

Building it right first time.

ZEDstandards define a buildings performance from the start - what should it provide, what should it consume, what impact should it have?

1. **Superinsulated building fabric. Uvalue 0.1w/per/m2**
2. **All glazing to have overall frame & glass**
3. **Airtight construction tested to acheive 1.5 air changes per hour at 50 pascals.**
4. **Passive heat recovery ventilation using a wind cowl.**
5. **Passive solar gain where possible.**
6. **Energy saving lighting throughout.**
7. **Maximised daylighting to all habitable rooms & workspaces.**
8. **Solar shading covering 100% of the glazed aperture at noon in summer.**
9. **Night time purge ventilation.**
10. **Thermally massiveceilings walls and floors with a minimum of 50mm dense concrete (or equivalent) of 75% of visible surface area.**

So what are the ZEDstandards, and what do they achieve?

- Global oil demand now exceeds supply, gas is running down and even toxic nuclear raw material has a 20 year supply. The UK has gone from being 2 million in 1700 to a population of 60 million and we import 70% of our food.
- From countries that will lose their surplus agricultural productivity as climate change accelerates.
- We cannot afford to lose any Greenfield sites to urban expansion - it will become increasingly important to grow locally produced food without without oil based fertiliser.
- Even if we build every wind farm and tidal barrage ever proposed, we could never meet our current energy demand from renewable energy sources.
- But if we reduce demand by 70% this target now becomes possible. There is enough biomass in the UK for 160 dry kg per person per year.
- Saving electricity is most important as this is the hardest to generate. One kwh of mains electricity has the same carbon footprint as three kwh of gas. So working within the sensible limits of renewable energy stocks available within our national boundaries we give every UK citizen their fair quota.

two thirds of the worlds productive farm land will be lost if a 5deg tempertaure rise is experienced by the end of the century.



In 2002 approximately 10 people were killed or affected in climate change hotspots for every 1000 tonnes of CO2 emitted that year. 250 million/25757 million tonnes of CO2

The ZEDfactory process

- 1 We then carefully studied how we could design buildings and infrastructure that were comfortable working whilst still only consuming their fair share of national renewable energy potential stocks.
- 2 We found that passive solar gain combined with super insulation, and passive heat recovery ventilation coupled with thermal mass produced homes and workspaces that were so efficient that they needed no space heating or cooling in the in the UK Climate, and a fraction of conventional buildings in more extreme countries.
- 3 We found that for 6 months of the year almost all hot water requirements could be met by solar thermal panels. We found that only winter hot water needed additional heat input and this could just be supplied within the 160 dry kg biomass per person per year, staying within the limits of the national renewable energy stock.
- 4 We then clad the south facing roofs with solar electric panels, fitting building integrated wind turbines where possible, and near zero carbon buildings become possible at typical UK average densities. This combination of minimising the need for energy, then maximising opportunities for local microgeneration - sets the zedStandards for new buildings.

If all new buildings are built to these standards from this point onwards within 75 years the UK could be free from it's addiction to fossil fuel.

If you want to see how applying the ZedStandards could work anywhere in the world

- we have a limited range of different building types that can simulate overall building fabric specification.
- The thermal heating, cooling and electrical loads are calculated on sophisticated IES software models, and then individual Microgeneration solutions using available renewable energy harvesting technologies are proposed.

Zedfactory has the experience of providing low carbon solutions in most climate zones, ranging from temperate to high humidity, and can provide desktop studies at a fraction of the cost and time of engaging a conventional engineering analysis.

The enclosed analyses show how a 3 storey terraced ZedStandards home can be zero carbon in a range of different climates all over the world.

The ZED tools are a software application pioneered by Bobby Gilbert working for Zedfactory that calculate how ZEDfabric buildings perform in different locations and climates. This service is available to order, and is included with all Zedfactory architectural commissions as standard.

the zedfactory roadmap to a low carbon future

www.zedstandards.com



... from the Toxic Generation



EACH YEAR
50% energy efficiency
60% solar hot water
50% solar electricity
25% micro wind turbine
100% biomass heating

80% Carbon reduction

zedfactory.com
zero fossil energy developments[®]

... to the Micro Generation

ZEDtypes

Development density is one of the most important criteria for choosing which low carbon strategies to prioritise in both urban and rural regeneration and new infrastructure construction.

There is considerable confusion in the industry about which technologies are appropriate for a specific location. For example is solar access for passive solar gain more or less important than maximising development density around a good public transport node ? The answer is not simple, and relies on a careful analysis of each context, with planning legislation and local community consultation often setting the maximum permitted densities for many development sites.

It is also important to remember that new build should never exceed its fair share of our collective national renewable energy budget, otherwise it will not be possible to conserve our extensive stock of historic urban fabric. The ZEDstandards propose a simple set of guidelines based on the following ZED density options

- **RuralZED (detached) 15 homes/ha**
- **RuralZED (semi) 15 to 35 homes/ha**
- **Rural ZED (Terrace) 35 to 75 homes/ha**
- **Live/work ZED 75 to 120 homes/ha**
- **Urban ZED (to 6 storeys) 120 to 240 homes/ha**
- **City ZED (SkyZED) 120 to 240 homes/ha**

Each density option requires a different resource approach.

At 15 homes per hectare it is possible, should you wish, to produce a large percentage of your food on site or in communal food growing areas. However public transport and district heat mains will not generally be viable.

At 120 to 240 homes per hectare, local shops and public transport are viable so there is little need for cars, but there would not be enough land available to grow large percentages of food. Solar access for space heating and electricity generation would also be reduced.

We have produced a set of scenarios that inform what expectations should be placed on planning briefs for different density options.

						
	RuralZED (15/ha)	RuralZED (15-35/ha)	RuralZED (35-75/ha)	UrbanZED	LiveworkZED	SkyZED/ CityZED
Food supply						
% of diet which is animal - based	20	20	20	20	20	20
% of food which is fresh, unprocessed & local	100	100	60	21	50	21
Reduction in food waste (%)	50	25	10	1	5	1
% efficiency savings in food supply chain[1]	80	80	80	80	80	80

	RuralZED (15/ha)	RuralZED (15-35/ha)	RuralZED (35-75/ha)	UrbanZED	LiveworkZED	SkyZED/ CityZED
Mobility						
Veg oil vehicle (vkm/week)	52	43	14	6	14	6
Ultra-efficient petrol car (vkm/wk)	0	0	58	17	29	12
Electric car (vkm/wk)	52	43	14	6	14	6
Bus and coach (pass. km/wk)	12	29	29	87	58	92
Housing						
Fossil fuel con- sumption kWh/yr	0	0	0	0	0	0
Consumption of renewables (excl. wood) kWh/yr	1500	1500	1500	375	425	1500
<i>Of which Renewable electric- ity- wind</i>	750	750	1125	225	375	1350
<i>Renewable electric- ity - PV</i>	750	750	375	150	150	150
Wood fuel con- sumption kg/yr	400	400	400	1000	1000	400
Material & waste						
Municipal waste (kg/person/week)	6.00	6.00	6.00	6.00	6.00	6.00
... to landfill	0.90	0.90	0.90	0.90	0.90	0.90
... to recycling	3.60	3.60	3.60	3.60	3.60	3.60
...to composting	1.50	1.50	1.50	1.50	1.50	1.50
% efficiency sav- ings in industrial sector [2]	60	60	60	60	60	60
Services						
Spending £/month	200.00	200.00	200.00	200.00	200.00	200.00
% efficiency sav- ings in services sector [3]	60	60	60	60	60	60
Footprint gha/capita/yr	1.7	1.8	1.8	1.9	1.9	1.8
CO2 t/capita/yr	2.1	1.8	1.8	1.6	1.7	1.7
Number of Worlds	0.9	0.9	0.9	1.0	1.0	0.9

Notes [1], [2], [3] These can be considered as either efficiency savings, reductions in consumption or the consequences of extending the ZEDStandards to these other sectors. The case study in Section 2 of a Zero Emission Farm (or ZEF) suggests how to adapt the concept to the food supply chain.

Note that all the example developments listed comply with the ZEDstandards:

- Fossil fuels have been designed out - the housing requires no fossil fuel use and renewably- powered transport options have been integrated into all the developments
- Residents have an Ecological footprint of less than 2 global hectares per person
- Residents have CO2 emissions of less than 2.1 tonnes per person
- The developments use no more energy that could be provided from native renewable sources (in this case from the UK).

ZED Standards Checklist

	Density (homes/ha)	20	80	120	500
	Example description	Rural housing	Terraced live/work units	Townhouse and flats with work units.	High rise flats with commercial units.
NOURISHMENT	Aim: To reduce the environmental impact of the food supply chain.	■	■	■	■
N1: On-site cultivation space	Minimum % of dwelling that have private gardens (minimum size 10m ² per bed space) with at least 300mm of soil to enable food to be grown. Garden to receive at least 1,800 sun hours/year.	100%	100%	60%	0%
N2: Off-site food growing	Access to an allotment which is within 500 metres OR links made with local farm box scheme. Note: allotment could be provided on-site in larger developments.	✓	✓	✓	✓
N3: Reducing food miles	Dwellings provided with space for 'Homeport' or similar secure delivery boxes. All new residents to be offered option for installing system.	✓	✓	✓	✓
N4A: Promoting local food	Dwellings provided with secure space for drop off of food boxes. All new residents to be provided with details of any local farm delivery schemes and farmers markets. Developments	✓	✓	✓	✓
N4B: Promoting local food	Paved area to be provided suitable for farmer's market.		✓	✓	✓
N5: Reducing food embodied energy	Food retail outlet and bakery to be provided within ZED fabric.				✓
N6: Learning and Skills	Residents to be provided with information pack on the current food supply chain, educational materials on growing local food and seed pack suitable for local growing conditions.	✓	✓	✓	✓
N7: Orchard	Fruit and nut tree planting (minimum one per household – of mixed varieties in larger developments). Note: In larger developments can be communal orchard. Greenhouse could be commercially managed.	✓			✓
N8: Greenhouse	Greenhouse provided (either unheated or heated from waste heat). Note: In larger developments can be communal greenhouse. Greenhouse could be commercially managed.	✓			✓
SHELTER	Aim: to reduce on-going environmental impacts associated with buildings infrastructure.	■	■	■	■
S1: Reducing space heating, cooling and hot water demand	Designed for heating/cooling (including hot water) requirement of 15kWh/m ² /yr or less. Designed for passive heating and cooling. Note: specification of U-values (roof, ext. walls & floors <= 0.1 overall & windows <=1.2) and less than 2.5 air changes/hr at 50pa. See Note S1/S2.	✓	✓	✓	✓
S2: Reducing electrical demand	Designed for electricity consumption (cooking, lighting, appliances) of less than 20kWh/m ² /yr. Note: All internal lighting to be low energy, electrical appliances to be A-rated and preferably A+ or A++, cooking to be electric induction or clean burn biomass. See Note S1/S2.	✓	✓	✓	✓

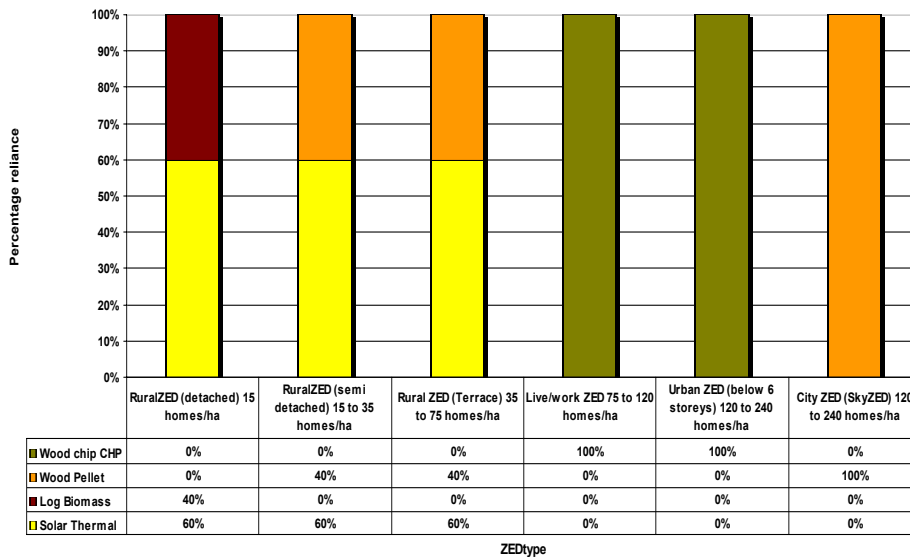
S3: Autonomous renewable energy supply	100% of direct energy demand to be met by onsite renewable generating capacity giving zero net CO2. Note: appropriate technologies include solar thermal, photovoltaics, micro wind, wood fuelled stove or chp. Communal schemes more appropriate for larger developments. Wood fuel does not have to be grown onsite.	✓	✓	✓	✓
S4: Sun spaces	% dwellings to have sun space designed to also serve as drying space. Note: Sun spaces can provide useful solar gain in winter months, reduce need for artificial lighting, and are pleasant additions to living space. However, they must be designed to avoid over-heating during summer months and be thermally isolated to avoid increased heating loads in winter.	100%	100%	60%	100%
S5: Learning and skills	Building 'operations' manual to be provided. Metering of utilities to be prominently displayed to increase 'resource literacy'.	✓	✓	✓	✓
MOBILITY	Aim: To reduce the need to travel and the impact of any mobility.				
M1: Accessibility	Minimum % of dwellings within 500m of following amenities (public transport stop, food shop, chemist, school, medical centre, leisure centre or community centre, public house, children's play area). Note: For larger development these can be on-site.	0%	100%	100%	100%
M2: Cycle Parking	Secure, covered cycle parking – one space per bedspace.	✓	✓	✓	✓
M3: Workspace	12m2 workspace provided on-site per bedspace. Include broadband connection where this is available plus additional power and telephone sockets.	✓	✓	✓	✓
M4: Car club	Car club established. Pool cars available in larger developments.		✓	✓	✓
M5: Car parking	Car parking spaces <=0.5 per dwelling bound by agreement		✓	✓	✓
M6: Alternative fuel vehicles	Facilities provided for charging electric vehicles from zero emission sources. One charging point per 10 dwellings.		✓	✓	✓
M7: Learning and skills	Map of local area to be provided highlighting local amenities and local public transport timetables. Educational materials to be provided on 'green travel' which should include description of any on-site amenities (i.e. vehicle charging points).	✓	✓	✓	✓
M7: Eco-travel agent	Green travel agent on-site.				✓
GOODS & SERVICES	Aim: To reduce the impact of products and services tackling both consumption and waste reduction and management.				
G1: Indoor recycling storage	All dwelling to be provided with space in the home for recycling at least five separate material streams (for example, paper, glass, clothing, , electrical, cardboard, plastic, compost) plus landfill waste. Minimum capacity per waste stream; 10 litres per bedspace.	✓	✓	✓	✓

G2: Outdoor recycling storage	All dwellings to be provided with space outside the home for recycling at least five separate material streams (for example, paper, glass, clothing, , electrical, cardboard, plastic, compost) plus space for landfill waste. Minimum capacity per waste stream; 20 litres per bedspace.	✓	✓	✓	✓
G3: Learning & skills	Information to be provided on local Council and community recycling schemes. Safe disposal/recycling/reuse information should be provided for at least 25 waste streams. Also, background information on waste reduction, re-use and recycling (see G3 Note).	✓	✓	✓	✓
G4: Composting	On-site composting facility to be provided.	✓	✓	✓	✓
G5: Waste management	On-site re-use/recycling facility. Note: could be repair shop, secondhand store or reprocessing facility.				✓
WORK IN PROGRESS FOR ZEDSTANDARDS VERSION 2					
Nourishment	Zero fossil energy farm (ZEF) supply chains				
Shelter	To be added: external and internal water use.	■	■	■	■
Construction	New section proposed. Intended to deal with sourcing and certification of construction materials, recycle content, commissioning standards, biodiversity assessment, SUDS, daylighting and sound insulation, climate proofing and post-occupancy assessment.				

Zero carbon / zero waste / low investment

eco minimalism - design away the problem!

Domestic Hot Water

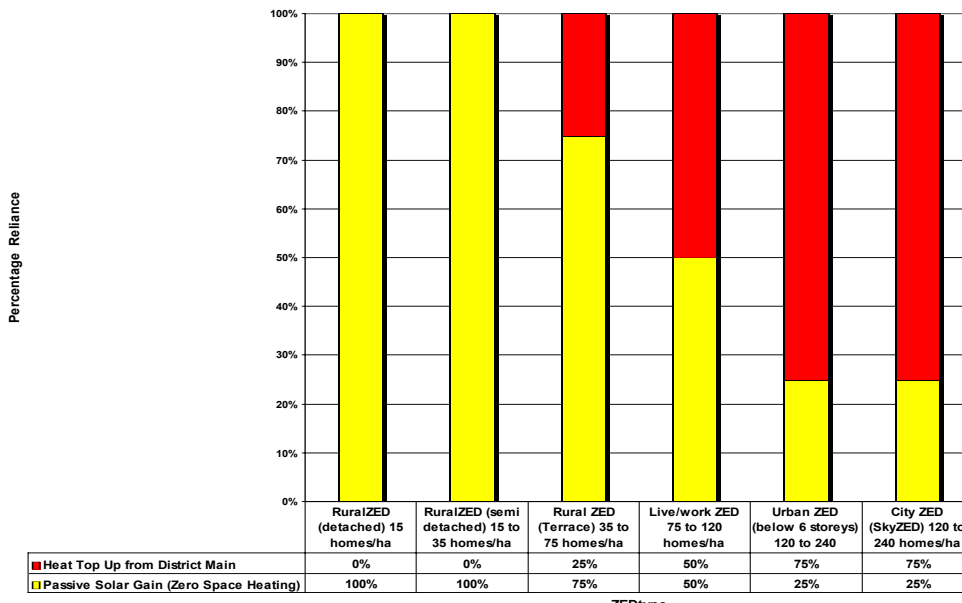


It is important to use the most appropriate technology for the development density. For example if high density developments of 120 to 240 homes / ha use valuable wood pellet biomass as the fuel for a highly centralised chp,- national stocks of woodpellet would soon run out.

Woodpellet is is appropriate for lower density developments where smaller biomass boilers requiring low maintenance and good energy density fuel sources become important due to the difficulty of installing district heating.

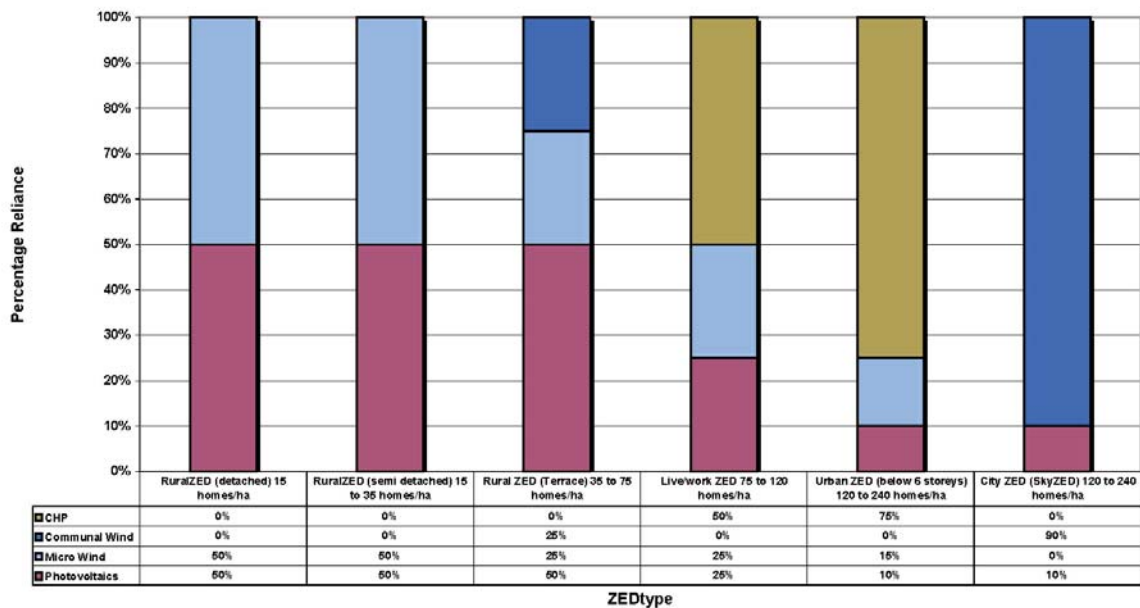
Higher density developments can use biomass with automatic woodchip fuel loading systems and storage bunkers, allowing the use of a lower energy density fuel. Similarly, if the same development used woodchip chp without adopted the ZEDstandards building fabric, so much biomass would be required that again national stocks would run down too fast. This is already starting to happen in greater London - where the GLA 10% renewables legislation encourages developers to adopt the lowest capital cost strategy of using excessive quotas of biomass heating rather than adopting state of the art energy conservation techniques such as ZEDstandards.

Space Heating



low or zero carbon and a high standard of living

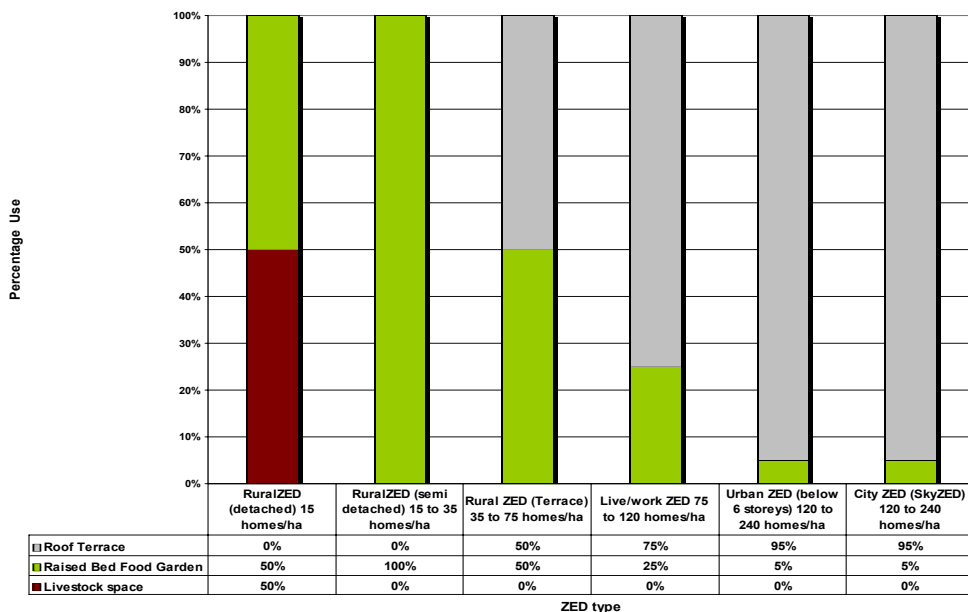
Electrical Supply



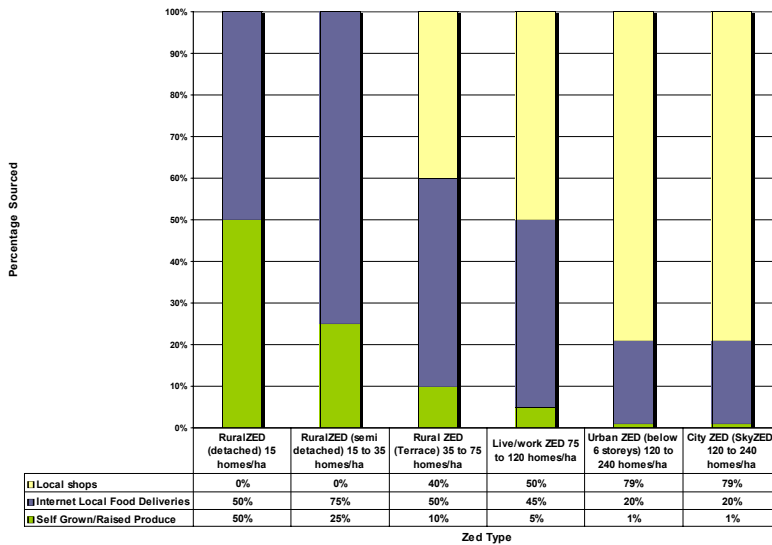
Another major concern in the UK must be the classification of heat pumps and geothermal energy as a renewable energy source. This technology does not generate renewable energy, it just uses large amounts of highgrade electricity to provide lowgrade heat. However electricity is the hardest renewable energy to generate and will be in short supply in a low carbon future particularly in the UK. This technology may use underground stocks of low grade heat or coolth, but uses excessive amounts of scarce electricity to do so - potentially massively increasing the city's electrical energy demand far beyond the point where it could ever be met by its fair share of national renewable reserve.

The best performing specification for each density will always be the one that minimises demand on scarce national renewable resource, and maximises heat and power generation using renewable energy and water sources generated within the plot boundaries, ie typically wind, sun and rain. For this reason it is important to set renewable energy generating targets that relate to density, but have been generated by taking the limited national annual resource available and dividing by the UK population. It is highly unlikely that it will be possible to import much renewable energy resource from other nations in the resource scarce future at the end of this century.

Gardens and External Space



Food Sourcing

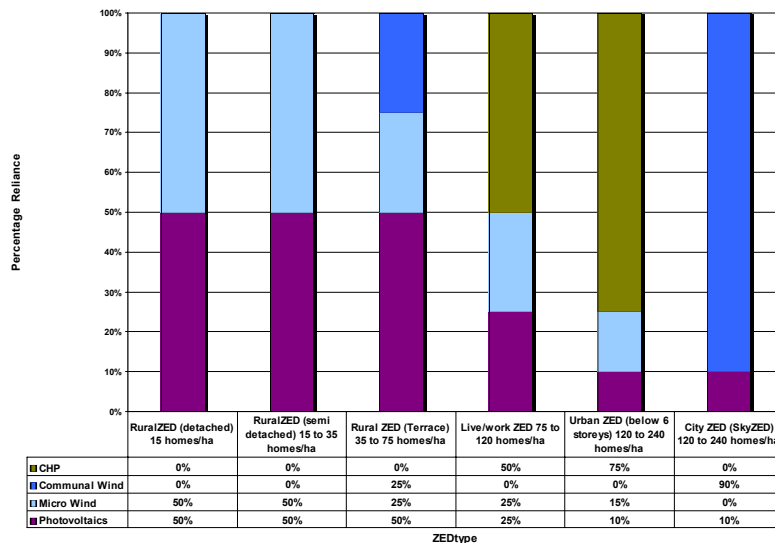


When carbon reduction strategy is not matched to density and buildings and masterplans are not designed around both energy conservation and maximising renewable energy harvesting, then nationally we are forced into adopting centralised nuclear power stations. Within ten years we will then experience 'Peak nuclear', where global demand for raw supplies of uranium in ore concentration suitable for extraction will exceed available supplies and inevitable violent competition for scarce resources follows the same pattern that we are currently experiencing with dwindling oil reserves.

“To secure future energy supplies within a stable civil society - there seems to be no real option but to design a society that can exist comfortably on the available renewable energy sources available within our national boundaries” - Bill Dunster

It is no accident that developers with large landholdings, that have paid premium current prices for their landbank, do not wish to have their investment devalued by having to increase the construction cost by building energy efficient development solutions, with building integrated renewable energy solutions.

Electrical Supply



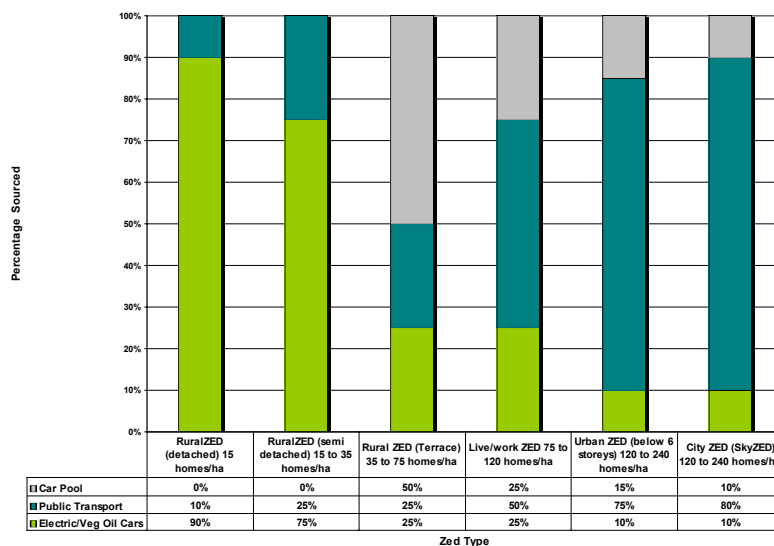
There is a massive financial incentive for these landholders to persuade the government to invest in centralised nuclear power generation, effectively externalising for them the cost of producing low carbon fabric.

Equally it is not possible for a high density development in central London to sponsor a windturbine on a Welsh hillside or the Thames Estuary - there is simply not enough communal renewable generating capacity available to justify this approach.

The C20 idea that an overcrowded city can always export its energy or environmental problems to another rural location is becomingly increasingly naive. Similarly, with household waste capable of generating around 3.5 % of a typical households annual energy requirements, it is not sensible to rely on energy from waste schemes as the prime power source for new demonstration low carbon communities - as this technology can only ever meet a fraction of global demand.

Planning for all new projects needs to be able to work within a fair share of our future energy reserves - possibly building in future upgrade paths, or planning to replace them within thirty years. We must remember that everything we build now has to work in the low carbon society of 2050.

Transport



Gradually fossil fuels will become more expensive to extract. The age of easily accessible fossil fuels is almost at an end. As this happens, society will have to manage increasingly on renewable sources of energy.

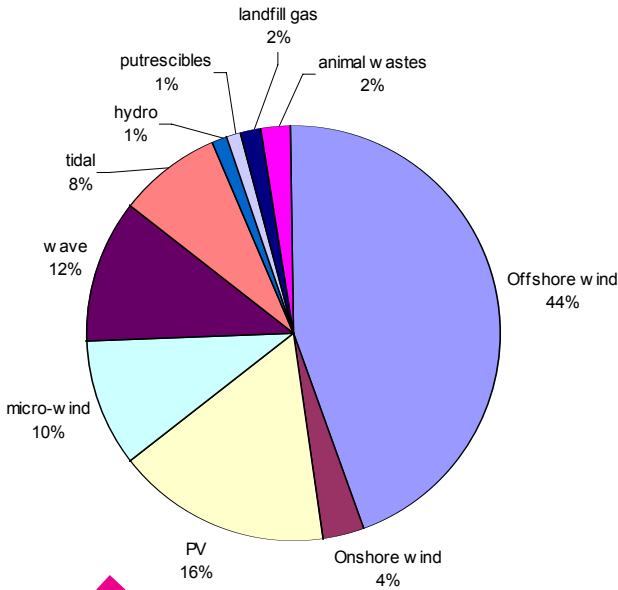
However, even with the most optimistic prediction of renewable energy that could be available to us, this amount of renewable energy is far less than the amount of fossil fuels energy we are currently used to.

It is wrong to think that housing can meet its energy needs by linking with a Welsh mountain side or burning someone else's rubbish. **In energy poor times, Wales will keep its windfarm energy** and everyone will keep their own rubbish to either recycle it or produce their own energy from it. Only 3.5% of national energy demand can be met by energy from waste technology. The ZEDfactory strategy is to design out packaging and waste. *see our ZEF delivery service.*

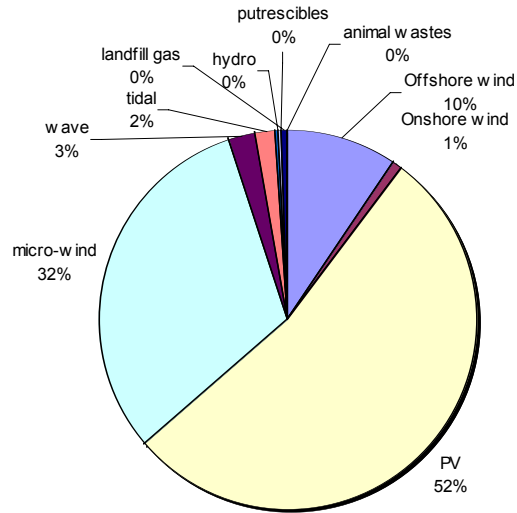
Housing is also not the only user of energy. What about industry, agriculture and transport?

Surely some of the potential offshore wind farm energy has to be allocated to these sectors.

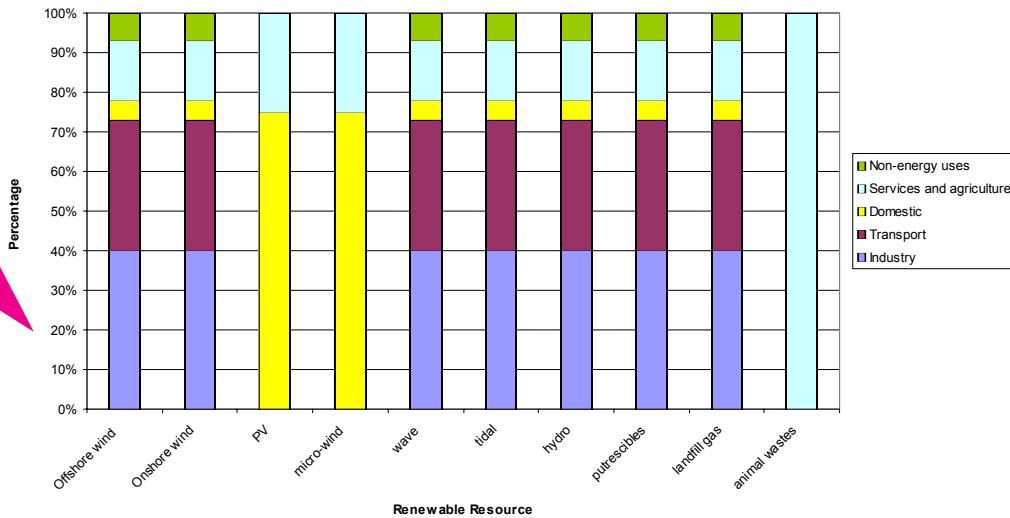
Renewable Resource per capita (before sectoral allocation)



Domestic Renewable Resource per capita (after sectoral allocation)



Renewable Energy Split Across Use Sectors



The study on this page attempts to look at the total amount of renewable energy available per capita from all potential sources within mainland UK.

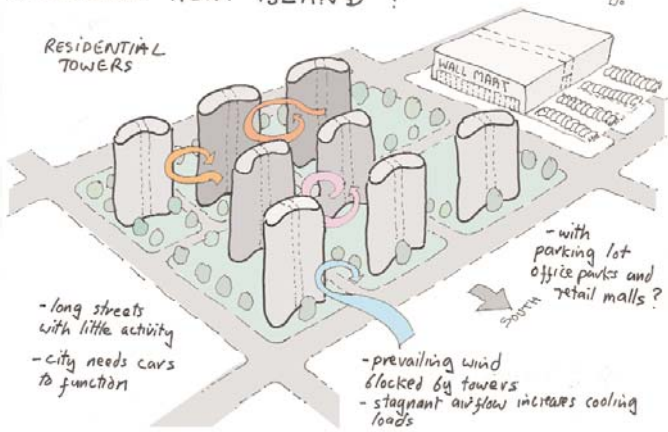
It allocates energy to various sectors based on need and local generation potential. It can be seen that as industry and transport do not generally have the ability to generate locally, they will have to be allocated energy from decentralised energy sources such as wind farms. Housing, which can generate locally, therefore would have to rely mainly on photovoltaic and micro wind for electricity and wood pellets plus solar thermal for zero carbon heat.

We feel that this study shows that unless housing takes up every opportunity to generate its own power it will become a future liability that will either drain energy away from economic functions such as industry, or more likely, become uneconomic to live comfortably, plunging many masses of people into fuel poverty. Both affordable warmth and affordable coolth will become critical for ordinary Londoners as fossil fuel sources deplete and climate change accelerates.

ZEDQuarter at 175 homes per hectare with workspace and retail
example from Changsha, Hunan Province, China



6. URBAN HEAT ISLAND ?



6. LANDSCAPE CITY FOR THE C21 - the 'ZEDQUARTER'

