TESTING THE NBN VISION

CAN AERIAL CONSTRUCTION TRULY DELIVER 'A HISTORIC NATION-BUILDING INVESTMENT FOCUSSED ON AUSTRALIA'S LONG-TERM NATIONAL INTEREST'?

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The Rudd government announced in 2009 its intention to roll out a fibre-to-the-home optical fibre-based national broadband network, proclaiming that the initiative would be a historic nation-building investment focussed on Australia's long-term national interest. This paper examines the appropriateness of such a vision where the network, being a government-mandated provider of last resort carrying lifeline telecommunication services, is to rely on infrastructure held up by electricity poles. An initiative so constructed outstandingly fails the basic notion of creating 21st century broadband as a building block of Australia's future digital economy.

INTRODUCTION

The April 2009 joint media release announcing the establishment of a new company to build and operate the National Broadband Network (NBN) ended by declaring:

> The initiative announced today is a historic nation-building investment focused on Australia's long-term national interest. It will fundamentally transform the competitive dynamics of the telecommunications sector, underpin future productivity growth and our international competitiveness (DBCDE 2009a).

A little over twelve months later, another media release accompanying the release of the NBN Implementation Study prepared by McKinsey & Company and KPMG (McKinsey 2010) trumpeted that the study concluded 'high-speed broadband for all Australians is achievable, and can be built on a financially viable basis with affordable prices for consumers'. The media release then ended by declaring that 'delivering the NBN will help kick start a revival in Australia's productivity growth, which has deteriorated in recent years'(DBCDE 2010). Minister Stephen Conroy specifically highlighted that the government 'has a role to invest in the nation-building infrastructure of the future' (Tanner 2010).

No doubt there are many criteria against which to test whether or not the proposed NBN will indeed constitute a nation-building investment that is:

1. in Australia's long-term national interest
2. in infrastructure of the future, and
3. appropriate to grow Australia's productivity.

This paper proposes a basic test for assessing the visionary nature of the NBN, viz. is aerial construction appropriate?

NBN STATEMENTS

The DBCDE Discussion Paper 'National Broadband Network: Regulatory Reform for 21st Century Broadband' (DBCDE 2009b) suggested in Chapter 2 that at least some of the proposed NBN will employ aerial construction to reduce roll-out costs and raised the prospect of amending relevant legislation to facilitate this.

Among other statements on the matter, Senator Conroy stated on 16 June 2009:

> […] the government wants the rollout to be as unobtrusive as possible. Where possible and where it is cost effective, fibre optics can and will be placed underground. In other instances, aerial cabling may be faster and more cost effective. Where necessary to facilitate the rollout of fibre optics, the government is prepared to amend the existing carrier powers and immunities (Senate Official Hansard 2009, 3315).

The Executive Chairman of NBN Tasmania Limited, Doug Campbell was more recently reported as saying the company will use power lines instead of underground connections wherever possible. 'It's a cheaper alternative. Throughout the country we'll be using overhead power lines not just in Tasmania', he said. 'Our studies have shown that the reliability of overhead is just as good as underground because underground cables get broken quite regularly by people with backhoes and other equipment' (ABC 2010).

Australian Greens Senator Scott Ludlam, who has been involved in the recent Senate inquiry into the NBN, doubted Mr Campbell's claims: 'I'd like to see the evidence that attests to the case that it's more reliable, because if that was the case then why would we be going through the process of burying power infrastructure.' Overhead cabling will be tested when the first of the Tasmanian towns, Midway Point, is hooked up in July 2010 – just in time for the winter storms, the news report said.

Subsequently NBN Co gave an even stronger indication that it was planning for life without access to Telstra's mainland pit and pipe infrastructure Australia-wide and, instead, 'may leverage utility infrastructure, as is the case with its early Tasmania rollout' according to an industry report. NBN GM of design and planning Peter Ferris gave no hint of plans to leverage Telstra's poles or ducts, but suggested instead that fibre deployment would be tied to existing infrastructure held by utilities.

> 'A key point to remember [...] is that if power is underground, our fibre is underground. I will not be known as the guy that actually designed putting poles back in the ground to build new aerial infrastructure,' said Ferris, seeking to downplay the role that contentious aerial fibre would play in the rollout. 'So if the power's underground, we're underground. If there is an aerial power distribution, we may have an aerial local fibre distribution. We will evaluate those on an individual, module-by-module basis'(CommsDay 2010a).

In March 2010, NBN Co announced it would be rolling out its fibre-to-the-premise network to five 'first release' sites on mainland Australia as part of live trials of its network design and construction methods. These first release sites were said to represent the diversity of situations NBN Co would encounter across Australia in the volume rollout, so sites were selected to facil-

itate the testing of different construction techniques. Part of an associated 'FAQ' asked: 'Will you be digging up streets and people's gardens as part of this work?' The answer was:

> 'It may be necessary to dig in some circumstances. However, we will be looking at a range of less disruptive rollout options such as using existing ducts where possible, or overhead power poles' (NBN Co 2009).

Reporting on NBN Co CEO Mike Quigley's announcement of the 'second release' roll-out sites in July 2010, a more recent industry report noted:

> With controversy still broiling about just how much of the NBN rollout will be hidden away underground and how much will depend on aerial cabling, Quigley said that the network firm was still working through detailed plans. 'But our aim is always to try and maximise the amount of underground facilities we can use,' he added. 'And the heads of agreement with Telstra, should it come to a definitive agreement, obviously will mean we can utilise as much of their underground infrastructure as necessary' (CommsDay 2010b).

REGULATORY BACKGROUND

Schedule 3 of the Telecommunications Act 1997 provides carriers with the power to inspect land to determine whether the land is suitable for the carriers' purposes, to install a facility on the land and to maintain a facility that is situated on the land. The power to install a facility may only be exercised with respect to certain types of infrastructure, such as a facility defined in the Ministerial Telecommunications (Low-impact facilities) Determination 1997 or a temporary defence facility, or if the carrier holds a Facility Installation Permit which is obtainable from the Australian Communications and Media Authority (ACMA).

The Telecommunications (Low-impact facilities) Determination 1997 specifically states that aerial cables are not of 'low impact' and hence carriers wishing to deploy cables aerially must seek planning approval from state, territory and/or local governments. This requirement was specifically introduced in response to significant concern among communities and local governments after Optus and Telstra rolled out substantial hybrid fibre-coaxial (HFC) cable networks between 1995 and 1997 for delivering pay television and broadband services, without community consultation and without consideration of the impact of the cables on the local environment.

NBN Tasmania Limited obtained a carrier licence on 27 January 2010 and NBN Co Limited a licence on 18 March 2010. Hence both NBN companies are bound by the Telecommunications (Low-impact facilities) Determination 1997 unless it is repealed or modified.

HYBRID FIBRE-COAXIAL NETWORK PRACTICE

Throughout mainland capital cities and the Gold Coast since 1995/97, electricity poles supporting 415 volt lines (and often also 11 kilovolt lines) have had to additionally support one or two HFC networks as well as customer lead-ins for electricity, telephony and pay television. Figure 1 depicts this common occurrence.

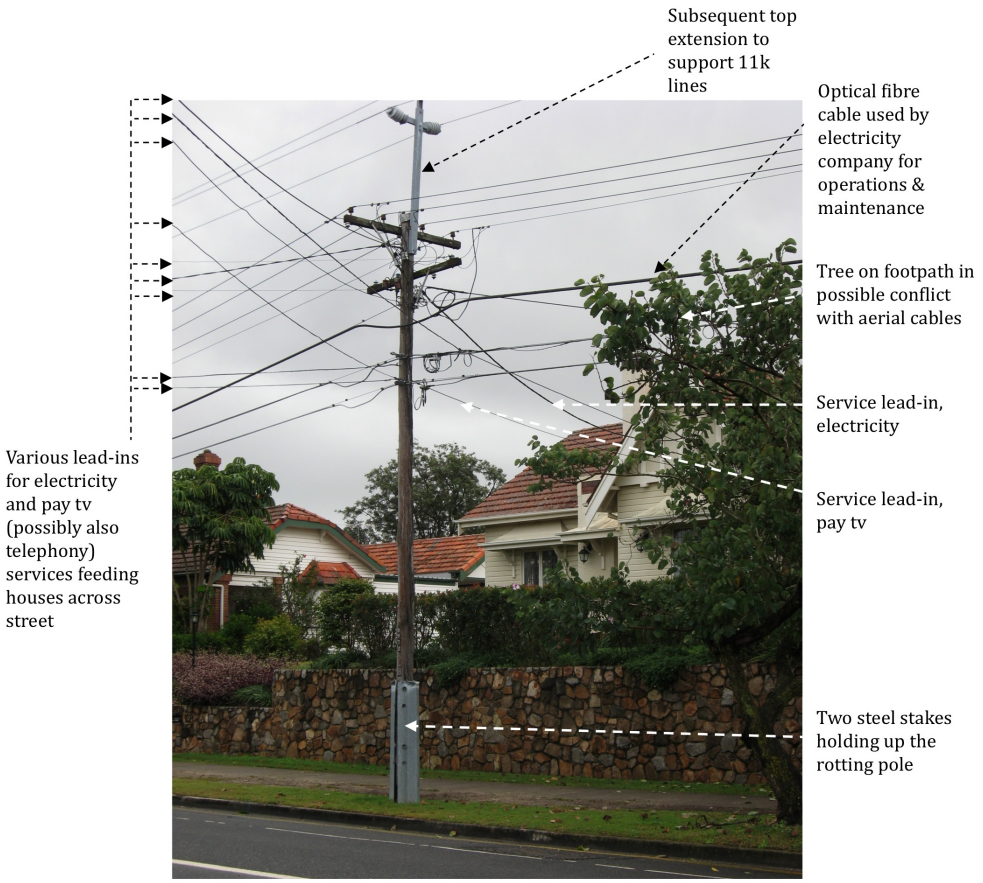

Figure 1
A typical electricity pole in Abbotsleigh Street (suburb of Holland Park, Brisbane) carrying 11 kilovolt and 415 volt electricity lines and since 1996 additionally burdened with Optus and Telstra HFC cables – illustrating the multitude of lead-ins serving houses on both sides of the street, plus the parlous state of the wooden pole which has been augmented by the steel extender on top supporting the 11 kilovolt lines and two large steel reinforcement 'stakes' compensating for the rotting wood below the ground.
Ross Kelso, extracted from submission number 94, Figure 1, http://www.aph.gov.au/Senate/committee/broadband_ctte/submissions_from_april_2009/sublist.htm

Electrical safety codes require that the upper pay television cable is suspended a certain minimum distance[1] below the 415 volt lines, and then the lower cable is attached a further distance[2] lower down each pole. The safety codes are pertinent because both the metallic outer sheath of the coaxial cable and the supporting metallic bearer wire must be grounded to earth potential.

When faced with demands by Optus and Telstra to attach their pay television cables to electricity poles, the electricity distribution companies immediately determined that the strength and height of certain poles was insufficient. Accordingly, many poles had to be replaced, strengthened or heightened – thereby perpetuating an already outdated form of essential infrastructure. Figure 1 appears to reflect this latter approach by extending the pole height to elevate the 11 kilovolt lines and so ensuring adequate clearance for the extra cables below.

Telstra and Optus pay annual attachment fees to the owner of the electricity poles.

FIBRE-TO-THE-HOME NETWORK PRACTICE

The 2009/2010 Senate Select Committee on the National Broadband Network saw fit to devote Chapter Four of its Third Report to the matter of aerial deployment of NBN optical fibre, titled 'To bury or not to bury … ' (Select Committee 2009a). It appears that Australia's first experience with such aerial cabling has been in Tasmania with the TasCOLT trial of ultra-high speed broadband networks and services around 2008.[3] This trial optical fibre network, installed by Aurora Energy on its electricity poles, established the standards and practices now being applied by NBN Tasmania for state-wide roll-out of the NBN. Similar standards and practices are expected to be adopted by contractors to NBN Co elsewhere throughout Australia; for safety reasons, the electricity distribution industry is more than likely to err on the side of caution.

Corning Cable Systems was awarded the tender for the passive optical fibre elements of Tasmanian NBN roll-out, utilizing their FlexNAP^{TM} System (Corning 2009). The distribution cable for aerial deployment, common to almost all other industry cabling in similar applications, involves multiple optical fibres within a cable sheath whose tensile strength is achieved with dielectric annular and central members. Hence, contrary to the situation of HFC cabling, an aerial fibre-to-the-home distribution network is non-metallic and so its potential with respect to earth or electricity lines becomes irrelevant.

In theory then, such optical fibre cabling could be safely installed immediately alongside electricity wires attached to pole cross arms and thereby become less visible and more protected from external interference. However, it appears that practical considerations related to installation and maintenance, let alone the standard of training required by personnel, result in an entirely different outcome. For example, Figure 1 illustrates that an optical fibre cable utilised for operations and maintenance by a Queensland electricity distribution company has been intentionally installed separate from the electricity lines. In other situations, the writer has observed what appears to be an electricity company fibre cable installed atop poles, but that cabling is of a long-distance nature between sub-stations and is not accessed on a pole-by-pole basis for local distribution.

Figure 2 reveals how optical fibre has been deployed as part of the NBN roll-out in Scottsdale, Tasmania during early 2010. Clearly, Aurora Energy reckoned that technical and service delivery standards of its electricity distribution operations would be adversely affected if the fibre-to-the-home network were to be installed more closely to the electricity assets – regardless of the fact that such a modern day fibre network is non-metallic. After all, the NBN network is foreign to the business of the electricity distributor. Visual inspection suggests that a separation of one to one-and-a half metres has been stipulated for the safety of personnel involved and/or to ensure minimal impact on electricity service reliability.

Of course, and the NBN contractor workforce could need to be trained to deal with high voltage lines, but this does not appear to have changed the outcome.

As with the attachment of HFC cables for pay television delivery, NBN attachment fees in Tasmania will provide a regular revenue stream to Aurora Energy.[4]

Figure 2
John Holland personnel deploying pole-to-pole NBN fibre in Scottsdale, Tasmania.
Digital Tasmania; 'Photos: building Tassie's Scottsdale NBN', 14 May 2010. http://www.zdnet.com.au/photos-building-tassie-s-scottsdale-nbn-339303163.htm

IMPACT OF AERIAL CONSTRUCTION

If the initial Tasmanian NBN aerial construction practice continues to be replicated elsewhere, then the adverse consequences of the HFC network aerial rollout will likely also apply to the NBN. Furthermore, where aerial NBN is deployed along with existing aerial HFC cabling, these consequences may be compounded.

ADVERSE CONSEQUENCES

All aerial cables (and electricity lines) naturally sag in a catenary fashion such that the lowest point occurs mid-span. Road traffic regulations require that this mid-span clearance of the lowest cable above the crown of the road must be no less than about 5 metres. Where this clearance is inadequate, high road vehicles are likely to snag the cable – resulting in broken cables, broken lines and interruption to electricity and communication services.

Maintaining the necessary minimum clearance becomes more difficult when the road slopes longitudinally or laterally (i.e. one side is higher than the other) and when, over time, poles bend due to their age and soil movement. At road junctions the clearance problem may be further exacerbated due to the extra number of cables converging at one location and allowance for street lights, stay wires, etc. Lead-ins to homes present a clearance problem for extra aerial cables, particularly when they pass over driveways (including those of neighbouring properties) and more so when houses are on the low side of a road and the electricity poles are on the opposite

and higher side. High vehicles such as Council garbage trucks and furniture removal vans accessing properties are more likely to collect the lowest hanging cable.

The clearance problem is starkly illustrated by the typical Australian residential street with footpath trees allowed to grow only on the side opposite the electricity pole route or, as in Figure 3, with trees under the pole route mutilated.

Figure 3
Mutilated tree in a Sydney street under a pole route also supporting two HFC cables. This was made necessary to obtain the required clearance; through increased utility charges, we actually pay for this to be done! Peter Downey, Cables Downunder Photo extracted from submission number 94, Figure 3, http://www.aph.gov.au/Senate/committee/broadband_ctte/submissions_from_april_2009/sublist.htm

All state road traffic and safety authorities are well aware of the regular occurrence of electricity poles being hit by vehicles, with electricity lines being brought down or even the poles being destroyed. Figure 4 graphically depicts an all too common example.

Severe storms regularly bring down trees on top of electricity lines and any telecommunications cables – particularly in rural areas and in the more tropical parts of Australia. In Townsville, much of the existing electricity and telecommunications infrastructure is said to be aerial. Due to cyclones, the City Council's strong preference is that the NBN be deployed underground (Select Committee 2010a) – yet NBN Co has announced that the local electricity distributor, the direct beneficiary of pole attachment fees, will be the contractor for the fibre roll-out there (ARN 2010).

Recent Victorian and New South Wales bushfires dramatically illustrated the vulnerability of all above-ground infrastructure, whether electricity or telecommunications, and conversely the protection offered by below-ground infrastructure which escaped destruction (Select Committee 2009b). The compound failure of aerial electricity, telephone and Internet services totally isolates affected residents; within a day or so even mobile phone batteries are exhausted.

Figure 4
Electricity pole destroyed and lines brought down by an errant road vehicle; imagine the impact on lifeline telecommunications if the government-mandated National Broadband Network had been attached to this pole!
Peter Downey, Cables Downunder and The Newcastle Herald; Photo extracted from submission number 94, Figure 4, http://www.aph.gov.au/Senate/committee/broadband_ctte/submissions_from_april_2009/sublist.htm

If access cabling for the NBN is installed aerially along local roads, it will cause old electricity poles to be unnecessarily upgraded, worsen the visual environment, reduce the clearance above road and driveway levels, and totally negate any remaining opportunity to retrospectively underground aerial cables and lines throughout Australia. Furthermore, every length of NBN aerial cabling shared by a number of customers may result in reduced service reliability for those customers due to the increased likelihood of an upstream cable being damaged by high vehicles, falling trees, bush fires or the supporting poles being hit by errant vehicles. Such causes of service unreliability remain regardless of whether the optical fibre cable deployed with the NBN has a slightly smaller diameter than that of the previous installed HFC networks (Senate Official Hansard 2009, 3316).

This prognosis applies where any NBN aerial cabling is the first non-electricity asset to be pole-attached and is even more applicable where one or two HFC pay television cables already exist.

Not only will NBN access cabling suffer degraded service reliability in its own right once aerially constructed, no broadband service is possible without reliable electricity to customer premises. With both NBN and electricity services supported on the same pole route, the incidence of outages having adverse lifeline consequences is further magnified.

BENEFICIAL CONSEQUENCES

It is beyond question that, compared to underground deployment, aerial construction of the NBN will be both faster to roll out and less expensive.

The McKinsey-KPMG Implementation Study was commissioned by the Government only to advise Government on 'how best to implement its stated policy objectives, not to evaluate those objectives, given that the policies have already been agreed by Government'. In doing this, the Implementation Study treated the matter of aerial versus underground fibre deployment solely in terms of which mode would allow the network to be built more quickly and cheaply. For example:

> Most obviously, Telstra has an estimated 100,000 to 140,000 km of underground ducts that NBN Co could potentially use to deploy its fibre. Where there is room in those ducts (estimates range from 50 to 80 percent) it is a win-win for NBN Co to pay a reasonable charge to use them. This creates value for NBN Co as long as it is cheaper than the alternative of stringing aerial cable or digging its own trenches to install ducts; and value for Telstra given there are few alternative ways of earning money from these ducts (McKinsey 2010, 22).

The cost of utilising Telstra's existing ducts was not explicitly discussed, however the cost of underground trenching in a new trench, depending on the trenching technique used, was said to range from $60 to $150 per metre compared to aerial installation estimated to be in the range of $20 to $30 per metre (McKinsey 2010, 213–214). Overall, the Implementation Study cost estimates assumed the fibre deployment would be aerial wherever possible and that this extent was likely to be some 55 per cent of cumulative total distribution distance.[5] Based on such an assumption, the McKinsey-KPMG Implementation Study concurred with the government's original figure of $43 billion to construct the NBN.

As part of a submission to an ACCC review of pricing principles, Optus considered that aerial deployments can be built four times faster than networks requiring underground cabling and that the NBN could be built for as little as $18 billion if 100 per cent aerial construction was used, $33 billion if the extent was 70 per cent and as much as $60 billion with all cabling underground (ACCC 2010). Although not agreeing with the McKinsey-KPMG Implementation Study figures, the broad trend is similar.

A TRULY INSPIRATIONAL VISION

It is timely to ask: what lessons can be learned from the pay television aerial cabling fiasco of 1995/97? Whilst the Ministerial Telecommunications (Low-impact facilities) Determination 1997 – due to the referral of approval powers back to state and local governments – effectively prevents further aerial cabling by telecommunication carriers, it must not be forgotten that the federal

government had only 'closed the door after the horse had bolted'. The Determination came into effect after Optus and Telstra had achieved their required roll-outs.

Nevertheless, the public at large did benefit from a comprehensive study into practical options for retrospectively undergrounding both aerial electricity lines and telecommunication cables throughout urban and suburban Australia. If electricity lines are undergrounded then there is no opportunity for telecommunication carriers to exploit aerial construction.

The Putting Cables Underground Working Group (PCUWG) study,[6] compulsorily funded by Telstra and Optus at a cost of $1.5 million, was most thoroughly undertaken with a large team of technical and economic specialists plus local government advisors. The study was co-ordinated by the then Department of Communications, Information Technology and the Arts. It involved significant input from the electricity industry nationwide and from Telstra.[7]

Of the many study findings, a rather prescient one concluded that decreased electrical transmission losses arising from underground installation would result in reduced greenhouse gas emissions. Other quantifiable benefits of putting electricity cables underground were said to include:

- reduced motor vehicle collisions with poles
- reduced losses caused by electricity outages
- reduced network maintenance costs
- reduced tree pruning costs
- beneficial impact on property values
- reduced electrocutions
- reduced bushfire risks.

Finding 1 on page six of the report reveals that the study scoped all urban and suburban localities with a population greater than 30,000. This roughly translates to 90 per cent of Australia's population and about 7.2 million households.[8] From the report Summary on pages three and four, the average cost of undergrounding both electricity and telecommunication infrastructure was estimated as $5516 per household in 1998. With innovative design and installation plus economies of scale savings, this could reduce to $3600 per household.

If these costs are projected forward from the study date of 1998 to 2008, it is reasonable to assume that the $3600 figure could rise to $4900.[9] Multiplying $4900 per household by 7.2 million households produces an estimated outlay of $35 billion; alternatively, one could multiply $5000 by 8 million and arrive at $40 billion. Such 'back of the envelope' level of estimation would appear to be at least as good as what has been publicly declared to date supporting the NBN announcement.[10]

Although the PCUWG scoped the cost of undergrounding electricity lines and HFC cables, the writer is not in a position to subsequently factor in the additional impact of the NBN – however in broad terms the cost should be equivalent if the NBN network were to replace the now over a fifteen years old HFC-based pay television and cable modem networks.

CONCLUSION

The Australian government has proclaimed that the National Broadband Network will be 'infrastructure of the future' and is 'in Australia's long-term national interest', yet the NBN project has not been submitted to any cost-benefit analysis (Martin 2010). Department of Finance and Deregulation requires cost-benefit analyses to take a long-term view, a community-wide perspective and incorporate all relevant costs and benefits (Finance 2010). According to the Department of Broadband, Communications and the Digital Economy, such an analysis is inappropriate since the decision to proceed with the investment was a political one (Select Committee 2010b).

Since the mid-1970s, Australia's electricity companies resolved to underground all electricity distribution services in new developments and this outcome has been enshrined in state and local planning schemes. For decades prior, the Postmaster General's Department, later to become Telecom Australia and then Telstra as the monopoly provider of telephony services, adopted the practice of undergrounding its telecommunications infrastructure in almost all urbanised areas.

This national consensus was only broken with the introduction of competitive infrastructure in providing pay television that resulted in significant areas of our mainland capital cities being criss-crossed with at least one and often two aerial networks of HFC cables. However the NBN is to be a government-mandated monopoly that replaces Telstra's entire copper-based customer access network; the NBN will become the infrastructure provider of last resort to carry lifeline telecommunication services.

There is no doubt that a fully underground NBN will be more costly and slower to roll out than one involving aerial construction. NBN Co declines to release details of any cost-benefit analysis (Select Committee 2010c), let alone one revealing the sensitivity of calculations with respect to changes in various key parameters – such as the extent of undergrounding. Clearly if such a cost-benefit analysis was undertaken and scoped the parameters in a narrow sense relating only to NBN Co's immediate business operations, the result will quite likely support the extensive application of aerial construction.

Correspondingly if each Australian resident undertook a cost-benefit analysis of paying for a local garbage collection and considered the impact only in a narrow sense, they may conclude it was cheaper to throw their rubbish on the street. However Australia is not a third-world country and NBN Co is a federal government entity that is supposed to be creating infrastructure of the future that is in Australia's long-term national interest.

Australians should be very worried about investing in nation-building infrastructure held up by electricity poles which tend to rot, get hit by errant road vehicles or burn in bushfires. Such an outcome outstandingly fails the basic notion of creating 21st century broadband as a building block of Australia's future digital economy.

Whilst the federal government's announced roll-out of a National Broadband Network represents a truly visionary national policy, it will be severely blighted if any significant extent of the access infrastructure is to be aerially constructed. Now is the time for the federal government to instead adopt a truly inspirational vision for Australia by issuing a revised policy that results in the NBN to be installed fully underground along with the retrospective undergrounding of all existing aerial electricity lines.

ENDNOTES

1 By visual inspection this safety separation appears to be about 1 to 1.5 metres.

2 Probably not related to safety, but rather more the practicality of allowing access for the 'cable spinner/lasher' device to deploy the second cable.

3 Also note Tasmanian Government Submission to DCITA, January 2006: http://www.archive.dcita.gov.au/__data/assets/pdf_file/0018/37611/88_Tasmanian_Government.pdf and Aurora Energy media release, 28 November 2007: http://www.auroraenergy.com.au/news/default.asp?file=27-november-2007.txt.

4 Aurora Energy is a Tasmanian Government-owned electricity distribution and retail company.

5 At least the Implementation Study admitted that community resistance to an aerial roll-out coupled with unsatisfactory electricity pole infrastructure (structurally incapable of supporting fibre and/or unsuitable due to impeding infrastructure) could reduce this amount to perhaps 43 per cent or even a lesser amount. (See page 215.)

6 The report of the Putting Cables Underground Working Group is noted at http://nla.gov.au/nla.cat-vn2246230 however an online copy of the report no longer seems available; interested persons could contact the writer of this paper for further information.

7 Though Telstra's detailed costing information was confidential and not explicitly divulged in the final report, it was fully factored into the financial conclusions.

8 For example, refer to http://en.wikipedia.org/wiki/List_of_cities_in_Australia_by_population ; for the purposes of this 'back of envelope' calculation it is safe to assume an average of 2.5 persons per household. The 90 per cent figure conveniently aligns with the announced NBN plans for cable-delivered broadband service.

9 For example, refer to http://www.rba.gov.au/calculator/calc.go whereupon an estimated escalation of $3600 at 1998 prices becomes $4900 at 2008 prices. RBA calculations for 2009 were not available at the time of writing.

10 We are dealing here with a gross average, whereby most of the swings and roundabouts even out and hence for national budgetary purposes the answer can be quite representative; the original PCUWG estimate was determined utilising a complex financial model from Monash University.

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