ECONOMIC IMPACTS OF MIGRATION AND POPULATION GROWTH

SUB MISSION TO THE PRODUCTIVITY COMMISSION

ENGINEERS
AUSTRALIA

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EXECUTIVE SUMMARY

Historical benefits from migration are widely accepted among Australians, and have formally been demonstrated in a variety of studies. It is clear from research into the ageing of the Australian population that the main vehicle to drive economic growth will need to be policies to raise productivity growth. *Engineers Australia* believes two key options to achieve this will need to be the further enhancement of Australia`s innovation policies and policies to overcome present underinvestment in infrastructure and policies which ensure future opportunities in this area are identified and taken up expeditiously.

Engineers Australia recommends that the next phase in developing Australia`s innovation policy adopt the techniques of microeconomic reform to develop an understanding of why some firms innovate while others do not, the factors inhibiting innovation by firms, the critical role of enabling skills in ensuring successful implementation of innovation and the importance of individuals and individual behaviour in fostering creativity and innovation.

Engineers Australia supports the development of a social and business environment conducive to and receptive of creativity and innovation. The elements of this initiative would ideally include an appreciation that innovation potential exists in all industries and that innovation is presently occurring in both high and low technology industries , that it involves new technology, new processes and new ways of using old technology and processes. Particular emphasis would need to be given to overcoming inhibitions to innovation and managing innovation risk.

The issue of current under investment in infrastructure has been documented. Overcoming underinvestment will take time and offers more than a temporary economic stimulus. Existing technology and processes would raise the average level of technology embodied in infrastructure thus lifting productivity growth. The context of lower labour force participation and the resultant smaller labour force in the future makes it imperative that unnecessary constraints to economic activity be avoided while maximizing opportunities for productivity growth.

The full long term implications of migration on population growth over the long term require techniques suited to that context. *Engineers Australia* believes that the techniques outlined by the CSIRO study Dilemmas Distilled offer the opportunity to develop more useful future pathways data which can in turn become the input to more conventional macroeconomic model of the economy. In this way the models could include how major economic stock concepts change in response to changes in the scale of the population knowing that the data reflect engineering and scientific feasibility. This approach also offers the opportunity to explore the implications of policies to mitigate energy use and greenhouse emissions to name two of many sustainability dilemmas posed by future growth. This approach will also help to identify areas requiring new technological solutions and areas where human constraints are likely to be most critical.

Engineers Australia is concerned about current and prospective skill shortages in Australia. While no doubt the market should play a role in resolving these shortages, the home grown supply of entry level engineers is barely growing and the emphasis in engineering schools appears to be preoccupied with an ever increasing proportion of overseas students who now constitute over one third of all award completions. Certainly it is true that current migration options ensures that a proportion of overseas engineering graduates stay in Australia because of the revolving door of on-shore visa mechanisms.

However, Australia cannot rely on this approach long term because the behavior of prospective migrants depends on the migration policies of other migrant receiving countries as well as those in Australia. *Engineers Australia* believes a more balanced policy combining support for the development of the skills, including the engineering skills, of Australian residents, together with a continuation of skilled migration is appropriate in the future. While it does not appear to have been a major issue in the past, there is emerging evidence that Australia is losing a growing number of its skilled citizens to overseas opportunities. Our skilled migration policies need to be reviewed to incorporate this potential vulnerability.

INTRODUCTION

Throughout its history migration has been a key aspect of Australia`s population growth. Indeed, Australia is one of the few countries in the world which has consistently accepted permanent settlers and this has shaped the characteristics of the modern Australian society. Migration, particularly post War migration, has contributed to a significant increase in the scale of the economy, and this underscores much of the debate about the future course of migration. On the one hand, conservationists argue that population growth should be limited; while on the other hand, wholesale growth through both natural increase and migration is urged by the proponents of population or perish. Settling on an appropriate intermediate course requires a more balanced consideration of the issues, including the most appropriate way to analyse the implications of population and population growth over a long time period.

A variety of studies have shown the economic impact of migration to be beneficial for the Australian economy and there is no reason to suppose this will not be the case in the future. Much of the support for this positive impact rests on the relatively high average skill levels of migrants compared to the average skill level of the resident population. The dominant issues for the Australian economy in the future are likely to be associated with population stabilization and ageing, given current natural increase and migration policies. In particular, the workforce is likely to be relatively smaller and much older. The impacts of these changes can only be avoided by adopting unusually high levels of migration. An approach like this simply exchanges one set of problems for another. But whatever level of migration is adopted it is vital that the full gamut of resultant impacts is explored.

Despite their undoubted sophistication, the economic models used in Australia are not well positioned to explore the scale implications of population growth. In particular, the specification of conventional models is in terms of economic flows and the models are designed to explore small departure from the status quo. A common assumption, the existence of constant returns to scale, inherently underestimates the effect of increasing population. *Engineers Australia* argues that the strengths of conventional models needs to be supplemented by other techniques more suited to long term projection. In this way it may be possible to address a range of issues which are not well represented at present. Even modest migration will, with generally accepted assumptions about natural increase, lead to large increases in population. In turn, a larger stock of Australians will have profound implications for other stock concepts such as housing, urban roads, energy and infrastructure generally. *Engineers Australia* believes that suitable long term analytical techniques need to be employed, in conjunction with conventional models, to fully understand these implications.

Future continuation of relatively high rates of economic growth in Australia appears likely to be more dependent upon productivity growth than in the past. Drawing on

available evidence, there is reason to believe that moderate migration intakes will need to be supplemented by other policies. This is not to suggest that the past positive influence of migration will no longer apply, rather it recognizes the difficult task of overcoming the negative influence on productivity growth of contraction in labour supply and labour force participation due to the ageing of the population. *Engineers Australia* believes that overcoming underinvestment in Australia`s infrastructure will contribute to increases in Australia`s economic growth and productivity for many years to come. As the scale of the population changes over time further opportunities in this area will become available. Infrastructure renewal is not only an economic stimulus in itself, but facilitates the conduct of general economic activity in the most effective way possible. Infrastructure renewal also offers significant opportunities for technology upgrading which brings with it further productivity growth.

Engineers Australia is also committed to the further enhancement of Australia`s innovation policies. The start made by Government in this area is essentially a top down macroeconomic approach. While supportive of current policies, *Engineers Australia* believes these now should be complemented by microeconomic policies based on the reasons why firms innovate and the business circumstances inhibiting innovation. There is a tendency in some quarters which places undue reliance on population as the main driver of growth in Australia. *Engineers Australia* believes that a more balanced approach, combining some population growth through migration, investment in innovation, and investment in economic and social infrastructure, is the key to raising productivity growth to the levels required by national aspirations.

There are already shortages of engineers in Australia and further economic expansion will make this problem more acute. A future economic direction oriented towards productivity growth will not be possible unless these and other skill shortages are resolved. Australia is acquiring more engineers through skilled migration. *Engineers Australia* is the assessment authority for prospective immigrants and is firmly of the view that skills assessment should continue to emphasize comparability to Australian standards. Without this scrutiny productivity potential is undermined.

Australia needs to do more to strengthen the production of home grown engineers. It is wholly inadequate for a country to aim for economic growth through productivity enhancement, and at the same time, rely unduly on migration to develop the skills necessary to implement its growth path. For some time now the proportion of overseas students graduating from Australian engineering schools has been rising. Recent changes to migration regulations have accentuated that trend to the point where some courses are effectively operating as screening instruments for the migration program. *Engineers Australia* is not opposed to skilled migration and accepts that this is a sensible policy option at times of skill shortages. However, *Engineers Australia* believes that higher education outcome trends show emerging signs of distortions arising from incremental change in skilled migration policies. *Engineers Australia* believes that long term policy is better characterized by greater balance between skilled immigration and developing the skills base of existing residents and their offspring, particularly in engineering,

Australian migration in an international context is briefly reviewed in the next Section of this submission. This is followed by a brief discussion of the economic impact of migration on the Australian economy. Population policies are intended to influence the overall size, as well as the composition of the Australian population. Typical macroeconomic models do not handle well the stock implications of longer term changes of this nature. Section 4 considers an alternative approach to assist in overcoming this difficulty. The submission then considers options for raising productivity growth to compensate for the productivity depressing effects of a smaller an older workforce. The final Section of the submission considers the interplay between ,igration, skill requirements and growth in the Australian economy.

2 AUSTRALIAN MIGRATION IN AN INTERNATIONAL CONTEXT

United Nations[1] statistics for the year 2000 show that Australia had numerically the 9th highest international migrant stock and ranked 11th in terms of the proportion of migrants in the population. While free migration to Australia began in the 1790`s, these outcomes were largely the product of *planned* post 1944 immigration programs. The underlying objective of post 1944 programs, to increase the overall size of the Australian population and hence the economy, has been undeniably successful. Today almost one quarter of the current Australian population was born overseas and some 43 percent of Australians were either born overseas or have at least one parent who was born overseas[2]. Immigration during this period comprised mainly people of working age and under 50 years of age which had the dual effect of supplying the voracious post-war demand for labour and reducing Australia`s aged dependency rate.[3] Many contemporary calls to raise Australia`s immigration intake are based on the belief that the scale effect on the Australian economy can be repeated and in the process at least partly offset the effects of an ageing population. Australian employers, who are not renown for their support of training, also see migration as a readily available solution to labour shortages.

Comparatively few countries account for the bulk of the international migrant stock. In 1970 Australia was one of 23 countries (or 10 percent of all countries) which accounted for 75 percent of the international migrant stock. By 2000, the number of countries accounting for the same proportion had only risen to 28, or 12 percent of all countries. The significant common outcomes of international migration in developed countries were to increase population growth by about 15 percent above natural increase, with the opposite impact in developing countries. A key point is that Australia, Canada, New Zealand and the United States are among the few countries in the world which admit immigrants for permanent settlement.[4] Indeed, the Australian discussion of migration remains rooted in considerations about permanent settlement, even though, as will be seen below, migration policies have shifted, opening the way for greater temporary skills intakes.

International migrants are increasingly concentrated in developed countries. In Australia, between the years 1970 and 2002, the composition of migration intakes has changed significantly

- The proportion of migrants from developed countries fell; from 69 percent to 41 percent.

- The proportion of migrants from developing countries has increased from 20 percent in the mid-1950`s to a peak 60 percent in 1990-94.

- The proportion of migrants from economies in transition has fallen from 12 percent to 6 percent.

- The proportion of migrants from Asian countries rose from 12 percent to 40 percent with a peak 51 percent in 1990-94.

In selecting its immigrants the Australian policy has had an increasing focus on skilled workers and a diminishing focus on family reunion and humanitarian intakes. In 1991 the proportion of skilled workers admitted was 45 percent, a similar proportion to the United Kingdom and Switzerland who recorded 49 percent and 47 percent respectively. By 2001 this emphasis had become more pronounced in all three countries and the proportion of workers admitted increased to 55 percent for Australia and Switzerland and to 54 percent for the United Kingdom. While the proportional intakes of family reunion migrants was relatively high in 1991 (47 percent, 51 percent, and 42 percent respectively for Australia, Switzerland and the United Kingdom), this emphasis was diluted more recently (to 33 percent, 42 percent and 35 percent respectively) to make way for the greater share of skilled workers.[5]

In Australia`s case, the proportion of skilled workers migrants rose rapidly from 37 percent in 1991 to 60 percent in 2001. Similar proportional increases in skilled worker intakes occurred in Canada and New Zealand, although at different intake levels. Despite being like Australia in the early 1990`s, the United Kingdom did not press ahead with a skilled migrant emphasis as hard and for as long as Australia, Canada and New Zealand. The proportion of skilled immigrants in the United Kingdom was only 7 percent in 1991, it rose rapidly to 33 percent by 1999 and then plateaued at that level through to 2001.[6]

These outcomes contrast dramatically with policies in the United States, Denmark, France and Sweden. Here the emphasis in immigration policies lay with family reunion and, to a lesser degree, humanitarian intakes. There was little change in the position of these countries in the years leading up to 2001.It is important to appreciate how the difference in scale between the Australian and United States migration intakes bear on intakes of skilled migrants. The United States admitted 175,000 skilled immigrants in 2001, swamping the 54,000 taken in by Australia. However, the United States intake was only 17 percent of its overall migration intake, and was simply a continuation of past policies which have favoured family reunion and humanitarian migration.[7]

Another notable aspect of the development of international migration is the rising significance of temporary workers admitted under skill based categories. The Australian situation is comparable to the developments in Canada and the United Kingdom. In 1992 the three countries admitted respectively 41,000, 70,000, and 54,000 temporary skilled workers. By 2000 these numbers had risen to 116,000, 94,000 and 124,000 respectively.[8] Hugo points out that this is a significant shift in Australian migration policies which in the decades following 1945 have favoured permanent migration.[9]

More recently Hugo and others have examined the characteristics of these temporary migrants concluding that they are "generally highly skilled people,---. Most are in their prime working age and relatively well educated compared with the Australian work force. Many are from developed countries and speak English or another language which they use in their job. They are comparable to the top knowledge workers in Australia."[10] This sign of Australia`s participation in global skilled movement extends to Australians leaving this country to take up opportunities elsewhere.

3 ECONOMIC IMPACT OF IMMIGRATION

Conventional economics suggests that immigration influences the economy through both the demand and supply sides impacts. Demand is increased by immigrants' requirements for housing, food and clothing and other household durables and services, through the expansion of businesses to accommodate this, and through the expansion of government services. Supply is increased when migrants join the work force and through additional human capital embodied in the new workers. Some migrants are also in a position to bring additional financial resources and/or entrepreneurial skills into the Australian economy.

Migration increases the overall size of the population. DIMIA reports that in the 2001 Census 65 percent of the Australian population was of non-Australian ancestry[11]. This included people born overseas and their Australian born children. The corresponding enlargement of the Australian economy is of fundamental significance because it offers the potential for economies of scale. Economies of scale occur when equal proportional increases in economic inputs result in a higher proportional increase in economic output.

The focus of most of the migration literature has been on demographic issues, and has exhaustively examined migrant characteristics and labour force experience. There have been comparatively few empirical studies which have considered the economic impacts of migration. However, there are enough studies to shed some light on the issues, albeit obliquely, in some instances. Unfortunately none of them specifically deal with the scale effect of migration on the Australian economy.

Williams[12] was one of the first accounts of the application of Econtech`s migration modeling framework. She concluded that

- Migration has only small effects on living standards, with some groups experiencing a rise in their living standards while others do not.

- There has been skills transfer from migrants to the rest of the population and a general raising of the level of skill in the labour force through the presence of the migrants.

- Immigration does not increase the unemployment rate.

- Immigration has little impact on prices and wages.

- Immigration has little long run impact on the balance of payments.

- Migrants over the long term are net contributors to government revenues.

- Overall, migrations has a small, or at worst a neutral, impact on economic activity.

Econtech,[13] in a series of regularly up-dated studies using their MM2 model, extend the use of their framework to consider in greater detail the possible impacts of migration. Their approach is to compare a hypothetical zero migration situation to the long term equilibrium effects of the migration program, for a given year, continuing for 20 years. They concluded that

- The skilled migrant stream added 2.1 percent to annual living standards as measured by the change in consumption of goods and services per head of population and the small changes from the family reunion and humanitarian components canceled each other out. In monetary terms, the increase in living standards is $794 and is distributed differentially between existing residents ($658) and the migrants themselves ($2,000).

- The source of these gains were the net effects of an annual increase in labour productivity (0.9 percent), an increase in labour force participation (2.2 percent), and a fall in the consumption share of GDP as migrants diverted resources from consumption to investment to redress their relative lack of capital (-1.0 percent).

- State and Territory economies gain through increases in annual living standards of between 1.3 and 2.4 percent, increases in labour force participation rates between 1.8 and 3.4 percent and substantial 20 year gains in gross state product and consumption. The factors determining relative gains are the settlement pattern of migrants, the composition of migrant groups between States and the relationship between migrant characteristics and those of the resident population.

The Econtech model, like many macroeconomic models, assumes a fixed rate of productivity growth for the economy as a whole.[14] The results reported above are the productivity effects resulting from the average skill levels of migrants exceeding the average skill level of the existing population.[15] The model also assumes a long term unemployment rate of 6 percent. This assumption limits the model`s capacity to explore employment and unemployment issues. The increase in population scale is noted to be 11.3 percent but the implications of this are not explored and, in any case, would be limited by the underlying assumption of constant returns to scale.

A similar style of study by Access Economics Pty Ltd[16], for DIMIA, estimates the impact of the different elements of the migration program on the Federal Government`s budget. This study is primarily differentiated from the Econtech work by its focus on the fiscal balance for different classes of migration visas, whereas Econtech was concerned with the distributional impacts of migration across Australia. While the economic models are different they are of the same generic type. Access Economics found that:

- All visa classes in the skilled migration category offered significant net operating surpluses to the Federal budget. The gains from the Employer Nomination Scheme and the Independent Skill categories offered by far the highest gains.

- In time, the humanitarian groups overcame initial adjustment difficulties and began to return fiscal surpluses at around 15 years, but family reunion categories tended to be in fiscal deficits throughout the study period.

- The overall migration program was in fiscal surplus throughout the study period.

- When the model was applied to the (then) planned 2004-05 migrant intake the first year fiscal surplus to the Federal budget was estimated at $314 million and was estimated to rise over time to $908 million in year 20 in 2004-05 prices.

As did Econtech, Access Economics assumed constant productivity growth, in this case 1.25 percent,[17] with productivity influences introduced through the skill characteristics of migrants.

While its principal objective was the Economic Implications of Ageing, the Productivity Commission[18] included several migration scenarios in its analyses and economic modeling. Some conclusions were

- Had there been no migration from 1944 to the end of the report`s study period in 2051, the Australian population would be about half the size it is likely to achieve under reasonable demographic assumptions.

- Large historical migration has moderated increases in aged dependency ratios but has not prevented them from rising. Extraordinarily high migration rates would be

necessary to maintain the 2003-04 aged dependency ratio through to 2044 (3.08 percent per annum) and this would result in other problems.

- The report considered the sensitivity of per capita GDP growth to varying labour force participation and demographic scenarios against a base case which included annual migration of 115,000. Compared to the base case migration intakes 25,000 lower and higher would vary per capita GDP growth by about 1 percent in 2044. Real GDP per capita under the base case would be $72,708 and the high and low migration scenarios would result in $73,178 and $72,198 respectively.

There are similarities between the Commission`s models and those of Econtech and Access Economics. The models assume an annual labour productivity growth rates and average skill differentials between migrants and the existing population generate productivity changes. A similar mechanism drives variations in labour force participation. The three models assume constant returns to scale. There is agreement that migration has improved Australian living standards, labour productivity growth and labour force participation. These outcomes extend to States and Territories and migration has a positive influence on budget surpluses. The main explanation lies in average skill differentials between migration intakes and the rest of the population.

The contribution of migration to enlarging the Australian economy is generally recognized and acknowledged. However, the inherent nature of these models limits there capacity to explore scale issues. The models are best suited to do what they were designed to do which is to examine comparatively small departures from the status quo. Beyond this, the mathematics used to calculate model elasticities are somewhat stretched. In general terms the models are specified in terms of flow variables. To the extent that stocks are represented this is typically incorporated by including the flow of services attributed to that stock. For example, the capital stock is normally represented by the flow of services rendered by that stock and changes in the stock by the investment flow which creates it. When time horizons become more distant, stocks become more dominant. For example, when the population doubles is it feasible to leave infrastructure such as the stock of housing or urban roads unchanged? Will it be necessary to increase the stocks of housing or roads by the same degree, or by a lower or higher proportion? These are key issues for *Engineers Australia* and for the country`s future.

4 MODELLING THE LONG TERM FUTURE

Modern economic models reflect an immense theoretical literature in economics and econometrics. There are now several models of varying complexity in Government agencies and Universities and there are numerous examples of how these models have contributed to public policy. The models have strengths and weaknesses and their proponents are typically the first to point these out. Model elasticities and relative prices and wages can only be stretched so far when projecting 30 to 50 years into the future. This section argues that the strengths of conventional models needs to be supplemented

by other techniques more suited to long term projection. In this way it may be possible to address a range of issues which are not well represented at present.

Over 30 to 50 years, migration by adding to the natural increase of the population will generate fundamental change in population scale. The elasticities associated with migration, as estimated in conventional models, may be sufficient for short term decisions. However, over very long periods, a larger population will impact on a broad range of related stocks including water, energy and mineral resources, housing, and infrastructure. Over long time periods the age and longevity of stocks become serious issues for concern because in some cases embodied technology restricts desirable change, and in other cases, the age of an existing stock is different to human life spans. For example, better new cars and new houses will have little moderating effect on total energy use and green house emissions until the newer stock begins to dominate the older stock embodying now undesirable technology.

Engineers Australia for some time has been reporting on the status of infrastructure in Australia. This work now encompasses all States and Territories, and Australia as a whole. *Engineers Australia* believes that there is considerable under-investment in infrastructure. Engineers Australia`s work has been extended by the Australian Council for Infrastructure Development which quantified this under-investment to be $24.8 billion in 2004.[19] Modelling work undertaken by Econtech and others confirmed that redressing this under-investment was beneficial to the economy.[20] While it is gratifying to know that the investment contribution associated with addressing infrastructure under-investment supports the position adopted by *Engineers Australia*, it is essential that the full extent of future requirements is explored before research for this reference is finalized.

Population growth has serious implications for Australia`s future infrastructure stocks and for the paradigm shift to sustainable development. The drivers of population growth are natural increase and migration with the burden of public policy resting largely with migration policies. *Engineers Australia* believes that the present reference to the Productivity Commission would be incomplete without a robust consideration of the population scale implications of relatively large migration intakes. This requires a different, but potentially complementary, approach to modeling such as employed by the CSIRO in its 2002 study Dilemmas Distilled.[21] There is no merit in unbounded support for any particular analytical technique. Support for a different approach here is a horses for courses argument to ensure all consequences of population growth are considered.

The CSIRO approach was influenced by the techniques “of foresighting and scenario development”[22] used by multinational companies such as Shell to develop possible pathways to future development. These were complemented by the development of two system simulators. The first of these, called OzEcco, uses embodied energy to construct an energy-based simulator of Australia`s physical economy. The second simulator “is a highly disaggregated simulation framework which keeps track of all physically significant stocks and flows in the Australian socio-economic system.”[23] This module is called the Australian Stocks and Flows Framework (ASFF). ASFF models physical activity in a dynamic, non-equilibrium, framework. It comprises 32 linked modules that

treat "the complete range of physical functions as separate entities (crops, animals, people, cars, steel production, chemical production) and allows a detailed treatment of 'vintageing' or age for most big ticket items of physical infrastructure."[24] The elements of ASFF "are designed to complement shorter term policy analysis by testing pathways to the future that are physically feasible in an engineering sense."[25] The model allows for the progressive introduction of new technologies, maintenance of old infrastructure while new infrastructure is being built and sets the basis for selecting sustainable policy by evaluating alternative scenarios.

The CSIRO study was over sighted by an external reference group which in its report made the following observations[26]

- "The complexity and richness of the analytical approach affords both government and business the ability to look across sectors and institutional silos in a long-term context that spans human generations."

- "The study provides an empirical basis to refresh the national debate on sustainable development."

- "The study suggests that federal government policy should focus mainly on managing national stocks (people, infrastructure, energy, and natural resources) rather than national flows. In the main, the shorter term national flows should be left to the fleet footedness of market forces."

This submission, which must necessarily be brief, cannot do justice to the CSIRO approach. However, a review of some outcomes directly related to the continuation of relatively large migration intakes would be useful to illustrate *Engineers Australia* support. There are small differences between the CSIRO demographic assumptions and the ones used by others, including the ABS and the Productivity Commission itself. Given this caveat, the CSIRO begins with three population scenarios, the first assumes zero net migration, the second assumes 70,000 annual net migration intake, and the third assumes that net migration is 0.67 percent of current population each year. These scenarios are the zero, base case and high migration options respectively. Some important outcomes for the period through to 2050 are:

- The Australian population overall in 2050 remain largely unchanged under the zero migration scenario at around 20 million, grows to around 25.1 million under the base scenario and to about 32.5 million under the high migration scenario.

- The zero scenario confines most capital cities to their current population size with the exception of Brisbane and Perth which grow by around 34 percent. Base case migration could result in Sydney, Melbourne, Brisbane, and Perth growing by around 1 million people with smaller increases in the other capitals. The high migration scenarios could result in Sydney and Melbourne each increasing by 3 million people, Brisbane and Perth double in size to around 3 million people and the other capital growing by 40-100 percent.[27]

- All three population scenarios lead to higher requirements in the number of housing units. At the time the study was undertaken the number of housing units was about 7 million buildings. Under the zero migration scenario, declining numbers of persons per household and internal migration could still result in an additional requirement of 30 percent in the housing stock. The base case will require an additional 60 percent and the high immigration scenario will require an additional 100 percent. In all cases the change in the required housing stock exceeds the change in population by significant margins.

- By 2050, under the base scenario, about half the housing stock is expected to be less than 25 years old, the balance is expected to be 30-100years old. To reduce energy consumption to sustainable levels, policy on energy efficient housing and associated greenhouse issues will require significant lead time before any discernable impacts arising from the overall stock become evident.

- The base scenario will require an additional 3-4,000 km of urban roads and the high growth scenario an additional 7-10,000 km, increases of about 20 percent and 50 percent respectively. The main issues here will be increased urban traffic congestion which has already been the focus of a Bureau of Transport Economics Study which showed the economic cost in 2015 to be around $30 billion.[28]

- Under the base scenario overall water use in Australia is likely to rise from 24,000 GL per annum to about 40,000 GL. This in itself will represent a significant challenge, primarily in respect of allocations. The difference due to alternative population scenarios is a range of 3,000GL per annum or about 8 percent. The principal issue is likely to be water quality. Water efficiency holds considerable promise providing reforms can deliver them.

- A wide range of other key stock variables will change broadly in line with population growth with the relative size effect due to migration playing a broadly proportional role. Some of these are the stock of urban delivery vehicles, the energy used by them, the energy used by the car fleet, stock of urban roads in capital cities, urban vehicle emissions in Sydney, and urban water requirements.

- Several other factors do not change proportionally with population and migration and changes over time are characterized by stock saturation effects, bumps in the demographic profile and lags of different kinds.

Changes of the type described above are not unusual and need to be represented in models of the economic impact of migration on population growth. Some of the expected changes will be welcomed, at least within parts of the community, others will not. There is significant scope for public policy to influence the course of events .The CSIRO model simulates some of these, notably, the outcomes from water and energy saving strategies.

Engineers Australia recommends that the Productivity Commission reviews the CSIRO work and incorporates relevant pathways and changes as inputs into its own modeling in support of this reference. While the CSIRO model does not contain relative prices and, therefore, does not reflect the role of economic incentives and disincentives, it offers a way to model economies and diseconomies of scale associated with growing a larger population. Combining the information and analyses of different types of models offers the best of both worlds.

5 THE DRIVERS FOR FUTURE GROWTH

In its report on the Economic Impact of Ageing the Productivity Commission noted, that in "the absence of any resurgence in Australia`s workforce, economic growth over the next four to five decades will overwhelmingly depend on productivity growth."[29] This submission has already pointed to the serious under-investment in infrastructure and studies which show the potential for economic growth in addressing this. Similarly, a more holistic approach to broad policy planning in respect of migration and population growth will give rise to further opportunities for growth through infrastructure development by recognising the wider canvas it reveals. Many currently known and understood technologies can be embodied in new infrastructure investment leading to improvements in the average technology embodied in the total stock of infrastructure.

The imperative for productivity growth also puts into fresh relief the importance of the Federal Government`s innovation policies. *Engineers Australia* is strongly committed to the idea that continuous innovation is the key to growth and prosperity in the global economy. In the context of this submission the Commission is reminded of its own reference to Greenspan`s well-known quotation that "necessity is the mother of invention"[30]and that slower Australian population growth need not become the constraint that some believe in. In a modern world, Australia`s best chance of maintaining and developing its international competitive edge is to build a culture of innovation in all sectors of the economy. Australia has made a good start to the development of an innovation policy framework but needs to go further. The achievements of the Federal Government`s innovations strategy—*Backing Australia`s Ability*[31] –are impressive, but on closer inspection comprises largely of the policy elements that many of our competitors have had for many years. *Engineers Australia* supports the start made by the Federal Government and accepts that complex policy is inevitably developed incrementally over time.

Engineers Australia also supports the view that an appreciation of how innovation occurs in an economy will more adequately facilitate understanding of public policy options and the framework within which issues, such as, creativity and human resource skills can be considered. The key initiator of innovation is the firm. Firms innovate to drive profits, to respond to customers needs, to increase market shares and to establish new markets. To progress innovation policy in Australia these motivations and the key factors inhibiting innovation need to be much better understood. *Engineers Australia* strongly supports the adoption of a microeconomic framework and associated techniques to do this.

In this framework the key to promoting innovation will be tilting the playing field in favor of innovators to enable them to deal with the higher associated business risks. The failure in Australia has not been a lack of invention; it has been a failure to create the necessary business environment to bring sufficient of them to the marketplace. ABS statistics[32] clearly demonstrate that while at present innovation is widespread across industries in the Australian economy, only 35 percent of firms were involved.

In this context it is vital to dispel the myth that innovation is the preserve of high technology industries. In all OECD countries, high technology industries (those with research and development expenditure to sales ratios in excess of 4 percent) constitute less than 3 percent of country GDP. Even extraordinary innovation success by such industries is unlikely to affect growth to the degree necessary. Innovation potential exists throughout the economy in high and low technology industries and much more could be achieved by promulgating this message. An associated issue is recognizing that innovation can be achieved by the application of existing technology and methods to new applications. Similarly, greater care is needed in regard to language. Most references carelessly refer only to the association between research and development expenditure, but the statistics show that while undeniably important, research and development expenditure comprises only 32 percent of firms` innovation expenditure with the balance being devoted to non-research and development expenditure.[33]

Understanding why individual firms innovate while others do not is critical. Also critical is an understanding of the skill inputs required to ensure the gains from innovation are realized in the form of higher productivity and economic growth. Skill shortages could restrict the impact of otherwise good policy, whether it is intended to address innovation or for that matter, infrastructure development. *Engineers Australia* is particularly concerned that unless current shortages of engineers and the low output of engineering graduates from Australian universities are addressed, a serious constraint to economic growth will become entrenched.

6 MIGRATION, SKILL REQUIREMENTS AND GROWTH

For some time *Engineers Australia* has been drawing attention to existing and prospective shortages in engineering skills and to the declining output of University engineering graduates who are Australian citizens.[34] The Productivity Commission has in the past acknowledged that there are grounds for believing that "at least temporary skill shortages in specific occupations"[35] exist. The Commission goes on to say that "such specific occupational skill shortages (and excesses) are transitory, as training institutions respond to demand, industry structures change and relative occupational wage rates vary."[36] Without denying the importance of the market, *Engineers Australia* is not convinced that the market is producing appropriate outcomes in respect of engineering skills.

There is a tendency to overemphasize the growth in the total numbers of engineering completions in Australian Universities. Between 1994 and 2003 there was an increase of 4423 in annual engineering award completions in Australian Universities, comprising all undergraduate and postgraduate awards and degrees. This apparently impressive 59 percent growth to 11,943 award completions does not convey the true situation (Table 2 Attached). Entry level engineering graduates joining the workforce for the first time are typically graduates with a Bachelor of Engineering degree at either pass or honours level. The annual output of Australian domestic students in this category grew by only 970 between 1994 and 2003, from 4859 to 5829, or 20 percent over 10 years. In essence there has been minimal growth in the annual output of this group which is the main domestic supply from which new demand for engineers and the replacement of older engineers retiring from the workforce must be met.

The key driver of growth in engineering award completions in Australian Universities is overseas students. In the same 10 year period from 1994 to 2003, the annual output of award completions for overseas students was over three times greater than for domestic students. The number of award completions for overseas students grew from 988 in 1994 to 4100 in 2003, with course-work Master`s degree graduation increasing from 175 in 1994 to 1,716 in 2003 and Bachelor degree graduation rising from 559 in 1994 to 1997 in 2003. In 2003 about on third of all engineering course completions were obtained by overseas students These outcomes are associated with the direction of Government funding of Universities and does not sit well with documented evidence that qualified Australian high school graduates cannot find University places.[37]

Australian policy emphasis on skilled migration has contributed to the stock of Australian engineers. The bulk of the intake has been from migrants settling permanently in Australia. For the 8 years to 2002-03, an average 1,214 engineers per year arrived in Australia as permanent settlers (Table 1 Appended). The 2003-04 intake was more than double this at 2,707 reflecting renewed preference for engineers in recent years However, the proportion of migrant engineers employed in various specializations, has not been large, except in the case of chemical, industrial and aeronautical engineers.[38]

TABLE 3 MIGRANT ENGINEERS AS A PROPORTION OF EMPLOYED ENGINEERS AND ENGINEERING UNEMPLOYMENT, 2002-03

	Migrants Intake in Employment (%)	Unemployment Rate (%)
Civil engineers	1.7	1.1
Electrical and electronic engineers	2.0	3.0
Mechanical, production and plant engineers	3.4	2.9
Mining and materials engineers	2.5	3.6

Chemical, industrial and aeronautical engineers	6.4	2.8

The corresponding unemployment rates were also low providing indirect evidence that skill shortages persist.

Under the general skilled migration program *Engineers Australia* is the designated skills assessment authority. Assessments are undertaken before potential migrants apply for their visas and are independent of decisions subsequently taken by DIMIA to admit migrants. There are two ways in which assessments occur, depending on whether or not the prospective migrant comes from one of the Washington or Sydney Accord countries. The Washington Accord is an agreement between engineering education accreditation bodies in Australia, Canada, Hong Kong, Ireland, New Zealand, South Africa, United States and Japan in which the participants recognize each others accredited professional engineering undergraduate degrees. The Sydney Accord extends this to engineering technologists and incorporated engineers, but includes a smaller group of countries (Australia, Hong Kong, Ireland, New Zealand, South Africa, and the United Kingdom).

In respect of applicants from countries not signatories to these accords, Engineers Australia prepares a Competency Demonstration Report (CDR). This process provides applicants with the opportunity to demonstrate that their engineering knowledge is equivalent to Australian standards. Applicants are also required to provide evidence of English language competency in speaking, listening, reading and writing under the International English Language Testing System. An exemption from this requirement applies to native English speakers or to graduates from a Masters program from an Australian University.

Agreements of this nature are important elements in ensuring that migrants entering the Australian workforce present employers with credentials compatible with the grades of skills required. They are also evidence of the growing globalization of the skilled labour market in which young highly qualified Australians are increasingly participating. In the 7 year period 1995-96 to 2001-02, the number of Australian resident engineers who left Australia long term averaged 221. This trend was reversed briefly in 2002-03 when more residents who were engineers returned to Australia than left. However, in 2003-04 the net out-flow resumed and 666 more Australian resident engineers left Australia than returned.

There is a view which suggests that in this process Australia is losing its best and brightest talent. In 2001-02, for the first time, Australian born permanent departures exceeded foreign born departures.[39] This is part of a rising trend among Australian born persons evident since the mid 1980`s. This group is typically better educated, better remunerated and younger than the population as a whole and has given rise to speculation about an Australian ‘brain drain.’ Others dispute this concept and see the emigration of skilled Australian as part of an international “skill exchange”, arguing that the movement

in most cases is not permanent and that in time the returnees will bring enhanced skills and experience back to Australia[40].

The number of Australians now living and working permanently overseas has been estimated to be 900,000, or about 4 percent of the Australian population.[41] The impact in Australia has been offset numerically by positive net inflows of very competent temporary migrants. However, little seems to be known about differences in the levels and types of expertise and training exchanged and the consequential geographic impacts in Australia. Many engineering skill shortages in recent years are regionally based. Furthermore, as Hugo points out, the shift towards skilled migration, including the substantial increase in non-permanent visas has occurred in a context where the debate on migration issues has revolved around permanent migration issues.[42]

Engineers Australia believes that an improved understanding of the geographic redistribution of skills, particularly engineering skills is essential to a comprehensive review of the economic impacts of migration. Research undertaken by the Department of Employment and Workplace Relations indicates that despite falls in annualized engineering employment growth rates, there have been persistent skill shortages in the same occupations as measured by the frequency with which these occupations appear in national skill shortage lists.[43] Many migrants are attracted to major cities such as Sydney while the Australians they replace may well be distributed differently. Aggregate shortages exist alongside this problem.

To date, Australian skilled migration intakes, while large in the local context remain small by comparison to the United States and Canada.[44] However, the numbers of temporary skill visas approved by Australia now exceed Canadian numbers. The key issue according to Cobb-Clark and Connolly[45] is that Australian outcomes in attracting skilled migrants are not necessarily controllable by Australian migration authorities. They argue that Australian skilled visa applications are influenced by the skilled migration intakes of the United States (negatively) and Canada (positively) and economic circumstances in Australia. The implication is that long term reliance on skilled migration may become more risk prone if circumstances in the United States change.

Besides firming up policies on evaluating the skills of intending migrants, Australian migration policies have been changed to enable overseas students, on temporary visas, graduating from Australian Universities to apply, on-shore, for permanent residency. In this way the distortions created by University funding policies are being massaged to benefit the skilled migration intake. In aggregate, the number of visas approved in this way has increased from 5480 in 2001-02, the first year of this arrangement, to 14,441 in 2004-05[46].

So far as engineers are concerned, the numbers are respectively 252 in 2001-02 and 1,652 in 2004-05. Granted that these various arrangements are producing results, but at the same time they bring new meaning to the concept of economic efficiency. *Engineers Australia* is not opposed to skilled migration. This is evidenced by the role *Engineers Australia* is playing in assessing the skills of prospective skilled migrants. However,

Engineers Australia remains resolute in its support of reforms to training and higher education institutions to raise the production of Australian graduates essential for the growth of the Australian economy. Engineering schools ought not become de facto skills screening agencies for skilled migration.

TABLE 1
Net Gains to the Stock of Engineers From Permanent and Temporary Migration, 1995-96 to 2003-04

Year	Engineer Settler Arrivals (1)	Net Flow of Engineer Residents (2)	Net Flow of Engineer Visitors (3)	Net Movements of Engineers to Australia (1+2+3)
1995-96	1,333	-135	237	1,435
1996-97	1,144	-236	270	1,177
1997-98	1,190	-422	620	1,388
1998-99	1,221	-354	611	1,478
1999-00	1,327	-168	525	1,684
2000-01	1,365	-194	582	1,753
2001-02	1,055	-41	574	1,588
2002-03	1,079	100	530	1,709
2003-04	2,707	-666	946	2,987

Source; Bob Birrell,, Virginis Rapson and T Fred Smith, Immigration in a Time of Domestic Skilled Shortages, Centre for Population and Urban Research, Monash University, May 2005

TABLE 2 AWARD COURSE COMPLETIONS IN ENGINEERING IN AUSTRALIA 1994 TO 2003

Level of Course	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Doctorates	290	310	413	471	436	436	475	421	481	531
Prop of Overseas Students (%)	42.0	35.8	29.5	30.1	25.9	26.6	25.0	23.0	20.6	20.5
Masters by Research	261	249	239	261	230	195	190	207	188	194
Prop of Overseas Students (%)	36.0	28.9	24.7	23.0	28.7	26.1	24.2	29.0	21.8	23.7
Masters by Coursework	627	709	831	949	972	1,059	1,052	1,552	1,695	2,379
Prop of Overseas Students (%)	27.9	35.4	38.9	37.5	41.7	48.9	56.5	59.0	63.2	72.1
Graduate Diplomas & Certificates	574	582	630	698	650	554	513	517	484	556
Prop of Overseas Students (%)	5.7	6.9	13.5	22.7	19.5	6.5	17.3	20.9	31.0	26.1
Bachelors, Pass & Honours	5,418	5,923	6,008	6,330	6,559	6,507	6,613	7,719	7,469	7,828
Prop of Overseas Students (%)	10.3	10.7	12.0	12.7	15.4	19.1	21.5	21.5	23.4	25.5
Other Awards	350	349	217	175	150	170	129	297	519	455
Prop of Overseas Students (%)	1.4	2.6	5.5	2.9	6.0	6.5	6.2	6.0	7.9	19.1
TOTAL	7,520	8,122	8,338	8,884	8,999	8,921	8,972	10,713	10,836	11,943
Prop of Overseas Students (%)	13.1	13.7	15.8	17.2	19.2	22.1	25.4	26.7	29.1	34.3

Source; Engineers Australia Data Request from the Department of Education, Science and Training.

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