SEPTEMBER 2023

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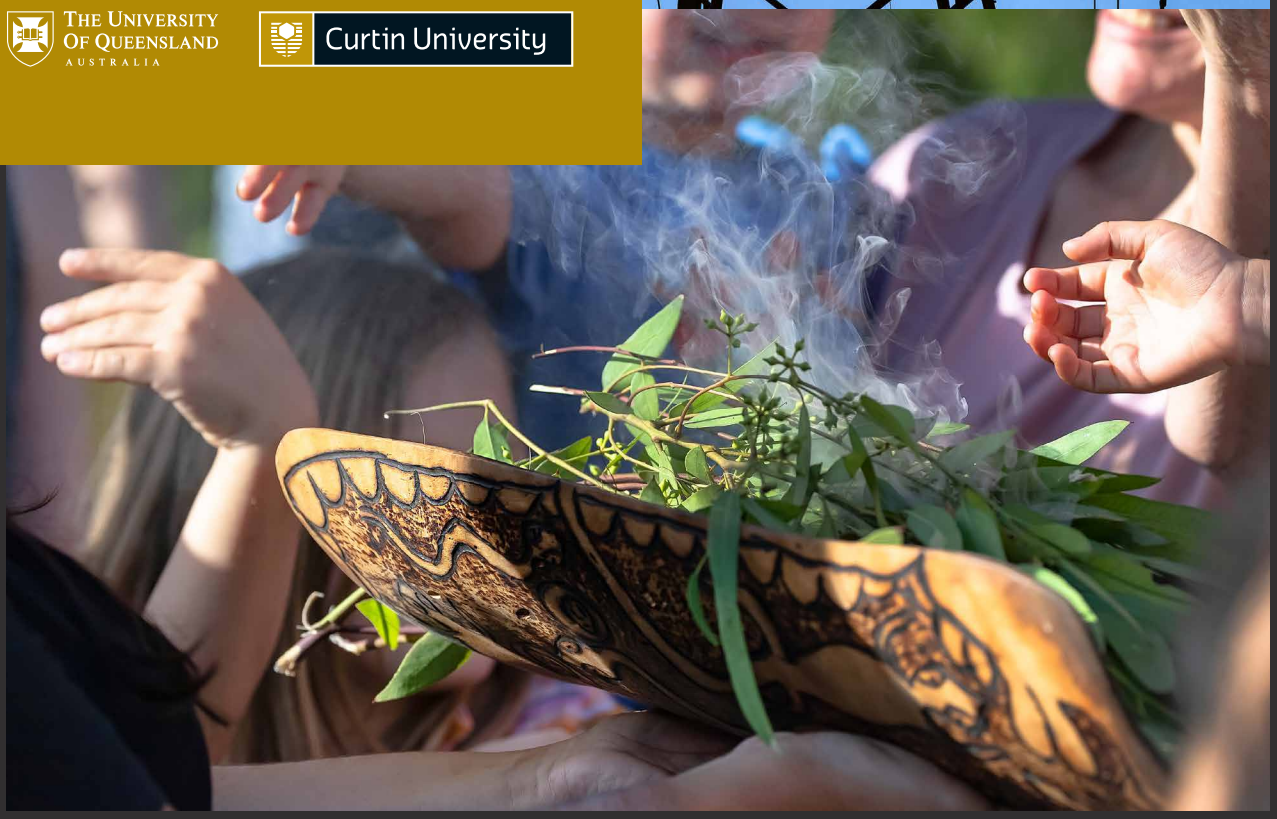
Social and Cultural Aspects

Comparing high voltage overhead and underground transmission infrastructure (up to 500 kV)

Audrey Cetois, Nasrin Aghamohammadi,
Gary Madigan, Fran Ackermann and Peta Ashworth

The University Of Queensland
AUSTRALIA

Curtin University



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Acknowledgements

We would like to acknowledge the contributions of:

Susantha Wanniarachchi

For his help in seeking copyright for the images included in the document

Members of Powerlink's Customer Panel

Who guided us through the research design elements of the project

Report Reviewers

Who generously gave up their time to provide much needed feedback on the report and chapters

1.

Introduction

This study aims to investigate the benefits and trade-offs between overhead and underground transmission line infrastructure, specifically focusing on issues associated with under-grounding new transmission infrastructure. It seeks to establish a clear and consistent approach to the evaluation of overhead lines and underground cable transmission, including the consideration of community concerns around the need for new transmission infrastructure to connect large renewable energy generation projects. It does this through systematic reviews of the literature as well as incorporating experiences of Transmission Network Service Providers (TNSPs) in Australia and overseas. The study has a particular focus on 500kV transmission infrastructure which are projected to figure in most large projects in Australia going forward.

Historically, transmission networks in Australia developed from the need to transfer large amounts of power from large coal fired power stations, typically co-located near coal reserves, over long distances to major cities and industrial load centres. In contrast, the proposed large scale renewable generation facilities, mainly solar and wind farms, require greater land areas and are largely being located in greenfield areas with little or no existing transmission network infrastructure. These new developments are naturally creating community interest and concerns around a range of potential impacts, including but not limited to: visual amenity; environment; Traditional Owner lands; agricultural land use; and social licence to operate concerns. This has led to questions surrounding when it is appropriate to underground transmission infrastructure and the likely implications of doing so.

This chapter focuses on the social and cultural dimensions that influence the acceptance of overhead and underground transmission lines. It does this through consideration of individuals, communities and First Nations People in two parts. It first focuses on the factors that influence social acceptance and social licence that emerged from the peer reviewed literature in Scopus and Web of Science, using the PRISMA methodology to guide the process (refer Appendix A). Through this process, 102 papers were included in this review. Geographically, nearly 90% of the studies were conducted in Europe or the US, with only 4 studies being located in Australia (all of which took place in Queensland). The second section summarises an overview of considerations for ensuring culturally responsive engagement with First Nations People and details the principles for cross-cultural collaborative design with a detailed account provided in Appendix B. The key findings from the literature review were compared with the engagement principles of the 2017 CIGRE Greenbook. The findings from the literature review differ in that they have a stronger focus on normative aspects to ensure social justice considerations enhance collaboration with communities. Finally, the chapter presents some overall conclusions and key findings arising from the review and discusses their associated implications.

2.

Results

2.1 Frameworks in the literature

Since 1988, there have been a variety of social acceptance frameworks developed in the literature that investigate the key factors that influence the social acceptance of transmission lines. They mainly focus on overhead lines which, until recently, have been the predominant form of transmission infrastructure [1], [2]. The earliest study by Furby et al., (1988) [5] (Figure 1), details a number of factors that extend beyond the physical features of the technology. All have appeared in subsequent frameworks and are applicable today.

In addition to the physical factors these include: types of participation; information and knowledge; issues of procedural and distributive justice [2]; fairness and trust [3]; along with perceptions of risk; - all of which lead to the formation of an individual's attitude (positive, neutral or negative) towards a project. Many of these factors feature in Moffat and Zhang's [4] social licence to operate (SLO) framework and the term most often referred to in the co-design workshop that informed this project (refer Chapter 2). SLO refers "to the ongoing acceptance and approval of an industry's operations by local community members and other stakeholders that can affect its profitability" [4, p. 61] and is particularly relevant to the challenge of deploying transmission lines.

A more recent framework that has frequently been applied to studies investigating the acceptance of energy technologies is the *Technology Acceptance Framework*, developed by Huijts, Molin and Steg (2012) [6] (Figure 2). This model shows more detail of the range of factors that influence a person's willingness to accept or oppose a technology. These factors highlight the ways in which individuals will make trade-offs when

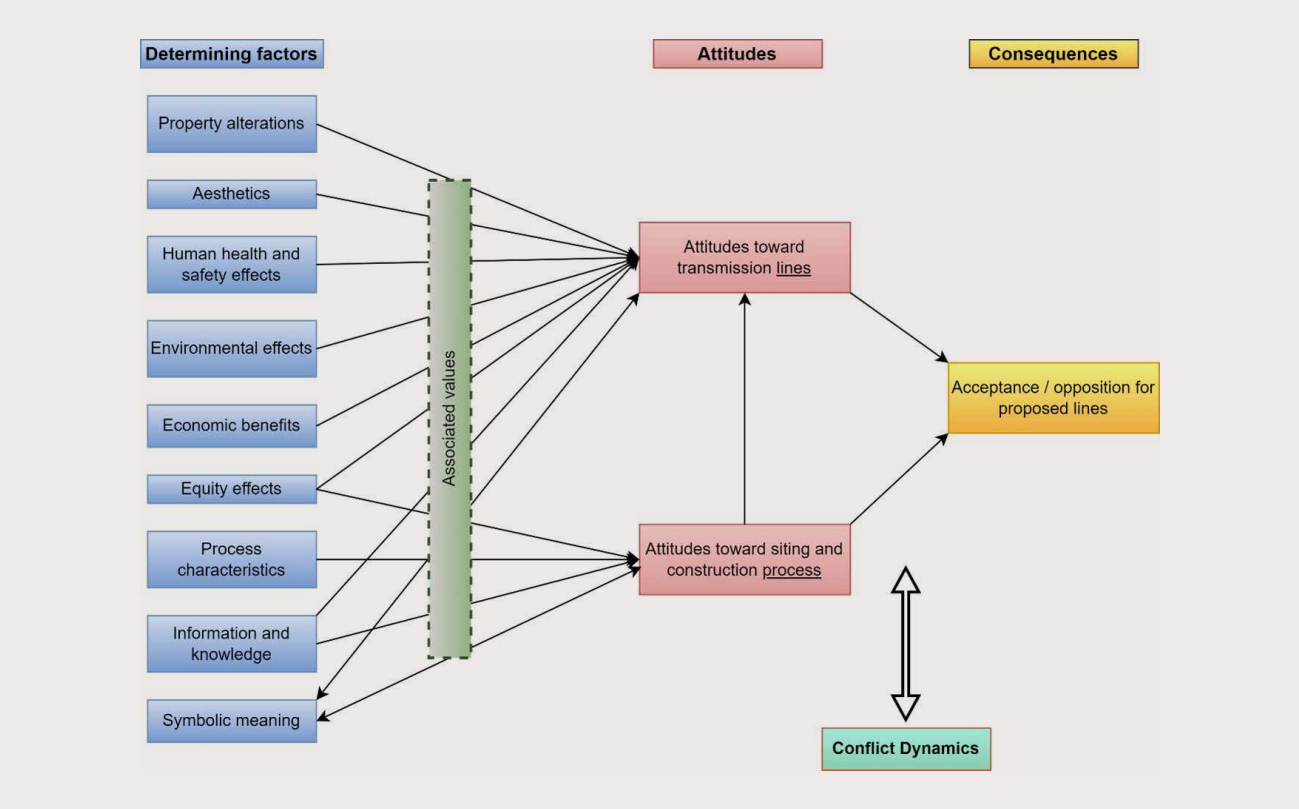

Figure 1 - Social Acceptance Conceptual Framework Adapted from - Social acceptance conceptual framework adapted from Furby et al. [5]

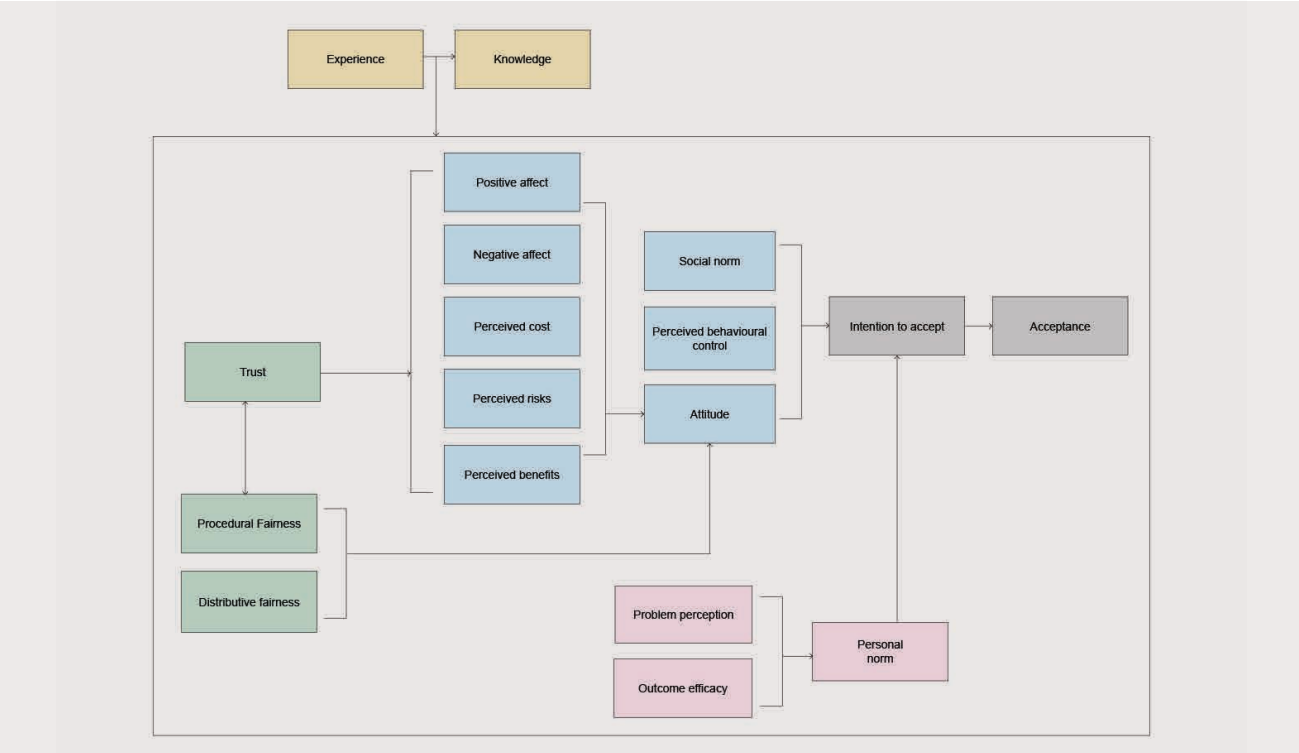

Figure 2 Technology Acceptance Framework (Huijts, Molin & Steg 2012) [6]

considering proposed transmission projects. It also highlights the influence of social norms and how local community, friends and families will influence how an individual might perceive a project and decide to accept or reject it [6]. This has been the case in Australia with groups of farmers and other stakeholders influencing their counterparts in their response to proposed transmission projects.

Other relevant and important considerations that have evolved in response to transmission lines (and other energy projects) and the earlier studies of NIMBYism (Not In My Back Yard), are the concepts of place attachment and place identity [7]. Devine-Wright (2009), summarises "place attachment" as a *"positive emotional connection with familiar locations such as the home or neighbourhood"* (p.417), which builds over time, while "place identity" describes how local characteristics, both *physical and symbolic*, contribute to an individual's sense of identity. For example, do they identify as a cattle farmer, a city dweller, or something else. When new projects are proposed, that may change or disrupt a local area, an individual's sense of place is likely to be challenged. How they respond to such disruption not only depends on their strength of attachment (i.e. length of time in the place), but similar to the *Technology Acceptance Framework*, the likely impacts of the change (positive or negative), trust in the developer and procedural justice considerations [8].

2.2 Factors influencing social licence and acceptance

2.2.1 Complexity, context and changing norms

The literature highlighted how the factors that influence social licence and acceptance can be difficult to understand. This is mainly due to the combination of: a) electricity system complexity, b) dynamic views (reflecting changing norms, identity and place attachment), and c) context dependency (each site has its own unique characteristics). The complexity of the electricity system from governance mechanisms to technology deployment, renders gaining a shared understanding and participation between stakeholders difficult, particularly for members of the general public [9]. Additionally, several papers showed that societal attitudes and acceptance of transmission line projects are dynamic [9]–[13]. That is, they will be influenced by project related events which can arise at any stage [14], [15], as well as broader *socioeconomic and political events* that have the potential to influence acceptance of a project [12]. However, Friedl and Reichl [16] showed that once a person's attitude solidifies, either for or against a project, they are less likely to change their mind.

Context dependency and the difficulties in generalising findings from one study to the next was mentioned in the majority of papers and highlighted in several reviews ([5], [13], [17]). The two quotes below reflect

the dynamic and context dependent nature of social acceptance.

"...each transmission line siting presents a unique combination of characteristics, and it is unlikely that we will be able to predict exactly how the affected public will react with respect to all the relevant elements" [5, p. 39]

"Interventions that worked in 2008 would probably not have worked out in the same way in 2013. This suggests that there is no blueprint approach for organizing stakeholder participation in transmission grid planning, yet the France–Spain interconnection project shows that true dialogue can foster societal support." [18, p. 226]

This means that projects to date, whilst useful in understanding and identifying what has led to acceptance in the past, cannot be applied independently of the specific context in which the project is occurring.

2.2.2 Aesthetics and visual impact

In the studies reviewed, overhead transmission lines and towers were always viewed negatively because of their visual impact on the landscape [5], [19]. Unsurprisingly, this was not mentioned in relation to underground cables. When comparing other energy infrastructure projects, roads, or telephone towers with overhead transmission lines, transmission lines were ranked as being the worst when considering negative visual impacts [20]–[24]. Visual impacts were reported to have additional negative effects on the character of the place and property values, depending on the setting (i.e. rural or urban, farmland or wilderness). They were also inferred to have additional potential impacts on recreational activities, tourism, and local commerce.

A German study cited in Menges and Beyer [25] from the environmental non-government organisation Environment Action Germany (*Deutsche Umwelthilfe*) found that in 2010:

"over 70% of participants at least 'agree fully' to the statement 'overhead lines impair a landscape's character'. In contrast, 70% of respondents see no noteworthy landscape impairment in the case of underground cables". [25, p. 34]

To understand whether the negative response to visual impacts of transmission line towers could be reduced through improved design, Priestly and Evans [26] surveyed 236 US residents affected by the upgrade of an existing overhead transmission line in California. Their methodology used photographs of tubular and lattice overhead towers within different landscapes and with towers painted green to blend in more to the background. The authors reported that the tubular design was more attractive for some participants (47%) but less attractive for others (21%). The green paint fared similarly. However, the landscaping of easements received overall positive reviews. This concurred with the study by Brinkley and Leach [27] where landscaping of easements was found to overcome initial negative impacts on property values.

In Queensland, Australia, Elliott and Wadley [28] conducted focus groups with homeowners and found that single steel pole tower designs were preferred to lattice towers. Similarly, Devine-Wright and Batel [29] surveyed the preferences of UK citizens for three different designs of overhead transmission towers - t-shaped, totem, and traditional - and found that 77% of respondents ranked the t-shaped tower as their first preference, while the traditional lattice pylon came last. For the Hinkley Point transmission line in the UK, Cotton and Devine-Wright [14] also noted that during workshops with affected residents, they were most concerned about tower height, and of their own accord discussed alternative designs to lattice designs and their potential suitability.

Lienert et al.'s, [20] survey of Swiss citizens (n=248) showed that new transmission line projects and the use of larger sized towers, both led to lower acceptance. Interestingly, Wadley et al., [19] linked visual impacts with health impacts where it was felt that:

"visual factors might act as a proxy for, or reminder of, the alleged harm of EMFs. Both externalities constitute not shocks but stresses, the visual one overt, the health one covert." [19, p. 751]

In contrast to the above research, Keir et al., [30] reviewed citizen submissions to the Department of Energy (DOE) in the US in relation to a new overhead transmission line project - the 187-mile Northern Pass in New England. Concerns with visual impacts were only present in 11% (4th ranking) of the submissions and the dominant concerns were with the procedural and distributive justice elements of the project (refer section 2.2.9).

2.2.3 Human health

The literature shows that concerns relating to human health impacts arising from transmission lines mostly focus on the impact of electromagnetic fields (EMF) and to a much lower extent noise [19], [31], [32]. Additionally, the risk of electrocution and or accidents such as collision with equipment was mentioned in a few studies [5], [28], [33].

The strength to which EMF was reported to influence acceptance varied significantly between studies. The studies suggest that the depth and source of the

information influenced an individual's response to the concept of EMF, with some individuals expressing considerable concern surrounding EMF while others were much less worried. It could be assumed that communicating the most up to date and factual information will be an important factor to minimise these concerns.

German, Swiss, and Australian research conducted with residents not directly affected by transmission line projects, showed that perceptions of EMF risk significantly undermined acceptance [1], [28], [31], [34]. These results align with studies conducted in transmission line host communities in the Netherlands [35], Denmark [10], Germany [36], and the UK [14] where overall, local residents expected negative EMF related health impacts. For the UK Hinkley Point transmission line, the most commonly discussed issue during focus groups involving local residents was EMF [14]. Some residents raised concerns about *"the 'contamination' of food systems or ecosystems and the release of 'gases' from HVOTLs"* illustrating some of the confusion regarding the impact of EMF. In addition, residents mentioned that they did not trust electricity utilities to provide accurate and unbiased information on the matter. In Denmark, local residents, interest organisations, and municipalities raised concerns with EMF which focused mainly on the quality of information provided and calculations in relation to the required safe distances from houses [10].

Conversely, Cotton and Devine-Wright [37] found, using a prioritisation method (Q sort) that EMF was not the main concern for professional stakeholders nor local residents. Similarly, EMF was only included in 8% of citizens' submissions to the DOE in the US for a new overhead transmission line project [30]. In Germany, Mueller [38] reported that residents' concerns over EMF was not a significant driver to take action against transmission lines. In another study they reported:

"residents living at the underground HVTL project site do not expect more or less harm from future power lines than people living in the overhead HVTL project area." [39, p. 462]

2.2.4 Proximity

Carley et al.'s [17] systematic review of survey-based studies, found no consistent findings on the impact of energy infrastructure proximity on resident acceptance. They concluded that proximity acceptance was a context dependent issue. It was also noted in large national surveys by Konisky et al., [40] of a representative sample of US citizens' attitudes (n=16,200) towards energy infrastructure - with some living in proximity of existing transmission line projects and others living near proposed transmission line projects - found that proximity played a limited role. However, Zaunbrecher et al.'s survey across Germany found that for a hypothetical project located 400m, 800m, and 1200m from their residence *"the highest possible distances from residential dwellings are preferred"* [34, p. 436]. Similarly, Stadelmann-Steffen's [31] survey of Swiss residents (n=1,129) found that negative perceptions was highest in those not living near transmission lines while those living closer were less likely to hold this perception. This suggests there is an element of normalisation for those living in proximity.

Several investigations targeted the effect of proximity on affected communities. For example, when Cotton and Devine-Wright [14] conducted focus groups with 38 residents affected by a proposed new transmission line project, the residents were most concerned with EMF in relation to the proximity of homes and schools, but their discussions suggested that those concerns could be mitigated by tower heights and undergrounding. Nelson et al., [41] showed that when residents (n=358) along the Tehachapi transmission line in the US had negative attitudes towards the transmission lines, they perceived the line as closer, and they were more likely to take action and oppose. While Mueller et al., in their survey (n=1,302) of people living along a proposed overhead transmission line in Germany, *"revealed that increasing spatial proximity significantly enhanced local residents' risk perceptions, reduced general public support for grid expansion, and triggered their information seeking and oppositional behaviour"* [42, p. 145].

However, it is important not to generalise, when trying to evaluate how close is too close for local residents. Giaccaria et al., [43] surveyed (n=1,410) residents in communities affected by existing overhead transmission lines in Italy and participants' perceptions of impact from the existing line were stratified according to their proximity. The perceived impacts cited were visual, health and property value. No impact was reported by 6.9% of residents living 0 to 50m from the line, 31.8% for those living between 50-200m from the line, and 60.8% for those living in the 200-1000m area.

Bertsch et al., [44] studied what the minimum acceptable distance might be for hypothetical overhead and underground transmission line projects in Ireland (n=1,044). The research revealed that less than one third of participants would accept an overhead line within 5km of their residence, while approximately 50% of participants would accept an underground line within 5km.

2.2.5 Familiarity

Building on proximity, Devine-Wright and Devine-Wright [45] theorised that when something new becomes familiar it "loses specificity and potentially threatening

qualities" (p. 359). As such, this familiarisation could potentially lead to greater acceptance of new transmission lines where older transmission line projects are already in place. Bailey et al., [46] conducted interviews of local residents along a proposed overhead transmission line in the UK and found that long term residents of the area had higher acceptance of the new line and this acceptance was attributed to their familiarity with other powerlines in the area. Joe et al., reported that:

"people who can see existing HVOTLs from their homes also do not think the HVOTLs are intrusive; that they are not opposed to siting new HVOTLs near their home; and that they did not think new HVOTLs would decrease the property value of their homes". [47, p. 132]

Simora et al. [48] showed that for a convenience sample of 6,568 German citizens, existing transmission line towers in their area had no influence on acceptance of new transmission line infrastructure. However, Wadley et al. [19] surveying Queensland residents revealed that acquaintance with overhead lines was a reliable predictor of concern.

2.2.6 A strong preference for undergrounding

Recognising overhead transmission line acceptance issues, the German government "introduced more technology options, in particular the use of high-voltage direct-current (HVDC) power lines and extended the usage of underground cables" [36, p. 225], starting with pilot projects with the objective of assessing public acceptance. Zaunbrecher et al., [49] surveyed German residents (n=109) and reported that overhead HVDC did not significantly influence acceptance. Additionally, when information about HVDC powerlines was provided, it only mildly positively influenced preference.

In their assessment of several energy technologies including hypothetical overhead and underground transmission lines Bertsch et al., [44] showed there was a marked preference for underground transmission lines (Table 1). Similarly, surveys by Lienert et al., [50] in Switzerland and by Sharpton et al., [51] in the US found that undergrounding was preferred, although US responses were still neutral to positive towards overhead lines.

In the Cotton and Devine-Wright [14] focus group (n=38) study in the UK, the majority of participants supported undergrounding with a minority discussing EMF and environmental impacts of undergrounding [17]. A German study cited in Menges and Beyer in 2010 showed that 77% of participants *"would support construction works without any further conditions if underground cables were used"* [25, p. 34].

Table 1. Comparing Acceptance of Overhead and Underground Transmission Lines

Level of acceptance	OH (%)	UG (%)
Positive	5	43
Somewhat positive	18	32
Neutral	30	21
Somewhat negative	30	3
Negative	14	1

Data sourced from Bertsch et al., 2017 p. 477

For existing overhead transmission lines, Wuebben [24] conducted a survey of visitors (n=81) to a US arboretum specifically designed around an existing overhead transmission line and its associated substation, 46% of respondents indicated that powerlines should be removed or buried. Elliott and Wadley [28] facilitated focus groups (n=78), with mixed communities from across Queensland to assess overhead transmission line tower design preferences. They reported that undergrounding was preferred to any overhead transmission line tower design presented. However, participants acknowledged that cost might preclude undergrounding.

2.2.7 Economic considerations

Installation impacts

In advance of projects being deployed, economic impacts, such as the effects on tourism, were mentioned as a consequence of the loss of visual amenity through the use of overhead powerlines in a UK study [14]. In the US, local communities linked overhead lines with a number of economic impacts including lower productivity because of disruption, job losses and a reduction in community tax bases [30]. Conversely, in Delaware and New Jersey (US), Firestone et al., [52] found that the local population expected neutral or positive effects from a submarine cable in terms of local jobs and commercial fishing impacts.

Post project deployment, Sæpórsdóttir and Hall [53] investigated tourist views of overhead transmission lines in Iceland and found that 54% had a negative experience and they were amongst *"the least desirable infrastructure in natural areas"*[54]. Further research by Sæpórsdóttir and Hall [54] confirmed that tourism operators found tourism prospects were much better at creating jobs than energy projects. However, any

economic effect of these perceptions was not quantified with other authors suggesting it may or may not translate in lower visitation and loss of revenue [55].

Property values

Elliott & Wadley defined the loss related to residential property value from nearby overhead transmission lines in two ways:

"a resident's perceived loss of utility in foregone views and compatibility of adjacent land uses, but also in a reduction of investment value if prospective purchasers perceive a place as stigmatized" [28, p. 198].

Perceptions surrounding the impact of overhead transmission lines on property values is mostly negative though its prevalence and magnitude varies. For example, Nelson et al., [41] surveyed residents along the Tehachapi power line project (California, US) and showed that health impacts and property values were their main concerns. Lienert et al.,[20] surveyed Swiss residents and showed that house owners were more likely to have low acceptance and attributed it to fear of property values losses. Similarly, Simora at al., [48] asked German citizens to vote on hypothetical local overhead line projects and found that homeowners are less likely to vote in favour of the projects.

Mueller [38] conducted a survey in German rural communities in the vicinity of proposed transmission lines (n=2,605). The author found that the expected decrease in property value was slightly greater for overhead compared to underground. This in turn was expected to increase participation in the planning process.

In contrast, Keir et al., [30] analysed citizen submissions for a new transmission line in US and showed that only 5% of submissions included property value concerns, so whilst an important factor to consider, it was not a major concern. Similarly, Wadley et al., [19] surveyed Queensland residents and showed that loss in property value was cited by less than 50% of participants and ranked last amongst concerns. Joe et al., [47] in the US showed that those who could see the lines were not concerned with decreasing property values, suggesting pre-existing experience with powerlines helps improve their acceptability, when it comes to property values.

Although Furby et al., [5] raised the importance of understanding property professionals' perception to reduce any rippling effect to buyers and sellers. More recently Wadley et al., [32] showed a difference in perception between homeowners, property valuers and real estate agents. The study revealed that all three participant groups ranked visual impacts and noise as their main concerns. For homeowners, the second-ranked concern was EMF, while for valuers and agents, it was property value. Regarding the quantifiable financial impact of transmission lines on property values, Brinkley and Leach [27] conducted a meta-analysis of various technology impacts on property values including overhead transmission lines. The meta-analysis focused on overhead distribution and transmission lines between 1960 and 2008. The authors established that the range of average value change was *"+ 10% if including improved access to greenspace to -30%"*(p63). This aligns with a review by Cain and Nelson [13] showing that studies on property value loss have revealed mixed results.

The relationship between price-distance was also demonstrated to be non-linear [27]. However, only two of the reviewed studies were conducted pre- and post-construction, offering few possibilities to compare value variation for specific properties. Thus, for the vast majority of studies the variation in property value is calculated according to the distance to the overhead line or its visibility from the house along with the property market value at the time. The decrease in value is attributed to visual and aesthetic impacts while an increase in value was observed with accessible landscaped easements and the possibility of recreational activities. It was also observed that the property value loss disappeared over time (e.g. after 5 to 14 years post construction) which confirms the concepts of familiarisation and normalisation occur [27].

While most property value studies focus on family homes, few have been found to focus on commercial and industrial or agricultural land [27]. Sardaro et al., [56] conducted a review of farmland depreciation in the Apulia region, Italy and calculated that it ranged from approximately 6% for wheat through to 14% for vineyards. This was mainly impacted by where the lines intersected the land and the area it occupied, along with the height of towers and distance from the property boundary. However, the study did not discuss that such loss of property value is offset by compensation, with the main consideration being whether the compensation is adequate enough to cover any such loss of value.

Use of cost benefit analysis

Cost benefit analysis (CBA) is used to justify projects ranging from whole of transition and a zero carbon economy for grid expansion (AEMO ISP) to individual transmission projects [57]. For individual projects, the analysis supports decision makers with technology selection, transmission line siting, and compensation schemes. CBA is used to evaluate the balance of a project's positive and negative effects and through an accounting exercise, decide if the project would, overall, have positive outcomes and therefore should go ahead. The CBA process includes calculations, estimations, or

attribution of values, often numerical, within the decided boundary of the assessment. The numerical value most used for transmission line projects is financial value.

Based on this literature review, there are five fundamental issues arising from CBA:

- CBA assumes that everything valued can be monetised and that all stakeholders agree with the assigned amount. Some components of CBA, such as the cost of underground cable versus overhead lines, are objective and relatively fixed. However, the monetisation of environmental or human health impacts becomes contentious. Additionally, the values attributed are subjective, highly context dependent and dynamic [57].
- The boundaries of the assessment are often considered to be too narrow e.g. limited to economic impacts, and do not evaluate alternative options for the transition as a whole or the transmission corridor location, or transmission corridor technology [14], [33], [37], [57], [58].
- Transparency and communication are lacking. Multiple decisions and assumptions are made throughout the assessment which require transparent and adequate communication for all stakeholders, and even more so as the project grows in complexity [10].
- Regulated processes to conduct CBAs are either missing or unsatisfactory [10], [58]. This includes issues relating to discount rates [57].
- Citizen's participation and its influence on CBA process and outcomes are not clear and/or mandated [10], [57], [58].

Compensation

The research confirmed that local impacts and associated losses should be compensated to allow impacted stakeholders and communities to receive the same level of benefits from infrastructure projects as the wider community [5], [59]. In the case of land resumption or compulsory acquisition, established compensation measures are determined *"by assessing the fair market value [FMV] of the land. FMV is the theoretical market value a willing buyer and willing seller would reach in a voluntary transaction"* [5], [60, p. 541], [61]. However, this does not account for several factors including the fact that owners of the land may not be willing sellers, and that attachment to place and community, or the suitability of land for particular uses such as farming, is not accounted for in the calculations [5], [60].

Beyond land resumption, testing households' compensation amount below 1000 euros in the general German population, Zaunbrecher et al., [34] revealed that compensation had no influence on acceptance and Simora et al., [48] showed that such compensation amounts may diminish acceptance. They suggest that the notion of what compensation amounts should be tested in communities and opened up for discussion if it is to have a positive impact on acceptance.

Furthermore, the literature pointed to a tension between individual and collective compensation. Hyland and Bertsch [62] conducted a national survey (n=1,044) of Irish residents associated with new transmission lines and found higher acceptance for infrastructure when compensated via a collective community benefit scheme. Additionally, Koelman et al., [63] interviewed transmission project community engagement personnel involved in negotiations with landowners along a new underground line in the Netherlands. They found that the majority of landowners were less concerned by their individual financial compensation than its fair distribution according to benefits and burdens.

Devine-Wright and Sherry-Brennan [64] investigated the impact of a community fund associated with a new overhead transmission line in the Leinster province of Ireland to compensate for visual impacts. The fund of 360,000 euros related to 24km of the new line and was administered by local councils and a national NGO through grants. It was additional to any financial compensation provided to landowners within 200 m of the transmission line. The authors found stakeholders within the local community broadly viewed the community fund as positive. However, they contested its geographical boundaries and its foundation on visual impacts only. The authors suggested that a collaborative approach to boundary setting could lead to further positive outcomes.

Vega-Araujo and Heffron [65] conducted interviews with a mix of stakeholders along a new overhead transmission line in Colombia, including Indigenous stakeholders. Three compensation schemes were available for socio-cultural impacts, use of territory, and ecosystem losses. Socio-cultural and use of territory compensation were both one off payments, which Indigenous communities criticised for their narrow boundaries, the lack of continuous assessment of project and compensation effects through the lifespan of the project. Compensation for ecosystem losses was also criticised as being ineffective and not fully understanding Indigenous cultures.

Use of the willingness to pay (WTP) analysis.

Willingness to pay (WTP) analysis is used to quantify the potential gap between the cost to implement people's preferences for a product or service, or in the case of transmission lines, a technology or certain level of reliability, and the maximum amount they are prepared to pay for it. WTP for mitigation measures of

local impacts is difficult to calculate as it was shown to be non-linearly affected by distance to the transmission lines and requires disaggregation according to its drivers (visual, health, property value) as they result in significantly different WTP values [43].

WTP itself is a contested measure [57]. WTP for mitigation measures of local impacts such as pylon design or undergrounding do not reflect local stakeholders' preferences as transmission line projects benefit the entire nation and as such the cost of their impact should not be expected to be borne locally [29]. This issue was also encountered in Navrud et al.'s, [66] study that found Norwegian households did not believe a scenario in which locally impacted households would have to pay for mitigation measures.

2.2.8 Environmental impacts

In 17 articles, impacts on the environment by transmission line projects were cited as contributing to low acceptance. This is also consistent with the social licence to operate (SLO) literature where minimisation of environmental impacts and having strong environmental regulations in place were critical for ensuring an SLO existed. Keir at al., [30] reported that environmental impact was cited in 18% of the submissions to the new Northern Pass overhead line project in the US. Additionally, Lienert et al., [50] cites a German survey showing a lack of awareness of impacts of underground transmission lines on landscape modification in 82% of participants.

Challenges here include the quality of the Environmental Impact Assessment process, ensuring a real financial value is attributed to the environment, and how it is monitored. Key considerations include environmental damage in general or more specifically vegetation clearance, habitat and wildlife loss (6 papers), soil degradation (2 papers), water and groundwater quality and flow (2 papers), noise (6 papers), fire (1 paper), weed dispersal (1 paper), waste (1 paper), impact on national park and conservation areas (1 paper) and impacts on agriculture (2 papers). In some studies, transmission projects were found to have a positive impact on the environmental quality perception through landscaping and specific design with the OHTL easement [23], [26].

2.2.9 Process

The process theme was by far the most significant of all themes that emerged in the literature, cited in 68 papers. Many of these studies were concerned with either: (i) distributive justice—concerned with the allocation of benefits (e.g. are revenues shared sufficiently) and burdens or costs (who suffers from the burden or environmental impacts of the siting of the infrastructure) or (ii) procedural justice—concerns about whether the process is fair, transparent and follows a due process with adequate governance and attenuation to any power imbalances; allows for participation and engagement; information sharing and so on (Vega-Araujo & Heffron [65]). These concepts are expanded upon in the following section.

Distributive justice

The electricity system and the services it distributes throughout the grid can represent equity ideals while at the same time, the system itself is an epitome of spatial injustice for the community affected by the infrastructure [45]. Batel and Devine-Wright [67] argue that the energy transition, as it is currently being implemented, perpetuates neoliberal and colonial models of development on local and global scales and increases inequalities. Furby et al., [5] reported that cost benefit analyses estimated overall positive outcomes for the broader community, while local communities carry most of the burden of the projects. As inequalities emerge between communities then so do the concerns of distributive justice [65].

According to Vega-Araujo and Heffron [65], Indigenous communities disputed the financial compensation procedure and calculation for the overhead transmission line projects taking place in La Guarija region of Colombia. They cited concerns from Indigenous communities across several areas including the proportionality of impacts and benefits, and the need for reparation for historical wrongdoings. Having the capacity to negotiate better outcomes is an important consideration for overcoming distributive justice concerns.

Financial compensation and land resumption are key areas where distributive justice issues emerge. Koelman et al., [63] showed that within an affected community, distributive justice and appropriate sharing of benefits, was considered more important than individual financial compensation. Another example of lack of distributive justice was highlighted by Porsius et al., (2016) who found that when land resumption takes place—in this example land was resumed for those within the 0.4m zone—those outside the zone were also concerned about the impacts of health and on property values but were without compensation [28].

The literature confirms that accelerated approval processes for transmission line projects are counter to ensuring considerations of distributive justice, as they often are not seen to give due consideration to community concerns [36]. Furby et al., [5] suggested that procedural justice could help to compensate for distributive justice issues and this view was widely shared across the literature, in particular the need for early citizen participation [37].

Procedural justice

A core component of procedural justice is ensuring adequate governance structures are in place that allow for transparency and public participation. This can be both formal and informal interactions, depending on the decision-making processes in place. Azarova et al., [68], confirmed that while the attributes of the technology are important, so too are the governance structures that surround its design, implementation and operation. Additionally, a lack of coordination and efficiency in the planning processes between jurisdictions can lead to project delays. An issue now being rectified in several European jurisdictions, with the potential for fines if projects take too long [18], [36], [69].

Regulated public engagement is common throughout Europe, the US and the UK. However, regulations can at times fall short. For example, there is a balance to be found relating to timing. That is, when to involve communities and end users. Involving communities in scenario and transition planning where a specific route may not have been settled upon can cause undue concern for communities who may end up not being impacted by it. This means at times, early engagement can be seen to be counterproductive. Moreover, the need for new transmission lines may need to be revisited (for every project in the area) and re-evaluated with community input causing engagement fatigue, delays and potential cancellation of projects [2], [36], [37], [58], [70].

As such, the goals of public engagement and participation require clarity for all stakeholders, including electric utilities [70]. Furthermore, adequate resources for engagement, including the use of independent experts or processes facilitated through research institutions, can help to facilitate more successful and fair project outcomes [5], [71], [72]. The latter due to a view of independence of the research institution. Lastly, acknowledging that full consensus is unlikely to be reached, even with best practice public engagement, having a clear picture of what constitutes "good enough" consensus and support, and communicating this upfront may improve transparency and fairness [16].

In some instances, a single cross-jurisdictional planning entity has also been seen to add value in transmission line project governance. Although again, such an entity may not always be able to deal with specific contexts. However, having a single point of contact for the public, providing access to a core group of experts, has been seen to improve perceptions of procedural justice [36], [69]. Coordination of spatial planning between electricity projects as well as between other economic development activities such as tourism, telecommunication or transport was also regarded as an important contributor to just and fair governance and reducing engagement fatigue [18], [54].

Information and knowledge

A lack of knowledge about the electricity system, coupled with a lack of information about projects has been identified as drivers of opposition amongst various transmission line projects [9], [73]. Quality information for building acceptance has multiple purposes including raising awareness, education, developing capacity, and relationship building. Filling knowledge gaps around governance structures and regulations of the electricity system, environmental and health impacts and risks, and alternative technologies and their trade-offs have all been seen to enhance acceptance of projects [5], [74], with a warning not to assume a knowledge deficit exists for all [14], [38], [70]. Regardless of the information, transparency was key. Stadelmann-Steffen [31] posited that because negative information can substantiate latent fears, opponents' use of *"information about the negative consequences of a project will generally be more powerful on the debate compared to the arguments of the proponents of a project—rather independently of whether the arguments are appropriate or not"* [31, pp. 540–541].

However, when it comes to information provision, the literature shows there is no consistent message or information bundle that helps build confidence in the process. For example, Cohen et al., [75] found that messages including the economic and decarbonisation effects of transmission line projects were more likely to reduce opposition compared with local compensation information. Technical details and project maps were seen to be useful information to be shared by electric utilities [58]. However, it was found there were several misperceptions that were hard to overcome through engagement around transmission lines. For example:

- decentralisation renders grid expansion and transmission lines unnecessary
- the extent to which soil shields from EMF
- underground lines result in landscape alterations [20]
- why EMF safe distance calculations use average rather than peak load [10].

Similarly, who shares the information relating to EMF, was found to be important for building trust. There was some caution suggested with using regulators or those seen to have a vested interest in the outcomes of the project [5], [10], [14], but at the same time information from multiple sources that are contradictory can also be problematic [35]. These findings are in line with the SLO literature which talks about the need for quality not quantity of information and the importance of trusted

experts as sources [4], [76]. These instances highlight the fine balance required by projects to contextualise and tailor information for the range of audiences to ensure perceptions of procedural justice and fairness are present [2].

Porsius et al. noted a *"mismatch between the information they* [residents] *wanted and the information they received"* [35, p. 1504] and that personalised information was desired (touching again on context sensitivity). For example, pylon height in comparison to local landmarks could allow local residents to picture the towers and their impacts on the landscape better [14], or maps with the transmission line location and the EMF sensitive zone marked out was deemed to be helpful [35]. Additionally, Moyer and Song [76] highlighted that narratives rooted in cultural identity are likely to be more effective.

Continuous access to information organised by various stakeholders through media, public meetings, press conferences, website containing transcripts of meetings and letters allowed all stakeholders to keep abreast of up to date information [18]. However, again according to the SLO literature this must concentrate on quality not quantity.

Collaborative engagement and participation forms

Public engagement can be thought of as the sum of the interactions between project related information, people, structures, organisations and the public and its representative organisations. Devine-Wright and Batel [7], [80], posited that those interactions would be the key determinants of acceptance.

According to Fiorino [81], participation exists in three forms that will lead to different outcomes:

- *Instrumental participation* aims to increase trust in, and social acceptance of, the process and outcomes, and stems from the question - how do we get this done [18]? It is associated with top-down approaches, later stage public engagement, and legitimisation of predetermined outcomes [14], [30], [65], [69].
- *Substantive participation* recognises that stakeholders, including non-experts (local or others), have value which leads to essential knowledge creation; it is described as constructive dialogue and enables collaboration that leads to two-way knowledge creation in which contextualised learning takes place, and shared understanding is developed, ultimately reflected in the design and construction of the project [2], [18], [29], [31], [58], [65], [72].
- *Normative participation* is concerned with citizens being ultimately in control of the decisions directly affecting them and focuses on how to enable meaningful and inclusive participation [18]. From a social justice perspective, it is concerned with inclusion and representation, legitimacy, transparency, accountability, agency, and power balance.

Who is being engaged by decision-makers plays a major role in the substantive considerations of procedural fairness and the perceptions of it. As such, the processes of identification of stakeholders to be engaged matters and requires a process that has a clear rationale, is transparent and inclusive, and ultimately enables adequate communication [70], [82].

Activism was overtly mentioned in 15 papers and depicted as being highly influential on community acceptance, conflict development, project delays and cancellations [13], [18]. However, it was not an actual focus of any studies. Furby et al., [5] cited a study that showed that organised activism can play a greater role than negative media coverage in the development of conflict. For some projects, activist groups were seen to provide value by local residents and electric utilities [18], however they could also lack legitimacy [14].

Activist groups can originate from, and be composed of, diverse groups of people. In the examples provided by the literature, sometimes the groups acted independently and at other times they formed networks or coalitions [13], [83], [84] and would often participate in actions both within and outside, the formal processes of engagement [13]. Some local action groups declined to participate in transmission line consultation because they did not believe the project was needed and did not trust the transmission line company to manage it properly [58].

Trust

Trust was often viewed and observed to be a key component of acceptance. It was seen to play an important role as a mediator of the perception of risks and benefits, and likelihood of contestation and activism [13], [30], [85]. Ceglarz et al., highlighted that trust is *"a complex, multidimensional and context-dependent concept"* [79, p. 571]. They identified three dimensions of trust relating to transmission line projects: interpersonal, institutional, and generalised or social trust. Institutional trust instilled confidence in the need for the energy transition as a whole and the requirement for the individual project within it. Social or generalised trust allowed for common good to take precedence over individual interests, as well as improving citizens' willingness to participate in a constructive manner. Finally, interpersonal trust was the most significant of all dimensions and is exemplified by transmission line project employees establishing open and respectful dialogue with citizens, where personal values are heard,

taken seriously and well-integrated into the process to allow trust to develop.

Trust in all entities and individuals, involved formally or informally in the process, affected overall acceptance [1], [14], [16]–[18], [30], [37], [40], [58], [65]. Genuine integration of outcomes from participation into decision-making and project outcomes can increase trust. However, a participation process perceived as disingenuous, will reduce trust and impacts subsequent participation processes [30], [72]. Nelson et al. [41] showed how trust can influence perceptions of the project, where residents with low trust in the process, perceived the overhead lines to be closer and were more likely to oppose projects.

3.

Culturally-responsive Collaborative Design with First Peoples

3.1 Contextual considerations

Building on the co-design workshop it was recognised that the implementation of transmission line projects in Australia will bring proponents into contact with First Peoples that require specific personal, social and cultural considerations. A more detailed approach to enabling culturally-responsive collaborative design with First Peoples is found at Appendix B. However, some of the key considerations are detailed here.

Under the United Nations Declaration on the Rights of Indigenous Peoples [86], First Peoples are identified (rather than defined) via:

- Self-identification as Indigenous Peoples at the individual level and accepted by the community as their member
- Historical continuity with pre-colonial and/or pre-settler societies
- Strong links to territories and surrounding natural resources
- Distinct social, economic or political systems
- Distinct language, culture and beliefs
- Forming non-dominant groups of society
- Resolution to maintain and reproduce their ancestral environments and systems as distinctive Peoples and Communities

As such, First Peoples are fundamental rights-holders in many locations in Australia, with approximately 60% of mainland Australia expected to soon be managed, or jointly-managed, by First Peoples. The complex interplay with First Peoples between Culture, Country and Community manifests a suite of values, some of which align with Western colonial values and the institutions they have implemented, and several which are fundamentally different. In the past, these value differences have, in part, led to post-colonial disempowerment and dispossession of First Peoples in land management decision-making with foundational production sectors including pastoralism, irrigated and dryland cropping, mining and urban development.

The onset of energy transition initiatives, including transmission line projects, provide opportunities for exploring and implementing new approaches for sharing the benefits provided by these projects across stakeholder groups, including First Peoples as rights-holders. However, the general absence of a history of collaboration between production sectors and First Peoples manifests uncertainty in new and emerging projects. Such a lack of understanding between First Peoples and proponents of development limits the effectiveness of assessment, planning, management and adaptation of projects. The opportunity to build respectful relationships – not simply transactional engagements – between First Peoples Communities and proponents can promote delivery of more effective, cost-efficient and ethical transmission line projects. However, there is little empirical evidence to support the adoption of methods and methodologies for building respectful relationships by proponents with First Peoples. As evidenced in this review, only one article was identified that focussed on First Peoples Communities as stakeholders, and none as rights-holders. That said, pockets of expertise founded upon experiential learning are exhibited by individuals and groups in many locations. The development of evidence-based guidelines that synthesise empirical evidence with experiential knowledge to identify the values, knowledge, skills and attributes of individuals, teams and organisations that support the building of effective, cost-efficient, ethical and resilient professional relationships offered by transmission line projects will contribute directly to their success.

3.2 Impacts of Transmission Lines on First Peoples

It is likely that transmission lines will impact First Peoples as rights-holders, in ways similar to other groups of stakeholders. However, based on the situation-specific character of their connections to Country, combined with the substantial knowledge gap in understanding the broader impacts of transmission infrastructure projects on First Peoples' Country, Culture and Community, there is a need for proponents to authentically invest time and resources to develop a deep, pragmatic, working understanding of First Peoples, values, aspirations, protocols, responsibilities and history as they interact with the design and implementation of projects (including pre-project discussions). This will ensure that the Cultural Safety

and Cultural Security of individuals and groups is secured, and promotes the Cultural Proficiency of all participants in transmission infrastructure projects.

Some fundamental differences in the perspectives, attitudes, responsibilities and behaviours of First Peoples individuals, groups and Communities to the wider Australian community may result in different responses to transmission infrastructure projects. These may include: i) Loss of species of cultural significance and/or important for subsistence; ii) Compromising intangible sites of cultural significance; iii) Degradation or destruction of tangible sites of cultural significance; iv) Visual disruption of the night sky; v) Ecological impacts associated with these losses rendering First Peoples unable to meet their cultural, social and personal responsibilities; vi) Community and personal health and wellbeing impacts and costs associated with individual and collective losses that leave First Peoples unable to meet the social and personal cultural responsibilities; vii) The weaving of transmission lines into contemporary stories and Songlines; and viii) Declining opportunities for self-determination, which exacerbate existing marginalisation of First Peoples as individuals and Communities.

Accordingly, the 'Prudent Avoidance Policy' (i.e., the Precautionary Principle) needs to be enacted to ensure the values of First Peoples are not compromised as a result of new transmission infrastructure projects. Current guidelines create a situation where the prudent avoidance policy adopted by TNSPs only requires proponents to, for example, implement no cost and very low-cost measures that reduce exposure of individuals and Communities to transmission lines and the potential health impacts, while not unduly compromising (from a proponent's perspective) other issues. Unlike planning to avoid health impacts, where in most cases the application of prudent avoidance can be implemented without the need for a specific assessment, cases where First Peoples are potentially impacted requires a more comprehensive assessment of the tangible and intangible aspects of Country than historically has been enacted. This can be achieved by investing time and resources to levels sufficient to ensure authentic, meaningful working relationships are established with Communities prior to initiating new transmission projects.

4.

Collaboration and Engagement Principles

To ensure a comprehensive review of engagement principles for all stakeholders, including First Peoples as rights-holders, the principles and guidelines for electric utilities from the 2017 CIGRE Green Book [87] were reviewed and contrasted with the findings from the systematic review. The CIGRE engagement principles cover instrumental and substantive aspects. However, they do not engage with normative aspects and social justice considerations which, while it might be expected from an engineering and technical standpoint, would likely have consequences in how genuine the public perceive the engagement to be in its process and outcomes. Table 2 highlights the differences and details enhancements to the principles from the literature.

Table 2. Merging CIGRE Engagement Principles and Systematic Review Findings

Principles from CIGRE, 2017	Principles as per CIGRE Green Book [87]	Enhanced Principles	Additional contribution from PRISMA review
Approach to stakeholder relationships	Stakeholder engagement processes should be consistent and aim to build trust.	**Approach to developing relationships**	Highlights that consistency in collaborative protocols and processes across industry and economic sectors, combined with coordinated and efficient processes, can help to reduce engagement fatigue and frustration. Thus improving the quality of the process for host communities, rights-holders, and the broader public.
Project scoping (Proportional approach)	The scope of stakeholder engagement for each project stage must be defined including its objectives, constraints and limitations.	**Project scoping (Proportional approach)**	In order to minimise the contestation of the need for new OHTL and avoid compromising First Peoples' and other stakeholders' rights, early collaboration and engagement at the electricity system planning level is required.
Stakeholder identification	The stakeholder mapping and selection process needs to be consistent. Local stakeholders, including those with specific community interests and those difficult to reach, need to be specifically targeted. The engagement also needs to reflect an understanding of stakeholders' requirements and preferences.	**Rights-holder and stakeholder identification**	Culturally-appropriate dialogue and clear communication of stakeholder and rights-holder mapping and selection processes is an integral part of the relationship building and engagement processes.
Start engagement early	Early engagement, i.e. during the formative stage, is valuable for knowledge creation including for subsequent engagement and for establishing the integration of stakeholders' input into routing and design.	**Start collaboration and engagement early**	The literature goes further and advocates for rights-holder and stakeholder collaboration at electricity system level planning and potentially even earlier when planning the transition to a low carbon economy. However this is (currently) outside the scope of transmission company remits. Collaboration should ideally begin prior to the conceptualisation of a project.

Principles from CIGRE, 2017	Principles as per CIGRE Green Book [87]	Enhanced Principles	Additional contribution from PRISMA review
Targeted mix of consultation/engagement methods	Engagement methods need to be tailored to their targets and allow for regular engagement. A dedicated community liaison representative is suggested.	**Targeted mix of methods for building relationships and engagement**	Amongst other challenges, collaboration and engagement processes need to account for individual and community willingness and capacity to engage with the complexity of the electricity system and its governance, as well as the process more broadly. The literature emphasises the value of a single point of contact for rights-holders and stakeholders which can contribute to a more fair and just process.
Create an open and transparent process	The scope of the engagement is transparent at each stage of the project and broadly communicated.	**Create an open and transparent process**	Transparency of the collaborative process and quality information provision contributes to procedural fairness and building trust.
Provide feedback to stakeholders (Monitor and evaluate)	A clear and transparent process is established to demonstrate and communicate how stakeholders' input was integrated into the project and provide rationale for inclusion and exclusion.	**Provide feedback to rights-holders and stakeholders (Monitor and evaluate)**	The literature shows that this step is amongst the most important, if not the most important, for building trust and fostering subsequent constructive engagement and participation.
Engagement should be proactive and meaningful	For engagement to be meaningful, it needs to have influence on the project outcomes. As such the scope of influence need to be clear and clearly communicated. Engagement should be proactive, accessible and inclusive.	**Collaboration and engagement should be proactive and meaningful**	Meaningful relationship building is paramount. Acknowledging that full consensus is unlikely to be reached even with best practice public engagement. Having a clear picture of "good enough" consensus and communicating it upfront improves transparency and perceptions of fairness.

Consideration of normative aspects and social justice issues also apply for First Peoples. The First Nations Clean Energy Network developed *Best Practice Principles for Clean Energy Projects* to help address this issue. The 10 Principles aim to guide projects to provide economic and social benefits as well as ensure Free, Prior and Informed Consent (FPIC) is secured by First Peoples, as rights-holders, for energy projects. The Principles include: "Engage respectfully; Prioritise clear, accessible and accurate information; Ensure cultural heritage is preserved and protected; Protect Country and environment; Be a good neighbour; Ensure economic benefits are shared; Provide social benefits for Community; Embed land stewardship; Ensure cultural competency; and Implement, monitor and report back." Combined with the principles outlined in Table 2 these can help to inform how to engage proactively with First Nations representatives.

5.

Discussion

5.1 Social Licence and Acceptance

It is evident from the literature that social acceptance and social licence of either overhead or underground transmission lines is not straight forward. Based on the more recent transmission projects that were able to progress with either hybrid overhead and underground, or fully underground outcomes, undergrounding may appear as the sole route for gaining acceptance. However, the picture is far more complex. The impacts and trade-offs between the two require high levels of contextualised understanding (what does this mean and look like here), and collaborative engagement and deliberation with all rights-holders and stakeholders.

While the review systematically highlighted the different factors influencing social licence and acceptance, they are extremely interrelated. Therefore, they need to be considered in a systemic way. For example, when considering visual impacts, issues relating to health, property values, proximity and compensation will also need to be considered. Furthermore, when attending to context sensitivity, a recognition of the various trade-offs is necessary as rights-holders and stakeholders are often weighing up multiple factors and thus making relative rather than absolute judgements. Understanding the individual context, in particular, the history of what projects have occurred previously in an area - that may not be related to transmission lines - is critical. Whether previous local experiences have been negative or positive is particularly important to know.

In terms of process, whether overhead or underground, whole of economy transition - including transmission line planning and design— that is based on human rights and social justice principles is fundamental. This involves deep contextual understanding and integration from the national to the local level, inclusive of cultural, social and political landscapes. While this is outside the scope of transmission line entities it does highlight the need for a whole of government approach to collaboration and engagement over the need for the energy transition and what it entails. While community responses often exhibit a preference for undergrounding, the review shows that it is not a one size fits all approach and there is a need to provide all of the information on the benefits, costs and consequences that will emerge as a result of such choices. Regardless of the outcome, transparency in project decision making and the ability to listen and reflect community concerns in the planning process may help to alleviate some of their concerns.

Constraint mapping is an essential tool for transmission experts when route planning. Common constraint considerations include cultural heritage, threatened species, areas of environmental significance, population density, and existing land use. These are well documented in the CIGRE Report 147 [88]. A mix of qualitative and quantitative assessment is then undertaken to identify the most preferred routes. The list of constraints are usually shared with communities to build transparency in the siting process but also to identify if there are any additional local constraints that may have been overlooked by the proponent and need to be included in the constraint mapping exercise. To help build support for the final outcome, an essential step has been to undertake a weighting exercise that brings together community and proponent preferences to reach agreement on the preferred priorities for siting transmission routes, including representatives from First Peoples. While such processes can be exacerbated by individual preferences and values, such rigor goes some way in helping to gain broad community support for the final route selection (CIGRE 147 [88] p.26).

Cross-cultural collaboration has historically been viewed by proponents as a hinderance to extractive industry activities and this has manifested in numerous and consistent breaches of the human rights of First Peoples. Opportunities exist for deriving substantial benefits from cross-cultural collaboration to enhance the resilience, sustainability, profitability and ethical delivery of transmission line projects. Promoting the connection of First Peoples to Country, Culture and Community can minimise and avoid ecological, economic and social risks to proponents, developers, companies, the wider public, as well as First Peoples Communities. Such activities include investing in developing sector-leading practices to drive investment and, more broadly, a national values-led economy (Chalmers 2023 [89]) to promote the interest of all Australians, inclusive of First Peoples, through the emerging clean energy economy and transmission line projects.

5.2 Limitations

Considering how much context matters in enabling social acceptance, the literature offers few Australian examples. The Australian context was only explored through four publications directly addressing transmission lines. Additionally, only one article focussed on First Peoples as stakeholders, and not as rights-holders. As part of this literature review no articles were found where the research design was to test an actual intervention and measure its influence on acceptance. The literature comprised predominantly of hypothetical projects or project observations without a purposely designed intervention method. Both Carley et al. [98], and Brinkley and Leach [27] highlighted a dearth of pre- and post-studies and a lack of control groups. As such, the efficacy of specific measures thought to contribute to acceptance cannot be evaluated. However, this does create an opportunity as the projects in Australia continue and the latest observations from the Australian and international cases are documented in this report.

6.

Conclusions

The emergence of transmission line projects in Australia to support the nation's transition to clean and sustainable energy provides a bright opportunity for collaborating in authentic, meaningful and just ways that share genuine benefits across all groups inclusive of First Peoples' Communities, proponents, developers, companies, and other rights-holders and stakeholders. This includes fundamentally maintaining and promoting the connection of First Peoples with Country, Culture and Community which is most effectively and sustainably achieved through the implementation of culturally-responsive cross-cultural collaborative design.

The co-design workshop, conducted to inform this review, also spoke of the need to be inclusive of all stakeholders and highlighted the importance of process, including distributive and procedural justice considerations, the requirement for good governance for gaining a social licence. While the literature provided overarching principles for engagement it did not provide a practical guide.

Illustrating the importance of gaining social licence and acceptance, there are a multitude of guidelines that exist in Australia for engaging with communities on transmission and energy projects, with many more emerging. For example, the Queensland Farmers' Federation recently released their Renewable Energy Toolkit; The Energy Charter, The Landholder and Community Better Practice Engagement Guide which underpins their *Better Practice Social Licence Guideline;* and the Energy Grid Alliance, Acquiring Social Licence for Electricity Transmission: A Best Practice Approach to Electricity Transmission Infrastructure Development; and the First Nations Clean Energy Network. Internationally, the Renewables Grid Initiative provides a wealth of resources (videos, fact sheets etc.) and publications that explain impacts and trade-offs for transmission infrastructure projects.

In August, the findings from the NSW Parliamentary Inquiry were published stating that *the current plan for constructing HumeLink as a 500 kV overhead transmission line is the correct approach* (p.34)[1]. However, on the 13 September 2023 a further Inquiry by a Select Committee was announced to report back their findings by 31 March 2024. The Australian Energy Market Commission (AEMC) also published a draft determination and rule change for *enhancing community engagement in transmission building* with the intention to fast track its release by December, 2023. At the same time the Australian Energy Infrastructure Commissioner is also undertaking a review to *enhance community support and ensure that electricity transmission and renewable energy developments deliver for communities, landholders and Traditional Owners*. Their website also provides a comprehensive list of best practice guidelines that relate to energy projects. So there are a multitude of resources for proponents and community to draw upon. Critical is ensuring the procedural and distributive considerations underpin any approaches to communities to ensure fairness for all who are likely to be impacted.

6.1 Key Findings

1. In addition to the physical factors of the technology there are a range of factors that will influence the public's willingness to accept transmission lines which include issues of procedural and distributive justice, fairness and trust in the process, along with how individuals assess the trade-offs between the cost, risks and benefits.
2. Place based engagement using two-way engagement that focuses on local values, aspiration, needs, concerns and histories can help to ameliorate negative reactions to new projects but requires adequate time and reflexive processes to ensure feedback from communities is incorporated into the final project plans.
3. Such context specific considerations also includes First Peoples and ensuring adequate engagement and collaboration with them is in place from the start – the First Nations Clean Energy Network have published principles for engagement which provide a basis for informing these processes.
4. Constraint mapping has been used by TNSPs to inform their route selection and this includes checking in with communities for local constraints. Involving the community in weighting the importance

[1] https://www.parliament.nsw.gov.au/committees/inquiries/Pages/inquiry-details.aspx?pk=2966#tab-reportsandgovernmentresponses

of each of the constraints at the early planning stages to create agreement for prioritisation of the various constraints will help to build support and buy-in for the final route.

5. Compensation for local impacts and associated losses is important and approaches to compensation also need to be fair and consistent, including recognising beyond just the local host to near neighbours. Understanding the interaction of the project on suitability of the land for other uses will also influence the final outcome, but compensation alone does not guarantee project success.
6. Engaging with communities for energy infrastructure projects is not new and there are a number of best practice principles that have been developed for engagement which can help to guide more successful outcomes.
7. There is a need for more consistent public education that explains in plain language: (1) Why we need to build more transmission infrastructure; (2) What HVAC and HVDC transmission infrastructure is; and (3) How transmission costs will be reflected in state capital borrowings and electricity bills – more transparent conversations around this at both the federal and state level should help increase the public's understanding of the trade-offs required.

6.2 Comparison Table – Social Aspects of HV Transmission Infrastructure

A summary comparing the social and community factors of overhead and underground infrastructure is presented in Table 3 below.

Table 3. Comparison of HV Overhead and Underground Cable Transmission- Social and Community Factors

	Factor	HVAC Overhead	HVAC Underground	HVDC Overhead	HVDC Under-ground
	Social Acceptance Factors				
1	**Overall social licence and acceptance**	Context dependent and dynamic. *Potentially reduced in host communities because of the perceived burden of the project. *Influenced by the factors described in this table.	Context dependent and dynamic. Potentially improved in hosting communities. Influenced by the factors described in this table.	Only one study. Similar to overhead AC.	
2	**Aesthetic and visual**	Visual impacts negatively influence acceptance. Expected flow on impacts include diminished recreational activities, tourism, local commerce, and health stress. Tower design, paint, and landscaping of the corridor may positively influence acceptance.	Undergrounding can positively influence visual impacts, but clearing is required (which is a negative impact).	No data.	
3	**Human health**	EMF concerns' influence on acceptance is neutral to negative. *Information provision from independent, trusted sources, and transparency in decision-making process can contribute to mitigating concerns.	Limited data in the literature. An awareness gap was identified for underground EMF effects.	Only one study. No influence on acceptance compared to overhead AC.	
4	**Proximity**	Proximity influence is neutral to negative on acceptance. Concerns relate mostly to EMF and effects on property value. Acceptance does not follow a linear rule with distance from the transmission line.	Similar to OHTL, however acceptable distance appears to be reduced compared to OHTL.	No data.	
5	**Familiarity**	Familiarity is linked to proximity of an existing OHTL and may positive influence acceptance.	No data.	No data.	

	Factor	HVAC Overhead	HVAC Underground	HVDC Overhead	HVDC Under-ground
6	**Financial compensation**	Geographic boundaries, calculation, and administration of compensation are the subject of contestation and may be mitigated with engagement and participation. Individual compensation for land and homeowners is expected. *Beyond property value loss, it needs to account for attachment to place and community (in the case of resumption) and land use. Community benefits positively influence acceptance. For Indigenous communities compensation needs to account for cultural values.	No data.	No data.	
7	**Environmental impacts**	Environmental impacts negatively influence acceptance. Concerns are focussed on vegetation clearance, habitat and wildlife loss, soil degradation, water and groundwater quality and flow, noise, fire, weed dispersal, waste, national park and conservation areas, and impacts on agriculture.	Often seen as a mitigation measure of impact on significant landscape and biospheres, however lack of awareness of UGTL environmental impacts was highlighted.	No data.	
8	**Distributive justice: equity**	If the distribution of benefit and burden is unequal it negatively influences acceptance. This may be mitigated with community benefits and sound environmental measures in place. Capacity to negotiate better outcomes is often unequal between communities. This may be mitigated with capacity building and use of independent experts. Accelerated processes negatively influence acceptance.	Undergrounding might be seen as a mitigation of unequal distribution of burdens.	No data.	
9	**Procedural justice: Governance**	Fair and transparent governance influence acceptance positively. Coordination and efficiency in the planning processes between jurisdictions and economic sectors alleviate engagement frustration and fatigue compared to multiple, confusing and, at times, contradictory processes. Participation in national transition planning through to regional transmission line planning may influence positive acceptance. Clear goals and outcomes for all processes, including participation, may contribute to alleviating lack of trust issues.			
10	**Procedural justice: Information**	Quality, contextualised, timely and transparent information about available technologies, risks, trade-offs, and governance positively influences acceptance. Trusted sources and easy access also positively influence acceptance.	Similar to overhead AC. An awareness and knowledge gap was identified about EMF and environmental impacts from undergrounding.	Only one study. An awareness and knowledge gap was identified about HVDC. Information provision can be helpful towards improving acceptance.	

	Factor	HVAC Overhead	HVAC Underground	HVDC Overhead	HVDC Under-ground
11	**Procedural justice: Engagement & Participation**	There is a need to have a clear and transparent stakeholder identification process. Engagement is the sum of all interactions between all stakeholders of TLs and can influence acceptance. Participation is an essential component of engagement and requires clear goals and expected outcomes. A goal to solely increasing acceptance tends to negatively influence acceptance. Contextualised knowledge creation and relationship building based on shared understanding, transparently incorporated into project design and construction positively influences acceptance. Participation processes that are inclusive and ensure adequate local representation, provide agency and power balance positively influence acceptance. Accountability in the process is key.			
12	**Procedural justice: Trust**	High levels of trust in the process and the institution positively influences acceptance. Lack of trust hinders participatory processes and ultimately acceptance. The elements highlighted in this summary are critical to building trust in the proponent and their associated activities.			
13	**First Nations' Engagement Principles**	"Engage respectfully; Prioritise clear, accessible and accurate information; Ensure cultural heritage is preserved and protected; Protect Country and environment; Be a good neighbour; Ensure economic benefits are shared; Provide social benefits for Community; Embed land stewardship; Ensure cultural competency; Implement, monitor and report back" Source: https://www.firstnationscleanenergy.org.au/network_guides.			

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Appendix A: PRISMA Methodology for Social Licence and Acceptance

1. Eligibility Criteria (Inclusion & Exclusion)

The major criteria that were used to decide what information was included or not are detailed below.

Inclusion criteria

- Studies which cover social acceptance of overhead transmission line and underground cables
- Voltage level is not cited in the social science literature but is referred to as "transmission line"
- There was no limitation placed on date of publication

Exclusion criteria

- Publications or studies that were duplicated
- Studies that were irrelevant to the scope of this review. For example, technology other than transmission lines
- Language other than English

2. Information Sources

Both Scopus and Web of Science databases were the selected databases for peer reviewed articles.

3. Search Strategy

Both databases were searched for Title, Abstract and Keywords. However, the original search terms returned too many irrelevant papers. However, some of the words were related and therefore needed to be part of the same sentence. To search in this way, we used the proximity search function which increase the likelihood of those words appearing in the same sentence. This resulted in the final search terms being:

To establish the domain of enquiry: (electric* OR energy) AND

To narrow the domain to transmission lines: (power OR transmission OR "high voltage") within 2 words of (line OR cable OR wire))

To target social acceptance: (social OR public OR *owner OR community OR resident* OR local* OR indigenous OR farmer*) within 4 words of (licen* OR acceptance OR perception OR attitude OR willingness OR support OR opposition OR benefit* OR resistance OR cost* OR compensation)

4. Data Collection Process

Based on the above eligibility criteria, information sources and search strategy, publications were identified as per the procedures presented in the flow chart in Figure 3. According to the search strategy, 1,209 publications were found through Web of Science and Scopus, after removal of duplicates and papers outside the inclusion criteria, 591 were determined to be potentially contributing to the scope of this study. The papers were then screened by reading all publications' titles and abstracts and 169 were deemed within scope. These shortlisted publications were read in detail resulting in 102 publications being selected for further consideration and analysis.

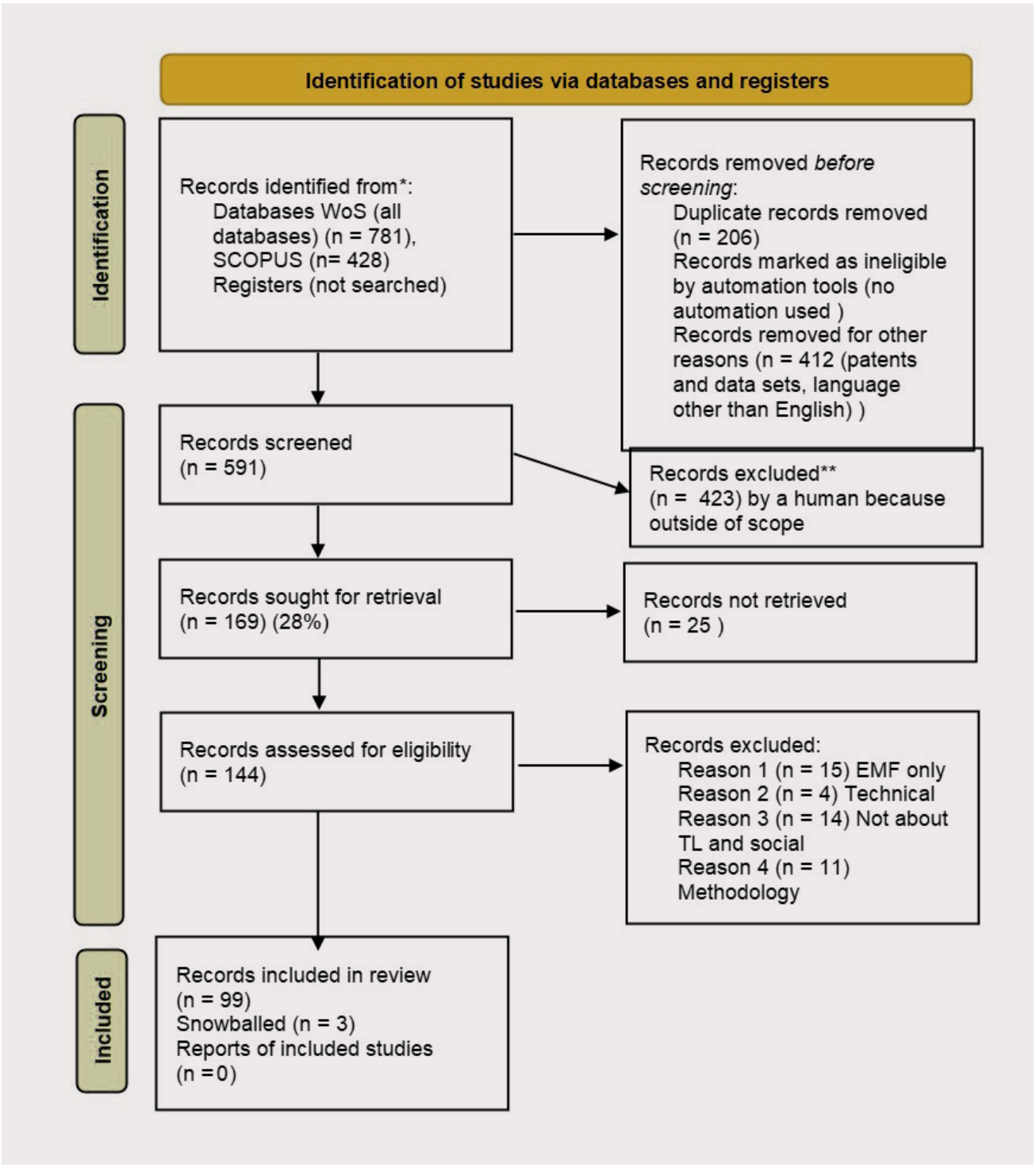

Figure 3 - Prisma flow diagram of studies to be included in the systematic literature review

5. Thematic Analysis

Data analysis of the 102 articles was undertaken using the software NVivo 12, a software package used to organise and help analyse the data through the following methods. This first stage is a thematic analysis through which the main themes are identified (refer Appendix C for the further details of the 102 papers). The second stage consisted of categorising extracts from the articles further and organising the findings into a cohesive argument.

Literature characteristics

Geographically, nearly 90% of the 102 studies were conducted in Europe or the US (Table 4) with only 4 studies being located in Australia. All four Australian studies took place in Queensland.

There was no date restriction applied to the search. The first paper available in Scopus and Web of Science was published in 1988 and was a review of the literature to that point in time. Between 1988 and 2013, one to two papers were published each year with a focus on social acceptance. The field then developed and peaked to 13 publications in 2020 but has reduced since, as seen in Figure 4. The lower publication rates in the earlier years possibly reflects the lack of transmission infrastructure built during that time, with recent focus likely to be related to the increased renewable energy projects being developed and the need to integrate them into the grid.

The data collection methods used in the reviewed studies are presented in Figure 5. A large number used a survey (50%) as the method of investigation, followed by interviews (17%) and focus groups (9%). There were 4 papers based on the literature review method but only one was a systematic review. Some studies used a combination of methods e.g. interviews and focus groups or interviews and reviews.

Notably, 53 studies targeted a specific project, 14 studies were based on hypothetical projects, and 35 were not applied to any project at all. For those studies that investigated people's views and acceptance, over 30 focussed on local or hosting communities that were directly affected by a proposed or current transmission line development (Figure 6). Whereas 27 studies recruited participants at the national level. In total 16 studies targeted professionals, namely electric utilities' employees, policy makers or property agents. Three studies targeted visitors to a specific area.

Table 4. Studies' Target Population Location

Country	Number of papers
USA	22
Germany	22
UK	18
International	8
Norway	7
Switzerland	5
Italy	5
Ireland	4
France	4
Iceland	3
Europe	2
Australia	4
Netherlands	2
Austria	2
Colombia	1
Denmark	1
Finland	1
Sweden	1

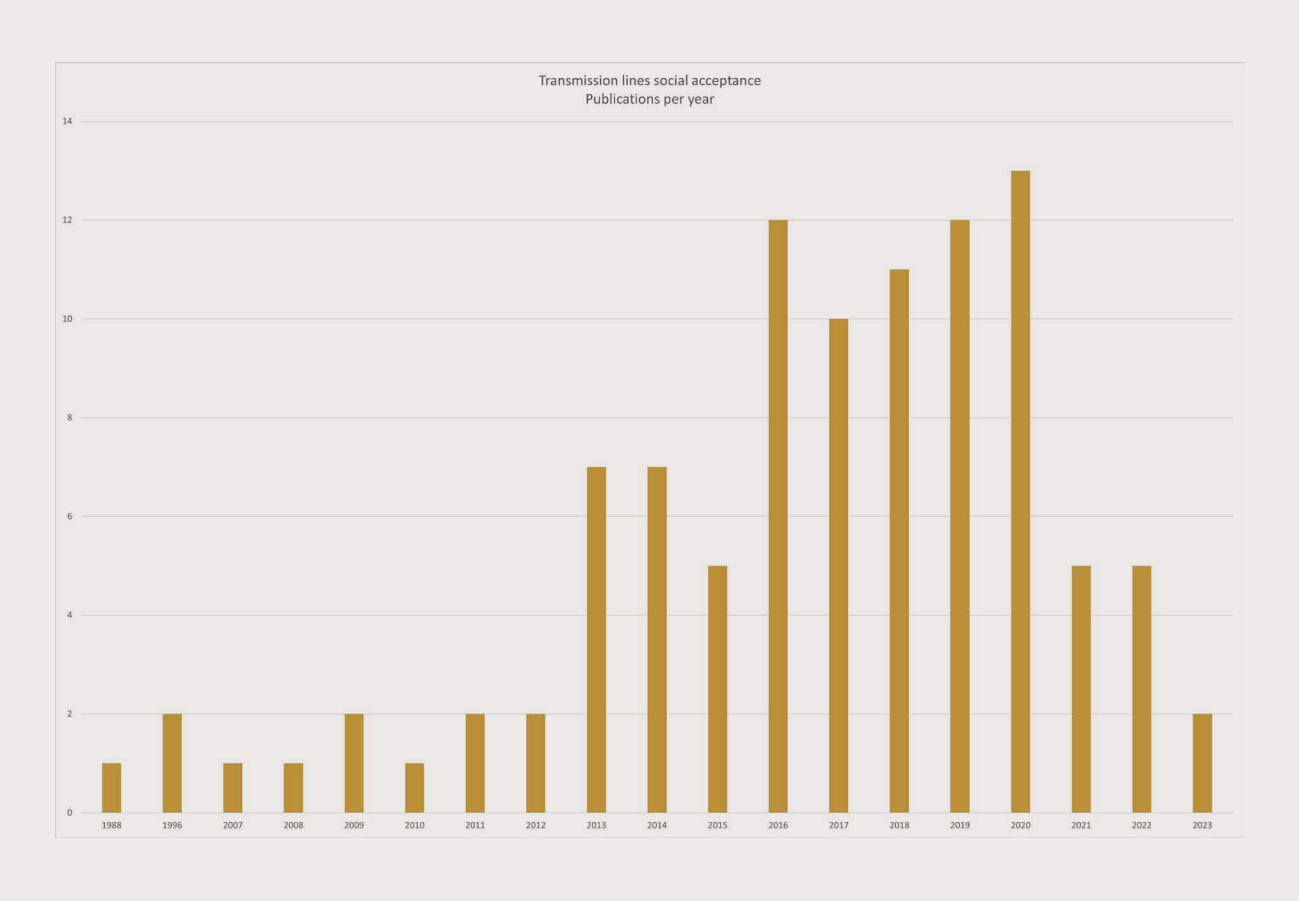

Figure 4. Number of Publications

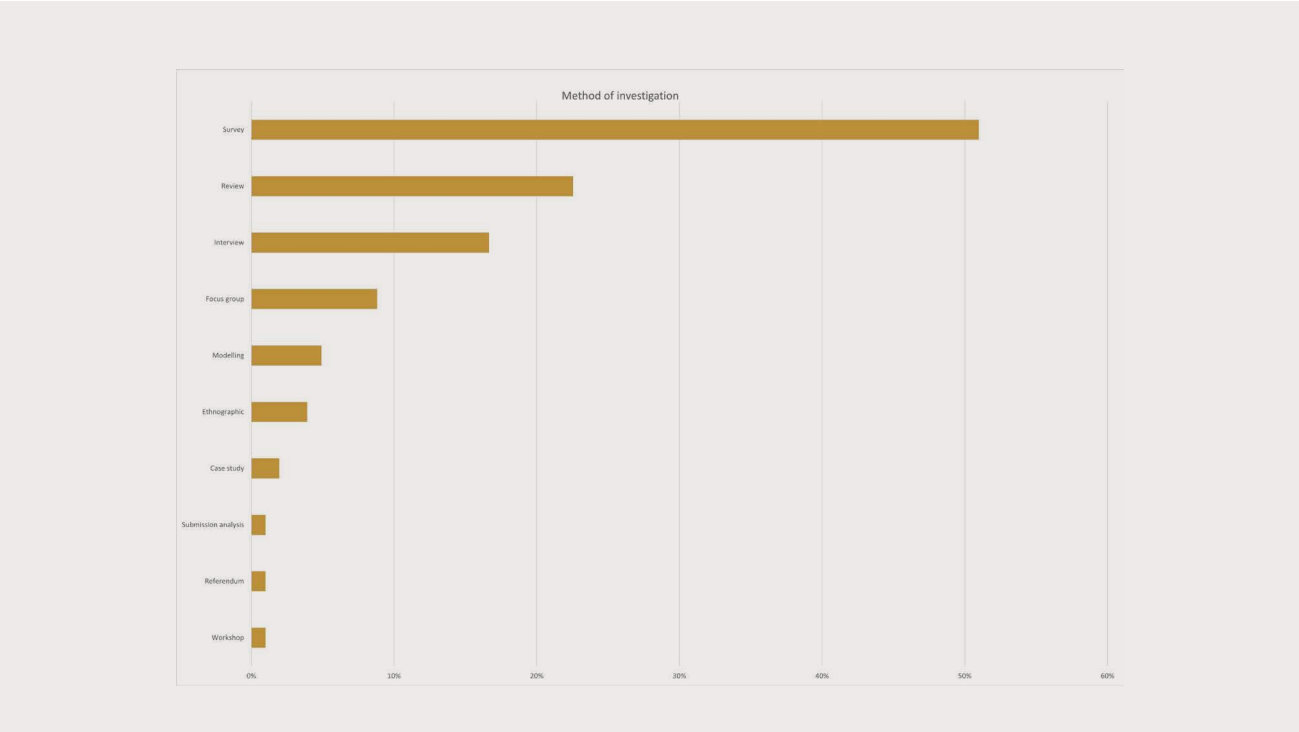

Figure 5. Method of Investigation

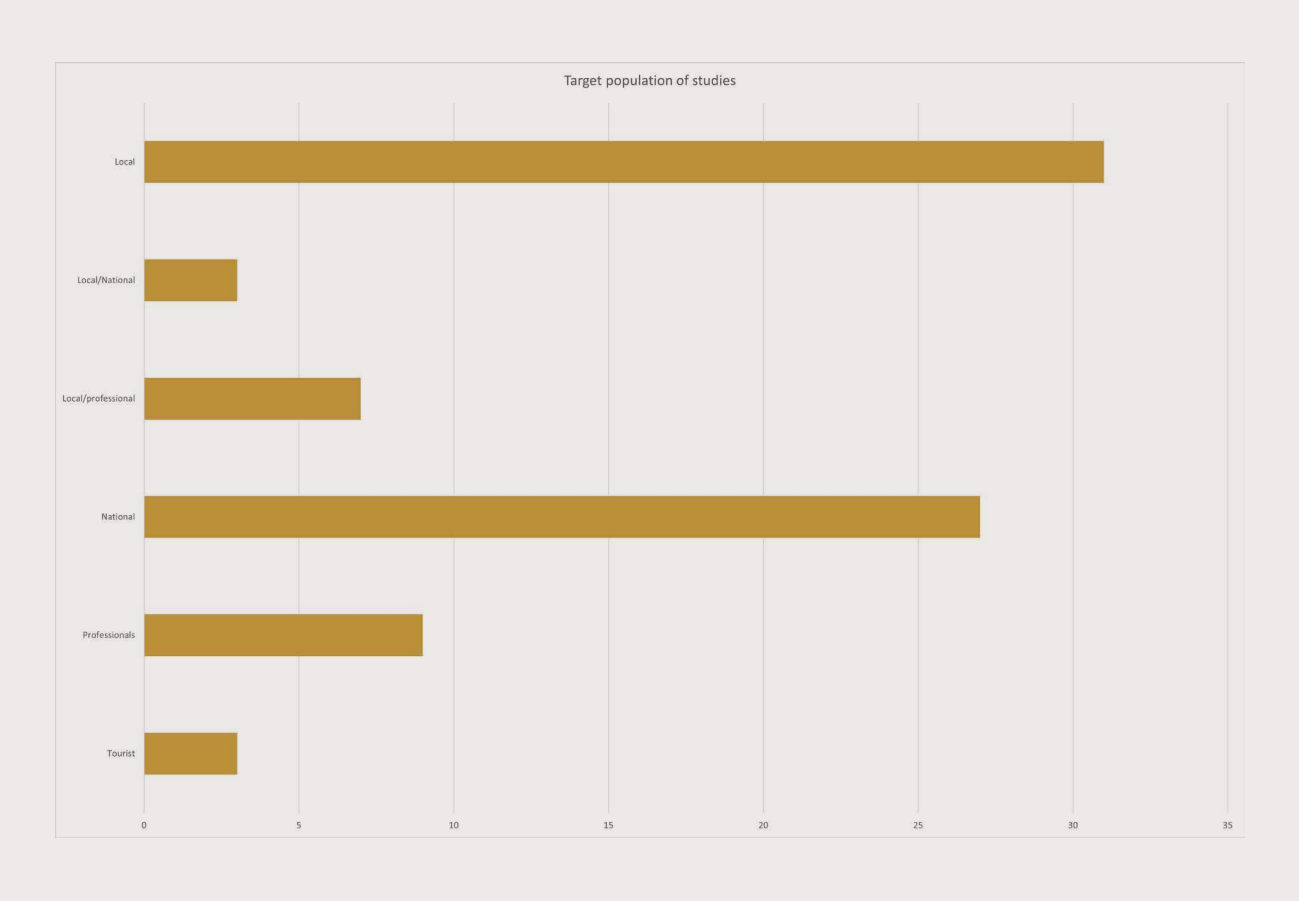

Figure 6. Target Population of Studies

Appendix B: Culturally-responsive Cross-cultural Collaborative Design with First Peoples

By: Assoc. Prof. Andrew Knight, ARC Industrial Training Centre for Healing Country

1. Introduction

The implementation of transmission line projects in Australia will bring proponents and government, and in some locations other stakeholders, into contact with First Peoples. Under the United Nations Declaration on the Rights of Indigenous Peoples [86], First Peoples are identified (rather than defined) via:

- Self-identification as indigenous peoples at the individual level and accepted by the community as their member.
- Historical continuity with pre-colonial and/or pre-settler societies
- Strong links to territories and surrounding natural resources
- Distinct social, economic or political systems
- Distinct language, culture and beliefs
- Forming non-dominant groups of society
- Resolution to maintain and reproduce their ancestral environments and systems as distinctive peoples and communities

As such, First Peoples are fundamental rights-holders in many locations in Australia. Approximately 60% of mainland Australia is expected to soon be managed or jointly-managed by First Peoples. The complex interplay with First Peoples between Culture, Country and Community manifest a suite of values, some of which align with Western colonial values and the institutions they have implemented, and several which are fundamentally different. In the past, these value differences have, in part, lead to post-colonial disempowerment and dispossession of First Peoples in land management decision-making with foundational production sectors, including pastoralism, mining and urban development. Energy transition initiatives, including transmission line projects, provide opportunities for exploring and implementing new approaches for sharing the benefits provided by these projects across stakeholder groups, inclusive of First Peoples.

The general absence of a history of collaboration between production sectors and First Peoples, the divergence in values of land, sea and sky, coupled with the manifestation of some of these values in intangible ways (e.g., Songlines) manifests uncertainty in new and emerging projects. For example, recent research in the mining sector has revealed that most managers believe social and environmental uncertainties pose the most significant risks to mining ventures (Ernst & Young 2022 [90]). The lack of understanding between First Peoples and proponents of development limits the effectiveness of assessment, planning, management, and adaptation of projects. Building relationships – not simply transactional engagement - First Peoples Communities can deliver effective and ethical transmission line projects.

Little empirical evidence exists to support the adoption of effective methods and methodologies for building relationships between First Peoples and proponents. For example, the review of social aspects of transmission lines presented in this report found only one article focussed on First Peoples as stakeholders (p.158). That said, pockets of expertise founded upon experiential learning are to be found in many locations. The development of evidence-based guidelines that synthesise empirical evidence to identify the values, knowledge, skills and attributes of individuals, teams and organisations that support the building of ethical and resilient professional relationships offered by transmission line projects will contribute directly to their success.

2. Impacts of Transmission Lines on First Peoples

The design, planning, implementation, maintenance and decommissioning of transmission lines may impact First Peoples in ways similar to other groups of rights-holders and stakeholders. These impacts may include: health impacts such as effects on the rate of specific chemical reactions, minor compromising of hand-eye coordination and visual contrast, vertigo and nausea; economic impacts such as forgone current and future income and degradation or loss of ecosystem services; environmental impacts such as the loss of valued genes, species, habitats and ecosystems; and social impacts such as the loss of ecosystem services such as the provisioning of experiential and intellectual interactions.

Whilst investments have been made into understanding the broader impacts of transmission line developments, very little time and effort has been invested in understanding the impacts upon First Peoples. This is a substantial and unsatisfactory knowledge gap, given the typically marginalised status of First Peoples, and the situation-specific character of their connections to the world around them. Proponents need to invest time and resources in collaborating with First Peoples if developments are to be effective and ethical.

First Peoples may be impacted by transmission line projects in ways that differ to other rights-holders and stakeholder groups. These result from fundamental differences in the perspectives, attitudes, responsibilities and behaviours of First Peoples individuals, groups and Communities to the wider Australian community. These may include:

Loss of species of cultural significance, including terrestrial, aquatic, marine and subterranean species of plant and animals, which may have spiritual, totemic, ceremonial and/or medicinal importance;

Loss of species important for subsistence, as some Communities harvest directly from Country in subsistence or partly-subsistence livelihoods, for example, foodstuffs such as kangaroo, goanna, native yams;

Compromising of intangible sites of cultural significance, for example, transmission lines may align with Songlines and other important routes used by First Peoples, as these were commonly adopted in some locations as they represent pathways of least effort for traversing land- and seascapes.

Degradation or destruction of tangible sites of cultural significance, for example, physical destruction of landforms, waterholes and wetlands, and/or specific types of ecosystems or habitats, inclusive of underground sites;

Visual disruption of the night sky, for example, for sighting constellations necessary for navigation or for undertaking cultural ceremonies and story-telling, is a specific impact of overhead transmission lines;

The *ecological impacts* associated with these losses rendering First Peoples unable to meet the cultural, social and personal responsibilities that ensure their connection with Country, Culture and Community, and hence the active management of, for example, fire;

The social and personal health and wellbeing impacts associated with these individual and collective losses that leave First Peoples unable to meet the social and personal cultural responsibilities to Country, Culture and Community;

The *social and personal health and wellbeing costs* associated with the need to practice 'code-switching' when communicating with individuals outside their Community regarding the design, planning, implementation, monitoring and evaluation of transmission line projects;

The weaving of transmission lines into contemporary stories and Songlines, which requires maintaining infrastructure that may have been scheduled for decommissioning;

Declining opportunities for self-determination, which exacerbate existing marginalisation of First Peoples as individuals and Communities.

Accordingly, the 'Prudent Avoidance Policy' (i.e., the Precautionary Principle) should be enacted to ensure that knowledge gaps (i.e., low cultural competence) do not result in the values of First Peoples being compromised and recognises the potential for health risks and aims to minimise exposure as a precautionary measure. Current guidelines create a situation where the prudent avoidance policy adopted by TNSPs only requires proponents to, for example, implement no cost and very low-cost measures that reduce exposure of individuals and Communities to transmission lines and the potential health impacts while not unduly compromising other issues. Unlike planning to avoid health impacts where in most cases the application of prudent avoidance can be implemented without the need for a specific assessment, cases where First Peoples are potentially impacted will require comprehensive assessment of the tangible and intangible aspects of Country.

3. Keeping Connected: Culturally-responsive Transmission Line Projects

Transmission lines connect places for a specific purpose – to provide electricity. Without connections that are robust and genuine, the integrity and functioning of a transmission line system is compromised. In much the same way, First Peoples can be compromised when their connection to Country, Culture and Community is compromised. Proponents and First Peoples both require connection. When connections are lost between First Peoples and Country, Culture and/or Community, individual and Community rights, health and wellbeing are compromised. First Peoples 'connections' are complex and should be explicitly identified, mapped and incorporated in decision-making processes (where culturally-appropriate) (Figure 7).

Figure 7. A conceptualisation of the Social and Emotional Wellbeing Framework depicting the interplay of social and historical determinates on the wellbeing of First Peoples (Dudgeon et al. 2020 [96], as adapted from Gee et al. 2014 [91])

The values, perspectives, attitudes and behaviours of First Peoples differ fundamentally from those of colonial and post-colonial settlers in Australia. This divergence places First Peoples in situations in their day-to-day lives where their view of themselves, their mental and physical health, their responsibilities to Country, Culture and Community, and hence their willingness and capacity to navigate work and life in a Western world is compromised.

An understanding of the concepts of Cultural Safety, Cultural Security, Cultural Proficiency and Code-Switching is essential for reducing the uncertainty surrounding cross-cultural relationships, and hence increases the probability of success for transmission line projects. This understanding allows proponents to design, implement, evaluate and refine approaches to building relationships that are trusting and resilient. These concepts apply equally to those who do, and who do not, identify as First Peoples. For example, the concept of 'Cultural Safety' is analogous to the concept of 'psychological safety' commonly used in the organisational and management sciences (Edmondson 1999 [92]). These concepts manifest across individuals, teams and organisations (Figure 8). This conceptualisation allows for the identification, assessment and actioning of thinking and practices

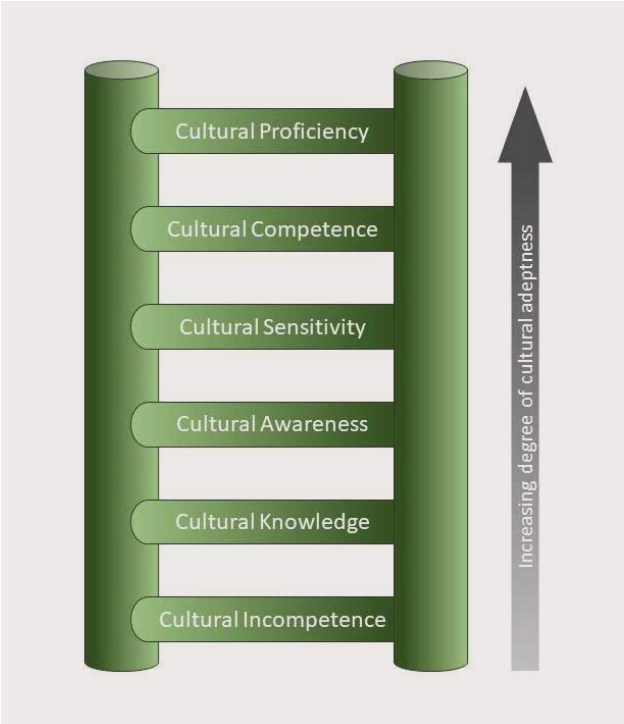

Figure 8. A representation of the stages of progression towards cultural proficiency that can be actively fostered by individuals and teams (adapted from Wells 2000 [93]).

that promote an agreed and appropriate degree of participant proficiency for situation-specific cross-cultural collaborative design activities for transmission line projects.

Cultural Safety is a situation-specific *state of mind* experienced by an individual where she or he feels themselves sheltered from exposure to some form of risk. Risks might include the compromising of personal psychological wellbeing, physical harm, and/or their rights, cultural expectations and responsibilities to their cultural or social situation. Individuals perceive risks differently and idiosyncratically, meaning one team member may feel culturally safe in a specific situation whilst another may not. An example of cultural safety being promoted could be the arranging of special leave entitlements for First Peoples to attend extended periods of time away from work for cultural reasons, such a 'sorry business'.

In contrast, Cultural Security is a situation-specific *state of participation* where respect for cultural differences is intrinsically embedded within the thinking and practices developed, adopted, implemented, evaluated and refined by an institution. This may include activities such as acknowledging the historical causes of inequity and inequality; ensuring Indigenous leadership and participation; and recognising Country, Culture and Community as foundational to effectiveness. The principle of cultural security includes not only cultural differences between First Peoples and other Australians, but also differences between, and within, Indigenous groups. For example, providing working parents with facilities for changing and feeding infants in the workplace.

The knowledge deficit that exists between First Peoples and other Australians in transmission line projects is best overcome by learning about the foundations of effective professional relationships. Reflective practice is a foundation to learning in professional contexts (Schon 1983 [94]). Cultural Proficiency is a dynamic, situation-specific and continuous process through which an individual, and the team, organisation and community of practice of which they are a part, strives and evolves towards a state where Cultural Security is able to be effectively sought and secured through ongoing personal and group learning and adaptation. It is distinct from cultural competence in that competence denotes a willingness and ready capacity for the routine application of culturally-appropriate thinking (e.g., attitudes) and practices (e.g., individual behaviours, institutional systems). Cultural proficiency is not an end unto itself, but rather an evolving state responding to change in the situation of an individual and the 'space' in which they operate (e.g., the uptake of Community responsibilities following the passing of a Community Elder, a change in legislation) and cultural change (the natural evolution of social norms and practices).

The cultural differences between First Peoples and the groups within wider Australian society in which they live and work prompts several responses from First Peoples as individuals. One of these is known as code-switching. Code-switching can be broadly defined as the adjusting of one's style of speech, appearance, behaviour, and/or expression in ways that will optimize the comfort of others in exchange for some type of benefit, or to avoid some form of risk, such as fair treatment, quality service, and employment opportunities (McCluney et al. 2019 [95]). Practicing code-switching can impact First Peoples through hostility from members of their Community for conforming to another cultural or social group's expectations; depletes cognitive resources through the need to be vigilant to maintain a preferred persona; contributes to burnout; undermines the building of trusting relationships; and generally hinders performance.

Recognising the costs and benefits to cross-cultural relationships between First Peoples and others regarding code-switching, Cultural Safety, Cultural Security and Cultural Proficiency will facilitate resilient relationships and thereby promote successful projects.

4. Principles of Culturally-responsive Collaborative Design

A significant number of approaches to collaborative design (sometimes known as 'co-design') involving First Peoples have been developed in Australia. The land management and healthcare sectors are notable for their contributions. The scope and level of detail providing direction for the implementation of individual projects and programs across these approaches varies substantially, with some providing a philosophy or conceptual foundation of collaborative design, whilst other publications provide information on which, and how, specific activities can be implemented. Several commonalities exist across many of these approaches, which reflect the need for generic advice and basic foundational elements of collaborative design projects and programs. One common component is the inclusion of principles for guiding collaborative design activities.

The First Peoples Clean Energy Network Best Practice Principles for Clean Energy Projects provides useful guidance for transmission line project proponents. The 10 Principles are intended to help ensure projects provide economic and social benefits such as business development and employment opportunities; ensure mutual respect, clear communication and cultural and

environmental protection; promote sustainable land management; and ensure Free, Prior and Informed Consent (FPIC) is secured for First Peoples, as rights-holders, for the activities conducted. The 10 Principles (in no priority order) are:

1. Engage respectfully

The *United Nations Declaration on the Rights of Indigenous Peoples* states that the principle of "Free, Prior and Informed Consent" (FPIC) must apply when engaging with First Peoples communities. Putting in place mechanisms for building respectful relationships must be prioritised, established and maintained (inclusive of funding for independent expert legal, scientific, business, commercial and other advice) from the commencement of scoping a project in culturally-responsive ways. The agenda, character and timelines must be negotiated jointly by Community, the project developer and other rights-holders and stakeholder.

2. Prioritise clear, accessible and accurate information

Accessible, timely, accurate and detailed information on the character, design, construction, impact, ongoing life and decommissioning of transmission line projects on or near their land is fundamental to ethical and effective decision-making by First Peoples. This includes transparent processes for Community feedback with insights, concerns and advice to be received and acted on in actionable and respectful ways. Opportunities must be provided for Communities to have agreements reviewed (before they are finalised) by expert advisors to ensure that terms and conditions are fair, binding and provide avenues for benefit-sharing.

3. Ensure cultural heritage is preserved and protected

Proponents, industry and investors must commit to avoiding damage to cultural sites and ensuring First Peoples connection to Country. First Peoples should be able to choose assesses, plans and manages cultural heritage. Companies should fund First Peoples to undertake cultural heritage assessment protection work. Regular and ongoing cultural competency training should be prioritised by companies for their employees. The cultural rights and obligations to care for Country, including cultural sites, requires access to project sites, which should be provided respectfully, proactively and in a timely manner.

4. Protect Country and environment

First Peoples have occupied Country for thousands of years and their rights to Country were never ceded. Companies should respect a Community's authority and responsibility to preserve and actively manage areas of environmental value. First Peoples must have representatives with Cultural decision-making authority on environmental protection decision-making bodies. Procedures should be implemented for the collaborative design of culturally-responsive land and environmental protection plans, inclusive of the design, operation, transition, closure (including remediation, rehabilitation and restoration) and restitution phases of a project. Companies should adequately resource the ongoing management, implementation and enforcement of the plan.

5. Be a good neighbour

Solutions to a project's potential visual, noise, traffic and other impacts should be sought through collaborative design of transmission line projects. Impacts to manage and mitigate may include the use of shared water resources and disposal of waste. Regular monitoring and evaluation of impacts should be funded, undertaken and reported to Community and the wider public.

6. Ensure economic benefits are shared

Companies must explore and provide a range of culturally-responsive opportunities for First Peoples Communities to share the benefits provided by projects. These may include priority for employment opportunities; owning a stake in a project and its assets; and/or rental payments for the disturbance, use and occupation of land or sea. Prioritising, setting employment targets, and reporting on First Peoples employment should be undertaken through joint culturally-responsive procedures, with accountability assigned to senior executive company personnel. Clear career pathways, that ensure a workplace conducive to the recruitment and retention of First Peoples through ongoing mentoring and training, can assist companies to enhance delivery of their objectives by producing a highly competent First Peoples workforce. First Peoples goods and services must be prioritised for use over those brought in from outside Country.

7. Provide social benefits for Community

Projects should proactively work to provide social benefits for local Communities. The types of community benefits should be discussed during the design stage of a project, and their delivery built into a project's governance and accountability structures and procedures. Providing renewable energy to communities will help to ensure energy security positively contributes to improving community outcomes and well-being.

8. Embed land stewardship

Transmission line projects have opportunities for demonstrating models of greater sustainability, equity and resilience than past extractive projects. Companies can explore and implement Nature Positive activities,

moving beyond simply securing a 'no net loss' of ecological, cultural and agricultural values of land and sea. This could include funding First Peoples Ranger programs to manage feral animals and invasive weeds and restore important local wildlife habitats.

9. Ensure cultural competency

A company must develop, mainstream and evaluate ways – guided by a Reconciliation Action Plan – in which staff, at all levels, and particularly senior personnel, can experience and learn about local Country, Culture and Community, inclusive of (where culturally appropriate) cultural heritage sites and stories. Cultural competency training, provided by the local community, should be part of the company's governance structures, with explicit targets to drive the continual improvement of cultural competency across all levels of the organisation.

10. Implement, monitor and report back

A project's development life-cycle should include personnel, structures and procedures detailing and mobilising explicit and trackable company commitments to local First Peoples Communities. These must ensure future project owners and operators are bound by them. Company commitments to First Peoples communities should be linked to the performance executive personnel. Commitments must also be adequately resourced to ensure effective, ethical and equitable delivery and should be regularly monitored, evaluated and reported to Communities, shareholders and the wider public, inclusive of feedback provided by Communities, promote continuous improvement of company operations.

5. Opportunities for Delivering Multiple Benefits Through Cross-cultural Collaboration

Culturally-responsive cross-cultural collaboration has historically often been viewed as a hinderance to extractive industry activities. This view manifests in the numerous and consistent breaches of the human rights of First Peoples. Opportunities exist for deriving substantial benefits from cross-cultural collaboration which enhance the resilience, sustainability, profitability and ethical delivery of transmission line projects. Promoting the connection of First Peoples to Country, Culture and Community minimises or avoids ecological, economic and social risks to proponents, developers, companies, the wider public, as well as First Peoples Communities. Such activities include:

Proponents, developers, companies, First Peoples Communities, and other rights-holders and stakeholders where appropriate, invest in developing sector-leading practices to drive investment and, more broadly, a national values-led economy (Chalmers 2023 [89]) to promote the interest of all Australians, inclusive of First Peoples, through the emerging clean energy economy, and transmission line projects specifically;

Proponents, developers, companies, First Peoples Communities, and other rights-holders and stakeholders where appropriate exploring *'biocultural' perspectives*, mechanisms and tools that avoid the current limitations of reductionist approaches to the assessment, planning, management and evaluation of the land and sea on which transmission lines projects are located. For example, biocultural mapping of First Peoples values may optimise the securing of cultural, ecological and economic benefits simultaneously;

Seek multiple benefits on sites occupied by transmission lines through the implementation of 'onsets' (sometimes known as 'insets'), as opposed to offsets, which can optimise delivery of project objectives. For example, rehabilitating or restoring transmission line locations can employ plant species valued for the medicinal, totemic and food values of First Peoples; soil binding properties and carbon sequestration potential.

Framing company cross-cultural collaboration thinking and practices so as to align with the United Nation's *Sustainable Development Goals* (SDGs) so that activities for maintaining First Peoples connection to Country, Culture and Community simultaneously promotes global reporting responsibilities and Environmental, Social, and Governance (ESG) expectations of investors and shareholders;

Exploring and developing novel and situation-specific authentic, culturally-responsive and collaboratively-designed mindsets, methods and methodologies for land and sea management which deliver more effective, cost-efficient, equitable and resilient. For example, the collaborative design of 'traditional burning' fire management policies and procedures.

Exploring and developing new culturally-responsive policies, procedures, structures and activities involving First Peoples, especially local Communities, and proponents, developers and companies to enhance the delivery of the values, priorities, profitability and expectations of a company, its investors and shareholders, and their targets markets.

Development, testing and implementation of innovative methods and methodologies for monitoring, evaluating and improving the Cultural Safety, Cultural Security and Cultural Proficiency of all stakeholders, including First Peoples, to ensure accountability, defensibility, reliability and confidence in transmission line projects.

6. Conclusion

First Peoples have not only been marginalised, but have also suffered directly from activities in all land-use sectors in Australia. The emergence of transmission line projects in Australia to support the nation's transition to clean and sustainable energy provides a bright opportunity for collaborating in authentic, meaningful and just ways that share genuine benefits across all groups inclusive of First People's Communities, proponents, developers, companies, and other rights-holders and stakeholders. This fundamentally requires maintaining and promoting the connection of First Peoples with Country, Culture and Community. This is most effectively, cost-efficiently and sustainably achieved through the implementation of culturally-responsive cross-cultural collaborative design.

Appendix C: Summary of References from the Literature R eview

Authors	Year	Country	Method	Target population	Number of Participants
Aaen, Sara Bjørn; Kerndrup, Søren; Lyhne, Ivar	2016	Denmark	Interview/ Ethnographic	Local	4
Aas, Øystein; Devine-Wright, Patrick; Tangeland, Torvald; Batel, Susana; Ruud, Audun	2014	Norway Sweden UK	Survey	National	5,107
Aas, Øystein; Qvenild, Marte; Wold, Line Camilla; Jacobsen, Gerd Blindheim; Ruud, Audun	2017	Norway	Interview/focus group	Local	75
Azarova, Valeriya; Cohen, Jed; Friedl, Christina; Reichl, Johannes	2019	Austria Germany Italy Switzerland	Survey	National	2,000
Bailey, Etienne; Devine-Wright, Patrick; Batel, Susana	2016	UK	Interview narrative	Local	25
Batel, Susana	2018	International	Review	Not Applicable	Not Applicable
Batel, Susana	2020	International	Review	Not Applicable	Not Applicable
Batel, Susana; Devine-Wright, Patrick	2015	UK	Survey	Local/National	2,021
Batel, Susana; Devine-Wright, Patrick	2017	UK	Focus group	Local	Not specified
Batel, Susana; Devine-Wright, Patrick	2018	UK	Survey	National	2,560
Batel, Susana; Devine-Wright, Patrick	2020	UK	Focus group	Local	50
Batel, Susana; Devine-Wright, Patrick; Tangeland, Torvald	2013	UK Norway	Survey	National	2,123
Batel, Susana; Devine-Wright, Patrick; Wold, Line Camilla; Egeland, H.; Jacobsen, Gerd Blindheim; Aas, Øystein	2015	UK Norway	Focus group	Local	83
Bertsch, Valentin; Hyland, Marie; Mahony, Michael	2017	Ireland	Survey	National	1,044
Brinkley, Catherine; Leach, Andrew	2019	International	Review	Not Applicable	Not Applicable
Cain, Nicholas L.; Nelson, Hal T.	2013	USA	Review	Not Applicable	Not Applicable
Carley, Sanya; Ansolabehere, Stephen; Konisky, David M.	2019	USA	Survey	National	2,000
Carley, Sanya; Konisky, David M; Atiq, Zoya; Land, Nick	2020	International	Review	Not Applicable	Not Applicable
Ceglarz, Andrzej; Beneking, Andreas; Ellenbeck, Saskia; Battaglini, Antonella	2017	Norway	Interview/ focus group	Local	17
Ciupuliga, A.R.; Cuppen, E.	2013	France	Case study	Local	Not Applicable

Authors	Year	Country	Method	Target population	Number of Participants
Cohen, Jed J.; Reichl, Johannes; Schmidthaler, Michael	2014	International	Review	Not Applicable	Not Applicable
Cohen, Jed; Moeltner, Klaus; Reichl, Johannes; Schmidthaler, Michael	2016	Europe	Survey	National	7,659
Cotton, M.; Devine-Wright, P.	2011	UK	Interview/ survey	Local/ professional	25
Cotton, Matthew; Devine-Wright, Patrick	2012	UK	Interview	Professionals	22
Cotton, Matthew; Devine-Wright, Patrick	2013	UK	Focus group	Local	38
Devine-Wright, Hannah; Devine-Wright, Patrick	2009	UK	Focus group	Local	62
Devine-Wright, Patrick	2009	UK	Review	Not Applicable	Not Applicable
Devine-Wright, Patrick	2013	UK	Survey	Local	503
Devine-Wright, Patrick; Batel, Susana	2013	UK	Survey	National	1,519
Devine-Wright, Patrick; Batel, Susana	2017	UK	Survey	National	1,519
Devine-Wright, Patrick; Devine-Wright, Hannah; Sherry-Brennan, Fionnguala	2010	UK	Survey	National	1,041
Devine-Wright, Patrick; Sherry-Brennan, Fionnguala	2019	Ireland	Interview/ Ethnographic	Local/ professional	13
Di Angelo, Luca; Gherardini, Francesco; Di Stefano, Paolo; Leali, Francesco	2020	Italy	Model	Not Applicable	Not Applicable
Elliott, P.; Wadley, D.; Han, J.H.	2016	Australia	Survey	Local/National	600
Elliott, Peter; Wadley, David	2012	Australia	Focus group	National	78
Escribano, Gonzalo; Gonzalez-Enriquez, Carmen; Lazaro-Touza, Lara; Paredes-Gazquez, Juandiego	2023	France Germany Italy Spain	Survey	National	4,000
Firestone, Jeremy; Bates, Alison W.; Prefer, Adam	2018	USA	Interview/ survey	Local	443
Flachsbarth, Franziska; Wingenbach, Marion; Koch, Matthias	2021	Germany	Model	Not Applicable	Not Applicable
Friedl, Christina; Reichl, Johannes	2016	Austria Germany	Interview/ workshop	Local/ professional	16
Furby, L; Slovic, P; Fischhoff, B; Gregory, R	1988	USA	Review	Not Applicable	Not Applicable
Gerstle, B.	2014	USA	Review	Not Applicable	Not Applicable
Giaccaria, S.; Frontuto, V.; Dalmazzone, S.	2016	Italy	Survey	Local	1,410
Giron, R.	2014	USA	Review	Not Applicable	Not Applicable
Gölz, Sebastian; Wedderhoff, Oliver	2018	Germany	Survey	National	2,009
Henry, Sebastien; Panciatici, Patrick; Parisot, Alexandre	2014	France	Review	Not Applicable	Not Applicable
Hyland, Marie; Bertsch, Valentin	2018	Ireland	Survey	National	1,044
Joalland, Olivier; Pereau, Jean-Christophe; Rambonilaza, Tina	2019	France	Model	Not Applicable	Not Applicable

Authors	Year	Country	Method	Target population	Number of Participants
Joe, Jeffrey C.; Hendrickson, Kelsie; Wong, Maria; Kane, Stephanie L.; Solan, David; Carlisle, Juliet E.; Koehler, David; Ames, Daniel P.; Beazer, Robert	2016	USA	Survey	Local	695
Kamlage, Jan-Hendrik; Drewing, Emily; Reinermann, Julia Lena; de Vries, Nicole; Flores, Marissa	2020	Germany	Case study	Local	Not Applicable
Keir, L.; Watts, R.; Inwood, S.	2014	USA	Submission analysis	Local	Not Applicable
Knudsen, Jørgen K.; Wold, Line Camilla; Aas, Øystein; Kielland Haug, Jens Jacob; Batel, Susana; Devine-Wright, Patrick; Qvenild, Marte; Jacobsen, Gerd Blindheim	2015	UK Norway	Focus group	Local	Not specified
Koecklin, Manuel Tong; Longoria, Genaro; Fitiwi, Desta Z.; DeCarolis, Joseph F.; Curtis, John	2021	Ireland	Survey/ modelling	National	1,057
Koelman, Mark; Hartmann, Thomas; Spit, Tejo J. M.	2022	Netherlands	Interview	Professionals	15
Komendantova, Nadejda; Battaglini, Antonella	2016	Germany	Survey/ Ethnographic	Local/ professional	Not specified
Konisky, David M.; Ansolabehere, Stephen; Carley, Sanya	2020	USA	Survey	Local/National	16,200
Lienert, Pascal; Suetterlin, Bernadette; Siegrist, Michael	2015	Switzerland	Survey	National	248
Lienert, Pascal; Sütterlin, Bernadette; Siegrist, Michael	2018	Switzerland	Survey	National	515
Linzenich, Anika; Zaunbrecher, Barbara Sophie; Ziefle, Martina	2020	Germany	Survey	National	147
Linzenich, Anika; Ziefle, Martina	2018	Germany	Survey	National	70
Maney, CT	1996	USA	Review	Not Applicable	Not Applicable
Martiskainen, Mari; Sovacool, Benjamin K.	2021	International	Review	Not Applicable	Not Applicable
Menges, R.; Beyer, G.	2014	Germany	Survey	Local	1,003
Moyer, R.M.; Song, G.	2016	USA	Survey	Professionals	420
Moyer, R.M.; Song, G.	2019	USA	Survey	Professionals	420
Mueller, Christoph Emanuel	2019	Germany	Survey	Local	1,300
Mueller, Christoph Emanuel	2020	Germany	Survey	Local	1,303
Mueller, Christoph Emanuel	2020	Germany	Survey	Local	2,605
Mueller, Christoph Emanuel; Keil, S.I.	2020	Germany	Survey	Local	859
Mueller, Christoph Emanuel; Keil, S.I.; Bauer, C.	2017	Germany	Survey	Local	1,302
Mueller, Christoph Emanuel; Keil, S.I.; Bauer, C.	2019	Germany	Survey	Local	2,605
Navrud, Ståle; Ready, Richard C.; Magnussen, Kristin; Bergland, Olvar	2008	Norway	Survey	Local	604

Authors	Year	Country	Method	Target population	Number of Participants
Nelson, Hal T.; Swanson, Brian; Cain, Nicholas L.	2018	USA	Survey	Local	358
Neukirch, Mario	2020	Germany	Interview	Professionals	12
Porsius, Jarry T.; Claassen, Liesbeth; Weijland, Patricia E.; Timmermans, Danielle R. M.	2016	Netherlands	Interview	Local	15
Priestley, T.; Evans, G.W.	1996	USA	Survey	Local	236
Sæpórsdóttir, A.D.; Hall, C.M.	2018	Iceland	Survey	Tourist	1,078
Saethorsdottir, Anna Dora; Hall, C. Michael	2019	Iceland	Interview/ survey	Professionals	221
Salak, B.; Lindberg, K.; Kienast, F.; Hunziker, M.	2021	Switzerland	Survey/ modelling	National	1,062
Sardaro, Ruggiero; Bozzo, Francesco; Fucilli, Vincenzo	2018	Italy	Review	Local	Not Applicable
Schmidt, Peter; Lilliestam, Johan	2015	Europe	Review	Not Applicable	Not Applicable
Sharpton, Tara; Lawrence, Thomas; Hall, Margeret	2020	USA	Survey	National	2,550
Simora, Michael; Frondel, Manuel; Vance, Colin	2020	Germany	Referendum	National	6,568
Soini, K.; Pouta, E.; Salmiovirta, M.; Uusitalo, M.; Kivinen, T.	2011	Finland	Survey	Local	630
Stadelmann-Steffen, Isabelle	2019	Switzerland	Interview	National	1,129
Stefansson, Porkell; Saeporsdottir, Anna Dora; Hall, C. Michael	2017	Iceland	Survey	Tourist	2,075
Steinbach, Armin	2013	Germany	Review	Not Applicable	Not Applicable
Tate, R.D.	2021	USA	Review	Local	Not Applicable
Thomas, Heiko; Marian, Adela; Chervyakov, Alexander; Stueckrad, Stefan; Salmieri, Delia; Rubbia, Carlo	2016	Germany	Review	Not Applicable	Not Applicable
Tumlison, C.; Moyer, R.M.; Song, G.	2017	USA	Survey	Professionals	420
Vajjhala, Shalini P.; Fischbeck, Paul S.	2007	USA	Survey	Professionals	56
van de Grift, Elisabeth; Cuppen, Eefje	2022	International	Review	Not Applicable	Not Applicable
Vega-Araujo, Jose; Heffron, Raphael J.	2022	Colombia	Interview	Local/ professional	10
Wadley, D.; Han, J.H.; Elliott, P.	2019	Queensland, Australia	Survey	National	780
Wadley, D.A.; Han, J.H.; Elliott, P.G.	2019	Australia	Survey	National	780
Wolsink, Maarten	2018	International	Review	Not Applicable	Not Applicable
Wuebben, Daniel	2017	USA	Ethnographic/ survey	Tourist	81

Authors	Year	Country	Method	Target population	Number of Participants
You, Jongeun; Heikkila, Tanya; Weible, Christopher M.; Kim, Serena; Park, Kyudong; Yordy, Jill; Smolinski, Sharon L.	2022	USA	Interview/ review	Local/ professional	43
You, Jongeun; Weible, Christopher M.; Heikkila, Tanya	2022	USA	Review	Local/ professional	Not Applicable
You, Jongeun; Yordy, Jill; Weible, Christopher M.; Park, Kyudong; Heikkila, Tanya; Gilchrist, Duncan	2023	USA	Interview/ review	Professionals	7
Zaunbrecher, Barbara S.; Linzenich, Anika; Ziefle, Martina	2017	Germany	Survey	National	149
Zaunbrecher, Barbara S.; Stieneker, Marco; De Doncker, Rik W.; Ziefle, Martina	2016	Germany	Survey	National	109

The University of Queensland
Professor Tapan Saha
saha@eecs.uq.edu.au

Curtin University
Professor Peta Ashworth
peta.ashworth@curtin.edu.au