1
INTRODUCTION

> *The point is not to see who may be the more correct, but to see the areas which will be particularly vital in the future and also to note some of the profound moral, ethical, and human questions which will be raised.* - Sir George Thomson

The purpose of this book is to present a forecast of what steady state means for humankind by addressing the direction of changes required to achieve steady state. Any forecast is laced with the assumptions and value judgements of the forecaster. Some of the following content in this book might be as yet unfamiliar to the reader. Nonetheless, this is the time where I bear a responsibility to be frank and candid to the reader by listing my assumptions and value judgements which relate to the following pages.

A forecast can be a plan or a prediction. We plan those events subject to our control and predict those that are not. This book is a combination of both plan and prediction. The following pages support my conviction underpinned by logic and hard evidence that humankind will not prove to be an exception to the laws of growth and thermodynamics. Humankind is and will continue to be subject to the same laws of growth as any other organism on Earth. When our high-grade fossil fuel energy resources are eventually too expensive in energy terms to further extract from the ground, humankind will either live in a homoeostatic, steady state, symbiotic relationship with the entire ecosystem on Earth or face extinction. I make the assumption that humankind will continue to survive for many millennia into the future. I have no wish to be foolhardy and make rash predictions. Instead I will attempt to predict the future we are able to have rather than the future we would desire to have.

The following diagram maps growth in our human population and use of resources, including energy, from the past to the present and projects alternative paths into the future.

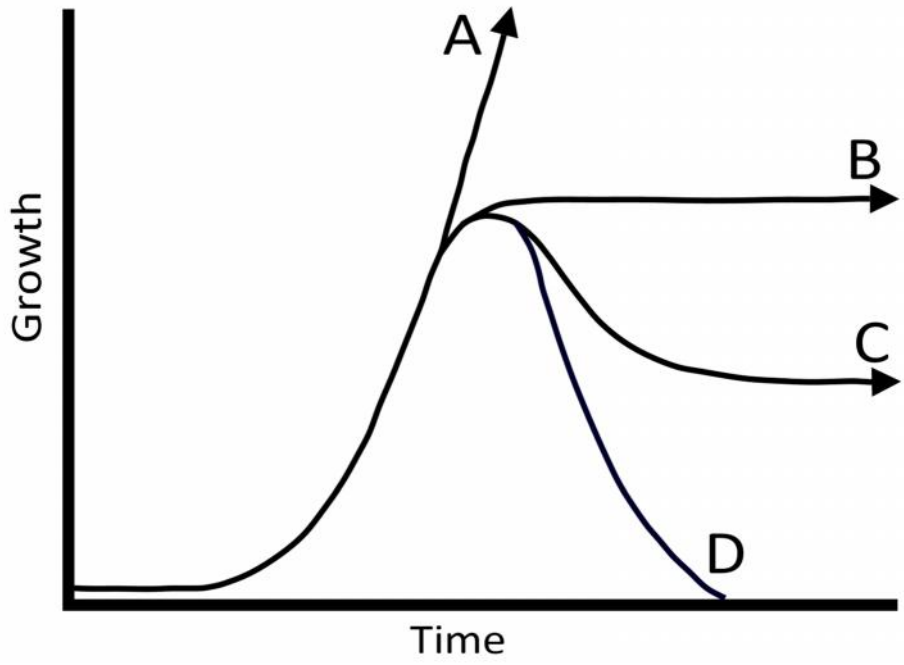

Figure 3 -1 Alternative Pathways into the Future

Pathway A which shows continuing growth into the distant future is a nonsense. Non-renewable energy sources such as oil, coal, gas, and shale are finite and the surface area of our planet Earth is also finite. Our human population simply cannot continue to grow forever, and because humankind is totally dependent on using energy for survival, our species will either eventually become dependent on using renewable energy resources or face extinction.

Growth in human population, energy use, and the use of mineral resources cannot continue. At some stage in the future there will be a transition from growth to either a steady state or a decline and eventual collapse to extinction. Possible future paths include Pathway B which is a logistic pathway to steady state, Pathway C which shows a decline over a hump down to a lower level of steady state, or Pathway D which is a collapse to extinction.

The actual level of steady state that is possible as depicted by Pathway C depends on the availability of renewable energy and mineral resources, the level of human population, and the carrying capacity of our species within the total ecosystem on Earth. There will be fluctuations in the level of steady state because regardless of whether future society is based on a market or planned economy or a mixture, there are likely to be periodic runs on the use of resources which need to be curbed and reeled back in.

Whatever the overall level of steady state might be, there will be a gradual and inevitable decline in that level because it is physically impossible to 100% recycle the mineral resources that we are currently reliant on using in a technological society. As time progresses, it will become more and more energy expensive to extract mineral resources from the ground. The peak production process that applies to extracting oil and other non-renewable energy sources from the ground also applies to mineral resources used in a technological society. 100% recycling is possible in natural ecosystems, so an inevitable decline of a technological society might result in a return to a hunter-gatherer society with a much-reduced population in the far distant future. As Nicholas Georgescu-Roegen (1971, p. 304) has put it, every additional Cadillac today represents a reduction in the life support system of distant future generations. Ultimately Earth will face a fiery death when in a few billion years' time the Sun will expand into a Red Giant. We need not dwell on the far distant future. Our immediate challenge is to confront a transition from fossil fuels to renewable energy in the here and now.

Pathway C, a decline over a hump down to a lower level of steady state, is more likely than a gentle logistic transition from growth to steady state as shown in Pathway B for the following reasons. Humankind currently faces a double whammy. In order to avoid severe consequences of climate change, we need to curb our use of fossil fuels which adds greenhouse gases to the atmosphere and we need to transition over to renewable energy sources. Setting up alternative infrastructure that provides and supports renewable energy will require additional use of fossil fuels at the very same time that we need to curb our use of those fossil fuels. In the long run, viable renewable energy source systems need to be able to maintain and replace themselves in order to be truly sustainable, but renewable energy systems are unable to bootstrap themselves through a transition without assistance of fossil fuels in the short-term.

There are already indications that we have reached the stage of peak conventional oil where the rate of conventional oil production has started to decline due to factors of diminishing returns which are covered in more detail in a later chapter. Ideally, humankind needs to divert the use of fossil fuels from unnecessary consumption to that of investment in renewable energy. However, regardless of voluntary curbing of the use of fossil fuel on consumption, peaking of all forms of fossil fuels will increasingly limit the rate of supply of fossil fuels in the future. Delays in enabling a transition from fossil fuels to renewable energy can only but exacerbate the difficulties of transition over time.

The big question is whether we are able to simultaneously curb our generation of greenhouse gases and transition to non-renewable energy. Given our response over the last 40 years to early warnings of climate change and the consequences of peak oil, I have no confidence that both targets will be met. I am essentially an optimistic pessimist. I want there to be and hope for a smooth and peaceful transition to a stable steady

state economy for all nations with greater equity between and within all countries. However, given the multiplicity of information and data from diverse and what seem to be the most reliable sources of information, I fear that the future before 2100 will be strife for millions around the globe. Society has ignored warning signals about both climate change and peak oil over the past 40 years and tends to respond only to emergencies. I suspect that even now insufficient action will be taken in New Zealand and other countries to fully address the issues of climate change, peak oil, and the need for zero population growth.

Yes, the elephant in the room is population growth. Steady state for humankind means zero population growth (ZPG). If all countries were to immediately adopt a policy of ZPG, then the global population would continue to grow for a number of decades despite the low growth and even declines in the natural population of a number of developed countries. Continued increases in population during a transition from fossil fuels to renewable energy can only but result in a Sisyphus like undermining of any efforts for a smooth transition.

Continuing with a focus on Pathway C, renewable energy currently includes hydro-electricity, phytomass (plant material), wind power, solar energy concentrators, photovoltaic cells, geothermal power, and tidal waves. The scale and extent that each of these energy systems can be used by future human settlements depends on the availability of mineral resources needed to create these energy systems, the resulting net energy produced by these energy systems, and the convenience of the form of energy that is generated. For example, hydrogen is a convenient concentrated form of energy suitable for transport, but the production of hydrogen does not result in net energy because it takes more energy to produce than the energy content available in the hydrogen. Hydrogen is a convenient carrier of energy, but is not an additional energy source independent of the energy required to produce it.

I have a strong value judgement against the use of nuclear fission as an energy source on ethical grounds that we bear a responsibility to future generations of humankind and other species not to endanger their existence and leave them a heritage that will have to be guarded for centuries. This book is also concerned with technology that we have already developed. Should our level of technology improve in the future to include nuclear fusion, then the carrying capacity and the consumer level of life could both increase, but within limits which are addressed in subsequent chapters in this book.

We, our children, and our grandchildren are privileged to be living in a period of transition that is unparalleled in the entire history of humankind. The decisions and actions that we have made in the past and the decisions and actions that we will make over the next number of decades have and will limit the options of future generations. We need clear visions of alternative pathways to transition from growth to steady state. I trust that this book will provide some measure of contribution to that vision.