Here is my submission to your enquiry.
I attach it as an HTML file and as a Word file. Both entitlied: WA SUSTAINABILITY ENQUIRY FUTURE SETTINGS by Sheila Newman
My submission examines Australia's capacity to sustain population and economic activity in the light of trends in petroleum depletion and takes into account coal substitution, nuclear substitution and use of flow energies. In order to highlight the biophysical characteristics of this country and how they affect sustainability, a comparison has been done with France's potential under the same conditions. I have used recent CSIRO documents and have discussed my work with biological ecological scientists. I have one written scientific academic review of my submission and could find two others if this would help its weight.

Note that I have given some importance to the development of wind power as a means of buffering energy source decline whilst awaiting population attrition. Nevertheless I have also suggested that trends are that no such buffer is likely to be developed.

I have an MA by research in population, environment, energy and land-use planning sociology, which compares policies on these between different first world countries.

Sincerely,

Sheila Newman
96 Kars Street
Frankston
Victoria 3199

Tel. (03) 97835047

# "FUTURE SETTINGS" by Sheila Newman

## *Population changes and energy milestones in France and Australia.*

### Introduction:

The purpose of this article is to explore and contrast the potential for human survival in Australia and France after the petroleum interval, assuming that this interval may have lasted between around 1850 and 2035. To do this it is first necessary to establish pre-fossil fuel carrying capacity, assuming that soil, water and climate retain their productiveness. The carrying capacity sought for France is as an agricultural self sufficient country, with a high proportion of cereal crops. In conceptual terms, a return to later 19th century land use and farming intensity, if not techniques, and to early to mid 19th century population numbers may not be as difficult as it might look because we need only go back to the past. For Australia the method is different, because the people there prior to European settlement produced no recorded history. It is also difficult to compare pre-fossil fuel European agriculture in Australia because much of the land was developed after the second world war. To work out Australia's productivity it is necessary to use palaeontology, archaeology, anthropology and ecology. Fortunately Australian scientists have pioneered the collection and analysis of this kind of data for just this purpose.[1](1)

Palaeontologist, Tim Flannery has popularised the notion of vastly greater carrying capacities in Europe than in Australia by referring to calculations of biomass in both regions.[2](2) For instance, he points out how Europe easily sustains a vast population of humans plus 27

[1] The most important sources I have used were Barney Foran, Franzi Poldy, *Future Dilemmas,* CSIRO Resource Futures Working Paper 02/01, CSIRO Sustainable Ecosystems, GPO Box 284, CANBERRA ACT 2601, available online at http://www.cse.csiro.au/futuredilemmas and the *Australian Resource Atlas*, http://audit.ea.gov.au/anra/agriculture/docs/national/Agriculture_Landscape.html which are products of long-term and ongoing work by CSIRO natural and physical scientists. For other ecological works on population see S. Newman, *The Growth Lobby and its Absence: The Relationship between the Property Development and Housing Industries and Immigration Policy in Australia and France, 1945-2000 with projections to 2050*, http://www.alphalink.com.au/~smnaesp/population,land,biodiversity.htm, Chapter3, pp35-51.

[2] Tim Flannery, *The Future Eaters*, Reed Books, 1994, Chapter 27.

species of mammalian carnivores, including two species of bears, which are the biggest, most energy-intensive mammal, in an area not much bigger than Australia.[3](3) Australia, of course, supports a much lesser biomass. The reason for this difference, apart from the good rainfall, is Europe's soil resources and the role of glaciation - major glaciers only having completely withdrawn in the last 8000 years, grinding and renewing the earth as they moved. Such major geological events are responsible for Europe's rich and thick topsoils 8 or 9 feet deep.

**Fossil Fuel Population Settings for Australia and France today:**

Presently, Australia's population is about 20 million, and since 1990 population has increased by 2,198,550 people, or approximately 12.8% for an average rate of +1.6% per year. Almost half of this increase was due to immigration. In 2003 Australia was on course to reach about 30 million by 2050. By contrast France's population is 60 million and, since 1990, France's population grew by 2,462,700 people for an average rate of +0.39% per year. A large part of this growth was due to natural increase. After 2050, with the demise of most baby-boomers, France's population is set to decline. (4)

## *Australia:*

In contrast to the rich, deep European soils of France, in Australia the topsoil is often only a few inches deep, if that. The biophysical constraints of this - the oldest continent - are largely due to flatness and lack of recent major geophysical upheaval. As well as affecting the potential for rainfall, the flatness means that rivers flow slowly, little silt is gathered or deposited and salt accumulates in the soil. Lack of volcanoes, earthquakes or glaciers means that the soil fails to be renewed through widespread grinding and crushing of minerals and rocks. Successful non-nomadic Australian mammals tend to be small with unusually slow metabolisms. The largest mammals are nomadic macropods - the kangaroos - which can travel quickly away from drought to rain to find better foraging. Many of the largest fauna are land-based low food-energy requiring reptiles, which use heat from the sun to raise their body temperature.[4](5) Nomadic birds, like cockatoos, parrots, and the flightless emu, also do well. Both flora and fauna display numerous adaptations to precarious, stingy soils and an arid climate. Some of many unusual features are the number and variety of adaptations to extreme soil infertility. These include those of the world's largest variety of carnivorous plants, which are thought to supplement nitrogen-poor soils with insects, and a tree-size mistletoe that parisitises nutrients from the roots of other vegetation.[5](6) The scleromorphous structure of much indiginous vegetation is an adaptation to water shortage.

**Human adaptation to biophysical constraints in Australia prior to the fossil-fuel economy:**

In Australia pre-fossil fuel society was hunter-gatherer, averaging on continent-wide terms, less than one person per 8.5 square kilometres, possibly as few as one person per 51 square

[3] Tim Flannery, *The Future Eaters*, Reed Books, 1994, Chapter 27.

[4] Tim Flannery, *The Future Eaters*, Reed Books, 1994, p.114. The "... remarkable assemblage of large, predatory and predominantly land-based reptiles has no parallel outside Meganesia."

[5] Tim Flannery, *The Future Eaters*, p. 92-93.

kilometers.[6](7) There was no agriculture, almost certainly due to the climate and soils.[7](8) To get an idea of what this means requires the understanding that the majority of the continent is hot desert.[8](9) Total land stock is 770 million hectares or 7,700,000 square kilometers but less than 30 million hectares or 300,000 square kilometers (less than 4%) is of good or very good quality in terms of broadscale cropping potential.[9](10) Rangelands encompass some 75% or 570 million hectares of the continent. About 406 million hectares is used for grazing, with stock density running as low as one beast per 100km. Rainfall is highly variable, with frequent droughts lasting several seasons, resulting in massive die-offs.[10](11) Like the nomadic adaptations of kangaroos and birds to erratic climate, the aborigines, who were hunter gatherers, moved with their food sources in response to changing conditions, with the exception of those hunting and gathering under more settled conditions in comparatively more fertile, less arid parts, especially the South East. The continent supported numerous clans at different densities according to regional soils and climate. The distribution of the fossil fuel era population is similar, also reflecting climate and soils, although abundant fossil fuel has made it much denser and more numerous.[11](12)

**Primary productivity improvements since the fossil fuel economy.**

Net primary productivity continent wide was about 5% less prior to European settlement in 1788.[12](13) For all intents and purposes this increase has been restricted to 25% of the continent, mainly in the South East. From this we can infer that net primary productivity has increased in this more fertile quarter of the continent by about 20%, and that productivity in the most fertile 4% would have increased over 100%. Almost all of this is due to the application of fossil fuel sourced synthetic fertilisers, irrigation, and internal combustion

---

[6] Total land stock is 770 million hectares or 7,700,000 square kilometers. Source: Barney Foran, Franzi Poldy, *Future Dilemmas,* CSIRO Resource Futures Working Paper 02/01, CSIRO Sustainable Ecosystems, GPO Box 284, CANBERRA ACT 2601, available online at http://www.cse.csiro.au/futuredilemmas, p.130 Estimates of population range between 150,000 through 300,000 to 900,000. The estimates of people per sq.km. were derived by dividing these total population estimates into the total land stock. Of course this does not reflect true settlement patterns which were lower or denser according to land fertility, which is highest on the south west and south east coasts. (See later note for sources.)

[7] Tim Flannery, The Future Eaters, p 148-49

[8] Falling below the UNCCD rainfall benchmarks defined as above the desertification threshold. Almost all of Australia's annual precipitation (465mm) is evaporated, leaving the lowest runoff for an inhabited continent in the world, at 52mm water, compared to 310mm of annual global average. Most living creatures and most of the humans live in the southern coastal regions where climate is more temperate and rainfall is higher.

[9] Foran and Poldi, *Future Dilemmas*, *Ibid.*

[10] "National Report by Australia on measures taken to support implementation of the united nations convention to combat desertification", Commonwealth Intergovernmental Working Group for the UNCCD, April 2002, p.3-4.

[11] Graham Zable's paper www.dieoff.org/page199.htm

[12] Net productivity is measured by carbon gained through photosynthesis and carbon lost through plant respiration. Net primary productivity averages 0.96 Gt of carbon each year for the Australian continent. Nearly 60Gt of the total continental carbon is stored as plant biomass (45%) and soil carbon (55%). Source: Australian National Resources Atlas, http://audit.ea.gov.au/anra/agriculture/docs/national/Agriculture_Landscape.html, "Australian Agriculture Assessment 2001 - ...s: water, carbon, nitrogen and phosphorus"

engines for machinery and transport.[13](14) Synthetic fertilisers and irrigation are beginning to seriously go wrong, leading to desertification of previously productive areas.

Prior to European settlement, for at least 40,000 years, Australia was occupied by clans of Aborigines totalling a population estimated to have been between 150,000 and 300,000, although some estimates have taken it up as high as 900,000.[14](15) With wood, wind, draft animals and some coal the population rose to around 6 million prior to the first world war. This is the number that Flannery thought would be sustainable in the long term for Australia and at a relatively comfortable lifestyle.[15](16) He was however probably also thinking of continued fossil fuel use. It is likely that long term carrying capacity *without* substantial quantities of fossil fuel may be closer to that of the pre-European Aboriginal population.

The question of determining the carrying capacity[16](17) of Australia, as a pre-fossil fuel agricultural self-sufficient economy, is problematic on multiple levels. None of these, however, should stop discussion. Firstly, the notion of an agricultural economy is counterintuitive because of the inherent unsuitability for cultivation of most regions and soils of Australia and because of severe, widespread damage to soil and water resources since European settlement. Secondly there is the certainty of further and massive land degradation induced and entrained by ongoing processes. Problems with dryland salinity (currently irreversible) affect 2.5 million hectares, with 17 million hectares among the 30m good likely to be destroyed by salinity by 2050 on current trends, leaving 13 million "good" and probably at least halving agricultural productivity.[17](18) More than 24 million hectares of soil is considered acidic. Much of this is natural, but agricultural management technologies are

---

[13] Carbon, organic nitrogen and organic phosphorus have been nearly doubled since pre 1788. Some of this is now counter productive. Source: Australian National Resources Atlas, http://audit.ea.gov.au/anra/agriculture/docs/national/Agriculture_Landscape.html, "Australian Agriculture Assessment 2001 - ...s: water, carbon, nitrogen and phosphorus."

[14] Prior to European settlement, for at least 40,000 years, Australia was occupied by tribes of Aborigines totaling a population estimated to have been between 150,000 and 300,000, (Stefania Siedlecky & Diana Wyndham, *Populate and Perish, Australian Women Fight for Birth Control,* Allen and Unwin, Australia, 1990, p142) although some estimates have taken it up as high as 900,000. *(The Australian People, an Encyclopedia of the Nation, its People and their Origins,* Angus & Robertson, Australia, 1988, p148. The higher figure refers to estimations by Noel Butlin in 1983.)They survive now in numbers slightly above that lower estimate, but with a variety of lifestyles, from traditional through to post-industrial. Cook and Joseph Banks commented on the low density of the Aboriginal population and Banks correctly inferred this to be a consequence of the low fertility of the land. Thomas Malthus wrote that he was inspired by these comments to write his first volume on population. Source: Thomas Malthus, *An Essay on the Principle of Population and A Summary View of the Principle of Population,* the second essay, entitled, *A Summary View of the Principle of Population* Penguin Classics, Penguin Books, London, 1985, p.251.

[15] Tim Flannery, *The Future Eaters*, *op.cit*., pp 368-369. Utilising 20-30% of the carrying capacity of the land, which is the practice of hunter-gatherers and which suits the ENSO (El niño southern oscillation) dominated climate with its variable cycles of drought and floods.

[16] The notion of 'carrying capacity' is in itself highly problematic, but not an issue that we can go in to here. Suffice to flag some major implications: 'carrying capacity' needs to take into account population, energy use per capita and total population, waste products, length of time planned for. To put this simply: Australia could have a population as large as Bangladesh, living at Bangladesh standards, but that population would only survive for a few days or weeks. The population of the Aborigines, pegged around 300,000, probably had survived tens of thousands of years.

[17] Foran and Poldi, *Future Dilemmas*, *Op.cit.* p.125.

causing the soil acidification process to accelerate.[18](19) The logistics of distance and area required for traditional agriculture, are so vast that they are generally incomprehensible to Europeans from the Northern hemisphere who do not have science-based ecological knowledge.

So, in doing a ball park calculation of carrying capacity[19](20) post fossil fuel, we need to consider the following. With productivity of land approximately halved by 2050 and population of 30 million (half as big again as it was early in the 21st century), Australia's export economy, which consists mostly of agricultural and mineral product, will be reduced in line with the growing needs of its own population unless an elite continues to export at the expense of the local population. We can assume that both oil and natural gas will have run out by then.[20](21) Taking into account its role substituting for declining oil and gas, coal may last, according to high economic and population growth rate scenarios, up to around the middle of this century, or, at a quite unlikely zero growth rate, up to the middle of the 22nd century.[21](22) Conventional sources of nuclear energy will possibly last until around 2100.[22](23)

Back to the notion that an agricultural economy is counter intuitive. The idea of a hunter gatherer, herding economy, with, so to speak, some oases of gardening and crop production, is the one that offers itself up as the most natural, logical and efficient. In Australia we have a natural biodiversity that has adapted beautifully to the biophysical restrictions of the Australian continent. This ecology has probably maximised the greatest productivity at an indefinitely sustainable level. In the absence of large quantities of fossil fuel, it makes far more sense for humans to adapt to this ecology than to continue to try to reorganise, with multiple prosthetic innovations, something so big and organically synthesised.

After those forms of energy stored as fossil fuel have run beyond their commercial production lifetime, the capacity of the continent to support more than its natural biomass will be

---

[18] Foran and Poldi, *Future Dilemmas*, *Ibid.*. Such as legume pastures without balancing lime applications, and the application of nitrogenous fertilisers.

[19] Bearing in mind that 'carrying capacity' is a much abused term that would be better replaced with 'optimum population', however the latter is too complicated for this paper. The reader is asked to consider that carrying capacity means long term sustainable best we can manage.

[20] Foran and Poldi, *Future Dilemmas*, p. 121.

[21] These are very rough estimates, based on total estimated global stocks of coal, rather than Australia's local stocks. This assumes that coal would be shared out equitably, which seems unlikely. Values for coal demand were calculated by finding a value based on current coal demand adjusted for economic growth and adding the additional demand due to diminishing oil. Oil and Coal production data comes from the U.S. Energy Information Administration which obtained its data from The World Energy Council. These very rough estimates are based on initial studies by Gregson Vaux, of the Department of Civil and Environmental Engineering, Carnegie Mellon University, USA. See his article in this book.

[22] Conventional nuclear energy sources (as opposed to possible new ones like thorium) are projected to run out around 2100 by some, including Kenneth Deffeyes (also the author of Hubbert's Peak) who has performed an extensive study on this, published in the format of a book length report and also as a short summary in Scientific American. The study indicates that a moderate increase in extraction difficulty will be met with a 300 fold increase in available uranium, after which some expect Breeder Reactors to be brought into use. These projections suppose that conventional nuclear energy will be called in, along with coal and flow energies, to replace depleated petroleum and gas. They are probably very unreliable. Most of the objections to nuclear energy are environmental, health or in terms of energy efficiency.

enormously reduced, and the human population will shrink, one way or another, as a result. If we assume a loss of at least 50% of the 5% gain in agricultural productivity since 1788, then we are perhaps contemplating a population 2.5% larger than the aboriginal population pre 1788. Such a population would subsist mainly through hunting indigenous fauna (like macropods and birds) or herding exotic fauna (like cattle), using draft animals (camels and equine and bovine), cultivating, by recycling manure and other wastes, a greatly reduced area of relatively arable land, and using flow energies,[23](24) of which the most representative will probably be wind, with some solar and some biomass if combustion engines are maintained for limited specific purposes. These flow energies might add to the productivity of the land, but from that gain should be subtracted the land needed for accommodation and food supply of beasts of burden.

#### Organisation and Infrastructure

It is unlikely that such a small population would benefit by organising big scale commercial electricity from flow sources, except perhaps in the island of Tasmania, which has some fast flowing rivers. Inland water sources on the mainland, with the exception of the unreliable Murray-Darling River system, are almost all unviable for commercial transport and power. Wind and draft animals were the power source most used prior to fossil fuel in Australia. Geothermal, solar, and tidal energy offer limited opportunity, but require high technology for sophisticated harnessing and this may not be practical for a small post fossil fuel population living largely off the land. Failing massive technological breakthroughs, these sources are not likely to greatly increase on the continent's original fertility. Note that I have not talked about utilising existing transport infrastructure, as I have done for France. This is because, although it might be possible to use trains and grid electricity on a limited scale, the distance between cities and the fall in population makes maintaining these options unlikely. There might perhaps be a case for a wood fired railway from the major inland food production area (should any of this survive), and then redistribution via road by draft animal and a coastal shipping transport service.

#### On the way to sustainability without fossil fuel:

In Australia at present time there is capacity to generate enough electricity through wind power to strongly assist transition to a smaller population and the depletion of fossil fuel. The capacity to plan for and implement this potential is the big problem, due to the influence of the coal lobby and the property development and construction industry which are institutionalised at a structural level in the Australian planning and political system.

Dr John Coulter, has been lobbying to change these inertias, and has developed a plan based on study of costs and production for a wind farm in Albany, West Australia. [24](25) He writes

---

[23] Flow energies are those renewed in nature: water, wind, solar, as opposed to fossil fuel, which is energy stored in the earth in the form of oil, gas, coal and uranium etc.

[24] In Australia at present time there is capacity to generate enough electricity through wind power to strongly assist transition to a smaller population. The capacity to plan for and implement this potential is the big problem, due to the influence of the coal lobby and the property development and construction industry which are institutionalised at a structural level in the Australian planning and political system.
From Dr John Coulter, "Size, Cost & Timing of Change", Paper presented at the National Conference of Sustainable Population Australia, University of Adelaide, July 2002. Dr Coulter was for several years the leader

that "Each of these turbines in the Albany wind farm built for Western Power is rated at 1.8 MW; the towers are 65 metres tall and the blades 70 metres in diameter. The farm is connected into the West Australian grid through a 15-km underground 22,000-volt line. The expected completed capital cost will be $1.81/watt.

Because the wind does not blow all the time the capacity factor for wind generators is between 25 and 30% depending on the location. The capacity factor is the percentage of electricity actually generated compared with the amount that would be generated if the generator worked 100% of the time. Therefore between three and four times the number of wind generators must be installed over a widely dispersed area and interconnected in a grid if wind is to become the principal and reliable source of the country's electricity.

We need to install some 7,500 MW of wind power each year for the next decade. That is equivalent to building 71/2 Torrens Island power stations every year. At $1.81 per watt this represents an investment each year of $13.5 billion or about 2% of GDP. This is a large amount of money but last year Australia spent $44 billion on building construction or 6.5% of GDP. The physical dimensions of the task are also enormous. At 1.8 MW per generator we will need to build approximately 4,200 towers and generators every year. It must be interpolated here that the building industry is one of the very strong lobbies for population growth. How much more progressive it would be if it were building wind farms rather than more and more houses?"

The Australian land planning development and construction industries and system have successfully fought necessary policies to reduce population growth and energy demand. Australia's incapacity to plan and adapt infrastructure, industry, and resource draw-down for radically changing circumstances is a major problem. It has been bedevilled and will likely remain bedevilled by the federal government's lack of legal authority to direct, oversee and co-ordinate state and local government land-use planning.[25](26)

## *France:*

Although Europe and France were blessed by very rich soils and a climate conducive to agriculture, it must be noted that modern agricultural equipment, irrigation, single-cropping and near-total reliance on mineral fertilizers has radically increased erosion and soil degradation[26](27) all over Europe, this being compounded in regions north of about 45°N by increasing rainfall, probably due to climate change.

### Human adaptation to biophysical constraints in France prior to the fossil-fuel economy:

---

of The Australian Democrats political party. He is currently Vice President of Sustainable Population Australia and founded Zero Population Growth in Australia in the 1970s.

[25] These remain captive to local investment traditions, global capital, and speculative property development which dominate a poorly organised, poorly financed, and, in the main, technologically backward construction industry. S. Newman, *The Growth Lobby and its Absence: The Relationship between the Property Development and Housing Industries and Immigration Policy in Australia and France, 1945-2000 with projections to 2050*, http://www.alphalink.com.au/~smnaesp/population,land,biodiversity.htm, Chapters 3, 7 and 8.

[26] 27 "Agriculture durable et conservation des sols," European Conservation Agriculture Federation, http://www.ecaf.org/frances/First.html

From medieval times until the middle of the 18th century France's population oscillated around 18-20 million, which at the time was the largest in Europe. Growth was then relatively rapid; attaining nearly 30 million by 1815.[27](28) Territorial expansion through warfare also increased France's population by altering the borders: in 1850 nearly one million more people and their territory, in the form of Nice and Swiss Savoy, were added. Since the middle of the 19th century, however, increased agricultural land due to drainage, irrigation and other works was more than counterbalanced by loss of better land to urbanisation, soil degradation, and pollution both from industry and intensive agriculture. Despite this, it seems possible to consider a population of around 20-25 million as sustainable in the post fossil fuel era. Further, the policy and practices applied regarding the conservation of soils, the recycling of soil nutrients, and the recovery of biotope diversity may enable France to reconstitute soil quality and restore pre 19th century productivity in some regions. In such case it might be possible to maintain the higher end of the above, very general, sustainable population estimate.

France did not begin to experience its own industrial revolution until around 1880. The First World war, the Great Depression, and the Second World war further delayed this development. There was little local coal except in rather isolated and restricted areas. Probably for this, but for other reasons as well, French population growth was modest relative to those of Germany, the UK and Italy. Between 1815 and 1845, France's population grew from 29.4 million to 35 million, largely due to skilled immigration. Subsequent growth still remained lower than for other large European nations, with the French national population only increasing from 35.6 million to 38.4 million through 1850-1869.

In 1869, when the population of France had reached 38 million, horses, donkeys, oxen and even cows and dogs were used for road transport and hauling. The dominant industrial energy sources were still the water wheel, windmills and tidemills. Rivers provided the most energy-efficient form of transport and were extensively used before the fossil energy period, with some transport networks connecting to those of other European countries. Bulk transport, wherever possible, was by boat and barge. Today, and excluding large scale hydro power (producing about 70 TWh/year) small scale and run-of-river hydro installations (below 150 kW) produce about 4.5 TWh/year. France also has one of the world's few operational, larger-sized tidal electric power stations (Rance river, Brittany). In the late 19th century coal was increasingly used, but wood, which still provides about 40% of space heating fuel requirements in rural areas, was a major source of both commercial and non-commercial energy.

Much of the pre-fossil energy infrastructure either exists or could be reconstructed, or even improved upon. This is particularly true of the canal system and woodlands. France's woodlands and forests have been maintained, even increased on earlier times. Efficiently used, in combined heat-and-power facilities, wood and other biomass energy resources can easily provide envisageable heating, and rational electrical energy needs of an equilibrium or sustainable population of around 20-25 M persons. The capacity of the managed forests of France to support the return of a functioning biodiversity which people could supplement diet with would, however, require big changes in vegetation species mix and variety.

---

[27] Francis Ronsin, *La Population de la France de 1789 à nos jours,* Seuil, 1997.

In the future, there may be potential for wind-powered transport, both along canals and rivers, as well as roads.

The late 19th/early 20th century, primarily rural population of France, employing candles and mineral- and animal-oil lamps for light, was often little-integrated in the growing, urban- and industrial-based cash economy. The peasants had acquired land ownership rights through the French Revolution of 1789. This relatively secure peasantry, with strong cottage industries, lacked the motivation to provide the 'factory fodder' of the dispossessed in the UK and other European countries where the people were still surfs, or had lost all title and communal access to land by the Middle Ages. The French were similarly reluctant to settle France's colonies. Some of the 19th century's demographic growth may have been supported by wealth, or related commerce, arising from foreign possessions, particularly in the cities.[28](29) Without question, access to land, food- and energy-producing resources will form an important part of those 'social contracts' that new regional or national entities will construct or develop in the period from about 2035.

**Primary productivity improvements since the fossil fuel economy:**

While the French may claim status as 'the EU's breadbasket' this ignores two key factors. The first is the pollution and depletion of water tables, most spectacularly for pollution in Brittany, and most intensely for depletion of water resources in the entire south and south-west of the country. Secondly, although French agriculture is among the most productive in the world, it is heavily dependent on fossil fuels and petroleum products, both directly for machines, and indirectly for fertilizers, insecticides, animal medication and other inputs vitally necessary for intensive production. Once these are stripped away, food self-sufficiency for perhaps 25 million persons, less than 50% of France's 60 million population in 2002, becomes an optimistic but perhaps attainable target.

**Organisation and modern infrastructure:**

It should not be forgotten that France was not really a political, linguistic or cultural entity before the early 19th century. Development of railroads, post and telegraph systems played a major part in the sudden rush of 'nation building' that occurred in Europe through 1780-1860, and France provides an excellent example of this. The ability to cover wide areas with fast physical transport, and now communications, necessary to bind disparate communities and cultures into what are called 'modern nations' would necessarily diminish fast with loss of fossil fuel. It might however be possible for France to maintain electricity supplies for a certain level of high- or medium-speed rail transportΘΘ through a mixture of renewable energy sources – that is water, wind, wood and biomass, and tidal energy, although nuclear electricity will most certainly be the first choice of current policy makers.[29](30) The

[28] The industrialisation of France relied in part on an influx of immigrants, mostly skilled, and this also made a difference to the population size. As opportunities for employment increased in the industrialised cities, young rural women sought work there, hoping to improve on their subordinate positions in rural families. (Conversations with Francis Ronsin.)

[29] France's electricity production tripled in the period 1973-2000, growing to 540 TWh of which about 80% was nuclear-origin by 2000, and French power exports have become an import trade item. However, as the article by Marc Saint Aroman/Title TBA indicates, French nuclear power is riddled with hidden fossil energy subsidies, and like any nuclear power system is inherently high-risk. France has become, in less that 10 years, one of the very few remaining EU states that has not renounced the nuclear option. Necessity will probably breed tolerance for this option however.

infrastructure is also still largely in place for canal traffic at certain levels of capacity (a few percent of current road transport capacity). Urban and settlement spatial organisation, outside the unsustainably large and energy-intensive large cities, includes certain amounts of building stock capable of being adapted to much lower energy operation and therefore utilization. France's centralised land development planning system and construction industry organisation and technologies have previously adapted to and offer more scope for innovative adaptation to energy and population logistics than Australia's. [30](31)

The 20th century infrastructure overlay to the above target population (20-25 M), which is the same as that at the beginning of the 19th century, offers some potential for restructuring, adaptation and continued utilisation. This notably includes rail transport. At present some all-electric, but mostly diesel-fuelled onboard electricity generator powered trains link major points of the country and neighbouring countries. Other than canal and maritime transport, rail transportation is the most energy-efficient. Building stock, insulation and design improvements could be applied to selected building groups in efficiently and rationally located settlement centres outside the major urban areas, such as Paris-Ile de France, Marseilles, Lyon, Lille and Bordeaux, enabling a stabilised and decentralised population to live in an increasingly sustainable way. Most areas of France have inter-settlement distances set by pre-fossil fuel 'nested population hierarchies'[31]Θ(32) which reflect distances easily travelled on horseback, by foot or by boat. It should be possible to return to the use of horses and other beasts for transport. If all else fails, it might even be possible to use animals, wind power and water power to draw light trains along rail lines, and for city transport to include biomass electric or horse-drawn trams such as were used in the 19th century. The critical question will remain the *maintenance of energy-intensive infrastructures*, which at present are entirely, or greatly dependent on fossil fuels.

[1]. The most important sources I have used were Barney Foran, Franzi Poldy, *Future Dilemmas,* CSIRO Resource Futures Working Paper 02/01, CSIRO Sustainable Ecosystems, GPO Box 284, CANBERRA ACT 2601, available online at http://www.cse.csiro.au/futuredilemmas and the *Australian Resource Atlas*, http://audit.ea.gov.au/anra/agriculture/docs/national/Agriculture_Landscape.html which are products of long-term and ongoing work by CSIRO natural and physical scientists. For other ecological works on population see S. Newman, *The Growth Lobby and its Absence: The Relationship between the Property Development and Housing Industries and Immigration Policy in Australia and France, 1945-2000 with projections to 2050*, http://www.alphalink.com.au/~smnaesp/population,land,biodiversity.htm, Chapter3, pp35-51.
[2] Tim Flannery, *The Future Eaters*, Reed Books, 1994, Chapter 27.
[3] Tim Flannery, *The Future Eaters*, Reed Books, 1994, Chapter 27.
[4] Tim Flannery, *The Future Eaters*, Reed Books, 1994, p.114. The "... remarkable assemblage of large, predatory and predominantly land-based reptiles has no parallel outside Meganesia."
[5] Tim Flannery, *The Future Eaters*, p. 92-93.

---

The 'standard workhorse' of the SNCF are BB locos (1960s and 1970s vintage, still in service), and TER 'automoteurs' or power cars (some of 1950s vintage), both of which rely wholly or mostly on diesel fuel.. TGV or high speed trains are mostly-electric powered but utilize much onboard diesel-fuelled equipment, and all French railtrack and ancillary equipment is completely dependent on fossil fuels at this time Source: Andrew McKillop, Sub editor for Pluto Publishers, London, on book in progress with running title "Final Energy Crisis."

[30] S. Newman, *The Growth Lobby and its Absence: The Relationship between the Property Development and Housing Industries and Immigration Policy in Australia and France, 1945-2000 with projections to 2050*, http://www.alphalink.com.au/~smnaesp/population,land,biodiversity.htm, Chapters 3, 7 and 8.

[31] Natural settlement hierarchies in traditional Europe. Nested, hexagonal service centre hierarchies were the dominant feature of pre-industrial Europe, and set by distances able to be covered by foot, horse, canal and river, etc

[6] Total land stock is 770 million hectares or 7,700,000 square kilometers. Source: Barney Foran, Franzi Poldy, *Future Dilemmas,* CSIRO Resource Futures Working Paper 02/01, CSIRO Sustainable Ecosystems, GPO Box 284, CANBERRA ACT 2601, available online at http://www.cse.csiro.au/futuredilemmas, p.130 Estimates of population range between 150,000 through 300,000 to 900,000. The estimates of people per sq.km. were derived by dividing these total population estimates into the total land stock. Of course this does not reflect true settlement patterns which were lower or denser according to land fertility, which is highest on the south west and south east coasts. (See later note for sources.)
[7] Tim Flannery, The Future Eaters, p 148-49
[8] Falling below the UNCCD rainfall benchmarks defined as above the desertification threshold. Almost all of Australia's annual precipitation (465mm) is evaporated, leaving the lowest runoff for an inhabited continent in the world, at 52mm water, compared to 310mm of annual global average. Most living creatures and most of the humans live in the southern coastal regions where climate is more temperate and rainfall is higher.
[9] Foran and Poldi, *Future Dilemmas*, *Ibid.*
[10] "National Report by Australia on measures taken to support implementation of the united nations convention to combat desertification", Commonwealth Intergovernmental Working Group for the UNCCD, April 2002, p.3-4
[11] Graham Zable's paper #
[12] Net productivity is measured by carbon gained through photosynthesis and carbon lost through plant respiration. Net primary productivity averages 0.96 Gt of carbon each year for the Australian continent. Nearly 60Gt of the total continental carbon is stored as plant biomass (45%) and soil carbon (55%). Source: Australian National Resources Atlas, http://audit.ea.gov.au/anra/agriculture/docs/national/Agriculture_Landscape.html, "Australian Agriculture Assessment 2001 - ...s: water, carbon, nitrogen and phosphorus"
[13] Carbon, organic nitrogen and organic phosphorus have been nearly doubled since pre 1788. Some of this is now counter productive. Source: Australian National Resources Atlas, http://audit.ea.gov.au/anra/agriculture/docs/national/Agriculture_Landscape.html, "Australian Agriculture Assessment 2001 - ...s: water, carbon, nitrogen and phosphorus."

[14] Prior to European settlement, for at least 40,000 years, Australia was occupied by tribes of Aborigines totaling a population estimated to have been between 150,000 and 300,000, (Stefania Siedlecky & Diana Wyndham, *Populate and Perish, Australian Women Fight for Birth Control,* Allen and Unwin, Australia, 1990, p142) although some estimates have taken it up as high as 900,000. *(The Australian People, an Encyclopedia of the Nation, its People and their Origins,* Angus & Robertson, Australia, 1988, p148. The higher figure refers to estimations by Noel Butlin in 1983.)They survive now in numbers slightly above that lower estimate, but with a variety of lifestyles, from traditional through to post-industrial. Cook and Joseph Banks commented on the low density of the Aboriginal population and Banks correctly inferred this to be a consequence of the low fertility of the land. Thomas Malthus wrote that he was inspired by these comments to write his first volume on population. Source: Thomas Malthus, *An Essay on the Principle of Population and A Summary View of the Principle of Population,* the second essay, entitled, *A Summary View of the Principle of Population* Penguin Classics, Penguin Books, London, 1985, p.251.

15 Tim Flannery, *The Future Eaters*, *op.cit*., pp 368-369. Utilising 20-30% of the carrying capacity of the land, which is the practice of hunter-gatherers and which suits the ENSO (El niño southern oscillation) dominated climate with its variable cycles of drought and floods.

[16] The notion of 'carrying capacity' is in itself highly problematic, but not an issue that we can go in to here. Suffice to flag some major implications: 'carrying capacity' needs to take into account population, energy use per capita and total population, waste products, length of time planned for. To put this simply: Australia could have a population as large as Bangladesh, living at Bangladesh standards, but that population would only survive for a few days or weeks. The population of the Aborigines, pegged around 300,000, probably had survived tens of thousands of years.

[17] Foran and Poldi, *Future Dilemmas*, *Op.cit.* p.125.

[18]From S.Newman, *The Growth Lobby and its Absence: The Relationship between the Property Development and Housing Industries and Immigration Policy in Australia and France, 1945-2000 with projections to 2050*, http://www.alphalink.com.au/~smnaesp/population,land,biodiversity.htm, Appendix 4, "Statistical Appendix" - not available on the net. Available from the author at smnaesp@alphalink.com.au. Original Source for Australia was the Australian Commonwealth Year Books and the Australian Bureau of Statistics Demographic Statistics (Cat. 1301.0) using total net immigration numbers derived from "Excess of Arrivals over Departures" prior to 1958 and "Net Overseas Movement" in later years, and for population projections, ABS 1995, 1999

series, (Cat. 3220.0). Sources for France were Roselyne Kerjosse, Irène Tamby: La situation démographique en 1994: mouvement de la population, INSEE, Paris, 1996, Table 3, "Evolution de la population depuis 1946, Evaluation fondée sur les résultats des recensements de 1946 a 1990. For Population projections: Quang-Chi Dinh, Projection de population totale pour la France metropolitaine, Base RP90, horisons 1990-2050, INSEE, Annexe II, p.30 and Table A5, p.139 and Eurostat projections to 2040, a paper for Annie Mesrine, Direction des statistiques démographiques et sociales, Department de la démographie, Division Enquêtes et etudes demographiques.

19 Foran and Poldi, *Future Dilemmas*, *Ibid.*. Such as legume pastures without balancing lime applications, and the application of nitrogenous fertilisers.

[20] Bearing in mind that 'carrying capacity' is a much abused term that would be better replaced with 'optimum population', however the latter is too complicated for this paper. The reader is asked to consider that carrying capacity means long term sustainable best we can manage.

[21] Foran and Poldi, *Future Dilemmas*, p. 121.

[22] These are very rough estimates, based on total estimated global stocks of coal, rather than Australia's local stocks. This assumes that coal would be shared out equitably, which seems unlikely. Values for coal demand were calculated by finding a value based on current coal demand adjusted for economic growth and adding the additional demand due to diminishing oil. Oil and Coal production data comes from the U.S. Energy Information Administration which obtained its data from The World Energy Council. These very rough estimates are based on initial studies by Gregson Vaux, of the Department of Civil and Environmental Engineering, Carnegie Mellon University, USA. See his article in this book.

23 Conventional nuclear energy sources (as opposed to possible new ones like thorium) are projected to run out around 2100 by the sources I can find, which also anticipate that a moderate increase in extraction difficulty will be met with a 300 fold increase in available uranium, after which some expect Breeder Reactors to be brought into use. These projections suppose that conventional nuclear energy will be called in, along with coal and flow energies, to replace depleated petroleum and gas. They are probably very unreliable because they originate with marketing agencies and have not been subjected to much expert comment. One source is: "Supply of Uranium, UIC Nuclear Issues Briefing Paper # 75", http://www.uic.com.au/nip75.htm, August 2002 Uranium Information Centre Ltd, A.B.N. 30 005 503 828, GPO Box 1649N, Melbourne 3001, Australia. Another source is Some other objections are to be found in a short piece at www.dieoff.com/synopsis "... Although there is some debate regarding the quantities of available uranium ore, there is general consensus that the available feedstock will fuel the current generation fission reactors only for decades, not centuries However, it has long been recognized that it is possible to design fission reactors in a manner to convert 'fertile' material into a 'fissile' material, thereby greatly extending the useable fuel supply. [Fast Breeders]," Alan E Walter, *America the powerless: Facing Our Nuclear Energy Dilemma*, Cogito, 1995, p.56. Following this quote there is another on the inefficiencies and cost of nuclear breeder reactors.

[24] Flow energies are those renewed in nature: water, wind, solar, as opposed to fossil fuel, which is energy stored in the earth in the form of oil, gas, coal and uranium etc.

[25] In Australia at present time there is capacity to generate enough electricity through wind power to strongly assist transition to a smaller population. The capacity to plan for and implement this potential is the big problem, due to the influence of the coal lobby and the property development and construction industry which are institutionalised at a structural level in the Australian planning and political system.
From Dr John Coulter, "Size, Cost & Timing of Change", Paper presented at the National Conference of Sustainable Population Australia, University of Adelaide, July 2002. Dr Coulter was for several years the leader of The Australian Democrats political party. He is currently Vice President of Sustainable Population Australia and founded Zero Population Growth in Australia in the 1970s.

[26] These remain captive to local investment traditions, global capital, and speculative property development which dominate a poorly organised, poorly financed, and, in the main, technologically backward construction industry. S. Newman, *The Growth Lobby and its Absence: The Relationship between the Property Development and Housing Industries and Immigration Policy in Australia and France, 1945-2000 with projections to 2050*, http://www.alphalink.com.au/~smnaesp/population,land,biodiversity.htm, Chapters 3, 7 and 8.

27 Place address of site as note? Synearth Web site has good sources #

[28] Francis Ronsin, *La Population de la France de 1789 à nos jours,* Seuil, 1997.

[29] The industrialisation of France relied in part on an influx of immigrants, mostly skilled, and this also made a difference to the population size. As opportunities for employment increased in the industrialised cities, young rural women sought work there, hoping to improve on their subordinate positions in rural families. (Conversations with Francis Ronsin.)

[30] France's electricity production tripled in the period 1973-2000, growing to 540 TWh of which about 80% was nuclear-origin by 2000. Some is exported. The industry has many hidden infrastructure and processing costs as well as the well known problems of disposal and risks of sabotage or breakdown. Source an article by Marc Saint Aroman, "Aberration economique du nucléaire prise dans la tourment d'une libéralisation totale des march de l'electricité, www.sortirdunucleaire.org.

France has become, in less that 10 years, one of the very few remaining EU states that has not stated preparation to replace the nuclear option with coal or other energy sources. The occurrence of a Chernobyl-type catastrophe in Western Europe could signal a halt to and renunciation of any concept of 'all-nuclear' or even mainly-nuclear national electricity supply systems, and the acceleration of movement towards a nuclear-free power system for the continent, if it comes before economic breakdown through fossil fuel depletion prohibits major innovation in infrastructure.

TGV or high speed trains are mostly-electric powered but utilize much onboard diesel-fuelled equipment, and all French rail track and ancillary equipment is completely dependent on fossil fuels at this time. The 'standard workhorse' of the SNCF are BB locos (1960s and 1970s vintage, still in service), and TER 'automoteurs' or power cars (some of 1950s vintage), both of which rely wholly or mostly on diesel fuel.

Among other possible energy sources, but requiring major initial capital cost, geothermal energy of at least 60°C is available four miles below the surface in France as elsewhere in Europe.

[31] S. Newman, *The Growth Lobby and its Absence: The Relationship between the Property Development and Housing Industries and Immigration Policy in Australia and France, 1945-2000 with projections to 2050*, http://www.alphalink.com.au/~smnaesp/population,land,biodiversity.htm, Chapters 3, 7 and 8.

[32] Christaller and Losch, *Natural settlement hierarchies in traditional Europe*. Nested, hexagonal service centre hierarchies were the dominant feature of pre-industrial Europe, and set by distances able to be cobered by foot, horse, canal and river.