

# RISE OF THE SUSTAINABLE CIVILIZATION FROM THE ASHES OF THE OIL EMPIRE: The Nature of Social Change and the Role of Engineering

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**The Fall of Rome.**

## Abstract

*Only a sustainable system can function sustainably. Economics, technology, regulation, environmental impacts and costs are the context for individual choice, they are not the reason for it. The irresistible driver for any civilization is continuity. If the people could see and experience the context of continuity, then the journey to that destination could begin through deliberate action. Through integration of the disciplines, and utilization of 21<sup>st</sup> Century technology, we can forge a new capability to envisage the architecture of a sustainable civilization, and the implement for realizing it through strategic change. The alternative route to change is both conceivable and inconceivable.*

## Introduction

If there has been one constant in human history, it is that things change. Humans have always been subject to the same environmental pressures for change as all other species and have adapted to the resources and challenges of their habitat around the globe. Unlike other species, humans experience change factors that originate from within as well as in response to the environment. This is an important distinction. All of nature adapts to the surroundings, evolving to new forms in integrated, complex synergy with the whole ecosystem. Humans adapt their surroundings to themselves, to greater or lesser degrees with industrial-age civilizations achieving the penultimate capability of catastrophic change of the entire planet. Historical evidence demonstrates this capability for active change when resources are plentiful and adaptive change when disasters strike. Is our

civilization impelled to follow the historical cycle of rise and decline?

This discussion paper proposes that our historically unprecedented capabilities in science, information, computation, communication, visualization, engineering modelling and simulation, can be integrated to forge a new capability for constructive, deliberate change. The idea is based on a systems view of civilization in the resource and environmental context. It holds that continuity is the inexorable driver for all civilizations, through the irrefutable fact of constraints on resources. The process of positive change is to first develop a concept of a sustainable architecture, then to develop a scenario of the specific infrastructure developments which would lead to the *sustainable civilization*.

The paper begins with an examination of ideas about change, how we fear change and how we express that fear, yet how we also embrace and celebrate changes which we perceive as development or *progress*. In this

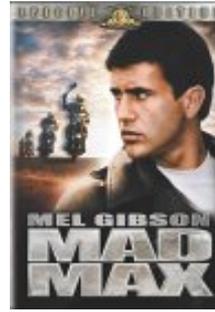
discussion, the point is made that the current ideology, referred to as the *oil empire*, has elevated the idea of supply and demand economics to the status of fundamental law. This ingrained idea now jeopardizes the prospects for peaceful and prosperous change. The concluding section introduces the work of a new interdisciplinary research initiative at the University of Canterbury. Using the system continuity theory of civilization structure, the group is discovering the architectural fundamentals of the sustainable society and developing the modelling, communication, and visualization technology necessary to provide answers to the real questions of the rise of the sustainable society from the ashes of the oil empire.

### **Nature of Change: Rise and Fall**

Things are going to change. From ancient times, scholars have been fascinated with the fall of previous civilizations. How did it happen? What went wrong? Didn't they see it coming? Couldn't they find solutions? Weren't they as smart as we are now? An interesting commonality in the collapse of high cultures is that these events are not pretty. We understand these events as disasters of people's own creation. If there was a historical example of an established and prosperous civilization that changed gracefully, in a planned and organized way into a new form, it would be prominent in our history and legend. Such a *metamorphosis* would be celebrated in light of all of the disintegrations, falls, collapses, and mysterious disappearances of entire civilizations.

We know history. Our psychological mechanisms for self-preservation leave us disinclined to contemplate the possibility of our own civilization's demise. We hope we are different from our ancestors. Hope preserves us, but it is not a strategy. We have faith that the future is in God's hands, or that new technology will be developed, or that we will find the resources we need. Faith uplifts us, but it is not a plan.

### **Perception of Change**



#### *Change is Frightening*

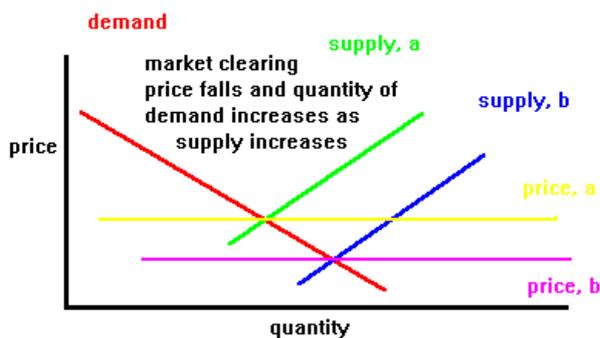
People are afraid of change that they perceive to be forced on them. This fear is often expressed in our pop-culture mythology, adapted from age-old ideas of struggle, triumph, and tragedy. The popular culture is widely disseminated through entertainment and virtual reality games. Few of these visions of the world's future are uplifting. They reinforce fears of change. Unfortunately, those that are positive, like the Star Trek genre, are also implausible. The vast majority of modern mythology is set in the context of a world out of control. We appear to be doomed to the folly of our own technological achievements. A popular author, Michael Crichton, utilizes a common theme that tragedy arises from not recognizing the difference between what you *can* do with science and what you *should* do. On the big screen, we learn life's lessons that people who look to technology to solve their diplomatic problems may lose control and end up at the mercy of their own Terminators.

Is all of this just the way people have always dealt with anxiety, or is it an expression of our feeling that we are diminishing our prospects for the future, and we don't know what to do about it? Is it just entertainment, or does the mass media reflect the collective understanding of impending risks?

#### *Change is Progress*

We embrace change. New products, growth and development are the roots of prosperity. The *law of supply and demand* has indeed become the law of the land. If you supply a new and interesting product or service, then there will be a demand for it. If customers want or need something, then the market will provide it. Profit is spun out of the dynamic dance of the "next new thing". Engineers and scientists can always be hired to produce new designs for next year's model, find new

scents for laundry detergent, or provide new materials and faster computers. The market economy of sustained growth is such a tenet that all other analysis is conducted in this context. What is the cost of a tumour caused by toxic chemicals? What is the estimated full cycle cost for extinction of four species of frog? What is the economic value of a fragment of native bush? What is the price of human life?



### *Growth is Intrinsic and Incontrovertible*

Things are going to change. Will the oil empire necessarily go up in flames? Oil, natural gas, and coal make possible virtually every activity, crop and product in the oil empire. Even more worrying, the empire continuously requires *more* of these and other resources, at the cheapest prices, to sustain its measures of prosperity.

The tenets of the oil empire include a very serious and fundamental flaw, which diminishes the prospects for avoiding a catastrophic change scenario; the belief that the technology to supply more energy and sustain growth will become available through price signals. The longer that this fallacy holds sway, the more destructive future change scenarios will be.

The oil empire has many illusory and distracting ideas which are presented as solutions, but which serve mostly to allay fears of change and maintain the status quo. Of course, to citizens of the empire, low cost solar cells and hydrogen fuel cells appear to

provide answers to the problem. The core issue, however, is the definition of the *problem* not the science and engineering of the solution. The problem for the oil empire is that over the next twenty years, world oil and gas energy demand is expected to increase by 30% over today's production rate, while oil and gas production rates from existing resources are projected to decline by 50%. (ExxonMobil Report on Energy Trends 2004) The law of supply and demand requires that this demand will be met by the lowest cost option.

We propose that the problem definition is flawed. The problem for the oil empire is: provide 80% more oil and gas by 2020. The problem for the sustainable civilization is: use 50% less oil and gas by 2020.

### **The Ashes of the Oil Empire**

The oil empire will end in the early part of this century. The most difficult change will be in the collective perception of the way things are. The oil empire understands only growth and does not have mechanisms to manage constraints. This is the fundamental functional flaw in the system. Countless well-intentioned scientists, engineers, and

#### **Preserving the Oil Empire**

- More Energy: more oil and gas through technological advances, exploration and development of unconventional resources
- Hydrogen Economy: potential new fuel and power systems for automobiles
- CO<sub>2</sub> Sequestration: solution to global climate change through separation and storage of emissions from coal and natural gas combustion.
- Sustainable Growth: oxymoron
- Renewable Energy: Replacement of fossil fuels with renewable energy or increasing energy supplies through developing renewables.
- Natural Capitalism: technological advances for improved energy efficiency

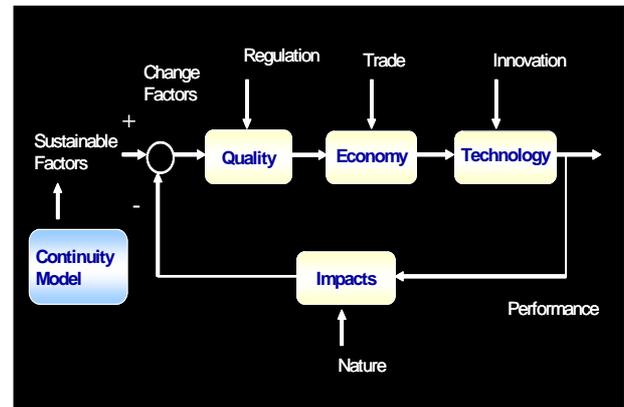
business people work to develop hydrogen vehicles, reduce the cost of renewable technology, and improve energy efficiency, but these *solutions* don't begin to address the fundamental issue, that the resources people want more of do not exist.

Continuous growth despite the fact of constrained supply is not the only conceptual flaw with the oil empire philosophy. The free market and the economy are understood to be the driving force of the entire system when they are actually expressions of the relationships between people. There is, necessarily, no control and no direction provided by relationships, they are consequential not causal. Technology represents the tools that people use to go about their chosen work and other desired activities, not the *reason* that they do those activities. People at home, business, industry, and on the farm make decisions based on the achievement of desired outcomes, and these decisions are negligibly affected by consideration of environmental impacts. People make decisions and go about their activities in the context of their social, economic, and regulatory environment, using the technology, infrastructure and resources that are available to fulfil their needs and desires. The cost, sustainability, and environmental impacts of their decisions are secondary, minor, or even not considered as factors in these decisions.

The citizens of the oil empire continue to use the technology of their system in exactly the manner it was designed for. The services that people gain from the energy they use have never been more impressive. And yet, because they inherently understand the fallacy of continued growth in consumption of finite resources, a darkness and fatalistic sense of doom pervades thoughts of the future. Historically, humans have shown that they are capable of achieving what they envision. We can hope that the future will not look like Mad Max, but hope is not a strategy.

## The Rise of the Sustainable Civilization

Sustainability can never be achieved through consumer education, solar hot water heaters, carbon taxes, recycling, improved efficiency, reduced consumption or positive thinking, as long as the tenets of the oil empire survive. A sustainable system can only be achieved through design. In order to begin working on the energy and resource architecture for the sustainable civilization, the fundamentals of the dynamic behaviour and relationships between system components must be understood. The figure below shows the basic structure of the theory of continuity for the energy/environment/resource system of a civilization in a given locale.



**Continuity Theory** (Krumdieck and Wood 1989)

As individuals go about their daily activities, they make choices about which technology they will use, how much money they wish to spend, and how efficiently they will use resources. These decisions depend on cost and availability, and on behavioural predispositions which may arise from regulations, values and culture. For example, in the transportation sector, individuals have the choices of walking, biking, driving a car, a motor scooter, or taking the bus. They may also decide to carpool. While hydrogen-based fuel cell cars would be an interesting option if people are willing to spend \$70/km for transportation, it is not an option which actually exists due to technical feasibility issues. Individual decisions are made within the context of what is available through the

mechanisms of the local economy. Thus the economy represents a relationship between people and other parts of the community system.

The technological infrastructure of the region is the main focus for theoretical modelling. People using the existing system consume energy according to the characteristics of the technology and the greater structure of the infrastructure. It is the cumulative effect of individuals using technology and resources available through the market to do what they want to do that produces the ultimate performance of the system in terms of consumption of primary energy and production of wastes.

The feedback in the system consists of the energy and resource consumption, but also includes the impacts which result from the activity in the system. This can include the pollution, safety issues, and the amount of resources remaining available for consumption. It is in the feedback loop where the impacts of nature feed back into the system and in turn have an effect on the activities of individuals. If the actual performance of the system is in balance with the sustainability factors, then there are no pressures for change through adaptation. If the consumption is not sustainable, then there will be pressure for change.

In the theory development one of the most important new concepts is that a model describing how a sustainable civilization would perform would need to be developed in order to generate the sustainability factors. This is a novel concept. The state of international research focuses on finding technologies for *improving* the sustainability of the oil empire. The continuity theory proposes that sustainability must be fully understood, conceptualized, and realized in the system design and construction. Monitoring of the system performance and impacts would then be required to maintain sustainability.

In a continuity-based system, people have free choice, but the context of their choices means that, no matter what they choose, the consumption of resources and the environmental impacts are sustainable. The primary question posed by the continuity theory is:

*What are the characteristics and forms of a sustainable civilization, and how does it work?*

### **The Way Forward**

Continuity research can supply answers to this question through existing information, calculation and modelling techniques, plus adding new ideas and concepts from architecture. Once we can conceive of a sustainable civilization in terms of technology, infrastructure and balance of resource consumption, then it will be necessary to communicate the results to people from all walks of life. This imperative can also be achieved using existing virtual reality capabilities.



**Architectural conceptualization and structural design and realization**

Through the discovery of sustainable forms for a civilization in a particular locale, many new insights into strategic planning for change are gained.

The research that could actually provide some answers to the real problems of change from the oil empire to the sustainable society has been initiated at Canterbury University. We have already gained insight into the issues of sustainability and have realized new ideas which will be developed into new products and strategies for change toward continuity.