Executive summary

From
Future Dilemmas: Options to 2050 for Australia's population, technology, resources and environment

Report to the Department of Immigration and Multicultural and Indigenous Affairs

By CSIRO Sustainable Ecosystems

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Executive summary

1 **Three population scenarios are physically feasible to 2050**

Using an analytical framework which represented the physical transactions underpinning the Australian economy, this study compared the effect of three population scenarios on infrastructure, resource and environmental issues out to the year 2050. The three population scenarios were determined by net immigration rates of (i) zero persons per year, (ii) 70,000 persons per year, and (iii) two thirds of one percent (0.67%) of the current population size each year. These population scenarios were meant to reflect approximately (i) the policy position of some environmental organisations (ii) the most likely outcome of current immigration program settings and (iii) the population growth rate preferred by Australian business interests. After the many permutations and combinations of numerous simulation experiments, all three scenarios were found to be physically feasible. All three scenarios carry with them a number of rewards and risks that merit wider public debate by proponents of each policy position. More detailed analysis of the many issues that lie outside the terms of reference of this research report, would also benefit from such debate.

2 **The zero scenario gives close to 20 million people by 2050**

The zero scenario sees a domestic population of 20 million by 2050. The rewards of this scenario include smaller increases in energy usage and subsequent emissions, potentially more robust physical trade balances and perhaps the opportunity to focus on refurbishing national infrastructure, rather than making more of it. The risks include the possibility that mature aged workers may have to work longer and harder, a potential loss in economic confidence if the nation cannot replace economic growth due to population increase with another source, the potential for terminal population decline if birthrates do not increase, and the problem of decline in rural areas and some regional cities.

3 **The base case scenario gives 25 million people by 2050**

The base case scenario gives 25 million people by 2050 and that population size should be maintained indefinitely if the assumed birth rates and immigration rates are maintained. This scenario involves continuing growth in a number of major cities and regions, perhaps the continuance of current beliefs as an aid to innovation, a steady progression to a more or less balanced population size and structure by 2050, the potential to refurbish the physical metabolism of our urban areas under conditions of moderate growth, and options to enhance the transition from the old economy to the new economy. The risks of the base case scenario include the potential to stay with moderate but inadequate measures of environmental management because they are comfortable and known, and a retention of the old industries because they are profitable and historic.

4 **The 0.67%pa scenario gives 32 million people by 2050**

With net immigration of 0.67%pa, Australia's population increases to 32 million people by 2050, and to 50 million people by 2100. The rewards of this scenario lie with a continually growing economy, a strong home base from which to mount export industries, possible synergies that come from service clusters and competition, and the formation of a number of world-sized cities to act as hubs for international commerce. The risks lie with the potential for continually expanding energy use and greenhouse emissions together with a potential

decoupling of the large urban agglomerations from the base of ecosystem services that support their lifestyle and function.

5 **Ten important issues**

Running parallel to the direct population effects posed by the three population scenarios, the study has identified ten major issues that must be dealt with during the next human generation, whatever the population number and structure by 2050 and 2100.

- Air emissions in city airsheds and traffic congestion
- Dependence for personal mobility on continuing supplies of oil and natural gas
- Loss of land in the agricultural heartlands and increasing salinity levels in river systems
- Dependence of physical trade exports on old economy manufactures and commodities
- The place of mature-aged citizens in the national workforce
- Greenhouse gas emissions from the fossil energy sector
- The per capita levels of material flow underpinning the monetary economy
- The energy and material content of personal consumption
- Incentives for large-scale investment in long term natural capital
- The steady transition from an old 'physical' economy to a new 'brain' economy

6 **Four levels of population influence**

In accounting for the direct and indirect effects of population on resource availability and environmental quality, the study has proposed four levels of population influence (direct influence to more diffuse influence). Behind these levels is the assumption that over the long term, all national management is eventually undertaken for the good and betterment of the nation's citizens. The first level is a direct one where a population has basic requirements of food, water, habitation and transport. The second level relates to the effects of lifestyle and scale where rising standards of living enable more sophisticated requirements to be met. This can have both positive influences (better systems of environmental management) and less positive influences on resource use (more leisure time, more short holidays, more transport energy usage and more greenhouse gas emissions). The third level relates to the physical trade effect whereby Australia exports of goods and services are exchanged for imports. The physical trade balance is the physical component of the nation's balance of trade accounting where goods from agriculture, mining and manufacturing contribute to payments for imports. The fourth level relates to the level of international debt. Positive population influences occur when moderate imports and strong exports produce lower international debt levels and a more resilient economic structure. The opposite is true over the long term, when higher imports and lower exports increase international debt levels and potentially increase the complexity of managing the nation's future affairs.

7 **Where will new cities be located?**

The key urban issues in all scenarios relate to the increasing material flows into our cities, and the degree to which this continues to grow as population grows and affluence increases. There are many opportunities for technological and management efficiencies but there is little evidence of major change. Adoption of the higher population scenarios would require a

decision on whether to grow the current cities on their margins, or form new cities. If the latter option were chosen, by 2100 under the 0.67%pa scenario, the equivalent of 90 cities the size of Canberra would have to be located and established.

8 **Bold actions required for farmlands and rivers**

Most resource issues relate to the broadscale loss of land in the farming heartlands, the prospect of increasing river salinity and river depletion and the continuing loss of habitat and biodiversity resources. Bold actions are required under all population scenarios: for example it may be necessary to reforest and refurbish 10 to 20 million hectares of cleared land. This might reverse the broadscale slow moving trends now underway, but the physical and monetary requirements of such a proposal are enormous.

9 **Greenhouse gas targets may not be achieved**

The underpinning of current national productivity and lifestyle by fossil energy resources, and the complement of current technologies will continue to see total greenhouse gas emissions growing for all population scenarios, even if advanced technologies are implemented. A combination of the zero population scenario and a 'factor-4' economy (a radical innovation in material processing) does bring greenhouse emissions close to the 1990 benchmark levels, but this is considered an unlikely combination. The supplies of domestic oil and gas are critical to the nation's mobility and constraints on availability may occur after 2030. Strategic options for transport fuels should be explored with time horizons of the next 50 to 100 years.

10 **Water use set to double**

Water extraction from the managed water system is simulated to increase from its current level of 24,000 gigalitres per year to over 40,000 gigalitres per year in line with continued growth in agricultural production under all population scenarios. Supply constraints mean that the only way to meet these expectations would be through a major expansion of irrigated agriculture in northern Australia. Such expansion brings many risks, not least the risk of irrigation salinity and river decline, but this need not be so. While population size strongly influences the need for urban water, transfers from current agricultural usage are expected to maintain requirements in most areas. The location of new cities is critical for the 0.67%pa scenario in the period 2050 to 2100, when large urban concentrations might outgrow regional water availability. While urban water systems are sometimes characterised as being creaky with age and under-investment, with the right mix of technology and policy innovation, we should be able to maintain water quality particularly if the integrity of city water catchments, and their ecosystem services, are improved.

11 **The physical economy**

For much of the twentieth century, growth and development proceeded unhindered by any shortage of natural resources. That situation may well continue in this century as technological innovation and substitution of materials (eg ceramics for metals) continue. While the concept of limits is still hotly debated by opposing ideologies, it is apparent that the capacity of the natural world to assimilate the waste and effluent from modern industrialised economies is reaching its limits. Thus, productive agricultural systems in Europe pollute water bodies and natural vegetation with overflows of nutrients. Modern cities accumulate a wide range of toxic materials caused by the products of both industrial metabolism, and personal consumption. Understanding the physical dimensions of modern economic systems is central to the concept of ecologically sustainable development (ESD). The philosophy of the physical world that underpins the monetary economy has been implemented in the *Australian Stocks and Flows Framework* used in this study. Some of the outcomes of the study will inevitably differ with contemporary viewpoints. However in time, the 'physical economy' viewpoint should develop

as a strong complement to traditional macro-economic analysis, as both streams of national analysis are used together.

12 **Resource use and the rebound effect**

When technical efficiencies are introduced into a nation's energy system or its farming, fishing and mining sectors, it is often assumed that the resource requirements from the physical economy will stabilise and then fall, as the innovation penetrates the production system. In fact, resource use generally increases as production efficiencies improve. In both the physical and monetary economies this perverse outcome is termed the 'rebound effect'. This study has not implemented the rebound effect in any of the technological innovations simulated in the various scenarios. It is therefore possible that we may have underestimated simulations of resource use, pollution generation and personal affluence effects. Managing the rebound effect within the physical economy is one of the greatest challenges to national policy design, whatever population and development options are chosen for Australia's future.

13 **Six core dilemmas requiring national policy consideration**

While there is no single solution to the complete set of options and challenges facing the nation over the next 50 years, six core dilemmas posed by the population scenarios are presented. These relate to population ageing, physical trade balances, energy use and greenhouse gas emissions, per capita material flows, resource availability and environmental quality. It is perhaps possible for a concerted policy attack on two or even three dilemmas in unison, but there are many interactions, where advances in one area can undermine the function of another. Perhaps a revolution in thinking is needed before a combined resolution of the six dilemmas is possible.

14 **Australian affluence and lifestyle**

At the core of the analyst's inability to design more reasonable environmental outcomes for the three population scenarios is the issue of physical affluence and lifestyle, that is the degree to which energy and material flows are entrenched in our daily lives. In general, even an aggressive implementation of technological innovations did not solve the challenge satisfactorily. Under the current economic and social structure, the growth of lifestyle and affluence represent important stimuli to economic growth. More thought and analysis of the energy and material implications of Australian lifestyle patterns and trends are required before reasonable conclusions and new designs, can be proposed.

15 **Population proponents and defence of their scenarios**

Finally in drawing a list of 10 conclusions in Chapter 7, a set of challenges is presented to the policy proponents of the three scenarios. This is an attempt to set some boundary conditions for the next round of the national population debate. The zero scenario proponents might suggest how economic growth rates can be maintained in the face of a declining population. The base case scenario proponents might develop detailed plans to deal with greenhouse gas emissions, land loss, river salinity and urban air emissions. The 0.67%pa scenario proponents might present well honed plans on the location of 90 new cities the size of Canberra over the next 100 years, greenhouse issues, oil and gas availability and everything else as well. While there is much work to be done by the proponents of each scenario option, this analysis should facilitate innovative thinking by highlighting the nature and the scale of the many challenges that face Australia over the next two human generations.