Futuristic Report: Building

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Scope
This report is designed to be viewed by people who have a vested interest in the future of Australian building techniques. It has been formatted to inform them about the ways in which the building industry will develop throughout time. The report itself is set in 2030, reflecting back on predictions that are currently being made. This report is purely fictional, but concepts have been based upon non fictitious statistics and trends.

(ECOCRED, 2012)
1. Introduction

The building industry was once extremely resource intensive. Building infrastructure accounted for 40% of energy consumed, 26% of CO₂ emissions and 40% of all anthropogenic waste (CSIRO, 2010).

This problem escalated with the increasing average floor area of new residential buildings, as quantified in the graph below. Resource consumption was thus accelerated by an increase in construction of buildings and infrastructure. If the issue was left unattended, base resource depletion would have been inevitable and our very existence would have been at immediate risk.

![Average Floor Area of New Residential Buildings](image)

(Australian Bureau of Statistics, 2013)

Within 20 years of building in Australia, we were able to improve our sustainability by 75% through innovations in construction techniques and retrofitting of the decrepit buildings.

This report explains the driving forces instigating the change in focus of the building industry by identifying the environmental and social drivers, as well as the responses made by the government and the building industry itself.
2. Environmental Influences

2.1 Introduction
The building industry has always been dependent on the condition of the environment. It provides both the materials and the space for structures to be built. Over the 4.5 billion years of the Earth’s existence (Hazen, 2010), the environment has evolved drastically. The more recent environmental climate has been ideal for the human civilisation to develop. Consistent weather patterns have allowed for agriculture to flourish and the Earth’s plethora of natural resources has induced humans to innovate in all forms of construction. There is no doubt as to how the recent environment and climate has affected the growth of civilisation. Now in 2030, the varying climate and environment has once again affected civilisation, diverting it in a new direction of innovation. The impending depletion and rising cost of natural resources have altered their application in buildings. The increased variability in climate, population and price of food has transformed residential and industrial development.

2.2 Resource Depletion
An awareness of the finite resources available on the planet has stimulated a change in their application. As resources become less abundant their value increases, thus promoting the recycling of materials that have already been extracted from the Earth. The amount of materials required for a build has been limited utilising recycled materials in collaboration with the retrofitting of old, vacant and dilapidated buildings. Rather than bulldozing an existing building, an assessment of the existing structure on its strength and serviceability takes place. The unnecessary and decrepit components are removed and appropriately recycled or disposed of.

If new concrete is to be poured in a structure, it is to be comprised of 60% or more recycled aggregate, which can be sourced from crushed concrete reclaimed from the building or other buildings. Wherever it is possible preference is given to recycled and recyclable products such as bricks, timber, steel and copper. If brickwork is to be used, bricks can be reclaimed from the parts of the building that were dismantled or they can be sourced from other buildings. The same method is utilised for metal elements in structures. Wherever possible steel and other metals used on buildings are reclaimed or recycled. All timber products are also reclaimed; some timbers have incredible durability, such as Redgum. Elements such as flooring and staircases if constructed using Redgum have extremely long life and do not require replacement. Timber that is not suitable can be recycled by engineering it into other products. There are a vast variety of engineered timbers that can be produced out of reclaimed timber. However if new timber is required it is sourced from pine plantations.
2.3 Rising Oil and Electricity Prices

The peaking of the world oil supply was not considered a policy worthy issue in Australia two decades ago (Coventry, 2011). In 2013 on June the 2\textsuperscript{nd}, the price of oil was merely $91.61 a barrel. 2020 saw oil’s value soar to almost double that of 2013 to be $200 per barrel. The woes however, did not end there as the cost sprouted again, this time to $300 a barrel in 2030. The cause for this proliferation in the price of oil was due to two main factors. The first is the declining production and supply of oil, which has been steadily declining since the end of 2019. The second, being conflict in the Middle East occurring between Turkey and Iraq over the oil rich Kurdish region in Northern Iraq (Bollier, 2013). The fears that peak oil had been reached were realised shortly after the conflict began and the supply decelerated. Signs of the weakness of the oil supply were evident in the July of 2008 when prices rose to $147 a barrel but then receded to below $100 in September (Whipple, 2008). Now in 2030 the petrol-powered car has become almost obsolete as the running costs far outweigh the benefits. Electric powered cars are now more common, but their increased use has put a strain on energy production.

In 2012 Australia’s energy consumption was primarily composed of non-renewable energy sources (coal, oil and gas), which represented 95% of the total energy consumption. The remaining 5% consisted mainly of bioenergy (wood and wood waste, biomass and biogas) (Australian Department of Resources, Energy and Tourism, 2012). Since then, Australia has installed solar panels on an industrial scale, utilising the vast desert expanses to setup fields of solar panels. Despite this, coal is still the primary energy source, accountable for 65% whilst the remaining 25% is generated via Solar, hydroelectricity and bioenergy. Solar energy’s inability to provide a consistent flow of electricity has meant that coal still remains the dominant provider. However more hydroelectricity plants are currently being built in an attempt to store energy from the solar panels. The new developments in the energy sector have resulted in an increased electricity cost. Commercial solar panels are more affordable than ever, meaning that more houses are willing to adopt them.

For small scale builds, it is common procedure to source materials locally, as the cost of transport from petrol or electric powered vehicles are too expensive. Materials that have minimal energy consumption have preference, as they are considerably cheaper. For example, stainless steel is favoured over the energy intensive chrome for various fittings. It is cheaper and does not have the toxic residue as a by-product of its generation (60L Green Building, 2000). The exorbitant price of oil has had repercussions on the residential aspect of building. More residences are being established closer to town, allowing householders to commute to work without the aid of a motor vehicle. Simultaneously more people decided to work from home, reducing the need for as many office
blocks to exist in city centres. Hence office blocks and multi storey car parks became deserted. Newly claimed properties such as high rises and car parks are now being converted into accommodation.

2.4 Rise of Food Cost

Increasing population has increased the demand for food and hence the price. Householders have sought to resolve this issue by cultivating their own produce in their backyards. However, not all householders owned the luxury of a backyard suitable for agriculture. Residents in high rises, small flats and other accommodation with confined spaces had to adapt their present location to allow for small scale gardens. A common solution is to line all possible passage ways and walkways within the existing infrastructure with large pots and vessels to contain vegetable produce. This arrangement allows for all residents within the building to contribute and benefit from the surrounding garden beds. Rooftop spaces of high rises and car parks have also been utilised to grow produce to nourish the residents within. The added loads on buildings created the large scale domestic farming have instigated a change to the design of high density accommodation. The structures have to be checked to ensure they can support this added load, if not; suitable reinforcement has to be employed.

2.5 Increasing Climate Variability

Australia’s climate has become more extreme over the past decade. Average temperatures during summer in the major cities have swelled beyond 50°C, whilst average winter temperatures plummeted to -10°C. The discrepancy in average temperatures between the seasons put a strain on the climate control systems. These systems have not evolved much since the late 2000s. 2025 saw the beginning of plans to extend some cities underground, where the temperature is more stable. The inspiration for such a plan was sourced from Coober Pedy, Mexico City, Canada and Dubai. The benefits of building underground include the temperate climate and the relief from natural disasters such as bushfires and cyclones.

Extreme weather events such as droughts, bushfires, floods and cyclones have become more common throughout Australia. Fewer people are prepared to construct their abodes in areas where these catastrophes are known to occur frequently. Many home-owners who witnessed their properties being swept away by flood or consumed by fire have opted to relocate to lower risk areas of Australia. This has changed Australia’s spread of population from having slightly dense populated main towns, with smaller country towns surrounding, towards denser populated main cities, with larger regional towns surrounding. This has further put demand on the larger cities and some large
rural centres to accommodate more people. To ease overcrowding in such places, underground cities are being considered as the possible solution.

The sea level in coastal Australia has risen by 18cm since 2013, claiming several properties and endangering more. Various geofabrics have been utilised to decrease the rate of erosion and to prevent some properties from perishing in the sea. Sand bags made out of geotextiles and Coir logs have been placed along coastlines to prevent erosion, promote stability, and curb water seeping into properties.

2.6 Conclusion

<table>
<thead>
<tr>
<th>2.2. Resource depletion</th>
<th>Gradual depletion of the resource base has encouraged more recycling of materials from dilapidated buildings.</th>
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<td>2.3. Rising Oil and electricity prices</td>
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3. Consumer Market Changes

3.1 Introduction
The considerable change in the attitude of the consumer market has been a driver for sustainable living over the past 20 years. The consumer market consists of the individuals and businesses that provide all demand. Whether this demand is for energy consumption, government legislation, natural resources or sustainable living, humans influence the drive within the market in which the world revolves around. The alterations in the consumer market over the past two decades has been brought about from a high population increase within the major cities of Australia and the change in preferred working conditions. The price rises in food and also the housing sector have provided additional drive towards the changes that have been seen in the consumer market.

The building sector has been vastly revamped with moderations being made to design requirements infrastructure surrounding the buildings. The energy crisis has also played an influential role in the alterations that have been made to the consumer market over the past two decades.

3.2 Population Increase
Due to the severe population increases that have occurred within Australia in the past 20 years, the population has blown out to 30.4 million (Euromonitor International, 2012). This has seen a large trend towards higher density living. As a consequence of this large homes are not seen for single occupants. The trend has focused on an increased development for units and high rise apartments. This style of living has proven the preferred option in the major cities as it enables people to live a lot closer to their workplace. The new apartment buildings are no longer built with large car parks due to the social emphasis on cycling or using public transport to commute to work. The rate in which these apartment buildings are being erected has seen a large demand for pre-fabrication of the structural elements, which is enabling a quicker erection time.

The industry has seen older dilapidated dwellings, built on large areas of land being demolished in order to make room for the construction of units. This is seeing many engineering firms growing in size to accommodate the growth of the industry. The building sector has developed a sustainable trend of recycling and reusing as many elements as possible from the demolished buildings. This is seeing the use of crushed concrete as an aggregate and wooden elements being mulched and used in gardening to minimise the overall waste. The other alternative that has been seen through the last decade is the retrofitting of existing buildings on both the housing and
industrial scale. In doing this there is less waste and landfill produced. This can prove a cost effective alternative which has made it one a desirable avenue to pursue for the consumer market.

Building design and layout has now been focused on incorporating a greater deal of precast elements into the structure when compared to the methods and techniques used in 2010. This avenue of structural design has opened doors for employment with in the precast fabrication sector in combination with the construction process.

3.3 Working from Home

The cost in building rent and demand for high density living has seen less businesses within the city, being replaced with high density accommodation. Medium sized businesses have slowly been phased out of the market due to the dominance of the large organisations. With the increase in rent, small businesses have turned to operating from home and advertising their business through the use of the internet.

This has become an increasingly popular option since the implementation of the National Broadband Network (NBN), particularly for stay at home parents, as the internet speeds have become sufficient to allow for ease of videoconferencing, the development of smart homes.

With the phasing out of medium sized businesses, operations now based largely at home with remote access to infrastructure. This has been largely seen in the concept of interactive shopping, which has removed the travel time to and from such businesses as the supermarket, dress shops and takeaway stores.

(Digital & Social Media Marketing, 2011)
3.4 Housing and Renting Sector

Due to the heightened price of utilities many family members are moving in together, filling unused bedrooms and living space in their relatives houses. This attitude to living has made it a lot easier to pay the bills, as a consequence newer buildings are being designed with the same floor area, though more bedrooms which are smaller to accommodate for this growing trend.

The size of properties has continued to decrease, though the houses have not. This has seen large houses on small blocks, consequentially killing the traditional Australian back lawn. These properties are primarily for rental purposes, which have continued to be a popular option for many younger couples. The overall prices in the housing market have continued to increase throughout the past two decades. This is due to the availability of land within close proximity of the city's business district.

(DesignBUILD Source, 2013)

Energy efficiency has undergone large improvements in the past decade, with an image of having no impact on the environment all appliances and building techniques have been modified to enhance energy efficiency. Insulation techniques have been developed which maintain heat in winter and reflect the heat in summer. This has drastically reduced the required energy to maintain a comfortable climate in the building. The alterations of materials have seen the thermal conductivity of materials enhanced, the methods in the design requirements have consequentially be adjusted to account for such designs. The national standards are an example that the consumer market pushed to amend to account for an energy efficient future.
The rising price of energy has had many influences on the consumer market. These effects have seen increased energy efficiency on the living and industrial scales. The design of buildings has been focused on accommodating for the energy requirements and techniques being implemented in order to reduce overall energy consumption. A large influence of minimising energy consumption is the northern orientation of the building which provides desirable heating throughout the seasons.

The soaring cost of rent has not seen deterrence in the amount of rental properties. The market has opened business ventures for many people, buying properties and renting them for a consistent inflow of money (Mawby, 2013). The building of houses for the primary purpose of the rental market has seen an influx in smaller high density housing developed throughout city areas. This influx has kept renting prices bearable though with the increasing demand for rental properties it is predicted that the rental prices will extend into an unrealistically high dollar figure before people are deterred from the renting option.

3.5 Food Costs

As a result of the heightened price in food across the country, Australia has seen many new apartment buildings designed with designated areas for the growth of agriculture. This concept has been broadly adopted, with gardens for the growth of fruit and vegetables being incorporated in the standard apartment building. The buildings are being designed around the food gardens; as a result this will inevitably optimise the growing conditions for the food. Considerations that are being made in the design process are the building orientation and access to sunlight throughout the year. This small scale farming has seen grocery bills dramatically reduced for that average buyer.

The urban regions have seen a large change in the past two decades, with a complete redesign of the “urban backyard”. With house sharing a common concept, friends and family are all moving back in together, with the addition to a more sustainable approach to living. This is achieved by the increased amount of solar panels per house as well as many greenhouses for the production of household consumables (Holmgren, 2013).

3.6 Changes to Design Requirements

Changes in design requirements will be ever changing dependent on the consumer market trends. Over the past 2 decades there have been many changes which have influenced building design and layout. As little as 15 years ago there was a large demand for large car parking facilities. This saw expensive and robust structures built to withstand great loads for long periods of time. There
has been a large shift in this trend with developments in time. Of recent it has been eminent that the use of cars is a dying age, with public transport a booming industry and people living close to work, alternative and sustainable avenues of transport are being used. Bicycles have replaced the large demand for cars in new office buildings and apartment buildings, the buildings are being designed and renovated to accommodate for bicycles rather than cars. This huge influence is a result of the consumer market, which would rather see people cycling to work and leaving minutes earlier than get stuck in congestion within inner city traffic.

Due to the consumer market there has been an increased demand for showers and change rooms, incorporated into building design. This comes as the level of people using public transport in combination with walking and cycling to work increases. This approach within large organisations has been encouraged by both the government and the employees. This has beneficial impacts on the sustainability of an organisation.

3.7 Infrastructure Surrounding Buildings

Australian is largely dependent on its infrastructure, which extents outside the discussion of buildings. With the social trend of using public transport there has been a sufficiently large increase in train activity throughout the country. Coupled with the addition of electric cars infrastructure throughout cities requires development to match the consumer market trends. Building development has seen electric power stations introduced within the building car parks that remain to charge vehicles whilst people are at work. The increased amount of bike activity has also seen an increase in the width of cycling lanes to provide safety and space for the cyclists. These changes were driven by the consumer market in which has been a major driver in Australia’s improved sustainability.

3.8 Energy Crisis

The energy crisis prominent within Australia has seen the cost of electricity and gas increase causing nationwide fuel poverty. As a result people who cannot afford large energy bills are suffering in the winter climate. In the summer time the elderly are finding they have insufficient funds to pay for electrical bills. This has seen an increased level of deaths as a result of the heat waves, particularly seen in the elder generations (Diana Ürge-Vorsatz, 2007).
## 3.9 Conclusion

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<th>Description</th>
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| **3.2 Population Increase** | High density living  
Changed building design |
| **3.3 Working from Home** | Phasing out of medium sized businesses  
Small businesses home based |
| **3.4 Housing and Renting** | Decreased size in property  
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| **3.5 Food Costs** | Food Gardens  
Building orientation |
| **3.6 Changes to Design Requirements** | Change room facilities at worksite  
Minimised car parking  
Increased bike storage |
| **3.7 Infrastructure Surrounding Buildings** | Power stations for electric cars  
Width of cycling lanes |
| **3.8 Energy Crisis** | Increased heat waves  
Putting the vulnerable at risk |
4. Government Legislation

4.1 Introduction
Conventional designs are being made increasingly expensive by the rising cost of once abundant materials. Increasing costs of living means that the general public are unable to purchase uneconomically designed accommodation. The government has now acted to ensure that the building and development industry are working for the public’s best interest in terms of building affordability. In addition the government addressed environmental concerns associated with the high usage of energy. It has become apparent that the industry is undergoing a turning point for a new building standard with respect to sustainable living, but it requires government incentives to become implemented within the entire industry, assisting in the removal of the out-dated requirements.

Such changes were bought through alterations to four main areas of building:

- Improving energy efficiency within building works and designs,
- Adaption of the Australian Standards and planning acts,
- Creation of transparency in the usage and consumption of power within a structure and,
- Creation of financial incentive towards sustainable homes.

4.2 Energy Efficiency
The government began to change energy consumption in 2020 through a staged program to improve energy efficiency and performance grades within the building industry. This program was based on the use of recycled materials, energy conserving techniques, power usage and generation through fitted utilities primarily facilitating the use of solar panels.

Separate grading was created to differentiate between low and high density sectors to account for economic efficiencies within the user market. As a consequence the system has resulted in high density residential constructions which are neutral in energy consumption. It has been introduced that usage of recycled materials from demolition must be no less than 80% for all building works.

Through the creation of these standards, in combination with the progressive increases in the efficiency performance criteria, significant energy savings can be made within the lifespan of the structure. History has indicated buildings have the potential to last in excess of 50 years. These improvements within efficiency standards, when introduced early within life of a structure, have seen significant savings in building energy use over the structures lifespan, as well as reducing the need for significant and expensive retrofitting in the future.
4.3 Changes to Standards and Planning Acts

4.3.1 Alterations to the Australian Standards

The Australian standards were revised to provide additional guidance within the rising sectors of recycled concrete, fly ash additive and natural materials. This is shown with the inclusion of bio-algae plastics and natural fibre composites in the building codes. These changes allowed for further simplification and adaptation of sustainable materials within structures. The alterations improved clarity to the material strengths through the standardized grading and modification of concrete mixes. Provision of design methods has improved the addition of new materials in innovative and traditional structures which also incorporate the concept of retrofitting a building.

These modifications to the standards promoted the industry into moving into the replacement and modification of high embodied energy or resource laden materials. Virgin concrete is a material that is widely being introduced. There has been an alteration in plastics towards newer, more sustainable methods and procedures within the manufacturing process. This has arisen without the strong risk that is associated with the use of unfamiliar and new materials within construction projects.

4.3.2 Alterations to the Planning Act

The planning act required adaption to meet changing requirements of changing lifestyles and environment. With concerns surrounding the rising food and water costs there has been a strong decline in car ownership within highly populated areas due to the changing transportation requirements for workers. Such changes were not reflected in previous versions of the urban planning act, instead focused on the requirements of older style living which showed little concern for materials and energy usage.

The issues of food and water costs have become a major concern within the residential community, contributing to increasing financial difficulties within both urban and rural environments. The old planning act was amended for new buildings containing residential and commercial applications to allow for a suitable level of rainwater collection facilities. In high pollutant areas suitable filtering systems must be incorporated. The incorporation of solar heating systems and garden space has also been modelled into the new planning act (Holmgren, 2013). These alterations helped in subsidising food and energy costs for residents.

Given the low use and ownership of personal motor vehicles, changes to the high density housing and businesses planning act were required. As a consequence a lower number of car parks were required for residents and workers. With large amounts of workers commuting through public transport and cycling an additional requirement of locker and wash rooms are needed. This provides
secure bike storage for employees and residents who choose these forms of transport. The facilities provide workers who choose to jog or cycle with a way to become refreshed prior to commencing work. They also provide ease of mind to know that their bike is safe and will not be stolen. The new act encourages workers to maintain a healthy lifestyle whilst reducing energy consumption and carbon emissions.

4.4 Transparent Energy Consumption
With a demand on projects being highly efficient, conditions were also introduced in the real estate market. This resulted in housing to undergo testing to ensure the buildings complied with the updated efficiency standards. These changes were implemented to make potential owners and tenants fully aware of the expected energy requirements to maintain comfortable living conditions within their houses. These changes promoted the concept of retrofitting older buildings with energy efficient designs and materials. This approach has attracted greater interest, with better financial return in sales. These improvements also allow for the ability to increase the rental asking price of a property.

The introduction of a minimum energy performance level was also introduced into the rental sector. This required that housing must meet a minimum performance level which is set by the state in order to make occupants liable for negative gearing and taxing purposes. This promoted the improvement of rental properties to meet higher energy standards, which allowed more people from outside home ownership to gain access to housing with sustainable and affordable energy consumption housing.

4.5 Financial Incentives
To further the promotion of energy efficient structures, a low cost loan scheme was conceived to encourage planners and owners to complete sustainable and energy efficient structures that far exceed the government’s performance standard. This is to be achieved through the construction of buildings that create more energy than they consume. These grants would allow for a suitable applicant to receive a government subsidised loan for a designated period to allow for an initial higher expenditure in the structure. This has the proviso that the government sees fit that the technologies and developments used within warrant the extra expenditure. This is commonly seen through providing benefits to the community and extending the structures design life. These projects have also been used to demonstrate the benefits of sustainable construction, though the publication of costing data for the construction and management of the building throughout the designated loan period.
The expenditure of the government within this program will not see any initial benefits within the economy, but will give greater profit over the life of the project. The structure provides a reduced cost of occupation for owners and renters, which allows them to increase their expenditure within other areas of their lifestyle. This boosts spending which contributes to economic gains within the future. The financial incentives also aid in displaying to the surrounding community the benefits of sustainable design.

4.6 Conclusion

<table>
<thead>
<tr>
<th>4.2 Energy Efficiency</th>
<th>Staged energy performance targets for building construction</th>
</tr>
</thead>
</table>
| 4.3 Changes to Standards and Planning Acts | Improved Standards content for renewable materials and processes  
New planning requirements towards sustainable living and transportation needs |
| 4.4 Transparent Energy Consumption | Testing and public release of data on all housing for buyers/renters. Minimum energy performance for rental market to receive financial tax support |
| 4.5 Financial Incentives | Creation of government loan scheme to encourage net zero or energy producing structures. |
5. Building Industry Response

5.1 Introduction

To create a sustainable future for the residential, commercial and public building sectors, the building industry has had to adapt over the previous two decades. In order to remain economically viable, the industry has changed its methodology drastically since 2013. Improvements have been made in the design/operation of buildings and waste management. This change in the building industry approach has aimed to meet the requirements of the public and government in relation to changing condition within the environment and the surrounding infrastructure.

5.2 Changes to Company Structure

The organisational alterations to various companies within the building industry have been some of the largest to occur within the new age 2030 market. Companies that had been successful in producing large numbers of low cost housing in the past have found the transition to sustainable design difficult given their investments in low efficiency and mass produced designs. Their lack of insight to change early for the new market ultimately resulted in their demise. Shareholder confidence in these companies declined along with the amount of clients prepared to commence new building projects, thus resulting in financial collapse of these companies (Lily Wong, 2012). The failure of these companies has promoted a shift in the remaining companies to have a greater focus on their environmental impact and a reduced interest in their gross profit margins. This shift has been instigated by the consumer’s demand for high quality sustainable buildings. The businesses that have been able to evolve to meet these demands and manage their reduced availability of materials have a greater chance of success than their rivals.

Environmental measures have been implanted within companies in a similar manner to quality control. An environmental officer is appointed to oversee the construction and design works to ensure that designs meet and exceed government requirements. They are also required to provide an analysis and assessment of building works, designs and company operations that are lagging or exceeding goals for sustainability standards. This analysis is designed to provide feedback for the company, promoting companies to either continue their current processes or change their methods.
5.3 Innovative Design

Sustainable design in 2030 is focused on providing commercially viable, healthy, low energy, resource-efficient workplaces and residential accommodations. The processes from design to completion of a build focus on having a minimal impact on the environment.

Materials and design

Materials are selected on based on their energy consumption, impact on the environment and renewability. Materials that can be salvaged from a building after the buildings useful life has expired are used in preference to materials that cannot be recycled.

The environment is sought to be protected by astute selection and use of materials in a build:

- Old and cracked concrete is salvaged and crushed to create aggregate for a new batch of concrete.
- Strong timber elements of a build are re-used or recycled and used to make engineered timber products such as LVL, PSL, LSL or particle board.
- New timber products are sourced from renewable pine plantations.
- Timber is treated using natural oils rather than polyurethane.
- Bricks that are recycled from old sites are washed without the aid of bleach, acid or other toxic materials harmful to the environment.
- Steel beams are recycled from old factory sites (such as Ford) that have been abandoned.
- Small components such as shower drains, door and window fittings, nuts and bolts and finishing element are made from stainless steel, rather than chrome-plated steel due to its lower embodied energy.
- Copper is used wherever possible as it is a fully recyclable material.
- The amount of PVC piping used in buildings (for water, electrical conduits and electrical insulation) are reduced by early specification and negotiation in the design phase.
- The use of silicon sealants, fixers and adhesives, composed of highly volatile chemicals are minimised during construction.

Appropriate technology that suffices for a building is taken in preference over leading edge technology. Appropriate is defined as a technological solution that balances energy and minimisation of resource use with the best outcome for the building’s inhabitants.
Wherever possible in design, buildings are preferably aligned north-south, so that larger windows can be placed on the north and smaller facsimiles on the south. This maximises the amount of potential sun, light and heat captured by the building.

**Heating, cooling and ventilation**

Buildings are being fitted with natural ventilation to ensure an air quality similar to or exactly the same as outside. This reduces the need for an air-conditioning tower and hence eliminates the risk of legionnaire’s disease or other respiratory related problems, such as flu or asthma from recirculated air from within the building. Buildings are built using standard double glazed glass to capture and retain as much heat from the sun as possible. Heating and cooling needs vary according to the function of the building, large offices and factories require industrial computer controlled cooling and heating systems, whilst single residential accommodation requires less technology. High rises that contain many flats, are designed with atriums, light wells and thermal chimneys to regulate the internal temperature. Structures that are to be built underground however can use the surrounding earth as a natural insulator.

(Designbuild, 2012)
Water
Minimising the consumption of mains water and maximise recycling of treated wastewater is one of the primary principles in building design. Australia’s drought-prone nature is a driver for this mode of thinking. Water conservation is approached by:

- Minimising the demand for water though the provision of water efficient fixtures and fittings, water-less urinals and low flush volume toilet pans
- Collection of rainwater and utilising it in place of mains water whenever possible.
- On-site treatment and reuse of grey-water and black water in roof garden irrigation and flushing toilets.

Energy
Buildings have to be designed with the intention of generating zero emissions to the greatest possible extent. Regardless of whether an emission has been proven to cause climate change or not, the releasing of carbon dioxide into the atmosphere from burning fossil fuels is considered to be air pollution and is therefore unacceptable.

Maximising the amount of daylight that penetrates through a building is crucial in cutting energy costs. The aim is that artificial lighting should only be utilised during night time, and where possible these lights powered from renewable energy sources. Atriums and light wells are employed to provide as much light wherever possible.

When designing the interior elements of a building, reflecting and light coloured surfaces are to be used to draw light into the building. To reduce heat escaping through the roof, roof insulation of R-rating 3.5 or more is to be used.

Recycling materials and selecting materials that have low embodied energy can reduce the overall energy required to construct a building.

5.4 Changing the construction site
The construction of buildings is very energy intensive. The transformation of the natural site to the finished product requires electricity and oil to transport materials and workers to the site, power the tools of construction and to format the initial state of the site.

To reduce the amount of energy used in site preparation, natural slopes and gradients are preserved as much as possible and worked into the design. This minimises the use of heavy excavation equipment for site preparation. When a site contains an existing structure, the structural elements that are still suitable for use are incorporated into the new build to reduce the energy used to remove and
replace these elements. Tie-ins can be employed to attach a new structure to an existing concrete slab on site, reducing the time required to remove the old concrete and pour a new slab.

5.5 Investment strategies
For companies to retain their market share in the 2030 building sector they have had to employ new sale points to entice clients. The traditional sale methods where materials and roofing frames were purchased in have become less effective, as innovative design continues to evolve and newly developed materials show more promise than the older stockpiled materials.

A new market has emerged where building companies are sponsoring or employing scientists and engineers from the material and energy development sectors. This has created a new source of funding for universities and has boosted the job market for this sector. This sponsorship allows for the companies to have their own specialists of sustainable technology, where the technology ranges from localised power generation such as solar and biomass to building and material design. This added knowledge for the companies allows them to offer the best possible environmental solution for their client. This insight into newer technologies gives these companies a competitive edge over their rival companies.

5.6 Waste Management
Waste within the building industry has always been a major issue for sustainability. Traditional construction methods of two decades ago wasted large amounts of embodied energy through the disposal of new and used materials in conjunction with the waste of the packaging surrounding the materials during transportation.
Reductions in waste have been made by the salvaging of waste materials from the site. These materials are sourced from an existing structure on the site, or from natural elements such as trees and rocks present on the site. These materials are formatted or rehabilitated to be used in the new buildings design.

Materials such as crushed concrete and asphalt can be recycled as aggregate for a new concrete mix. Excess wood or timber can be used as mulch for the properties garden or on a nature strip. The initial design of the structure has to be adapted to accommodate the recycled materials or the design has to be formulated after a review of the available materials that can be reused.

If the waste products are unable to be reused within the project, the materials are stockpiled for later use. They can be used for another construction project or they can be traded to another construction company at a cost based on benefit/cost associated with the use of the material.

The use of new materials on site is also responsible for significant waste of up to 13% (BRE Group, 2013). On site trade agreements have been made with suppliers to reduce the amount of non-recyclable packaging associated with the material’s delivery. For example, packaging such as shrink wrap has been replaced with rope or with concrete liner that can be used on the site. Suppliers are also providing a monetary exchange system for unused building materials on site, creating a second-hand building materials market. This trade agreement allows a construction company to trade back its off-cuts and unused materials with a supplier, and then the supplier is free to remanufacture or sell off these products to other parties. The combination of the two above mentioned methods of waste reduction, for both the demolition and new material waste, create an economic incentive for companies to minimise waste. This also provides a potential revenue increase for companies who choose to utilise difficult to recycle materials such as asphalt and concrete in their projects that once would have been considered a waste material.

5.7 Conclusion

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<th>Changes to the company structure</th>
<th>New focus on sustainable, personalised buildings instead of mass produced, unsustainable designs.</th>
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<tr>
<td>Innovative Design</td>
<td>Sustainable design in 2030 is focused on providing commercially viable, healthy, low energy, resource efficient workplaces and residential accommodations.</td>
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<tr>
<td>Changes to construction sector</td>
<td>Improved adaption of natural site and existing structures within construction. Modular construction to reduce on-site energy use.</td>
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<td>Investment Strategies</td>
<td>Focus on the research sector for new materials and localized energy generation.</td>
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6. Summary

Building design in 2030 has been moulded by many factors over the two previous decades:

- The climate has changed considerably, altering where people have decided to live and promoting innovations in overcoming uninhabitable climates.
- The consumer market has evolved to hold the building industry accountable for its designs.
- Government legislation has been altered in terms of planning acts, transparent energy consumption and financial incentives to promote a change in the building industry to meet the demands of the public.
- Building companies have been forced to modify their methodology to be more environmentally minded with a focus on sustainability.
7. Works Cited

Front Cover Picture sourced from ELCORED. This reference is inside the works cited.


Sustainability

As defined by David Holmgren sustainability is the ability of a system to persist without collapse, fundamental restructure or erosion of its resource base. The term “persist” refers to maintaining the functionality of the system. Sustainability commonly refers to the diverse infrastructural, organisational and behavioural changes associated with a shift to a renewable energy base.

Influencing factors for accommodation and housing development by 2030

- Increasing population
  An increasing population will result in higher density living, with house sharing and boarding becoming a lifestyle option for many individuals in Australia.

- Higher utility prices
  The ever increasing price of water and electricity will result in many homes being fully self-sufficient, with solar panels creating energy and tanks capturing all rain water from their roofing.

- Developing technology
  By 2030 there will be many technology developments that will see transportation becoming increasingly more efficient. The fuel used in cars will become greener through technology that is being introduced today such as hydrogen fuel-celled cars. The energy conversion efficiency of solar panels will increase to an amount that will provide enough energy to run an entire household; they will also improve the places in which they can be located.

- Higher prices for natural resources
  With transportation becoming more costly, local food sources will become more competitive against major brands which will boost local economies and see more people growing their own food to live off. Using household compost and having organic farming in the back yard will minimise the waste produced on a daily basis.

Expected changes in accommodation and housing in Bendigo by 2030

Through developments, by 2030 there will be higher density living with new housing becoming smaller and closer together. House sharing amongst friends and family will result in five or more people living in each household. There will be a large push towards renewable energy sources, with all new housing having solar panels and rain water tanks as a standard accessory. This will see a greater number of smaller supermarkets opened up which will reduce transportation distances.

With 2030 only being 17 years away there will be many more aspects for improvement still to come in the way of energy sources. There currently is not enough emphasis on green energy sources from the government to warrant being drastic changes in the immediate future. Having solar panels incorporated into the roofing and drainage being used to water the gardens is an option now, but costs money, whereas if it were government subsidised there would be a greater number of people
incorporating this into their new housing design. Existing housing will not alter too much, though upgrades will occur in which it is hoped that solar panels are installed and

**Most interesting aspect of both presentations**

David Holmgren’s presentation was most interesting when he was showing the developments in “Aussie Street” from the early 1950’s to what it will look like in the not too distant future. The way in which modern culture and perception of living has changed I found fascinating. Also the way in which it will push towards more boarding and shared housing with community gardens showed how modern outlooks will change in the future to incorporate a denser population.

The most interesting aspect of Cameron Cecil’s presentation was certainly his views on using recycled concrete piping and a move towards High Density Polyethylene (HDPE) piping instead of using the heavier reinforced concrete piping in new housing developments. The ways in which his colleagues viewed the newer alternative and how their perception was to clear the land and start concreting showed how much the modern attitudes still need to change in the future.

**Dylan Ringuedé- Housing Report**

David Holmgren defines sustainability as the ability of a system to persist without collapse, fundamental restructure or erosion of resource base. Where the term “persists”, relates to the time frame over which the sustainability occurs. The time frame must be suitable so sustainability can be maintained for as long as possible.

Influencing factors for accommodation and housing development for 2030:

- Increasing population
- Contracting energy and resources, shrinking economy, financial crisis.
- Rising energy and utility prices
- Poor use of public infrastructure, inefficient use of space
- Lack of money, large debts.

Bendigo’s population could increase exponentially by 2030. Rising accommodation costs in the larger cities like Melbourne and surrounding suburbs could cause a migration to Bendigo and other regional centres. Immigration from overseas will also further increase the population of Bendigo.

By 2030 petrol prices could have risen due to its rapid depletion. As a result many people might not have the financial means to purchase petrol or even a car. This would instigate a change towards a more densely populated inner city centre to allow for modes of transports other than cars, such as walking and cycling. As fewer people would own cars, hence there would be fewer garages and parking spaces in town. Garages on blocks could be reinstated as temporary accommodation, or they could be removed to allow for a subdivision of the land. Larger blocks could be subdivided to accommodate more housing. The vacant spaces above most shops in town could be converted into shop top housing as some already have been.

Further economic crisis could see more rooms being let out, as an extra source of income for the residents. More housing estates will have been established by 2030; however the size of blocks might
decrease in size to fit more accommodation onto the site. A shift towards more produce being grown at home could influence a purchasing of larger blocks of land in the suburbs of Bendigo.

To save on space, to allow for larger household sizes the interior of houses might be designed differently, with fewer bathrooms. Less extravagant houses might be designed where the kitchen, bedroom and bathroom are all in the same room. Old and derelict sites in town like Gillie’s Factory could be reconditioned into large apartment blocks or community housing, similar to the development made at the orphanage in Kennington.

The people with more expendable income might invest more in energy saving and water saving devices to improve on to their homes. Solar panels to supply hot water and electricity and grey water systems for irrigation could become more common on houses. On site gas makers, that is fuelled by recycled human or pet waste to provide the house with gas for cooking and heating could be installed.

The most interesting aspect of David Holmgren’s presentation was the concept of Permaculture, how the community can contract from being global to a more localised public domain. It was also interesting that he suggested that people can be pressured into giving up their technology for a “simpler” life because of the rising costs of energy.

Cameron Cecil’s presentation on Bendigo’s newest estates being developed in Huntly was remarkable in that the customers are not buying into the newer technologies like solar panels, photovoltaic windows and grey water systems. It shows that some of the buyers lack the foresight to know that to save or make money in the future; risks have to be taken by investing.

**Vincent Fitzpatrick - Housing Report**

1. Define sustainability as defined by David Holmgren?

   Sustainable was defined by David Holmgren as 'a system capable to persist without collapse, fundamental restructure or erosion of its resource base'. This definition lays the groundwork for his main point regarding the suitability of lifespan models regarding the expected lifespan of the idea/issue form 1yr to exceeding 1,000 years, as determined by its usage of usable energy available to us. This ideology is applied to housing/lifestyle and business as these systems require significant amounts of energy (through use of fossil fuels, minerals and emissions) over time to maintain the current accommodation and housing currently present. Through this consideration these models should lifespan of many hundreds to thousands of years of sustain the ability to maintain future generations in housing and suitable lifestyle without severe limitations to resources due to our current actions. This definition of sustainable opposes our current models, with the average business having a sustainable lifespan approximately the same as a human lifespan.

2. List the influencing factors (drivers) for accommodation and housing development by 2030?

   The major influencing factors for housing by 2030 will be the ability for a household to be a self-sustaining as possible in regard to power and potentially even food through concepts such as solar water and power, development of personal food gardens and maximising the available energy and resources available through improving the thermal efficiency and capturing and maximising the capture and reuse of water for household and external purposes. Building materials will change in
incorporate the near or independence from new materials, through use of second-hand and organic materials to reduce the non-renewable resources required in construction projects.

Lifestyle practices will also undergo change, through improving number of persons per m² of floor space and reducing travelling distances outside the residence. This will result in increased time within the household (working or not) will mean a greater percentage of active and well-populated housing suburbs as opposed to relatively vacant homes and suburbs present.

3. Describe what changes you would expect in accommodation and housing development in the Bendigo region by 2030?

Accommodation and housing within Bendigo will soon begin to change focus from cheap initial construction present within the majority of new housing projects and begin the movement towards sustainable design practices (such as those listed in question 2) to allow for the continually rising costs of utilities and depleting natural resources. Housing will begin to experience a more key focus on self-reliant transport, with housing preferred with easy access to public transport and walking proximity to facilities as opposed to existing selling points such as garages and remote housing as personal transportation such as cars become more expensive to use.

Existing housing will most likely undergo retrofitting of energy efficiency upgrades to reduce the cost of living in the home, and houses with backyards will become more based on food supply than aesthetics to counter the cost of rising fresh food.

4. Write a paragraph about what you found the most interesting aspect of both presentations?

The most interesting aspect of the two presentations was the analysis made by David Holmgren on the basis of Cameron Cecil’s ‘sustainable’ housing development appraisal, highlighting the difference in the view of what sustainable enlargement is, and the influence financial decisions make in the ultimate view of energy efficient housing. Cameron’s presentation demonstrated the cost and effort of deriving strategies to achieve the more sustainable development compared to the cost of a conventional cost saving design. David then highlighted points of issue with the ‘sustainable’ site, such as wasteful removal of trees removed from the site, being simply disposed of instead of being used in heating or landscaping purposes, as well as a discussion regarding industry opposition to the introduction of northerly facing housing to achieve a five star rating. This discussion illustrated the extent that David’s ideology is from current design regimes regarding both existing and more modern concepts with respect sustainability in the housing industry.