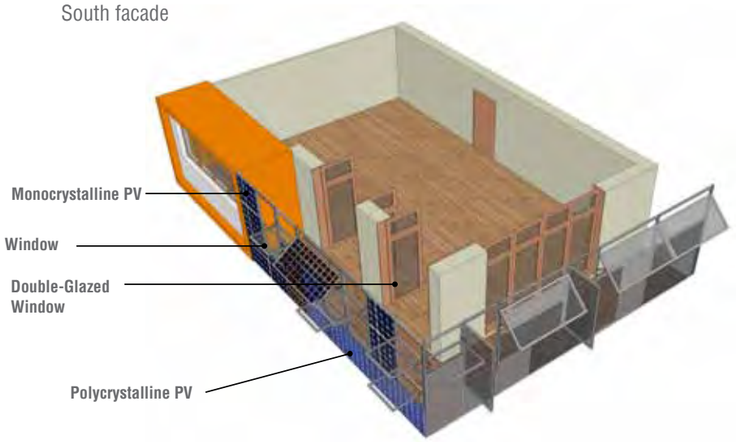
This system can replace cladding panels on unshaded facades +/- 20 degrees to south. Given the rate of reduction of PV prices these are cost effective even though they produce roughly less than the energy of a roof panel. The façade can also be used as a preheat twin façade to the surface of the building.

Two different arrangements of the PV panels have been explored depending on the distance of the screen from the wall.



In the first one these are fixed alternated with openeable windows and all the panels have same module.

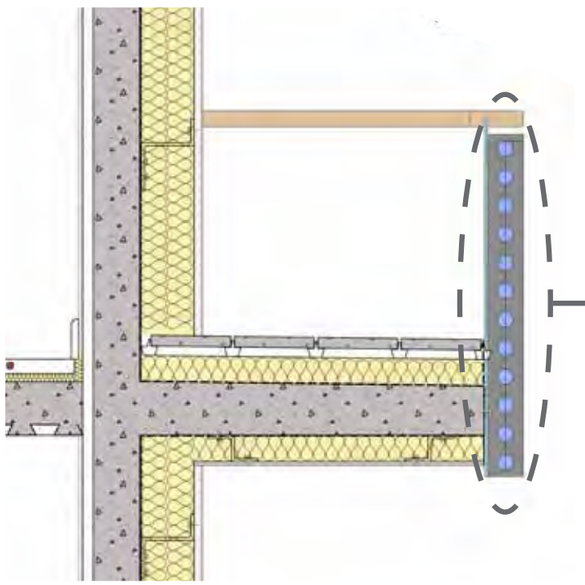
South facade



In the second arrangement PV panels are openeable, they only have one module but can be placed horizontally or vertically and alternated with squared windows to give more variety to the facade.

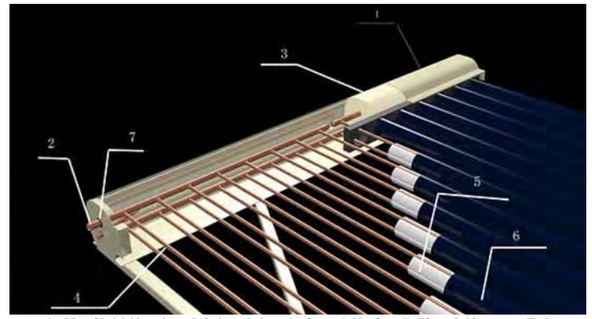
Solar Thermal Balcony

Solar thermal collectors can be integrated into balcony balustrades on higher density projects – freeing up roofspace for green roofs or PV.

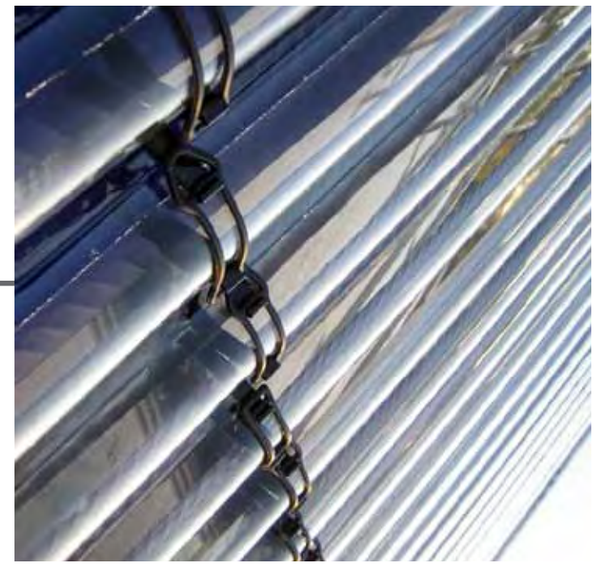


Solar Thermal

The U pipe collector is a type of Solar Thermal which is comprised of a manifold and many vacuum tubes each containing one U-shaped copper pipe. Sunlight is captured by the coated vacuum tubes which absorb the radiation as heat and conduct it through aluminium fins to the U pipes. A manifold on the top of the solar collector allows the working fluid (typically anti-freeze) to be pumped through all of the U pipes in parallel, and then through an external heat exchanger which transfers the heat to water in a pressurized storage tank.



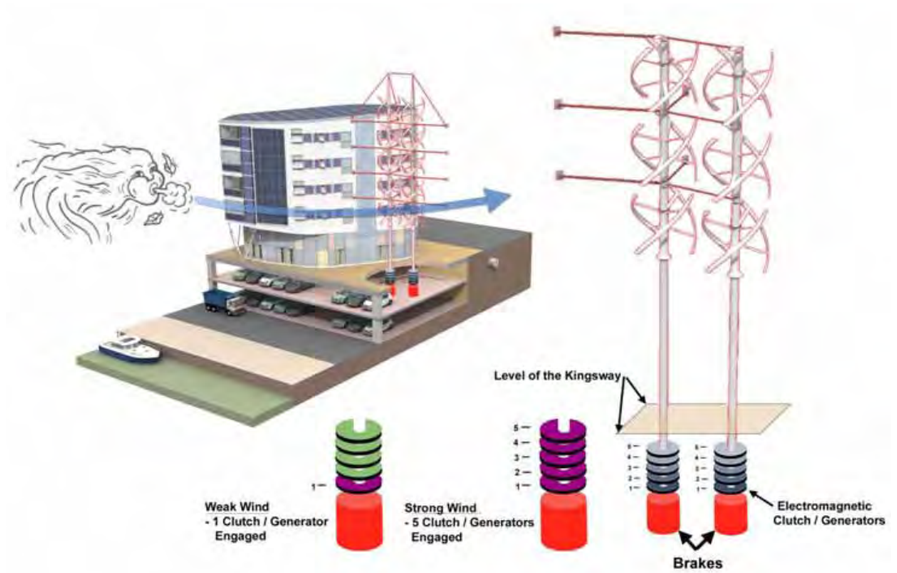
1. Manifold Header 2.Inlet 3.Insulation 4.U pipe 5.Fin 6.Vacuum Tube



Wind Power

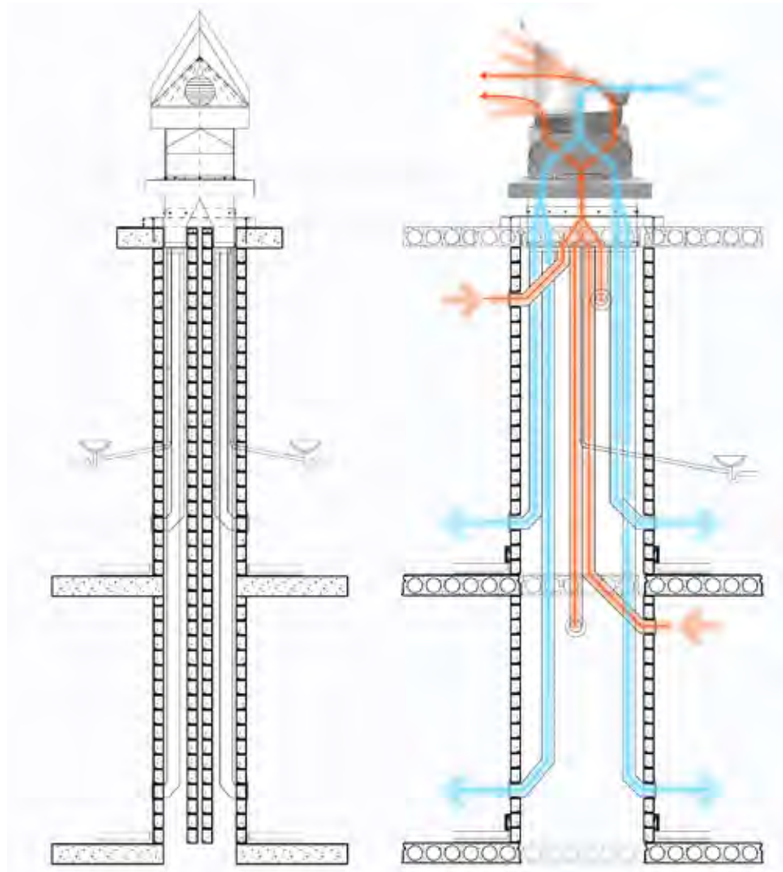
Wind Turbine

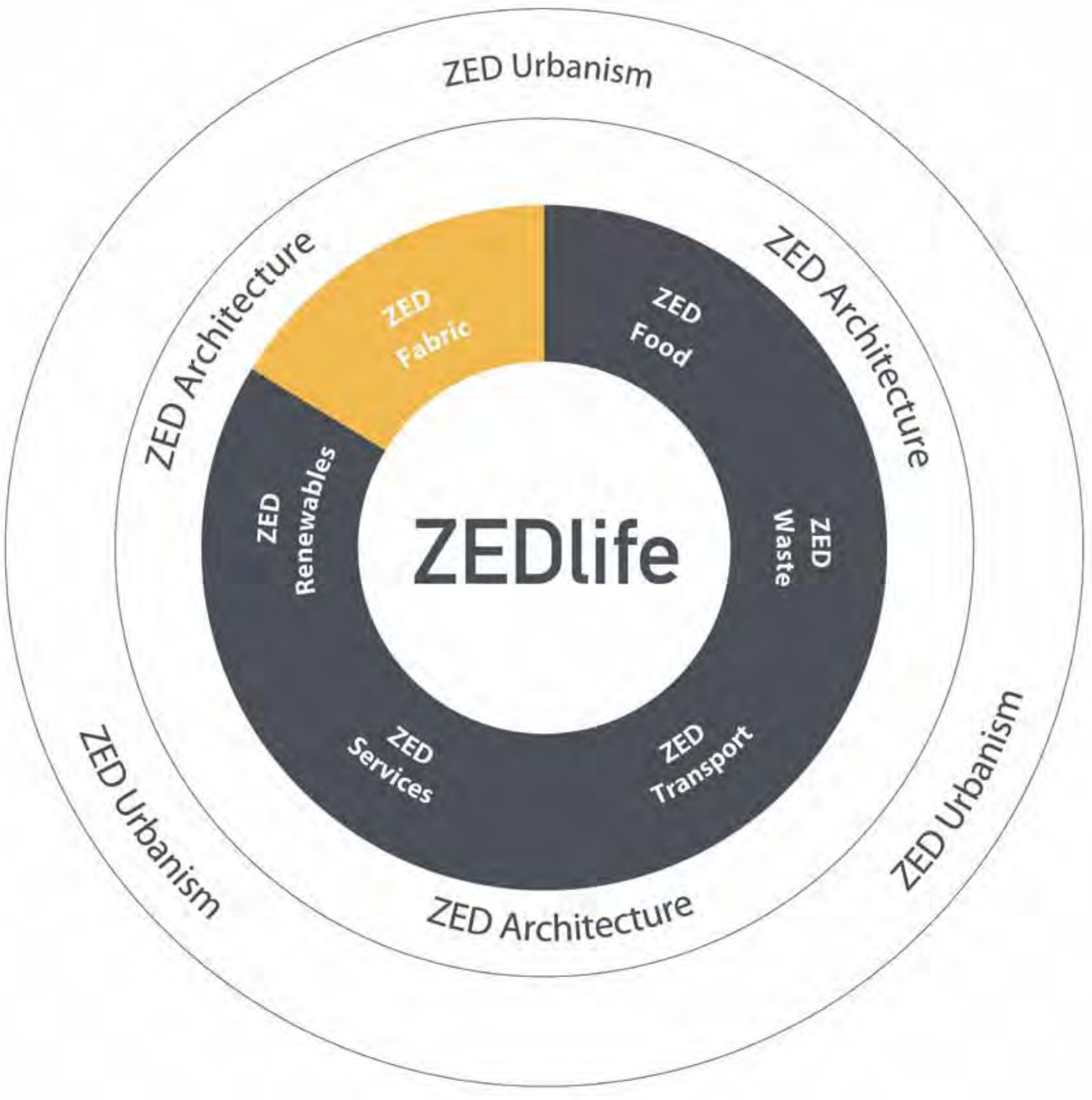
Low velocity wind turbines which isolate mechanical gear from the outside environment provide suitable aerodynamically designed building with wind energy similar to that of open field conditions given wind concentration they are silent in operation and can be shut down by a photocell and electromagnetic break in case of flicker effect.



Windcowl

The windcowl product is used in buildings up to four storeys in height to provide 70% heat recovery ventilation without the use of motors or fans. This uses a combination of wind driven and thermal buoyancy effects to allow fresh air requirements during the heating season.



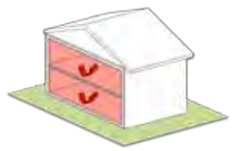


In this section we look into some of the vital ingredients and concepts which go into making a zero carbon house…

Vital Ingredients for Zero Carbon Houses

FOR ALL TRUE ZERO CARBON HOMES PASSIVE SOLAR DESIGN SHOULD BE FOLLOWED WITH THE FOLLOWING INGREDIENTS:

Thermal Mass



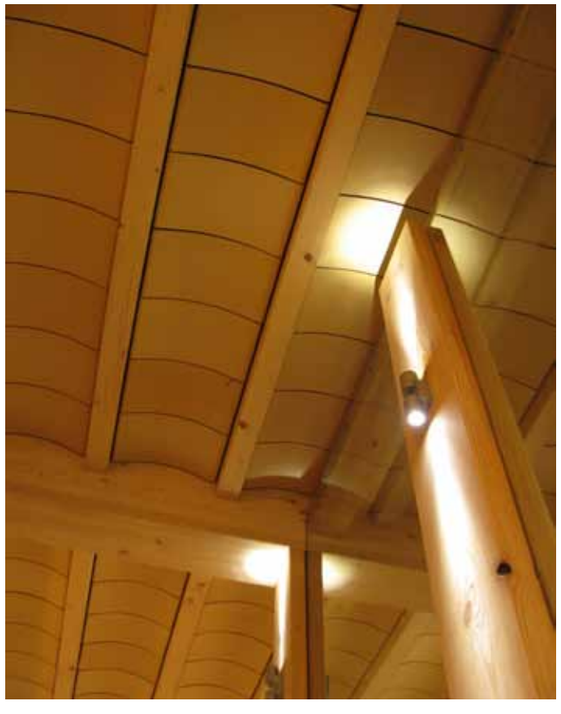
Using dense materials in the ceilings and floors reduces fluctuations in temperature from internal heat gains and losses through open windows

High levels of insulation

Wrapping the thermal mass in high levels of insulation reduces the need for active heating and cooling in a building to an absolute minimum.

COOLVAULT

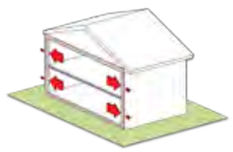
Developed with a brick manufacturer is a self firing clay brick that can be placed in timber beams to provide low carbon thermal mass to dwellings. This is primarily used in the timber framed solutions RuralZED and StramitZED listed below



RuralZED concrete plank wall

Vital Ingredients for Zero Carbon Houses

Airtight Construction



In order to keep the valuable heat and coolth in, the building should have as little uncontrolled ventilation as possible, particularly during the heating season.

ZEDheat-hub™ heating&ventilation system

- A ventilation system with heat recovery
- A micro-heat pump
- A compact hot water cylinder
- Plus an additional coil for a wood stove.

HiminZED ZEDroof integrated PV panels to generate all net electricity

It is now possible to meet 110 % of a typical homes annual electric demand from grid connected roof integrated PV @ residential densities up to 50 homes / ha = around 70 % of UK new build annually

Vital Ingredients for Zero Carbon Houses

Low-embodied-energy building

timber structure

Reducing the embodied CO2 of any construction means that the time taken to payback the original CO2 construction debt is shortened. This improves the overall 'cradle to cradle' lifecycle carbon analysis – which will eventually become the key performance parameter for comparing and assessing different low carbon projects, particular when the embedded CO2 tally for each project is added to BIM CAD design systems.

Construction Waste

It is advisable that prior to commencement of construction, the construction site puts in place a Site Waste Management Plan.

The following issues should be considered during design development and in preparation for construction:

- Identify resources already on the site, such as top soil or hardcore, which can be put to useful effect in the new development.

- Good practice in terms of waste management should be employed including monitoring of waste streams.

- Every opportunity should be taken to recycle materials or send waste materials to waste recovery centres.

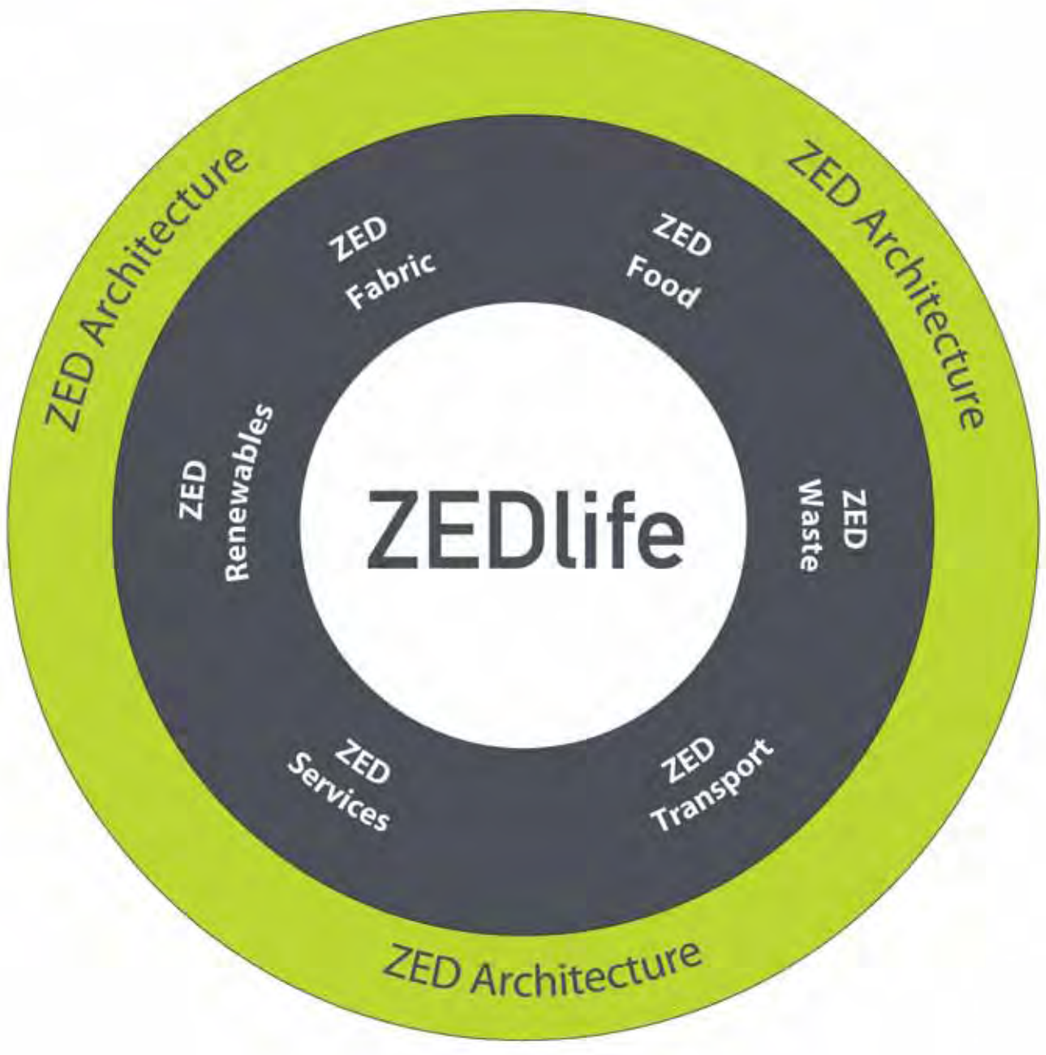
- Ensure options for the uses of reclaimed and recycled construction materials, which meet the materials specification, are considered.

- Recycle suitable spoil, demolition materials, pruning, and surplus construction material arising from the works on site to avoid the need to transport materials.

- Keep the site tidy to reduce material losses and waste.

- Many choices in the design process have downstream impacts in terms of waste generated. In particular, opportunities should be sought to use modular designs, which make use of many identical building components, but at the same time avoiding blandness in external appearance and being in keeping with the character of the local area or suburban context.

- Ensuring that measures have been taken to enable more components of a building to be recycled during refurbishment or demolition.



ZEDfactory have designed different building typologies , always investigating how to minimise embodied carbon and operational energy use...

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zero fossil energy developments

Different typologies need different low carbon constructional systems

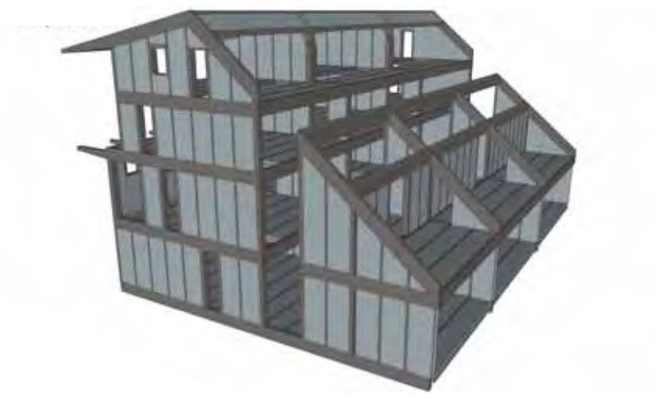
ZEDfactory have spent a decade developing practical construction details that make new architectural forms easy and affordable to deliver

BedZED
Using a standard brick and block system, a distinct supply chain was set up for roll out of future projects

StramitZED
Using a compressed straw system to provide a low carbon cladding shell with an oversized balloon frame system to deal with thermal mass loadings

PortZED
Buildings aerodynamically designed to capture wind creating wind speed up for renewable harvest and driving ventilation

HollowZED
Using hollowcore in prefabricated panels for both floor and wall units that can be structurally tied together to provide earthquake resistance



RuralZED
Glulam/box frame timber system with distinct packages that ties a great deal of the embodied carbon within sequestered timber building materials using thermal mass where necessary

PipeZED
Using civil engineering products to create earth bermed structures allowing the reduction of spoil export from site by use within the building structure.

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Environmental Footprinting

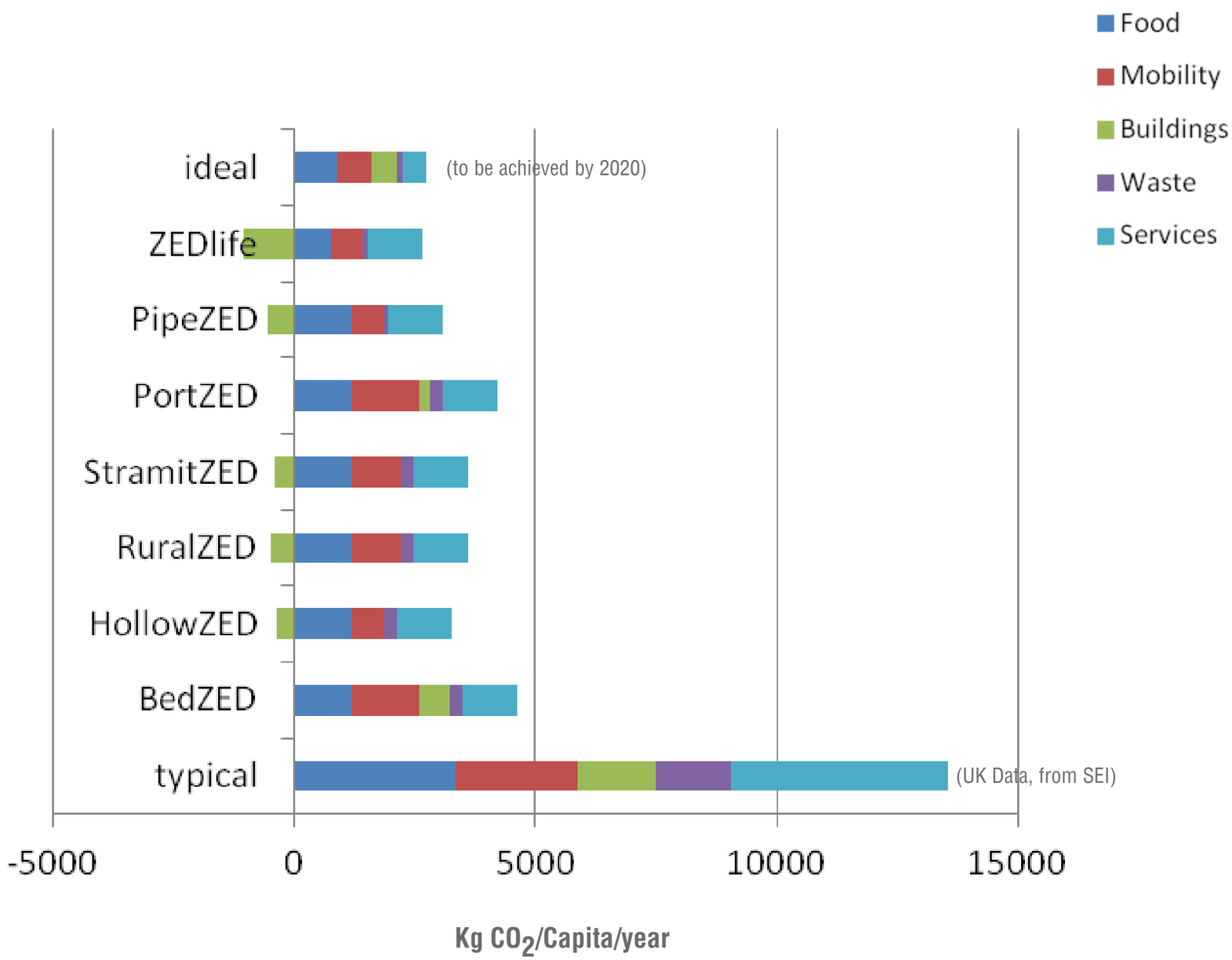
The ideal scenario demonstrates the limit set for 2020 under the contraction and convergence data given the projected rise in population. Studies have shown that all sectors need to be significantly reduced to achieve the target emission levels. A severe change in lifestyles will be required to achieve these targets. The element that indirectly links all of the sectors is the built environment, encompassing local food sources, public transport, closed loop waste recycling or simply a school that is within walking distance.

The diagram to the right illustrates previous data collected from our projects as well as the hypothetical "ideal" scenario to be achieved for 2020.

Some of the projects' "buildings" segment falls to the left of the Y axis. This shows that in these cases, these projects' buildings generate more energy than they use (even after embodied carbon is taken into account). This therefore means that this "surplus" can be used to offset other parts of that resident's life, such as transport or services.

The climate neutral buildings concept provides a rigorous whole life carbon footprinting methodology. This shows how careful building and urban design becomes the mechanism that allows the other sectors to function and obtain the targets required.

Range of projects using the main sector data.

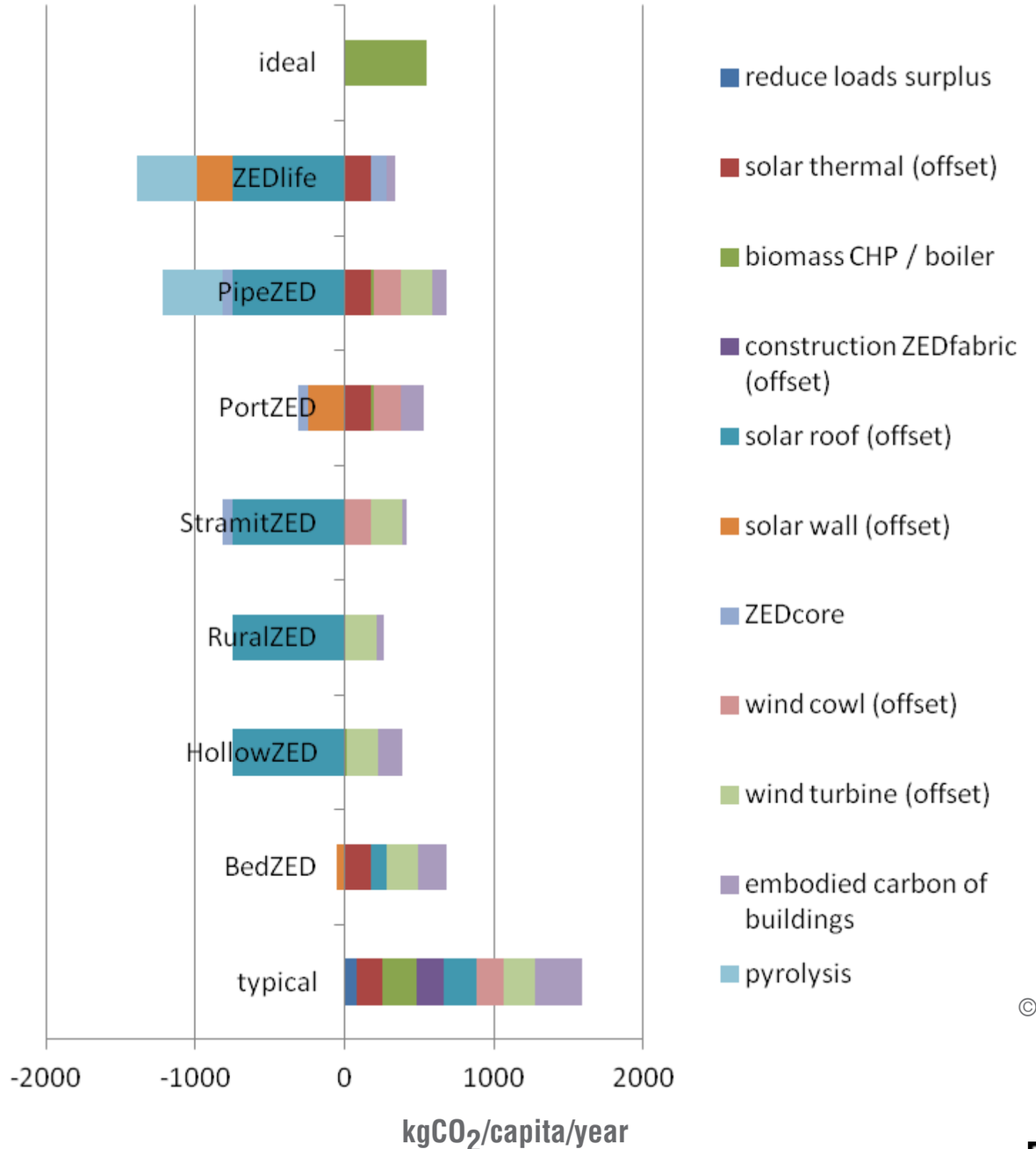


Environmental Footprint

All the technologies described have been developed by ZEDfactory with industry partners over decades. We have found that working with our supply chain consistently over a long time makes better, lower cost construction components that fit together easily and minimise the risk inherent in introducing new technologies into a conservative construction industry. We offer these products as options to clients, and they often help us deliver a far higher specification given tight budgets. We encourage other teams to specify these products, as larger orders for the manufacturers reduces costs for everyone. We also welcome new manufacturers wishing to participate in this low carbon supply chain – either regionally or internationally.

We also try hard to measure the environmental footprint of our supply chain, wherever possible accounting for regional production and site specific transportation strategies. We think its important to manufacture bulk materials locally and use local labour for both manufacture and site erection at the same time as creating jobs, and stimulating the local economy. However components that are compact and high technology often require lager investments in centralised production facilities and may have to travel some distance by sea.

Individual Environmental Footprints per capita on a range of ZED projects.



Climate Neutral Methodology

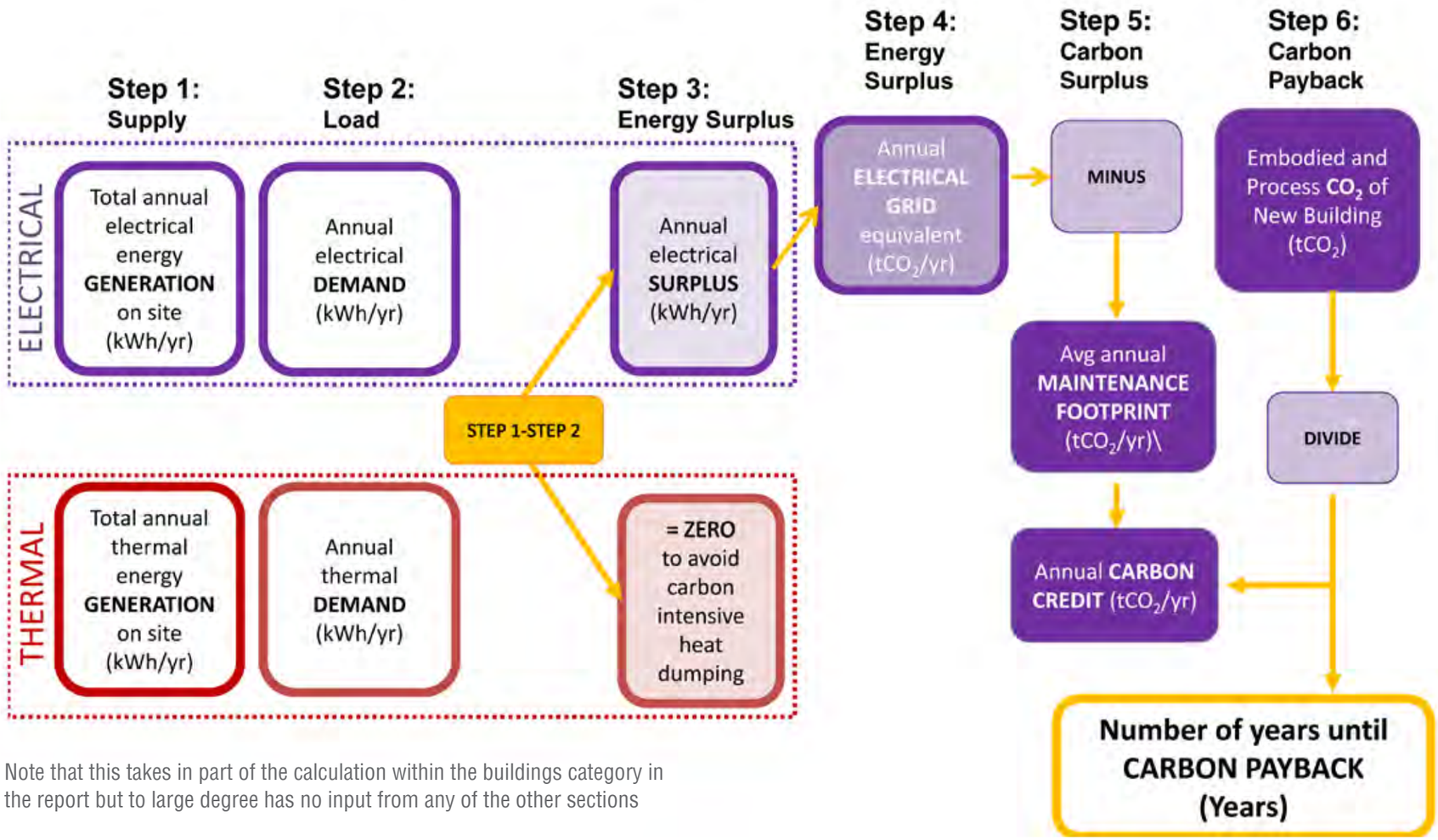
ZEDfactory Climate neutral methodology flowchart

This study looks at how to create a healthy building that works for both the local occupants as well as the global context – addressing the spectres of peak oil, peak gas, peak nuclear, food and resource shortages and accelerating climate change.

Buildings are ideally designed to be powered by slightly more renewable energy than they need to meet their annual requirements. At times they become power stations exporting zero carbon electricity to the national grid and displacing carbon emissions from fossil fuel power stations.
Over the buildings' minimum working life of around twenty five years enough carbon will have been displaced from the UK fossil fuel powered grid to offset the embodied CO2 used in the initial construction and its eventual deconstruction for recycling. This is only possible if the buildings have minimised their running energy demand by incorporating state of the art energy efficiency, features enough building integrated renewable energy systems, and have an extremely low embodied carbon payload achieved by careful building component specification. This strategy makes the whole project more or less climate neutral, and sets a new corporate standard for reducing the environmental impact of this industry.

To obtain the 'correct' carbon footprint a range of interlocking technologies is required rather than a single solution. The footprint of the buildings sector can make buildings net producers of energy allowing some of this bonus to be placed within other sectors where societal values make reductions unfeasible for the general public.

The targeted intervention within other sectors although measured values are not significant can have a large influence on the reduction of emissions in these sectors. The scale and site constraints of such a development is vital in achieving the target footprint per resident with mistakes made at masterplan level resulting in target values to be unobtainable without a detrimental effect on quality of life of residents.



Note that this takes in part of the calculation within the buildings category in the report but to large degree has no input from any of the other sections

Net Zero Energy Bill Homes

Similar to above in replacing cladding panels on unshaded facades +/- 20 degrees to south given the rate of reduction of PV prices these are cost effective even though they produce roughly have the energy of a roof panel. The façade can also be used as a preheat twin façade to the surface of the building

Although this has a positive carbon footprint the device delivers a heat recovery whole house ventilation system with hot water and heating to a unit. This is a fraction of the cost of conventional systems without the infrastructure expense of centralised plants

‘ Generating enough income from renewable energy to meet the monthly payments on the extra capital cost required to fund the zero carbon specification’

The ZEDhouse™

A low fabric heat loss design with high levels of insulation, thermal mass and passive solar gain.

+

The Energy System

An integrated energy solution using the HiminZED ZEDroof™ system and the ZEDheat-hub™ integrated micro-heat pump, compact hot water cylinder & ventilation heat recovery system with additional coil for a wood stove.

+

Income from Energy

The energy system provides an income under the FIT’s scheme that is sufficient to offset costs, even under the 2013 FITS rates using current pricing.

-

The Costs

We take into account the additional mortgage repayment required to fund the technology. We estimate this as the cost over and above building to current building regulations. We also include running costs in the calculation.

=

The Net Zero Energy Bill Home

The ZEDroof™ maximises FITS returns by substituting traditional roofing costs with a single integrated solar roof at around £150/m2 . The ZEDheat-hub™ reduces costs by integrating all heating solutions into a compact unit which replaces the standard boiler system. A small biomass wood burning stove provides top up space heating and hot water in the coldest months, although the superinsulated, draught proofed building fabric hardly needs auxiliary heating to stay comfortable.

Notes

The Zero Energy Bills concept is based on the annual offsetting of incomes and outgoing. For example the house will still incur an electricity charge for the electrical consumption at night however this is offset by the FITS income. £850 rebate for the ASHP is included

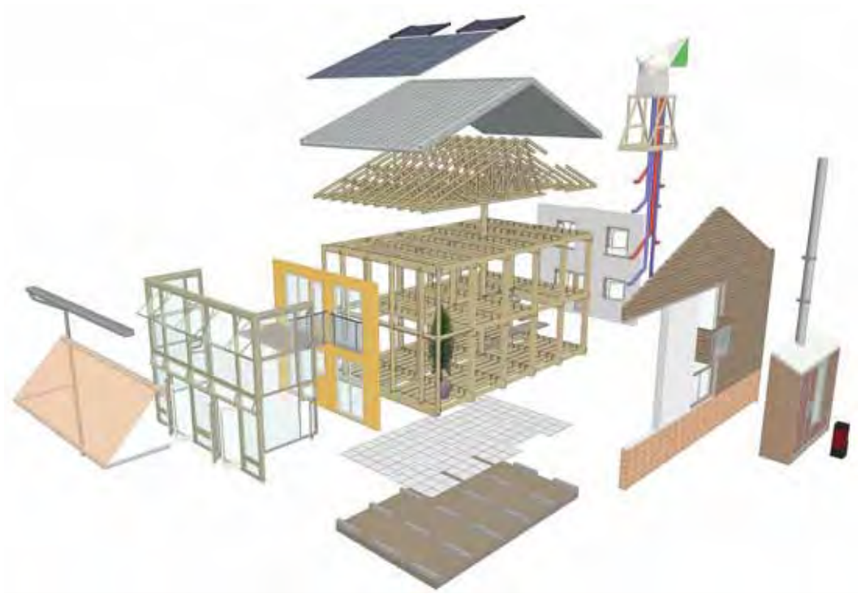
Kit House

RuralZED

This construction system uses a post and beam box frame, manufactured from Welsh timber. This provides a durable structure which is flexible in layout and provides the unique experience of a traditional timber frame building.

RuralZED in Grande Synthe, France

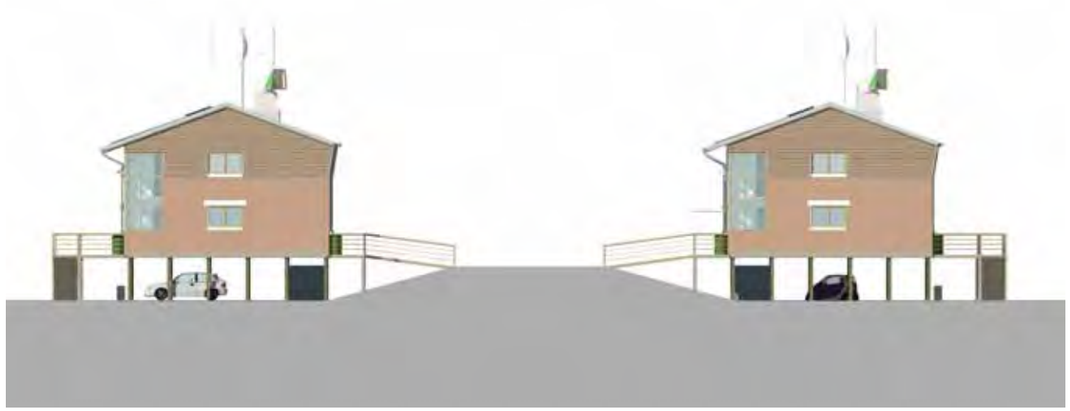
TIMBER POST AND BEAM STRUCTURE
Durable frame provides flexibility.



RuralZED interior

Kit House

RuralZED _ Flood proof



Kit House

Pre-designed Affordable Zero Carbon Houses

Kit House

ZEDhouse

This construction system uses a timber stud structure

Ground Floor Plan | First Floor Plan | Second Floor Plan | Second Floor Plan

Standard Pre-Designed Floorplans

ZEDhouse development - EcoGrove, Barking

ZEDhouse development - Bickleigh Down

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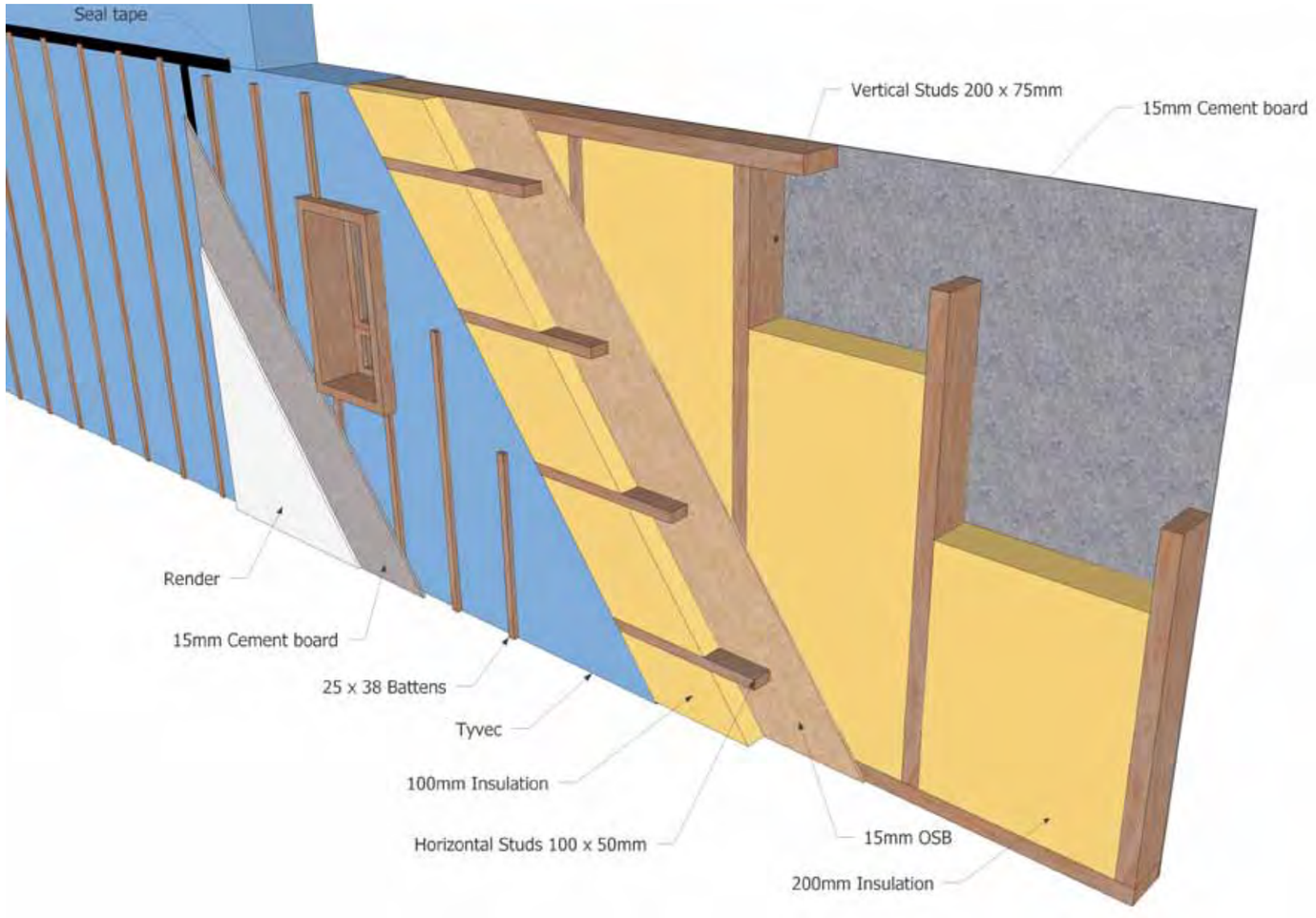
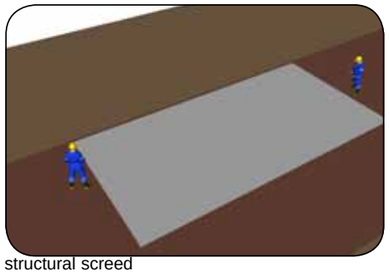
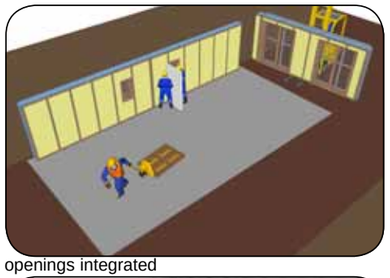
Kit House

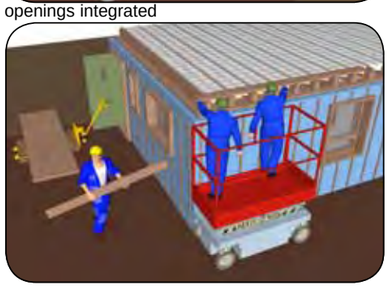
The construction system used is that of an oversized balloon frame This timber framed solution allows for a largely dry construction system that does not require multiple coordinated concrete deliveries and coordination of many site labour interfaces which are likely to increase the risk of cost escalation.

Wall panels can be pre-fabricated on site at the assembly facility, and lifted into position on demand - ensuring high quality construction in a quick build procurement strategy.




structural screed


openings integrated



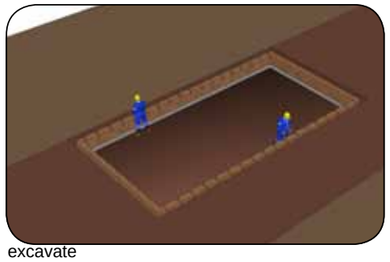
Coolvault
Developed with a brick manufacturer this is a self firing terracotta brick that can be supported on timber beams or joists to provide low carbon thermal mass and a self finished durable ceiling. Lower cost alternatives of polished eco-concrete slabs can be substituted without detriment to the thermal performance of the building.

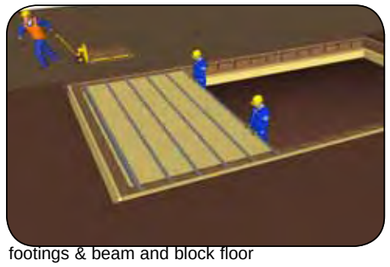
Kit House

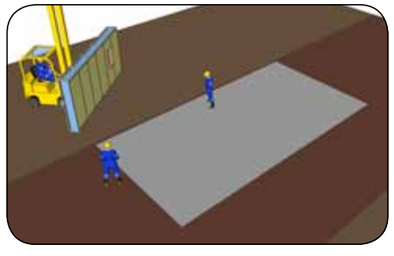
Potential House Construction Sequence

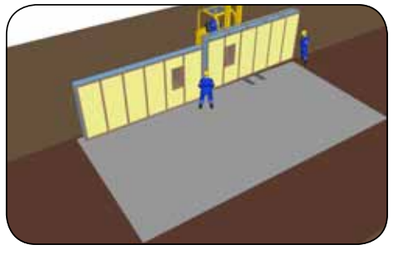
The following shows what type of processes are involved in the typical house construction and what type of jobs could be created on site.

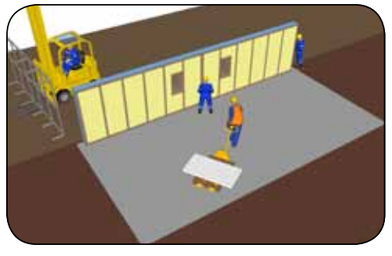
Note extensive use of prefabricated panels minimises need for scaffolding.

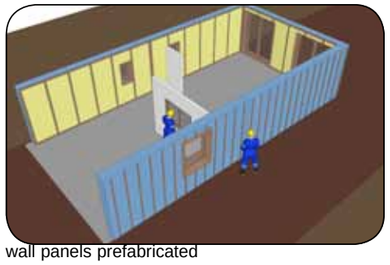

excavate


footings & beam and block floor

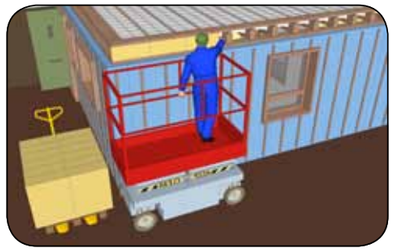


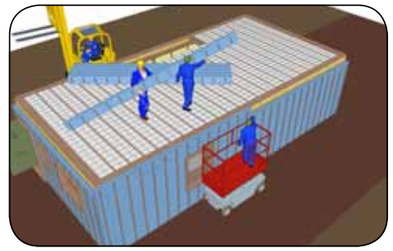


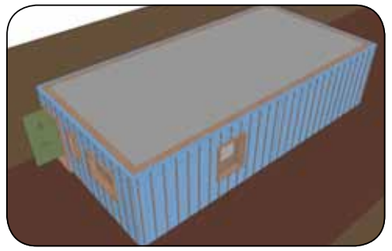


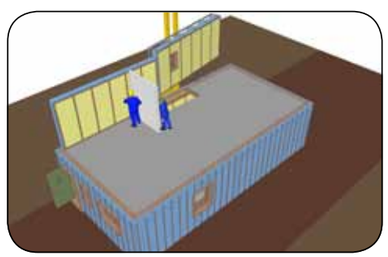

wall panels prefabricated

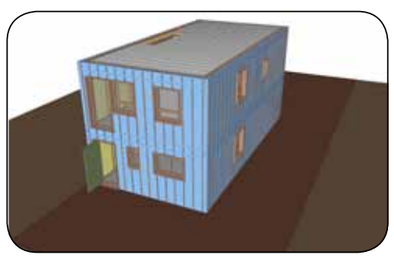

thermally massive ceiling planks

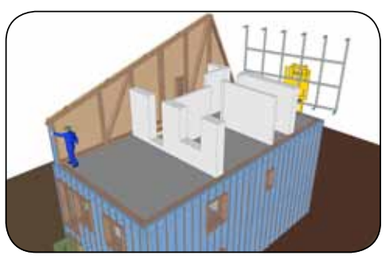


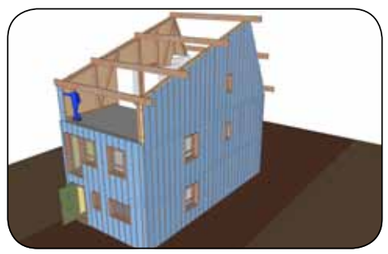


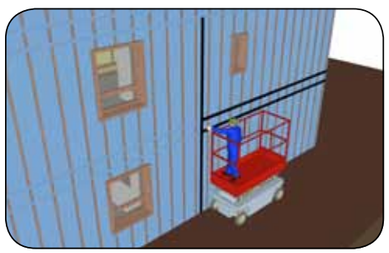


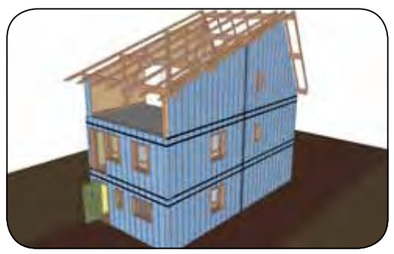


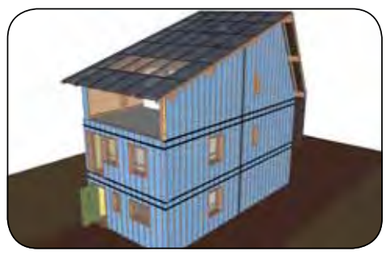












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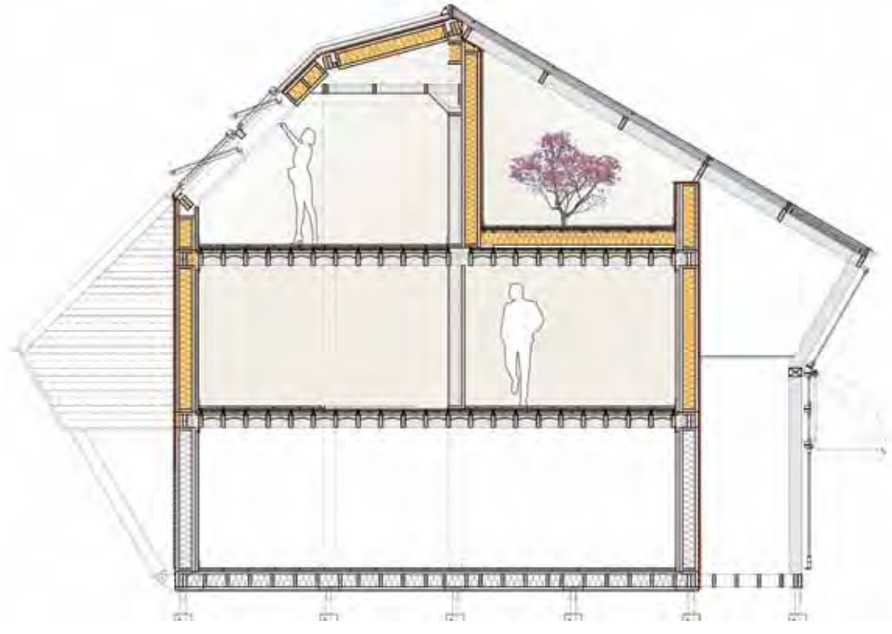
Retrofit

Domestic Refurbishments

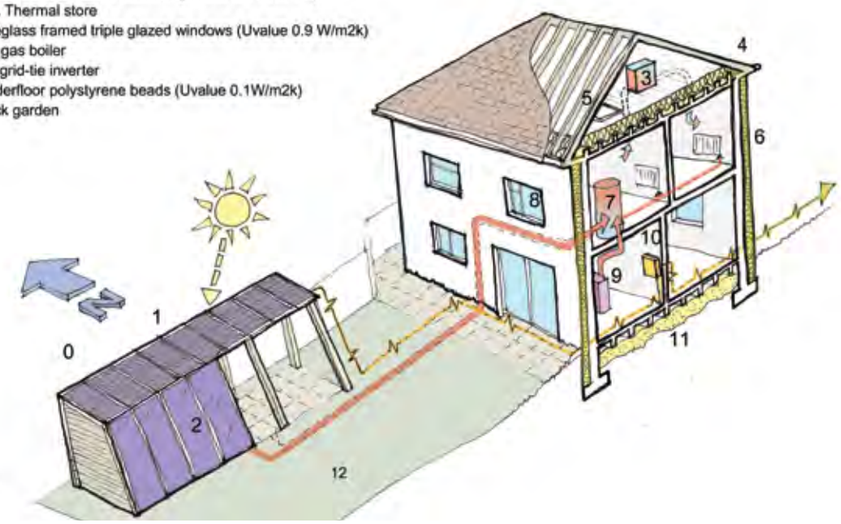
We work on a range of scales and budgets from large extensions to refurbishments and new build.

ZEDfactory offer standard architectural services for designing individual houses and developments.

We have recently completed a Retrofit For The Future House.



0; Solar shed, permitted development
1: PV panels, 1.7kW
2: Solar Thermal flat-plate collectors (9 sqm)
3: MVHR unit
4: Soya foam and mineral wool to loft space (U value 0.1 W/m2k)
5: Airtight loft hatch
6: 180mm external cork insulation (Uvalue 0.15 W/m2k)
7: 350L Thermal store
8: Fibreglass framed triple glazed windows (Uvalue 0.9 W/m2k)
9: New gas boiler
10: PV grid-tie inverter
11: Underfloor polystyrene beads (Uvalue 0.1W/m2k)
12: Back garden



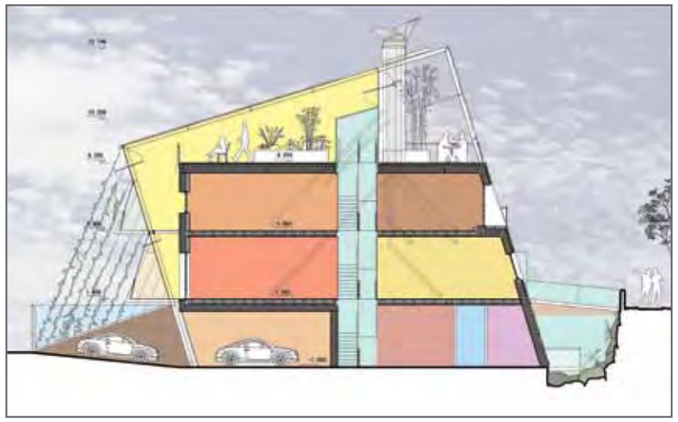
Bespoke Houses

Hope House, London

BowZED, London

Bespoke Houses

Vanke, Shenzhen



ZEDhouse development - Bickleigh Down

StramitZED house in Milton Keynes

Multifunctional Buildings

MULTIFUNCTIONAL BUILDINGS

Earth Centre

PortZED

POSCO Korea

Chalkwell Hall

ZEDpavilion Shanghai Expo

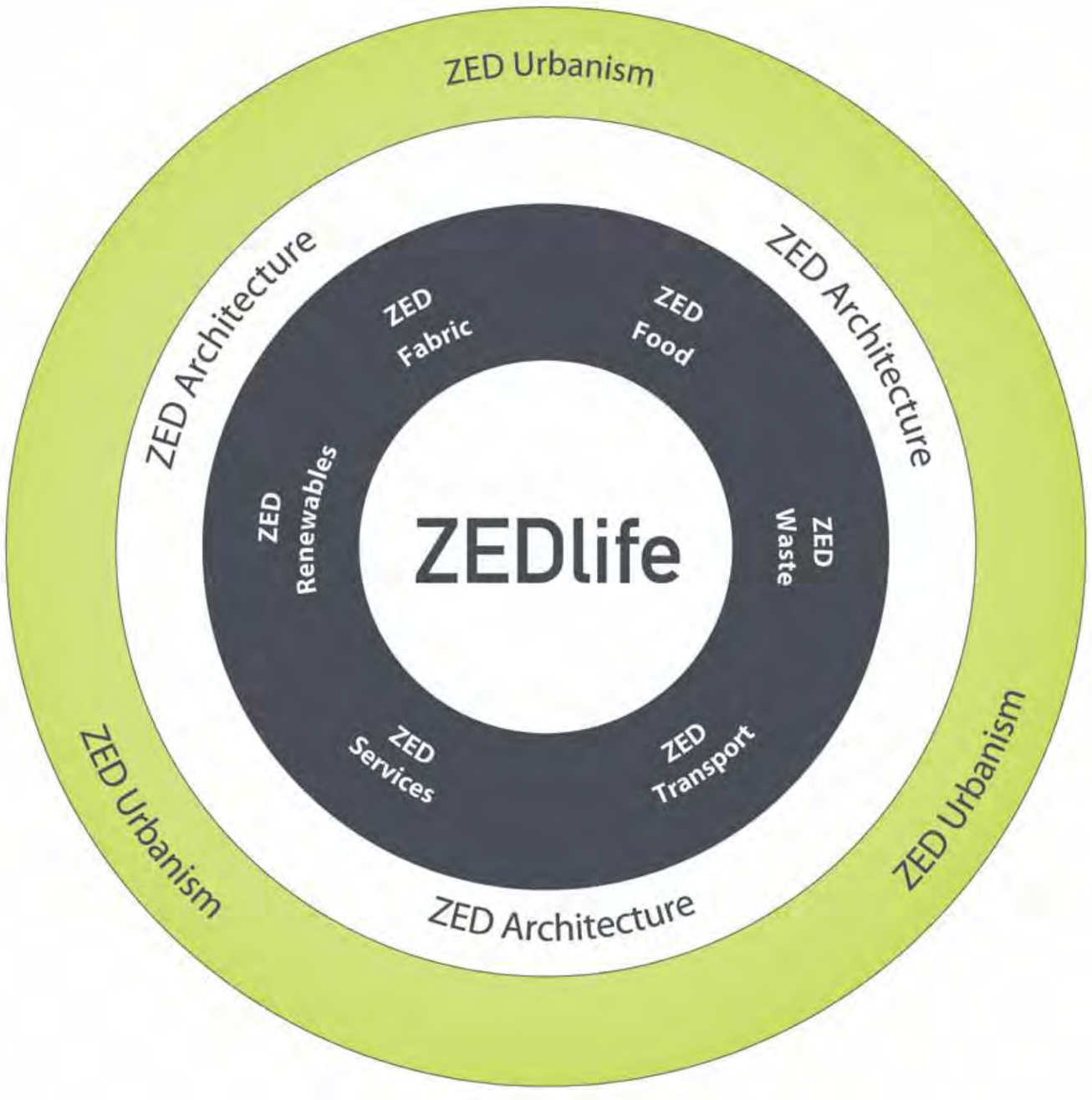
Jubilee Wharf

Multifunctional Buildings

Jubilee Wharf Case Study

Jubilee Wharf is a mixed use development that contributes to the community life of the coastal town while drawing attention to the ambient energies it harvests. It provides an enhanced quality of life at the same time as reducing the environmental impact of the activities that occur there.

Jubilee Wharf provides certain community services that were previously lacking in Penryn. The studios provide a platform for local artists and craftspeople to showcase their work. The nursery helps parents balance childcare and employment. Affordable offices help small businesses get established. The hall is used for a variety of events by different community groups, for example band nights, art exhibitions and town fetes. The cafe/bar on the water's edge is a vital focal point and meeting place for all the community.



Having introduced all the ingredients we look into to achieve a zero carbon life, the next step is to integrate them into the city and apply them to building forms. We illustrate ways to achieve this, and to build low carbon at high densities in this section...

MASTERPLANNING

ZEDfactory has masterplanned on various scales, in different countries, with different climates. Each masterplan is a combination of climate, client requirements, local housing markets, current and projected demand and budget. The end goal for all of our masterplans is to produce a place which meets the needs of today's population, without inhibiting the needs of tomorrow's population.

BedZED, UK

High Density, China

Ningbo, China

Doha, Qatar

Upton, UK

Yelland Solar Farm, UK

Designing for World Climate Zones

London, UK

Northampton, UK

Plymouth, UK

Dalian, China

Incheon, South Korea

Seoul, South Korea

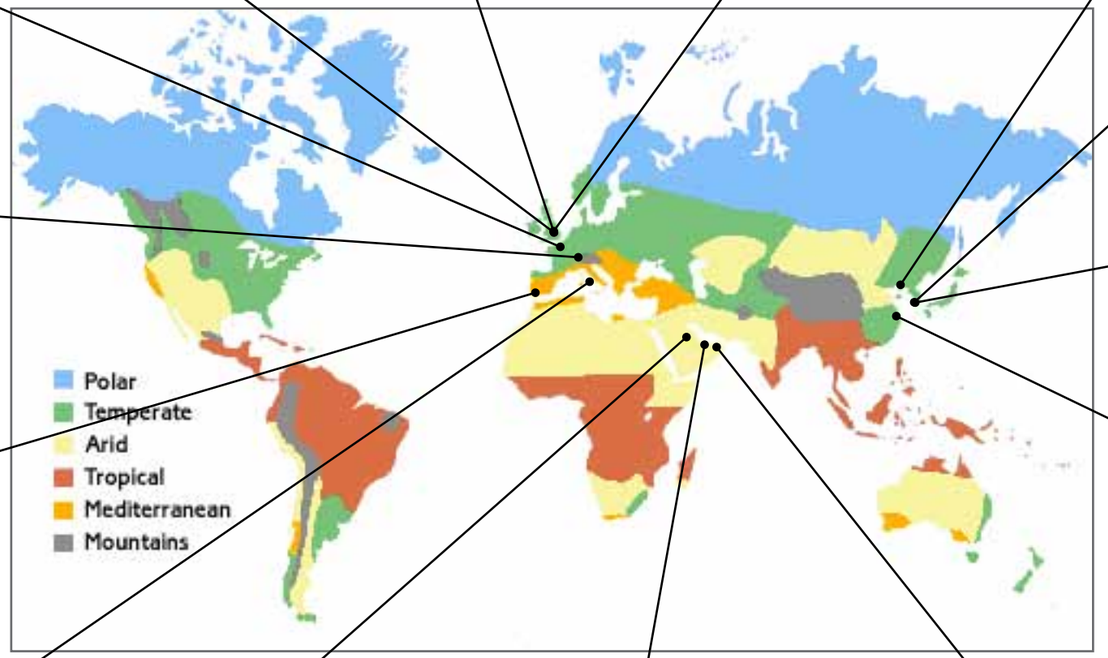
Shanghai, China

Dunkerque, France

Lausanne, Switzerland

Ourique, Portugal

Sardinia, Italy



Doha, Qatar

Masdar City, UAE

Dubai, UAE

ZEDfactory has substantial experience in designing buildings and cityscapes in many of the world's climate regions. By selecting the most suitable energy strategies, construction methods and renewable technologies, we are able to produce buildings and design urban extensions suitable for a large percentage of the earth's populated area.

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Key Performance Indicators

PRO-JECT	INDICATOR	QATAR	TONG-SHAN	BedZED	UPTON	ZED KO-REA	DALIAN	ParkZED
COUNTRY		United Arab Emirates	China	United Kingdom	United Kingdom	South Korea	China	Concep-tual
YEAR		2009	2007	1999	2009	2011	2012	2012
GENERAL	Site Area (Hectares)	1 ha	90 ha	2 ha	0 ha	3 ha	5 ha	6 ha
	Number of Residents	100	12116	300	30	1451	2944	3846
	Number of Bedrooms	80	9320	162	18	1319	1970	3898
	Number of Dwellings (dw)	20	3000	82	6	434	974	1282
	Bedrooms per hectare (br/ha)	119 br/ha	104 br/ha	95 br/ha	174 br/ha	496 br/ha	384 br/ha	683 br/ha
	Residents per hectare (persons/ha)	149 pr/ha	135 pr/ha	176 pr/ha	290 pr/ha	545 pr/ha	574 pr/ha	674 pr/ha
	Residents per dwelling (average)	5.0	4.0	3.7	5.0	3.3	3.0	3.0
	Dwellings per hectare (dw/ha)	30 dw/ha	33 dw/ha	48 dw/ha	58 dw/ha	163 dw/ha	190 dw/ha	225 dw/ha
	Gross Internal Floor Area (m^2)	6200 m^2		9207 m^2		61361 m^2	106727 m^2	209509 m^2
	Area of Residential (m^2)	6200 m^2		6707 m^2		41312 m^2	58251 m^2	121800 m^2
	Area of Community Facilities (m^2)			500 m^2		3620 m^2	4364 m^2	12792 m^2
	m^2 of underground car parks, ancilliary			None	None	20000 m^2	15449 m^2	32800 m^2
	m^2 of above ground circulation space			200 m^2	None	12338 m^2	27662 m^2	23931 m^2
	Plot Ratio	0.92		0.54		2.31	2.08	3.67

AMENITY	Sunspace/Balcony Space (m^2/br)	Not Suitable for this Climate	1.7 m^2	2.0 m^2	6.6 m^2	6.0 m^2	3.6 m^2	6.8 m^2
	Public Green Space (m^2/br)	15.7 m^2	38.6 m^2	30.0 m^2	None	12.4 m^2	.8 m^2	20.5 m^2
	Children's Play Space (m^2/br)	3.1 m^2	tbc	3.3 m^2	None	.5 m^2	1.1 m^2	2.0 m^2
	Sports Facilities (m^2/br)	1.6 m^2	tbc	26.2 m^2	None	.2 m^2	None	.8 m^2
		QATAR	TONSHAN	BedZED	UPTON	ZED KO-REA	DALIAN	ParkZED
WORKSPACE	Home Office Space (m^2/unit)	13.8m^2	13.6m^2	79.0m^2	Up to 10m^2	Up to 10m^2	9m^2	Up to 10m^2
	Area Rentable Workspace (m^2/br)	None	2 m^2/br	10 m^2/br	None	2 m^2/br	None	7 m^2/br
	Workspace per hectare (m^2/ha)	None	193 m^2/ha	76 m^2/ha	None	150 m^2/ha	None	2499 m^2/ha
	Retail / Commercial (m^2)	None	tbc	None	None	4293 m^2	None	14268 m^2
	Electrical Consumption (kWh/m^2/yr)	40 kWh/m^2/yr	27 kWh/m^2/yr	31 kWh/m^2/yr	30 kWh/m^2/yr	23 kWh/m^2/yr	23 kWh/m^2/yr	23 kWh/m^2/yr
	Heating / Coolth Consumption (kWh/m^2/yr)	45 kWh/m^2/yr	45 kWh/m^2/yr	42 kWh/m^2/yr	45 kWh/m^2/yr	35 kWh/m^2/yr	45 kWh/m^2/yr	35 kWh/m^2/yr
	PV (kwp/dwelling)	11.2	tbc	1.6	3.7	0.8	None	1.8

Key Performance Indicators

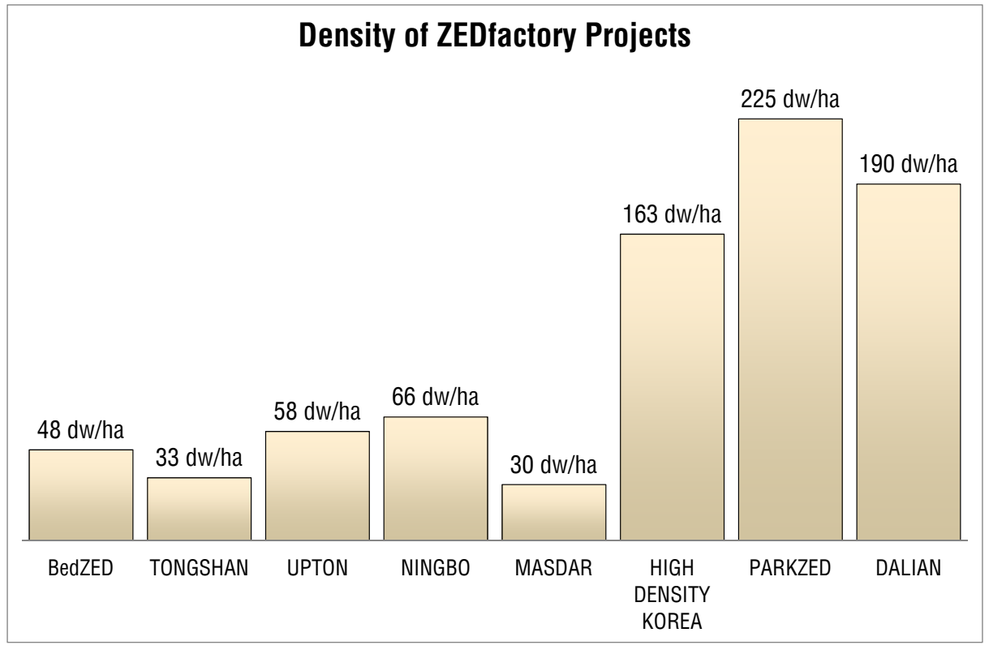
PRO-JECT	INDICATOR	QATAR	TONG-SHAN	BedZED	UPTON	ZED KO-REA	DALIAN	ParkZED
COUNTRY		United Arab Emirates	China	United Kingdom	United Kingdom	South Korea	China	Concep-tual
YEAR		2009	2007	1999	2009	2011	2012	2012
TRANSPORT	Private Parking Fossil Fuelled (sp/dw)	3.00	1.00	0.50	1.00	0.75	0.40	0.50
	Car Pool Spaces (sp/dw)	None	None	0.04	0.04	0.13	0.10	0.15
	E-Trike Parking (sp/dw)	1.0	None	None	None	1.0	0.20	1.0
	Charging Points (sp/dw)	None	None	0.1	None	1.5	0.5	1.2
	Bike Storage (bikes/br)	1.0	1.0	1.0	0.9	1.0	1.0	1.0
	Public Transport within 1km of site	None	Bus	Bus & Rail	Bus	Bus & Metro	Bus	Bus & Tram
	Distance to nearest Bus Stop	2km	50-500m	40m - 160m	150m	40-150m	40m - 350m	40m-200m
	Distance to nearest Train Station	Metro Under Construc-tion	More than 5km	650m	3.2km	220m-580m	4.2km	1km
FOOD	Communal Growing Space (m^2/br)	No	Yes	Yes	No	3 m^2	No	1 m^2
	Private Growing Space (m^2/person)	None	4 m^2/per-son	4 m^2/per-son	6 m^2/per-son	3 m^2/per-son	15 m^2/ person	1 m^2/per-son
	Farmers Market	None	None	None	None	Yes	None	Yes
	Cafes (m^2)	None	tbc	50 m^2	None	700 m^2	None	1400 m^2
BIODIVERSITY / EMBODIED CAR-	Undisturbed wildlife habi-tat %	None	17%	15%	28%	None	None	None
	Water Use (litres per per-son per day)	80 m^2	85 m^2	87 m^2	80 m^2	80 m^2	80 m^2	80 m^2

Key Performance Indicators

As part of ZEDfactory's on-going research, we have developed the use of Key Performance Indicators (KPIs) to enable us to compare, contrast and benchmark our projects. Whilst still in the early stages of development, over time we expect these metrics to reveal patterns and relationships which may otherwise be left to empirical evidence. For example, as the density of a development increases, we expect to see the amount of energy generated on site per capita to decrease; and similarly, as the density of a development increases, the less the space available for growing food on site per capita.

Patterns may also begin to form over time and location. For example, we hope that new projects will perform better on energy consumption per capita than older projects do. Additionally, certain climates will inevitably cause variance in energy consumption, but that different cultures and lifestyles may also play a part determining whether certain countries perform better than others in sustainability.

ZEDfactory is not aware of other architectural practices engaging in this kind of benchmarking, and as such gives us a competitive advantage for designing zero carbon projects in a wide range of countries and climates.



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Cityscape

Landscaping

BIODIVERSITY
Biodiversity is maximised by optimising growing surfaces on buildings and within public and private areas. Native vegetation regimes typical of the local landscapes are advised alongside more formal ornamental planting to maximise visual amenity. Surface water drainage can be used to provide a landscape backbone for the development attenuating run off within the site boundary, providing wetland style wildlife habitat opportunities and visual amenity value.

STRATEGIC LANDSCAPE CONNECTIONS
The design of a site should reinforce the green connections between the existing landscape features of the immediate area, providing wildlife movement opportunities and a robust landscape structure to the wider townscape. Pedestrian and cycle access routes are rationalised to maximise pedestrian footfall in newly created public spaces, whilst private and private communal spaces should be provided with a level of visual screening and increase security.

LANDSCAPING BUILDINGS
The choice of extensive green roof systems across the inaccessible roof areas allows for a more bulky vegetation canopy to be established at high level. This provides a great degree of roughness to the roofline and effectively slows wind speeds over Sky Garden spaces.

PROTECTING A DEVELOPMENT
Courtyard and perimeter tree planting can assist in reducing wind turbulence and increase precipitation of dust and particulates from vehicular traffic where required.

EDIBLE LANDSCAPES
Edible landscaping allows productive use of communal spaces from the planting of Meokgol pears orchards in community squares. This type of planting should require minimum attention for maximum gain. Planting should also be encoraged on private balconies; lettuces, spinaches, crown daisies, Chinese cabbages, green onions.


Above: Farming in the allotments


Above: Water in the landscaping - Urban swales allow natural flooding and slow run off.

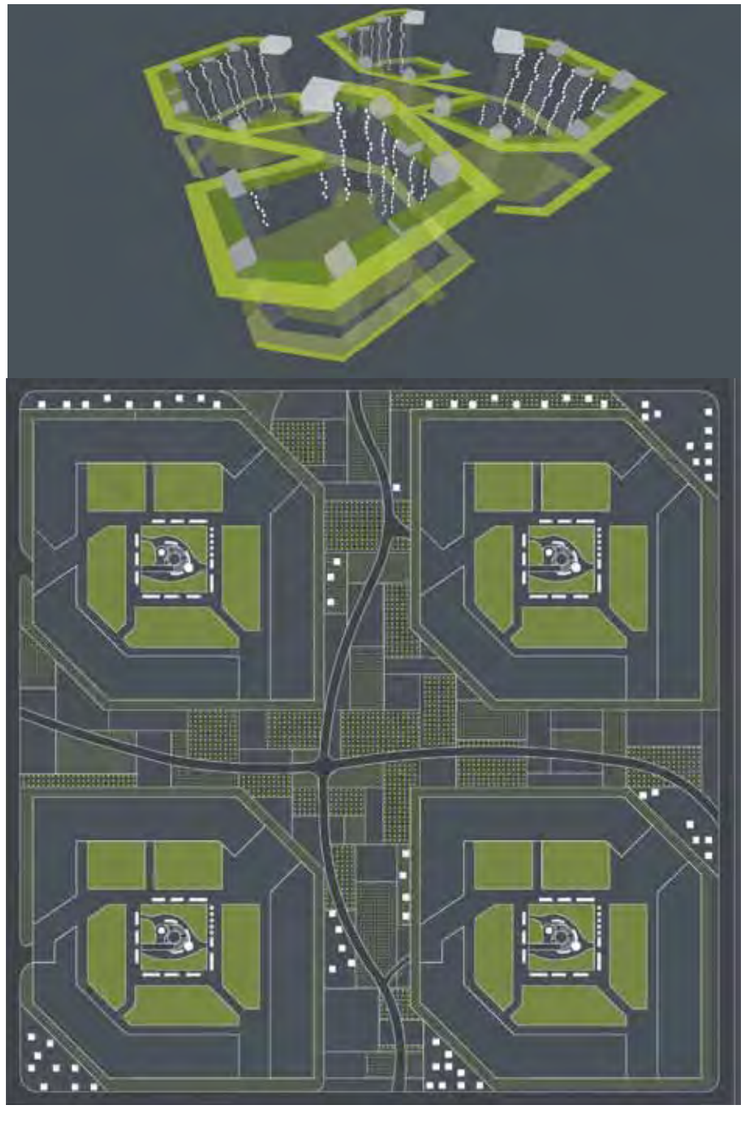

Above: Sunspace in BedZED


Above: Edible planting in Plymouth masterplan


Above: Green Roof in Carcassone

Cityscape

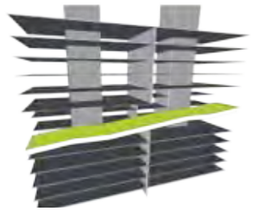
PARKZED- Integrating personal electric vehicles with high density housing and rooftop landscape parks to create a fresh urban landscape that is capable of both maximising amenity and increasing sales values.



landscape ramps

landscape terraces

semiprivate courtyards

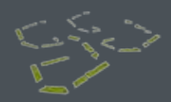


cores

roof top activities

parking lobbies

The green roof connects the buildings at different heights through a continuous landscaped ramp accessible by pedestrians, e-bikes and e-trikes.



Stepped terraces create places for various activities to attract people to use the roof. The terraces are accessible through ramps and cores at all levels.

Semiprivate green courtyards will provide residents with space for common activities on the ground level and create natural ventilation and access to the parking level.

As the green roof forms a means of escape, this creates an additional emergency escape route from each core. In an emergency you can go up or down the core.

At the top of each core, a PV canopy generates solar energy and gives rooftop access to the terraces. Upon reaching the pinnacle of each building, an iconic volume provides community facilities such as swimming pools, viewing gallerys and bars.

E-Trike and e-bike parking is provided outside each apartment. This reduces basement car parking and therefore associated embodied carbon.

Personal electric vehicle parked outside your own flat.
Drive straight to your front door via the landscape ramp or lift.

Cityscape

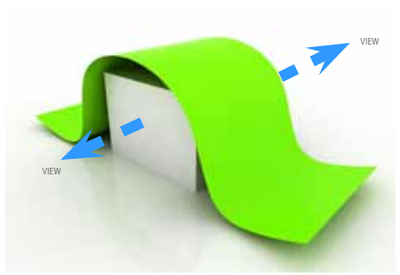
GS, Korea

NATURE IN THE URBAN JUNGLE: our proposal allows uninhibited access onto the roofs of all perimeter blocks, for residents and neighbours to enjoy. We have also found space for 165 trees across the site.
We believe that the exterior of the building (and indeed the spaces created in between buildings) has to form part of the resident's experience; not just the interior. Assuming 1700 future inhabitants with a maximum occupation of the area, the design includes local sports facilities such as badminton courts, and clubhouse facilities.

Cityscape

DALIAN, China

Whilst a common high density development would seperate itself from its surrounding landscape by rising up from it, without a relationship with it, our design takes that high density building form and delicately places the landscape over the top of it. This creates a more integrated building form, which encourages the connection between the man-made and natural forms. This is a crucial stage in the quest to get humans to live more sustainably by understanding how natural processes work.



Buildings emerging from landscape as a part of the landscape provides:

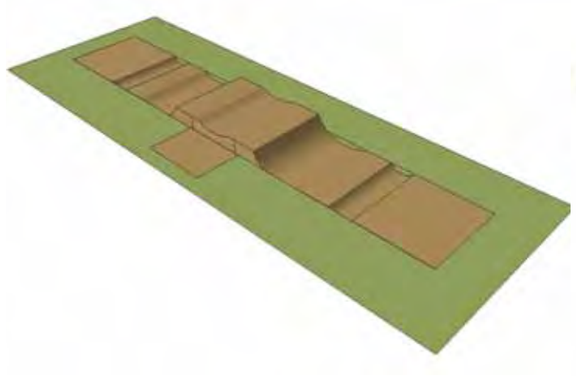
- good quality usable spaces
- additional benefits of roof top activities
- an additional escape route in case of emergency; residents can potentially go up the staircases and climb down the outside of the building
- a reduction in energy use by giving the option for residents to ascend the building via external flights of stairs
- a sense of respect for nature among residents
- the chance to grow organic food to reduce carbon footprints

Cityscape

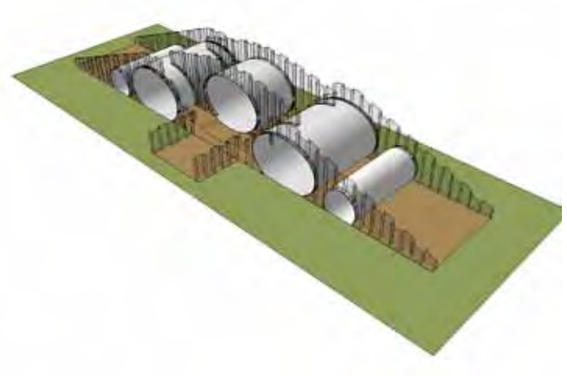
TONGSHAN, China

Low cost earth sheltered housing

Low cost earth sheltered housing



Tubes placement

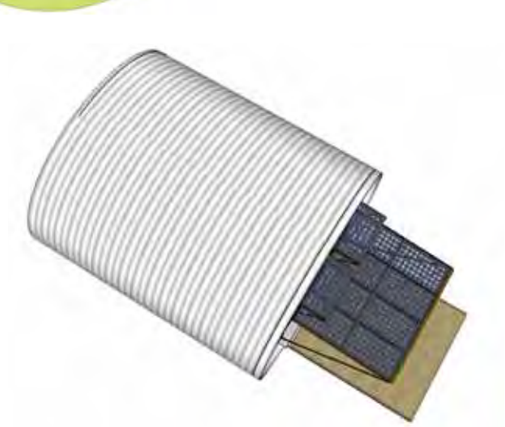


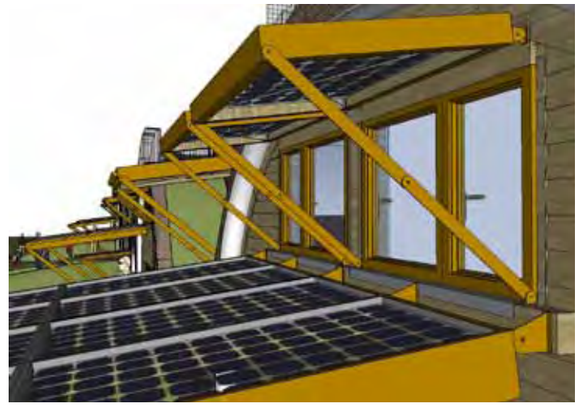
Steel tubes and mesh

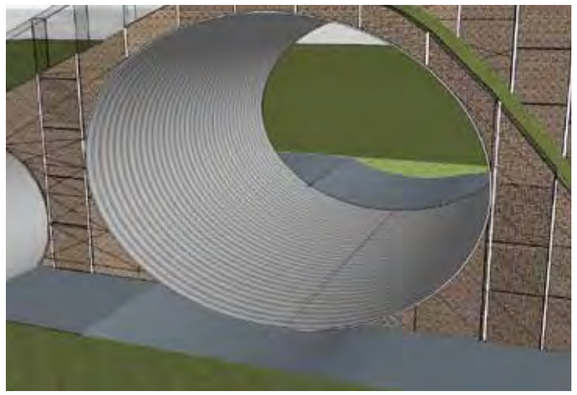
Pebbles into the steel mesh and fix hollows with soil

Construction of the houses inside the Pipes

Low cost earth sheltered housing

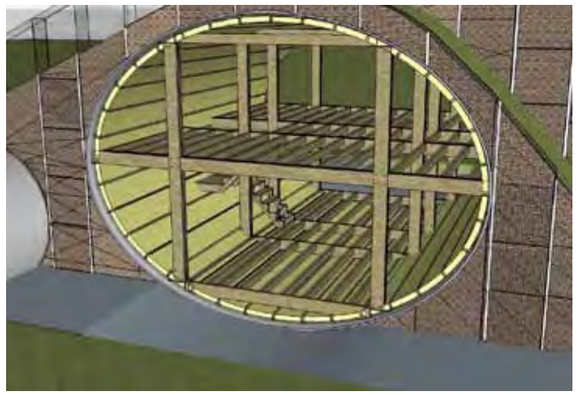




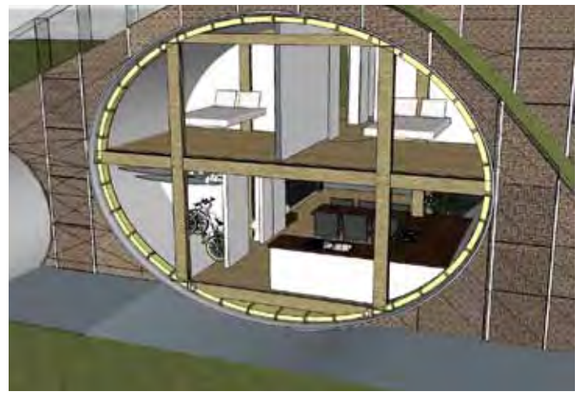


Tube empty

Structure inside tube



Tube internal coating



Inside tube finished

External wall without solar canopies and protective bridge

External wall with solar canopies and protective bridge opened

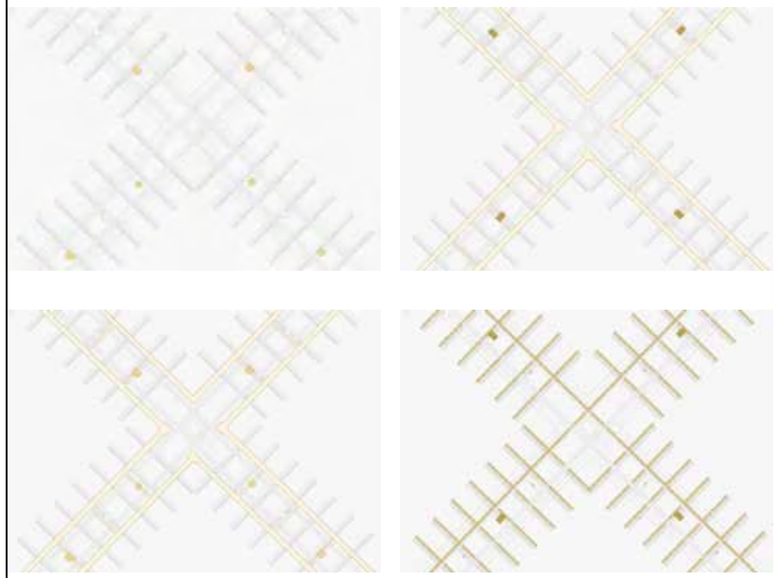
Solar canopies closed and protective bridge opened

Solar canopies and protective bridge closed

ZEDstreet

The ZEDstreet - if the cost of building roads, public transport, electric power supplies, district heating and cooling, walkable urban neighbourhoods, fresh water supplies, foul water treatment, grey water recovery, rainwater storage, surface water attenuation, recycling and biogas distribution was calculated for both a new urban extension and the refurbishment of tired existing urban infrastructure - we found that the cost / per capita could be substantially reduced by integrating all these ideas into a new street product. It becomes far easier to integrate renewable energy systems and zero carbon personal and public transport if the street does all the hard work. And if existing wide car orientated dual carriageways can be converted into shaded pedestrian Rambla's following the Barcelona model - then the urban quality of life can be increased, and almost all of the zero / carbon / zero waste targets can be easily met.

COOLING & DEHUMIDIFICATION



COMMERCIAL

Retail

Bike Hire & Maintenance

Coffee & Bar

Hostel

WASTE

Waste Segregation Points

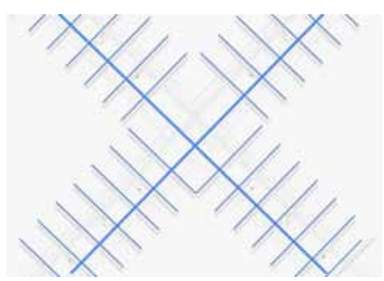
Pyrolysis

FOOD

Urban agriculture

Farmers Market

WATER



Drinking Water Supply

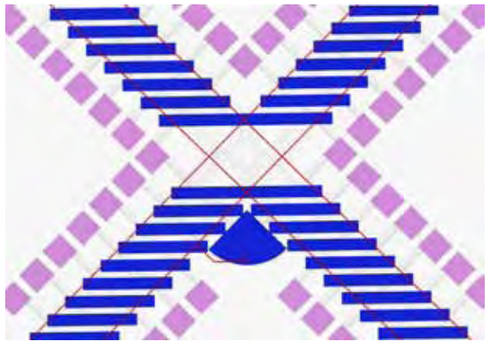
Grey Water Supply

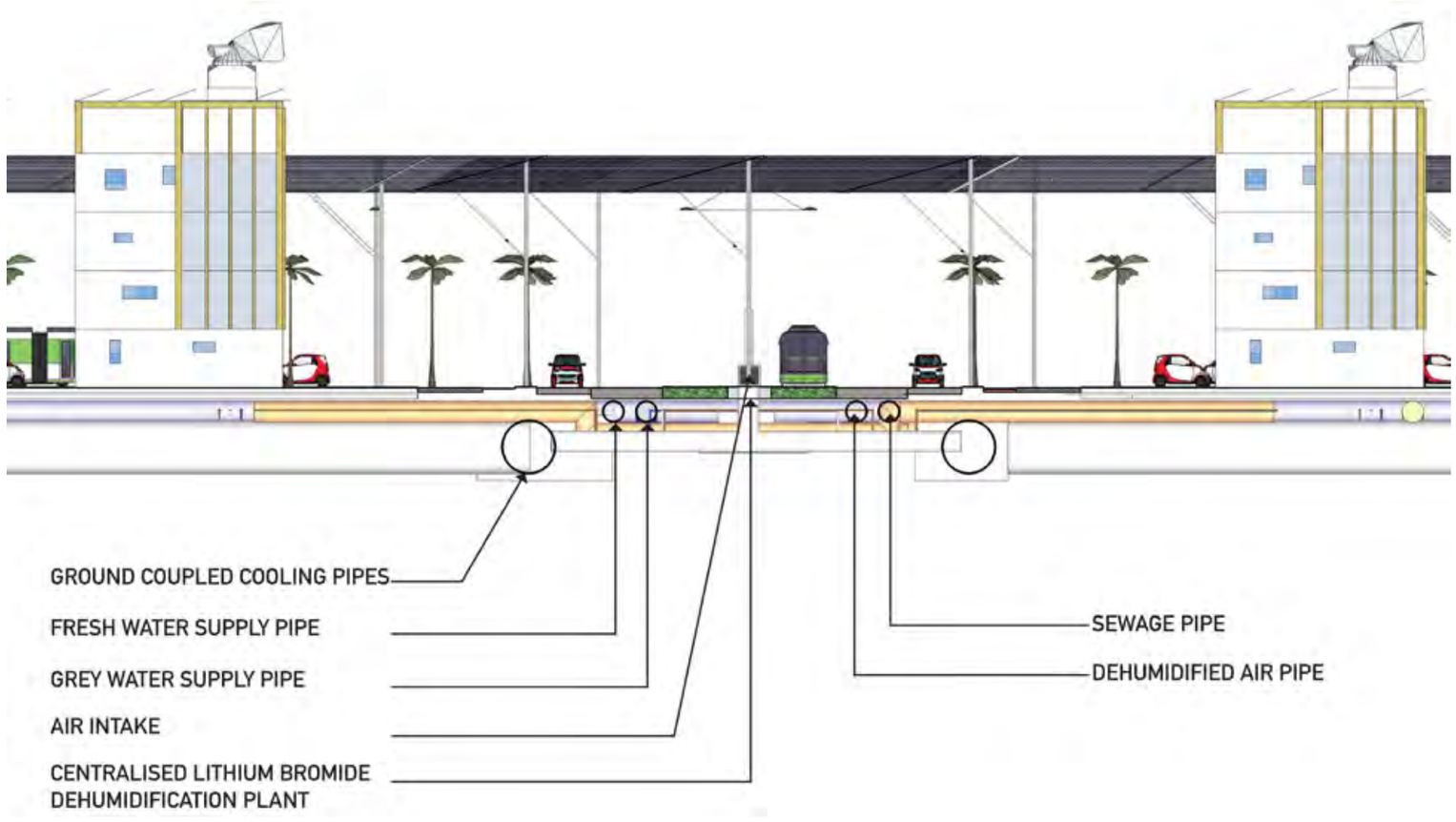
zedfactory
zero fossil energy developments

ZEDstreet

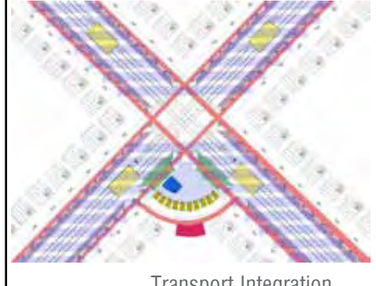
The ZEDstreet allows the city freedom to build energy efficient buildings inside each urban block, knowing that almost all of the communal services have been provided by the street. This urban model makes it possible to design a climate neutral city - where enough renewable energy is integrated within the urban fabric to payback the embodied carbon of the original construction and the annual maintenance, as well as meet the annual running demand. When the street photovoltaic shades are combined with urban pyrolysis of organic waste - energy supply can match demand, and an efficient urban metabolism can run powered by a mixture of sunlight and urban mixed with agricultural organic waste.

POWER





TRANSPORT


Transport Integration


Bike Lanes


Fabric Road System


Street side car parking & EV chargers


ZED Urbanism
ZED Fabric
ZED Food
ZED Waste
ZED Transport
ZED Services
ZED Renewables
ZEDlife
ZED Urbanism
ZED Urbanism

ZEDstreet

City Oasis

Middle East Zero Carcon development

zedfactory
zero fossil energy developments

City Oasis

Al Ain, Abu Dhabi

Known as the 'garden city' of the UAE, Al Ain is a natural oasis in the Emirate of Abu Dhabi and is characterized by lush vegetation and fertile urban farms, which have supported continuous settlement for thousands of years. Today, Al Ain remains an environmental and cultural jewel in the crown of Abu Dhabi.

"Through a balance of conservation and development, Plan Al Ain 2030 will foster the authentic Arabic identity of Al Ain whilst supporting a continuously evolving modern culture," said Al Ahbabi.

Plan Al Ain 2030 promises special treatment for the city's oases, ensuring that they remain at the heart of the community. The masterplan is founded on key environmental, cultural, social and economic sustainability principles. "To create a truly sustainable city, Plan Al Ain 2030 proposes a range of urban development, renewable, water conservation and public transport initiatives. This will ensure that local residents continue to enjoy an excellent quality of life as the city's population grows to one million and beyond," concluded Al Ahbabi.

Case Study

Site

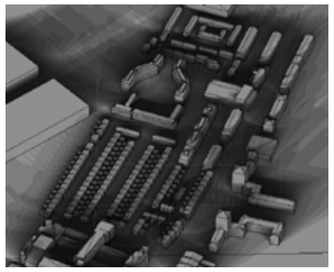
An extract of the city of London (South-West) as been explored as a case study for an urban development. Zone N is located in a relatively dense urban zone, bordered on one side by Wandsworth Road and barricaded on the other by the New Covent Garden Market.

It is composed of a range of typologies; from medium density Victorian terraces in the south to higher rise (6 storeys) social housing units to the north of the site. A range of construction types are in place, as the urban fabric ranges in age from 19th century housing to brand new developments. The following pictures give a flavour of the zone.

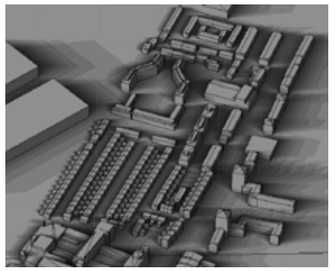
Shadowing Analysis

No major problems were found within the shading analysis. There is slight overshadowing in patches. The main culprits at the equinox stage (September 21st) are Lambeth college in Zone O overshadowing the southernmost terraces, and the 11 storey buildings in Zone M giving a slight shade of the retail units in Wandsworth Road.

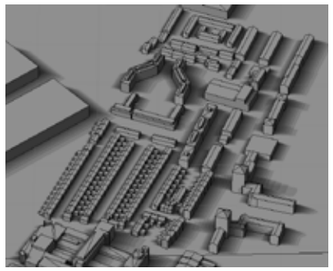
Shading should be taken into account very strongly in the vision as it play an important role in reducing the heating levels in existing buildings and new builds.



December 21st



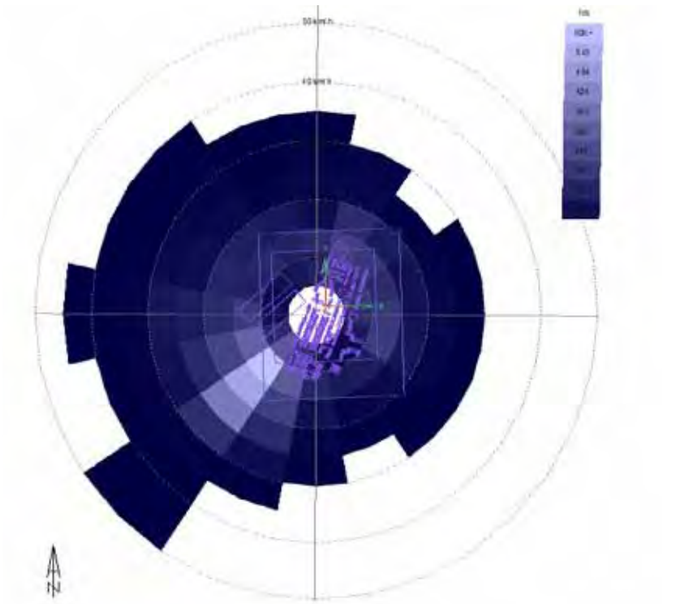
September 21st



June 21st

Prevailing Winds

The lighter the colour, the more prevailing the wind, in the diagram below. Therefore we can see that in this zone, the majority of the wind comes from the SW, and the majority of the velocity is under 20km/h. This makes the area unsuitable for wind power



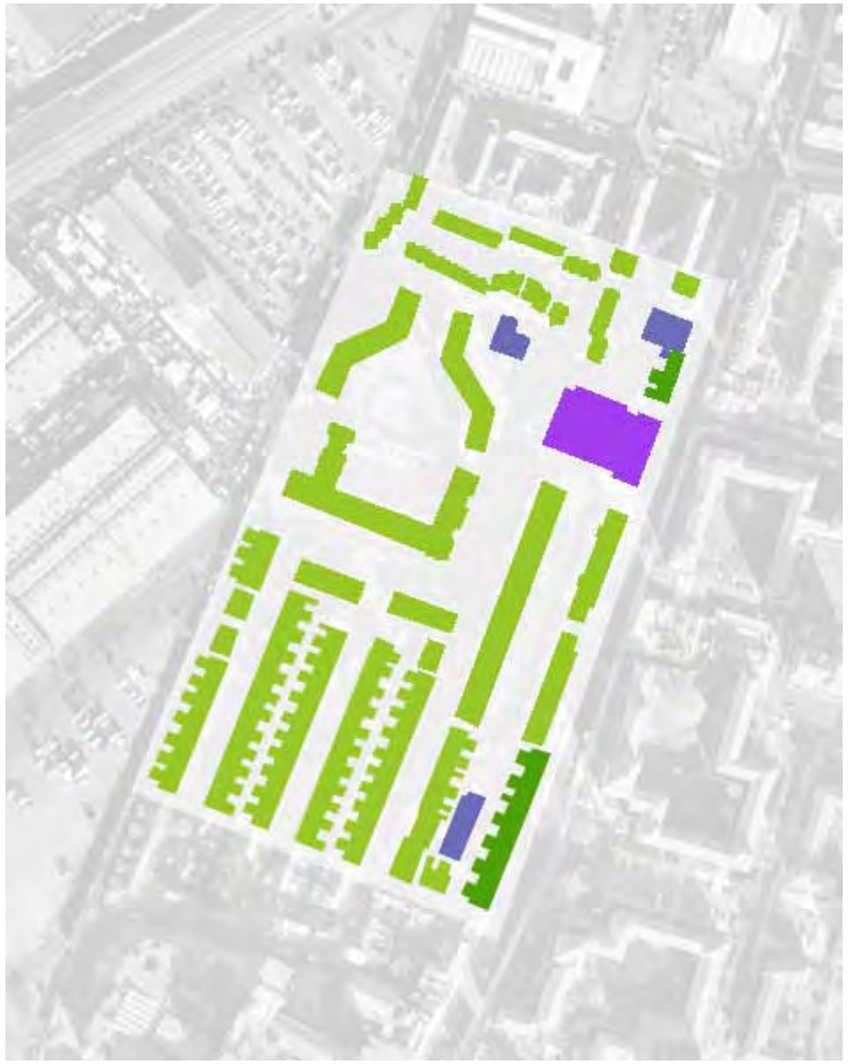
prevailing winds _ wind frequency (hrs)

Case Study

Land Use

- residential
- mixed retail / housing
- leisure
- industrial / vacant

The majority of the zone is residential (87%), ranging from Victorian Terraces in the southern side to higher density social units in the northern area. No offices are located on the site. The only retail is located on Wandsworth Road, as is leisure: a converted cinema into gym. Small amounts of industry are located in the area, limited to one warehouse and two disused buildings.



Open Space Analysis

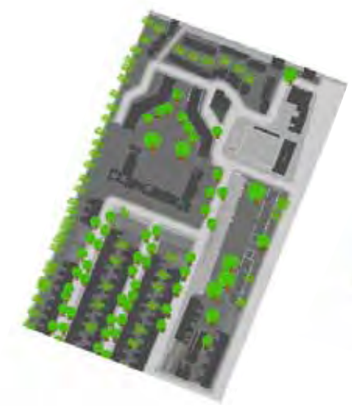
Approximately 50% of the open spaces are small, private gardens. These are defensible spaces, too small to be used as vegetable gardens.

The remaining 50% open space is classified as private open space; in that it is shared between blocks of social housing or gated communities. The quality of this open space varies, but lacks many amenable features such as seating or flowerbeds.

A very low proportion of space is genuinely open to the public, although a park is located two zones away. Extra public open green space should be therefore added to increase the site value.

- private open space
- private garden
- public garden

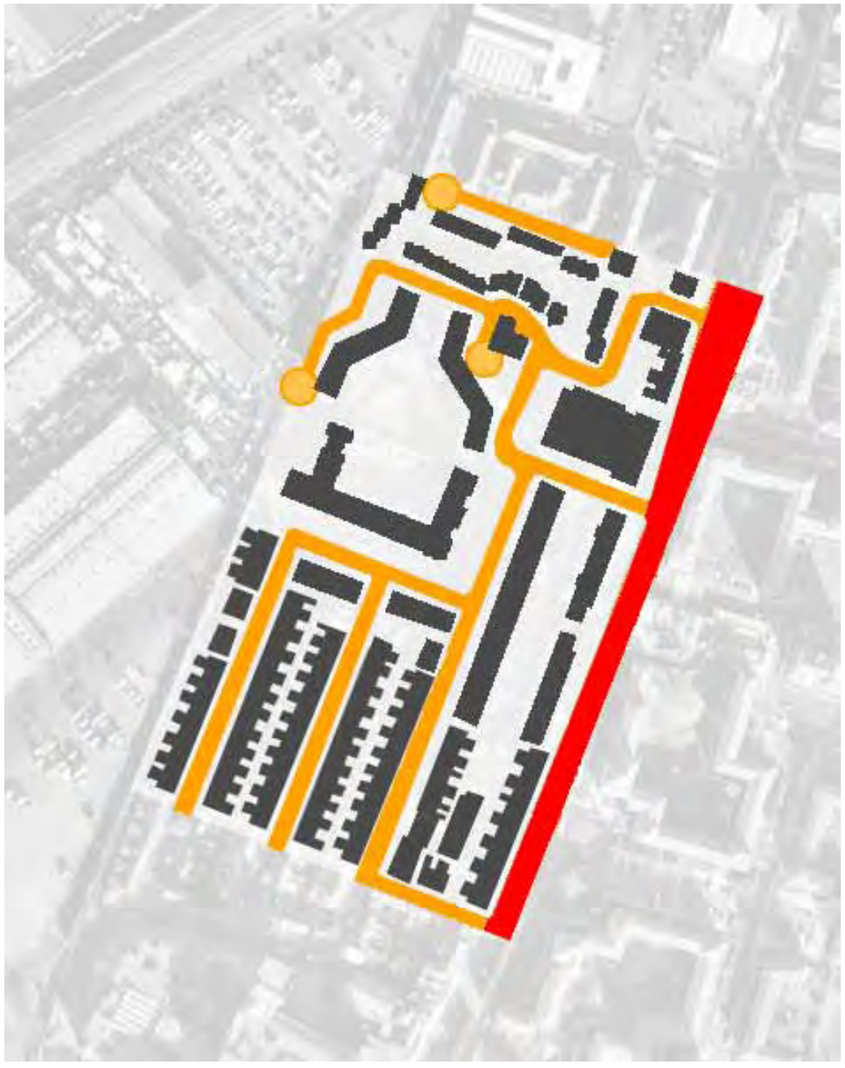
Trees Distribution



Case Study

Road Hierarchy

main route
residential route
dead end

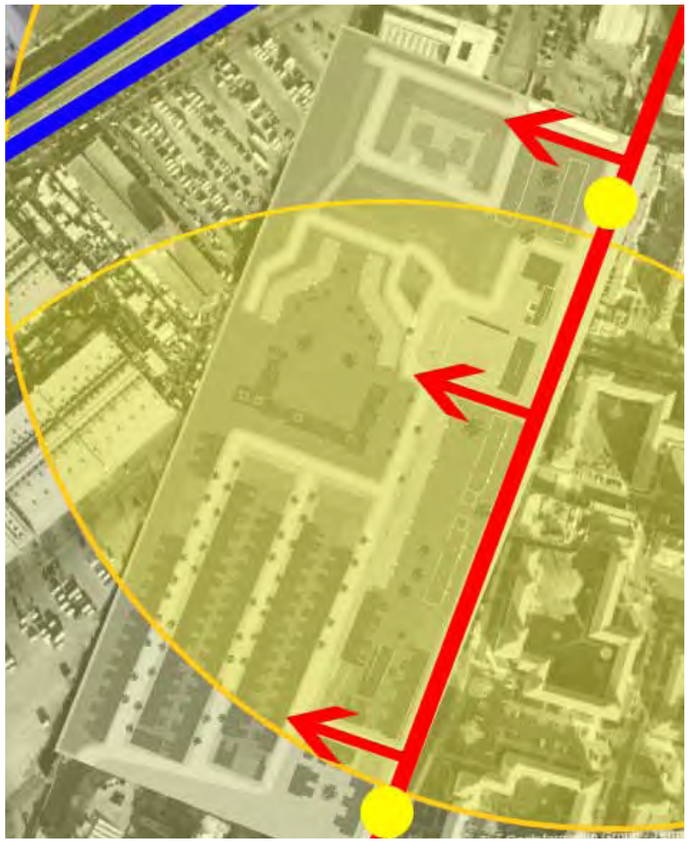


As aforementioned, the road layout does not permit any through traffic. The roads are divided into two uses – the main route (Wandsworth Road) and residential streets.

There are currently 4 dead ends in the plot, which the vision should seek to reduce or remove all, to increase permeability through the site. Cars are currently littered all around these dead ends, creating non-areas.

Transport

bus stop
railway
access point
5 mins walk from the bus stop



Two bus stops are located on the site, down Wandsworth Road. This gives access to the London Bus network. Vauxhall tube station and mainline station are located approximately 500m north of the site.
The whole site is within a 5 minute walk from one of the bus stops, as the crow flies, but owing to a bad road layout, there are actually only 3 main access points to the site, and 2 smaller ones. This lack of access points should be resolved in the vision.

Case Study

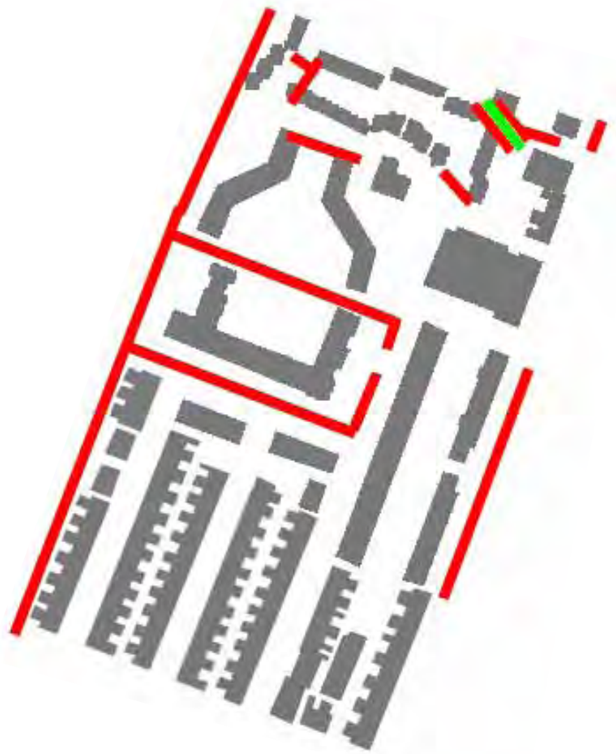
Pedestrian Permeability

physical barriers (not including buildings)

tight alleyway

Permeability is not good in Zone N. There are many hard and soft barriers such as walls, railings and hedges which inhibit free walking through the zone.

The zone's main barriers are formed from the long hedgerow and fence which borders the market on the western front, and the gated community located in the centre of the plot which effectively divides the plot into two distinct sections. Additionally, the zone in the North of the plot is formed of an awkward road layout and hence building layout which is not conducive to walking.



Parking & Emergency Access

traffic calming

emergency access

on street car parking

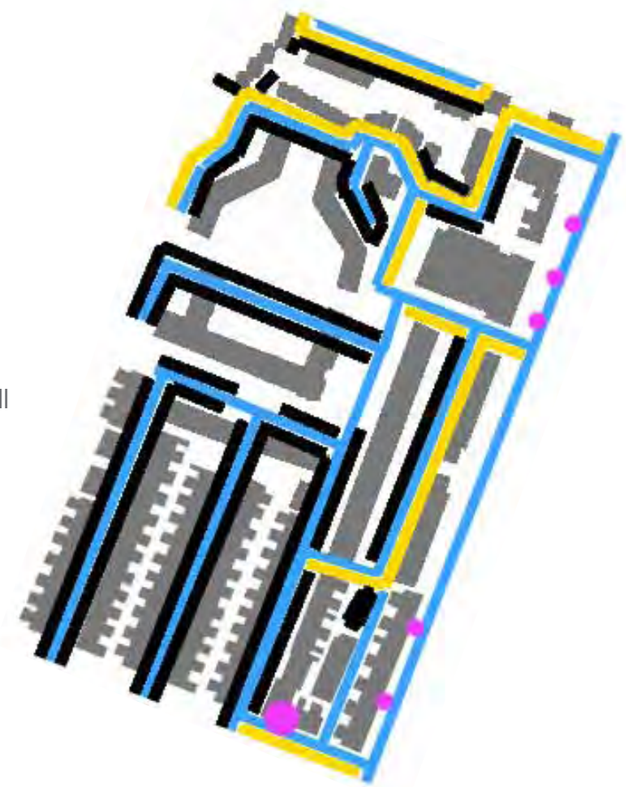
motorcycle parking

single bike parking

The zone has generally good emergency access, with access lanes around the social units to provide car parking doubling as extra emergency access.

Around 50% of the site has traffic calming measures, which would inhibit emergency access.

Car parking takes many forms on site; in small car parks surround social units and the gated community, but also as on street parking in the terraced housing section.
There are approximately spaces for 15 motorcycles, but only 7 bicycles in public space across the whole site; all located in Wandsworth Road. There is a lack of cycle tracks.



The vision should improve bicycle provision and rack facilities for storage so people are not constrained to keeping them within their properties. It should also retain good emergency access, but vehicles should be restricted to meet environmental standards and also stored away where possible to improve the townscape.

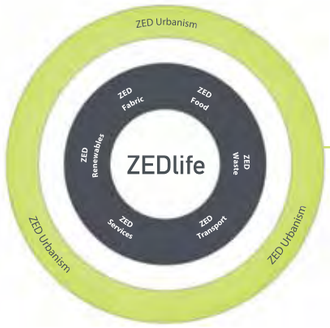
Case Study

The Vision

- district heating/ electricity
- bike path
- new pedestrian route
- green linkage
- pyrolisis

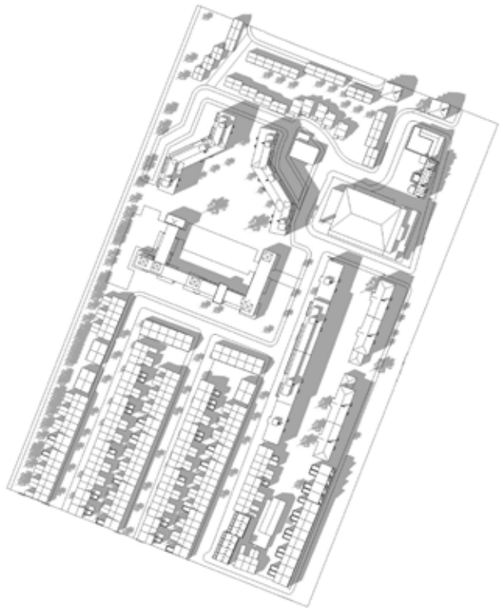
Firstly, the vision calls for new green infrastructure which runs in broadly east west directions to link other zones beyond my one to the New Covent Garden Market; which would be opened out to operate as a domestic food supply base. People in eastern zones can then have a pleasant walk to stock up on necessary supplies. Secondly, new east-west streets would be formed in the northern half of the site with new social units constructed in them to enable easy solar gain, simplify the street layout, provide emergency access, and more access points for pedestrians. A new north/south pedestrian route would be constructed to help this movement. Additionally, all new roads would in fact be shared space between cyclists, vehicles, and pedestrians, putting people first over vehicles. A cycle route would also be added down Wandsworth Road.

A pyrolysis plant would be constructed just outside the site perimeter, taking organic waste from localised food production and the market. This would then provide heat and power for the Zone X, N, M, L and J, which would be ducted through new buried infrastructure under the green fingers. There is also the potential to be hooked up the to the CHP plant located in Zone G to provide residential heating and electrical loads to counter the office loads found in that Zone to prevent heat dumping. Finally, to mitigate against flooding, the green fingers and any new buildings would be elevated approximately 2m up. The green fingers also cross the Wandsworth Road at an elevated level to assist with the flow of pedestrians over the space, so they are unimpeded by the fast flowing traffic on the arterial route.



Case Study

Time Progression



2013

2038

2063

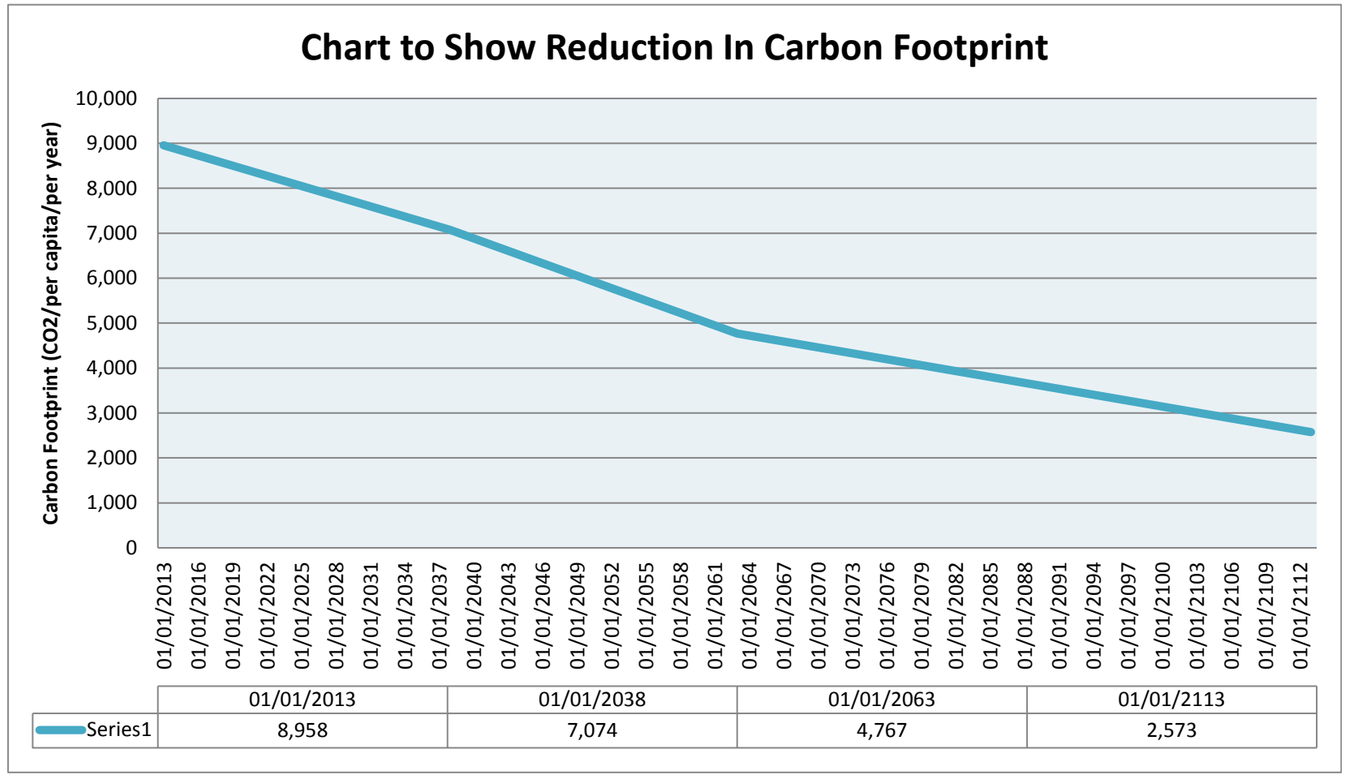
2113

Case Study

Time Progression

ZEDfactory's strategy has consisted of a gradual densification of the masterplan. Simple measures such as putting pedestrians first and increased tree planting have resulted in a zone with better quality of life.
Approximately 50% of buildings were demolished, and the remainder upgraded to high thermal standard. Natural ventilations and insulation have been either inhanced or added completely. Energy footprint has been calculated to decrease by 75.3% per capita, whilst the lifestyle footprint of energy has been reduced by more than 50%.

The initial thinking of increasing the site density with apartments up to 5 or 6 stories high has resulted in a higher construction cost which though is balanced by the sale value for the 80% of its total. The just 20% of deficit could be assumed to be a public investment that could easily happen within 100 years time.
Furthermore, by building up rather than out, public open green space has increased by 9300%!
Also, as built space becomes ever more expensive in the years to come, the overall space per person within buildings is likely to decrease. Apartment buildings can be re-formatted internally to match up with prevailing market conditions; if we move back to larger household sizes in the future; two apartments can be knocked through into a 4 bedroom apartment for example.



2013

2038

2063

2113

Case Study

Case Study Time Progression

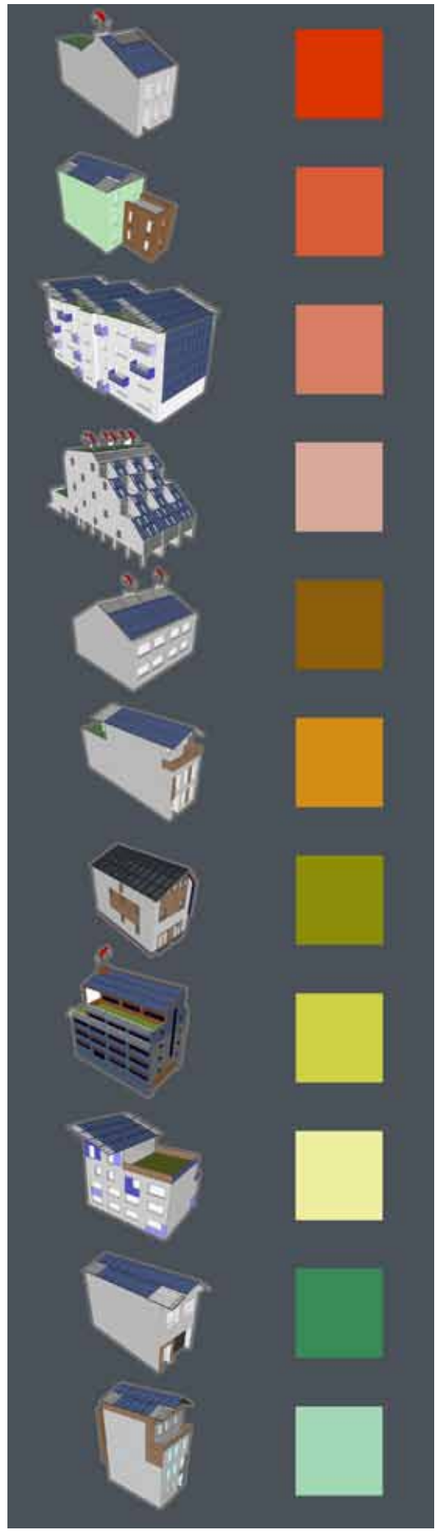
Key Performance Indicators		2013	2038	2063	2113	2013 to 2113 increase (%)
SITE AREA	square metres	65,650.00	65,650	65,650.00	65,650	0.00 %
Gross Internal Area	square metres	51,944.00	52,562	58,624.00	63,258	21.78 %
PLOT RATIO		0.79	0.80	0.89	0.96	21.78 %
PERSONS / HA		301.61	342	416.53	493	63.50 %
RENEWABLES Tot Area	square metres	1	2,842	6,543	15,769	1,576,783.80 %
Tot PEOPLE on site	people	1,980	2,246	2,735	3,238	63.50 %
total electrical	kwh/year	2,465,251	2,087,303	1,744,008	1,634,628	-33.69 %
Tot THERMAL	kwh/year	14,714,566	11,683,091	8,527,700	7,060,938	-52.01 %
ELECTRICAL RENEWABLE	kwh/year	1	234,918	538,238	1,572,105	157,210,444.80 %
THERMAL RENEWABLE	kwh/year	1	406,383	948,475	1,746,575	174,657,419.00 %
BIOWASTE Import/Export	kwh/year	1	1	1	1	0.00 %
FUEL Import	tonnes/year	1	1	1	1	0.00 %
BIOMASS per person	kg/person/year	1	0.45	0.37	0	-38.84 %
Tot SALES VALUE	£	184,929,613	186,803,713	230,825,775	257,003,617	38.97 %
Tot CONSTRUCTION VALUE	£	1	34,175,000	77,250,000	108,996,000	10,899,599,900.00 %
PROFIT BALANCE	£	184,929,612	152,628,713	153,575,775	148,007,617	-19.97 %
ENERGY FOOTPRINT	kg/CO2/year	4,048,577	2,723,249	1,816,597	999,726	-75.31 %
LIFESTYLE FOOTPRINT	kg/CO2/year	13,533,072	12,865,000	10,748,270	6,734,000	-50.24 %

Case Study

The New Scheme

improved permeability

typologies



new built & refurbishment

zedfactory
zero fossil energy developments

Conclusions

ZEDfactory realised a long time ago that the only way to create a holistic zero carbon / zero waste community was to have a consistent long term design methodology spanning decades, and then improve the understanding of the building physics and detailed component performance each year. With each project comes a more refined design and construction process - always trying to reduce environmental impact whilst improving durability and physical performance.

Gradually perceived risks are designed out, reliability improves and costs reduce as the supply chain picks up volume. Gradually we have moved from prototype to mass production, and what seemed almost impossible in the mid 90's becomes a mandatory performance specification by 2016. The importance of pioneering zero carbon best practice demonstration projects cannot be underestimated - as these raise aspirations and targets for the more conservative industry to follow. ZEDfactory tries to think further ahead than the minimum legal specification, and works with manufacturers to evolve new product lines that have the potential to make zero carbon urbanism an easy, desirable and achievable target.

Over the past ten years glazing integrated photovoltaic cells have reduced in price by a factor of four - now translucent monocrystalline panels integrated within a durable rainscreen are cheaper than the terracotta rainscreen cladding used to clad commercial buildings - making energy positive facades and roofs cost effective. The combination of building integrated solar technologies backed up by heat and power from the organic urban and agricultural wastestream can now easily deliver a zero carbon city, with big wind and tidal powering the intercity travel and national shared services. In this way the low carbon lifestyle is facilitated and accelerated by low carbon infrastructure. This thinking will change the way we build, plan and even consider our host environment - and the joy of moving from powerless consumers to productive individuals will empower a stable, equitable society with a higher quality of life for all of us.

Thank you.

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