5

Infrastructure and the environment

5.1 The Committee heard a range of evidence about the opportunities for Australia to increase its use of innovative ICT applications to better manage its built and natural resources and to improve environmental sustainability.

5.2 The Committee was told that an expanded digital economy, supported and enhanced by the NBN, can provide a means to 'dematerialise' the traditional economy. That is, it can replace 'physical goods and activities with network based alternatives',[1] allowing the economy to grow with less need to consume physical resources or to damage the environment.[2] SAIC Pty Ltd described a critical development from broadband expansion as:

> … the ability to better manage our consumption of critical natural resources. Population growth, changing environmental conditions, and technology expansion itself continue to stress the regional and global supplies of oil, gas and water to limits that threaten sustainability. Ultimately, our ability to counter the stress we are putting on our natural resources will rely on our abilities to reduce demand for power and energy, better predict storms and floods, and more effectively provide food and water to our populations.[3]

5.3 There are a range of broadband-enabled technologies that can be employed to achieve more efficient use of resources. For example, 'smart infrastructure', which involves combining ICT technologies with infrastructure such as electricity grids, road networks and water systems, enables that infrastructure to be used more efficiently and sustainably.[4]

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1 Mr Tom Worthington, *Submission 17*, p. 4.

2 Dr Dean Economou, Technology Strategist, National ICT Australia (NICTA), *Committee Hansard*, Sydney, 29 April 2011, p. 60.

3 SAIC Pty Ltd, *Submission 35*, pp. 4–5.

4 Department of Infrastructure and Transport (DIT), *Submission 213*, p. [2].

Infrastructure Australia has identified a national broadband network as one of Australia's key infrastructure priorities, largely because of its ability to enable smart infrastructure technologies that make better use of Australia's existing infrastructure.[5] A ubiquitous NBN will serve as an enabler for this type of convergence between the physical and digital world, providing the network that is required to transport the extremely large amount of data generated by these activities.[6]

5.4 Access Economics has estimated that employing intelligent technologies into five key infrastructure areas could increase Australia's labour productivity by 0.5 per cent, create more than 70 000 jobs and increase GDP by between $35 and $80 billion over the first 10 years of implementation.[7]

5.5 This chapter will initially discuss some of the ways the NBN can lead to energy savings and reduced carbon emissions by promoting activities such as tele-working and green data centres. It will then explore how the NBN will enable better management of resources through the use of intelligent sensor networks. Finally, it will discuss how the NBN can increase the accessibility of spatial data, satellite and mapping services.

Reducing energy use and carbon emissions

5.6 The Australian Information Industry Association (AIIA) told the Committee that ICT initiatives, supported by a world class national broadband network, have the potential to cut Australia's carbon emissions by 21 per cent.[8]

5.7 The Federal Government has identified as one of the key goals of its *National Digital Economy Strategy* that 'by 2020, the majority of Australian households, businesses and other organisations will have access to smart technology to better manage their energy use'.[9]

5 Infrastructure Australia, *Getting the Fundamentals Right for Australia's Infrastructure Priorities*, June 2010, p. 40.

6 NICTA, *Submission 198*, p. 19; Professor Doan Hoang, *Submission 177*, p. 3.

7 Access Economics, *The Economic Benefits of Intelligent Technologies*, May 2009, p. ii.

8 AIIA, *Submission 184*, p. 14

9 Department of Broadband, Communications and the Digital Economy (DBCDE), *National Digital Economy Strategy*, May 2011, p. 29.

Direct energy savings through more efficient networks

5.8 Several submitters and witnesses told the Committee that the NBN's FTTP network offers significant environmental advantages over alternative network technologies.

5.9 Huawei told the Committee about its own research that suggests moving from traditional phone networks to next-generation fibre-based networks could reduce network energy consumption by about 40 per cent.[10]

5.10 The Institute for a Broadband Enabled Society (IBES)'s supplementary submission provided a representation of the relative power consumption of seven different fixed line and wireless broadband technologies. It showed that the fibre-based technologies that will make up the majority of the NBN—PON and PtP—are by far the lowest consumers of power at fast broadband speeds.[11] Professor Rod Tucker, Director of IBES, explained to the Committee FTTN and HFC networks use more energy than FTTP because of the amount of equipment that needs to be deployed onto streets and power poles, and that wireless technologies (UMTS and WiMAX) are the highest consumers of energy due to the number of towers required to provide fast broadband speeds to each user.[12]

5.11 The Committee acknowledges the views of some contributors that the NBN also has the potential to harm the environment and therefore supports constructive advice to mitigate any negative impacts. Mr Tom Worthington submitted that the technology being deployed in the NBN is relatively energy efficient; however, as the NBN will be overall a very large user of electricity, the network should be designed in such a way to minimise energy consumption:

> … for a given technology, as the data rate increases, so does the power consumption. Most of the time, most of the NBN will be carrying little or no data. The equipment used should therefore be designed to switch to a low power mode to conserve energy when possible.[13]

5.12 Mr Worthington also told the Committee that 'in the absence of sufficient planning and investment, there is a risk the NBN will harm the environment through the creation of electronic waste', in particular the back-up batteries provided with NBN Co's household units and

10 Huawei, *Submission 105*, p. 9.

11 IBES, *Supplementary Submission 84.1*, p. [1].

12 *Committee Hansard*, Melbourne, 18 March 2011, p. 36.

13 Tom Worthington, *Submission 17*, p. 4.

equipment such as ADSL modems that will be made obsolete under a FTTP network.[14] Citing similar concerns, the Communications Alliance indicated to the Committee that it 'strongly supports' an 'opt-in' policy for NBN back-up batteries to help minimise the potential for improper disposal of such waste.[15]

Supporting green data centres and consolidated ICT provision

5.13 The Committee heard that the NBN will enable large organisations to consolidate their databases and application servers into centralised locations, potentially leading to significant savings in energy and equipment. For example, the South Australian Government submitted:

> Improved bandwidth into schools and government locations will support centralised provisioning of applications and storage of data. This will result in a significant reduction in ICT equipment and lead to associated reduction in the use of power for the equipment and necessary cooling.[16]

5.14 Monash University told the Committee of its existing plans to consolidate its ICT provision:

> Data centres themselves are sizeable contributors to the carbon footprint of a university. To reduce this, Monash University is consolidating much of its ICT to a specialised off campus green data centre and utilising its high speed network to link the data centre to its campuses and some affiliated teaching hospitals.[17]

5.15 Monash has already been able to decommission 24 physical servers and three separate data centres through this policy, and expects to migrate another 770 servers to a 'virtual server farm' at its green data centre in 2011.[18] The University told the Committee that it is currently unable to consolidate its servers at locations that do not have high speed data links, such as its facility at Mildura Hospital, and these locations continue to require individual data centres 'with their own servers, storage, associated cooling, backup power equipment and travel for support personnel'.[19] This limitation is even more acute outside university premises:

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14 Tom Worthington, *Submission 17*, p. 4.
15 Communications Alliance, *Submission 185*, p. 16.
16 SA Government, *Submission 195*, p. 8.
17 Monash University, *Submission 205*, p. 15.
18 Monash University, *Submission 205*, p. 16.
19 Monash University, *Submission 205*, p. 15.

> This lack of connectivity is particularly acute within industry, businesses and the broader community. Schools in particular require their own data centres again with associated backup cooling and backup power equipment contributing to the overall carbon footprint of the educational sector. Readily available, affordable broadband connectivity could allow schools to pool resources utilising server virtualisation technology. Regional hubs could also act as backups for other hubs, increasing the resilience of the network and reducing the need for additional backup equipment at each site.[20]

5.16 The NBN will enable this type of consolidation to increasingly occur in other sectors, particularly as applications are increasingly delivered through cloud services, as discussed in Chapter 2 on government services and Chapter 6 on economic development. The environmental benefits of data centre consolidation are maximised if data centres are located close to sites of energy generation, particularly renewable energy, and the extensive fibre network provided by the NBN will help make this possible in more locations. Mr Tony Brun, Chief Executive Officer of the City of Greater Geraldton, told the Committee that his Council is looking at opportunities for green data centres to be set up in the small community of Mullewa, which has recently been connected to fibre backhaul.[21]

Reducing the costs of travel

5.17 One of the goals identified in the Federal Government's *National Digital Economy Strategy* is that by 2020, 'at least 12 per cent of Australian employees report having a tele-working arrangement with their employer'.[22]

5.18 As discussed in Chapter 2, tele-working may provide benefits across a range of areas, including for the environment. The reductions in fuel use that are possible through tele-working could have a significant impact on reducing carbon emissions. Citing a recent Access Economics report,[23] DBCDE told the Committee:

> It is estimated that a 10 per cent increase in Australian employees that tele-work 50 per cent of the time would save an estimated 120 million litres of fuel, avoiding 320,000 tonnes of CO2 … and would

20 Monash University, *Submission 205*, pp. 15–16.

21 *Committee Hansard*, Perth, 6 May 2011, pp. 3–4.

22 DBCDE, *National Digital Economy Strategy*, May 2011, p. 40.

23 Access Economic, *Impacts of Teleworking under the NBN*, August 2010.

> reduce traffic at peak periods by 5 per cent, resulting in a reduction of $470 million in congestion costs. These outcomes would have a flow-on benefit of reducing strain on infrastructure.[24]

5.19 A number of other submitters and witnesses told the Committee about the positive environmental and economic impacts of tele-working. For example, Regional Development Australia (RDA) Illawarra told the Committee:

> The ability to tele-commute and work remotely will decrease the need to travel for work purposes, and will therefore decrease the impact on our natural resources. This is particularly relevant to the Illawarra which has the largest commuting population in the country. Some 20,000 people commute to Sydney daily, having a huge impact on transport systems and roads, and contributing to carbon emissions.[25]

5.20 By enabling the increased use of video-conferencing and 'tele-presence' to facilitate meetings, the NBN will also encourage a reduction in the amount of business travel. DBCDE told the Committee collaboration online through the use of high quality, high-definition video-conferencing can reduce the need to travel for meetings:

> The Australian Government and State and Territory governments, for example, have used high-definition tele-presence technology for numerous COAG meetings. The National Tele-presence System has been operational since July 2010. Benefits from the use of the system for the period from October 2010 to January 2011 include estimated savings of $3 million and reduced greenhouse gas emissions attributed to the Australian Government of an estimated 490 tonnes.[26]

5.21 Infrastructure Australia cited the example of CISCO, a company which by using video-conferencing, avoided 53 788 meetings that would have involved travel: 'They estimated this at a $81 million annual productivity cost saving not to mention the 116,000 metric tons of emissions.'[27]

5.22 The Committee considers that the benefits of tele-commuting and tele-presence apply equally in the higher education sector. While the broader benefits of the NBN to the education sector are discussed in detail in

24 DBCDE, *Submission 215*, p. 55.

25 RDA Illawarra, *Submission 90*, pp. 2–3.

26 DBCDE, *Submission 215*, p. 56.

27 Infrastructure Australia, *Submission 10*, p. 3

Chapter 4, it is worthwhile considering some associated impacts from an infrastructure and environment perspective. The Committee notes evidence from Monash University that the 'classroom of the future can be delivered to students on and off campus' which 'will minimise the need to attend campus', a development not supported by the current copper networks.[28]

> … Monash University is already taking steps in this direction by utilising its high-speed network connectivity with other universities to share data and electronic versions of research materials and journals. Initiatives such as electronic delivery of lectures to students in teaching hospitals or conferences, contribute toward reducing the need for lecturer and student travel.[29]

5.23 By reducing the frequency with which academic staff need to attend conferences, including those held overseas, in order to share knowledge and interact with their colleagues, Monash noted that: 'video-conferencing, virtual reality and collaborative tools can markedly reduce travel requirements. The cost savings to universities and the reduction in carbon footprint can be significant.'[30]

5.24 The Committee notes with interest the additional benefits which are associated with reduced travelling, including social and community benefits as will be discussed in detail in Chapter 8. Not only would the type of technologies and applications described above decrease the need for travel between cities to attend meetings, training programs and seminars, but they could also 'allow businesses to locate outside of the traditional central business districts, potentially reducing the overall need to travel for employees, customers and goods.'[31]

5.25 Increasing growth in regional centres could also ease congestion and other infrastructure pressures in cities. The Committee understands that the NBN will help make regional centres more economically and environmentally sustainable. RDA Northern Rivers described the 'natural amenity' of its region as a 'key attribute which accounts for the rate of in-migration':

> The management and maintenance of our natural amenity and environmental sustainability are a priority and the encouragement

28 Monash University, *Submission 205*, p. 15.
29 Monash University, *Submission 205*, p. 15.
30 Monash University, *Submission 205*, p. 15.
31 DIT, *Submission 213*, p. [6].

> of home-based businesses which rely on high speed broadband as opposed to travelling long distances by motor vehicle to an office base … might ensure the sustainability of our environmental credentials.[32]

5.26 The Committee heard from inquiry participants that the NBN would enable efficient new technologies, such as remote mining operations and transport monitoring systems, to be deployed in the mining and resources sector.[33] The NBN could also increase the ability of mining companies to attract and retain employees, for example, by enabling video links that offset the impacts of isolation in rural and remote areas.[34] Employees and their families would have more opportunities to access training, education, healthcare and social services on-site, which would help encourage them to live in remote towns rather than relying on fly-in/fly-out arrangements.[35]

5.27 The broader economic benefits of the NBN for regional Australia are discussed in Chapter 6.

Smart grids to reduce energy waste

5.28 Another way in which the NBN will enable a reduction in energy use is through 'smart grids'; that is, the embedding of technology, particularly 'smart meters', into the electricity grid to better manage energy supply and demand. A useful description of the operation of smart meters and smart grids was provided by the Department of Resources, Energy and Tourism (RET):

> Smart meters are electricity meters that are capable both of measuring and recording energy consumption in short intervals, and of two-way communication, enabling energy providers to read and control features of the meter remotely. Smart meters are a key component of smart grids, which combine advanced telecommunications and information technology applications with 'smart' appliances in the home to enhance the energy efficiency of the electricity power grid, while helping householders save on their energy bills.[36]

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32 RDA Northern Rivers NSW, *Submission 55*, p. 11.

33 Thales, *Submission 109*, p. A-4; CSIRO, *Submission 171*, pp. 14–15; SA Government, *Submission 195*, p. 8.

34 SA Government, *Submission 195*, p. 8.

35 RET, *Submission 190*, p. [5].

36 RET, *Submission 190*, pp. [3–4].

5.29 A key aspect of smart grids is that energy consumers are made more aware of their energy usage, enabling them to make more informed choices. According to Infrastructure Australia:

> … smart energy grids help to enhance the efficiency with which consumers use energy by enabling sophisticated choices such as time of day consumption, pre-specified tolerance to interruptions, the defined management of appliances, and consumers' sensitivity to price fluctuations. [37]

5.30 The Committee was advised that smart grids are becoming more essential as the use of renewable energy sources increases. The Whitsunday Hinterland and Mackay Bowen Regional Organisation of Councils (WHaMBROC) submitted:

> Alternative energy sources such as solar, wind, hydrogen fuel cells, clean batteries and so on will become the distributed sources of energy in the future and will introduce greater complexity to energy generation, distribution and consumption. This brings new opportunity to manage demand and generation to minimise carbon outputs, but requires this new and complex network of energy elements to be interconnected and controlled; a very different situation from the largely passive energy networks today. The NBN will offer an opportunity to connect many thousands of points of demand and generation inexpensively, and bring control to the new form of energy network that will form in the coming decades.[38]

5.31 Describing the benefits of smart grids for managing fluctuating energy supplies, Mr Matthew Sundberg, Market Analyst for the 'Picture the Future' project at Siemens Ltd, told the Committee that smart infrastructure is needed:

> … when you have wind and solar generation happening whenever—and they are a lot harder to predict—you need to manage the consumption side. That is where the smart grid comes into play. You will have smart meters to give you a good understanding of what is being consumed where, what is connected to the grid, whose solar PV is seeing sunshine and whose micro wind turbine is seeing wind. There is all this data

37 Infrastructure Australia, *Submission 10*, p. 3.

38 WHaMBROC, *Submission 62*, p. [4].

> that needs to be processed and brought into one big stability control for the grid.[39]

5.32 The Committee was told by NICTA that the NBN will provide the stable, reliable network that is required to underpin smart grid technology.[40] DBCDE told the Committee that while individual smart meters do not require high bandwidth in themselves, as uptake increases the cumulative data that is generated will require 'ubiquitous, reliable, high-speed broadband'.[41]

5.33 Professor Tucker of IBES told the Committee that ubiquity and reliability are more important than bandwidth for supporting smart grids.[42] Similarly, in their joint submission RDA Hunter and RDA Central Coast told the Committee that the ubiquity of the network is essential:

> Devices that connect to the network … will need to communicate via a common communications protocol. The NBN will be a key enabler of a concept known as device convergence. Because all devices will communicate via the IP protocol they will be able to communicate with one another as well.
>
> This will lead to innovations in utility management and will improve fault rectification, increase efficiency, reduce costs and potentially forestall the requirement for additional utility capacity.[43]

5.34 CSIRO told the Committee that as the sophistication of smart grids increases, the capacity of the networks underpinning them will become increasingly important:

> CSIRO is investigating systems that can switch high energy-use appliances in homes and small businesses on and off depending on the load on the network, price of electricity and preferences of the customer. Such a change requires a whole-of-network approach, including integration with thousands of components in the grid that need to be monitored and controlled. Smart grids will become increasingly complex with high data flows. While the data required per site is small, when aggregated these data flows are significant and will require broadband infrastructure.[44]

39 *Committee Hansard*, Melbourne, 18 March 2011, p. 61.

40 NICTA, *Submission 198*, p. 20.

41 DBCDE, *Submission 215*, p. 53.

42 IBES *Committee Hansard*, Melbourne, 18 March 2011, p. 37.

43 RDA Hunter and RDA Central Coast, *Submission 57*, p. 10.

44 CSIRO, *Submission 171*, pp. 12–13.

5.35 The RET submission further explained the relationship between smart grids and the NBN:

> The broader adoption of smart grids is contingent on the existence of appropriate communications technologies that enable two-way flow of data across the entire energy delivery chain … there are a range of potential opportunities that may be leveraged between NBN Co's FTTP deployment and the adoption of smart metering and smart grids. These opportunities consider a collaborative approach to the deployment of NBN and smart meter / smart grid services and, if realised, may deliver a more efficient commercial and operational model than would be achieved individually …
>
> Electricity utilities may also find benefit in utilising the NBN for their communications requirements due to the following factors:
>
> - its wide-scale geographic coverage with defined communications service capability,
> - the ability to leverage pre-existing operational support processes and models,
> - reliable service delivery, and
> - the need not to increase the utilities communications workforce to deal with operations and maintenance issues …[45]

Box 5.1 Smart Grid, Smart City

The $100 million National Energy Efficiency Initiative—Smart Grid, Smart City—will demonstrate Australia's first commercial-scale smart grid, ways to improve the reliability of electricity services for consumers and, in conjunction with smart meters, help consumers understand and manage their electricity consumption.

One of the principle objectives of Smart Grid, Smart City is to investigate synergies with other infrastructure (such as gas and water) and the NBN. This includes considering how smart meters can be integrated with NBN equipment (including home devices), and considering how NBN Co should interact with energy suppliers.

Source: RET, *Submission 190*, p. [9].

45 RET, *Submission 190*, pp. [3–4].

Managing infrastructure using sensor networks

5.36 While smart grids can be used to more efficiently manage energy networks, there are other types of smart technologies that can be used to monitor and manage physical infrastructure, particularly using networks of sensors. This section will examine how these sensors, which include high definition video cameras, can be used to more effectively manage transport, other public infrastructure, natural resources, agricultural assets and the environment.

Intelligent Transport Systems (ITS)—reducing traffic congestion

5.37 Traffic congestion is a significant problem for Australian cities, with large social, environmental and economic costs. DBCDE told the Committee:

> The Bureau of Infrastructure, Transport and Regional Economics (BITRE) … estimated that in 2005 the social costs of congestion across Australia's capital cities equalled about $9.4 billion. This figure is based on costs associated with people's loss of private time, loss of business time, extra vehicle operation and extra air pollution. The BITRE estimates these costs will double during the 15 years between 2005 and 2020 to $20.4 billion.[46]

5.38 Intelligent Transport Systems (ITS) involve deploying smart technologies into transport infrastructure in order to relieve congestion and improve safety. ITS includes a range of wireless and fixed line information and electronic technologies. Infrastructure Australia explained that such technologies relieve congestion, improve safety and enhance productivity when integrated into transport networks.[47]

5.39 ITS 'adaptively control traffic signalling and speed limits to help manage congestion, reduce the number of starts and stops, reduce travel times and reduce greenhouse gas emissions'.[48] NICTA noted that:

> Using networks of sensors across the transport network and, increasingly, sensors inside vehicles allows intelligent transport systems to control traffic signals, speed limits, ramp metering, variable tolls and other methods to manage road congestion, reduce delay and reduce the number of starts and stops …

46 DBCDE, *Submission 215*, p. 52.

47 Infrastructure Australia, *Submission 10*, pp. 2–3.

48 NICTA, *Submission 198*, p. 20.

5.40 Infrastructure Australia informed the Committee of three current applications of ITS:

- IntelliDrive applications utilise information technology to enable connectivity between vehicles to maximise safety, and between vehicles and network infrastructure to maximise flow.
- General Motors' OnStar technology (an in-vehicle ITS) enables automatic crash response by reporting the condition of vehicles and occupants to emergency agencies via Global Positioning System (GPS).
- Integrated Corridor Management (ICM) technology allows management of transport networks as whole systems, not individual assets. For example, a driver in an ICM corridor can be informed of congestion and given alternative travel options, improving overall network efficiency.[49]

5.41 The Committee notes the current collaboration between Infrastructure Australia and the States and Territories on a proposal for managed motorways. This involves managing demand, congestion and safety on Australia's major motorways.[50]

5.42 While the Committee accepts that ITS is not a new concept, and is already operating to varying degrees across Australian cities and around the world, its acknowledges NICTA's view of Australia's pioneering role in developing ITS. NICTA told the Committee that Australia has led the world developing ITS systems such as the Sydney Coordinated Adaptive Traffic System (SCATS) in the 1970s, now used across Australia and in over 100 cities globally:

> Through the use of algorithms for coordinating traffic lights, this system is typically capable of reducing travel times by 20%, and reducing the number of stops by up to 40%. These savings are directly reflected in reduced greenhouse gas emissions in Australia and across the globe.[51]

5.43 During the course of the inquiry, NICTA demonstrated to the Committee how networks of high-definition cameras can be used for traffic monitoring. NICTA's submission explained that the NBN would enable SCATS and other traffic management systems be improved and deployed more widely:

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49 Infrastructure Australia, *Submission 10*, p. 3.

50 Infrastructure Australia, *Submission 10*, p. 3.

51 NICTA, *Submission 198*, p. 20.

> NICTA is working with the NSW RTA to optimise the algorithms used in SCATS as well as developing traffic lights which can 'see' cars and other vehicles approaching intersections to provide for more efficient traffic control and to further reduce road congestion. NICTA also has deployed technologies for better routing of delivery and service vehicles. These technologies, leveraging off the NBN, will provide a more efficient transport and logistics industry and overall a reduced carbon footprint.[52]

5.44 DIT told the Committee about the increasing telecommunications capacity of ITS applications, particularly in relation to next-generation applications in which data is transmitted between moving vehicles and roadside infrastructure. Examples of applications include:

- Traffic Management Systems: manage the transport system with knowledge of the real-time location of every vehicle, including pre-emption at traffic signals for priority vehicles;
- Incident Response: improved response to incidents and improved traffic flow restoration times; and
- Access to Information En-route: vehicle access to real-time safety and congestion advice and information such as weather en-route.[53]

5.45 DIT explained that the NBN would be essential to enable these types of applications to be delivered:

> Future ITS opportunities will depend on short range roadside and vehicle-to-vehicle communication, via satellite and wireless technology, being linked back to road network control by optic fibre. For that reason the NBN will be integral to future ITS delivery and the Department is actively engaged in further developing its understanding of how the NBN can contribute and add value to ITS technologies and their application.[54]

Smart infrastructure to manage assets and water resources

5.46 Infrastructure Australia told the Committee that smart infrastructure can also be used for monitoring the safety and managing the maintenance of a range of physical assets:

52 NICTA, *Submission 198*, p. 20.

53 DIT, *Submission 213*, p. [5].

54 DIT, *Submission 213*, p. [5].

> For example, the newly reconstructed I-95 Minnesota bridge in the United States includes $1 million of sensors that enable it to continually monitor the condition of girders, ice on the road surface, and general traffic—an obvious safety benefit to motorists that can also help manage maintenance expenditure more efficiently.[55]

5.47 Similarly, Townsville City Council submitted that remote sensors supported by broadband would improve the decisions made by resource managers:

> An ability to monitor the health and well-being of our built and natural environments is fundamental to the development of sound management systems … Increased broadband capacity across a network will allow for resource managers to better manage their resources.
>
> One area where the NBN will provide significant benefits for resource managers is remote sensing. Having a network capable of relaying large volumes of information from a wide range of sites and having applications able to process this information will allow for more effective and efficient management of resources.[56]

5.48 Other submitters told the Committee that the NBN could enable more widespread use of smart building management systems, which could reduce energy consumption by an estimated 30 per cent.[57] For example, SAIC told the Committee it has developed energy-saving building management systems that are designed to interact with sensors in large manufacturing facilities.[58]

5.49 Building Information Modelling (BIM) is the process of generating and managing building data during its life cycle by the use of three-dimensional, real-time, dynamic building modelling software, potentially leading to significant productivity gains in the construction sector.[59] DIISR told the Committee that while BIM software was not dependent on the NBN itself, the NBN would make electronic building models more accessible to the public and to planning authorities. The information would become available throughout the life of the building, enabling

55 Infrastructure Australia, *Submission 10*, p. 3.

56 Townsville City Council, *Submission 199,* p. 4.

57 NICTA, *Submission 198*, p. 20.

58 SAIC, *Submission 35*, pp. 4–5.

59 Mr Mike Lawson, Head of Manufacturing Division, DIISR, *Submission 219*, pp. 15–16.

aspects of the building such as the shadow it casts and its visual amenity to be used by planners into the future.[60]

5.50 The ACT Government told the Committee about its plans for BIM:

> The concept of a 'Virtual ACT' is being investigated to utilise web 2.0 to facilitate improved planning and public consultation utilising, amongst other technology, 3D modelling. This will enable urban infill building applications to be modelled and viewed against environmental and aesthetic considerations such as shadowing, solar access and visual impact. Broadband capacity currently limits the flexibility and usability of current systems however the NBN would enable greater interactive analysis and more real-life modelling.[61]

5.51 The Committee heard about the potential improvements which would be made possible by the NBN in the management of water resources, including during floods and natural disasters. In terms of the better management of water resources, the Committee was advised that:

> Water is a precious resource, and broadband enabled smart systems can make an important contribution to protecting this resource and ensuring that it is used wisely. Intelligent systems can be used to monitor water flows and provide 'on demand water supply'. The savings from providing water as required and reducing water wastage can be substantial.[62]

5.52 Mr Bob Carmichael, Manager of Business and Economic Development at the City of Tea Tree Gully in South Australia, told the Committee that the City intends to use the NBN to improve its existing stormwater and wastewater systems by implementing remote digital operating and monitoring systems. Mr Carmichael observed that the difficulties the city experiences with monitoring its stormwater and wastewater facilities, caused by inconsistent internet services, are expected to be overcome with the NBN's implementation. He also explained that the NBN will be the basis for managing the future sustainability of the 592 parks and reserves administrated by the city, for example, by 'allowing the use of remote digital systems to control and monitor efficient water use'.[63] Mr Carmichael noted that:

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60 *Committee Hansard,* Canberra, 6 July 2011, p. 2–3.

61 ACT Government, *Submission 227*, p. 9.

62 ACT Government, *Submission 227*, p. 9.

63 *Committee Hansard*, Adelaide, 4 April 2011, pp. 27–28.

> Our re-use of water is continuing to grow. To send it off to our various ovals and reserves and to perhaps sell it to neighbouring councils, we need to have a reliable system. That is what we are looking for.[64]

5.53 Ipswich City Council submitted that the recent floods affecting its region highlighted the need for advanced river monitoring technology that would improve the monitoring and management of flood events.[65] CSIRO told the Committee about current activities in that region, including the deployment of sensors at Lake Wivenhoe Dam to monitor water column temperature and catchment health, a project which has allowed dam operators to control the quality of water supplied to the city of Brisbane. CSIRO noted that:

> This type of sensing technology can be adapted to sense many other parameters such as water levels, temperature changes and video surveillance of traffic and other assets. With the addition of adequate network reach, remote control of valves, switches or other actuation devices will be possible.[66]

5.54 In considering monitoring of water during flood events, the Committee noted the impacts of flood waters on infrastructure. Glenys Schuntner, Chief Executive Officer of RDA Townsville and North West Queensland, told the Committee that real-time video monitoring supported by the NBN would greatly improve the ability of authorities to assess the condition of roads and infrastructure during flood events:

> While we have talked about the remote management of energy systems, I would also apply that need to our management of rail and road infrastructure, so you do not have to send someone out hundreds of kilometres in a disaster to find out the status of a road or railway. By real-time monitoring, which is enabled through [the] NBN, you can actually have someone in Julia Creek or someone in Mount Isa seeing what the situation is. They do not have to get out in their car to physically see things as well.[67]

Agricultural applications

5.55 Although the broader potential of the NBN to support agriculture is discussed in Chapter 6, the Committee heard that NBN-enabled sensor

64 *Committee Hansard*, Adelaide, 4 April 2011, p. 32.
65 Ipswich City Council, *Submission 83*, p. 14.
66 CSIRO, *Submission 171*, p. 11.
67 *Committee Hansard*, Townsville, 19 April 2011, p. 43.

networks can be effectively deployed in a range of agricultural settings, leading to improved productivity.[68] The University of New England (UNE) provided a concise summary of how these types of sensors could be used:

> The farmers can get sensors that tell them where their stock is, what parts of fields they preferentially graze, what the weight gain is. They can remotely monitor pasture for moisture content, for pasture growth and thus they can work out when and how to move stock around for maximal yield. But at present they cannot handle that data themselves, because they do not have access to enough bandwidth. NBN will enable on-farm analysis of data and real time application of results to the better management of the farm.[69]

5.56 At a public hearing, Mr Robert Walker, Chief Executive Officer of AgForce Queensland, told the Committee:

> Remote monitoring of vegetation, remote monitoring of waterholes and remote monitoring of watercourses have all been regulated and prescribed by governments at all levels. Unfortunately, the technology is not there to deliver the information that governments require. Again, the delivery of an effective and efficient broadband technology to those areas would certainly facilitate that.[70]

5.57 Goondiwindi Regional Council similarly described the potential of high speed internet access for agribusiness, catchment management groups and environmental management organisations in accessing new forms of data collection and analysis, in turn improving the quality of local decision making:

> As rural industries move to more scientific management systems for water, soil quality, cropping and animal production the need for real time data collection and analysis is becoming essential to ensure the environmental and economic sustainability of the region.[71]

5.58 CSIRO submitted that NBN infrastructure could 'provide the backbone of a whole-of-farm sensor network' which would enable 'new methods for pest detection (and potentially control) and development of new

68 NICTA, *Submission 198*, p. 21.

69 UNE, *Submission 191*, pp. 4–5.

70 *Committee Hansard*, Brisbane, 18 April 2011, p. 29.

71 Goondiwindi Regional Council, *Submission 69*, p. [2].

harvesting techniques using robots or automated or semi-automated farming equipment'.[72] CSIRO also told the Committee about a recent project working with dairy farmers in Tasmania to continuously monitor soil moisture in their fields, enabling irrigation to be optimised.[73]

5.59 Noting that 'protecting [the] Australian environment and farmlands from invasive pests and diseases is a major and very expensive goal', UNE outlined to the Committee the significant benefits the NBN could produce in the field of agricultural biosecurity. UNE noted that the likely sites of entry of pests and diseases are often remote, but expertise is limited and often centred in major cities. Delays are experienced in effectively identifying and treating crops before diseases spread:

> What if the farmer could take a photo of the infected cereal on his mobile phone, beam it straight to the plant pathologist, who could give advice on how to deal with it within a few hours, thus enabling control, preventing widespread dispersal and preventing major crop loss with the associated economic loss. The NBN will enable this.[74]

5.60 CSIRO told the Committee that it has developed a tele-presence system to 'monitor and manage disease outbreaks with high resolution communication, laboratory analysis and geospatial information'.[75] This system will enable sharing of information between scientists during biosecurity emergencies in a way that was not previously possible. CSIRO advised that the system will eventually be deployed around the country, and while it will focus on exotic and emerging animal disease, similar systems are envisaged for human health applications. CSIRO notes that with a ubiquitous high speed network 'this type of technology could be made more widely available to the agribusiness industry, not only for biosecurity, but to share information about methods for improving productivity'.[76]

Environmental monitoring applications

5.61 The Committee heard that the deployment of NBN-enabled sensor networks could considerably improve environmental monitoring services. For example, SAIC Pty Ltd told the Committee that its work in weather

72 CSIRO, *Submission 171*, p. 12.
73 CSIRO, *Submission 171*, p. 11.
74 UNE, *Submission 191*, p. 5.
75 CSIRO, *Submission 171*, p. 12.
76 CSIRO, *Submission 171*, p. 12

prediction, climate research, seismic and ocean monitoring, including the tsunami warning buoys operated by the Bureau of Meteorology, could all benefit from the increased number of sensors and increased capacity for data collection in remote locations that will be enabled by the NBN.[77]

5.62 The Australian Institute of Marine Science (AIMS) submitted that its network of remote monitoring stations, such as the ones that provided information about Cyclone 'Yasi', would be enhanced by the NBN. AIMS also submitted that the improved availability of bandwidth will 'support work such as forecasting the impact of a warming ocean, box jellyfish monitoring and monitoring and forecasting coral bleaching'. AIMS's work in very remote locations, such as the outer Great Barrier Reef, would be particularly enhanced.[78]

5.63 Similarly, CSIRO told the Committee that NBN-enabled sensor networks could:

> … operate as early warning systems to alert communities about algal blooms, pest outbreaks, natural disasters such as floods and bushfires; environmental accidents such as contamination of drinking water; or terrorism events such as poisoning of a major water supply.[79]

5.64 Professor Ian Atkinson, Director of James Cook University (JCU)'s eResearch Centre, told the Committee about the potential of video-based monitoring for environmental research:

> An enormous amount of information can be extracted from video. At the moment we just look at pictures and maybe walk away, but we can assess vegetation states. We could probably determine levels of rainfall at particular points in time. Environmental health and quality can be measured …[80]

5.65 Chapter 7 on research and innovation contains further information on the how NBN-enabled video monitoring could transform environmental research.

77 SAIC, *Submission 35*, p. 5.

78 AIMS, *Submission 60*, p. [1].

79 CSIRO, *Submission 171*, p. 11.

80 *Committee Hansard*, Townsville, 19 April 2011, pp. 7–8.

More accessible spatial data, satellite and aerial observation services

5.66 The Committee was told that spatial information is essential for resource management across a wide range of government and industry sectors. PSMA noted:

> The management of Australia's natural resources and assets largely relies on location information to assist in their tracking and use. Industries readily using location information include mining, logistics, and agriculture.[81]

5.67 RET advised the Committee that:

> The concept of mapping information to better understand business activities is being widely adopted to make improved decisions and increase the effectiveness of work activities. A current example is the efforts being put into maps to support the recovery processes of the Queensland floods and the northern Queensland cyclone, which, through the application of spatial information, have resulted in significant public safety outcomes.[82]

5.68 RET further explained that the NBN could have a significant role in increasing the capacity of organisations to access spatial information, which is currently limited due to the large amounts of data involved:

> Spatial resources are quite frequently large in size and organisations must invest significantly in data management infrastructure to hold up to date spatial datasets. This large investment often weakens the business case for leveraging the location component of their information and, as a result, organisations may reduce their effectiveness and the quality of their decision making processes.[83]

5.69 1Spatial Asia Pacific also noted that the spatial information industry is synonymous with large file types and the need to process large files, and went so far as to describe the NBN as a 'game changer' for the spatial information industry. Their submission stated that a paradigm shift in thinking would be required 'to maximise the opportunities that [the NBN]

81 PSMA Australia, *Submission 64*, p. [3].

82 RET, *Submission 190*, p. [7].

83 RET, *Submission 190*, p. [7].

will present us and possibly position Australian companies to take a leading role globally …'[84]

5.70 1Spatial submitted that the NBN, by increasing the availability of bandwidth, will enable it to make its services available online as a cloud service, eliminating the need for its customers to invest in expensive technologies and expertise that currently have to be duplicated at every customer site in order to utilise spatial information. Industries located in rural areas will benefit the most, as they 'will have access to effectively online expertise and processing capabilities equivalent to anywhere in Australia'.[85]

5.71 The Committee was also told that the NBN would increase the accessibility of aerial mapping services. Mr David Farmer, General Manager of Wollongong City Council, told the Committee that the Council has a range of online Geographic Information Systems (GIS) and coastal hazard studies that are currently limited in their accessibility:

> … some of our really big documents are extremely difficult to access with ADSL, for example, the coastal hazard study. We have 100 kilometres of coastline …and 3000 properties are at risk of tidal inundation … Obviously people are interested. When they get to the documents and the maps they are quite difficult to download.[86]

5.72 The Committee heard from NearMap Pty Ltd, a Perth-based company that specialises in high-resolution aerial photo mapping and terrain mapping technology (see Box 5.2 below for more details).

5.73 The uptake of NearMap-type products is dependent on the widespread availability of the type of fast broadband the NBN will provide:

> We are a very high bandwidth, rich-content product and, even on our relatively fast ADSL 2+, it can still take quite a while to download the content. In terms of the impact of the NBN on our customers, in the community, in business and in government, our view is that access to bandwidth, the speed of that bandwidth and price are key.[87]

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84 1Spatial, *Submission 229*, p. [1].

85 1Spatial, *Submission 229*, p. [1].

86 *Committee Hansard,* 28 April 2011, p. 47.

87 Mr Adrian Young, Director of Sales, Nearmap Pty Ltd, *Committee Hansard*, Perth, 6 May 2011, p. 29.

Box 5.2 NearMap

NearMap publishes detailed and regularly-updated photo maps of large towns and cities around Australia which are made available online in time series archives. The imagery is free to the general public and most small businesses at nearmap.com. Revenue is generated through licensing to government and large corporations.

The spatial information provided by this photographic content has broad applications across many service sectors including environmental compliance and natural resource management, building regulations, customer service and strategic planning, and emergency management. Insurance companies, the mining industry, the tourism industry and a variety of government agencies are all increasingly reliant on this type of information.

As an example of the practical application of the technology, during the Queensland floods of January 2011, NearMap was requested by Brisbane and Ipswich City Councils to quickly capture photo maps of their area. The maps were used both for the immediate response and reconstruction effort, and to record the high water mark for future disaster planning.

Source: Mr Adrian Young, Director of Sales, Nearmap Pty Ltd, *Committee Hansard*, Perth, 6 May 2011, pp. 28–29.

5.74 The Committee heard that the NBN could also enhance emergency management by improving the reliability of communications infrastructure and information services.[88] Mr John Grant, Chair of the IT Industry Innovation Council, told the Committee that during the January 2011 floods in Brisbane, the websites that contained maps of the areas expected to be flooded 'collapsed' due to the large demand for information from the public. Mr Grant said that if these website servers had been hosted in 'the cloud', connected with robust NBN-style infrastructure, there would have been unlimited capacity for people to access the information they needed.[89]

5.75 The Committee was told by several inquiry participants that Earth Observation from Space (EOS) is crucial to a variety of government programs and contributes significantly to Australia's economy. The Space Industry Innovation Council submitted:

88 Mr Shenal Basnayake, Economic Development Officer, Cassowary Coast Regional Council, *Committee Hansard*, Townsville, p. 49.

89 *Committee Hansard*, Brisbane, 18 April 2011, p. 33.

> Increasingly, earth observation satellites are creating an explosion in the quality and amount of imaging data available for analysis and interpretation. In fact, in Government alone, there are currently at least ninety two programs, totalling $1.3 billion in annual expenditure, which are dependent on EOS. EOS contributed at least $3.3 billion to Australian GDP in 2008-09 and on conservative assumptions it is estimated that the contribution to GDP could grow to around $4 billion by 2015.[90]

5.76 Government services that are supported by satellite observations include programs for national security, weather forecasting, safety, and climate change monitoring.[91] With increasingly large datasets being generated, the Committee was told that Australia's ability to continue to benefit from EOS capabilities is being put at risk due to a lack of effective communication networks to satellite ground stations.[92] RET told the Committee:

> Current telecommunications networks cannot cope with the load associated with satellite data and, as such, much of the information has to be transferred across the country and internationally via postal and courier services. This method of transportation is too slow for emergency situations.[93]

5.77 For example, the Department of Innovation, Industry, Science and Research (DIISR) told the Committee that the satellite data pertaining to the 2009 Black Saturday Bushfires was delayed by the inability to transfer files electronically.[94]

5.78 The Space Industry Innovation Council submitted that the NBN would provide the connectivity required to overcome these problems and for satellite datasets to be used more effectively:

> The speeds available via the NBN to transport increasingly large satellite datasets for analysis into decision support information will lead to productivity gains and improved outcomes in fields such as weather forecasting, climate change, resources management, emergency response, and defence surveillance. It is important that NBN access be available to the major earth

90 Space Industry Innovation Council, *Submission 73*, p. 4.
91 DIISR, *Submission 219*, p. 6.
92 RET, *Submission 190*, p. [7].
93 RET, *Submission 190*, p. [6].
94 DIISR, *Submission 219*, p. 6.

observation infrastructure used predominantly for public good services throughout Australia.[95]

5.79 Chapter 7 on research and innovation contains further information on how the NBN's satellite capacity could be used to expedite developments in the area of environmental monitoring.

Committee Conclusions

5.80 The NBN will be the enabler of technological innovations that could improve the way the environment and infrastructure are managed in Australia.

5.81 Fuel use, carbon emissions and traffic congestion could be significantly reduced as the NBN reduces the need to travel by supporting more effective methods of tele-commuting for employees and students, and tele-presence for business meetings. The Committee welcomes the Federal Government's target in the *National Digital Economy Strategy* of doubling the rate of tele-working amongst Australian employees.[96] The Committee anticipates that further Government action in terms of public education and incentives may be required to meet this ambitious goal.

5.82 Underpinned by an effective and reliable communications network, smart grids have the potential to achieve significant cost savings and emission reductions across the electricity network. Smart grids will also enable electricity providers to better manage the distributed sources and fluctuating loads associated with renewable energies such as wind and solar. The Smart Grid, Smart City project underway in the Newcastle region promises to demonstrate to industry and the public how smart grids can operate on a commercial scale. As renewables continue to account for a larger proportion of Australia's energy supplies, the importance of smart grids will continue to grow. Leveraging the NBN will help enable smart grids to be deployed in more areas.

5.83 The NBN will provide the base communications network required to deploy intelligent sensor networks, including those used in transport and water management systems, in a range of locations around Australia. There are a number of exciting applications that will be made possible through these networks, including systems to improve asset and infrastructure monitoring, ease traffic congestion, improve agricultural

95 Space Industry Innovation Council, Submission 73, p. 1.

96 DBCDE, *National Digital Economy Strategy*, May 2011, p. 41.

sustainability and enhance environmental monitoring services. The NBN's fibre network will provide the capacity to support high definition video monitoring and the backbone required to manage the extremely large amounts of aggregated data that will be generated.

5.84 The NBN will also enable spatial information, aerial mapping services, and satellite ground-station data to be more readily accessed by government agencies and the public, particularly in regional areas. Among the many potential benefits of this is the increased ability of authorities to respond to emergency situations and help individuals to make more informed decisions during natural disasters.

5.85 In many of the instances discussed in this chapter, the ubiquity and reliability of the broadband network are at least as important as the bandwidth. However, the high bandwidth capacity and scalability in the fibre components of the NBN will enable sensors and monitoring systems of increasing sophistication to be deployed.

5.86 The Committee also notes that while fibre-to-the-premises is the most energy efficient technology for high speed broadband, effort is required to ensure the significant environmental benefits of the network are not offset by unnecessary environmental costs. The NBN network itself will be a large consumer of energy and steps should be taken to ensure that the energy efficiencies of all the network's components are maximised. There is also potential for a large amount of electronic waste to be produced from obsolete equipment and back-up batteries, and the Committee encourages the development of environmentally sound policies to deal with this issue.