



Radical Re-Design

Fossil Fuel Freedom, Prosperity, Liberty, Beauty, Profit

Associate Professor Susan Krumdieck
Department of Mechanical Engineering
University of Canterbury

 **AEMS Lab**
Advanced Energy and Material Systems

Trafinz National Conference
10 Years to Change Our World
8 September 2010
Wellington

Overview:

What if Business as Usual is not good enough? What if we are missing a big opportunity by focusing on what seems nearly impossible rather than working on what needs doing? There has been a bit of media stir about my “other” research area and my involvement in the National Hypersonic Science Center in the USA. A group of researchers funded by NASA and the US Air Force are working on the nearly impossible science behind the next generation space vehicle. How do you go ten times the speed of sound, fly to space, and survive temperatures over 2000 °C and the vacuum of deep space? This is a nearly impossible problem, yet we don’t wring our hands about it, we get on with the research. Over the past four years, I have brought to the attention of the Trafinz conference first the problem of Peak Oil, then the truth as straight as I can tell it about what will and will not work. Now, I am going to give you a sneak preview into the radical redesign of the suburban form – the next generation settlement. This is not a new green-field development or eco-town. Rather it is a strategic re-development of our existing investment in the oil age. We do know what the answers are, fossil fuel freedom, safety, prosperity, liberty, beauty.

Do you want to know what the future looks like? Would you like to know how it can be achieved?

More research results and innovations from Dr. Krumdieck’s Advanced Energy and Material Systems Lab are available for download from the group website:

www.aemslab.org.nz

Every Generation

Changes what is not sustainable,
or they don't.

*The Question is
Who and How?*



I'm not a historian, but it seems to me that it's hard to think of a generation in the past several hundred years that has not made choices that affect me, and the way my life is experienced. For example, how ever it was that enlightened people convinced everyone that leeches really don't help sick people, or that women could own property and attend university, or that the differences between the capitalist and communist economic systems was not worth blowing the world up over... I'm glad that they went to the effort!

My life today is profoundly affected by what happened seven, five and three generations ago, but particularly by the evolution that these other people demanded. Yes, demanded. Women weren't "given the vote" when 100% of men decided to give it to them. Evolutionary changes that improve our humanity and dignity happen through struggle and indecision and pressure, and in spite of dire warnings of the terrible costs to the economy. I'm almost 100% certain that none of my ancestors seven generations ago thought about me. As they were clearing forests, shooting all the wild animals that they saw, ploughing fields, digging for gold – did any of them spare a thought for the seventh generation? Now, when we fight to protect the "postage stamps" of native bush left in our country from exploitation, we state explicitly that we are thinking of future generations. When we debate charging ourselves carbon taxes, we are taking the wellbeing of future generations into consideration. Could it be that we are evolving again?

I have been studying the core mechanisms of evolutionary change in history, when a group of people were waving signs and demanding change, that was important. But there was always something else going on in the background. Somehow there were winners and losers in the debate, but really the winners always seem to have been proven right by history.

So let's spare a thought for the losers. I propose that the people who were actively pursuing or leading the pathways that have ended up as the losers throughout history believed they were working for success, not failure. How many people who set up the Apartheid system thought of it as a doomed proposition? How about the people who built New Zealand's vast railway system (of the past) or the electric trolley lines in the towns and cities? What were they thinking? I think it's important for just a moment to realise that the people who have worked hard to design, build and bring to the market the most energy intensive, highest foot-print society ever seen in the history of humanity, probably did not do this because they wanted to disrupt the planet's climate. But this system, is doomed, historically. It will evolve to a much lower intensity system. What is that evolution going to look like?

Radical Reduction of Energy and Material Footprint

Mission Impossible?

- Radical Re-Design Project
- Find the mechanisms of change



We understand and are comfortable with Business-As-Usual. We will change to radically reduce our footprint. Mission Impossible? What if we are missing a big opportunity by focusing on what seems nearly impossible rather than working on what needs doing? There has been a bit of media stir about my other research area and my involvement in the National Hypersonic Science Center in the USA. A group of researchers funded by NASA and the US Air Force are working on the nearly impossible science behind the next generation space vehicle. How do you go ten times the speed of sound, fly to space, and survive temperatures over 2000 oC and the vacuum of deep space? This is a nearly impossible problem, yet we don't wring our hands about it, we get on with the research. Over the past four years, I have brought to the attention of the Trafinz conference first the problem of Peak Oil, then the truth as straight as I can tell it about what will and will not work. Now, I am going to give you a sneak preview into the radical redesign of the suburban form of the next generation settlement. This is not a new green-field development or eco-town. Rather it is a strategic re-development of our existing investment in the oil age. We do know what the answers are, fossil fuel freedom, safety, prosperity, liberty, beauty.

Do you want to know what the future looks like?

Would you like to know how it can be achieved?



What to Change?
What is the Problem?



Problem = Too Much

Here is the way I define the "Problem" = Too Much

Cows aren't a problem, too many of them in one place is.

Fishing isn't a problem, too much fishing is.

Using water isn't a problem, taking too much is.

Cutting trees isn't a problem, denuding 90% of your forests is.

Cars are not a problem, complete dominance of our public spaces, our architecture, our homes, our culture, our spending, our policy... is a problem.

Using petrol isn't a problem, using 16 litres per person per week is.

The Solution isn't More, it's Better

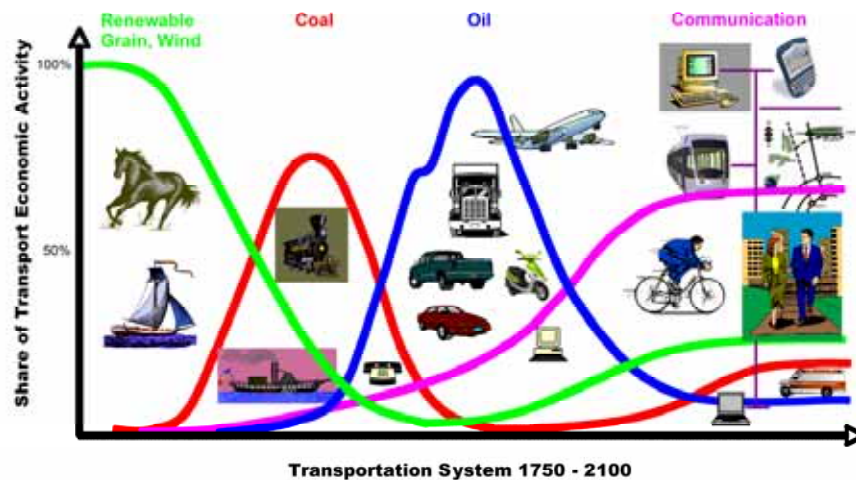
- Electric Cars, Hydrogen Fuel Cells
- Carbon Footprint and Off-setting
- Wind, Marine, Solar Energy
- Carbon Capture and Sequestration



At this point we are definitely faced with insurmountable evidence that the development pathway of seeking sustainable solutions is a dead end. No amount of new sustainable energy or products or home gardens will change the un-sustainable use of fossil energy, consumption, or food production. It's time to path-jump and return to the fundamental definition of the problem. Un-sustainability is the problem, not lack of sustainability. Evolutionary change is the only project left, really.

The Real Question: Who, How?

Developers, Business, Sales, Growth



This is a diagram I made some years ago to put the future change from oil-based transport economic activity into a historical perspective. Of course, right now we are at the peak of the oil activity era. We don't use any coal for transport activities, and only a few percent of renewable energy. But, we have already started a transformation in economic activities to communication based transport – that is, moving of services and information that people are paying for, or carrying out of trade and activities via communication rather than by physically moving. In my crystal ball, this will be the growth area in the future. The future will be about carrying out activities by communication, and then having much less movement of goods and people that requires transport energy. Indeed, I think that a lot of the renewable energy that will be expended on transport activities will be food as people move themselves through their urban spaces rather than being moved. There is a lot of potential for renewable energy to be used in electric trains and buses, but the petrol-automobile urban form of the oil era can't really be functional without the oil. Thus, the activity system will evolve to make use of communication, shared electric transport networks, and walking/biking.

Everything Evolves with Transport

*Production
Trade
Urban Form
Home
Lifestyle*

*True in the past,
will be true in the future*



8000 years ago people started settling down in permanent settlements. The locations of settlements and and lay-outs of cities have been structured around transport ever since.

But - Structured around transport and dominated by it are two different things.

Clear Forests, Drain Marshes, Plant Crops, Build Railroads



Welcome to the new New Zealand.

Clear Forests, Drain Marshes, Plant Crops, Build Railroads



The Pahekha people who came to this place to build colonies had a pattern of development in mind. They accomplished this pattern – primary production by “converting” the useless bush to pasture and cropping, and establishment of civic and trade centers on ports.

Now, the biggest developments are conversion of productive crop and pasture land to suburban and lifestyle residential use.

Subdivide - 100% Automobility

Gainsborough Residential Development - West Melton

Situated on the bright side of Christchurch away from the mad Northern traffic is Gainsborough of West Melton, a master-planned community with a stunning array of section sizes averaging around 2600m². This is the latest project undertaken by R. D. Hughes Development, the team that brought us Northwood.

www.grd.co.nz



This subdivision development is real. It is “only” 13 km from the edge of Christchurch. It is a 100% personal automobility form. There is no other option for these people. 0% of their activities are within walking or biking distance, they have no public transport. You might want to ask the question - “Will the buildings and infrastructure investment in this development out-live the auto-mobility age?” I think a better question is “How long until the demand for 100% automobility begins to decline?” These kinds of investments are very short term for the developer, longer term for the home owner, and very long term for the governments and rate-payers that pay for the roads, water, sewer, schools, parks, libraries...

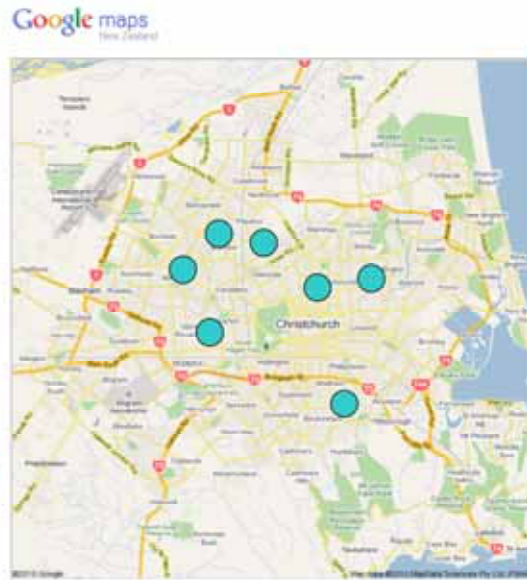
What are the risks to the developer if the demand for this residential development drops in 10 years? - no risk - but to the homeowners and councils, there is a substantial risk.

Let's say that I am an investor. I want to invest in some development project that will provide me with a reasonable rate of return, say 10%. Let's say that I am a long-range thinker. This means that in 50 or 100 years, I want to still getting a return on my investment. What would I invest in right now?

Prospecting for Development

The most important long-term investment considerations:

- ***Future Transportation***
- ***Activity Systems***
- ***Re-Development Potential***



Let's say I go prospecting for this long-term development investment. Let's say I consult with Professor Krumdieck at Canterbury University. The most important considerations are the long term locations of activity centres, and the long term forecast of transportation energy and technology. This future transport system will shape the city and the demand for services and locations. We are looking for places with high potential - good access to activity centres, like schools, jobs, recreation, markets, medical facilities.

Prospects for Development



Here is one of those good development prospect areas. There have already been a few of the 1960's era homes demolished and new homes built. This is a signal of re-development potential in this area.



This is the neighborhood in the suburb of Ilam in the city of Christchurch. Ryeland Ave and a small piece of Braithwait are two dead-end streets that come off of a major road, Ilam Rd. There are 80 homes in the target development. It is also very near another major road into the city centre, Memorial Ave. The development was done in the mid 1960's when a dairy farm and other farms were covered with quarter acre lots and brick single family homes. Four of the old homes have been or taken down and replaced with one or two new homes on the same lot, and two of the old homes have been substantially remodelled. The area is in good school zones, near the university, and has high property values. There is a medical clinic and pharmacy 10 m away on Memorial Ave, and elementary, middle and high schools within 20 min walk.

The travel demand of current residents is not high.

Here is a sample of the km driven by vehicles registered at addresses in this development area over the past year:

4313 / 14109 / 5054 / 7703 / 5270 / 8294 / 39582 / 5364 / 4224 / 9383 / 8459/

The VKT per household is:

10159.55

km/yr

Average for Christchurch is: 10700 km/yr/household (now including all cars...).

Public Space 22,000 m²



The neighbourhood is tidy in the typical Kiwi way. There is a good deal of pavement, and the storm water drainage clogs up and floods during moderate rains. Many homes have walls in the front, but on this street most are low walls.

80 Homes Total, 65 Pre 1960



I'd call this a pavement dominated bit of community space. We also have a kindy on our street with a bit of playground. The public space is completely dominated by the private vehicle.



Here is the re-development plan. I'm a developer, I want to buy the street and sidewalk from the city. I will develop this land into intensive organic gardens producing food that the local population has specified they desire. Fruit trees will replace ornamental trees around the village as determined by the village gardener. At the entrance to the new Ryeland Village will be a commercial and transport centre. There will be a small market where produce from the gardens and the chooks that roam the gardens. There will be a café/bistro that develops menus in consultation with residents and can provide take-away and picnic meals. There is a transport centre where villagers can check out a car or scooter for errands that require it or holiday trips. They can book a shuttle to the city bus exchange or catch the bus on the main routes. There is also a commercial centre and appliance library. Commercial activities include advertisement of local skills, goods and services both in the village and the surrounding urban area. There is also a hostel booking service whereby villagers with spare rooms can put them into the market for backpackers, B&B or homestay that is handled through the Village Commercial Manager.

Vision of Re-Development



Access to homes will be by a path which is smooth and wide enough for emergency vehicles and delivery trucks. There are four electric golf carts which can be used for residents to carry heavy loads or other things to their homes. The longest walk anyone has to essential services, food sources, and transport is 320 m.

The agricultural work will be done by the highly skilled Village Gardener, not by the residents unless they wish to work for wages. The agriculture, operations and services of the Village Centre are a business. They will receive cost saving funding from the City Council for taking on the maintenance and service of the road and drains for these streets. The developer will also build several distributed energy plants in the village at strategic places. These units collect solar energy, and boost the temperature of hot water with biofuel boilers. Distributed hot water is metered and sold to residents on several circuits. The landscaped area includes swales and other features to diminish storm surges, which are monitored by the city, and a subsidy is provided to the village management for operation of this storm water system. The Village Manager also provides installation of rainwater collection for use in the agriculture.

The property values for these homes will rise as it becomes a novel and desirable way to live, in a garden village.

Some other light industrial activities at the Village Centre include a large kitchen for processing and preserving produce.

Notes: This concept was developed as a thought exercise. The question was, how would we build social capital in a "proximity" community? That means people who live close to each other. "Community" wouldn't describe it. Safety issues like speeding could be used as a focal point, as could security, for example community watch. But often these things become a particular person's responsibility, so people at most perceive their participation as minimal. I thought that if a development proposal such as this were brought to the people it would generate discussion, and we would get to know the neighbours.

Property Investment

- Structural, Roof, Foundation
- Windows, Doors
- Insulation
- Electrical, Plumbing

*\$30-120 Thousand
Investment per
House*



The residential properties in the Garden Village brand will be assured to be Trouble-free (e.g. up-dated and up-graded plumbing, electrical)

Modern (e.g. well placed outlets for modern access to computers, cell chargers, and new ensuite bathrooms added),

Comfortable and healthy (e.g. any leaking or mouldy structure issues fixed, double glazed windows installed, bathroom and laundry vents)

Energy Lean (e.g. Fully insulated and draught-stopped to European standard, ground vapour barriers, low flow showers and sinks)

Old-to-New Transformation

- Kitchen - Dining - Lounge
- Bathroom Ensuite
- New Gib
- Lighting Design

\$ \$ *Appreciation, Brand
Recognition,
Demand Growth*



The interior of a Garden Village Brand house will essentially be new and modern: Open plan, 30% maximum window area, efficient and effective lighting design, long-wearing materials and finishes, sustainable materials

Energy Transition

*Fuels, Spot Market
Sales, Utility Demand
Reduction Investment*

- Solar Hot Water
- Gas Cooking
- Passive Solar Re-Design
- Efficient Heating
- Demand Management, Peak Limit



The energy transition package is known. The question is how to make money from investing in it. We will actually charge people for the hot water produce by solar, we will sell the fuels for the boilers and cooking, and we will get interesting peak and spot price electricity deals with the utility.

Water

*Rates Reductions on
Storm Water and Supply
Demand Reduction*

- Rain Water Collection
- Storm Water
- Low Flow Fixtures



We will get a rates savings pay-back to the company from the council for limiting the storm water discharge to 20% of previous value, and by reducing the water demand in the development by 50%.

Business Development

- Village Square
- Bakery, Café, Catering
- Tools, Shop, Equipment
- Hospitality Services - Homestay
- Gardening Services



This development is actually a capital, retail and service business. We are not running a development where we build then run away. We want to make our money here over an indefinite term. Thus, this re-development involves setting up and running of businesses including elder care and child care if profitable.



Public Spaces

- Food Gardens
- Fruit and Nut Orchards
- Play and Picnic
- Group Gathering Facilities



\$ \$ Land Levy,
Fees
Sales





When we start looking at the 22,000 m² of public space that we have for development, we see great potential - we can cater parties for example.

We estimate that we can produce 360,000 kg of food in the form of fruit and vegetables. Because of direct communication with customers, we have no middle men, no mark-up, no transport costs, reduced wastage, and we can save hugely on processing, packaging, warehouse and inventory expenses. The plan is to find out what kinds of foods the customers like best, and focus on producing those. If we meet the supermarket price but beat the competition on flavour, freshness, and convenience, we can expect about \$3.00 per kilogram for produce, or a turn over of over \$1M per year.

Public spaces as profit generators rather than paved wasteland???

Transportation

- No Cars in the Village
- Car Share Service
- Electric Golf Cart Pool
- Public Transport Links



\$ \$
Sales
Service
Profit



I hope you didn't miss the part of the development plan where I said we were going to remove the pavement and sidewalks and front walls of the residential units. If you rent or own a residence in the Village Garden, you will be trading in your personal automobile(s) and all of the expenses and maintenance that goes with it for a peaceful, safe, low-crime, living space. You will have access to the village transport services to get you where ever you want to go, including use of the caravan and people mover for holidays or when guests visit.

Here is the business concept. Transport – getting people from their home to their activities (mostly shopping according to stats) could be seen as a service to be provided on a fee-for-service basis. We already know that renting vehicles and providing taxi services is profitable. How about transport services for 100 or so households?

Long Term Developments

- Future Growth of Garden Villages
- Future Development of Electric Bus Networks linking villages
- Growth in demand and brand recognition



This first development I have described is the pilot project. It launches the brand and establishes the product and the business plan. It goes beyond this, however. The location of our future projects is based on another criteria as well. We plan to build and operate electric bus services for our customers (and others). We know where and when they want to go, and we are designing an electric transport network that will connect the villages with the destinations and will have fares that are much below the current \$0.45/km that it costs to own and run a petrol vehicle or below the alternative diesel bus service fares. ESPECIALLY in the future as fuel prices continue to be high.

Transition to sustainability as a growth market? As a profitable enterprise? How else do you think it will happen?

Now all I need is an investor!

Conclusion: Radical Redevelopment

*Development
Potential*

Demand Growth

*Long Term
Investment*

*High Quality
Product*

 **AEMS Lab**
Advanced Energy and Material Systems



www.aemslab.org.nz

Thanks for thinking with me.

This is my group of PhD students and my post-doctoral researcher. The group has thinkers from around the world:

Germany, Iceland, America, Brazil, New Zealand, Maldives, Ghana, Bangladesh, the UK, Malaysia, Thailand, France

Here we are, on one of our thinking days. Please visit our website and read our papers at www.aemslab.org.nz

What is the other asset of our new Garden Village brand that keeps the waiting list for properties and rentals in our developments so high?

Social capital is an interesting concept. Of course it is trying to ascribe an artificial economic context to something that is much more important. Would you go to your neighbour and ask to borrow a cup of milk? If you would, you have good social capital.

I think there is a way that this is built and maintained, and it is when people make contact with each other for non-commercial reasons. The community church used to provide a reason for people to get together once per week. I think that a place to gather and a reason to gather other than engaging in production, education or business is the building block of social capital. The TransitionSpace concept is an idea that we had about a new way to do this. People come together because of their belief in transition. They listen to speakers. They get inspired. They have their beliefs affirmed. They sing. They have pot-luck dinners. They eat particular foods that mark their group affiliation. They dress in a certain way. They follow inspirational leaders. They read books on subjects important to them and talk about them. They have their transition bible handbook and they can quote passages. They volunteer to help other people and do good work. They try to influence greater society with their vision. They recruit new members. They tithe enough funds to support the place and a pastoral worker/organiser.