Remaking settlements for sustainability: the Simpler Way

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Abstract

In view of the global resource and ecological situation, per-capita resource consumption rates in the rich world probably need to be reduced by 90%. This can only be done if there is a "de-growth" transition to some kind of Simpler Way centered on mostly small, highly self-sufficient and self-governing communities in control of local economies within a culture that is not focused on material wealth. It is not surprising that the viability of such a vision is typically regarded as implausible. The aim of this study is to show that normal outer city suburbs could be restructured along the lines required to cut global impacts by the necessary amount, while improving the quality of life. Data on typical Australian consumption rates, food production yields, suburban geographies, etc. is used to estimate the achievable reductions. The theoretical conclusion that such reductions could be made aligns with a study of the Dancing Rabbit Eco-village in northeast Missouri. Heavy cuts in resource consumption cannot be made without extreme change in economic, political, settlement and cultural systems.

Key words: The Simpler Way, de-growth.

Résumé

Compte tenu des ressources mondiales et de la situation écologique, il faudra probablement réduire les taux de consommation de ressources par habitant dans les pays riches de 90%, ce qui ne peut être fait que si la transition vers une sorte de «voie plus simple» se produit centré sur la plupart des collectivités de petite taille, extrêmement autonomes. Celles-ci auront le contrôle des économies locales au sein d'une culture qui ne met pas l'accent sur la richesse matérielle. Il n'est donc pas surprenant que la viabilité d'une telle vision soit généralement considérée comme invraisemblable. Le but de cette étude est de montrer que les banlieues normales pourraient être restructurées selon les critères requis pour réduire les impacts globaux du montant nécessaire, tout en améliorant la qualité de la vie. Les données sur les taux de consommation, les rendements de production alimentaire et les banlieues typiques sont utilisé pour estimer ces réductions réalisables. La conclusion théorique selon laquelle ces réductions pourraient être corroborées par une étude de l'éco-village de Dancing Rabbit dans le nord-est du Missouri. La consommation ne peut être faite sans un changement extrême des systèmes économiques, politiques, de peuplement et culturels.

Mots clés: La voie la plus simple, décroissance.

Resumen

Frente a la situación ecológica global, así como de los recursos, los índices de consumo de recursos per-cápita en el mundo requieren ser reducidos en un 90%. Esto se puede lograr solamente con una transición de "decrecimiento" hacia un tipo de "Simpler Way" que se centre principalmente en comunidades pequeñas, altamente autosuficientes y autogobernadas que tengan control de las economías locales y una cultura sin interés en riqueza material. No sorprende que la viabilidad de esta visión sea normalmente considerada como poco plausible. El objetivo de este estudio es mostrar que los suburbios convencionales en los márgenes de las ciudades, pueden ser reestructurados según los lineamientos requeridos para hacer a un lado los impactos globales que se requieran, y al mismo tiempo mejorar la calidad de vida. Los datos de los índices promedio de consumo, rendimiento de producción de alimentos, geografías suburbanas, etc.,

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en Australia, son usados para estimar las reducciones plausibles. La conclusión teórica de que tales reducciones puedan lograrse, coincide con un estudio de la eco-villa Dancing Rabbit en el noreste de Missouri. Los recortes drásticos en el consumo de recursos no pueden lograrse sin un cambio extremo en los sistemas económico, político, cultural y de compensación.

Palabras clave: Simper Way, decrecimiento

1. Introduction

The general "limits to growth" case that planetary resource demands and ecological impacts have far exceeded sustainable levels is widely accepted, but the magnitude of the overshoot is not well understood. The World Wildlife Fund's "Footprint" index provides an effective illustration (2016). It indicates that the amount of productive land needed to provide current "living standards" for Australians is in excess of 7 ha *per capita*. Therefore, if by 2050 the expected world population of 9.6 billion people were to rise to the present Australian way of life, approximately 67 billion ha of productive land would be needed. But only about 8 billion ha is available on the planet (and at current loss rates the present area of agricultural land might have been halved by then; Rees 2017). Numerous other measures and studies confirm a multiple of this order or greater (Trainer 2017a).

This means that that present rich world rates of resource use and ecological impact are grossly unsustainable, being in the region of ten times the levels that would enable a sustainable and just world. Yet the supreme priority in virtually all nations is economic growth; that is to increase levels of production, consumption, "living standards" and GDP without limit. Some assume that technical advance can "decouple" economic growth from resource use, but the extreme implausibility of this is detailed in Trainer 2016c.

If the foregoing points are sound then the rapidly worsening global predicament cannot be solved unless there is enormous de-growth down to *per capita* resource consumption rates that are in the region 10% of current rich-world rates. The Simpler Way project has been concerned to show that this can be done, but only if there is enormous change away from the structures, systems and values of consumer-capitalist society (Trainer 2016a; 2018). Understandably these claims tend to be seen as unduly optimistic and implausible (Trainer 2019). The *Remaking settlements* study (Trainer 2016b) was a detailed numerical assessment of what might be achievable through radical reorganization of the land uses and socio-economic arrangements of East Hills, a representative outer suburb in Sydney, Australia. It is updated and presented here. The study finds that it would be possible for the inhabitants of such a suburb to live well on something like 10% of present Australian *per capita* dollar, energy and footprint costs.

The study does not imply that hardship and deprivation would have to be accepted, and indeed advocates of The Simpler Way argue that the quality of life would be markedly improved. However it would require extremely radical change in the geography of settlements, in economic and social systems, and in attitudes and values. The feasibility of the general vision being argued is supported by evidence from the eco-village movement, some of which will be referred to below.

It will be argued that given the severity of the limits to growth predicament the vision elaborated here is not optional; it is not one choice among many that are viable and available. It is the only general path that can lead to a sustainable and just world. An extended, more critical argument supporting the Simpler Way was offered in a companion article in this journal (Trainer 2019).

2. Methodology

This article focuses mainly on the reorganization of suburban food supply, adding only brief notes on provision of the many other necessities dealt with at length in the 52 page *Remaking settlements* report which also deals with buildings, clothing, tools, machinery, materials, leisure, energy, media, health, aged care and retirement, education and several other topics (Trainer 2016b). Estimated figures are derived from national statistics on areas, yields and dollar costs etc., plus evidence from existing alternative systems.

Section 3 *1)* on food makes transparent the kind of numerical derivations carried out for other sectors but not reported in detail here, hopefully adding weight to the credibility of findings which might at first sight seem implausible. It should be kept in mind that quite radical restructuring of land use, social arrangements and culture is being assumed.

The locality on which the analysis is based is the outer Sydney suburb of East Hills, 26 kilometers south-west of the Sydney CBD on a bend of the Georges River. The climate is suitable for agriculture, humid subtropical, with mean monthly temperatures between 14^{0} and 23^{0}C and a rainfall average of c1,000mm pa.[2] Figure 1 gives some summary figures and an indication of land uses.

Variable	**Units**
Total area of the suburb	142 ha (1.42 km^2) 
Population	2,114 usual, but 3,200 incl. "non-permanent"
Households	941
Persons per household	2.7
Cars	1,600, 1.7 per dwelling
Roadspace	17.3 ha, most are 19 m fence to fence, but two major much wider through-roads are included 
Average house size	c.160 m^2
House block size	Average 760 m^2
Total land use, housing	15 ha
Parks	16 ha
Potential agricultural area: ...house blocks minus house area, plus narrowing some roads and the railway corridor plus one third of existing parks	c. 82 ha, including c. 25 ha for commons.

Figure 1: East Hills, Sydney Data from East Hills Quickstats, Australian Bureau of Statistics (ABS).

[2] http://www.bom.gov.au

3. Results

1) Food supply

Estimates of areas, yields, and dollar and energy costs Almost all the suburb's roads serve only as driveways for vehicles to get out to the main road once a day. That means more than 17 ha, about one-eighth of all the land, remain unused almost all the time. The study found that with radical restructuring of this and other land uses most, and possibly almost all food could come from within settlements, that is from home gardens, community gardens, neighborhood commons, and very small farms, at very low dollar and energy costs, assuming radical reorganization of space and other factors. However some grain, dairy, oils, fruit and nuts would need to be brought in, ideally in bulk from nearby farms.

A summary of principles This list guiding the land use transition to food production derives from many sources contributing to the sustainable agriculture theme, especially Permaculture (Alexander and Gleeson 2019; Holmgren 2018; Mollison 1988). See also Smaje (2019) and Fairlie (2007).

- Home gardens, intensive planting of perennials and annuals over most of the house block.
- Community gardens, for families and cooperatives.
- Community co-ops, e.g., dealing with poultry, fish, orchards etc.
- Commons; most public space and especially retrieved road space converted to gardens, orchards, woodlots, fish ponds, processing and storage sheds, cool rooms, "edible landscapes" and "food forests" providing free fruit, nuts, mulch, timber, honey, poultry, reeds, herbs, fish. Commons developed and maintained by voluntary working bees and committees.
- "Farms", from small to tiny, in backyards, vacant blocks, on commons, producing for local use, some in the form of co-operatives, including small animal production, and some larger farms for field crops such as soybeans and grains. Many households able to sell or barter small quantities, reducing the need to earn money to purchase food.
- All "wastes" including human, animal, food scraps, garden and farm, recycled to local soils via compost heaps, animal feed and garbage gas units, thus eliminating the need for artificial and imported fertilizers. Suburbs constantly recycle a more or less stable quantity of nutrients through kitchens, toilets and animal pens back to soils producing the food taken to the kitchens.
- Towns own/licence/contract some nearby farms, producing their bulk grain, dairy, soy, sugar beet, fruits and nuts for supply of these more land-expensive items. These farms would also be sites for holidays.
- Considerable use of Permaculture design principles, such as "edible landscapes", recycling, multiple/overlapping functions, trees and perennials, almost all niches crammed with productive plants, "waste" outputs used as inputs, minimal use of non-renewable resources, and design to have many functions automatically carried out by animals, plants etc. within the system.
- Systems which reverse "soil mining" and improve soils and ecosystems, e.g., via nitrogen fixers and deep rooted plants to bring up minerals.
- Long-term research and trials to find food varieties that thrive in local conditions and are most pest resistant, tasty, nutritious, storable and drought tolerant. This maximises the diversity of varieties kept in use, countering the current dramatic loss of varieties. Finding plant varieties that ripen over a period to enable continuous supply (as distinct from commercial varieties where a whole field can be harvested at one point in time).
- Seed saving, grafting, developing and reproducing the best varieties for the locality.

- Much reduced consumption of meat, to come mostly from small animals, especially poultry, fish and rabbits. Little if any big animal production, except some pigs, sheep and goats, (and horses for ploughing and transport use).
- Small animals, especially poultry, fed by kitchen and garden scraps and free ranging on commons, orchards, woodlots etc.
- Planting on flat rooftops, especially in the commercial areas, and use of vertical spaces for vines and *espaliers*.
- Much reduced demand for dairy products, mainly via replacement by soy products.
- "Edible landscape" planting of dense food forests, "bush tucker" (edible wild/native plants) and edible weeds throughout settlements to provide free food and materials.
- Storage via low energy cost methods, e.g., fruit drying, bottling, cool rooms.
- Almost no packaging, "marketing", transport energy costs, middlemen, corporation profits or bank interest payments adding to the cost of produce. Negligible outlay for fertilisers, pesticides, preservatives.
- Mostly hand tools used, and labour-intensive home and small farm gardening, with little or no use of machinery, except on the mini-farms where equipment can be shared.
- Complex, multi-function, integrated landscapes, such as forest gardens, with built-in redundancy and resilience, as distinct from unstable monocultures dependent on imported inputs.
- Advantage taken of overlaps, e.g., bees pollinate crops as well as produce honey, complex landscapes provide habitat for birds that eat pests, dams provide water, fish, reeds and leisure facilities, forests provide fuel wood, mulch, honey, fruit, timber, understory food crop habitat, water retention, windbreaks and leisure resources.
- Few dog and cat pets but many small animals in the neighborhood, including sheep and goats, and some horses/donkeys for cartage, ploughing and leisure.
- Multi-cropping; the small scale enables new seeds to be planted immediately a small area becomes vacant, keeping the whole area in continual use.
- Highest quality food, fresh, no preservatives, most tasty and nutrient-rich varieties.
- Use of imperfect produce that can't be marketed, and recycling "wastes" to animals.
- Home and community gardening as a major source of leisure activity and exercise, creating diverse thriving, leisure-rich landscapes.
- Only short transport distance for the few non-local items. Almost no national food transport, imports or exports.
- Only use of fresh foods in season locally, eliminating use of energy on freight and refrigeration of produce from long distances away.
- Many desirable spin-off implications outside the food system, e.g., for health, community, leisure and education. Gardening increases fitness and for many it would be a major leisure activity. It makes landscapes beautiful and inspiring, especially when much of the effort is going into public spaces. In addition, the field days, shows, visits, talks and research activities would provide sources of learning, entertainment and community bonding.

2) Area and yield figures

This section indicates the way estimates have been derived for the amount of land needed to provide some major food items per person per year. These are only summaries of a few of the items dealt with at more length in the full report, and are included here to how that there is considerable support for the

numerical values stated. Nonetheless, the figures are not offered with high confidence but are indicative of possible general achievements.

Vegetables. Australian consumption is 112 kg/pp/y. This (along with fruit) should be greatly increased, via reduction in meat consumption. If 75% of the 111 kg/pp/y of meat consumption was shifted to vegetables, increasing vegetable consumption to 194 kg/pp/y, and vegetable production was 15 t/ha/y, then the vegetable growing area would have to be only 130 m^2 per person. The suburb East Hills has around 82 ha that could be used for food production, including roads that could be converted, i.e. 270 m^2 per person at current population levels.

Grain. Australian flour consumption is around 70 kg/pp/y (USDA 2015). Australian wheat farms average only around 1.6 t/ha/y but this is due to dryland production. At the NSW latitude yields are higher, closer to the world average of 2.4 t/ha. The EU average is 6 t/ha, and the Chinese yield is not far below this despite scarcity of good agricultural land. Bath (2015) reports 4.4t/ha for backyard grain growing and Pitzer (2009: 13) says it can be 13+ t/ha/y, suggesting that soil quality and care can make a major difference. However commercial rice yields are much higher, in the region of 8 t/ha, and corn in NSW averages 14 t/ha (DPI 2007). If it is assumed that village grain supply came from a combination of the best yielding grains for the region and that land would eventually be of high quality due to thorough nutrient recycling and addition of soil enriching biomass, a grain yield of 6 t/ha is conceivable although uncertain and possibly optimistic. *Per capita* land area would then be 117 m^2.

Dairy. Dairy products require relatively large areas. Dairy Australia (2017) estimates Australian *per capita* milk consumption, including quantities used to produce butter, cheese and yoghurt, at 180 kg/y. It will be assumed that half of this demand could be shifted to soy milk, adding that area to vegetable land area required (Soy production requires somewhat warmer areas, e.g., above 21 degrees Celsius, which is not likely to be problematic in this region but would be a limitation in colder climates. Milk yield can be c. 9 t/ha/y, but 7.5 t/ha/y will be taken here. This means 120 m^2 per person would be needed (this is somewhat uncertain as estimates vary. Feed supplements might need to be added, but these would require little land area per person; perhaps 30 m^2). Smaje (2016) notes that in addition dairy production would also provide 96 kg of calf meat p.a., plus butter milk for pigs.

The protein content of soy yield per ha for dairy substitute products is actually around four times as high as for dairy per ha. The Australian *Yearbook* states a ratio of c. 17/1 for soy protein yield to beef protein per ha (ABS 2012). To produce 59 kg/y of soy might require c. 51 m^2, assuming soy yield of 3 t/ha, and soy milk produced at the rate of 10 l/kg of soy beans. Therefore for total "dairy" produce (i.e., including soy) 171 m^2/pp will be assumed.

Fruit. Australian consumption is 62 kg/pp/y. At commercial yields of 10-20 t/ha/y this indicates a need for 40 m^2 per person, but many fruit trees can be mixed with timber and other plants within dense home gardens, along streets, in forest gardens, and on the commons and in parks. Fruit and nut orchard areas would double as free range grazing for poultry, sheep, dairy cattle and pigs. In addition, fruit trees and shrubs can be part of ornamental gardens around houses. Use of dwarf varieties, pots, and *espaliers* along walls and fences would reduce the area needed. Thus it is assumed that sufficient area will be available within the settlement.

Meat. Australian meat consumption is 111kg/pp/y, (including 47 kg of chicken, but not including fish). Beef production is an especially inefficient use of land, averaging about 0.4 kg/y per ha, and requiring a large amount of water. It will be assumed that present meat consumption is reduced by 75% (and vegetable consumption is increased accordingly, noted above). Most meat would be poultry plus other small animals, e.g., rabbits, pigeons, guinea pigs. A small number of pigs could free range in forests and be fed to some extent on food scraps and butter milk from the dairy. Fish consumption is assumed below to be doubled to 30 kg/pp/y (all via tanks, ponds, lakes and dams within settlements).

Thus meat consumption would be 28 kg/pp/y, one-quarter of the present figure, made up by 13 kg/pp/y poultry (plus rabbits, possibly pigs etc). and an increase of 15 kg/person/y of fish (making that 30

kg/pp/y). This assumes large reduction in poultry consumption, from the present 42 kg/pp/y so there is scope for a greater use of poultry if necessary. Pig and dairy calf sources would add to this scope but have not been accounted here.

Edible/dressed chicken weight might be 1.4 kg per bird. If eaten at 15 weeks of age the number of birds being fed to maintain this rate of harvest per household (2.7 people in East Hills) might be 5 (obviously not all households would need to keep poultry etc. as there would be production from co-ops and small farms). Poultry meat production would be integrated with egg production as birds beyond egg producing age would be eaten; see below.

These poultry meat figures are uncertain and might be unrealistically low. Note that eggs are regarded as additional to meat consumption. Some sheep and pigs, also providing wool and leather, might be included instead of some of the poultry, but this item has not been accounted separately here. Most sheep and pigs might be located on farms close by, possibly owned by the town. Pigs are good consumers of scraps, effective at preparing ground for cultivation, and do not require large areas. They would best be cared for by co-ops or on local mini farms.

Areas for poultry and fish are difficult to estimate due to significant overlaps in uses, and nutrient recycling. For instance much/most poultry food would come from kitchen scraps and free ranging through orchards and forests, while ducks, geese and fish would meet some of their food needs by free ranging in fields, forests and ponds (see below).

The area for fish production would be very low because much would come from recreational ponds on commons and from very small tanks (two or three cubic meters) in backyards and fish farms. Carp can yield 13 tonnes/ha from natural ponds, without added feed, 30 times the meat yield per ha.[3]

The surprisingly small areas needed for meat production are considered below, in the section on "waste" recycling. It should be noted that views about the desirability of meat consumption vary greatly and the assumption of a more vegetarian based diet would make a significant difference to the area figure arrived at above. The case for including meat in sustainability scenarios is strengthened by the fact that animals can digest gasses and other vegetation humans cannot eat, enlarging the food producing area.

Eggs. Australian consumption is 180 per person p.a., which at 50 g per egg is 9 kg/pp/y. Household consumption would average only 8.4 per week, so these might be produced by a long-term average of less than 2 chickens per household, or 0.4 per person (ABC 2014).

Almost no separate area would be needed specially for poultry apart from sheds, because birds would be fed mostly on food scraps, would free range on much of the dairy, orchard, forest, nut and oil (e.g., olive grove) area, and they would be rotated around vegetable patches to clean up, fertilize and cultivate. Some food supplements are accounted under the "animal feed" category below.

The surprising implication of these figures for meat, fish, poultry and eggs is that it would seem to be possible for a settlement of this kind to meet its (considerably reduced) meat demand from within its borders. This would free vast rangeland areas for reforestation etc. It would also be possible to greatly reduce industrial inputs to poultry production in view of the strict recycling of nutrients within settlements.

Animal feed. Poultry feed per dressed weight can be quite low, down to a ratio of 1.5:1 (and it is even lower for fish than poultry). A ratio of 2:1 for poultry will be assumed here. A chicken eats c. 0.5 kg per day so the 0.4 birds per person would need 70 kg/y. If it is assumed that free ranging provides 50% of the food needed and kitchen scraps etc. provide 25%, then feed to be provided for poultry meat production would be very low, in the region of 18 kg/pp/y (free ranging can provide up to 100%; a small US compost firm has chickens foraging on the heaps, producing eggs without any need for grain inputs. Beef cattle, pigs and even dairy cattle can be self-fed via free ranging, but at less than maximum yield for dairy). Thus a

[3] The river circling East Hills is not considered in calculations because it is presently downstream from an industrial area and occasional warnings have been issued about fish consumption.

considerable amount of kitchen scraps and garden waste would also be available to feed fish, rabbits and other animals. To grow 18 kg/y of lucerne at the common dairy farm rate of 20 t/ha/y would require only 9 m^2/pp.

It is appropriate to consider *food waste* further. Surprisingly large amounts of food are wasted, before and after reaching the kitchen. Many crops are not sent to market because of appearance or minor damage (… including bananas with unacceptable bends!). Supermarkets scrap large amounts and then the quantities thrown out from kitchens is considerable (Gascón 2018). Kane (2016) reports the amount of food wasted at around half a tonne per person per year, which is approximately equal to the weight of food eaten. Wise (2014) says Australian households throw out A$616 (US$435) worth of food pa. About 50% of Australian household garbage collected is biodegradable, most of it from the kitchen. In a restructured suburb all kitchen scraps would go directly to the animals or to compost heaps. Even more impressive, the amount or nutrient-rich material presently moving from toilets and grey water outlets into "waste" streams is more or less equals the weight of food put on the table and all this would be sent through methane producing digesters and then to soils.

Compare these quantities with the 46 kg/ha/y of artificial fertilizer applied to Australian farmland. Strict recycling of nutrients within a settlement would put much more than ten times as much nutrient rich material into soils, when crop wastes are included. Much fertilizer applied by agribusiness does not reach plants but runs off to cause environmental problems in waterways.

Fish in ponds, lakes and dams would feed themselves. Some of the suburb's nutrient flow would be recycled in the form of grey and black water running through biological filtering and harvesting systems involving wetlands and ponds planted with useful species. These systems can produce edible plants, fish and duck feed (…and at the far end, perfectly drinkable water). Duckweeds, worms and grubs can be grown specially for animal feed, along with Azolla to skim off as a nitrogen source for gardens.

These figures support the surprising possibility that very small areas of land would be needed to provide the (significantly reduced) amount of meat required.

Other food items. The full *Remaking settlements* document contains similar derivations of yield and area figures for nuts, cooking oils, sugar, honey, beverages, and confectionary.

Interim area conclusions

If grain and dairy items were produced on nearby farms, the remaining 305 m^2/pp could almost be found within the settlement, given the 270 m^2/pp available for food production.

Land required	M^2 per person
Vegetables	130
Grain	117
Dairy	171 for milk + soy milk products
Fruit	40, but assumed to overlap grazing etc. areas.
Meat	Very low due to small animals and waste recycling
Animal feed	9
Nuts	76
Oils, spreads	50
Interim total:	593 m^2

Figure 2: Summary of land area conclusions derived.

3) Reasons why the area figure derived is probably too high

The yield figures used above have come mostly from national statistics on commercial agribusiness production. Following are important reasons why home, collective and small farm food production could achieve far better yield and area figures.

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Much higher yields are possible than those conventional agriculture achieves Urban agriculture in Havana, Cuba is reported to produce 21 t/y of vegetables per hectare (Koont 2009). The figures from about five cases found on the Web are, average yield 27.7 tonnes per ha, and average value of A$125,600/ha/y (c. 2007 prices, over US$88,000). Dioron (2015) provides detailed itemized information adding to 17.6 tonnes per ha and A$167,000 ha/y (over US$118,000). As this is for Maine with only a 6 months growing season, much better yields should be possible in subtropical Australia. Aliades (2011) reports that his (not fully functioning) 64 m^2 home garden yielded 202 kg of food in its second year, equivalent to 12.8 tonnes /ha/y, on only 2 hours "work" per week. This does not include the produce given away, such as an estimated A$1,000 worth of berry plants (over US$700).

Compare these yield figures with the Australian wheat production average of around 1.6 t/ha or the world average around 2.4 t/ha/y. Watson (2015) points out that the "Victory Gardens" planted by ordinary people in England during World War 2 achieved on average ten times the typical agricultural yield.

Diggers Seeds claim that their trials using intensive home gardening, multi-cropping and heirloom seed varieties show that "…it only takes 60 m^2 of space to grow the 242 kg of fruit and vegetables we consume each year" (Blazey 1999). This includes 10 m^2 for vegetables, 8 m^2 for potatoes and 42 m^2 for fruit, for each person. The figure corresponds to c. 40 t/ha/y, and suggests that the weight of food one person consumes could be provided from c. 90 m^2, which is 15% of the above 593 m^2 area conclusion (i.e., if the food was all in the form of fruit and vegetables). Wise (2014: 11) says that the average lawn area on a suburban block could produce 800-1,100 kg of food p.a., enough fruit and vegetables for a family.

Joe Dervaes (2014) operates a remarkable "urban agriculture" in Pasadena where he reports production of 2,727 kg of food p.a. from his 0.04 ha house block. This corresponds to a barely credible 68 t/ha. His output would be even higher if the family was not also keeping chickens, ducks and goats on the block.

The mini-farms would tend to be run by people who take more delight in their craft than agribusiness managers and workers are likely to, therefore conscientiousness and innovation would be high. There is little incentive in agribusiness to recycle diligently and look for overlaps. It is well-established that small farms are more productive and efficient than larger farms (Rosset 2000).

It is likely that none of the figures used above assume maximum use of multi-cropping. Fields are typically left unplanted for long periods, and orchard lands usually produce only one crop each year. Home gardening and mini-farm production enable seeds to be planted in small patches immediately after harvest of the first crop, down to the level of individual plants such as cucumber vines. In addition the new seedlings might have already been well established in pots. Thus it is misleading to add area needed for each separate crop because the one area might produce many crops in a year.

Roof areas have not been taken into account. These can be used for shallow vegetable plantings in containers, and as space for trellis vines. Nor has use of walls for *espalier* fruit growing in restricted spaces been included. Thus large flat roof areas in city centers can be gardened via containers.

No production has been included from greenhouses, which can greatly increase yields, provide summer crops in winter, and include space for fish tanks and warm roosting space for chickens that contribute some CO_2 for plant growth.

Some of the above Australian consumption figures would include the large quantities going into pet food (in the early 2000s Australian expenditure on pet food and care was AU$1,500 million p.a. and 83% of veterinary income was for pet care).

Present consumption rates include the very large amounts of food waste noted above. The ABC (2014) reported that this was around 30% of food weight required, so eliminating this one factor would in effect reduce the required production area by 30%.

Settlements and surrounding woodlands would be planted to provide many foods in the form of "weeds" and bush tucker (wild foods), growing beside roads and in parks while contributing to the suburban landscape.

Changing consumption habits could shift demand to the more easily grown plants and away from exotic and resource-expensive items. Simple basic vegetable, fruit, fish and poultry sources can provide almost all meals. Village agriculture committees would research interesting but ecologically friendly and low cost recipes using local inputs.

There would be meat from pigs and dairy calves, not accounted above.

The figures do not include use of aquaponics, which would dramatically reduce area needed, due to very high yield rates for fish and vegetables. Many small greenhouses and open ponds in backyards and on neighborhood commons could be producing fish and recycling nutrient rich water to trays growing vegetables all year round. Various sources propose that an 18 square metre fish pond can produce 150 kg of fish p.a., plus 1,300 kg of tomatoes from trays the water is circulated through. This is 1/555 of 1 ha for the fish, corresponding to 82 tonnes of fish per ha per year (Rakocy *et al.* 2006; Schroeder and Serfling 1989). A thorough analysis would take in fish food inputs, and the area taken for the tomato growing. Monitored small home and cooperative systems can control diseases and pests better than those on an industrial scale.

Home gardens and small mixed farms enable many more overlapping functions and synergistic effects than have been mentioned. As noted above, beehives in gardens improve yields while providing honey, and orchards provide honey, shade, mulch, fire breaks, wind breaks and grazing areas, as well as fruit. Ducks eliminate the need to purchase snail poisons and this pest removal contribution reduces the amount of duck feed that needs to be provided. Duck and fish ponds can fix nitrogen from the atmosphere in the plant Azolla that can be composted for fertilizer. Agribusiness locates ducks a long way from the fish production so cannot take advantage of such overlap effects; outputs from one domain become wastes, not inputs to another, and resources have to be used to deal with both problems. Fruit and nut trees can be planted in parks, providing shade and wind protection, and woodlots and forest gardens can provide many other services. This is the Permaculture principle of designing for multiple functions. These effects cannot occur unless systems are small and integrated.

Application of these principles could markedly reduce the total land are needed from the above interim figure of 593 m^2 per person. For instance, if the c. 20 t/ha food yield achieved in Havana gardens and a *per capita* food consumption of 500 kg/y are assumed, the *per capita* area needed would be 250 m^2 (and much less if feeding small animals on wastes, and aquaponics, are added). Again, the area available in the suburb reported in *Remaking settlements* was estimated to be 270 m^2/pp.

4) Energy budget

Estimated per capita operating energy budget The following estimates are based on gardening at Pigface Point homestead, not far from East Hills, providing for approximately10 people (Trainer 2017b). For home gardens and commons there would be almost no running/operational energy cost, apart from (solar) electricity for a 12 volt irrigation pump. Estimation is uncertain but if 20 minutes watering a day by a 72 W pump is assumed, the annual household total would be 8.7 kWh, or 3.6 kWh/pp/y = 13 MJ/pp/y (however pumping is carried out when batteries are fully charged and the regulator is dumping input).

To this should be added the dollar and energy costs associated with importation of food from nearby small farms, and possibly from more distant grain farms. These have not been analyzed but the assumption below is that they add as quantities equal to the dollar and energy costs incurred within the settlement.

Estimated embodied energy costs: equipment inventory and replacement The stock of tools and equipment used in vegetable, woodlot and ornamental gardening at Pigface Point is given in the document *Remaking settlements: tool inventory: dollar and energy costs* (Trainer 2017c). These are all hand tools apart from the five 12 v pumps, and the six small home made concrete water tanks and tubs (averaging c. 2.5 m^3). The annual figures given take into account assumed lifetimes. The figures below double the Pigface Point estimates on the assumptions that half the food needed would be produced on local small farms as distinct from home gardens and commons, and that this would add costs comparable to those associated with home gardening.

Total equipment dollar cost comes to A$1,056/pp, A$54/pp/y (approx US$748, US$38). Total equipment embodied energy cost comes to 84 MJ/pp/y.

4. The comparative significance of these figures

The comparison between these energy costs and those for the conventional agribusiness-to-supermarket food supply system is stark. In 2007 US food production was taking 16 times as much energy as was contained in the food produced, and the amount has been claimed by Garza (2013) to be as great as all energy going into gasoline for cars. The energy needed to produce a kilogram of wheat in New Zealand has been estimated at 2 kWh, i.e., 7.2 MJ (derived from Safa 2011). In 2007 the US food supply system was taking around 16% of national energy, i.e., around 15 EJ/y, or 47 GJ/pp/y (Canning *et al.* 2010). That is around 200 times the above figure arrived at for local production, even though the conventional agribusiness figure does not include any embodied energy costs such as in machinery, ships, feed factories, roads or trucks. The ratio for operating costs is in the region of 1,200:1.

Possibly even more important are the improvements in ecological impacts and food quality. Local food is fresh and local gardeners select for the most tasty and nutritious varieties that will thrive in their particular conditions. This also means that a wide variety of species is kept viable, whereas agribusiness selects only the few that are most profitable. Local agriculture eliminates the soil damaging effects of agribusiness while using Permaculture practices to improve soils. It also largely eliminates the vast indirect global ecological effects of agribusiness in terms of energy, fertilizer, water and "wastes."

The full *Remaking settlements* report discusses twenty-one topics in addition to food supply. Following are brief summary notes on some of these. They also illustrate aspects of the radically new settlement pattern and social arrangements assumed in The Simpler Way. It should again be noted that the discussion assumes radical de-growth to far lower "living standards" measured in terms of GDP.

Buildings

In a stable economy there would only be maintenance and replacement building, mostly using earth. Assuming earth construction to humble but quite sufficient standards, dollar and ecological costs would be extremely low. For dwellings suitable for a couple or small family these could be under A$5,000 per person (US$3,550) for total (not annual) basic dwelling cost (the detailed derivation is in Trainer 2016d).

Tools

The Simpler Way preference is to work mostly with hand tools but local firms and farms would need some small engines, motors and machinery such as saw benches. Because the scale of manufacture and building would be enormously reduced, there would be little need for heavy machinery. It would be necessary to produce very few if any big bridges, skyscrapers, tunnels, silos, roads, freeways, aircraft and airports, big trucks, cars, ships, ports, cranes, mines, warehouses, fork lifts and bulldozers.

Derivations for the following summary figures are given in the *Remaking settlements* document. They are based on different lifetime assumptions for separate items, and a household of 2.7 persons. Included are gardening tools, equipment in home and community workshops, and kitchenware.

A$

Household:	A$3,270	$218/pp	A$9 pp/y		13 MJ/pp/y
Household plus community workshops etc.	A$4,770	A$278/pp	$15/pp/y	8,090 MJ	86 MJ/pp/y

US$, approx

Household:	$2,343	$156/pp	$6.5 pp/y		13 MJ/pp/y
Household plus community workshops etc.	$3,420	$199/pp	$11/pp/y	8,090 MJ	86 MJ/pp/y

Figure 3: Costs for tools, machinery and motors inventory. Summary figures for East Hills Simpler Way settlement. Sources: Trainer 2016b, 2017c.

Materials

Materials needs would be low in a stable economy, called on only to maintain stocks of housing and furniture etc. The national steel works would mainly supply towns and regions with mostly small strip, rod, tube and angle, galvanized iron roofing, fencing wire and chicken wire netting, plus inputs to hardware stores and tool factories (nails, bolts…). Because there would be little heavy industry or construction there would be very little production of heavy steel beams, pipes, plate, or castings. There would be little need for aluminum, copper, lead, zinc or special steels, or for plastics. Some production of small stainless steel items, especially bolts and screws, would be desirable as these enable long lifetimes for structures, and facilitate dismantling in future years. Eventually roofing iron, common in Australia, would be replaced by ceramic tiles made from local clay and wood-fired kilns. Timber would be a major material, replacing most metals and plastics. Eventually it could all be produced by neighborhood mini-saw mills powered by old car engines running on methane or ethanol and drawing on settlement woodlots. Village cooperative mills can be pubic infrastructures used when needed, rather than constantly staffed and needing to provide jobs and wages. There would be intensive research into local plant sources for chemicals, adhesives, medicines, paints, lubricants, fibers and fabrics.

Clothing

Almost all the clothes worn could be simple, tough, cheap and durable, old and much-repaired, and recycled. Few people if any would need to work in a suit or tie, let alone new clothes. A few small local firms might specialize in dress making and tailoring. Clothes making and repairing would be much-enjoyed hobbies. Factories would supply local hardware shops and clothing makers with bulk fabrics, mostly of the basic kinds needed to make tough every-day work clothes. Some footwear can be made at home via hobby production, especially slippers, sandals and winter Ugg boots. There would be much hand-knitting, using wool spun from the local sheep. The *per capita* wool need could be a small fraction of 1 kg/person/y, which might take 150 m^2 of land (…assuming 25 sheep/ha and 3.2 kg clean wool/sheep/year, on poor soil). Sheep

would graze on commons, orchards and in forest gardens. Cotton would have to come from more distant regions but would require far less area *per capita*. Other fibre needs including flax, hemp and sisal would add a little to this land area. Some of these would be imported from more distant farms.

Based on Pigface Point, the figures for clothing and footwear use an uncertain annual expenditure estimate might be under A$100/pp/y (mainly for footwear to work in, US$70). The Australian average spending on these two items is a remarkable A$982/pp/y or US$695/pp/y (ABS 2015).

Manufactured goods

Most manufactured items would be produced in households, neighborhood workshops and small local firms, and although some items would best be mass-produced in regional factories, including household appliances such as stoves. Many would be produced in craft ways, not via industrial factories, primarily because working in factories is generally not enjoyable. Crockery provides a good example as the low replacement needs could be met by hand production within suburbs or towns, from local clay and wood fueled kilns. Because the average time spent working for money might be no more than two days a week (see below) much time would be available for home and neighborhood craft production.

Small regional factories, e.g. within 5-10 km, would produce bicycles, cutlery, pots and pans, roof tiles, metal containers (although baskets would be hand made at the neighborhood level from rushes, willows and vines), nails, bolts, buckles, plate glass, preserving jars, ladders, barrows, needles, tools, brushes, paint (from vegetable and fish oils, milk, lime, and earthen colours), beverages (juices, fruit wines, beers and ciders), string and rope from yuccas and sisal, and as previously noted basic appliances such as stoves, radios and fridges. Only small quantities of technically sophisticated items such as electronic devices and medical equipment would need to be imported from the national economy, and even less from overseas. Effort would go into developing excellent designs for all items, especially models that would last a long time and be easily repaired.

Thus there would be little need for international trade and it would be confined to items that could only be produced within the nation at great difficulty or cost. Various manufactured items might cost much more than at present, given that they would be produced mostly in craft ways and that at present imports from China are dollar-cheap. This would not be important as not much money is needed to live well in The Simpler Way, and dollar costs would not be overriding considerations.

Many productive enterprises would be community owned cooperatives. A town or suburb that found it needed more eggs or preserves or apples or overalls might lease premises to a private family business to supply them, or set up a non-profit cooperative to meet this need.

Water

Water demand associated with annual crops would be greatly reduced because the new local agriculture would rely heavily on permanent crops, especially trees, and relatively little meat would be consumed. Water would be scrupulously harvested locally, from rooftops, catchments and creeks, there would be intensive mulching, and all household water would be recycled. There would therefore be little need for big dams, mains, large pumping stations or the bureaucracies to run them. Windmills and small electric pumps would do most of the pumping of fresh and "waste" water.

Because all sewage would be dealt with at the neighborhood level, recycling all water and nutrients back to local soils, there would be no need for large systems of mains and pumping stations to deal with sewage. Composting toilets would cut water use and garbage gas units would produce methane for use while both returned nutrients to gardens. Settlements would be landscaped to retain rainfall via earthen bunds, swales and ponds, eliminating the need for most concrete storm water infrastructure. Storm runoff would be channeled above ground to ponds and soak-in areas where trees were planted. Few if any underground concrete works would be needed. Above ground systems are easily monitored and repaired,

unlike underground systems. "Keyline" swales more or less following contour lines would carry water away from gullies to agricultural, storage and soak-in areas. The change to more vegetable and less meat consumption would make a significant difference as it can take 2,000 times as much water to produce a kilo of meat as it does to produce a kilo of vegetables (Diggers Seeds, undated: 32). Where possible redesign of settlements would catch water on the higher ground, feed it by gravity to houses, then take nutrient-rich waste water further down to orchards, pasture, ponds and farms, reducing the need for pumping energy. Runoff that could not be stored would operate water wheels along gullies, performing functions that can be carried out occasionally, such as mixing clay, shredding fiber for making paper, and sawing firewood.

An estimate of operational electrical energy costs for pumping based on the Pigface Point homestead (which is not connected to mains supply) might be 0.2 MJ/pp/day. Note again, this is energy that would otherwise be dumped.

Transport and travel

In the new economy of The Simpler Way there would be little need for transport to get people to work, because far less work would be done in offices and factories, and most work places would be localized and accessible by bicycle or on foot. The few large factories would be close to towns and railway stations.

A few cars, trucks and bulldozers would be needed. The vehicles in most use would be bicycles, with some but relatively little use of buses and trains. Horses could be used for some transport, especially carting goods the mostly short distances required, such as from local farms. Horses consume no oil, can refuel and reproduce themselves and do not need spare parts or expensive roads, and mostly repair themselves although they do occasionally need veterinary services. They are also used for leisure. Most roads and freeways would be dug up and the space used for gardens. The concrete chunks can be recycled as excellent building stone and bitumen lumps can stack as animal pen fences, requiring no mortar. Railway and bus production would be one of the few activities to take place in large centralized heavier industrial centers.

Very few ships, large trucks or aircraft would be produced because there would be little need for the transport of goods or people over long distances. There would be little international travel, partly because the fuel for that will in future be extremely scarce, and secondly because there would be relatively little need for it given the scope for local leisure and holiday provision (below).

As most of the small amount of travel would be by walking, cycling and use of horse/donkey and cart, one 20 km round trip per week by rail or bus to a larger town will be assumed. Train or bus efficiency is about twice the 11 km/l of a car, so about a liter or 44 MJ/pp/week would be needed, or 2,290 MJ/pp/y.

The few goods that needed to be transported into towns, assuming 10 kg per household per week moving 20 km, would probably have a negligible energy cost, perhaps in the region of 2 MJ/pp/week or 0.3 MJ/pp/d. However in addition materials inputs to local production such as steel and cement would need to be imported to local firms.

The travel plus transport total would seem to be about 2.4 GJ/pp/y, and the dollar cost might be A$400/pp/y (US$287/pp/y). The present Australian average *per capita* household transport energy consumption is costing A$4,014/pp/y (US$2,876/pp/y). This is only for car use and does not include delivery of goods to local shops. Household petroleum use is 457 PJ, or 20 GJ/pp/y, around 10 times the above estimate for all transport in the alternative settlement envisaged.

These figures are uncertain but they suggest that settlement restructuring could cut *per capita* travel and transport energy use to the region of under 5% of their present values. This aligns with the eco-village figures reported below. Transport energy demand is the category which renewable energy sources will have their greatest difficulty meeting.

"Work"

Because in a Simpler Way society much less would need to be produced and transported, and because many goods and services could be acquired without money from the commons and through swapping and gifting arrangements, people would probably need to work for money only one or two days a week. On the other five days of the week people would be producing important things, for themselves in their gardens and hobbies (e.g., knitting, pottery), in co-ops and craft groups, and for the community via the working bees, committees, volunteering at schools and hospitals, organizing concerts, leisure activities and festivals. Thus much of their work time would also be enjoyable leisure time, and the work/leisure distinction would largely disappear.

Working bee labor available

In the suburb studied for the *Remaking settlements* report, East Hills, there are around 2,500 adults plus children old enough to contribute to voluntary working bees (Figure 1). If 80% of them gave one hour each week, then 2,000 person-hours per week could be going into community production, maintenance, services, development and activities within an area only one km across. This is equal to having 50 full time workers, or one for each three hectares. At present paid labour by council employees being put into maintenance within the suburb would be a tiny fraction of this amount.

If many people moved to part-time paid work, and if informal "drop-in and help-out" activity was included, the total work time for community operation, maintenance and development could be many times this total. In a well-established alternative economy, as in many eco-villages, the *per capita* time that could be comfortably given to community contributions could be several days a week.

Some of this time would be spent on neighborhood committees, such as for agriculture, youth affairs, care of aged and disabled, leisure activities, infrastructure maintenance and working bee coordination. Within some of these domains there would be specialist sub-committees, such as for fruit and nuts, water supply and recycling, aged care, youth affairs, food preserving, recipe development, bee keeping, fish production, poultry, forestry and especially for research into many topics such as the best local plant varieties to grow.

These working bee and committee activities would contribute not just to achieving technical goals such as ensuring good food supply, but to the maintenance of high levels of solidarity, mutuality, social consciousness and responsibility, and morale, pride and empowerment.

Leisure

In consumer society leisure is a large dollar and resource cost item, but in The Simpler Way it is a major source of savings and of production. It has been partly dealt with above, in terms of having leisure-rich communities and much time to pursue leisure interests within them. At present leisure activity is mostly purchased from corporations or professionals and is resource intensive, and of negligible "spiritual" value.

Simpler Way settlements and lifestyles are rich in both spontaneous and organized resource-cheap leisure activities. Any town or suburb includes many talented musicians, singers, storytellers, actors, comedians and playwrights, presently unable to enjoy performing because the globalized entertainment industry only needs a few super-stars. These people will thrive, having several days a week to practice and they will be appreciated for their (largely unpaid) contributions to the many local gatherings, concerts and festivals.

Much more leisure time will be spent in creative and social activities, as distinct from the increasingly private screen watching (Americans are reported to be watching TV 5 hours a day; SixWise.com 2017). In addition, much leisure time will be spent in productive activities, such as gardening, arts and crafts and making things. In other words, leisure will often involve negative dollar costs. There will be time for reading, thinking and learning, discussing community issues, and for doing formal courses.

People will have the time to work on the issues that are important or on their personal and community development.

The community would be a rich spontaneous leisure resource. A walk around the town would involve one in conversation, observations of activities in familiar small firms, farms and mini-factories, and the enjoyment of a beautifully gardened landscape. Contributing to working bees would be enjoyable. Then there would be the festivals, celebrations, concerts, visits, dances and field days organized by the leisure committee. These many local sources of leisure interest would greatly reduce travel demand for holidays.

Thus for many people the dollar, energy and resource costs of leisure could be reduced to negligible amounts. Hobby, art and craft materials would involve low costs. An overall tally would be difficult to estimate because as has been noted, much leisure activity should also be accounted under "work" or productive activity. By contrast in consumer society neighborhoods are "leisure deserts" and entertainment is purchased, resulting in Australian *per capita* expenditure on recreation, sport and holidays around A$3,900/pp/y or US$ 2,794 (ABS 2015).

Retirement and aged care

Older, experienced people would be highly valued contributors to production and more importantly to social functioning, given their wisdom and their knowledge of local people, conditions and history. Having spent many years contributing to their stable community they would be known, appreciated and respected by the younger people caring for them, mostly informally and spontaneously. Few would retire in the normal sense as most would wish to remain active contributors. People could slowly phase down their level of involvement as they wished. This would ensure that the community continued to benefit from the productive time, expertise and experience developed over a lifetime that is wasted in present society, especially the wisdom of the elders who know the town and its history and can provide good advice ("village elder" is a formal role in some communities).

Much of the care of older people would be carried out by the community via the committees, working bees, rosters and informal and spontaneous contributions. With five days a week to spare, many people would drop in frequently to chat and help out. Old people would be able to remain in their homes much longer, there would be far less need for retirement "homes" and specialized staff. Most hospital-level care could be provided in small units in busy parts of town and near gardens and animals. Thus the experience of old, infirm, mentally and physically disadvantaged and ill people could be expected to be far better than it is now. Compare the way present Western society isolates older, invalid and mentally disadvantaged people in expensive institutions with nothing to do or to be involved in or contribute to. They are often bored, lonely and convinced they are worthless burdens (it has been estimated that 40% of people in Australian aged care institutions receive no visitors). Then expensive professional staff have to be paid for to deal with the consequences.

Government

A major element in The Simpler Way is that most governing must be devolved down to the level of the neighborhood, suburb, town and region, because it will be at the lowest levels where policy and welfare are mostly determined. In stable economies with limited resources the top priority of national governments would have to be ensuring that the towns and small regions get the (few) inputs they need to import. Their role and functions would therefore be greatly reduced.

Town meetings would be the basic formal governing institutions, but spontaneous discussion between people would usually establish what is best for the town, without voting, bureaucracy or paid professionals. Decisions would (have to) be made via thoroughly participatory processes. Most governing would therefore follow a basically Anarchist model. State and national governments would in the longer run be forced to move toward these ways. The principle of subsidiarity would leave few issues to be dealt with at higher or wider levels, and these would be dealt with by "federations." Delegates from towns and/or

regions would work out proposals to be taken back down to the town level for decision (for a detailed discussion of the transition process see Trainer 2017d).

Thus in the new context of limits and localism, government would be fundamentally transformed. It would not be primarily about determining winners in zero-sum competition for scarce resources, investment opportunities, markets and wealth. It would be mainly about communities cooperatively participating in working out the best collective arrangements for their town or region in a context of stability and frugality.

Quality of life, community

East Hills is presently a typical dormitory suburb, with little discernible community. If the suburb were to be restructured along the lines described above it is likely that strong community bonds would be created, along with synergistic effects on all aspects of society, such as familiarity, mutual support and assistance, care, generosity, working bee attendance and spiritual wellbeing. The most notable virtue of eco-villages is their emphasis on and achievement of community (Grinde *et al.* 2017; Lockyer 2017).

Overall energy cost summary

The full *Remaking settlements* report sets out details feeding into summaries of dollar and energy cost estimates. These yield an operating energy cost sum around 2,000 MJ/pp/y. This about 10% of the present Australian average within-household energy consumption of approximately 20,000 MJ/pp/y, which would be higher if transport was included (Dept. Environment, Water, Heritage and Arts 2008; Department of Industry and Science 2015: 15).

However the national saving in dollars and energy would be much greater because as has been explained the suburban restructuring described would greatly reduce or eliminate many large expenditures that occur outside the suburb, such as for waste removal, fertilizer production, food transport and marketing, and for many infrastructures such as roads, and water and sewage systems.

The significance of settlement integration

The most important factor in sustainable settlement functioning is to do with the reductions in consumption that can only be enabled by the integration of structures and functions made possible by smallness of scale. This is far more important than efforts within households to reduce consumption, or of industry to improve resource use efficiency. Some items such as steel and cement must be produced in large scale centralized ways involving much transport, but this is not so for most of those needed in alternative settlements. The significance of small scale, proximity, integration and informal management is well illustrated by a study of egg supply carried out by Trainer, Malik and Lenzen (2018). Commercial/industrial egg supply involves vast global networks of steel production, fishing fleets harvesting food inputs, agribusiness feed production, factories, ships, warehouses, chemical industries, trucks, road maintenance, packaging, advertising, floodlit supermarkets, IT, offices and computers, personnel with degrees, shoppers driving to supermarkets, and dealing with wastes at most levels. Thus "industrial-supermarket" eggs have very high resource, energy and environmental costs. However almost all of these are avoided when eggs are produced in backyards and neighborhood co-ops, largely because of proximity to other functions that can provide inputs to production and benefit from outputs from it; e.g., kitchen scraps become feed and manures become fertilizers. In addition informal community networks deal with maintenance tasks and problems spontaneously without need for bureaucracy or professionals.

A comparative study of the two production paths by Trainer, Malik and Lenzen (2018) found that the industrial/supermarket path had dollar and energy costs in the region of 50 to 200 times those of the local path. The study points to the typically overlooked issue of "diseconomies of scale" and indicates the potential for similar large savings from localizing other supply chains.

Supporting evidence from Dancing Rabbit Ecovillage

The above analysis is speculative, but the general scope of the achievable reductions indicated aligns with actual measures of energy and other costs associated with the Dancing Rabbit Eco-village in Missouri, USA, as reported by Lockyer in the *Journal of Political Ecology* (2017). The goal of this village is to build an example town of 500 people illustrating ways whereby frugal and cooperative settlements could be sustainable and enjoyable despite very low material impacts.

Lockyer found that participants achieved the following annual *per capita* consumption figures compared with US averages. Car use, 8%; distance driven, 10%; liquid fuel use, 6%; solid waste, 18% (…and 34% of solid waste is recycled on site); electricity use 18%, and water use 23%. The settlement generates its own power, and sends to the grid three times as much as is used. Two-thirds of water use is collected from village roofs.

The percentage of inhabitants reporting rating happiness at 7/10 or higher was 81%, and almost all reported that their lives had improved since joining the village.

5. Discussion: the wider implications

This exploration of restructuring and reducing possibilities indicates that the Simpler Way might enable a reduction in present rich world energy and dollar costs in the region of 90-95%, although the required, extremely radical changes could not be carried out without historically unprecedented economic and more importantly a cultural transition. Obviously not all important items can be produced at the local level, and some such as pharmaceutical and medical goods might need to be imported from overseas. However the volume of these would be low, given a national economy geared to supplying settlements and nearby regional factories with the basic steel, cement, plastic and other items required for local manufacture.

The required settlements could not function unless people are motivated by quite different ideas and values to those that drive consumer-capitalist societies. Most people would have to be conscientious and responsible citizens primarily focused on cooperating for the common good, practicing thoroughly participatory democracy, and, above all, happy to live frugally in stable economies with no desire to get richer. Lest it be thought that this is to assume an unrealistically saintly citizenry, the required culture can be found within eco-villages today. Again it is important to recognize that living in supportive, secure, caring communities and being aware of how good citizenship contributes to one's enjoyable experience reinforces good values and behavior; localism both requires and rewards goodness.

In addition, the imminent global impact of severe scarcity and limits is likely to be a powerful driver of the required change in culture. In coming decades there will probably be (hopefully slow) descent into economic depression giving most people no choice but to join and build the alternative local initiatives now being pioneered. However several analysts have stressed that the highly interdependent global economy is fragile and prone to sudden and irretrievable collapse, reducing the chances of a relatively smooth transition (Kunster 2005; Morgan 2012; Tainter 1988). This discussion has not suggested that achieving successful transition to the kind of alternative described is likely, only that a way out of the worsening global predicament cannot be found unless it is achieved.

The global political implications of The Simpler Way vision are difficult to exaggerate. If the increasing recognition of limits and the need for transition to simpler lifestyles and systems leads to transition to the kinds of arrangements discussed above, then most of the presently alarming global problems would be defused. Presently the (generally ineffective) efforts to deal with ecological destruction, the poverty of billions, resource depletion, war, refugees and deteriorating social cohesion take the form of "end of pipe", "tech-fix", bandaid and add-on solutions, aimed at ameliorating the undesirable effects being generated. However the Simpler Way focus is not on reform of existing systems, it is on their replacement. It is on preventing the effects from being generated in the first place, by shifting to radically different systems. The significance of the foregoing discussion is that it strengthening the claim that there are viable ways of doing this.

Consider for instance the implications for resource struggles, armaments production, military expenditures etcetera if people lived in ways that did not require access to many foreign mines, forests or oil fields. Consider the implications for the possibly three billion people who live in significant poverty and deprivation if the resources around them were not being taken by market forces to stock rich-world supermarket shelves, so that (a small proportion of them) could be put by those people into building local economies of the kind discussed above.

Consider especially the avoidance of the inevitable consequences of defining "development" in terms of growth of GDP, most obviously the prospect of 11 billion people striving to consume at the rate rich world people intend to have risen to, by 2100. Conventional development theory and practice takes it for granted that the goal is to increase production for sale in the global market, and therefore large amounts of capital must be attracted or borrowed to be invested in whatever is likely to maximize business turnover. As a result much land is put into export cropping and much capital goes into setting up export factories along with the power stations and ports, and the other infrastructures that investors want. The rationale is that the wealth generated will, in time, trickle down to lift all living standards. The grounds for rejecting this entire conception of development need not be discussed here (see Trainer 2010); the point is that billions could be liberated from it if development was redefined in terms of the kinds of lifestyles and settlements shown above to be viable. This is being done within the global eco-village movement. For instance the government of Senegal is working towards establishment of 1,400 eco-villages (St Onge 2015).

Finally it should be recognized that by indicating the viability and necessity of localism the foregoing discussion reinforces the case for the radical transformation of political theory and practice (Alexander and Gleeson 2019: Trainer 2019). It shows that a society that is sustainable and just, and the transition to it, must align with basic Anarchist principles. The argument has been that communities that function well without damaging impacts on resources or environment must be mostly small, highly self-sufficient and self-governing, must not involve domination, and must be committed to principles of cooperation, subsidiarity, federation and mutuality. This is not optional; the right decisions cannot be made unless they are made by the people who must implement them and live with the consequences. This is firstly a technical point, as those are the only people who know what will work in their unique circumstances. Secondly it is crucial for ensuring the cohesion, morale and empowerment needed to maintain their social systems. The town will not work well unless there are high level of agreement, enthusiasm and willingness to contribute and to care for the welfare of all. Thus citizens must feel that they are in control of their systems and that their town is admirable. These effects cannot be organized or administered or given or enforced by centralized states. In any case states will have few resources, they cannot expect to understand conditions in all localities and they cannot make voluntary working bees and committees and spontaneous citizen action work.

Thus the political processes must be Anarchist in form. Informal discussion among citizens in everyday interaction would clarify the best policies for the town, spontaneous actions would deal with many problems, repairs and tasks, town assemblies enabling thoroughly participatory democracy would make formal decisions. Issues involving wider regions, ultimately up to and including those the small remnant "state" would deal with would be handled by the classically Anarchist mechanisms of federations, conferences and delegates reporting back to the town level for decisions.

In addition the transition process itself must take an Anarchist form. Given the centrality of cultural change in this revolution it is evident that little could be achieved unless new ideas, values and ideals lead the way. This rules out the traditional "socialist" focus on "taking state power" as the means for revolution. As Tolstoy and Kropotkin realized, taking state power would be of no value if people still retained the conventional mentality (Marshall 1992: 372). Marx recognized that taking power before there had been sufficient development in ideas and institutions, as with the French revolution and the Paris commune, would then require violence to force adherence to the new ways (Avineri 1968). Those on the green-left political spectrum too readily makes the mistaken assumption that if only they had state power they could push green policies through. Previously the revolutionary task was seen as merely a matter taking power

from the ruling class and then running the same industrial-affluent society but with more just outcomes. But this revolution cannot be pushed through from the centre.

If all goes well, state power will be "taken" eventually, but only *after the cultural revolution*, which will have largely been achieved through the growth of the new ways within existing settlements. Thus the Anarchist notion of "prefiguring" is crucial; the basic mechanism has to be the gradual development of the alternatives within existing settlements, both setting up the required systems and more importantly doing the educational work, showing people that there are attractive alternatives. The eco-village and Transition Towns movements are, in Anarchist terms, "prefiguring" the required ways (for a more detailed discussion of transition theory and practice, see Trainer 2017d).

These are reasons why the preferred designation should be, not eco-socialism but eco-anarchism.

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