OFFICE OF THE PRIME MINISTER'S SCIENCE ADVISORY COMMITTEE

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Bringing science and policy together for good environmental outcomes

Hauraki Gulf Marine Park Seminar, Auckland Museum

22 August 2012

New Zealand faces many challenges, but perhaps the biggest is how does one balance resource conservation and environmental protection versus resource use and economic growth. This issue exists whether we look onshore or offshore and consider our very large and potentially resource rich marine estate. Two important questions follow: What trade-offs are involved in these decisions, and how do we choose which technologies to use to best effect and when should we limit their use?

Clearly our collective environmental conscience has grown in recent years as the impact of a growing and demanding population has impacted on the planet. Some might argue we can ignore growth in this equation, but that is utopian – sustaining 40% more people on the planet, many of whom quite rightly expect far better standards of living, will involve more energy, more food, more medical care and more resource use generally. There is no getting away from this even when we look at New Zealand in isolation. So how to fulfil what is needed while protecting an increasingly compromised planet?

The simple reality is that everything we do involves trade-offs. I have found that many people are uncomfortable about the word 'trade-offs'. Some would rather talk about 'balance' or 'equilibrium' or ecosystems. But in the end all are saying the same thing. Perhaps some try and avoid the expression 'trade-off' because emotionally it is harder to accept than saying balance or equilibrium. But trade-offs are inevitable at every level, from the planetary to the individual. In our own lives we prioritise – nearly all of us will prioritise our family and domestic economy over the environment no matter how much we value it. While one does not have to be rich to value the environment, it helps, which is why an interest in environmental protection rises as economies become wealthier.

Trade-offs are often portrayed as binary – more of this means less of that. Actually it is much more complex with all kinds of interactions and feed-back loops. What we are really looking for is optimal configurations that handle multiple and simultaneous demands. Thus settings on any one domain affect the settings of many of the others in non-linear ways.

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Optimisation does not mean any one domain is set to a maximum. Optimisation is about the identification of and the choice amongst options. This is in effect the nature of policy formation. And trade-offs are hard – that is why we elect politicians to make them. While we tend to focus in discourse about measures of economic progress, in reality, in considering trade-offs we also need to consider human, social and natural capital as well as dollar value. But again this is hard as it is very subjective.

But unfortunately in New Zealand too much of the discussion has been trite in imagining that trade-offs can be avoided or things can be changed without trade-offs: a much more sophisticated discussion is needed and science and technology are essential in informing the appropriate solutions, especially when we look at the interplay between the environment and other considerations.

But to take the best from science, we need to consider how we can move from a rather limited understanding of new technologies where there is often accidental or even intentional confusion between science and politics, values and philosophies. In what ways can knowledge have a much stronger role to play in our society? We also have a horrible tendency to confuse the technology itself with its application. It is generally the latter than needs to be controlled by society but we have tended to focus on the former and thus we may at times find ourselves boxed into corners we need not be in.

There is *no* challenge that we will face over coming decades that will not depend on science. And this does not just mean research in the laboratory or field setting, science must be owned by society as it has a critical role to play in the essential public dialogue on these matters.

Science and technology can help us find ways to use resources more efficiently, be it water for irrigation or environmentally friendly sources of fuel for transport, heating and energy. There is the undoubted prospect of some degree of win-win for both the economy and the environment if we can improve productivity while consuming such resources more efficiently or creating less pollution. Indeed one of the hoped for outcomes of greenhouse gas research through the NZ-led Global Research Alliance on reducing agricultural greenhouse gases is that we can increase agricultural efficiency through reducing methane production while sustaining food production.

But evaluating technologies and deciding on the trade-offs must require a much more scientifically aware, literate and engaged population. This will be essential if a participatory democracy such as ours is to navigate through the opportunities and threats associated with these challenges and the rapid changes that technology brings.

Sadly we have a relatively high level of dissonance between what we know and what we accept – sometimes to our cost. We have seen the potential global tragedy that has

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emerged because of the political rejection of the science of climate change in some countries.

Science is not just a collection of facts – rather it is a particular way of observing the natural and built world so as to gain a better understanding of it. It is wrong to assume science is about certainty, for in most of science certainty is not possible; it is largely about reducing uncertainty. But science, both formal and informal, remains the only process we have to gather reliable information about our world on any scale and from any perspective. To reject this is to reject the very basis of logical assessment of the challenges we face.

We are in danger of underestimating how much the nature of science has changed over recent decades; it used to be focused on linear questions, those aimed for reductionist precision. But much science has undergone radical change particularly as the biological and environmental sciences have come to dominate. The ensuing complex science has another dimension – it involves the consideration of values. Typical examples include the protection of biodiversity, food security, the use of genetic modification and the reality of climate change. These are issues of high public concern and political complexity. Such values-associated science has been termed post-normal science and can be defined as the application of science to public issues where facts are uncertain, values are in dispute, stakes are high and decisions are urgent. So by their very nature these characteristics mean that science is now intimately linked to and intertwined with the values and concerns of the public and body politic.

I have spent time on this issue because it is important that science is not seen to be something inaccessible or arcane. Science is part of, not distinct from, society. Science provides some forms of knowledge but societal decisions are properly made on many other grounds with strong value domains. These include community values, public opinion, and fiscal and electoral considerations; they are critical to policy making. In short, the role of science and scholarship is to provide the value-free knowledge and options for society to opine on using these other value-laden dimensions.

But at the interface of all these decisions involving trade-offs is a complex interaction that is reflected in part by the concept of risk. This may be the biggest elephant in the room. Risk means different things to different people – scientists may talk in mathematical probabilities, politicians think of risk in an electoral sense, the public generally see risk through 'system one' thinking, to use the decision theorist terms i.e. that which is instinctive and emotional. For most perceptions of risk are biased by who benefits. We have different attitudes to risk if we think we can benefit, rather than if we think someone else benefits. For example, we are happy to break the speed limit for our advantage and take the risk but conversely we are angry when someone else overtakes us at great speed. It is little different from when we think about oil wells or sources of energy. Too often our debates have been

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superficial, dogmatic and ill-informed – often emotion prevails without knowledge or consideration of the trade-offs.

We are proud of our environmental consciousness and we need to be as a trading nation dependent on selling in high quality food. But we must not confuse bottom-up efforts based on passion with the need to have a scientifically based approach to environmental protection. The best ideals will only be moved forward through scientific input. We have a particularly high environmental risk and there is need for world class defensive biosecurity research. This is inevitably painstaking and slow but in reality there is no alternative.

We need to understand what is the scope of our natural resources both biological and mineral? There is apparently an abundance of both offshore, so how should we manage, conserve and exploit them? The problem of decisions made on the basis of entrenched uninformed views is that it can fix positions in a political process that may not be in the best interest of NZ. Risks will always be assessed emotionally but those emotions should informed by what is known.

So how can science help take us to where we want to go? Public science has many purposes and it is important to have much more holistic and informed understanding of what its intents are.

To this effect, I want to comment on a couple of areas. Broadly, we need research that enhances our national identity, be it to understand our peoples and their history, or our indigenous flora and fauna, or our environment. We need research to understand and best manage our natural resources for both economic and conservation reasons. Conservation science is complex and can lead to important but not necessarily intuitive decisions. Again we come back to the issue of trade-offs.

At a high level, think about some of the trade-off decisions that we might face. Genetic modification has had a difficult history in this country, but could we accept genetic modification approaches that would enable nationwide eradication of possums or a solution to the problem of kauri dieback? Would we be more accepting of increased resource extraction if at least some of the revenues were applied to conservation research?

Let me drill down a bit on conservation research, if you will excuse the pun. Many decisions made about conservation are somewhat arbitrary – a line on a map is drawn and that defines a reserve. But there is in fact a large body of science that can be brought to bear in shaping such decisions. Has an ecosystem been preserved? Is there sufficient biodiversity and population density to be able to handle environmental change? Are buffer zones needed? How do we exclude pests and diseases from designated areas? These are real issues with real solutions based on science.

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And when it comes to protecting biodiversity and particular species we need to ask what we are doing. We tend to focus a disproportionate amount of resource on iconic species or subspecies – often after the species has reached an almost irreversible tipping point. But what about the less iconic species of plant or insect, like say blowflies that provide keystone ecological services to a habitat? Thus, what are the criteria for making us value one species over another? What is the cost of protecting one arguable subspecies versus protecting entire ecosystems? Thinking on such matters is often emotional and uninformed by analyses such as population dynamics and the development of food-webs.

Clearly everyone would love a planet and an environment which is pristine, but that cannot be. Just by existing, we humans impact on ecosystems and there is now a colossal number of us. Our impact is ubiquitous and now climate change is the most obvious result. We need to use models to anticipate extinction risks while there is still time to respond. It is this type of conservation science that has much to offer.

We have another challenge. As Simon Upton once said, we are the last bus-stop on the planet. Our flora and fauna evolved for 80 million years separated from other ecosystems. The plants and animals were not challenged by exotic and invasive species from elsewhere. As a result they are inherently very vulnerable to humans and their exotic animals such as cats, dogs, stoats, weasels and possums. The effects have been catastrophic. For example 40% of the country's native bird species have disappeared since humans arrived 700 years ago. Neither has the threat stabilised, with bigger and faster ships and planes threatening to bring in yet more weeds, pests and diseases. This is why we need effective biosecurity research – and we are actually rather good at it.

Ultimately the primary discussion at any level, from global to local, will be about the balance between resource conservation and resource exploitation, using these terms in the broadest sense. A mature conversation will depend on a solid evidential base which only unbiased science can provide, whereas the weighting of paths and priorities leading to decisions must be based on values that the whole community must own.

One simple example suffices to make some points about the environment and technology. In theory we could add at least 15 billion dollars per annum to our national bottom line by selling more milk – without adding one more cow to our national herd. The genetic potential of our cows is now such that we know that if they could be fed to their maximum potential we would double or triple our milk exports, and as last year's Fonterra results show, we certainly know how to sell milk. We could increase the value of this milk further through research – but more slowly – by developing value-added products such as foods with proven health advantage. So as a first step all we have to do is feed and care for the cows differently. And now comes the trade-offs and issues. How do we deal with effluent and run-off – a particular problem for the Hauraki Gulf – and what would we feed the cows on? Yes

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this is likely to involve more grain, more palm kernel and so forth, and would we need feedlots? Would GM-based forages make sense? Are such interventions acceptable?

What would such a discussion mean for the national conversation and national self-image – are we able to separate emotion, science and politics? We really must make our judgements based on what we know and do not know – but as we will face an ever increasing number of new technologies we need to have more calm conversations better informed by science rather than being based on visceral reaction and dogma.

Thank you.

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