Transitioneering

Large scale change on a small scale

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"Large Scale Change on a Small Scale: The role of the new field of Transition Engineering"

Engineers for Social Responsibility
Date and Time: 7.30pm, Thursday 18 September

Where: Room 3.407, School of Engineering, University of Auckland, 20 Symonds St, Auckland

Speaker: Associate Professor Susan Krumdieck, Director, Advanced Energy and Materials Systems Lab., University of Canterbury

Abstract:

Increasing awareness of the un-sustainability of profligate fossil fuel use has influenced the emergence of local "Transition Town" movements, which can start with even a small number of highly motivated people. First accomplishments of such a group may include the sponsoring of local educational seminars about sustainability issues, the establishment of a local farmer's market, and projects involving energy efficiency, recycling, permaculture gardening and local environmental reclamation. These first initiatives produce a new community awareness and satisfaction that may grow to include people less concerned about sustainability, but interested in the amenities of improved community social and environmental capital. The problem is that if the key services for wellbeing in the community, infrastructure and transportation, are to transition to sustainable systems then engineering will be necessary. The Transition Engineering team is a new kind of interdisciplinary working group.

This seminar will describe our team's experiences with the development of Transition Engineering fundamentals and design tools. In particular the Transition Town Workshop in Oamaru will be used as an example of the method applied to a particular project.

Transitioneering Overview

Fundamental Principles

- Point 1: Sustainability & Engineering
- Point 2: Transition Engineering

Demonstration

- Point 3: Oamaru Project

The two most important ideas I've had about engineering for low carbon, de-fosilised transition, and an example of a project.

A new field of engineering is emerging – which reflects the moral position that sustainability is a public good and an individual (though intergenerational) right.

Safety – Sustainability Spectrum

Sustainability:moral issue not a science or technology. Will emerge into practice in a similar way to Safety, but hopefully much more qickly.

The engineering project applied to sustainability

Oamaru Project

Point 1: Sustainability is a Moral Issue - Not Technology or Policy

People and their Fellow Species
Regardless of the year they were born
have an inalienable right to Sustainability

It is morally wrong to deprive a people or an ecosystem of wellbeing or the necessities of life.

Every time I'm in a group discussing or struggling with sustainability – there is always a diversion – What do we even mean by it?

Have you ever heard this? "what dose sustainability mean anyway?"

It's like prostitutes discussing chastity. It's too late for us, but we don't' want our daughters to have to live this way.

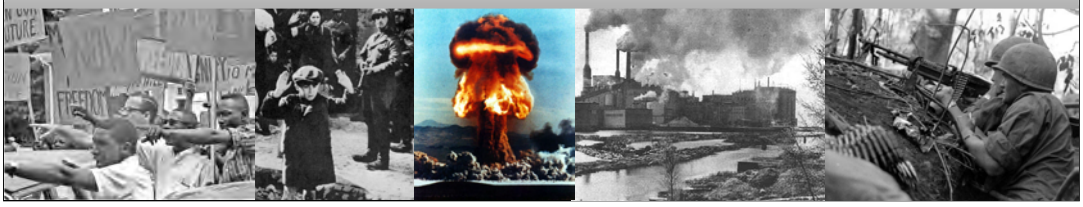
Sustainability

- Is a Moral Issue
- It's about design and operation within limits
- It's not about how to keep getting more, but in a better way

Engineering and Moral Issues?

Society grapples with its moral issues, and engineers just provide the infrastructure and hardware, right?

Safety



I have a proposition. Engineers work with at least one moral issue all the time. It is something that at the start of the industrial revolution, engineering did not consider, then moral outrage by society at the harm done by machines and chemicals brought about a paradigm shift in engineering practice that reflects the social values.

Think about Safety. If engineers design something in a way that is un-safe, it is either through ignorance, which the profession works to avoid, or it is through management pressure, but they know it is wrong. It isn't just a design choice, it is wrong and their conscience may even lead them to blow the whistle.

Engineering Incorporates Society's Moral Position

The industrial revolution brought a huge range of new products, technologies, chemical… into people's lives. The workplaces, practices, environment and products were usually not engineered for safety. Workers, consumer advocates, public safety awareness – there was a lot of work that went into changing things. It happened slowly, and often with resistance from a lot of big businesses. But now, all competent engineers consider safety in their work, and there is a field of engineering dedicated to safety. If you were to ask anyone – what is safety? - the same way we are now asking ourselves – what is sustainability? – The question would be just as hard to answer. If you ask people why they consider safety – the answer isn't about externalities, it's about a core moral position that it is "right" to consider safety. It is "wrong" to do things in a way that could be done better and that puts people at risk.

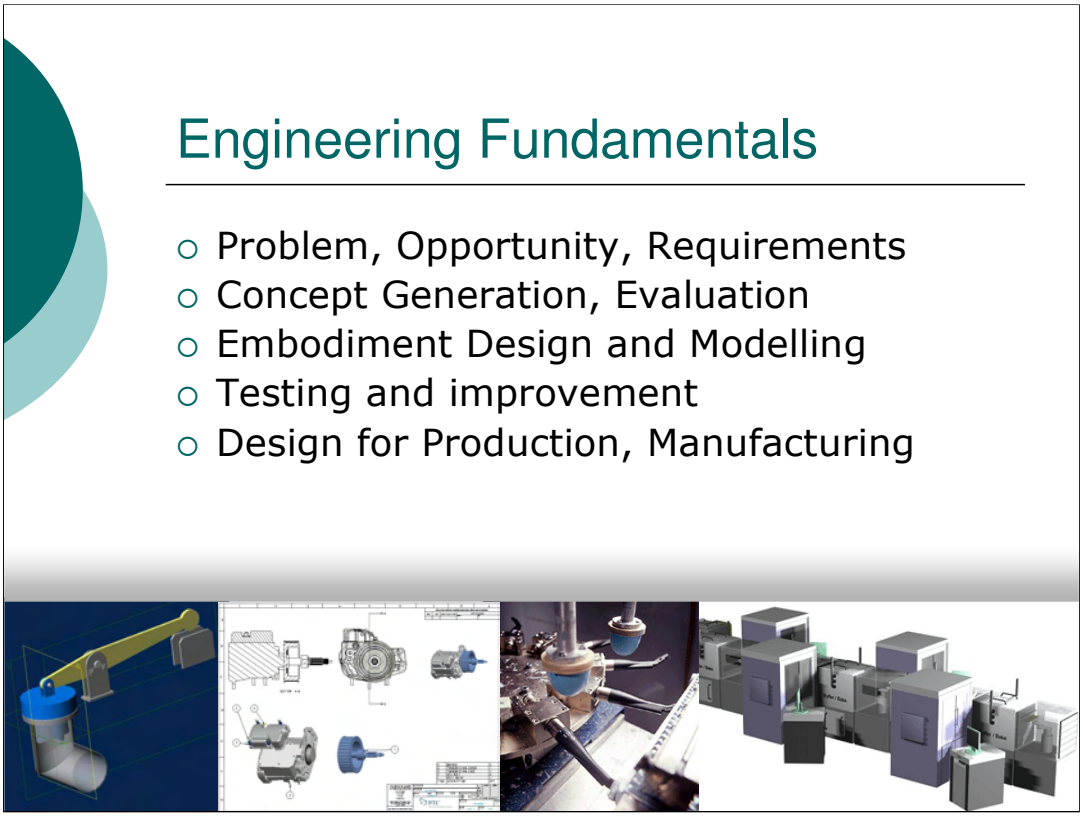
This is one of the best ideas I've ever had. If you are an engineer and you are struggling with how you "do" sustainability, look at the parallels with safety. Think about the measures you would use, and don't be bothered if your company or your product doesn't meet a measure of 100% sustainability at the moment. Sustainability will always be an on-going process. But there are no exemptions. Like safety, there is no sector of the economy, no level of society that doesn't have to think about safety. Sustainability behaviour amongst people will be informed by instructions and signals embedded in design of products and infrastructure. There will be standards that have been developed through research and testing and professional review. These standards will be enforced by the government, and will form the basis for practice in all fields. Like safety, sustainability can't be accomplished it can only be strived for with due diligence. And just like safety, it is everyone's responsibility, not something that is a response to market signals.

How will this evolution come about? If I'm right and sustainability is the same kind of moral concept as safety, then it will require advocacy. The people will have to demand sustainability as a morally right thing to do. There is evidence that this is beginning to happen as people start to reaslize that it isn't just about technology, and as they come to understand that there is no political leadership.

Point 2: Transition Engineering

- Changing the current system
- Curtailing or limiting un-sustainability

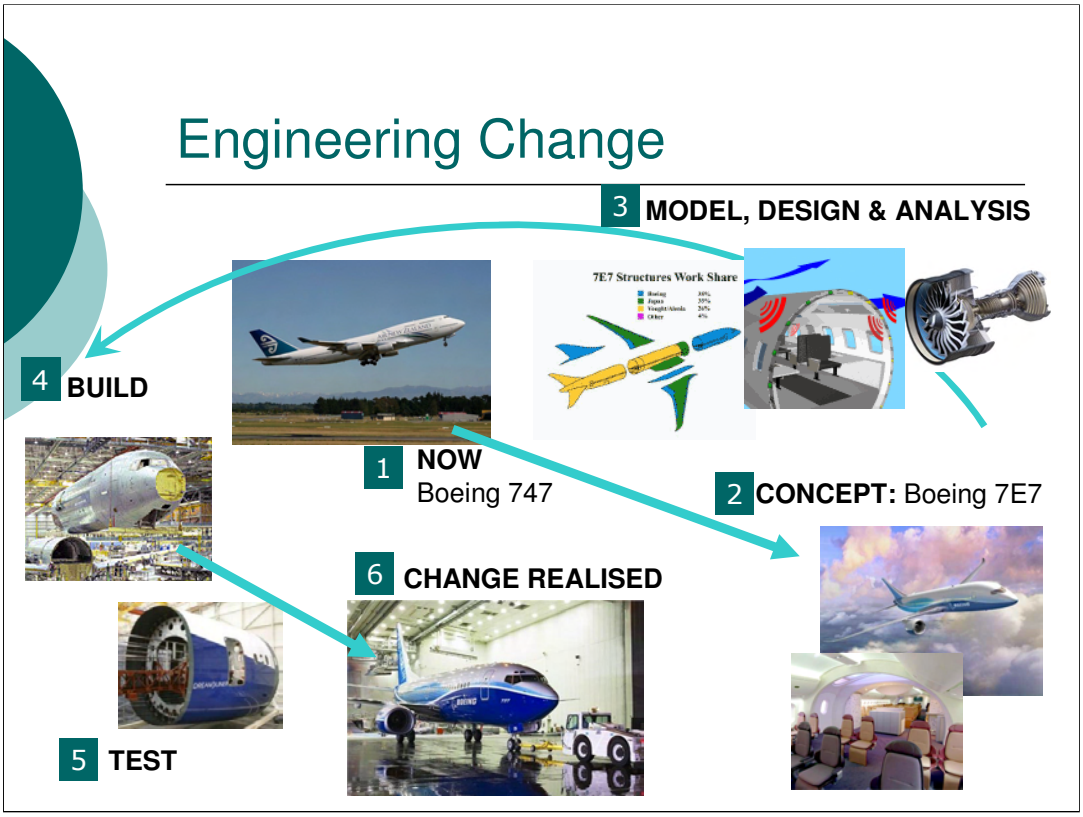
The past several hundreds of years have been rife with change. It really isn't something that bothers humans. We're extremely adaptable. So, the work of transition engineering is purposeful changes in existing systems of technology, infrastructure… to curtail un-sustainabilities. (again, think of what safety engineering is all about. You plan for safe designs and operation, but you definitely also assess and eliminate un-safe equipment and practices)



Engineering is a well understood way of applying science and mathematics to solve problems or take advantage of opportunities. Engineering is about “making things work”. The processes and methods are well understood.

Problem definition
Risks, costs, benefits
Wants, needs, requirement
Concept generation
Concept modelling and evaluation
Concept selection
Embodiment design and modelling
Testing and improvement
Design for production/construction
Development or construction
Evaluation

I think what we take for granted is how our current engineering disciplines developed. I propose that every great challenge gives rise to the engineering discipline that will solve that challenge. I propose that Transition Engineering is the field of engineering that will work on sustainability, energy descent, climate change…



This is a quick review of the process of changing a technology platform through the normal engineering process. There is a known solution. Requirements are set on how the next solution could be better. Concepts are generated, modelled, analysed, designs made. Realisation involves further design and development and testing, and finally, a new, more efficient, more comfortable platform for long haul transport is realised.

Current Approach to "Sustainability Engineering"

- Environmental Monitoring
- Carbon Footprint, EROI
- Low Carbon Scenarios
- Renewable & Alternative Energy
- Breakthrough Technologies, CCS, H_2
- Reducing Impact & Pollution
- Green Design, Sustainable Development

However, in the area of "sustainability", the projects don't really have this same cohesive vision. There is some prevalent idea that renewable energy and clean technology will be able to "substitute" for the bad, fossil fuel technology, and everything will be good. But this is not the case.

There are a lot of people developing scenarios for different prices of carbon and different breakthrough technologies and drawing nice graphs about the future. There are people working on improving energy efficiency, and even some people, like Amory Lovins, who are telling people that we can "Factor 4" ourselves into a sustainable future, by continuing to grow while we get more efficient.

The problem is that none of these people are crazy. But the sum of these parts is not something that will fly.

First Rule of Engineering

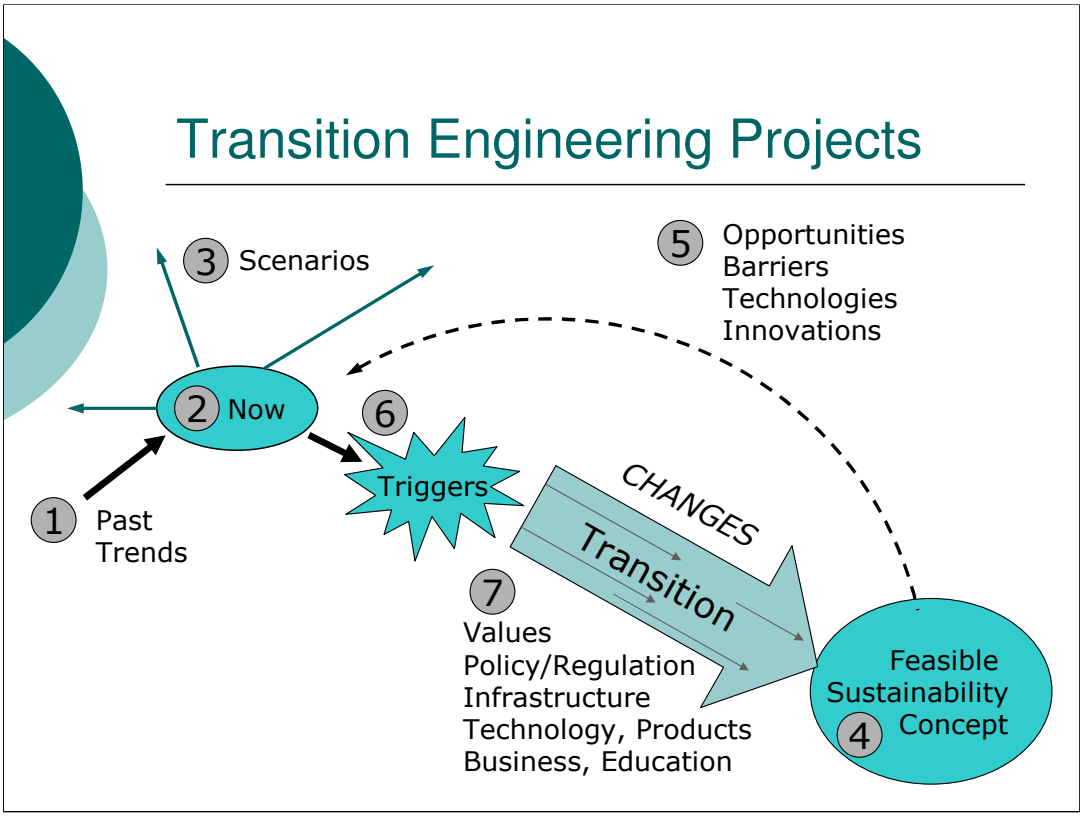
Know what problem you are working on.

Blind Scholars and the Elephant

The king was having a hard time with his advisors. The country was in a difficult situation, and he needed all the help he could get to make important decisions. His advisors were all wise and learned men, but they continuously argued with each other and disagreed at every turn. Finally, the king, who was a wise man himself, told his six advisors that the young servant girl who kept the water jug filled could see things more clearly than they could. They were shocked and argued some more. How could a mere servant girl know more than the architect for the city's aqueduct, the head economist for the king's treasury, the commander of the army, the ambassador and trade negotiator, the master of the historical records, and the chief natural resource and agriculture adviser?

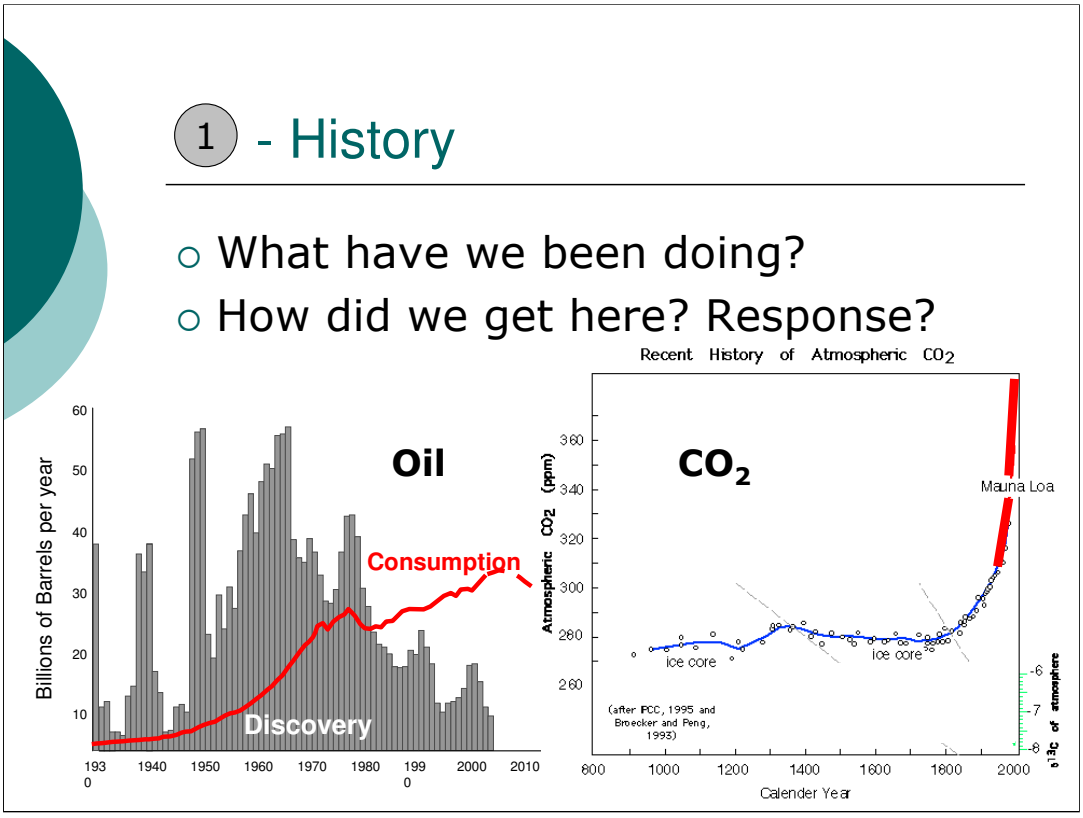
The king had the advisors blind-folded and taken to a room. He told them all they had to do was to tell him what was in the room with them, and see if they could provide a better answer than the servant girl. It is obviously a rope, long and frayed. It is obviously a tree, straight and tall. It is obviously a rock, smooth and hard. It is obviously a wall, solid and smooth. It is obviously a canvas tent, flexible and pliable. It is obviously a snake, and a large one at that.

The king shouted for silence over the arguing wise men. He asked the young girl, who had not been blind- folded, if she could tell the advisers what was in the room with them. She softly replied, "Master, anyone who looks can tell that it is an elephant."



So, this is my second great idea. Here is the “elephant”. The numbers represent different kinds of projects that – together and in the right order – might result in changes toward feasible sustainability. Let’s examine the individual parts.

This picture shows "the whole picture" of the progress of moving a society toward a sustainable position from an unsustainable, yet profitable and even comfortable position. This framework will look familiar to engineers, as it resembles the product development process. It also has common elements with business planning and management. Let's look at each of the seven projects depicted briefly, and see if, by putting the good work and wise thinking being done in the individual areas together, we get a new understanding of the whole picture.



Project 1 - Past Trends

It is important work to understand what we have been doing, and how we got to this point. Governments usually have whole buildings full of people collecting and publishing historical data and statistics. Energy use, GDP, agricultural production, manufacturing, imports and exports are just a few examples. Researchers in all fields as well as businesses use this data to understand past trends, and very often predict future performance based on past trends.

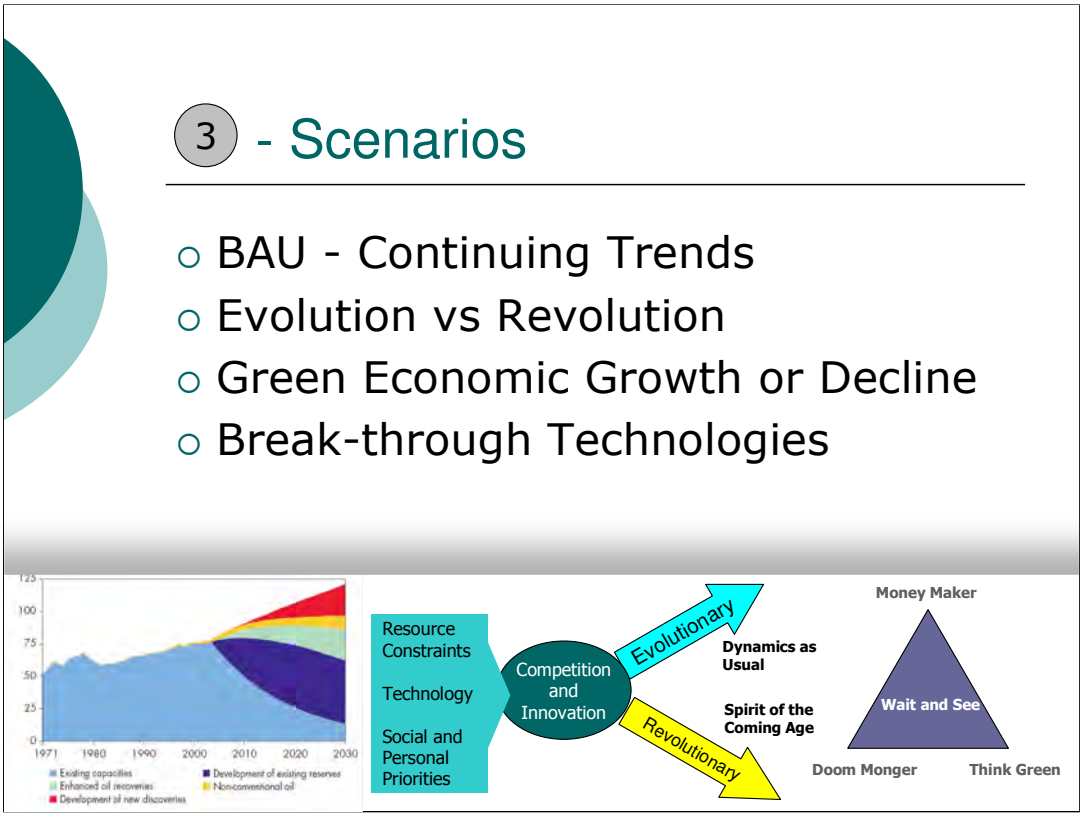
2 - Current Status

- What are we using?
- What are the impacts?
- What are the problems, issues, risks?
- What is un-sustainable?

Project 2 - Now

Where are we now? How much money do we earn? How much energy do we use and CO2 do we produce? How much fuel do we import? How unsustainable are we? Again, governments spend a great deal of money keeping track of how we are doing, and it is important to know.

One of the most important aspects of the Now project is identification of problems, risks and issues.



Project 3 - Scenarios

Where are we going? What if we kept up with business as usual? What if we go back to the past? What if constraints and market forces drove evolution or revolution? How about that hydrogen economy? Green-techno-economic utopia vs brown economy and eco-suicide? How much carbon capture and storage would we need to maintain growth of fossil fuel use while "filling the wedge" in the curve to reduce CO2 emissions? There are a lot of governmental workers, economists, businesses and a few researchers involved in developing scenarios about the future. Comparative scenarios are of course informative. Scenarios set the stage for discussion of change and let us explore responses to the problems, risks and issues that we face now. Scenarios and their simple forward projection graphs are used as ways to communicate issues to a general audience.

Project 4 - Vision for Feasible Sustainability

As stated above, our group may have been among the first to attempt this project. The vision project entails purposeful re-design of what we already have and what we already know, but with the un-sustainable aspects eliminated. The brainstorming work involved is focused on discovering what the people in that position, who know everything we know, are doing to meet their needs - but in a sustainable way. This is in contrast to scenarios (Project 3) which give projections about the future, but usually are lacking the hard-feasibility and virtual system design and modelling of the visioning project. Writers and movie makers often imagine future settings, but again, without real feasibility, these ideas about the future don't really provide vision.

Project 5 - Back Casting

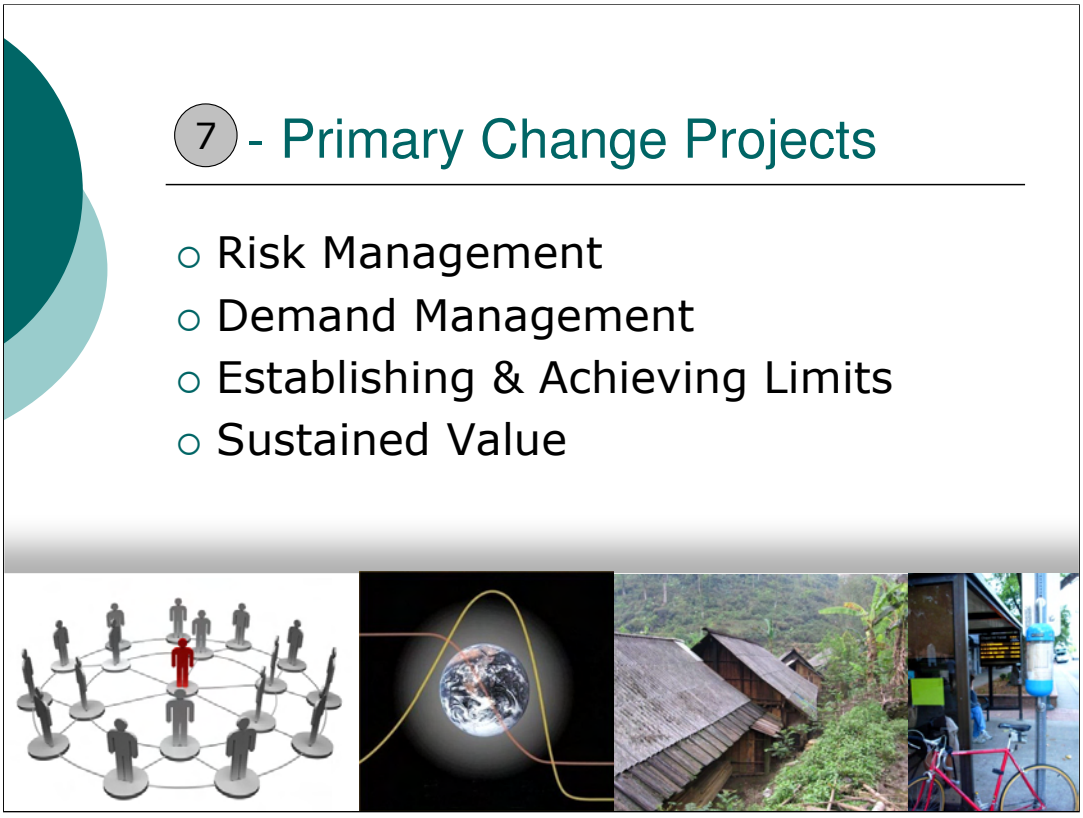
This project involves identifying the core differences between the feasible sustainability vision and the current system. It also involves identifying the barriers to change, the opportunities and benefits to be realised for different change routes, and the new technologies, infrastructure and economic relations that might be developed. In the framework shown in Figure 1, the consideration of possible new technologies and infrastructure change and investment opportunities is placed after the exploration of the feasible sustainability vision. Currently, this project is often done after the identification of problems and issues in what we have called Project 2. The placement in this framework should provide better identification of opportunities and barriers.

6 - Triggers

- What catalytic event(s) would start us changing toward sustainable us?
- What would cause us to curtail un-sustainabilities?

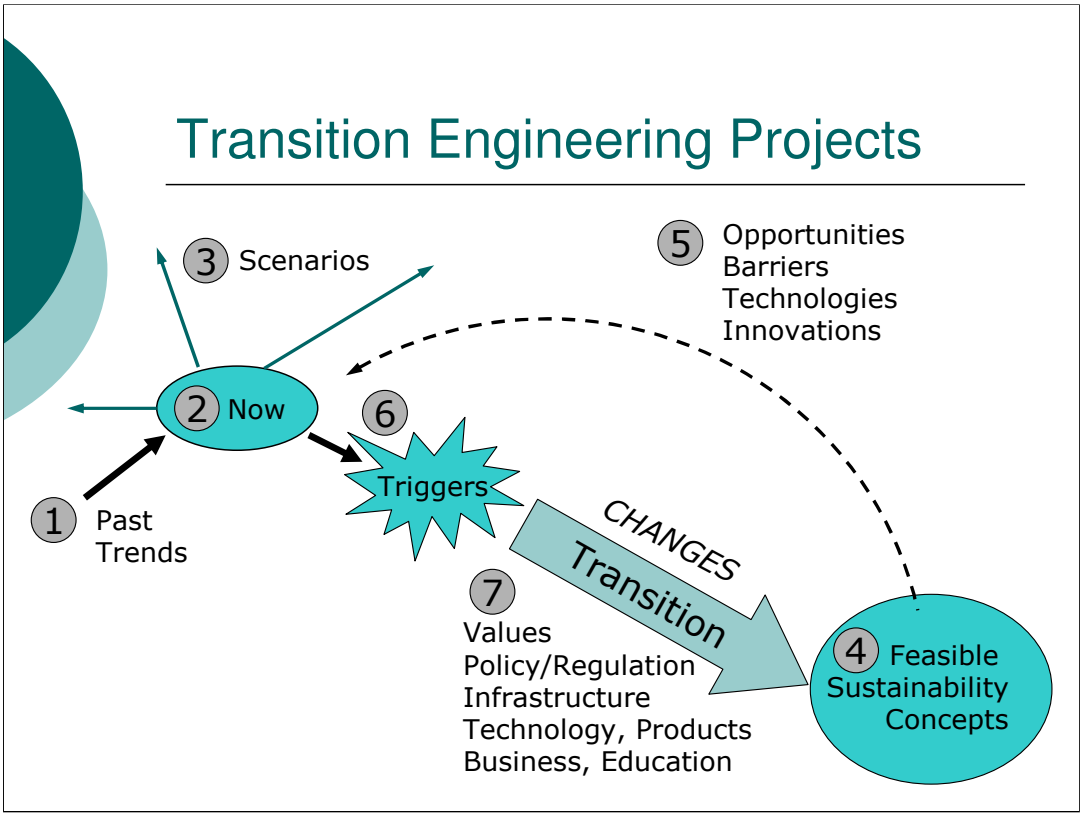
Project 6 - Triggers

All change projects involve decision points, and/or triggers. For example a decision to change an institution's main computer operating system will include a decision point - a certain circumstance or time when the change programme will begin. In a society the triggers for change can be changing values, expressed by protests or public awareness campaigns. Other triggers may be disastrous failures of current systems. It is important to explore the possible triggers for change to curtail un-sustainability, and to plan for them.



Project 7 - Transition

The types of changes that would lead in the direction of feasible sustainability will be made by businesses and communities, and will involve optimisation and change engineering. There is a great array of change projects, as nearly every facet of our current society has un-sustainable aspects. We propose that such a sweeping transition will probably happen in response to changing social values. This institutional shift could happen in much the same way that safety went from being something that was basically non-existent in the early part of the industrial age to something that is now expected by all sectors of society, planned for in design, regulated through standards, and communicated and actively managed at all levels. Thus, one of the main changes that will lead to a feasible sustainable future is a shared social attitude that un-sustainability is morally wrong.



The Whole Picture

My research group has used this conceptual framework to identify projects that need doing. In a particular situation, there might be progress in some of these areas, but things might be stuck until you make some progress on other areas.

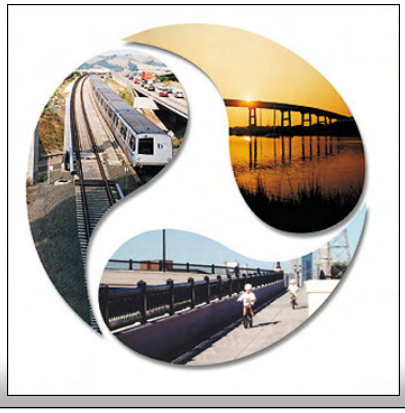
So you want to go green? If you have a company, and you have a good idea of your history, and your current position. That is good, but how is your company going to deal with peak oil, peak steel, peak phosphorous, climate change? You might run some scenarios to look at different conditions. Maybe you would hire a company to calculate your carbon foot print. Maybe you would hire an energy engineering company to put some solar PV on your roof. But then what?

A transition engineering consultant working with this company would know the projects that need to be done now – 4 through 7! You would certainly not want to just start investing in things that seem like “solutions” unless you understood the whole problem.

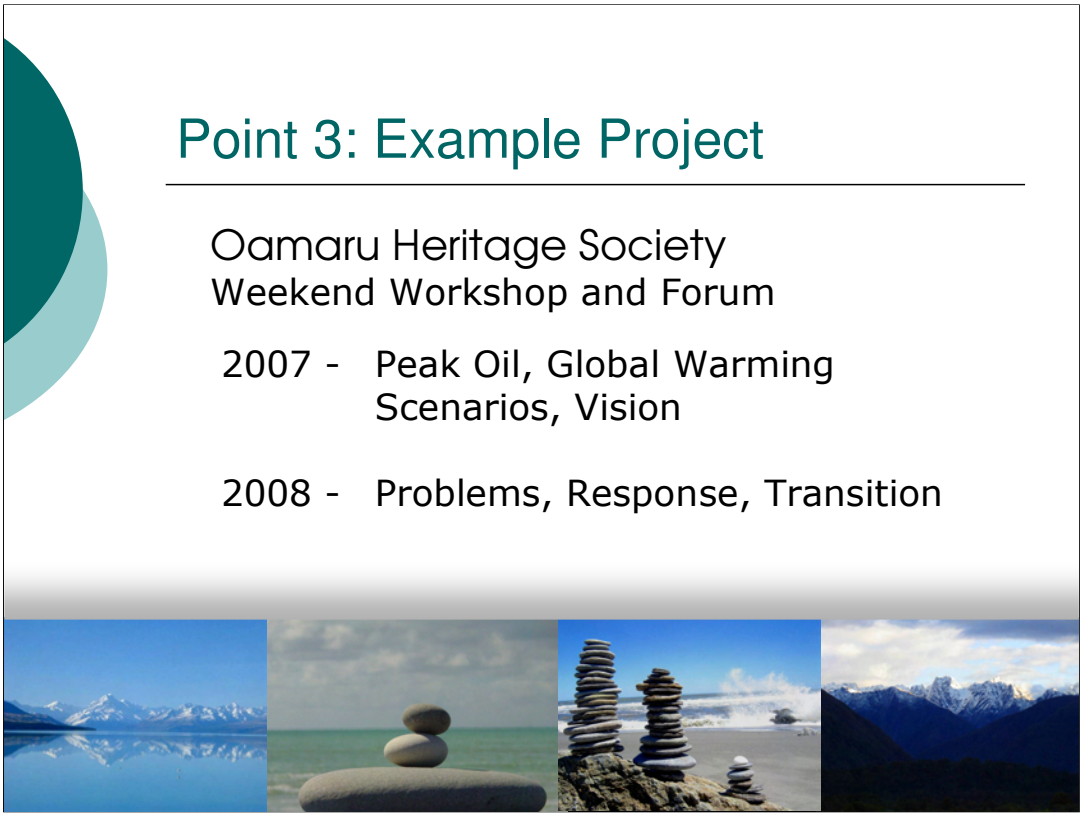
Point 2: Conclusion

- There are jobs for everyone!

Transition Engineering

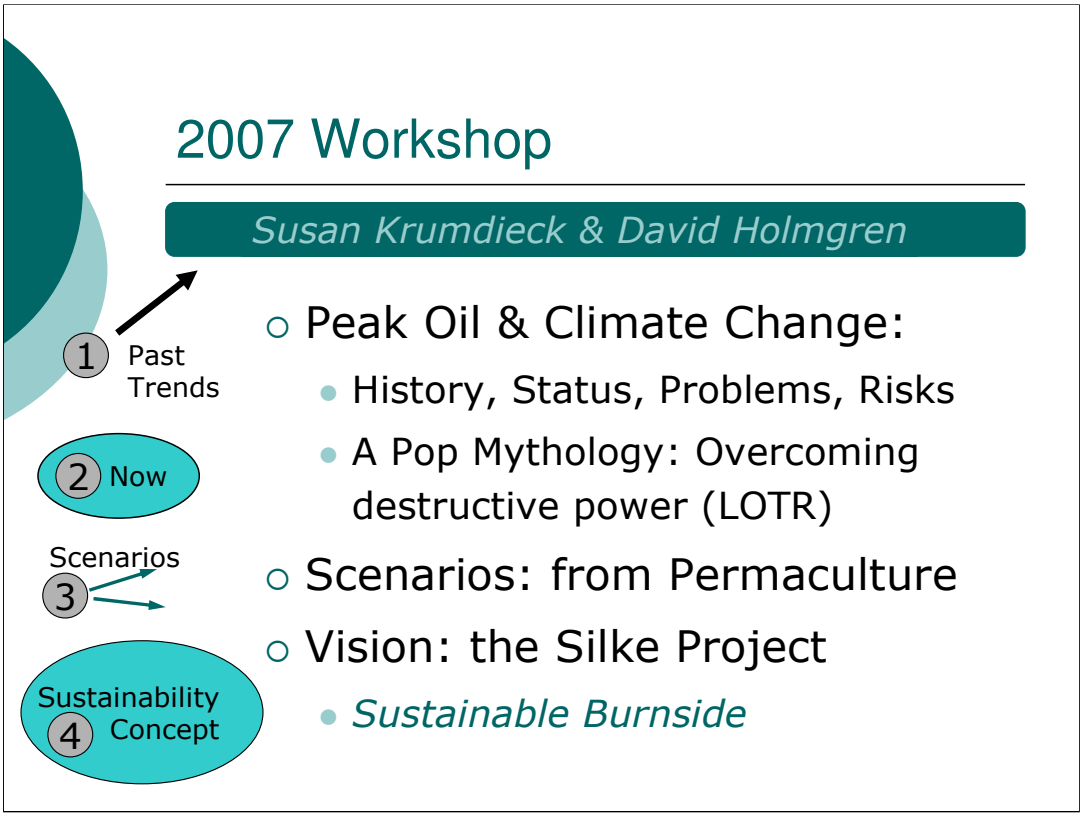


There is a huge amount of work to be done and hopefully, transition engineering will rise to the challenge and become part of the solution.

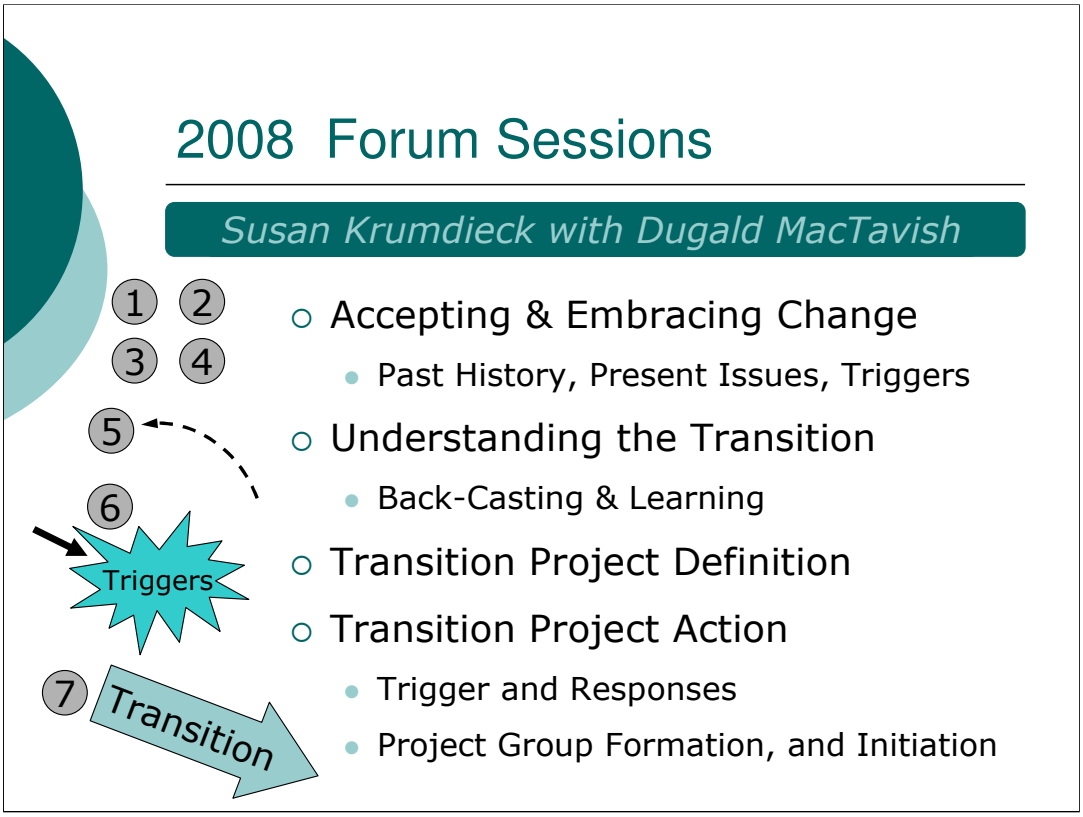


The rest of the talk gives an example of transitioneering work that the AEMSLab group has done with a South Island community. We are using this kind of work to conduct research and develop transitioneering methods and capabilities that our students can deliver professionally after they graduate.

I'll briefly show you how we did this transition engineering project to help a community move through the process and start on transition projects. Then I'll explain in more detail the design of a trigger that I developed to help a group of about 75 people move on from awareness of big problems and issues, and vision of possibilities, examination of their responses and opportunities and barriers into action on primary change projects.



There were two weekend workshops. In 2007, Myself and David Holmgren gave different presentations and led discussions. These presentations represented the types of information and thinking that fit with the transition project framework.



The forum this year, started with a review of the first workshop, then led into some new and interesting ideas about triggers and ways to help people understand and learn from their own responses to stories about possible (very possible) futures. For more information about this workshop, look for the Oamaru transition workshop on our website: www.aemslab.org.nz

The design of the workshop was tailored specifically for this community and the position they were in. The design was very successful with 8 projects initiated and still continuing to make progress.

Now I'll present a trigger design that I have developed for helping a group of people deal with information and facts that are not positive and up-lifting.

My research on how people process and deal with difficult circumstances that are largely beyond their control revealed that this is what myths do. They help people to mentally process situations and moral dilemmas that are beyond the every-day, mysterious, or incomprehensible.

The problem is that we don't seem to have a myth in our culture that deals with people in the situation we now find ourselves. There are some reflective stories like Dr. Seuss' *The Lorax*. But that is another expression of the situation, not an exploration of the human spiritual challenge and possible appropriate actions.

I chose *The Lord of the Rings* story as presented by the Peter Jackson films. The dilemma that the characters face in the trilogy is strikingly similar to the problems we now face, if you accept my premise that the root of the problem is the self-destructive power of pursuing "economic growth" and adhering to an un-verifiable economic premise that the MARKET will provide the most efficient distribution of resources and always provide for growth in consumption. There is a growing consensus of thought among sustainability scholars, beginning with the work of Meadows in the 1070's, that the fundamental assumption of sustainable growth and sustainable development is the root of the destructive un-sustainabilities now being carried out as economic activities.

It's too late to avoid changing our world, but we will have to take immediate dramatic action to avoid disaster.

Mastrandea & Schneider *Science* 2004

"I know there is not much point now in hoping. If I were a knight of Rohan capable of great deeds, but I'm not. I'm a Hobbit. And I know I can't save Middle-Earth."

The long buried treasure….and curse

It was coveted, precious

It was the key to great power, dominion, and wealth

They should have heeded the warnings

But the power was so alluring
So perfectly corrupting
The power could not be denied

The Dark Power

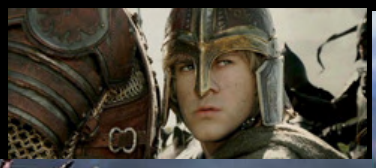
Became a hunger, a need…
Became the driving force of conflict, hatred, inhumanity

The Power became Destruction

Dark was rising, Hope was fading, Courage was failing

The Final Battle

"I don't want to be in a battle. But waiting on the edge of one I can't escape is even worse."



The Last Hope of Fools

An impossible task, for those without might to rid the world of the power that was destroying it.

The Final Battle

"We cannot achieve victory through strength of arms"

The Final Battle

Could only be won by a change of heart and mind, with the bonds of fellowship

"What are you waiting for? Just let it go!"

The Final Battle
Begins with a Brave Decision

It is a long, painful and dangerous journey through Mordor to do what must be done.

But it is the ***decision*** to go that is the turning point.

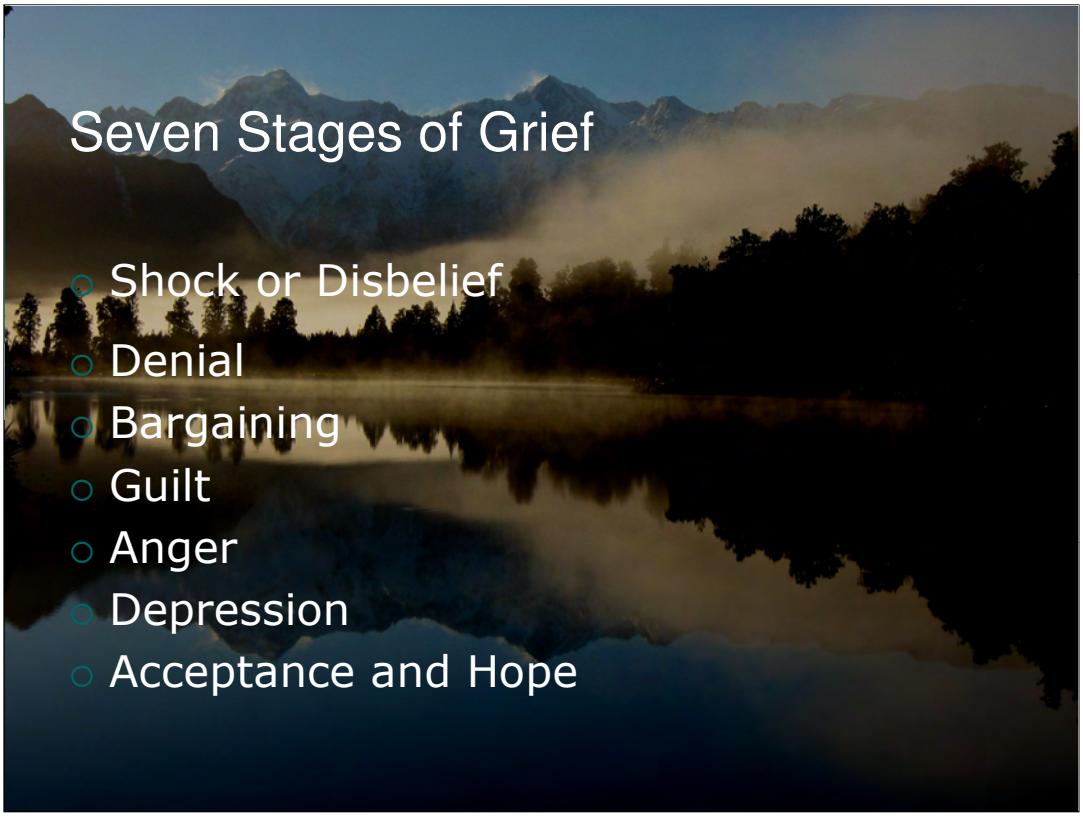
"I don't think there's gonna be a return journey, Mr. Frodo."

If you don't give it up…

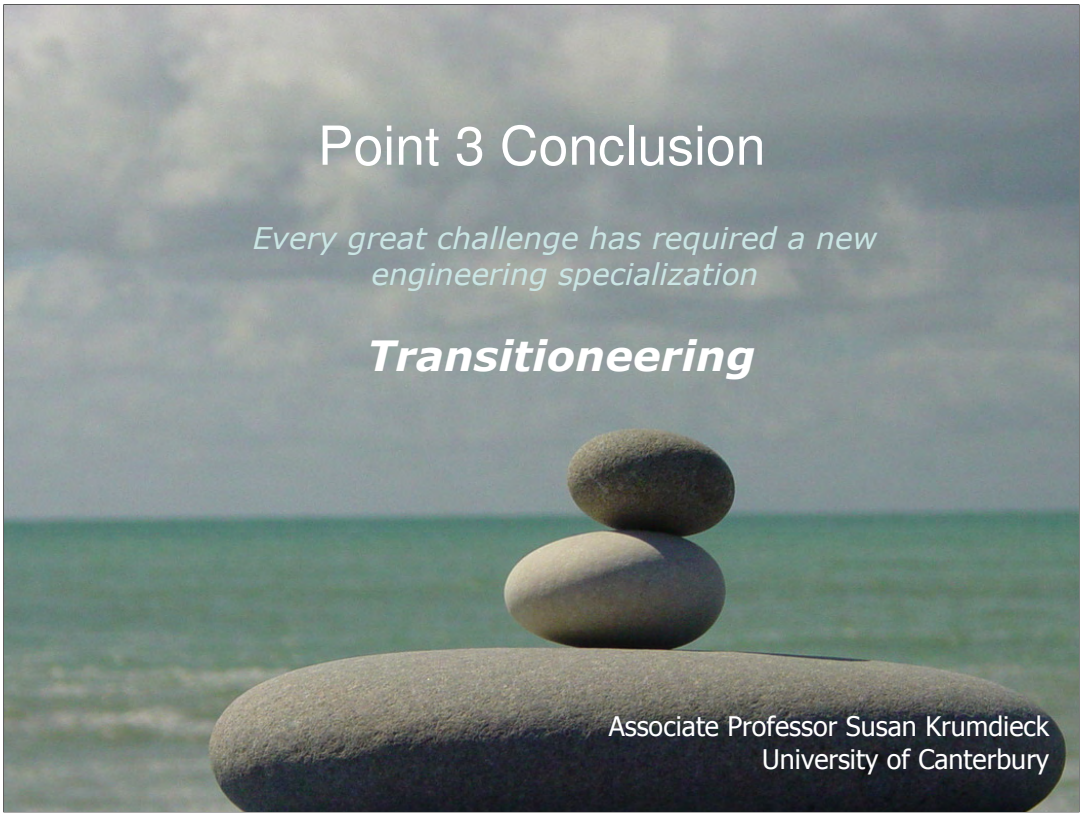
It will destroy you


The Transition Town Journey
begins with the decision to give up the
power of economic growth as we know it,
growth in consumption, growth in impacts


Can’t we continue with growth, but substitute Clean and Green Technologies?
Solar
Wind
Hydro
Biofuel
Wave
Nuclear
Hydrogen
False Hopes for Sustainable Growth


Seven Stages of Grief
Shock or Disbelief
Denial
Bargaining
Guilt
Anger
Depression
Acceptance and Hope

The Pop-Mythology design has been used at several other public workshops and seminars, and has thus far been found to be very effective for participants.


Point 3 Conclusion
Every great challenge has required a new engineering specialization
Transitioneering
Associate Professor Susan Krumdieck
University of Canterbury