Open Letter
18 January 2021

The Hon Rob Stokes MP
Minister for Planning and Public Spaces

The Hon Matt Kean MP
Minister for Energy and Environment

Snowy 2.0 transmission must be underground

Dear Ministers,

You will soon be presented with an Environmental Impact Statement (EIS) proposing high-voltage overhead transmission lines through Kosciuszko National Park for the Snowy 2.0 pumped hydro station. We believe overhead transmission lines would cause extensive, unnecessary, and entirely unacceptable damage to the Park.

We urge you to insist on a comprehensive analysis of underground alternatives prior to the submission of the EIS, in accordance with regulatory requirements. The proposed option in the EIS must be for underground cables, not overhead lines. Overhead lines would cause environmental impacts that are totally incompatible with the national and international significance of Kosciuszko National Park.

In the absence of your intervention, we understand that four 330 kV overhead transmission lines will be proposed, suspended on two sets of steel lattice towers (up to 75 metres high). The lines would traverse eight kilometres of Park within an easement up to 200 metres wide. One square kilometre of National Park would be permanently cleared. The lines would be visible over a vast area, totally destroying the ambience and integrity of this remote and largely pristine region. This proposal is far more intrusive than any of the single tower lines constructed in Kosciuszko before the Park was established in 1967.

Underground cables may be more expensive, but they have several offsetting benefits including minimal environmental impact, higher reliability, reduced maintenance, and less vulnerability to outages from lightning, storms and bushfires.

Kosciuszko National Park is a special and irreplaceable place on our National Heritage List. Despite the damage of the past and present, it is one of the most majestic areas in Australia and one of our planet's natural icons. It has fundamental cultural significance for Indigenous peoples and is very much loved and enjoyed by all Australians.

The unique character and values of Kosciuszko must not be sacrificed for the cheapest transmission option, overhead lines, when viable and far less damaging underground alternatives are available, as outlined in the accompanying Paper.

Photomontage (TransGrid)
Lobs Hole, Kosciuszko National Park

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Going underground
with the transmission connection for Snowy 2.0

18 January 2021

Figure 1 - Photomontage of proposed overhead transmission lines at Lobs Hole, Kosciuszko National Park (TransGrid)

NATIONAL PARKS ASSOCIATION OF NSW
protecting nature through community action

This Paper contends that the Snowy 2.0 transmission connection through Kosciuszko National Park should be placed underground

Going underground with the transmission connection for Snowy 2.0

1 Introduction

The Snowy 2.0 Transmission Connection Project (the 'Project') is to be built, owned and maintained by TransGrid, at Snowy Hydro's behest, and is the final component of the Snowy 2.0 pumped hydro development. The Environmental Impact Statement (EIS) is to be placed on public exhibition shortly.[11]

Advice from TransGrid indicates the EIS will propose the construction of two double-circuit 330 kV overhead transmission lines. The lines will traverse nine kilometres of Kosciuszko National Park (KNP) and the neighbouring Bago State Forest (BSF) along an easement up to 200m wide. The lines will be visible over vast distances and permanently raze 1.5 square kilometres of native vegetation and fauna habitat across a largely intact and pristine alpine region.

It appears that TransGrid has assumed approval will be granted and has already secured finance for the Project and awarded the design/construct contract.

This Paper argues that minimising environmental impacts on KNP, not minimising the cost, should be the primary consideration in selecting the most appropriate transmission option. This rules out overhead lines. The EIS must analyse alternatives and propose the best underground solution.

The previous Main Works stage of Snowy 2.0 had numerous serious environmental impacts that were unavoidable if Snowy 2.0 was to proceed. However, this is not the case with the Transmission Connection Project - there are several viable underground cable alternatives that would significantly reduce the adverse impacts on KNP. Underground cables would be more expensive than traditional overhead lines, but with offsetting benefits, including much lower environmental impact, higher reliability, lower losses, less maintenance, and reduced vulnerability to lightning and bushfires.

Overhead transmission lines are incompatible with our obligations for the protection of Kosciuszko National Park, the Australian Alps National Heritage Place, the UNESCO Kosciuszko International Biosphere Reserve, Aboriginal cultural heritage, head-water catchments for south-east Australia's major rivers, unrivalled natural landscapes, and unique biodiversity.

NPA opposes the Snowy 2.0 project, as it doesn't stack up economically, technically, or environmentally (NPA Website). There are cheaper, more efficient, and less environmentally damaging energy storage alternatives. Notwithstanding our opposition to Snowy 2.0, this Paper focuses on minimising the environmental impact of the transmission component of the project on Kosciuszko National Park.

The Paper is based on information provided by TransGrid in November 2020. TransGrid was asked for additional information and clarification on several issues but has yet to respond. Accordingly, it is possible that the way the Project has been described in the Paper may not completely reflect the latest design by TransGrid.

The Paper provides background to an Open Letter to the NSW Ministers for Planning and the Environment from 24 environmental organisations and 50 expert engineers, scientists, environmentalists, academics and economists, calling for a comprehensive analysis of alternatives and the adoption of an underground solution. Many of the signatories to the Letter, and others, have made significant contributions to the Paper.

2 The Project

Information provided by TransGrid indicates the Transmission Connection Project to be proposed in the EIS involves:

- two double-circuit 330 kV overhead transmission lines (on two sets of side-by-side towers[1])
- traversing about eight km of KNP and one km of BSF, connecting the Lobs Hole Cable Yard (near the entrance to the Snowy 2.0 underground Station) with a new Substation (Maragle) in BSF (see the two parallel black lines and dark blue 'disturbance footprint' in Figure 2)
- twenty-one sets of steel lattice towers, each up to 75m high
- an easement varying from 120m to 200m in width
- a series of new access tracks (the green lines in Figure 2)

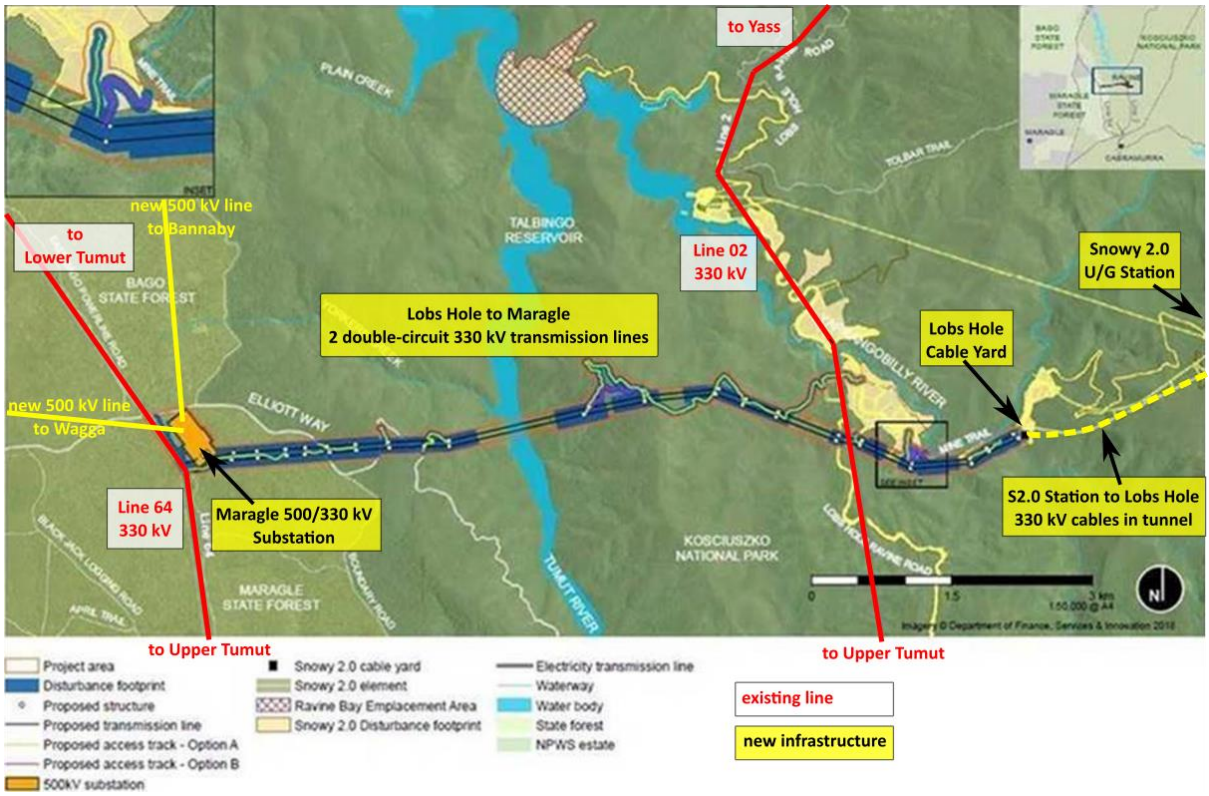

Figure 2 – Layout of Snowy 2.0 Transmission Connection Project

(TransGrid diagram – labels, existing transmission lines and Snowy 2.0 Main Works cables added)

3 Overhead transmission lines

Overhead transmission lines would cause significant environmental impacts, in addition to those from the Snowy 2.0 Main Works[2], including:

- permanent 'disturbance' to 100 hectares (1 square kilometre) of KNP and a further 44 hectares of BSF, which is also an area of high environmental value and sensitivity
- habitat fragmentation and barriers for animal movement
- wide easements requiring regular clearing and introducing sources of erosion, landscape instability and weeds. Easements also provide avenues for feral pests such as foxes and pigs

[1] There are proposed to be four 330 kV circuits in total, one circuit on each side of two sets of towers. Each circuit consists of three bundled conductors (for each of the three phases of alternating current), with each bundle consisting of two to four individual conductors. Each of the bundled conductors are suspended from one of three tower cross-arms. Each tower carries six bundled conductors. Also, two earth wires are strung from either end of a top cross-arm to attract and safely ground lightning strikes.

[2] "Snowy 2.0 doesn't stack up" NPA

- loss of native flora, including threatened species in currently undisturbed vegetation communities
- loss of native fauna, including threatened species such as the Yellow-bellied Glider, Eastern Pygmy Possum, Squirrel Glider, Gang Cockatoo, Greater Glider, Scarlet Robin, Flame Robin, Powerful Owl, Masked Owl and Booroolong Frog
- carbon emissions from vegetation clearance, ending sequestration across the permanently cleared areas
- jarring visual impacts of towers, wires, easements and access tracks, across the spectacular Yarrangobilly and Tumut River valleys and surrounding country for tens of kilometres

Figure 3 – Photomontage – Tumut River/Talbingo Reservoir Crossing (TransGrid)

- a web of criss-crossing overhead lines at Lobs Hole from the four new lines in addition to an existing 330 kV transmission line (Line 02), which traverses a 3km stretch of the Yarrangobilly River
- an intense buzzing from corona loss, particularly audible at night and in foggy weather
- increased risk of starting bushfires, with substantial consequences - human, environmental, animal, property and financial
- dumping of excavated spoil from the tower footings and access tracks in KNP and BSF
- weed transfer and erosion from the access tracks along the easement corridor
- the destruction of the amenity and attractiveness of this outstanding remote alpine region, with few visitors choosing to recreate in such a degraded area

Whilst the existing transmission lines in KNP, built before the National Park was established in 1967, are an eyesore and environmentally damaging, they are far less imposing and intrusive than the proposed lines (see Figure 4 – the campers and bushwalkers at the base of the towers indicate the scale). Compared to the existing lines, the proposed transmission lines will have:

- two sets of side-by-side towers, compared to one set of towers for the existing lines
- two circuits per tower (of three phases), compared to one circuit
- 28 individual wires strung between towers, compared to 8
- much higher towers (conductors strung vertically), compared to shorter towers (conductors

strung horizontally)
- easements of 120 – 200m wide, compared to 70m

For comparison, Figure 4 includes a depiction of the most environmentally impactful underground technique, being trenching, with a cleared easement of around 15-20m. Other underground techniques (tunnels and directional drilling) are less impactful, involving no above ground structures and no, or minimal, cleared easement (Section 4.2).

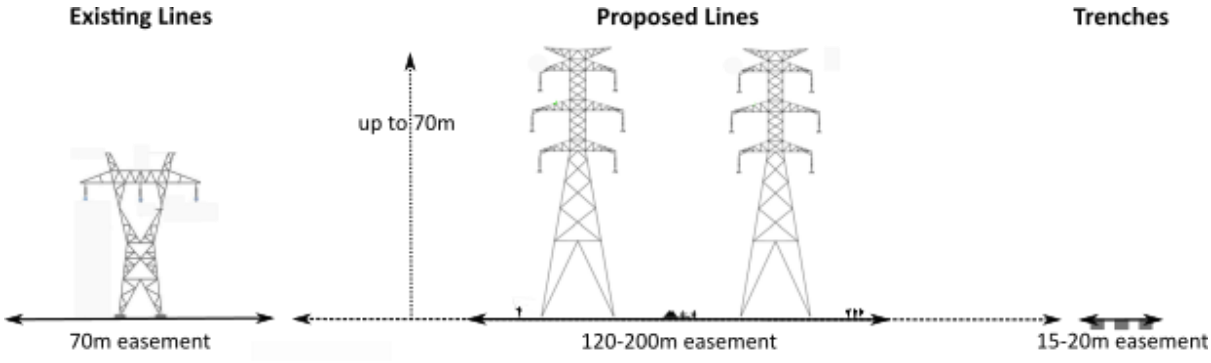

Figure 4 – Comparison of Existing KNP Transmission Lines, Proposed Lines and Trench

These environmental impacts compound an array of pressures on the ecological integrity and resilience of KNP. The alpine habitats have been subjected to historic damage, including clearing, grazing and unrehabilitated construction sites of the original Snowy Hydro-Electric Scheme[3]. They are now further challenged by global heating, rainfall variability, higher intensity storms, more frequent and greater intensity fires, feral horses, high impact recreational activities and the Snowy 2.0 project.

The January 2020 bushfires burnt one-third of KNP, including the entire route of the proposed lines. The burnt landscape is clearly visible in Figures 1 & 9. See the contrast with the pre-fire landscape in Figure 3. Recovery will take decades, leaving the area exposed to further damage from easement clearing and transmission line construction.

The cumulative impacts of these pressures risk large scale ecological collapse, and it is therefore imperative that every opportunity be taken to minimise any source of additional environmental damage.

4 Underground transmission cables

4.1 A common technology

High voltage underground cables are a viable alternative to overhead lines and are installed widely, particularly in cities and areas with high conservation value. NPA has been advised that almost all new transmission links are underground throughout Europe, in fact are mandated in some countries, and much of Asia. For instance, in 2010 the Netherlands capped the total length of overhead transmission and distribution – every new kilometre of overhead line must be compensated by undergrounding an equivalent length.

Underground cables can be installed in trenches, or tunnels or by under-boring (usually Horizontal Directional Drilling (HDD)). One or more of these techniques can be applied over a cable route,

[3] "Rehabilitation of former Snowy Scheme Sites in Kosciuszko National Park" Gabriel Wilks, 18 October 2019 https://site.emrprojectsummaries.org/2019/10/18/rehabilitation-of-former-snowy-scheme-sites-in-kosciuszko-national-park-update-of-emr-feature-2019/

depending on the circumstances.

4.1.1 Underground example - urban

TransGrid recently obtained approval for a 20 km, 330 kV underground circuit between Potts Hill and Alexandria in Sydney[4], at a cost of $285 million. The project involves the installation of two sets of three conduits, using a combination of trenches, HDD and cable bridges.

When installed in a trench the six conduits are to be arranged either flat or layered (triangular or stacked). A flat configuration trench is around 3m wide and 1.2m deep, whilst a triangular configuration trench is around 1.6m wide and 1.6m deep (Figure 5).

Figure 5 – Trench for Two 330 kV 750 MVA Circuits – flat and triangular configurations (TransGrid)

4.1.2 Underground examples - environmental

Transmission lines are often undergrounded partly or purely for environmental reasons, such as:

- the 'Directlink Interconnector' between Mullumbimby and Terranora in northern NSW; 63 km long, 180 MW rating and costing $100 million
- 'Murraylink', between Red Cliffs in Victoria and Berri in South Australia; 180 km long, 220 MW rating and costing $177 million
- the 87 km, 220 kV cable along the edge of Western Port Bay to connect the Victorian desalination plant
- undergrounding 132 kV transmission lines at Olympic Park prior to the Sydney 2000 Olympics, mainly for aesthetic reasons for world-wide TV audiences, at a cost of $37 million
- the 'Hinkley Connection Project' in the UK[5]; 57 km long, consisting of 48.5 km of 400 kV overhead line and 8.5 km of underground cable *"through the Mendip Hills Area of Outstanding Natural Beauty (AONB[6])"* [akin to a National Park]
- the 140 km, 400 kV Aalborg to Aarhus line/cable in Denmark[7] is another example of using cables to protect areas of natural beauty along a portion of the route, albeit at a higher cost. Fourteen km (10%) of the circuit was installed underground, across the Mariager Fjord and through the Gudenaa Valley, costing €35 million (25% of the €140 million total cost)

[4] "Powering Sydney's Future: Potts Hill to Alexandria transmission cable project EIS" TransGrid, October 2019 https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSI-8583%2120191010T060146.019%20GMT

[5] "Hinkley Connection Project" https://hinkleyconnection.co.uk/category/ourproject/

[6] An AONB is an area of countryside in Britain that has been designated for conservation due to its significant landscape value. AONBs enjoy levels of protection from development similar to those of National Parks. .

[7] "Underground High Voltage Cables: Wiring Europe for the Future" https://www.stjornarradid.is/library/01--Frettatengt---myndir-og-skrar/ANR/ANR---Raflinur-i-jord/33-Underground-high-voltage-cables-Leonardo.pdf

- Fifty underground cable projects are listed by Barber[8] and Moorabool Shire Council[9]

4.1.3 Snowy 2.0

Indeed, the Snowy 2.0 project will be installing six sets of 330 kV, 450 MVA cables (i.e. 2,700 MVA capacity in total) from the Snowy 2.0 underground Station to Lobs Hole Cable Yard (on the surface) in a multi-purpose tunnel used for emergency egress, cables, and ventilation. These cable sets (18 individual cables in total) will each be three km long – already covering one quarter the distance to Maragle Substation.

4.2 Underground alternatives for Snowy 2.0

This Paper contends that the cables to be installed from the Snowy 2.0 Station to Lobs Hole should continue all the way to Maragle Substation or the Lower Tumut Switching Station (SS). Five potential alternative options are described below (Section 4.2.1).

Underground cables could be installed in trenches, tunnels or HDD, or in combinations of the three:

- for those sections to be trenched, a flat cable configuration could entail three trenches (two circuits per trench, as per Figure 5), each about three metres wide, with two access ways between, resulting in a partially cleared easement of around 15 - 20m wide. Such an easement width is around 10% that proposed for overhead lines (see Figure 4). The easement could be narrower if the cables were layered, as illustrated in Figure 5.
- a tunnel for six sets of cables would typically be 3 - 4m diameter. No above ground clearing is required, just two portals at either end, resulting in minimal environmental impact. Tunnel spoil could be extracted from the Maragle end (or the Lower Tumut SS end for Alternatives C/D/E(2)) to avoid dumping in KNP.
- sections with HDD would require six bore holes. No clearing is required, except for cable jointing pits about every 1 – 1.2 km, though these would be installed below ground

4.2.1 Underground cable alternatives

Five underground alternatives for the transmission connection from the Snowy 2.0 Station are described below, with the indicative routes and lengths of the first four depicted in Figure 6.

A. extending the three km of underground cables from the Snowy 2.0 Station to Lobs Hole Cable Yard, generally following the direct route of the proposed overhead lines, for the remaining nine km to Maragle. The cables could be in a trench, tunnel or HDD conduit, or combination.

B. laying cables in a trench from Lobs Hole along, or near, the road to the Snowy 2.0 excavated spoil dump in Talbingo Reservoir, at the junction of the Yarrangobilly and Tumut Rivers, and then via a trench/ tunnel/ HDD to Maragle (about 13 km). Approximately half the route is under the road and therefore of straightforward construction, with no additional clearing or environmental impact.

C. as per Alternative B to the junction of the Yarrangobilly and Tumut Rivers, and then in, or adjacent to, Talbingo Reservoir to the existing Lower Tumut SS, located next to Tumut 3

[8] "Achievement and experience in service of long length High Voltage AC electrical links by insulated power cables" CIGRE Latin American Workshop 2013, Ken Barber
https://www.jicable.org/Other_Events/WETS_Brazil_13/slides/Presentation_Barber.pdf

[9] "Comparison of 500 kV Overhead Lines with 500 kV Underground Cables" Moorabool Shire Council, September 2020
https://www.moorabool.vic.gov.au/sites/default/files/largefiles/20200924%20MSC%20Transmission%20Comparison%20Overhead%20with%20Underground.pdf

Pumped Hydro Station at Talbingo (about 25 km). This alternative effectively relocates Maragle Substation to Lower Tumut SS, with ongoing new connections to the main grid being constructed from Lower Tumut SS, rather than from Maragle (see Figure 8).

D. laying cables in a tunnel from the Station directly to Lower Tumut SS (avoiding the need for cables from the Station to Lobs Hole).

E. laying cables in the tailrace tunnel from the Station to its inlet at Talbingo Reservoir, and then via a trench/ tunnel/ HDD to Maragle (E1), or via the Reservoir to Lower Tumut SS (E2).

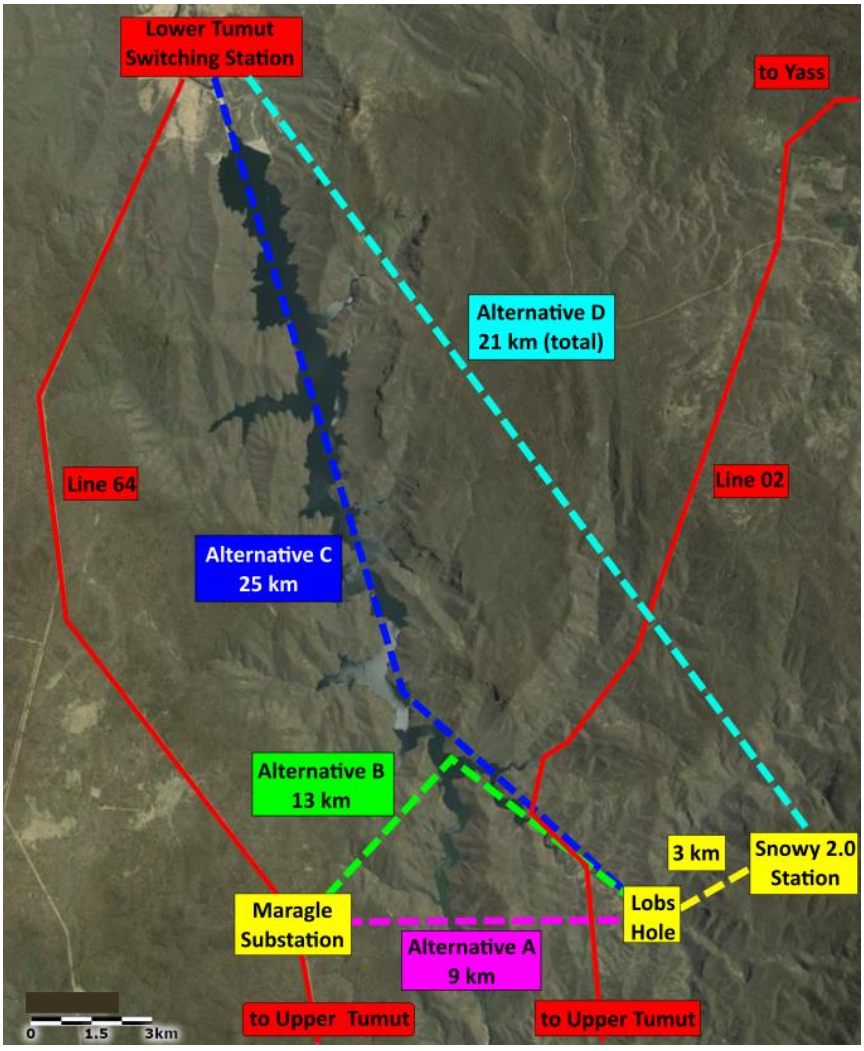

Figure 6– Four Alternative Routes for Underground Cables

A permutation on the first three alternatives would be to also connect the circuits to the existing 330 kV Line 02 running through Lob's Hole, to provide back-up transmission capacity in the event of an outage.

This Paper recommends that the above alternatives be comprehensively analysed by TransGrid. TransGrid should also use the full resources at its disposal to identify any additional underground options that warrant consideration. A preferred underground option should then be adopted and proposed for formal assessment through the EIS.

5 Obligation to analyse alternatives

The *Environmental Planning and Assessment Regulation 2000* (Clause 7(1)(c) of Schedule 2) requires all EISs to include 'an analysis of any feasible alternatives' for a proposed project:

> *"7 Content of environmental impact statement*
>
> *(1) An environmental impact statement must also include …*
>
> *(c) an analysis of any feasible alternatives to the carrying out of the development, activity or infrastructure, having regard to its objectives, including the consequences of not carrying out the development, activity or infrastructure"*

This requirement is repeated in the Secretary's Environmental Assessment Requirements for the Transmission Connection Project, which state *"In particular, the EIS must include a summary of the background to the project, including alternatives that were considered to the project".*

It would appear that TransGrid has dismissed underground cable transmission options without any analysis, possibly as the higher construction costs would not be agreed by Snowy Hydro. Recent actions by TransGrid bear this out, with financing arranged and the design/construct contract having been awarded (Section 7).

Failure to assess viable and lower impact alternatives is not consistent with TransGrid's statutory obligations nor the community's expectations that all reasonable steps will be taken to minimise the impacts on KNP.

6 Project cost and context

6.1 Indicative cost of Project

At this stage TransGrid has not provided information on the cost of the Project.

However, an indication can be gleaned from the announcement by the Clean Energy Finance Corporation (CEFC) of a $125 million corporate debt facility with TransGrid[10], *"to design, construct, operate and maintain a new 330 kV switching station and associated transmission lines as part of its agreement with Snowy Hydro Limited to provide connection services for 30 years".* This debt facility of $125 million appears to encompass the cost of the Project, covering three components - transmission lines, a switching station (possibly Lobs Hole Cable Yard), and operations & maintenance (O&M) for 30 years.

A further indication of the cost of the Project is provided by the announcement by the CIMIC Group (UGL)[11] of being awarded five electricity utility sector contracts *"for more than $112 million … including the design and construction of a 330kV switchyard at Maragle in the Snowy Mountains, NSW for TransGrid. The contract includes building 10 kilometres of 330kV transmission lines to connect the switchyard and the Snowy 2.0 pumped-hydro project cable yard."* The value of the Snowy 2.0/TransGrid contract was not disclosed but is likely to constitute the majority of the $112 million.

A 'ball-park' figure for double circuit 330 kV overhead lines, provided to NPA by transmission

[10] "CEFC and TransGrid Services in landmark investment to support Snowy 2.0 grid development" 27 Nov 2020 https://www.cefc.com.au/media/media-release/cefc-and-transgrid-services-in-landmark-investment-to-support-snowy-2-0-grid-development/

[11] "UGL awarded more than $112M in utilities contracts", CIMIC, 4 December 2020 https://www.cimic.com.au/en/news-and-media/latest-news/ugl/2020/ugl-awarded-more-than-112m-in-utilities-contracts

engineers, is $3.5 million per kilometre. This would imply a cost for the lines from Lobs Hole to Maragle of around $60 million, and is the figure assumed in this Paper.

This Paper also assumes the total cost of the Project to be $125 million, in line with the CEFC debt facility. This implies a cost for the 10-bay Lobs Hole Cable Yard (switching station) of around $40 million, with O&M and financing costs making up the balance of the $125 million.

Figure 7 – Photomontage - Lobs Hole (TransGrid)

6.2 Cost and benefits of underground cables

According to NPA's expert advisors, underground cables typically cost between three to ten times more than traditional overhead lines and involve different design and construction challenges. The wide range is due to the vastly different circumstances and installation techniques that can apply.

This 'rule-of-thumb' suggests that Option A has an indicative cost of $200 million to $500 million. Detailed information is needed before a more definitive estimate could be determined, but estimates for all alternatives should be produced by TransGrid in its EIS analysis.

Cable prices are currently dropping whilst the cost for constructing overhead lines is increasing, as evidenced by the Australian Energy Market Operator's (AEMO) recent adjustments to overhead transmission costs of +30% and recent higher tender prices. Tender prices are influenced by construction demand, so the forthcoming increase in transmission projects throughout eastern Australia (mostly overhead lines) may result in a further narrowing of the price gap between overhead and underground circuits.

6.2.1 General benefits of underground cables

Countering the higher cost of installing underground cables are several offsetting benefits, many with significant financial savings, including:

- less prone to physical damage
- no exposure to weather events – lightning, bushfires, storms, extreme winds etc.
  Such events are expected to become more frequent and intense with climate change, causing more outages, physical damage, more repair costs and lost revenue, sometimes costing tens of $millions from a single event (as was the case with the January 2020

bushfires[12]).

- higher reliability, though taking longer to repair. (The longer repair time should rarely be a concern, as if one cable is out of service the remaining five generators/pumps can still operate up to a combined capacity of 1,670 MW).
- the loss of one cable circuit due to a fault should not result in the need to back off Snowy 2.0 output/load to cover a subsequent cable loss. Whereas the loss of a double-circuit overhead line from a fault (or lightning strike or bushfire) would result in backing off output/load to cover for a subsequent loss of the second double-circuit. Also, the proximity of the two overhead double-circuit lines pose a system stability risk that is not applicable for underground cables[13].
- ready physical access for repairs and maintenance if in a tunnel
- lower operating costs (potentially one-tenth that of overhead lines[14]), though higher repair costs
- lower electrical losses (reputed to be around 30% lower)
- far less or zero easement clearing and maintenance cost
- little or no release of greenhouse gasses from vegetation clearing
- no potential to start bushfires, as can occur from overhead lines through fallen towers, conductor clashing or breaks, and subsequent insurance claims[15]
- and, most importantly, underground cables have substantially less environmental impact and no visual blight[16], other than a relatively narrow easement if trenches are used.

In addition to the above benefits all underground cabling alternatives in Section 4.2 avoid the need for the Cable Yard and overhead transmission lines, thereby saving the Project cost of $125 million.

6.2.2 Additional benefits of the proposed Alternatives connecting to Lower Tumut SS

Alternatives C, D and E(2) involve longer routes than the other alternatives as they connect to Lower Tumut SS rather than Maragle (see Figure 6). Alternatives C and E(2) are 28 km, including the leg from the Station to Lobs Hole. Alternative D is shorter, at about 21 km, and does not require the 3 km leg from the Station to Lobs Hole, so only entails an extra 18 km of cabling.

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[12] The January 2020 bushfires resulted in outages for some days in the Snowy, and separation of the NSW/Victoria transmission networks. Damage to TransGrid's assets in the Snowy region was *"north of $15 million to $20 million, which was not insurable "* [TransGrid CEO]. Snowy Hydro lost supply capability *"costing the company millions "* [Snowy Hydro CEO].

[13] "Queensland and South Australia system separation on 25 August 2018" AEMO, 10 January 2019 https://www.aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2018/qld---sa-separation-25-august-2018-incident-report.pdf

[14] "Overview of the Potential for Undergrounding the Electricity Networks in Europe" prepared for the European Commission, 28 February 2003 https://ec.europa.eu/energy/sites/ener/files/documents/2003_02_underground_cables_icf.pdf

[15] "Black Saturday bushfire survivors secure $500 million in Australia's largest class action payout" ABC News, 15 July 2014 https://www.abc.net.au/news/2014-07-15/black-saturday-bushfire-survivors-secure-record-payout/5597062

[16] "Valuing the social benefits of avoiding landscape degradation from overhead power transmission lines: Do underground cables pass the benefit–cost test? Ståle Navrud ,Richard C. Ready,Kristin Magnussen &Olvar Bergland, 12 May 2008 *"the social benefits of avoiding negative impacts [from overhead transmission lines] on the landscape exceed the costs of burying the lines as underground cables … based only on an assessment of the aesthetic impacts [urban setting]. Impacts of overhead power lines on wildlife and human health would likely make burial of power lines even more attractive."* https://www.tandfonline.com/doi/abs/10.1080/01426390802045921

Although these alternatives involve longer routes, they offer a number of significant advantages to those through Maragle substation, as outlined below.

6.2.2.1 Augmenting an existing substation rather than building a new substation

These Alternatives circumvent the need for Maragle Substation by using the site of the existing Lower Tumut SS. Augmentation of existing substation infrastructure at a more accessible, well serviced location should result in savings in construction and ongoing maintenance, compared to a 'greenfield site' in the middle of a State Forest.

6.2.2.2 Shortens HumeLink, with significant financial savings

The proposed HumeLink project aims to reinforce the southern NSW network by connecting Wagga Wagga and Bannaby with two 500 kV circuits. It is expected to cost up to $2 billion. One circuit goes direct and the second takes a substantial 'dog-leg' deviation via Maragle to connect Snowy 2.0 to the main grid backbone. In Figure 8 the two HumeLink circuits are depicted by the ochre-coloured lines showing the land corridor within which the lines are proposed to be constructed.

The routes for Alternatives C/D/E(2) run parallel with the proposed HumeLink lines to Maragle for about 20 km. Hence, terminating the two Snowy 2.0 connections at Lower Tumut SS (blue lines in Figure 8), rather than Maragle Substation, shortens their combined length by approximately 40 km. This would save about $140 - $200 million, depending on whether the lines are single or double circuit and are suspended from one or two sets of towers.

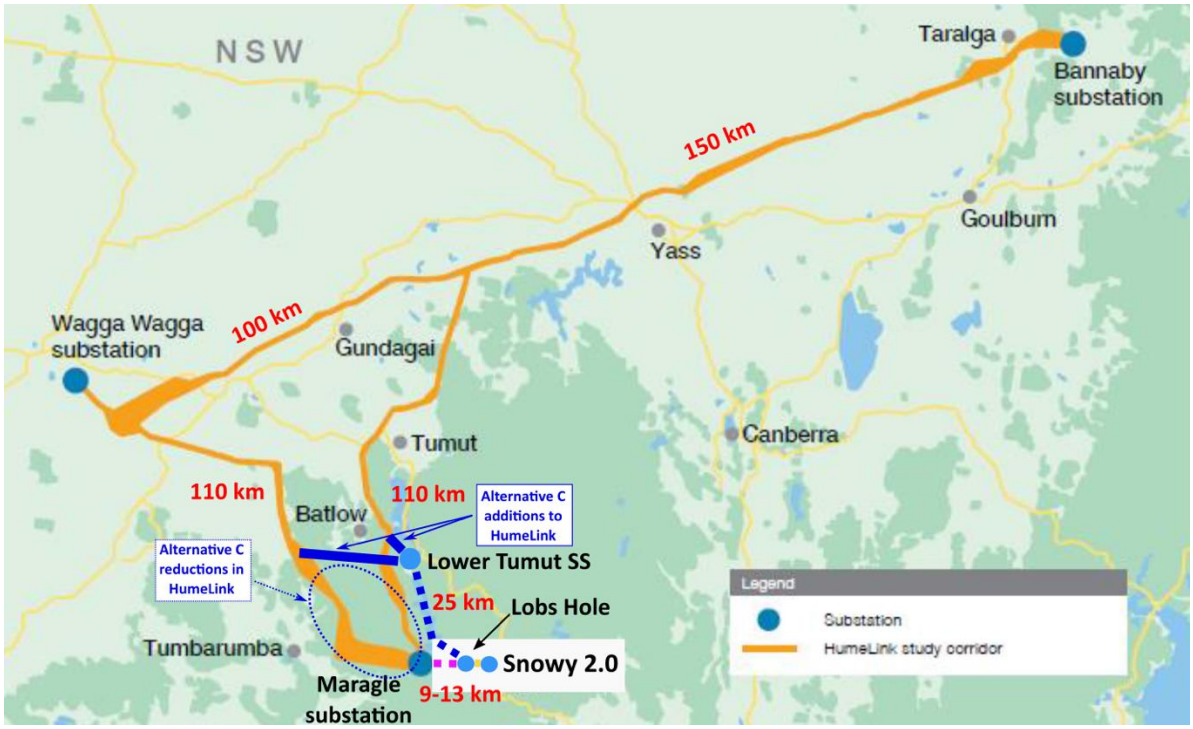

Figure 8 – HumeLink (TransGrid diagram, with distances and Snowy 2.0 Alternatives added)

Snowy Hydro would not be the beneficiary of a reduction in the cost of HumeLink if the Australian Energy Regulator (AER) agrees with Snowy Hydro's view that HumeLink should be paid for entirely by electricity consumers[17]. However, many energy experts contend that Snowy Hydro should be

[17] *"We've said this 150,000 times. Transmission is for the common good. Everyone benefits from it. We use it about 10 per cent of the time and the other 90 per cent it's used by everybody else, particularly on the renewable side."* Mr Paul Broad, Snowy Hydro CEO Behind Snowy's Battery Bet, Australian Business Review,

required to contribute to HumeLink due to the extra 120 km of deviated lines that are needed to connect Snowy 2.0 to the main grid. Also the transmission capacity needed is substantial, as Snowy 2.0 will be the largest load (for pumping) to ever be added to the National Energy Market (NEM) and the largest generator for a quarter of a century.

Irrespective of how the AER adjudicates, either consumers or taxpayers will benefit from constructing less HumeLink transmission lines. This public benefit is therefore a significant offset to the additional cost of Alternatives C/D/E(2). When added to the avoidance of the Project cost, the total saving is around $265 - $325 million.

6.2.2.3 Improved reliability from reduced exposure to lightning and bushfires

The 40 km of overhead lines not needed are in BSF, a high-risk area for lightning strikes and bushfires. 'Removing' those lines would improve the reliability of both HumeLink and Snowy 2.0's connection to the grid.

Avoiding the construction of new transmission lines in fire prone areas is consistent with the Snowy Hydro's CEO[18] assertion that new interstate interconnectors should only be constructed in non-forested areas west of the Great Dividing Range.

6.2.2.4 Potential network and financial benefits for Snowy Hydro

Linking Lower Tumut SS to HumeLink and the main grid would increase the transmission capacity from Lower Tumut SS, both to the north and the west. This may alleviate occasional transmission constraints to Sydney experienced by the existing Snowy generators[19], which have been claimed to cost $millions in lost revenue.

TransGrid's proposal to deviate HumeLink through Maragle provides no additional transmission capacity for the existing Snowy Scheme, except possibly partly through the tie-in to Line 64.

6.2.2.5 Potential to further reduce HumeLink and address local opposition

There is significant community opposition to the HumeLink connections to Maragle, particularly in the Tumut/Batlow/Adelong region. The issue has been raised in State Parliament and spurred TransGrid to engage a specialist negotiator. Terminating the two lines at Lower Tumut SS may provide an opportunity to re-route the lines through less contentious areas.

It may be possible to eliminate one of the HumeLink connections altogether. A double-circuit 500 kV line between Lower Tumut SS and Wagga would have ample capacity (6,000 MVA) to transmit Snowy 2.0's full output/load. This new line would be in addition to the three existing 330 kV lines from Lower Tumut SS to Wagga, Yass, and Canberra, providing further transmission and back-up capacity. Cutting back to one 500 kV connection would address much of the opposition to the HumeLink proposal and reduce the length of the HumeLink deviations to connect Snowy 2.0 by a further 85 km.

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14 Sep 2019

[18] *"The head of the nation's giant Snowy Hydro power scheme has warned rising bushfire risk along the east coast has spurred the need for critical electricity transmission lines to be built connecting Victoria and NSW, but through the west of the states in non-forested areas that are less prone to fires".* The Australian Business Review, "Fire sparks Snowy Hydro call to link NSW, Victoria power", 9 January 2020 https://www.theaustralian.com.au/business/fire-sparks-call-to-link-nsw-victoria-power/news-story/4543f7131e74e960691182020c73c609

[19] *"No; the transmission today is not enough for existing [Snowy output], so it obviously won't be enough for 2.0."* Mr Broad, Snowy Hydro CEO, Senate Environment and Communications Legislation Committee, 21 October 2019

A related possibility could be to use the existing 330 kV overhead transmission line and/or easement between Lower Tumut SS and Wagga (Line 051). This line could either be replaced by the double-circuit 500 kV HumeLink connection between Lower Tumut SS and Wagga or the new HumeLink line could be built beside it by widening the easement. Replacing the line seems the preferable option as then the only environmental impact of HumeLink would be taller towers, though possibly a few less towers, in place of an existing 330 kV line, but resulting in a three-fold increase in transmission capacity.

6.2.2.6 Environmental benefits

Finally, these Alternatives avoid the clearing of about 400 hectares (4 square kilometres) of BSF for the HumeLink lines, Maragle Substation, and the lines from Lobs Hole. Both the construction damage and ongoing easement and infrastructure maintenance impacts would be avoided.

Alternative D could provide drainage from the Station. The cable tunnel from the Station to Lower Tumut SS could be designed to also act as a gravity drain for seepage water that will accumulate at the base of the Station, saving pumping equipment and piping. It would be particularly valuable in the event of a Station flooding incident.

6.3 Context

The latest Snowy Hydro forecast for the 'construction cost' of Snowy 2.0 is around $5 billion (Snowy Hydro's initial forecast for the project was $2 billion). Many independent experts consider the latest forecast to also be optimistic, with a more realistic total project cost of around $10 billion, when all components and related grid augmentations are included.

This massive public expenditure is meaningless without the infrastructure to transmit power through and beyond KNP. The overhead transmission line Project option represents just over 1% of the total cost of Snowy 2.0.

The Project must be assessed in relation to the financial cost and environmental impacts of the Snowy 2.0 project in its entirety. In that context, NPA considers that a low impact underground transmission option would justify expenditures many times higher than the $125 million for overhead lines.

The Snowy 2.0 project is already costing considerably more because of its location within KNP than if it were not in a National Park. The environmental conditions imposed, such as minimising construction footprints (e.g. using more expensive compact equipment for substations), avoiding sensitive areas, offset payments ($100 million), waste management, monitoring etc have added many hundreds of $millions to the cost. Insisting on the transmission connection being underground should be another 'standard' condition for developments within National Parks.

Simply, if a developer wishes to build an electricity transmission circuit or pipeline, road or any other infrastructure through a National Park then such a proposal should normally be rejected out of hand and only considered in exceptional cases, and then only if it were demonstrated that the installation resulted in the minimal possible environmental damage. Snowy Hydro/ TransGrid should not receive special treatment compared to any other developer or NEM participant.

It is notable that $285 million has recently been allocated for a single 330 kV underground circuit in Sydney (Section 4.1.1). A similar willingness to invest in a low impact underground option to ensure that further damage is not inflicted on KNP is entirely appropriate.

Undergrounding transmission lines along portions of the route in areas of outstanding natural beauty

is common practice (see the UK and Denmark examples in Section 4.1.2). The Project should be considered within the wider context of HumeLink, and the entire length for the Snowy 2.0 connection to the main grid backbone.

For Alternative A, the connection from Lobs Hole to Maragle is just nine km out of the total 220 km of lines to Wagga and the Wagga-Bannaby corridor (see Figure 8). That is, only 4% of the total length of circuits needed to link Snowy 2.0 to the main grid backbone would be undergrounded, leaving the remaining 96% as overhead lines. For Alternatives C/D/E(2) the percentage that would be undergrounded is higher but still relatively minor, at 12%.

Surely such a small percentage for the connection of Snowy 2.0 to the main grid being underground is reasonable - Kosciuszko National Park is unquestionably an area of outstanding natural beauty.

7 Snowy 2.0 staging

Consideration of the Transmission Connection Project EIS, and its alternatives, should have occurred concurrently with the Main Works EIS, enabling the impacts of the two major components of Snowy 2.0 to be assessed together[20]. In fact, well before the release of the Main Works EIS, Snowy Hydro executives advised that a concurrent assessment of both components was intended.

However, there will be at least a 15-month gap between the release of the Main Works EIS in September 2019 and the EIS for the Transmission Connection Project. NPA is not aware of any technical reason for this extended staging and delay in the exhibition of the Transmission Project EIS.

Approval of the Main Works in June 2020 effectively guarantees that the Connection Project will also be approved. However, this presumption of approval must not mean automatic authorisation of whatever is proposed, especially the cheapest and most environmentally damaging option.

TransGrid is clearly assuming approval, as Project financing has been arranged[10] (November 2020) and a construction contract awarded[11] (December 2020). (It is noted that TransGrid has followed a similar presumptive path as did Snowy Hydro, which awarded the $5.1 billion Main Works contract in April 2019, six months before the EIS was exhibited and 15 months before it was approved).

Revising the design to an underground option will take some time, delaying the start of construction, but this should not hinder Snowy 2.0's commissioning.

The latest Snowy 2.0 forecast is *"to start up in the June half of 2025, ahead of an 18-month ramp-up"*, resulting in full commissioning of the Station in 2027 and 'landscape rehabilitation' thereafter. When announced in March 2017, Snowy 2.0 was to be completed in 4 years after the Feasibility Study – i.e. by December 2021. Many industry experts consider this latest Snowy 2.0 forecast also to be overly optimistic.

It is notable that AEMO acknowledged the possibility of construction delays and assessed that Snowy 2.0 is not needed until at least 2029-30[21]. Independent experts have further examined the AEMO

[20] "Kosciuszko: A Great National Park", Slattery & Worboys, May 2020. *"The impacts of the transmission lines will be huge but are not considered in the [Main Works] EIS. This fractured assessment process invites 'death by a thousand cuts' and obscures the true scale and impact of the project on Kosciuszko National Park."*

[21] The 2020 AEMO Integrated System Plan (ISP) included a sensitivity analysis of a four-year delay in the commissioning of Snowy 2.0 till 2029-30, concluding that *"the power system is relatively resilient to a delay, with minimal impact to the overall market benefits of the network development, as shown in Table 16 [Appendix 2]"*.

forecast and determined that the existing 1,800 MW Tumut 3 pumped hydro station can accommodate the demand for Snowy Hydro storage until 2033[22].

Nevertheless, if Snowy 2.0's latest construction forecast is achieved and the transmission connection needs to be completed by the start of 2025 for commissioning of the first unit, four years is ample time to design and construct underground cable circuits over such a short distance.

8 Conclusion

Kosciuszko National Park is a landscape of exceptional natural and cultural significance, protected for future generations.

Infrastructure development should not be permitted within KNP, but if genuinely unavoidable, it must be designed with the overriding objective of minimising environmental damage.

New overhead transmission lines have no place in any National Park, especially when there are practical alternatives with far less impacts.

The Snowy 2.0 Transmission Project EIS should adopt an underground connection.

Figure 9 – Photomontage - Lobs Hole (TransGrid)

[22] AEMO's Integrated System Plan: Does it leave Snowy 2.0 high and dry? Victoria Energy Policy Centre, 10 August 2020