THE LINEAR GARDEN CITY

A One Planet Vision

Wolfson Prize Entry March 2014 Reference: 97821508

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Part 1: Non-Technical Summary

A thinly populated corridor through the hills and valleys of Central Wales and South Shropshire is the potential location for a linear garden city encompassing villages and market towns, set within an 80-mile-long regional forest, mainly broad-leaved woodland, interspersed with farms and market gardens, orchards, allotments and public spaces.

Our linear garden city concept can be applied to both rural and brownfield urban sites. In rural areas like our project zone, we suggest that by diversifying the economic base it will be possible to revive areas suffering from economic decline.

Settlements resilient to future shocks need to have high capacity for self-sufficiency, which in turn will underpin employment. We expect local manufactures to gain in importance as international transport costs increase in response to lower availability and higher prices of fuel. Limiting energy consumption, including transport, is important because of sharply falling ratios of energy returned on energy invested in extraction, conversion and transmission. Adaptability is also crucial. Strict planning zones are not helpful when future circumstances, such as rising sea levels, may force us to abandon settlements and infrastructure quickly.

The linear garden city is planned around the under-used Heart of Wales railway, which runs the length of the proposed forest, with villages and small towns strung along it. The project, to consolidate existing communities, develop new villages, and link with local transport, forming a city-scale network, stretches from south-west to north-east between Llandeilo and Craven Arms.

Each extended and new village would comprise a ‘natural neighbourhood’, each of between 500 and 700 people, a number small enough for an individual to recognise a large proportion, and big enough to support services such as a shop and primary school. Twenty or so neighbourhoods would provide the population to sustain a secondary school, emergency services and general medical services.

The initial target population would be up to 70,000, double the current number, the majority achieved within a decade. In time the city could become larger, linking with other corridors into the West Midlands, and to Bristol and the South West of England. The plan does not depend on public money, but it does need a planning system with the power to approve experimental concepts for settlements that are resilient, economical, adaptable and low-carbon.

The incomes of most households will remain constrained, we believe, therefore we have to prioritise housing that is affordable to buy, rent and run. Landowners’ expectations of high sale value would have to be negotiated on a site-by-site basis by community land trusts (CLTs). As CLTs are not statutory bodies, they could not embark on a compulsory purchase programme, but share capital raised from public issues could be used to acquire land from owners who are willing sellers. The CLTs would retain freehold ownership and receive income from ground rents, and would have a first option to purchase when a lease is offered for sale. Lease purchasers would benefit from any capital appreciation.

A land trust federation should be the top-tier land management organisation for our project, serving land trusts established for each new community. The federation would collaborate with the Heart of Wales Line Forum, a community rail partnership, to create an improved transport

network. Alongside the railway in the central corridor a cycleway and footpath would have connecting links to the towns and villages along the way.

Settlements in the linear garden city would be diverse, but with ‘One Planet’ enterprises as essential elements. The Welsh Government has a ‘One Planet’ set of policies to foster lifestyles which do not exceed the carrying capacity of Earth. The people of the UK are using, on average, the resources of 3.5 planet Earths, and to help counteract this excess, the Wales ‘One Planet’ planning guidance allows development in the countryside if it uses no more resources than can be supplied sustainably by our single planet Earth.

To achieve balanced, mixed communities, we would need to relax planning restrictions for other low-carbon homes within ‘One Planet Vision’ villages and towns. Homes would be self-built as well as constructed by housing associations and other third-sector organisations. Average densities in the linear garden city would be lower than in a speculative development, and lower than the usual minimum density of 12 homes to the acre (30 per hectare). We propose an average density of 8 homes to the acre (20 per hectare), to allow for small-scale workspaces and productive gardens, with additional land for allotments, orchards, and employment and service centres. Employment space would cater for diverse enterprises but particularly those based on timber, food, textiles and creativity.

Self-employment and small and medium-sized social and commercial enterprises should form the economic basis for linear garden city settlements with a ‘One Planet’ vision. Each new household would require a minimum of one full-time-equivalent job, local because ‘One Planet’ vision demands minimal commuting.

Funding for both social and for-profit small and medium sized enterprises (SMEs) in the linear garden city is a barrier that could be overcome more easily with seed funding from the UK’s Green Investment Bank, but in the absence of recourse to public-sector bodies such as this, funding could come from collective investment funds created for the purpose.

As for energy, small-scale electricity generation from sun, water and wind helps support the rural economy. Its use will allow households and communities to increase their resilience. Local resilience is of critical and growing importance in an age when more extreme weather conditions and poor central energy planning are already exposing weaknesses of long supply chains. The topography of the terrain along the development corridor, and the high level of rainfall, present a particular opportunity for electricity generation through a network of micro-hydro installations.

There is growing awareness that we live on a planet with finite resources, making effective resource management vital. The linear garden city with ‘One Planet’ vision is our response to this imperative for change.

Part 2: Introduction

Real Regeneration

We see the economic dominance of London and the South East of England as damaging to the rest of the UK, including our project area within Mid Wales and the Marches. Our proposal is to initiate rural regeneration with a new style of linear garden city which is based on clusters of garden villages, a modern interpretation of the city concept which is

- Resilient
- Economical
- Adaptable
- Low carbon

Settlements of the future must have the capacity to cope with the storms and floods which characterise a warming world.[1] For this reason, new settlements on flood-risk sites near rivers or coasts, or serviced by vulnerable infrastructure networks, should be avoided.

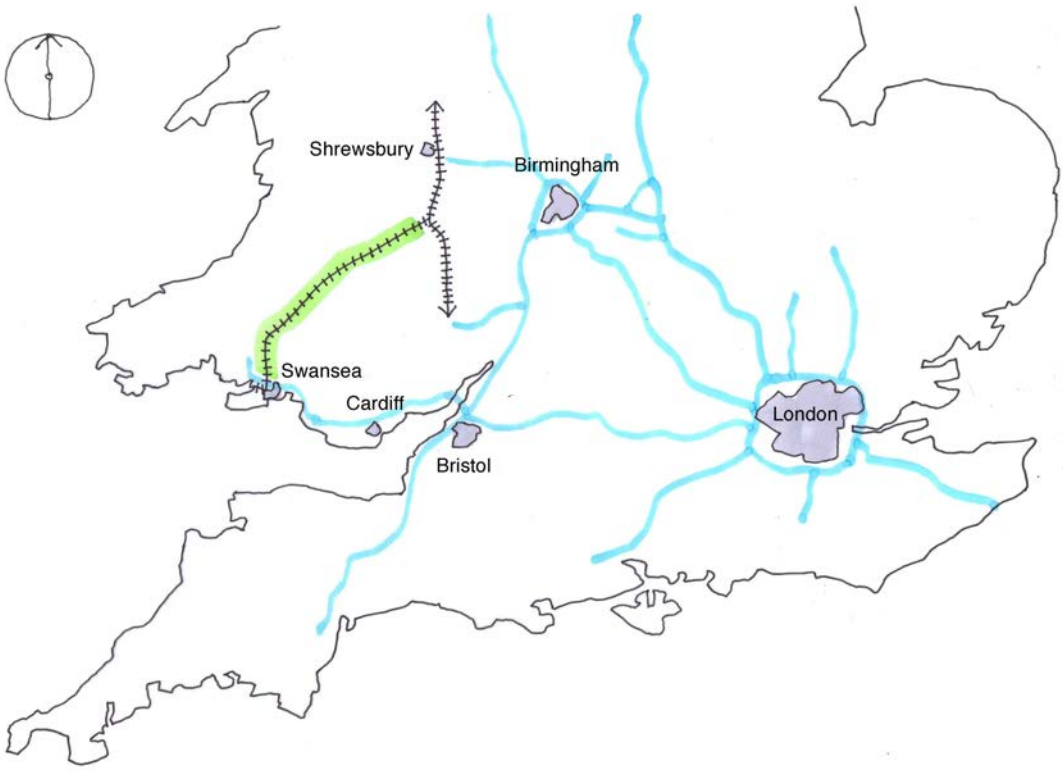
A traditional ring-fenced city is not part of our vision, and so our proposals for funding and governance are different from those applicable to a conventional city. Issues around popularity are also different. A new city of traditional shape imposes major and often unwanted changes on the environment and lifestyles of existing residents, but we argue that many rural communities will, on balance, welcome sensitive new settlements that will assist them to retain the public and private services that have been flowing away.

Our project territory is the central section of the Heart of Wales railway line, some 80 miles (130 kilometres) between Llandeilo in Carmarthenshire and Craven Arms over the English border in Shropshire. *(See map 1, location within the UK, and map 2, the linear city corridor)*

The corridor varies from approximately 2 to 3 miles (3 to 5 kilometres) wide depending upon the topography. Llandrindod Wells, the administrative centre of Powys, is located near the centre of the corridor. Llandrindod and the nearby market town of Builth Wells constitute a hub area with a population of about 10,500 in the urban and peri-urban areas. The open spaces and the existing smaller settlements either side of the hub provide the framework for, and the opportunity to, boost population. The settlements in this corridor are suffering from the outward flight of young people and of services.

The population in the central section of the railway corridor is approximately 35,000. Doubling this over ten years, focusing on the zones of Llandeilo-Llandovery, Builth Wells-Llandrindod Wells-Crossgates, and Knighton-Craven Arms, would create hub settlements with the critical mass to serve smaller settlements within a radius of about 15 miles (24 kilometres).

1 Evidence ‘suggests climate change link to storms’, NNC News, February 9th 2014, quoting Dame Julia Slingo, chief scientist at the Met Office. http://www.bbc.co.uk/news/uk-politics-26084625



Map 1 Location within the UK

Map 2 Linear City Corridor

Resilient and Adaptable

The context for our new settlement proposal is the imperative to reduce our use of finite resources. We argue that traditional cities are not the most appropriate response to present and future challenges of resource scarcity, or to the associated challenges of climate change, extreme weather events, and economic 'levelling down' towards a global average, which will reduce consumer spending and tax revenues. One of the principles underlying our vision is 'resilience': settlements resilient to future shocks because they will have high capacity for self-sufficiency, which in turn will underpin employment with resilience to the vagaries of the global market.

'Adaptability' is another principle, although at odds with the orthodoxy of zoning. Separating homes from employment, and of allowing settlement only in pre-determined locations, is not helpful when we need to concentrate on resilience to future shocks, because planning regulations force settlements into densities and shapes that may not be at all appropriate to the challenges of today and tomorrow.

Part 3: The Global Frame

Systems Thinking

Current planning theory and practice is framed within neoliberal economics, a frame criticised by ecological and biophysical economists, such as Nicholas Georgescu-Roegen (1906-1994) who argued that entropy affects economic theory. This insight was and is largely discounted by theorists in the neoliberal mould, men such as Milton Friedman (1912-2006) of the 'Chicago school' and Friedrich Hayek (1899-1992) of the 'Austrian school'.

According to neoliberal economists, free markets deliver the best possible outcomes for economic growth, but unfettered free market policies have the major drawback that they ignore entropy, the measure of the disorder, randomness or chaos in a system. Entropy is at the heart of the second law of thermodynamics, which shows that energy transforms from more ordered to less ordered forms. This means that when we use an energy resource, there will be less of that particular resource available for use in future.[2]

The capacity of planet Earth to support life forms is finite, a fact recognised in the report 'Limits to Growth' in 1972, prepared for the Club of Rome.[3] 'Limits to Growth' pointed the world in the direction of economic equilibrium, but the world has so far refused to abandon the quest for continuous growth, even in the 21st century now that easily obtained fossil energy has gone.

2 Chapter 5 p.142, 'Entropy in ecological economics' in 'Marxism and Ecological Economics' by Paul Burkett, Chicago: Haymarket Books, 2009.

3 'Limits to Growth' by Donella Meadows, Dennis Meadows and Jorgen Randers, Massachusetts Institute of Technology.

EROEI

Extraction of fossil fuels from increasingly dangerous environments means that ratios of energy returned on energy invested in extraction (EROEI) are falling. Meanwhile, the emissions from carbon extracted and burnt over a few decades affect world climates in ways that we cannot fully understand because of the capacities of systems to generate new, emergent properties which cannot be predicted. The delayed but severe impacts of climate change will become more and more problematic just as the energy resources to help cope with weather disasters will be in decline.

Long term, we expect fuel and energy prices to continue rising in relation to incomes. Therefore we foresee local manufactures gaining in importance as international transport costs increase in response to the lower availability and higher prices of fuel. This trend is already in evidence[4] and we expect it to accelerate.

We suggest that today's 'cost of living crisis' will persist into the future, and that the best way to tackle it will be to adopt simpler styles of living. Homes, either purchased or rented, and home running costs, must be affordable for households across the income range, including those in the range £10,000 to £20,000 a year, at current monetary values. We think it is better to design communities with low living costs than to rely on debt to paper over the gap between low incomes and the cost of living.

We believe that unless it becomes possible for more people to live affordably in rural areas, it will not be feasible to meet future food production requirements in an energy-constrained world, and it will become increasingly difficult to maintain infrastructure and impossible to reverse the pattern of service closures.

We envisage reversal of the trend to high-impact city living because labour will be needed to replace energy-intensive methods of agricultural production. More people will have to live and work in the countryside, producing and processing food, drink and other products of the land, and harnessing wind, water and solar energy to power homes, businesses and public buildings. Therefore, we prioritise local networks in which communities are able, over decades rather than centuries, to create what the Welsh Government calls 'One Planet' lifestyles.

Part 4: A Corridor for 'One Planet' Living

Welsh Government's Vision

The Welsh Government has a 'One Planet' set of policies to foster lifestyles which do not exceed the carrying capacity of Earth. The people of the UK are using, on average, the resources of 3.5 planet Earths,[5] a rate of use that is impossible to maintain. The Wales 'One Planet' planning guidance allows development which uses no more resources than can be supplied sustainably by Earth, and although the new permissions require

4 See for example 'UK firms are coming back from China, but they need more help', by Rachel Bridge, www.telegraph.co.uk, May 25th 2013.

5 See for example 'How many planets do you need?', World Wildlife Fund, www.wwf.org.uk, August 20th 2013. The calculations are made by estimating the quantities of land and water, and the produce of that land and water, required to provide the current lifestyles of people in nations around the world.

applicants to negotiate through layers of exacting bureaucratic requirements, they are a promising start.

We place job creation at the heart of settlement plans, but not job creation dependent on large multinational companies, which can close down and relocate at short notice. We argue that self-employment and small and medium-sized social and commercial enterprises, new and relocating, should form the economic basis for linear garden city settlements with a 'One Planet' bias. Each new household of working age would require at least one full-time equivalent local job, as efforts towards 'One Planet' living demand minimal commuting.

Funding for both social and for-profit SMEs in the linear garden city is a barrier that could be overcome more easily with seed funding from the UK's Green Investment Bank, but in the absence of recourse to public-sector bodies such as this, the funding needs could be met from collective investment funds created for the purpose.

Current 'One Planet' Policy Limitations

To achieve the objective of a linear garden city with a 'One Planet' vision, the existing regulations pertaining to 'One Planet' development require amendment. The regulations are too restrictive particularly concerning the expected timescale for the attainment of self-sufficiency, as this extract from the planning guidance illustrates:

> *"1.7 Planning Policy Wales[6] goes on to note that "land based One Planet Development in the open countryside should provide for the minimum needs of the inhabitants in terms of income, food, energy and waste assimilation over period of* ***no more than five years*** *from the commencement of work on the site. This should be evidenced by a management plan produced by a competent person(s). The management plan should set out the objectives of the proposal, the timetable for the development of the site and the timescale for review. It should be used as the basis of a legal agreement relating to the occupation of the site, should planning permission be granted" [9.3.12].* (Our emphasis)

The management plan makes no allowances for any changes in circumstance after its inception, such as adverse weather events or crop failure. Such changes in circumstances would slow the progress towards the legally binding ecological footprint of 2.4 global hectares per person after five years, and reducing to 1.88 global hectares after that. Global hectares are the sum of all the biologically productive areas on earth. As the present environmental footprint in Wales exceeds 5 global hectares per head, the reduction requires an exceptionally rapid downshift which an adverse change in circumstances could derail.

To put current profligacy into context, in 2007 there were some 11.9 billion 'global hectares', hectares which were biologically productive, for example arable land, grazing land, forests and fishing grounds. At 8.50am on February 20th 2014 there were about 7,214,518,090 persons alive.

6 4th edition, February 2011, paragraph 9.3.11

Using the 2007 carrying capacity, which is on a falling trend, and the February 2014 population, on a rising trend, there would be just 1.65 global hectares per person, if they were equally distributed.[7] Therefore an ecological footprint of 1.88 global hectares in the linear garden city would not be 'job done', but a vast improvement on the 'business as usual' model.

The 'One Planet' management plan does not allow for the costs of capital to achieve such a fast downshift. Applicants at present need access to 'free' capital, because borrowing money to be repaid at interest is an unrealistic option when the objective is to achieve a high level of self-sufficiency with a low level of financial transactions. Five years to slash planetary impact by nearly two-thirds is insufficient, given the 150+ years it has taken to achieve Western overshoot. We suggest that the Welsh Government revises the 'One Planet' planning guidance to extend the timescale for halving the average ecological footprint in Wales.

In addition, the 'One Planet' guidance does not allow what it terms 'Ecovillages' to contain the occupational diversity necessary for a fully functioning community, roles such as teacher, shopkeeper, engineer, and so this aspect of regulation would require review too.

We propose that pioneering 'One Planet' settlements should be diverse and mixed. They would augment existing settlements, and build employment based on local resources but – a key requirement of 'One Planet' living – incomes would not be high enough to permit consumer spending on inessentials to continue at typical modern levels.

Another feature of 'One Planet' guidance that could be problematic is the insistence that structures comply fully with building regulations. This imposes costs which would be exceptionally difficult to meet during a drive towards self-sufficient living. Therefore we argue that building regulations should be applied with greater flexibility so that the cost of compliance is minimised, but without compromising standards of durability and environmental performance.

Part 5: The First Linear Garden City

Heart of Wales Railway Corridor

Our first proposed location, within a rural region between Llandeilo and Craven Arms along the corridor of the Heart of Wales railway, contains small settlements, over-dependent on tourism and on public-sector employment, which is in retreat because of budget cuts. Low-carbon housing near the stations on this railway would be allied with workspaces particularly for diverse timber, food, textile, energy, engineering and creative enterprises. There is at present a surfeit of unoccupied housing in settlements which are unpopular with families because of the vicious spiral of service loss. These homes could be brought back into use if job creation attracted new residents.[8]

7 'Footprint accounts' in 'Ecological Footprint Atlas 2010', from the Global Footprint Network: http://www.footprintnetwork.org/en/index.php/GFN/page/ecological_footprint_atlas_2010

8 Data from the 2011 census shows that rates of unoccupied dwellings were high in many wards of rural Wales, for example 14.6% in Llanelwedd, where the railway passes north of Builth Wells, and 10.7% in Llanwrtyd Wells, also in the railway corridor. Not all of the unoccupied dwellings are empty

Roger Levett and James Shorten[9] argue that before 2050 the amount of car use in rural communities will decline dramatically. To prevent isolation and service inaccessibility, they propose joining "groups of settlements into sustainable clusters, sharing services and facilities, giving a broader foundation for the local economy, capable of being joined up by low-carbon transport".[10] The railway is a vital element of this low-carbon transport.

City of Villages

The concept of a city arranged as a linear network of villages, in a corridor traversing the sparsely-populated centre of Wales, emerged as a response to several interlocking concerns. The reasons for choosing this geographical region in preference to other marginal areas in the UK are as follows:

- The territory we have chosen is well served by excellent trunk roads, especially at both ends where there are large population and service centres: Swansea-Llanelli at the south-western end, and Shrewsbury-Telford at the north-eastern end.
- The European Union subsidy system for agriculture has favoured low-intensity livestock production in hill-farming areas, but livestock are inefficient processors of feed and it is more sustainable, although not at present favoured by policy, to grow foodstuffs for direct human consumption, and to plant woodlands of native species. In central Wales there is plenty of lightly farmed land which could, given a political will, be used in more productive ways.
- The local economy is heavily dependent upon tourism and public-sector employment, both of which are vulnerable in times of austerity.
- The existing communities are in need of repopulation with people of working age who can contribute to the wider economy.
- The corridor is a natural communication route and the under-used railway is potentially an important part of the wider rail network. The challenge is to increase traffic on the line, a challenge which a linear garden city would resolve.

The linear garden city would be located in a belt of woodlands, farms and market gardens, between 2 and 3 miles (3 to 5 kilometres) wide, between Llandeilo and Craven Arms, a distance of about 80 miles (130 kilometres), with the railway and its string of communities forming the spine.

The corridor follows a natural line across the spectacular landscapes of mid Wales, an ancient route following river valleys and skirting the blocks of upland. It is also a physical and symbolic link between South and North Wales. From north-east to south-west, the corridor crosses the local authority areas of Shropshire in England and Powys Carmarthenshire and Swansea in Wales. In the Welsh section, there is a series of small and declining rural villages alongside the railway.

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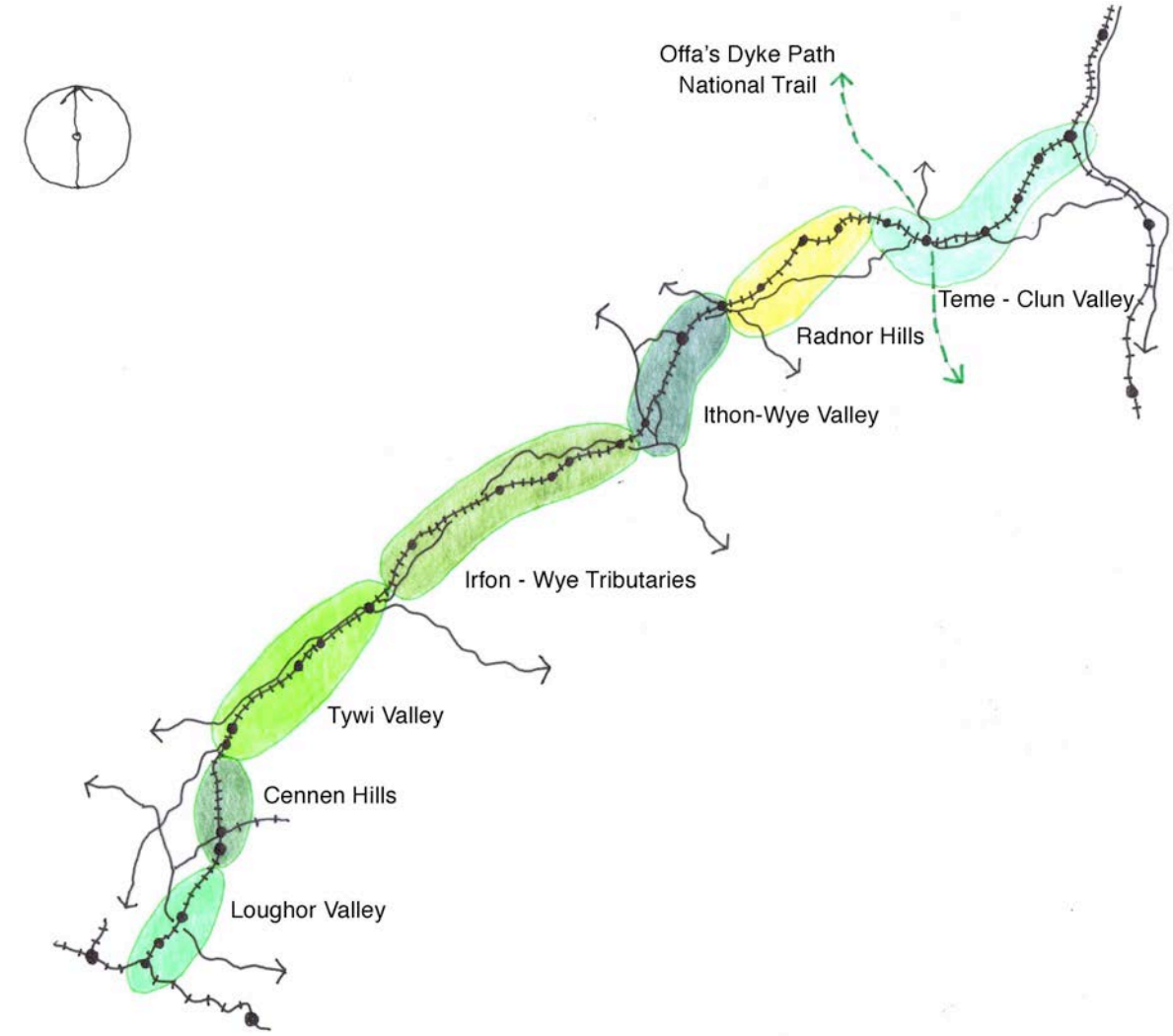
all the time: the figures include holiday homes, but these do not at present contribute to augmenting the number of permanent homes.

9 James Shorten drafted the planning guidance for Wales's 'One Planet' policy.

10 'Rural low-carbon transition – a critical issue for Wales' by Roger Levett and James Shorten, Institute of Welsh Affairs, spring 2011.



Map 3 Garden City landscape character tracts

In planning our linear garden city, we identified five separate landscape character tracts within the corridor between Llandeilo and Craven Arms, each quite distinctive. *(See map 3, landscape character tracts)* Travelling from south-west to north-east these are:

- Dyffryn Tywi – the fertile valley of the upper River Tywi.
- Irfon / Wye tributaries – the marshy basin of these upland rivers.
- Ithon / Wye – the undulating plateau following the Rivers Ithon and Wye.
- Radnor Hills – the upland valley of the River Arran, and steep, bare hills.
- Teme and Clun Valleys –the Shropshire Hills escarpment and Teme / Clun water-meadows.

We studied the existing settlements and the relationships between them to assess the benefits and possible negative implications of a large increase in population. Land-use and travel patterns, the Heart of Wales railway service and the highway network, and the topography and natural hydrology of the landscape tracts were all analysed to ensure that the theoretical strategy would also make complete sense at a local level.

Llandrindod Wells, the administrative centre of Powys, is located approximately in the centre and, together with the nearby market town of Builth Wells, it constitutes a form of hub with a population of about 10,500. Powys County Council also views the Builth Wells - Llandrindod Wells - Crossgates zone as a potential focus, referring to it in the emerging Local Development Plan as the "Heartlands Hub". Here, the north-south A483 and A470 trunk roads converge with the railway in the centre of the corridor before diverging again.

The population of the corridor between Llandeilo and Craven Arms is about 35,000, and the proposal is to nearly double this figure over a period of 10 -15 years or so. This increase would be structured as groups of discrete villages, mainly concentrated within and around three zones; the Heartlands Hub (+13,000), Llandeilo - Llandovery, (+5,500) and Knighton - Craven Arms (+ 9,000). These zones would become relatively more urban in density and able to act as service centres for the smaller settlements within a radius of about 15 miles (24 kilometres.)

The less populated sections between the three zones are suffering badly from the flight of young people and the decline of public services. But their struggling villages provide the opportunity and framework for a further, much-needed boost to local populations and viability. Initially these stretches of the corridor would accommodate a further increase of 5,500 – 6,000.

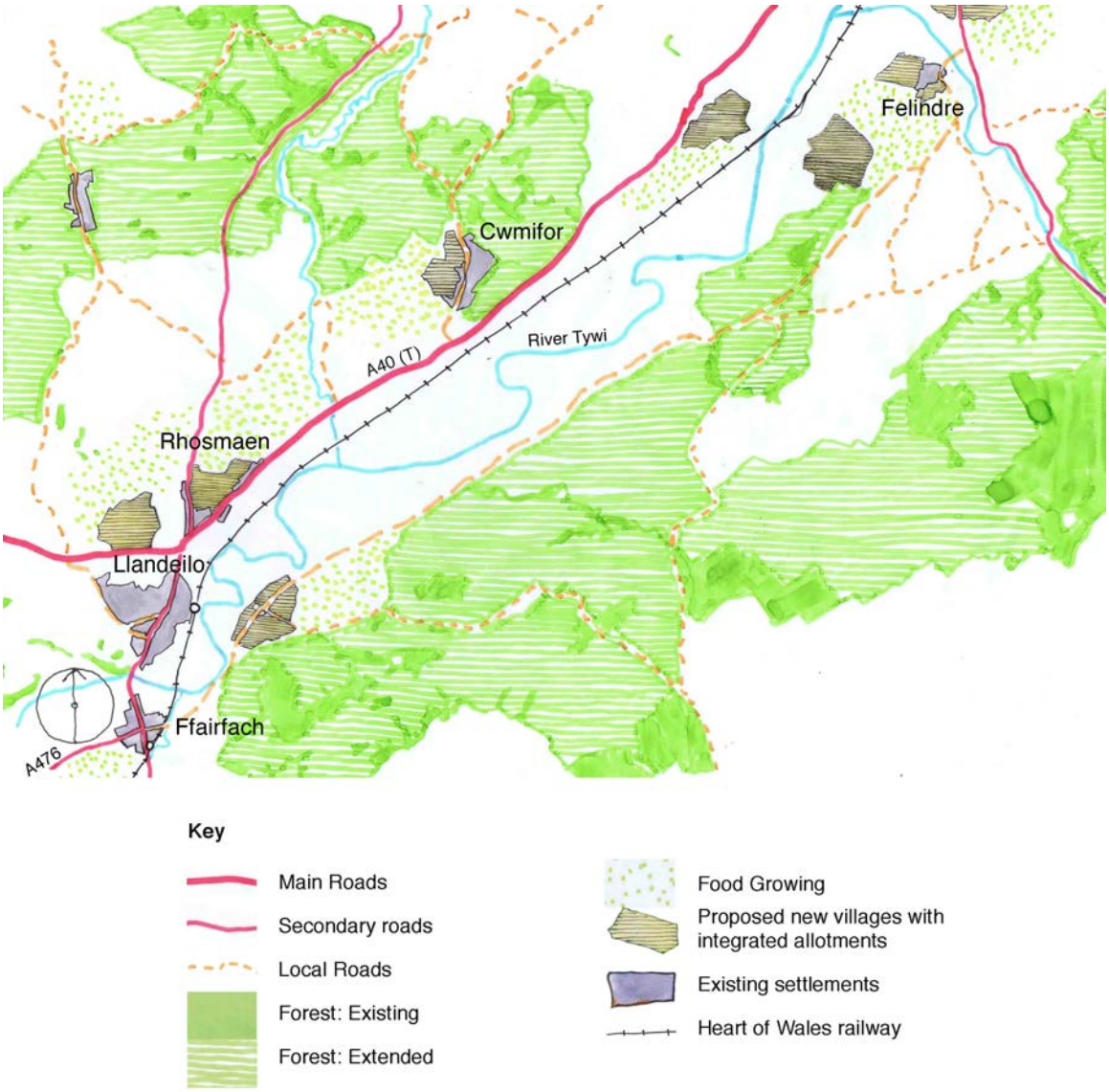
Llandeilo-Llandovery

(See map 4, south-west section, and map 5, north-east section)

At the southern end our linear garden city begins at the hilltop market town of Llandeilo, where the railway enters the Tywi Valley. From Llandeilo, the line runs along the valley floor to Llandovery, 12 miles (19 kilometres) to the north-east, crossing the meandering river several times as it goes. The A40 trunk road runs to the north of both river and railway, while minor roads run on the opposite side of the river valley. The only road crossing the valley for this entire stretch is at the village of Llangadog, approximately equidistant between the two towns.

Flanked by hills on both sides, and with the Brecon Beaons forming an impressive backdrop, this is mainly fertile grazing land and until recently supported a thriving dairy industry. Since the closure of the local dairy factory in Llangadog there are more sheep than cattle on these level meadows. Farming would remain fundamental in the garden city corridor: see the Appendix, 'The Future of Farming in the Linear City Corridor'.

Large areas of the valley floor form the functional flood plain for the River Tywi. However there are areas that are safely outside of the flood risk zone where sensitive development could be carried out and this would be achieved through the enlargement of existing towns and villages and also a number of new villages in carefully chosen locations.

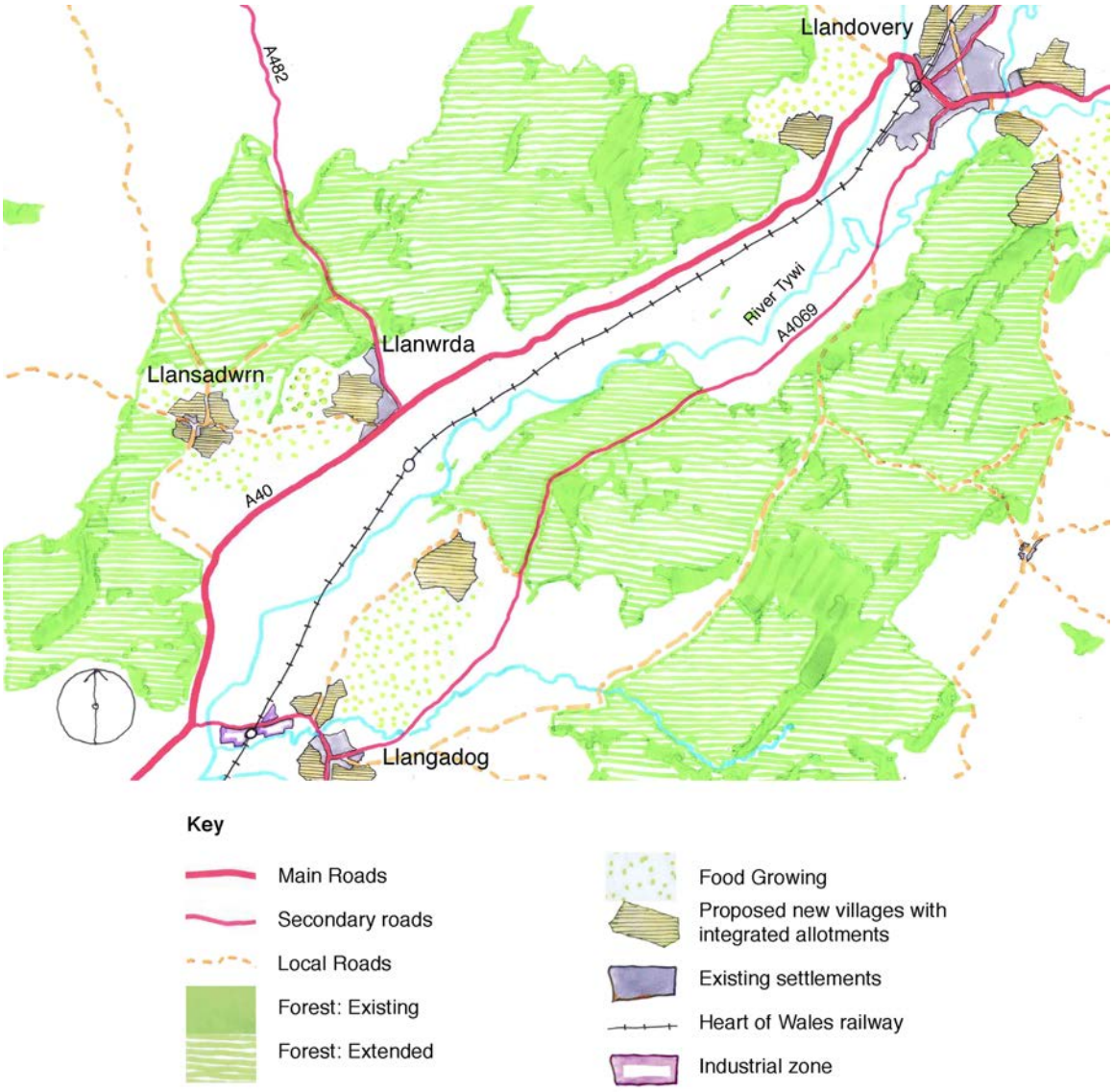


Map 4 The Linear Garden City: Llandeilo - Llandovery, south-west section

The population of this stretch of the Tywi valley is about 8,000 with Llandeilo and Llandovery having over half that number between them. Llandeilo is the larger of the two towns, with approximately 2,500, including Rhosmaen and Fairfach, but Dinefwr Park, owned by the National Trust, and the Tywi floodplain allow the town itself limited opportunities to expand.

However, a suitable site for a new neighbourhood to the east of the town has been identified, and there are opportunities for the enlargement of Rhosmaen. Collectively these additions would double the population of the Llandeilo area.

Another new neighbourhood would be developed on higher ground adjacent to Llangadog, currently a village of 650. This figure could be doubled, enhancing both the village's function as a link between Llandeilo and Llandovery and the importance of the river crossing. Llangadog has under-used industrial premises which could be regenerated, with the emphasis on sustainable manufacturing activities.



Map 5 The Liner Garden City: Llandeilo - Llandovery, north-east section

The next station along the line from Llangadog is Llanwrda, on the other side of the A40 from the village. Pedestrian and cycle access between village and station could be improved. The village could expand on higher ground to the west, towards the hilltop village of Llansadwrn. Improving the connection between Llanwrda and Llansadwrn would allow them to operate as a single community, large enough to support local services.

Llandovery is a historic drovers' town, a vital way-station on the long road to the markets in the big cities. Its population, which currently stands at 2,100, is in decline and the local authority's recent decision to close its secondary school means that without a bold new change of policy, this decline is bound to continue. Our proposals would involve the doubling of Llandovery's population through the creation of three new villages higher above the river than the existing town. These enlargements would provide critical mass and would allow Llandovery to re-establish its historic identity as an important market town and ensure it can support a secondary school and cottage hospital in the long term.

Builth Wells-Llandrindod Wells-Crossgates

(See map 6, southern section, and map 7, northern section)

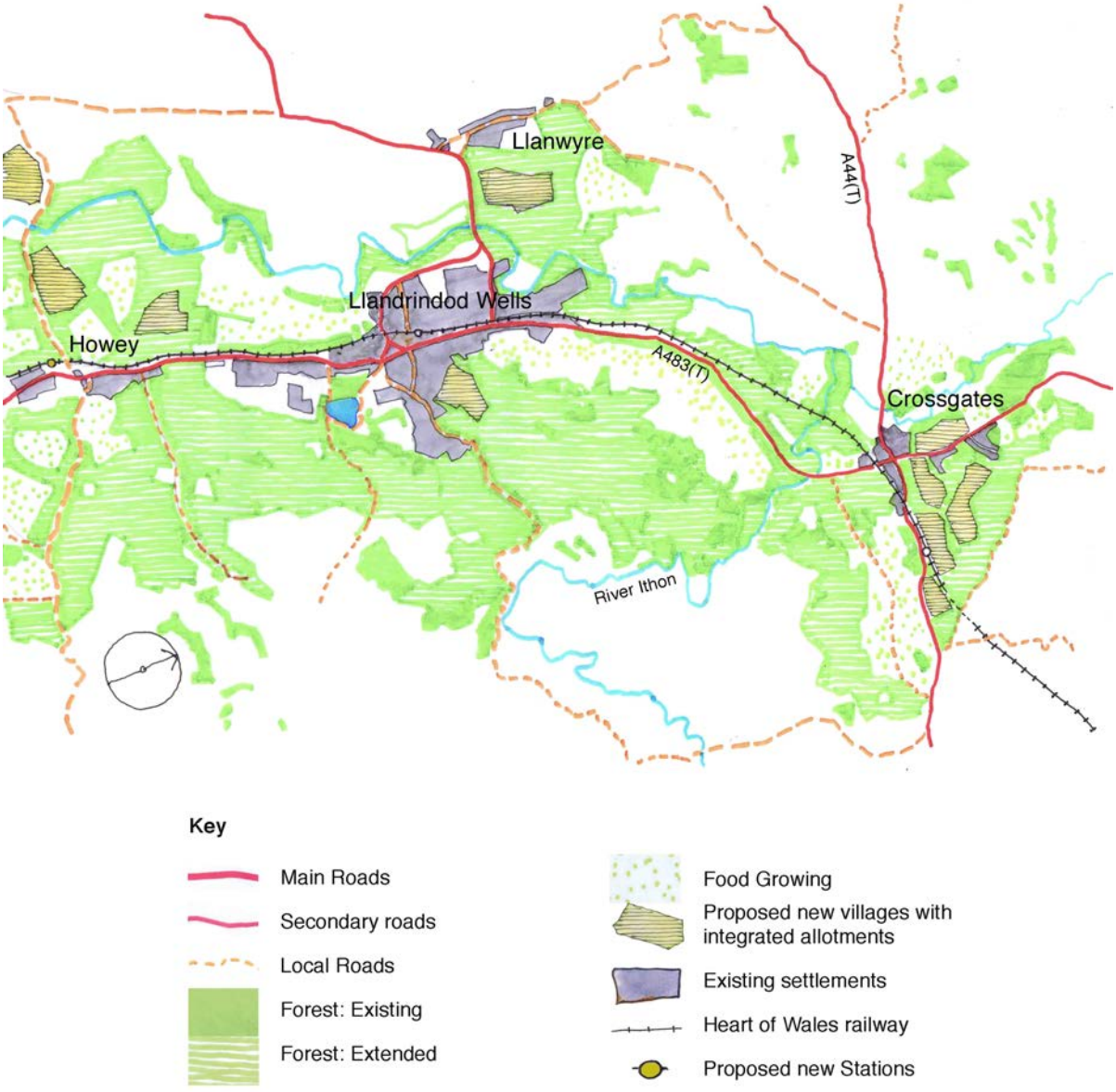
Builth Wells occupies a strategic crossroads location where the main north-south road artery through Wales, the A470, crosses the River Wye. It has the benefit the Royal Welsh Showground complex sited immediately over the bridge. The showground is the venue for several big public events which attract large crowds at certain times of the year and bring a lot of business for the town. Within this small market town there are only limited opportunities for expansion but we see it as the southern anchor of the 'heartlands hub' axis, providing services to the substantially increased population across the river.

Map 6 The Linear Garden City: Builth Wells - Llandrindod Wells - Crossgates, southern section

The railway does not touch the town but swings across the River Wye to the west, and the nearest station to Builth Wells is at the small settlement of Builth Road, 2 miles (3 kilometres) to the north on the A470. Builth

Road is a village built by railway companies in the late 19th century where two lines, the Central Wales Extension Railway (now the Heart of Wales line) and the Mid Wales Railway crossed. The Mid Wales line was closed in the 1960s. Builth Road never developed into a nuclear settlement and is now in urgent need of regeneration. Although there are floodplain and archaeological constraints, expansion would be of benefit to Builth Road, but its real importance would be as the focus for a nearby cluster of new villages.

The heartlands hub, extending from Builth Wells to Crossgates and taking in the Victorian spa town of Llandrindod Wells, is the most urban stretch of the corridor and would be augmented by up to 20 new woodland villages, extensions to existing settlements and infill sites, adding up to 13,000 to the present population, and making this the chief settlement of the linear garden city.



Map 7 The Linear Garden City: Builth Wells - Llandrindod Wells - Crossgates, northern section

Most of the new villages at the southern end of this section would be contained between the two north-south main roads, A483T and 470T, with the railway meandering through the middle. The minor roads crossing this area give convenient access to the villages and would be de-classified to allow priority for pedestrians, cyclists and the local bus system. A new railway halt would be created in the large village of Howey to serve that area but the new neighbourhoods further south would also have good, safe access to Builth Road station.

Llandrindod Wells is an attractive town of Victorian architecture and parks, and the main administrative centre for Powys County Council. It was formerly an important inland spa town located on the geological fault, which gave rise to natural springs rich in mineral salts. Unlike many other spa towns it has been declining for a long time as its appeal to visitors has faded. If it were not for the large number of public employees working in the town and living in its hinterland, it could shrink back to become just another struggling village.

The infrastructure to enable Llandrindod's rehabilitation and rescue is still intact, and an influx of young working households and small businesses would lift its stature and help it to become a thriving commercial and business centre, and the cultural capital of central Wales. It is a great opportunity.

A steeply sloping ridge runs parallel to and to the east of the town, extending almost as far as Crossgates. As in other stretches of the corridor the slopes would give more economic value if more were planted with woodlands. The lower slopes of this ridge, to the north of Llandrindod, would be used for allotments and small market gardens.

Crossgates is a large village on an important crossroads, where a cluster of neighbourhoods could be developed, to include the hamlet of Penybont, where the nearest railway station is located.

Knighton-Craven Arms

(See map 8, western section, and map 9, eastern section)

The small market town of Knighton stands on the banks of the River Teme and on the border with Shropshire. It is surrounded by the steep slopes of the hills which characterise this area. There is very little land suitable for development within or adjoining the town, but as the corridor continues east, skirting the Shropshire Hills escarpment, a village cluster and new railway halt would be developed at the Milebrook/Stowe river crossing, about 1.5 miles (2.5 kilometres) from Knighton. Further east, the large village of Bucknell and a series of four hamlets spaced a few miles apart, would all have their viability boosted by the addition of new neighbourhoods and another railway halt.

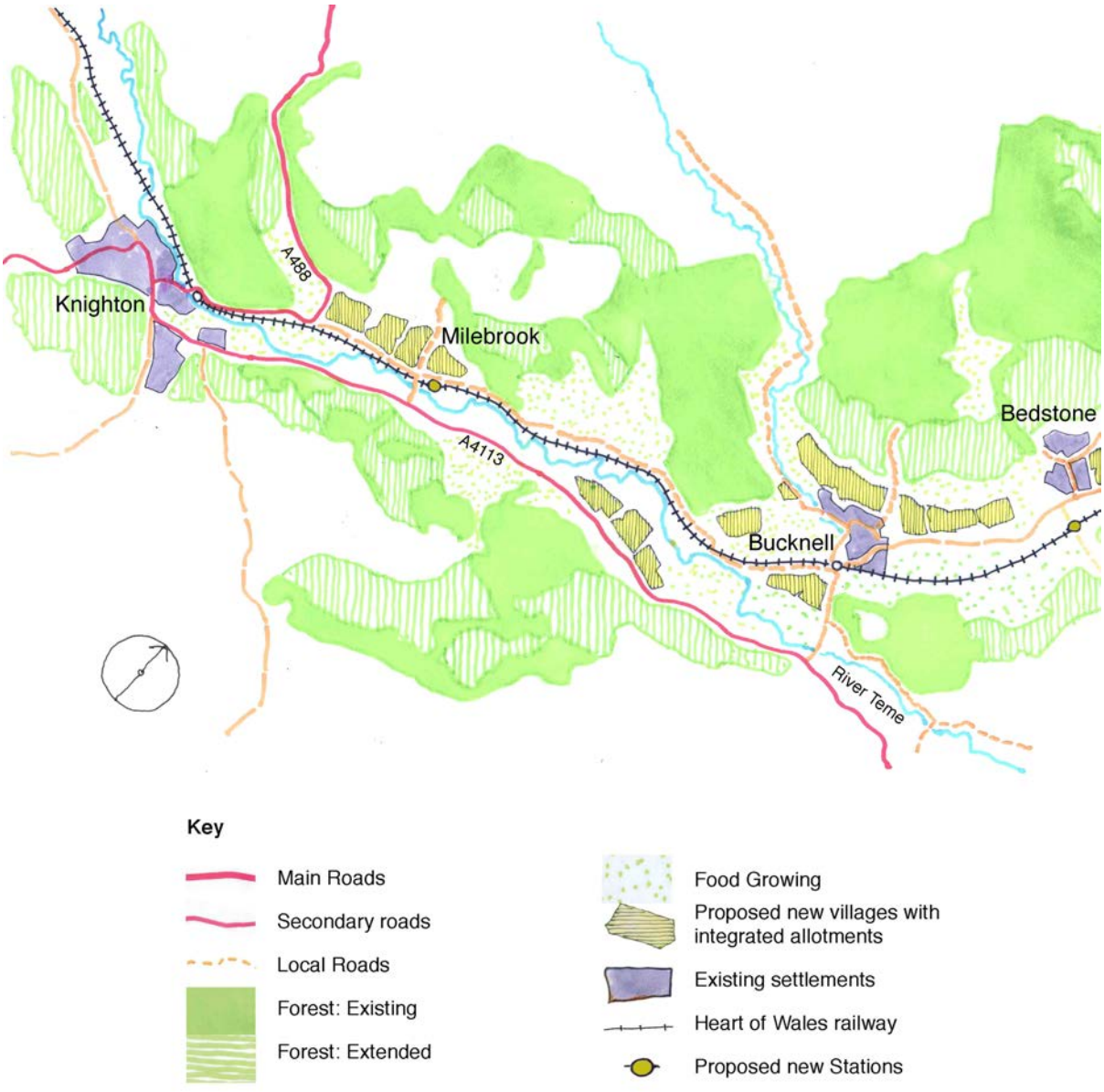
The railway corridor from Knighton to Craven Arms has the potential to accommodate up to 3,000 more people, we suggest, but most of the expansion, for up to 6,000 people, would be in the 25 square miles in and around the railway junction of Craven Arms. We would anticipate greater resistance to growth in this part of the corridor than further west, because it is closer to the fashionable centres of Shrewsbury and Ludlow, and so we would expect progress to be slower.

Some of the hills flanking the rail/road corridor have substantial areas of conifer forest but there are opportunities to add a lot of broadleaf

woodland, especially on the steeper slopes, while the south-facing lower levels behind the villages are ideal for horticultural use.

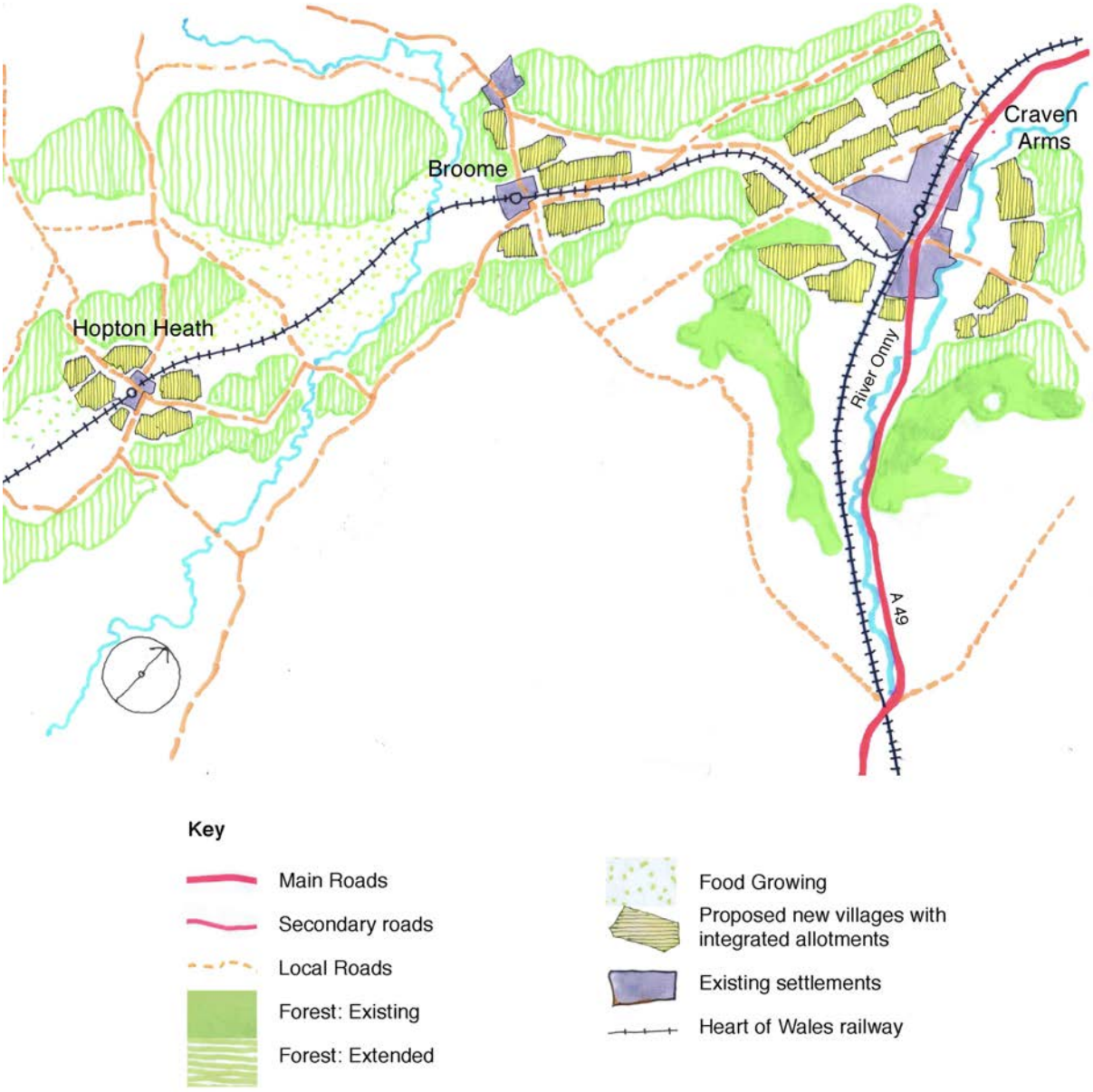
Craven Arms is a small railway town which was seen as a growth area by the former district council, which promoted it as the potential second market town in the region after Ludlow. It is still classified as a key settlement in the Core Strategy of the Shropshire Local Development Framework and it claims the title of 'Gateway to the Marches'. In our plan it also becomes the gateway to the linear garden city.

The town is in the valley of the Onny, 6 miles (10 kilometres) south of the larger town of Church Stretton and just outside an Area of Outstanding Natural Beauty. The A49 and the railway run through the centre, parallel and close together, the Heart of Wales Line having joined the Welsh Marches railway just south of the station.



Map 8 The Linear Garden City: Knighton - Craven Arms, western section

The Onny floodplain affects much of the town centre but there are areas suitable for development on the north-west fringe and on the sloping ground to the east. Craven Arms is in need of regeneration and an influx of young working families, which 'One Planet', and other live-work homes would encourage.



Map 9 The Linear Garden City: Knighton - Craven Arms, eastern section

Demographic Imbalance

The current population of the Heart of Wales railway corridor is elderly. There are over twice as many over-65s as under-15s in the Llandovery electoral ward, for example, and this is typical of rural Wales.[11] The National Housing Federation (NHF) has pointed out that such an unbalanced demographic profile means there will be too few people

11 Ward data from Carmarthenshire County Council, for 2012, shows that 27.2% of persons in Llandovery ward were aged 65+ while 13.3% were under 15.

locally to care for aged residents, presenting a substantial problem to hard-up social services departments within local authorities.

The NHF wants to see affordable housing built in rural areas, to help retain people of working age so that local schools, shops, pubs and bus services can be retained or re-opened. We agree with the NHF about the necessity for affordable homes in rural settlements, and although the presence of elderly people needing care will create jobs, that on its own is insufficient to generate a balanced employment profile. We have already outlined how we would plan to create or relocate at least one full-time equivalent job per additional household containing one or more persons of working age. Homes with offices and workshops would be integral to the design.[12]

Part 6: Increasing the Economic Value of the Heart of Wales Line

Plans to Improve Service

The Heart of Wales line is run by Arriva Trains Wales as part of the Wales and Borders rail franchise agreement with the Welsh Government. The terms of the agreement define the service to be run, and in common with over 90% of rail routes in Wales, the service is heavily subsidised. The line is valued by local people and by visitors, but the service has few trains and they run at unsuitable times for widespread use to travel to school or work.

The line is supported by the Heart of Wales Line Forum, a community rail partnership, which is working with the Welsh Government on plans to improve the service. This would involve a re-casting of the existing train service on the line to cater for more local journeys, while maintaining through services between the termini at Swansea and Shrewsbury. The forum is also building a case for the line to be operated more cost-effectively and flexibly, using local management.

The lead entity for land management in the linear garden city – probably a land trust federation – would collaborate with the Heart of Wales Line Forum to introduce freight carriage, and on 'local commute' sections of the line to introduce energy-saving technologies such as the kinetic energy light tram.

Local buses, possibly electric or hybrid vehicles, would connect with railway stations, for example at Llandeilo, Llandovery, Llandrindod Wells and Craven Arms. The line has the potential to provide low-carbon commuting and goods transport.

The line's potential is recognised by the House of Commons Transport Committee, which in 2007-08 suggested double-tracking the line for its entire length and extending it to connect with cross-routes.[13]

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12 Possibilities include the MOSS – Micro Office Systems Space – designed by Victor Vetterlein, incorporating a wind turbine, solar panels, underfloor heating and wood stove. 'MOSS office for working from home', Dezeen magazine, January 7th 2013.

13 Paragraph 3.12.5, 'Delivering a Sustainable Railway: a 30-year Strategy for the Railways', House of Commons Transport Committee, 10th Report of Session 2007-08, HC219.

Other lines in the UK could be similarly regenerative for areas vulnerable to service loss. Candidates could include the routes between Sheffield and Lincoln, Bradford and Carlisle, Norwich and Sheringham, and Carmarthen and Fishguard. We would not expect railways to be run for profit, but see them as a public service like roads, benefiting economic activity in the corridors through which they run, and managed as part of the service infrastructure.

Multi Purpose Spine

We see the Heart of Wales line corridor as accommodating a central footpath and cycleway alongside the track bed, with connecting links to the towns and villages along the route. Necessary diversions such as viaducts and tunnels would be routed along local paths and roads.

The footpath and cycleway would be constructed from modular sections using local timber, and where necessary it would be elevated above the flood plain. This lightweight deck would allow two-way traffic, and a services duct beneath it would include high-speed broadband links and other utilities. We see the railway right-of-way as the multi-purpose spine of the network that connects all the villages to form a city.

The central section of the city zone is served by two north-south trunk roads, the A470(T) and the A483(T), which meet and diverge again at Builth Wells. Although we expect private car travel to reduce over the coming decades as fuel costs escalate, we would expect the primary roads network to remain as a priority in the infrastructure hierarchy, particularly for public transport. Apart from a few short stretches, a main road runs close to the railway for the length of the garden city.

Where these main roads pass through the linear garden city, we believe there should be strict measures to control vehicle speed. Carriageway narrowing, shared surfaces and other traffic-calming systems would be employed within the corridor, drawing upon the experience gained in the Netherlands, Denmark and some UK towns.

Minor roads have a less certain future as hard-pressed local authorities are forced to reduce non-essential maintenance to a triage system at best. It is possible that the responsibility for the future upkeep of local roads may pass to community/parish councils, but in any event we would suggest that, within the linear garden city, all local access roads should give priority to pedestrians and cyclists.

Part 7: Community Land Trusts are the Management Base

Land Trust Federation

The concept of a linear garden city with ‘One Planet’ vision - neighbourhoods designed to be mixed use and to augment existing demographically unbalanced villages and towns - suggests to us that a land trust federation should be the top-tier land management organisation for our project, serving land trusts established for each new community.

The federation would consist of separate community land trusts (CLTs). Each CLT can be constituted as an industrial and provident society for community benefit, or a company limited by guarantee, or a community interest company. Members elect a board of directors which runs the trust

and is accountable to the members. Each separate board would elect one or more representatives to the second-tier CLT federation. Community land trusts could be set up by community councils, or work in partnership with community councils, which have local knowledge at their fingertips.

For England, the 2008 Housing and Regeneration Act contains a definition of a community land trust, which has to be established to further the social, economic and environmental interests of a local community by acquiring and managing land and other assets, to provide a benefit to the local community and to ensure that the assets are not sold or developed except in a manner which the trust's members think benefit the community. Any profits from a community land trust's activities must be used to benefit the community, and must not be paid directly to members. Individuals who live and work in the area covered by the trust should be able to become members, but membership is not necessarily limited to people living within the area. The trust members have the responsibility of controlling its activities.[14]

In Wales, there is not yet a legal definition of community land trusts, but a handful do exist, at Castle Caereinion, Cwm Harri (Newtown), Pantydwr, and Ashfield (Llandrindod Wells).

Despite the definition of CLTs in the Housing and Regeneration Act, the wider legislative framework in England and in Wales is not friendly to the CLT concept because of tenants' 'right to buy' housing and also the right to convert leasehold into freehold after holding the lease for at least two years. Mortgage lenders want the maximum possible security on each property, and therefore loans to buy a property, but not the freehold of the land underneath it, are perceived as a risky activity. Thus a CLT needs both a specific legal framework which may require special exemption from conflicting legislation in favour of tenants, and a source of funding for intending residents to build or buy their home. This funding will probably not come from mainstream lenders, but could be raised by selling shares in the trust, by gifts from charities and philanthropists, and from partnering with specialist lenders such as Triodos Bank and the Ecology Building Society.

Raising money from multiple sources in this way is not compatible with a definite timetable for a planned new town, but accords with our preference for incremental expansion of existing communities which have experienced service flight.

Political governance would remain in the hands of community councils and higher-tier local authorities. Local government in Wales, where the majority of the project area is located, is facing major reorganisation for the third time in 40 years, and administrative units are therefore likely to change. We cannot at this stage know the outcome of the reorganisation plans, and therefore we confine ourselves to comments on ideal sizes of human communities.

Natural Neighbourhoods

We agree with the ideas discussed by Antony Jay in his 2009 paper for the Centre for Policy Studies.[15] His base for political representation is a group

14 The book 'Common Wealth' by Martin Large (Stroud: Hawthorn Press, 2010) has a section on community land trusts, pps.193-208. The National CLT Network has a website at www.communitylandtrusts.org.uk.

15 Titled 'A New Great Reform Act', published in June 2009

of 20 to 30 households, electing a representative to a community council covering 200 to 300 households. This number of households, containing about 500 to 700 people, represents the number that one person could expect to know and interact with.[16] Representatives from this level of administration deal with civic amenities such as open spaces, public toilets, street lighting, public paths and community halls.

The next tier, district level, would ideally have similar populations to the smallest district councils in England, between 40,000 and 50,000 people, representing approximately 17,000 to 22,000 households, responsible for planning, housing, employment, recycling, highway maintenance and similar services.

Geographically, the administration areas for education, social services, health services and emergency services require larger populations still, to avoid unnecessary duplication and waste, and are beyond the immediate scope of our current proposal, but we expect that 20 or so neighbourhoods would contain sufficient population to support a secondary school, emergency services and a range of health services.

We envisage that settlements in the linear garden city would be included within existing local government structures, although we would campaign for those structures to give greater priority to cross-departmental planning in the interests of sustained progress towards 'One Planet' living.

Part 8: Property Markets

Shortage of Affordable Housing

The crowded island of Great Britain suffers an overall shortage of affordable housing, but there are striking geographic contrasts in mass-market property values, reflecting actual and perceived job opportunities more than anything else. The North West of England, where homes are the most affordable for buyers with lower-quartile incomes, has England's lowest rates of economic activity, with 19.9% of men and 30.2% of women aged 16-64 classed as economically inactive in the period August to November 2013. The North East is close behind, with 19.5% of men and 29% of women aged 16-64 in the inactive category. There is sufficient housing in many employment-poor urban and peri-urban areas. On the other hand, the gap between housing demand[17] and supply in employment-

16 Ibid p.16

17 The population of Great Britain and Northern Ireland grew by almost 420,000 in 2012-13, 104,000 of whom were in London. Calls for a new generation of garden cities are a response to the increasing unaffordability of housing, which reflects supply lagging far behind potential demand, the income insufficiencies and uncertainties which prevent potential demand from becoming actual demand, and the planning restrictions which prevent housing construction in locations where employment is plentiful. In the absence of the planning restrictions that have been in place since the 1947 Town and Country Planning Act, South East England would by now be a city of 10,000 square miles (25,900 square kilometres), stretching from Reading to Southend, from Brighton to Luton. Competition for housing has made owner-occupation unaffordable over broad swathes of southern and south-east England. Within England, only in three old industrial areas of the North East and four in the North West, and in the Yorkshire-Humberside city of Kingston upon Hull, and the pottery city of Stoke on Trent, are lower-quartile house prices less than four times greater than lower-quartile annual wages. The most 'affordable' English city in 2012 was Burnley, Lancashire, with a lower quartile house price 2.72 times greater than lower-quartile earnings. While nine English districts had a multiple under 4, in 49 the multiple was over 10, and in Kensington and Chelsea it was 24.53. In 10 more districts the multiple was over 12 times. All these expensive districts are virtually barred to newcomers whose incomes are in the lower quartile, and in many cases to those in the lower half, of the income distribution, except for a few who may be able to find subsidised housing. Everywhere, the multiples of lower-quartile incomes to lower-quartile dwelling costs have increased, in England as a whole from

rich areas of the UK, especially London and the South East, has created an affordability crisis which spills out into rural areas where the lack of well-remunerated employment is exacerbated by property prices pushed up, until recently, by demand from retirees and second-home owners. [18]

Housing Cost Challenges

We expect economic constraints to persist, so new housing and infrastructure need to cost less than in the previous generation of garden cities. We propose a wider mix of dwelling and plot sizes than is usual on housing developments with a focus on self-build and highly-insulated modular[19] kit homes at moderate cost,[20] on land purchased by community land trusts with contributions from crowd funding for shares redeemable after an agreed number of years. Landowners' expectations of high sale value are a major barrier to affordable homes, expectations which would have to be negotiated on a site-by-site basis by community land trusts.

Considering the homes meeting 'One Planet' criteria, there is currently either a huge time cost (for self-builders) or monetary cost attached to these dwellings. We would develop 'micro-dwellings', which would come pre-specified at a high standard and developed as a product: pre-fabricated prototypes, assembled on-site, already approved to meet the building regulations, providing guaranteed standards of air-tightness and thermal bridging. They will be high quality units using local timber and able to be easily disassembled for reassembly elsewhere if required when the owner moves. On site, these would be combined with ad hoc structures built with round wood timber, for ancillary workshops, storage etc. One design has already been developed based on a vernacular style, the Welsh longhouse.

Tri-Level Market for Existing, Low-Carbon and 'One Planet' Homes

We do not propose trying to interfere with the market for existing homes in linear garden city settlements. To do so would alienate their owners, and would make community cohesion harder to achieve. However, we feel that the association between homes and individual wealth has become too important in British society, and that new, lower-cost forms of long-term occupancy are required.

We suggest that communities in the linear garden city corridor should, through community land trusts, acquire and maintain control over development land by retaining freehold ownership, and requiring a first option to purchase when a lease is offered for sale. Movement in and out of settlements would need to be straightforward, and this requires purchasers to be able to benefit from capital appreciation of leasehold property they have purchased.

3.57 in 1997 to 6.59 in 2012, a near-doubling in 15 years, and substantially greater in the hot spots such as Ealing (almost trebling from 4.30 times lower-quartile wages to 12.17 times) and Haringey (the 2012 multiple of 11.35 more than two-and-a-half times greater than 1997's 4.31).

18 Demand for second and retiree homes in remoter rural areas has moderated since 2008, but at the same time employment prospects and incomes for local people have stagnated at best, and so property is no more affordable than it was.

19 Costing from £10,000 per module.

20 The hexagonal modular Hive Haus, developed by Barry Jackson in Wigan, Lancashire, is an example of housing that is affordable in the current and future world of constrained incomes.

Payment of annual ground rent[21] would provide revenue income for community land trusts. In a low-carbon, re-localising economy, ground rent affordability would be limited, and in the case of dwellings built to 'One Planet' regulations, would often have to be paid in kind, for example as volunteer labour.

In Wales, 'One Planet' homes may be constructed outside formal settlement limits. To achieve balanced, mixed communities, we would need to lift planning restrictions for other low-carbon homes within 'One Planet Vision' villages and towns. Homes would be self-built as well as constructed by housing associations; other third-sector organisations, and commercial builders.

The ratio of 'One Planet' dwellings, in the overall mix of the linear city, would be flexible and would vary along the corridor. It is likely that pioneer 'One Planet' enterprises would attract others to come nearby.

Expectations of Land Values and Densities

As community land trusts would have no recourse to public funds, and are not statutory bodies, they could not embark on a compulsory purchase programme, but share capital raised from public issues could be used to acquire land from owners who are willing sellers. To work out an affordable land price, the starting point would be the affordability of homes for local buyers, and then subtracting the construction and development costs. The typical new dwelling would to be priced under £100,000. The median household income in the Tywi region of Carmarthenshire, including Llandovery and Llandeilo, is £24,790,[22] and we do not expect an increase in real terms, in fact stagnation or decline is more likely. The county council regards 'affordable' prices in 2014 to be as follows: one-bedroom flat, £52,190; two-bedroom flat or house, £65,238; three-bedroom house, £78,286; four-bedroom house, £91,333.

Average densities in the linear garden city would be lower than in a speculative development, and lower than the usual minimum density of 30 homes per hectare, a fraction over 12 per acre. We propose an average density of 20 homes per hectare, 8 per acre, to allow for live-work homes and productive gardens. In addition there would be land for allotments, orchards, industrial enterprises, services and public spaces.

Planning permission would be valid only for development sanctioned by the purchasing community land trust. A maximum land cost of £80,000 to £100,000 per acre, £188,000 to £247,000 per hectare, should be sufficient to persuade several landowners to sell, while ensuring that homes would be affordable for buyers on mainstream to high local incomes, but community land trusts would have to acquire cheaper land, no more than £50,000 per acre, for full 'One Planet' enterprises to proceed, because of the intentionally small cash outcomes from such enterprises. Landowners' willingness to sell would, in many cases, be influenced favourably by the role of new homes in retaining or reviving essential local services.

21 Ground rent of £500 a year from 50 homes would yield £25,000, sufficient to pay a local manager.

22 'Affordable Homes Update' from Carmarthenshire County Council, January 2014.

Part 9: Employment: Example of Food as a Catalyst

Hidden Unemployment

Lack of employment in rural areas is seldom regarded as a serious problem because it is a dispersed and largely hidden problem. Insufficient recognition of the issue means that it has received little political attention.

On the surface, employment statistics for many wards, along and in the hinterland of the Heart of Wales line, look surprisingly strong. For the rural county of Powys as a whole, unemployment in November 2013 was 1.7%. At ward level, over the boundary in Carmarthenshire, Llandovery recorded unemployment of 1.6% for October 2013. Where is the problem?

It is this. Almost four in ten, 38%, of persons aged 16-74 in Llandovery ward were 'economically inactive', i.e. not earning. Three in ten of the economically inactive were neither retired nor studying. As for those in employment, a 2012 report for the Government Data Unit – Wales found that "[E]mployment in rural areas is more likely to be low pay, seasonal/intermittent and part-time" than in towns and cities.[23] The report pointed out that these factors, causing low incomes, were not picked up in the Welsh Index of Multiple Deprivation, which tends to highlight relatively homogenous urban wards as 'deprived': "the nine rural local authorities in Wales account for 33% of the total Wales population, 29% of people receiving income- or employment-related benefits, but only 13% of those areas in the most deprived quintile".[24]

The under-employed in rural areas are often dispersed among pensioners. In Llandovery ward, for example, over 32% of households are composed entirely of pensioners. The impact of incoming retirees on property prices is especially detrimental when young adults are working for low wages. As well as low pay, these young adults face high living costs, mainly because of the distance they and their families must travel to access services and often employment too. The Joseph Rowntree Foundation and Loughborough University found that the minimum cost of living in rural towns was 1% to 12% higher than in urban areas, in villages 14%-19% higher, and in hamlets 16%-24% more.[25]

Deprivation in rural areas rarely makes headlines because it is hidden, but it is a real problem which our proposal would help to alleviate. New residents in the linear garden city would increase demand for services, which could often be re-established locally, saving transport costs and carbon emissions. Shops, surgeries, primary schools, could all be re-introduced, and residents and visitors making more use of the railway would help ensure its future.

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23 'Getting the Measure of Rural Deprivation in Wales' by Oxford Consultants for Social Inclusion, with the Local Government Data Unit – Wales and Nick Holmes (Informing Decisions), May 2012, p.10

24 Ibid p.30

25 Ibid p.13

Multiplier Effect: the Example of Food Processing

Much of the new employment in the linear garden city would be self-employment, generated by self-builders aiming for a lifestyle which requires no more resources than the single Earth can provide. Each incidence of self-employment, even at a low level of cash spending, has a multiplier, and the benefit is maximised locally if spending stays within the community.

As an example, research from Scotland, published in Northern Ireland, indicates that in SME food processing activities, which would be fundamental in the linear garden city, each full-time job could create between 1.65 and 2 additional jobs.[26] In the Scottish experience, each job in meat processing led to the creation of 1.65 more jobs, and each job in the dairy industry created two more jobs, and this experience is as relevant to Wales as to Northern Ireland. The 'Value of Food and Drink Industry to Northern Ireland' report proposes that:

> *"A successful and growing food and drink industry is also likely to generate additional employment and income for the rural economy, where it sources from and as such is probably the single most important source of sustaining the rural population. When induced impacts of spending by those employed in the sector are added to the indirect effects in other industries, the overall contribution to the rural economy is likely to be very significant." (p.12)*

That contribution includes helping to achieve carbon reduction targets by keeping processing near to production and thereby reducing haulage. As well as food and drink processing, we would envisage more forestry and woodland enterprises, community-based water and wind-power schemes, and other ventures drawing on local resources and individual expertise.

The incremental creation of the linear garden city means that there would not be a sudden, substantial rise in job numbers, but a slower, steadier increase that would be much more in line with population and services. Successful small businesses would often need low-cost loans to fund growth, but the high street banks have been too reluctant to lend, or have imposed interest rates too high to enable the business to prosper. We are aware that returns to investors would generally be lower than can be achieved in the international markets, therefore we would propose a tax incentive, such as the capacity to offset a loss against other income, to encourage individuals to invest in employment in the linear garden city. This would entail a potential loss of income to the state, in individual circumstances, but over the long term we would expect the overall taxation yield to rise and benefit dependency to decline.

26 Reported in 'Value of Food and Drink Industry to Northern Ireland', by Goldblatt McGuigan for Northern Ireland Food and Drink Association, October 2010, p.12

Part 10: Energy in the Linear Garden City

Minimising Consumption

Before considering how energy is to be generated, it is important to first ensure that energy consumption is minimised. Low-energy design standards will be a fundamental requirement for any new build in the development corridor. New homes will need to be highly insulated, to minimise energy requirement for space heating. Once this is achieved, then locally sourced timber used in 'cleanburn' low-emission heat-producing appliances will provide a sustainable and economic heating method that also helps support the rural economy. Electricity generation from sun, water and wind contributes to greater local resilience to outside energy shocks, which may result from oil shortages, extreme weather events, and national deficiencies in generating capacity and grid transmission.

Local Energy

The 'One Planet' approach to development recognises the environmental benefits of a localised resource and energy footprint. We hold that local communities are best placed to make decisions regarding energy generation, as it is in their own interest to ensure that the most appropriate choices are made.

Large-scale electricity generation schemes have significant negative impacts on small rural communities. The high level of investment required leads to the involvement of national or international companies with little interest in the local area. Large wind farms in rural Wales are particularly unpopular, due to concerns about health, visual and environmental impacts.

Small-scale electricity generation allows local communities to make their own decisions based on an assessment of the relationship between setup costs, environmental and aesthetic impact, and projected returns. The electricity generated can be fed into the National Grid to ensure a valuable income for the community, while at times of electricity surplus, the power can pump water into a holding tank at high level.[27] When electricity is required, the water can be freed to flow down and turn a turbine, which spins a generator. High-level water storage can ensure continuity of electrical supply during grid failures.

The topography of the terrain along the development corridor and the high level of rainfall present a particular opportunity for electricity generation through a network of community-scale wind turbines and micro-hydro installations with the use of Pelton wheel turbines. Pelton wheels extract energy from the impulse of moving water, rather than its weight, and are therefore ideally suited to locations where significant level differences can be exploited, but where high flow rates may not be available. In mid Wales, there is an abundance of small streams, which run down from high ground to the valleys to meet larger watercourses. Water can be extracted from these and fed into pipes that are then laid so as to meet the stream 15 or more metres downhill. Before being fed back into the watercourse, the water is used to drive the Pelton wheel and hence generate electricity.

27 Katerina Chatzivasileiadi, at the Welsh School of Architecture, Cardiff, is studying the applications of these principles in her doctoral thesis on electrical storage technologies.

Micro-hydro has minimal visual impact compared to solar or wind generation. Pipes can be dug into trenches, and the turbines are small-scale, and can be easily housed in small enclosures built from local timber. Environmental considerations can easily be addressed. The technology is tried and tested, and its application in multiple locations along the development corridor would allow installation and environmental assessment methodology to become standardised, thus reducing cost and ensuring visual and environmental impact is minimised.

Microgrids for electricity generation would be a step forward. Robyn Beavers, senior vice president of innovation at NRG Energy in the USA, argues that "a microgrid can connect people with things like rooftop solar, storage, and micro-combined-heat-and-power generators". She draws an analogy with computing, which "formerly was based on a mainframe system, but of course computing since went in the opposite direction, smaller and diffused".[28] Microgrids should in addition enable those dwellings which fully meet 'One Planet' design criteria – including zero demand on utility grids -- to contribute to and benefit from local energy schemes. In addition, reliable local low-carbon energy would be an attraction for SMEs including manufacturers. This would assist the necessary diversification of employment all along the linear garden city, and help to improve the demographic profile by attracting young families.

Part 11: Reviving the Extremities

Popularity

Popularity is an important aspect of a settlement proposal. We aim to show that linear garden city settlements with scope for self-build and low-cost homes for rent and purchase, growing in step with self-employment and employment, would be popular with people of all ages including young families, who are outnumbered by the retired in settlements which have lost their services.

The 'One Planet' concept would be especially popular with low-impact living enthusiasts, probably representing approximately 1% to 2% of the adult population. Many more, especially young individuals and families, long to be able to afford their own home in an attractive, safe environment. In the view of David Montague,[29] chief executive of housing association L&Q, factors attracting people to places include:

- Diverse mixed communities with a wide range of tenures
- Connections with health and education services, employment and the arts, and
- Tapping into established community networks which have local knowledge and show commitment to the area.

We suggest that by expanding existing rural settlements, it will be possible for newcomers to access and if necessary revitalise organisational

28 'Person of interest: Robyn Beavers' http://bdmagazine.com/2013/25-robyn-beavers/, Green Building and Design, January/February 2014

29 'What we've learned about creating places where people want to live', www.theguardian.com, June 26th 2013.

networks and public services, and those newcomers will broaden the demographic profile of ageing communities.

Response to Location Degradation

The inherent unpredictability of interacting systems means that settlements should be adaptable and not permanently fixed. Linear garden city settlements with a 'One Planet' vision, including modular and often demountable buildings, would be a more realistic response to location degradation, a factor which has been given little attention when developments have been planned. We cannot predict which emergent properties systems will create, when, where, or on what scale. Therefore new settlement should be adaptable and flexible, more akin to the Mongolian yurt than the New York skyscraper.

Linear garden city settlements with a 'One Planet' vision should open up opportunities for small and medium-sized firms of engineers, urban designers, architects and builders. Professionals who are able to design productive and aesthetic uses of space between buildings, as well as the buildings themselves, should find a niche, as should builders who are interested in developments up to 50 or so dwellings in one location, diverse and multi-functional and affordable for occupants on incomes between minimal and median, and often constructed of modules manufactured off-site.

Ideally, the professionals would work in multi-disciplinary teams focused on understanding environmental, social and economic systems and the ways in which those systems interact with each other. We anticipate that especially in smaller settlements with low budgets, professionals would work mainly in not-for-profit organisations.

The concept of the linear garden city is applicable to locations throughout the UK, and has substantial potential to revive communities which have lost their services, the places which Ferdinand Mount, in his book about the rise of oligarchy, calls "the extremities":

> *"And the oligarchs still itch to shorten .....lines of command by closing down the extremities as uneconomic and inefficient. The Health Minister wants to close the cottage hospital. The bishops want to close the little churches and amalgamate the smaller parishes. The Home Secretary wants to amalgamate police forces, and the Chief Constable wants to close the local police station. The brewers want to sell off even more pubs for private homes and make more money by selling their products through the supermarket. The official pressure continues to work against the local and against the human scale."*
>
> Ferdinand Mount, 'The New Few: Power and Inequality in Britain Now' (Simon & Schuster, 2013 edition, p.164)

The linear garden city has the capacity to revitalise the extremities and thereby to start acting, in a modest way, as a counter-magnet to the overcrowded South East of the island of Great Britain.

Part 12: Afterword

The floods in England early in 2014 forced many people to realise that there are limits to the amount of emergency help, and that it is up to communities to protect themselves. This realisation parallels the growing awareness that we live on a planet with finite resources, making infinite growth impossible. As John Michael Greer suggests, we need new visions for the future:

> *"The widening gap between the future the people in the industrial world once expected and the one they seem most likely to encounter remains poorly grasped even now, when the 21st century we were supposed to get is rapidly becoming a subject for satire. Still, an awareness of the troubling changes now cutting the ground out from under today's lingering faith in progress has taken root in many corners of the world. What was merely a vague current of unease not so many years ago shows signs of taking on a social role of no small significance. In the near future, as the failure of progress becomes harder to miss, the need for new visions of the future may become an overwhelming force."*
>
> John Michael Greer, 'The Ecotechnic Future' (New Society Publishers, Canada, 2009, p.245)

Our proposal is a step on the long path to meet the demands of a resource-limited, climate disordered future, a step which can also help to reverse the loss of public services in an under-used transport corridor, thereby helping to make a linear garden city popular with people living in the area already. As for new residents, the city of villages would appeal to people seeking lifestyles connected to community and locality, rather than high levels of material consumption.

Appendix: The Future of Farming in the Linear Garden City Corridor

Rural Population Needs to Rise

Current planning policy presupposes that, for the foreseeable future, agriculture will employ diminishing numbers of people. This view is predicated on the assumption that fertilisers, pesticides, herbicides, purchased feeds, and fuel and power for machinery and equipment, will continue to be available and affordable.

We regard this confidence as misplaced, and argue that we should prepare policies to enable a repopulation of rural areas for the purposes of farming, food production, woodland management and other land-based industries.

This is not a popular view. In 'Limits to Growth: the 30-year update', the authors Donella Meadows, Jorgen Randers and Dennis Meadows issue a warning that "systems strongly resist changes in their information flows, especially in their rules and goals. It is not surprising that those who benefit from the current system actively oppose such revision".[30] Resistance to change amplifies the impact of the eventual enforced shift.

Paul Mobbs' 2005 book 'Energy Beyond Oil'[31] highlighted the inevitability of an enforced shift, arising from the dependence of our civilisation upon oil, which has become more costly to extract because the easily and cheaply extracted oil has already been consumed:

> *"It's hard to overestimate the importance of oil to industrialised society. It isn't just an energy source….. The products of oil and gas, such as plastics and agricultural fertilisers, and a large part of the world's chemical industries and manufacturing processes, are directly dependent upon the refining of crude oil and natural gas. As an energy source oil is also unique. It's not just that oil is a very dense source of energy – it packs a lot of energy into a small space. It also just happens to be a liquid at the Earth's ambient temperature. That makes it perfect for use in mobile sources. You don't have to use special pressurised storage systems like you do for gas….. It's a liquid – you can pour it, pump it, and you can utilise it without putting a lot of energy into the process that produces the required energy output."*
>
> 'Energy Beyond Oil' p.3

The rapid utilisation of fossil oil has underpinned the global population explosion. Malthusian theory expounds that populations expand to the point at which resources will no longer support them.

Causes of the rush to over-exploitation of resources were summarised by Richard J Barnett, co-founder of the Institute for Policy Studies, in his 1980 book 'The Lean Years: politics in the age of uncertainty'.[32] He noted the declining autonomy of governments because of the power of

30 London: Earthscan, 2005, p.270

31 Leicester: Troubador Publishing

32 New York: Simon & Schuster, 1980

corporations to outsmart them, by planning over the long term, across national boundaries, to maximise profitability:

> *"The Global Factory creates certain incentives that stimulate production – chiefly, acquisitiveness and competitiveness – but the incentives it kills – caring, frugality, and concern about social consequences – are the ones needed for global survival."*
>
> 'The Lean Years' (1981 Abacus edition, p.294)

Yet as David Holmgren points out, measures intended to slow resource depletion, and to share them with a greater degree of fairness, mean lower material living standards for populations who have become accustomed to continuous improvement (or at least, to promises of continuous improvement). This is an uncomfortable notion:

> *"Whether it comes from an ecological or sociological perspective, questioning economic growth threatens the very basis of our economic system. The lip service to environmental sustainability (so long as it can maintain essential growth) reflects this understanding."*
>
> 'Future Scenarios: how communities can adapt to peak oil and climate change' (Dartington: Green Books, 2009, p.105)

Demand for local food is set to rise. Long-haul import of food commodities, on which the UK depends for over 40% of consumption compared with 25% in 1990, will be less dependable in future as scarcer, costlier oil means transport costs will increase, and burgeoning populations in exporting countries will often want to restrict exports to boost their own consumption.

Help for Farming Entrants

Despite the fundamental importance of agriculture, it is extremely difficult for newcomers to start farming in the UK. The cost of land is the principal barrier facing them. The estate agent Savills'[33] statistics for the first three quarters of 2013 show that the average price of prime arable land across Great Britain was £8,300 per acre (£20,510 per hectare), and even for poor grassland was £3,927 per acre (£9,740 per hectare).

In the Heart of Wales corridor poor grassland for livestock rearing is more typical than prime arable land, but even so, the current returns on grassland are tiny, and farmers depend on subsidies to keep them in place. Figures in the 'John Nix Farm Management Pocketbook 2012'[34] for upland spring-lambing sheep enterprises give an average gross margin of £80 per acre. The gross margin is for variable costs only and excludes labour, machinery, rent, interest and other overheads. The figures are worse for beef. The fixed costs would be about £259 per acre on an upland beef or sheep farm of up to 320 acres, dwarfing the gross margin. With these figures in front of them, no commercial funder would lend a new-entrant sheep or beef producer money to buy a farm unless they had a reliable and substantial income from other sources.

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33 http://www.savills.co.uk/research_articles/141566/170942-0

34 Melton Mowbray: Agro Business Consultants, 2011

The value of land has little to do with its earning capacity from agriculture, but depends on its perceived 'safe haven' status as an investment, on its privileged tax treatment in the UK, on its diminishing quantity per head of population, and on its social prestige, especially if there is a historic or grand farmhouse.

No UK government in recent times has shown an inclination towards redistributive policies for land. Reporting in 2010, the journal the 'New Statesman' reckoned that 69% of the acreage of Great Britain was in the hands of 0.6% of the population, an extreme concentration.[35] Only a tiny proportion of farmland comes onto the market every year, less than 0.7% in the first three quarters of 2013, and the buyers are mainly investors or existing farmers who are expanding their businesses.

Given concerns about future food insecurity resulting from population growth, climate change, environmental damage, fresh water shortages and the rising costs of energy and of oil-derived farming inputs, we believe it is necessary to create opportunities for new farmers – smallholders, in the case of 'One Planet' components of a linear garden city -- who will be able to feed themselves and local non-farming households living in the city.

Community land trusts would prioritise land improvement over the payment of maximum rents, and would therefore rely on investment from those far-sighted members of the public and philanthropists who are also willing to favour land improvement over immediate returns, in the interests of creating resilient communities.

Land improvement through building soil fertility, drainage, appropriate crop rotations and the planting of orchards, shelter belts and copses, enables a wider range of crops to be cultivated, especially those for direct human consumption – top fruit, soft fruit, and vegetables. This in turn would encourage employment-creating food processing enterprises, in a re-localising economy that is responding to scarce and expensive energy.

35 'The coming battle over land and property' by Jason Cowley, October 19th 2010, http://www.newstatesman.com/society/2010/10/land-tax-labour-britain