Project PRISMED – Process revolution to integrate smart meter electricity data

Independent review of Vector Limited's DPP3 proposed Innovation Project

CONFIDENTIAL

/ DESIGN FOR A BETTER FUTURE

PROJECT NO. 6-P0350.00 / 5 MAY 2023

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Disclaimers and Limitations

This report ('Report') has been prepared by WSP exclusively for Vector Limited ('Client') in relation to preparing an independent report to provide WSP's opinion about whether or not the Client's proposed Innovation Project meets the requirements set out in Schedule 5.3(2)(c) of the Default Price-Quality Path determination in November 2019. The findings in this Report are based on, and are subject to, the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party

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Executive Summary

In WSP's opinion, the proposed Innovation Project meets the requirements set out in Schedule 5.3(2)(c) of the Default Price-Quality Path determination (November 2019).

Vector has developed an Innovation Project and plans to submit an application for the Innovation Allowance provided for under the Default Price-Quality Path determination in November 2019 (DPP3). Vector engaged WSP as a suitable specialist to undertake an independent review of the proposed Innovation Project and to prepare a report stating our opinion about whether or not the proposed Innovation Project meets the criteria set out in the DPP3 Schedule 5.3(2)(c).

Vector's proposed Innovation Project is aimed at developing a new process, or set of processes, that will provide Electricity Distribution Businesses (EDBs) access to near real-time smart meter data and a platform that will facilitate the analysis and use of the data for strategic and operational decision making. The proposed approach is an improvement to the existing processes which require manual handing of data by the Metering Equipment Providers (MEPs), Electricity Retailers (Retailers) and Vector and the frequency of updates is limited.

Vector has set out a schedule and proposed timeframe for implementation of the project and has developed a business case that sets out the high-level cost and qualitative benefits expected from the project.

WSP reviewed the information presented by Vector and also undertook a desktop study of publicly available information regarding the potential for the process to be applied by other EDBs in New Zealand and studies undertaken in Australia regarding the benefits to EDBs of access to smart meter data.

WSP then assessed the proposed Innovation Project against the criteria set out in DPP3 Schedule 5.3(2)(c). WSP's findings for each criteria are shown in Table 1.

Definition / Criteria	Clause	Achieved
The proposed project is an innovation project	Schedule 5.3(2)(c)(i)	✓
Purpose is to deliver electricity line services at a lower cost	Schedule 5.3(2)(c)(ii)A	✓
Purpose is to deliver electricity line at a higher quality of supply	Schedule 5.3(2)(c)(ii)B	✓
Purpose is to deliver electricity line at a lower cost and at a higher quality of supply	Schedule 5.3(2)(c)(ii)C	✓
The proposed project will be of general application to Vector or other EDBs	Schedule 5.3(2)(c)(iii)	✓

Table 1 Summary of the Innovation Project criteria

The WSP team that undertook this assessment meet the requirement of suitable specialists as required by DPP3 Schedule 5.3(2)(d) and CVs have been provided in Appendix A.

1/ Introduction

1.1 PURPOSE

The purpose of this report is to provide WSP's opinion on whether or not the proposed innovation project meets the requirements set out in Default Price-Quality Path determination in November 2019 (DPP3). Specifically, as detailed in Schedule 5.3(2)(c), WSP must identify if:

- the proposed project is an innovation project,
- the purpose of the project is either:
  - delivering electricity lines services at a lower cost to consumers, or
  - delivering electricity lines services at a higher quality of supply to consumers, or
  - delivering electricity lines services at a lower cost to consumers and a higher quality of supply to consumers, and
- the benefits of the innovation will be of general application to the activities of that non-exempt EDB or of other EDBs.

This report assesses the project against these criteria and definitions to explain how WSP's opinion was developed.

1.2 INNOVATION ALLOWANCE

The DPP3 provides an Innovation Allowance that allows EDBs to obtain funding for projects that align with the definition and purpose of an Innovation Project as set out in the DPP3.

The Innovation Allowance is defined as the maximum amount, set by the Commission, which the EDB may draw down upon for costs incurred by that EDB in relation to one or more Innovation Projects. The Innovation Project Allowance for Vector is defined in the DPP3 to be a cumulative amount of $2,022,000 for the period. The allowance does not need to be drawn down upon equally across the years, hence it allows for the lumpy nature of project expenditure.

The contribution from the EDB must be a minimum of 50% of the project cost and will be treated as either capex or opex. However, the recoverable cost (the allowance) will not enter the regulated asset base.

To access the allowance, the EDB must submit an application, that meets specific criteria, no later than 50 days following the end of an assessment period. An assessment period is defined as a 12-month period commencing 1 April and ending on 31 March of the following year. Hence, the application must be submitted on or after 1 April and no later than 20 May each year.

The application requires a report from an independent engineer or other suitable specialist which states that, in their opinion, the project planned by the distributor as evidenced by a published business case meets the Innovation Allowance criteria.

1.3 SCOPE

The scope of this report covers the criteria that are required to be reviewed by the suitable specialist to assess Vector's proposed Innovation Project and provide an opinion on whether it qualifies as an innovation project according to the criteria set out in the DPP3 and supporting regulation.

Specifically, the report will provide WSP's opinion on:

- if the proposed project qualifies as an innovation project.
- whether the purpose of the innovation project is delivering electricity lines services at a lower cost to consumers and / or delivering electricity line services at a higher quality of supply to consumers.
- whether the benefits of the innovation project will be of general application to the activities of Vector or of other EDBs. As expanded in the DPP3 final decisions reasons paper, this includes that the focus of the planned expenditure has a reasonable prospect of being scaled up within Vector or to other distributors if it is successful.

This report provides our opinion of the three items above and commentary to show how we arrived at our conclusions.

1.4 SUITABLE SPECIALIST

The review of Vectors report was complete by suitable specialists from WSP.

WSP is a multi-national engineering firm with specialisation in electricity networks. To complete this review, WSP assembled a small team consisting of:

- Rebecca Tjaberings - BE(Hons), CPEng.
- Raj Chand – BE, CPEng (Institute of Engineers Australia), PMP.
- Michael Van Doornik – BSc/BE(Hons) MAppFin CPEng (Institute of Engineers Australia) CAMA.

Both Raj and Michael have over 15 years each working with electricity networks and cover disciplines of engineering design, network planning, regulation, asset management and economic analysis. These areas of experience and capability are directly relevant to the project proposed by Vector, therefore the team undertaking this review meets the requirements of DPP3 Schedule 5.3(2)(d).

CVs are provided in Appendix A for further details on the team's experience.

1.5 APPROACH

Our approach for reviewing Vector's proposal was to:

- Review the regulations, including the DPP3, Input Methodologies[1], the Commerce Act 1986 along with the DPP3 Final Reasons Paper and other publications and guidance available from the Commission to define the criteria and definitions that must be met by the Innovation Project.
- Undertake a desktop assessment of the business case and supporting models and information provided by Vector.
- Undertake a desktop assessment of the business case and supporting models and desktop investigation into any similar projects undertaken by any other EDBs in New Zealand
- Review of industry documentation and studies related to smart meter data in New Zealand and Australia.
- Prepare a report encompassing our assessment and stating our overall opinion.

Our findings are set out in the following sections.

[1] *Electricity Distribution Services Input Methodologies Determination 2012, Amended as of 20 May 2020*

2/ Innovation Project – Accessing smart meter data

Vector has initiated a project to obtain data from smart meters so they can improve their understanding of the network, in particular the Low Voltage (LV) network.

This section reviews the appropriateness of Vector's asset maintenance programmes and planned (forecast) level of expenditure to enable Vector to manage risk on its network and for each major asset class. Maintenance programmes are also assessed to measure their effectiveness against network performance indicators. This section also reviews the quality and process of asset data collection which is in turn used for decision making.

2.1 BACKGROUND

Vector forecasts significant increases in the number of Distributed Energy Resources (DERs) that will connect to the network and is already observing the beginnings of these trends. DERs include small scale solar PV (ie residential PV systems), battery energy storage systems and electric vehicles. The transition to renewable energy sources is expected to result in electricity displacing fossil -fuel based services, increasing demand on the network.

The DERs will primarily connect to the LV network and are expected to result in changes to peak demand, consumption, timing of electricity use and power flows. Vector currently does not have adequate visibility of the LV network so is not well positioned to proactivity manage the impacts of increasing DER on network capacity and quality of supply.

Visibility of the LV network means having sufficient recent data (preferably near to real time) to understand the power flows and power quality metrics, the ratings of the network assets and protection settings. Combined, these factors will enable Vector to manage the network effectively and make prudent investment decisions.

Vector currently owns the data related to network assets and protection settings; however, network usage data is primarily obtained from smart meters which are owned by the Metering Equipment Providers (MEPs) and Retailers.

To address the existing limitations in obtaining access to the LV network usage data, Vector has developed an Innovation Project that is aimed at developing a new process, or set of processes, that will provide ongoing reliable access to near real-time smart meter data. The project will also establish a platform that will facilitate the analysis and use of the data for strategic and operational decision making.

Vector has identified that obtaining access to smart meter data is the most efficient approach to gathering the necessary data to provide visibility of the LV network. The types of data required are:

- **Interval consumption data** is recorded as peak demand (kW) and consumption (kWh) during a given time period. This data is currently recorded by the smart meters and is available from either the MEPs or Retailers and enables detailed analysis of the network demand at a more granular level than is currently possible.
- **Network Operational Data Services (NODS)** provides information on the power quality (including voltage, current, phase and frequency) and event data (such as outages) at the ICP level. This data will enable Vector to undertake detailed analysis of the network at a more granular level than is currently possible.
- **On-demand meter data** refers to contacting specific meters to extract data for specific time periods. The data obtained will be the same as interval consumption data and NODS. This is a functionality that will enable targeted data gathering by Vector for investigating specific network events.
- **Device data sourced from third parties** such as real-time event data from (privately owned) devices at customer's property such as Chorus' Optical Network Terminal (ONT). This would provide supplementary data that may assist Vector in providing LV network visibility and understanding of network events.

2.2 BARRIERS TO ACHIEVING THE OBJECTIVES

Vector has identified four key barriers to obtaining and using the data to manage the network:

- **Access to the data:** While smart meters have been rolled out across the network since 2008, they are owned by the MEPs. Data is shared between MEPs and Retailers, however, the main obligation for sharing data with EDBs was only established in 2021 by the Electricity Authority. The obligation enabled EDB to formally request access to kWh data via the Default Distributor Agreement (DDA), however this still required Vector to negotiate directly with each retailer individually to establish suitable terms and did not encompass all the data required by Vector.

  'Access to the data' also requires the ability to receive it on an ongoing basis and close to real time. Currently, data has only been provided as one-off data sets and there is no process or system to enable ongoing data transfer.
- **Availability of data:** Currently, there are no established requirements or standards regarding what data is captured, hence smart meters have not typically been configured to capture the NODS data as it is not required by the MEPs or Retailers. However, NODS data is of great value to Vector as it provides the most network information that is essential for effective outage management and planning.
- **Format and structure of data:** There have not been any requirements or standards established regarding the format of the data or how it is structured. Hence the data Vector has received to date has been formatted and structured differently between the Retailers and MEPs.
- **Internal systems:** Vector will need to establish an internal system to combine and store the data and then undertake analytics to derive network insights.

The scope set out in section 2.3 below describes the scope that will address the identified constraints.

2.3 PROPOSED PROJECT SCOPE

The project has been split into three phases, each with their own strategic focus and deliverables as shown in Table 2.

PHASE / TRACK	OUTCOMES
PHASE 1 (FY21-23)	**ESTABLISH FOUNDATION, GAIN ACCESS TO DATA, DISCOVERY & TRIAL, MINIMISE SPEND**
1. Establish DDA	
2. kWh data track	• Establish foundational pathways[2] for the acquisition of kWh data. • Onboard historical data sets from all retailers (from Jan 2017 to present) and establish monthly batch processing. • Build a curated 'whole of network' data repository of kWh data for analytics and use-case support. • Operationalise kWh-based use-cases.
3. NODS data track	• Complete an operational trial of the NODS data sets with both MEPs, carried out on a limited sub-set of the meter fleet. • Complete feasibility analysis of NODS + kWh use-cases.
4. Meter Ping track	• Develop the outage detection use-case based on the ONT data trial and Meter Ping trial with Vector Metering.
PHASE 2 (FY23-25)	**ESTABLISH FOUNDATION, GAIN ACCESS TO DATA, DISCOVERY & TRIAL, MINIMISE SPEND**
1. kWh data track + NODS data track	• Scale from a trial to full-network NODS data supply from MEPs. • Extend data set in line with MEP meter technical upgrade / deployment. • Build a curated 'whole of network' data repository of NODS data for analytics and use-case support. • Move from monthly data delivery to daily data delivery. • Operationalise kWh + NODS based use-cases.
2. Meter Ping track	• Operationalise Meter Ping application & expand to both MEPs. • Scale out additional metering ping use cases.
PHASE 3 (FY26-30)	**ESTABLISH NEAR-REAL-TIME DATA AVAILABILITY**
1. kWh data track + NODS data track	• Move from daily data delivery to near-real-time delivery & shorter integrated periods (e.g., 5 minutes in Australia). • Develop operational use-cases dependent on near-real-time data.

Table 2 Summary of the Innovation Project's scope

[2] *Refers to the initial phase of the Strategic Network Roadmap*

3/ Innovation project

The first requirement is that the project is an 'innovation project'.

An innovation project is defined in the Input Methodologies as:

"...a project that is focussed on the creation, development or application of a new or improved technology, process, or approach in respect of the provision of electricity lines services in New Zealand;"[3]

We have examined the proposed project against the criteria established by this definition. In our assessment we have considered the additional guidance provided by the Commission[4] as part of the Commission's response to Orion's Innovation Allowance application.

3.1 THE DEFINITION OF A 'PROJECT'

The term project is defined in as:

"...a temporary endeavour requiring concerted effort, undertaken to create a defined outcome;"[5]

The scope and project information provided to WSP showed that the proposed scope of work is to be completed over a set period, during which defined outputs have been set. Each phase has a defined timeframe, and the first two phases have defined objectives (outcomes) that are to be achieved.

We recognise that the project does have a long timeframe, however, since it is time-bound we consider that it is consistent with being a temporary endeavour. Given the type of changes to multiple businesses, communications systems and possibly to enabling regulation, a long duration is reasonable.

WSP therefore considers that this is a project, as defined by the DDP3.

3.2 ELECTRICITY LINES SERVICES

The definition of an Innovation Project requires that the project must be for the provision of electricity lines services (ELS). ELS are defined in S54C of the Commerce Act 1986 (the Act) and the Commission has provided guidance on how S54C should be interpreted and applied to assess if a project is within the scope of ELS.

The Commissions guidance set out in a review of the Input Methodologies (IM Review)[6] published in November 2015 was based on answering four key questions that are set out in the following sections of this report with the Commissions test question in bold text.

The Commission's assessment of Orion's Innovation Allowance application was used to provide additional guidance in our assessment of Vector's project.

[3] *Electricity Distribution Services Input Methodologies Determination 2012, Amended as of 20 May 2020., Clause 1.1.1(2) Page 31*
[4] *Email from the Commerce Commission, RE: Commerce Commission/ Vector: Innovation Project overview [CCNZ-IMANAGE. FID334685], 16 September 2022*
[5] *Electricity Distribution Services Input Methodologies Determination 2012, Amended as of 20 May 2020., Clause 1.1.1(2), Page 39*
[6] *Input methodologies review, Emerging technology pre-workshop paper, 30 November 2015*

3.2.1 WITHIN SCOPE OF THE REGULATED SERVICE?

Is what the EDB doing part of the service of conveyance of electricity by line, and not excluded by any of the exceptions listed in s 54C (2)?

WSP's opinion is that the project does form part of the conveyance of electricity by line and it is not excluded by 54C (2). Hence, it is within the scope of regulated services.

The Commission provided the following guidance in the IM Review:

- Clause 62: the definition of 'line' is relevant only to the extent that it describes the nature of the lines service (i.e. what the network is) and not as an exclusion of types of assets from being considered as supporting the regulated service.
- Clause 65: the next test in determining what falls within the scope of the regulated service is whether an asset is "used to provide" or "used to supply" the regulated service (here the service of conveying electricity by line). This test similarly applies to the question of whether an activity forms part of the regulated service, in which case the question is whether the costs associated with that activity are attributable to the regulated service.
- Clause 66: It is important to note that the test is whether the asset is used in providing (or the costs are attributable to) the service, not to whether they are themselves used (or incurred) in the physical conveyance of electricity.

WSP notes that Clause 62 means that supporting systems that are used in the provision of electricity services fall under regulated services. This is further supported by the Commissions statement in their response to Orion's Innovation Application[7] and guidance provided on the definition of 54C[8] where they clarified that costs incurred in supplying ELS are also considered as regulated assets in ELS.

WSP considers the proposed project meets the requirements of Clauses 65 and 66 as the outcome of the proposed project will be used for network management and to improve quality of supply to customers. Hence, the two clauses indicate that it falls within the scope of regulated services.

We also demonstrate in Table 3 that the proposed Innovation Project does not fall under any of the exclusion from ELS covered by 54C (2).

Clause 54C(2)	Services excluded from electricity lines services by 54C(2)	Applies?
a	conveying electricity solely for the supplier's own consumption or for the consumption of the supplier's associates:	No
b	conveying electricity only from a generator to the national grid or from the national grid to a generator:	No
c	conveying electricity (other than via the national grid) only from a generator to a local distribution network or from a local distribution network to a generator:	No
d	conveying electricity by lines that are not connected, directly or indirectly, to the national grid:	No
e	conveying electricity only by a line or lines that are mostly in competition with a line or lines operated by another supplier of electricity lines services that is not an associate of the person, provided that the competition is actual competition and not potential competition:	No
f	conveying electricity if the total circuit length of all of the prescribed voltage electric lines provided by the supplier (or over which electricity is conveyed by the supplier, as the case may be) is less than 25 kilometres:	No
g	conveying electricity if the total amount of electricity conveyed to consumers by the supplier is less than 20 gigawatt hours per annum:	No
h	conveying electricity if the total number of consumers to whom the supplier conveys electricity is less than 500.	No

Table 3 Services excluded from ELS by 54C (2)

[7] *Commerce Commission, RE: Orion Innovation Allowance Application June 2021, letter dated 21 December 2021*
[8] *ibid. Attachment: Guidance on s 54C definition of 'electricity lines services' under Part 4 of the Commerce Act, Clauses 9, 12 and 13.*

3.2.2 TREATMENT OF CAPITAL COSTS

Is the asset used for the service of conveyance of electricity by line? If so, how are the capital costs associated with this investment treated?

Section 3.2.1 demonstrates that the asset is used for the service of conveyance of electricity by line.

Vector has confirmed that the capital costs, excluding any Innovation Allowance received, will be treated the same as other capital costs incurred for the regulated network. The capital costs will be included in the Regulated Asset Base and recovered from customers through tariffs on regulated electricity lines services.

3.2.3 TREATMENT OF OPERATING COSTS

Are the operating costs attributable to the service of conveyance of electricity by line? If so, how are the operating costs associated with this investment treated?

Section 3.2.1 demonstrates that the operating costs of the Innovation Project are attributable to the service of conveyance of electricity by line.

Vector has confirmed that the operating costs, excluding any Innovation Allowance received, will be treated the same as other operating costs incurred for the regulated network and recovered from customers through tariffs on regulated electricity lines services.

3.2.4 TREATMENT OF REVENUES

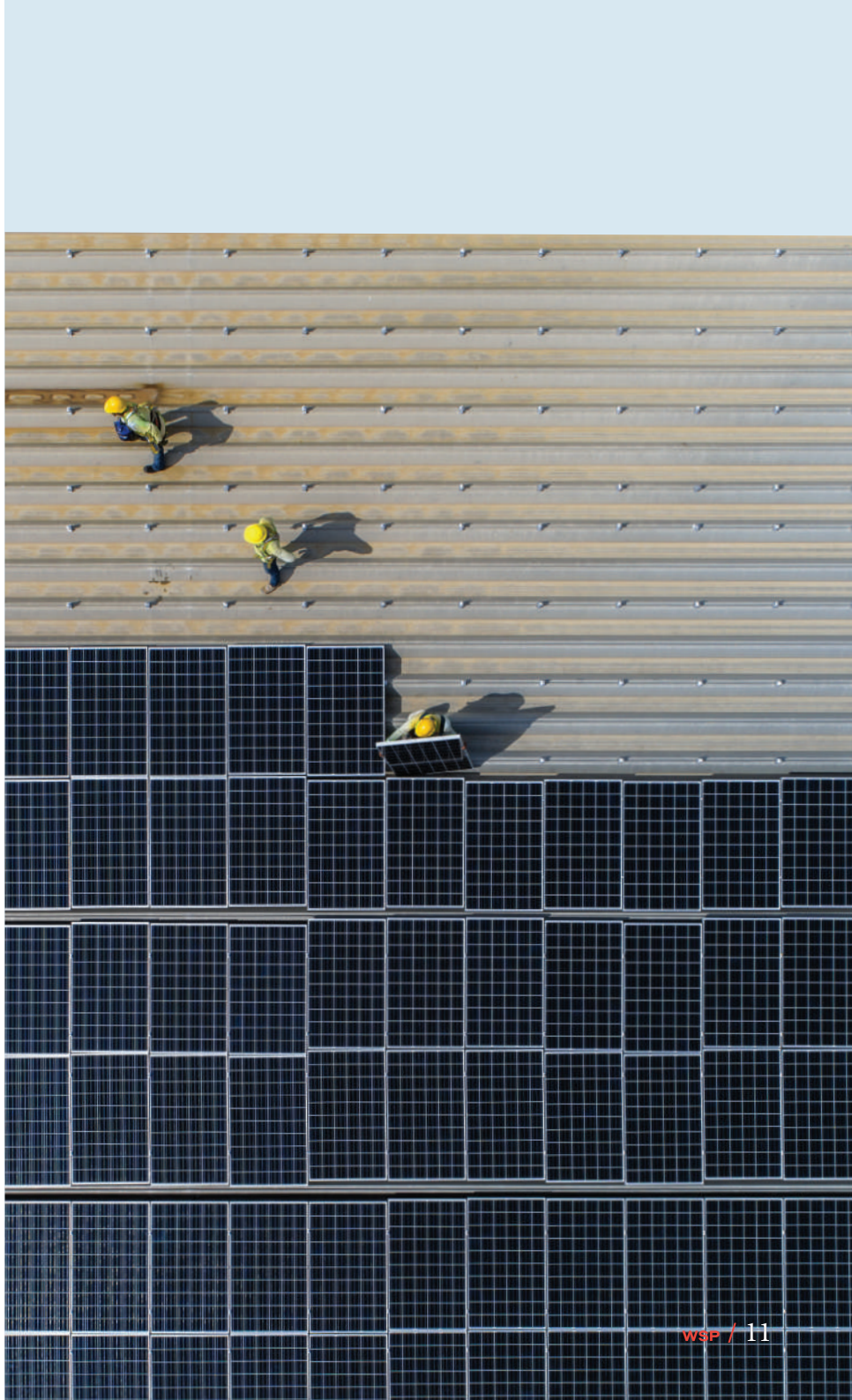
Are the revenues attributable to the service of conveyance of electricity by line? If so, how are the revenues associated with this investment treated?

Section 3.2.1 demonstrates that the asset is used for the service of conveyance of electricity by line, hence revenues are attributable to the service of conveyance of electricity by line.

Vector has confirmed that there are no non-regulated revenues that are expected to be received because of the proposed Innovation Project. All revenues will be received through the electricity tariffs on regulated electricity lines services.

3.2.5 SUMMARY OF THE ELS ASSESSMENT

Following assessment of the project against the test set out by the Commission for ELS and supported by additional guidance by the Commission and findings related to the Orion Innovation Allowance application, WSP's opinion is that the project proposed by Vector falls within the definition of Electricity Lines Services.



3.3 A NEW OR IMPROVED TECHNOLOGY, PROCESS, OR APPROACH

The definition of an Innovation Project also requires that it is related to a new or improved technology, process, or approach. A process is defined in the Oxford Dictionary as *'a way of dealing with somebody/something; a way of doing or thinking about something such as a problem or a task' and a process is defined as 'a series of things that are done in order to achieve a particular result'.*

WSPs review of Vector Innovation Project has found that it will establish a new way of addressing a task by implementing new processes (through ICT) to achieve an outcome. Specifically the project will establish automated processes that will:

- Collect smart meter data from multiple retailers and MEPs.
- Combine the data and store it in a structured database.
- Run on a set schedule, starting monthly and scaling up until it is near real-time or at an optimal frequency.
- Incorporate non-network devices into the model which will enrich the data set.

An analytical platform is also planned to automate analysis of the large data set for operational and strategic decision making. It will also provide a platform for continued innovation.

As set out in the project overview in section 2, the required processes do not currently exist as Vector has not been able to apply an existing process or approach to obtain the data in the format, structure and frequency that is required. Hence, WSP considers that the proposed scope of works meets the criteria of establishing a new process or approach that is required by the definition of an Innovation Project.

3.4 CONCLUSION

In WSP's opinion, the proposed project meets the definition of an Innovation Project as:

- It meets the definition of a project as it is a temporary endeavour to achieve a defined outcome.
- WSP's assessment against the S54C of the Commerce Act 1986 (the Act), including applying guidance from the Commission, found that the scope of the project is fully within the scope of regulated services and the provision of electricity lines services.
- Vector has demonstrated that there is no existing process or approach to enable access to the data at the frequency of updating (near real time) required. Hence, this meets the criteria of being a new process or approach.

4/ Purpose of the innovation project

> **The DPP3 Schedule 5.3(2)(c)(ii) A to C requires that the purpose of the Innovation Project is to deliver electricity lines services to consumers at a lower cost, a higher quality of supply or both a lower cost and higher quality of supply.**

The Commission has clarified in their correspondence[9] that detailed modelling of cost savings in not required for an Innovation Allowance application. Therefore, WSP has applied a high-level review of benefits based on both quantitative modelling and qualitative justifications provided by Vector, with consideration given to WSP's experience with other electricity businesses and publicly available studies.

WSP has considered these criteria and our assessment is presented below. Our assessment considers the information provided by Vector and our independent analysis based on a case study of smart meter experience in Australia to assess the benefits to customers in terms of cost and quality of supply.

4.1 VECTOR'S USE CASES

Vector has established nine use cases that show how benefits will be realised. WSP has reviewed these use cases based on our experience with other EDBs and publicly available studies and analysis.

In Table 4 we have summarised each of the use cases, identified if they will help achieve delivery of electricity line services at lower cost and/or higher quality of supply, and provided a reference to a section below the table that describes our reasoning.

	Vector use case	Lower cost	Higher quality	Reasoning for assessment
1	**ICP connectivity:** ICP-transformer and ICP-phase mapping to enhance connectivity model	✓	✓	Refer to Section 4.1.1
2	**Transformer loading:** Transformer, LV Feeder and LV Phase loading visibility for network planning	✓	✓	Refer to Section 4.1.1
3	**New customer connections:** New connections based on visibility of transformer loading (no loggers)	×	×	Refer to Section 4.1.3
4	**DER hosting capacity:** Visibility of transformer voltage and loading headroom to increase DER hosting capacity	✓	✓	Refer to Section 4.1.2
5	**Customer outage visibility:** Visibility of outages at individual ICP level	✓	✓	Refer to Section 4.1.1
6	**DER identification:** Visibility of unregistered DERs	✓	✓	Refer to Section 4.1.2
7	**Customer and market analysis:** Visibility of consumption to enable insights	×	×	Refer to Section 4.1.3
8	**Public safety:** High impedance fault detection to improve safety	×	✓	Refer to Section 4.1.1
9	**Load control:** Targeted load control using calendar function to manage peak demand	×	✓	Refer to Section 4.1.2

Table 4 Summary of benefits from use cases

[9]Email from the Commerce Commission, RE: Commerce Commission/ Vector: Innovation Project overview [CCNZ-IMANAGE.FID334685], 16 September 2022

4.1.1 OBSERVED BY WSP AT OTHER ELECTRICITY BUSINESSES

Electricity businesses in Victoria, Australia, have had full access to smart meter data since the roll out of smart meters was mandated by the state government. These businesses have developed systems that provide visibility to the granularity of individual ICPs and compiles the data based on the network model to identify network issues including unbalanced phases or overloaded distribution transformers.

Understanding these constraints will enable Vector to efficiently manage the network through actions such as phase balancing to remove constraints, undertaking proactive replacement or augmentation to address overloads and avoid an unplanned outage, or more rapidly identifying the extend of an outage to reduce overall outage duration.

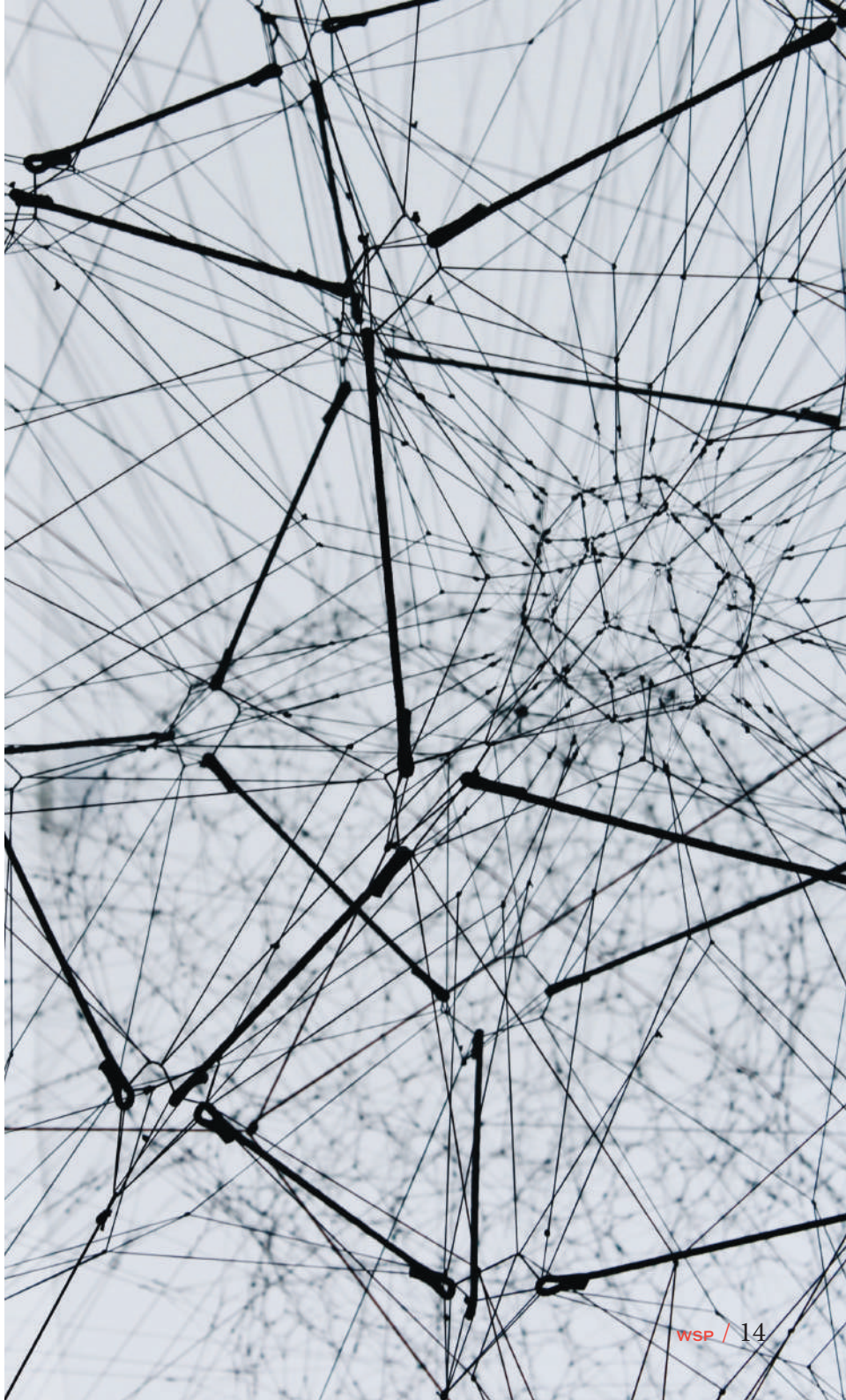
Based on these observations, WSP considers that these use cases are likely to enable delivery of electricity lines services at lower cost and/or higher quality of supply.

4.1.2 SUPPORTED BY FUTURE NETWORKS STRATEGIES AND ANALYSIS

In New South Wales, Australia, the electricity businesses are in a similar position to Vector where they do not own the meters or have access to the smart meter data. These businesses have recently submitted their regulatory proposals for the 2024-29 regulatory period to the Australian Energy Regulator (AER). The regulatory proposals are similar in nature to the Customise Price Path (CPP) in New Zealand and set out and justify the capex and opex (and therefore revenue) required for the 5-year regulatory period.

As part of the regulatory proposals, the businesses have published strategies and business cases that demonstrate the benefits that can be achieved by using network data (HV, LV and smart meter data) to inform network management and operations. They identify benefits of:

- deferred augmentation, operational expenditure reductions and reduced losses (lower cost to customers)
- reliability improvement and voltage regulation (higher quality of supply to customers)
- safety improvements.



In Essential Energy's business case[10], the cost of implementation includes acquisition of smart meter data, and the implementation is planned for a ten year period, so it reflects a similar scope and scenario to Vector. There is a cost to customers to implement the systems, but the business case identifies a net benefit from enabling more customers to connect DERs, deferring the cost of augmentation through improved management of exports and loads, and reducing ongoing opex. These benefits are consistent with the use cases identified by Vector.

Ausgrid also set out in their submission[11] their proposed approach to managing the network and DERs. A core element of the proposed approach included acquisition of smart meter data which made up approximately 20% of the expenditure forecast for the project. The proposed approach was found to result in the highest NPV – meaning the highest net benefit based on economic benefits to customers.

WSP's review of publicly available information regarding the projects being implemented by electricity businesses in Australia found that they had identified the project to have a net positive benefit to customers. Based on the similarity of Vector's use cases and proposed scope, WSP considers that expenditure to acquire smart meter data is a critical step to implement systems that will likely result in a net benefit to customers through the lower cost and higher quality of supply of electricity.

[10]Essential Energy, 10.05 Future Network Business Case Overview, January 2023
[11]AusGrid, 2024-29 Regulatory Proposal, 31 January 2023, Section 5.7

4.1.3 UNLIKELY TO HAVE A DIRECT IMPACT ON COST OR QUALITY OF SUPPLY

WSP considers that, based on the information provided by Vector and the description of the objectives, use cases 3 and 7 are unlikely to result in a direct impact on lowering cost or improving quality of supply for customers . However, we note that these items are likely to promote an improved experience for customers. Additional analysis may be able to quantify any benefits.

4.2 VECTORS COST BENEFIT ANALYSIS

4.2.1 COSTS AND BENEFITS

In correspondence with Vector[12], the Commission clarified that the Innovation Allowance Application is intended to be a low-cost mechanism and that detailed modelling of cost savings is not required.

Vector has demonstrated that the cost of acquiring data from the MEPs and Retailers has a lower net present cost compared to the alternative option of deploying meters on distribution transformers across the network. The analysis was undertaken based on three levels of deployment of distribution transformer meters compared to data acquisition. The alternative options were constructed on a similar basis to a report for the ENA by Sapere[13] and used cost assumptions and methodologies based on Vectors assumptions and studies published by Sapere and South Australia Power Networks. The analysis found that in all cases the acquisition of data had a lower net present cost.

In addition, a qualitative assessment of the applications and analysis that can be undertaken using smart meter data and transformer metering was completed. The assessment indicated that in all cases the smart meter data enables the implementation of all Use Cases whereas the transformer data is limited to only fully enabling a third of the use.

[12]Email from the Commerce Commission, RE: Commerce Commission/ Vector: Innovation Project overview [CCNZ-IMANAGE. FID334685], 16 September 2022
[13]Sapere, Business Case for Investment in Low Voltage Network Monitoring – Prepared for the Electricity Networks Association, November 2020

4.2.2 TIMING OF BENEFITS

Timing of benefits to consumers, both reduction in costs and improvements to quality of supply, are not likely to be achieved in DPP3 as Vector needs to implement the data acquisition processes, scale them to achieve the optimal frequency and develop the platform and tools to derive the insights from the data. As a result, Vector has stated that they do not expect to obtain full benefits from the project until DPP4.

In correspondence with Vector[14], the Commission has stated that the realisation of financial saving in DDP4 is not an issue and continued to state that '...due to the nature of innovation we expect, in some cases, that the full benefit of an investment may take a longer period to fully materialise...'.

[14]*Email from the Commerce Commission, RE: Commerce Commission/ Vector: Innovation Project overview [CCNZ-IMANAGE. FID334685], 16 September 2022*

Based on this guidance, WSP considers that the delay to realising benefits does not impact the assessment and the purpose of the Innovation Project is still considered to be achieving a lower cost and/or improved quality of supply, consistent with the Innovation Allowance criteria.

4.3 CASE STUDY OF EXPERIENCE IN AUSTRALIA

In November 2022, the Australian Energy Market Commission (AEMC) published a draft report on its review into the regulatory framework for metering services. The review assessed whether expectations are being met and identified any changes that may be required to improve efficiency and effectiveness[15].

While the report is focused on the how metering services are regulated and structured in the Australian context, it provides useful insight into how smart meters benefit customers.

In particular, the review identifies that *'Smart meters benefit individual consumers and the energy system as a whole'*[16] *and that '...the data and information provided by smart meters allow DNSPs Distribution Network Service Providers to improve their management of customer outages and, more generally, provide greater visibility of the low voltage (LV) network'*[17] . Further, the AEMC found that:

> *'Smart meter data enables DNSPs to make better investment and operational decisions that could support more CER*[18] *connections and potentially delay or remove the need for augmentation. This, in turn, allows for improved utilisation of network assets – which means higher productivity and lower average network costs for all customers.'*[19]

However, the AEMC caveated these finding by stating that *'a crucial enabler of smart meters providing more services is the access and exchange of power quality data they provide. Many of these benefits – and the services required to deliver the benefits – require consistent access to smart meter data'*[20]

The AEMC review clearly supports that access to smart meter data will enable benefits to customers through reduced costs through improved investment decision and improved quality of supply through improved operational decisions.

In WSP's opinion, this report by the AEMC supports that the proposed Innovation Project will deliver the benefits required by DPP3 Schedule 5.3(2)(c)(ii) C.

4.4 CONCLUSION

In WSP's opinion, the proposed Innovation Project has been demonstrated to comply with DPP3 Schedule 5.3(2)(c)(ii) and has the purpose of providing electricity lines services at a lower the cost and improved quality of supply for customers.

[15]*AEMC, Review of the regulatory framework for metering services, Draft report, 3 November 2022*
[16]*ibid, Clause 7*
[17]*ibid, Clause 8*
[18]*Customer Energy Resources. This is another term for Distributed Energy Resources (DER)*
[19]*AEMC, Review of the regulatory framework for metering services, Draft report, 3 November 2022, Clause 9*
[20]*ibid, Clause 41*

5/ General application of the project

The DPP3 Schedule 5.3(2)(c)(iii) requires that the 'benefits of the innovation project will be of general application to the activities of that non-exempt EDB or of other EDBs'.

This statement was further clarified by the Commission in the DPP3 Final Decision Reason Paper, that the requirement is satisfied if

> *'the focus of the planned expenditure has a reasonable prospect of being scaled up within the EDB or to other distributors if it is successful, i.e., the benefits are of general application to that distributor or other distributors'.*[21]

To assess this criterion, WSP reviewed the extent of smart meter roll out across New Zealand and the structure of meter ownership and the barriers that is likely to present.

WSP found that 83% of all residential connections in New Zealand have smart meters.[22]

The Electricity Industry Act 2010 establishes restrictions regarding ownership of distribution networks and meters, specifically that they must be operated as separate businesses, are termed Metering Equipment Providers or Metering Equipment Owners, and are defined as Industry Participants. The Electricity Authority states that all electricity industry participants are bound by the Privacy Act 1993 and that the Electricity Industry Participation Code 2010 requires the MEP to protect the consumption information of customers, ensuring it is only provided to authorised persons. Therefore, the barriers to sharing data described in section 2.2 are likely to be present for other EDBs.

Regarding the application to other EDBs, WSP reviewed a recent Innovation Stocktake completed by the ENA that provided an overview of the innovative projects being undertaken by EDBs across New Zealand. The projects are varied, but there is a common theme amongst many about obtaining LV visibility and improved network data for better decision making and network control.

Therefore:

- the extent of the smart meter rollout means that most EDBs will have a high proportion of customers with smart meters, making the data useful to the network,
- given the same barriers are likely to be present, the process and approach established by the proposed Innovation Project has a reasonable prospect to be of general applicability to other EDBs, and
- other EDBs are likely to be able to derive similar insights as Vector and achieve similar cost savings and improvements to quality of supply, through analysis of the smart meter data once the data is available. Hence, the proposed Innovation Project will be beneficial to other EDBs.

Therefore, in WSP's opinion, the proposed Innovation Project meets the requirements of DPP3 Schedule 5.3(2)(c)(iii) and supporting guidance by the Commission.

[21] *Default price-quality paths for electricity distribution businesses from 1 April 2020 – Final decision, Reasons Paper, 27 November 2019, Clause F23.4*
[22] *Electricity Authority website, www.ea.govt.nz/consumers/what-are-electricity-meters*

6/ Conclusion

In WSP's opinion, the proposed project meets the requirements set out in Schedule 5.3(2)(c) of the Default Price-Quality Path determination (November 2019). Specifically, in WSPs opinion:

- The proposed project has been demonstrated to comply with DPP3 Schedule 5.3(2)(c)(i) to meets the definition of an Innovation Project:
  - It meets the definition of a project as it is a temporary endeavour to achieve a defined outcome.
  - WSP's assessment against the S54C of the Commerce Act 1986 (the Act), including applying guidance from the Commission, found that the scope of the project is fully within the scope of regulated services and the provision of electricity lines services.
  - Vector has demonstrated that there is no existing process or approach to enable access to the data at the frequency of updating (near real time) required. Hence, this meets the criteria of being a new process or approach.
- The proposed Innovation Project has been demonstrated to comply with DPP3 Schedule 5.3(2)(c)(ii) as it has the purpose of providing electricity lines services at a lower the cost and improved quality of supply for customers.
- The proposed Innovation Project meets the requirements of DPP3 Schedule 5.3(2)(c)(iii) and supporting guidance by the Commission.

The WSP team that undertook this assessment meet the requirement of suitable specialists as required by DPP3 Schedule 5.3(2)(d) and CVs have been provided in Appendix A.

Appendix A

Team Summary

A1 Team Members/ REBECCA TJABERINGS

REBECCA TJABERINGS

PROJECT DIRECTOR / QUALITY ASSURANCE

Rebecca leads the Power business in New Zealand, working across generation, transmission and distribution. Rebecca's 23 years' of experience has included 15 years in the power industry in both consulting and project management roles. Rebecca has had a significant focus on renewable energy development and in asset management within the network industry.

Rebecca has assisted with the development of future network strategies, carried out reviews of asset management performance and practices, developed asset management plans and supported the development of business cases for capex / opex expenditure. She has also carried out regulatory reviews and audits.

EDUCATION

- Bachelor of Engineering (Mechanical) (Hons.), University of Birmingham, UK 1998

PROFESSIONAL ASSOCIATIONS

- Chartered Professional Engineer CEng
- Member, Institute of Mechanical Engineers MIMechE

PROFESSIONAL EXPERIENCE

Asset Management / Regulatory

- **State of the Network Review (2022, 2020), Vector, Project Director.** The WSP team carried out an independent review focused on the effectiveness of Vector's processes that support operational risk management for Vector's electricity network. Review included maintenance practice, network growth, capacity and security, risk management, data quality and asset management.
- **Customised Price Path Regulatory Disclosures (2022), Aurora Energy, Project Director.** WSP provided review of new documentation required by Commerce Commission for Aurora's CPP. The review was to provide assurance to the board that all requirements had been addressed.
- **Future Networks Measures (2021), Electricity Networks Association, Project Director.** WSP provided insights and advice for measures for network efficiency, decarbonisation and future networks indicators including use of global case studies.
- **Asset Management Support (2020). Vector, Project Director / Senior Consultant.** WSP provided general advice to Vector for improvements to asset management practice. We have assisted Vector in the development of their asset management plan, with a focus on network asset health, replacement and renewals, network growth and strategy development.
- **Technical Quality System development (2020-ongoing), Mercury, Senior Consultant.** Currently providing support to Mercury to develop a Technical Quality framework that spans across Hydro and Geothermal assets and gives consistency to the quality practices in the business. Includes the development of Quality processes and supporting documentation to include the complete development lifecycle.
- **Customised Price Path support, New Zealand (2019-2020), Aurora Energy, Senior Consultant.** Provided support to Aurora as they pulled together their CPP submission for submission to the Commerce Commision, through identification of gaps / weaknesses in the submission and support to close these gaps. We have also provided adhoc support to Aurora through the submission process.

A1 Team Members/ REBECCA TJABERINGS

- **Independent Review of State of Infrastructure, Dunedin, New Zealand (2018), Aurora Energy / Commerce Commission, Project Director.**
  WSP was engaged to carry out an independent review of the infrastructure in the Aurora network, in order to develop a risk profile for the network and provide prioritisation for future expenditure. Review included asset inspections, asset data analysis, staff interviews and development of the risk profile. Assessment of resilience, network performance and asset health were all considered.

- **Asset Management support, New Zealand (2018 -2019), Mainpower, Project Director.**
  WSP provided support to Mainpower on improving asset management practice in the business. This commenced with a ISO55001 assessment to highlight gaps.

- **Asset Management Plan development, Christchurch, New Zealand (2018), Orion, Project Manager.**
  Provided support and guidance to Orion on the improvements of their AMP for 2019, including drafting of sections and guidance to the AMP development team.

- **Default Price Path Reset Support – Asset Management Plan, Christchurch, New Zealand (2018), Orion, Senior Consultant.**
  Review of the 2018 Asset Management Plan against Information Disclosure requirements, expenditure objectives and best practice. Aim to ensure that the AMP supports Orion as they move towards Default Price Path reset.

- **Asset Management Plan revitalisation, Auckland, New Zealand (2017-18), Vector. Senior Consultant.**
  Providing asset management support, guidance and mentoring to staff. Assisting with review, drafting and development of Asset Management Plan material and supporting in project managing the development of the plan.

- **Asset Management Review, New Zealand (2017), Northpower. Consultant.**
  High level review of approach to asset management for network assets, consideration of alignment with ISO 55000. Included desk top review of documents and information, interviews with key staff and client feedback.

- **Asset Age / End of Life Assessment, Vic, Australia, (2015/16), United Energy. Consultant.**
  Assisted in establishing the status of asset age profiles and the impact of assets nearing the end of life on network performance, failures and defects. Provided report showing end of life trends and discussing how this is incorporated into Asset Management Strategies and used to forecast future replacement capex.

- **Asset Management IT Expenditure Review, Vic, Australia, (2015), United Energy. Consultant.**
  Led workshops for the review of IT expenditure included in the pricing submission to the Australian Energy regulator. Confirmed capex and ongoing opex costs for several IT initiatives and focused on establishing the business needs for effective management of the network assets and alignment with the regulator assessment process. Provided recommendations to strengthen project justification.

- **Future Networks Strategy, Vic, Australia, (2014), United Energy. Consultant.**
  Assisted with strategy development and writing of strategy paper required for the pricing submission. Strategy focused on changes required in the distribution network as a result of emerging technologies (solar PV, energy storage, electric vehicles) and changing customer behaviours. This document highlighted strategic focus areas and related initiatives.

Regulatory Compliance

- **Independent audit of the Regulatory Information Notice Non-Financial Information, Queensland, Australia, (2015), Ergon Energy. Consultant.**
  Audited the information required to be supplied to the Australian Energy Regulator. Involved interviewing staff, data analysis and reporting.

- **Independent review and audit of Power and Water Corporation regulatory compliance framework, Darwin, NT, Australia, (2015), Utilities Commission. Consultant.**
  Desk top review of compliance process and reporting against AS 3806-2006.

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- **Independent audit of the Reset Regulatory Information Notice Non-Financial Information, Melbourne, Vic, Australia, (2015), AusNet Electricity Services. Consultant.**
  Audited the information required to be supplied to the Australian Energy Regulator for the Augex model. Involved interviewing staff, data analysis and reporting.

- **Independent audit of the Regulatory Information Notice Non-Financial Information, Melbourne, Vic, Australia, (2015), AusNet Electricity Services. Consultant.**
  Audited the information required to be supplied to the Australian Energy Regulator. Involved interviewing staff, data analysis and reporting.

Renewable Power Development

- **Ruakākā Battery Energy Storage System (BESS) Balance of Plant Design, Meridian, NZ, Project Director (2022 – ongoing)**
  WSP are providing the full Balance of Plant design for a 150MW / 150 MWh BESS including concept and detailed design of civil, electrical and buildings. Rebecca provides oversight and direction to the project, ensuring the clients sustainability goals are met and the team delivers designs on programme.

- **NZ Battery Feasibility Study, MBIE, NZ, Project Director (2021- 2022)**
  Options assessment and feasibility study for a dry year storage solution for NZ, including geothermal, hydrogen, bioenergy, flow batteries and compressed air. Rebecca provided direction to the team, participated in all client workshops, review of all deliverables and was a key point of contact for the MBIE team.

- **Independent Engineer, Waipipi Wind Farm, New Zealand (2019 - 2021), Project Director**
  WSP carried out design reviews, monitored construction, attended project meetings and provided regular reporting to Lenders. As part of this we monitored the project expenditure, programme and provided Cost to Complete certification.

- **Technical and Portfolio Due Diligence, Tilt Renewables Assets, New Zealand (2021), Confidential Client, Project Director**
  Full technical due diligence for all Tilt Renewables operational and development assets in New Zealand and Australia for a bidder in the sale of the business. Included Geotech, civils, structural, electrical, environmental, wind energy yield and decommissioning, as well as inputs to the financial model.

PROFESSIONAL HISTORY

– WSP	2011 –	Present
– Genesis Energy	2007-2011	
– Fisher & Paykel	2006-2007	
– BAE Systems	1998-2005	

A2 Team Members/ RAJ CHAND

RAJ CHAND

PRINCIPAL ENGINEER, ELECTRICAL

Raj is a chartered professional electrical engineer (CPEng) and PMP certified project manager. He has been responsible for delivering complex projects in the power sector in New Zealand, Australia and United Kingdom across a number of industries including transmission and distribution, transportation and heavy industrial.

In addition to technical engineering design, Raj also provides strategic advisory services to several clients in the power sector in relation to regulation, due diligence, risk analysis, business case development and asset management.

EDUCATION / TRAINING

- Bachelor of Engineering (BEng) Electrical and Computer Systems, University of Auckland, New Zealand 2006

PROFESSIONAL ASSOCIATIONS

- Chartered Professional Engineer, Engineers Australia, Australia CPEng
- National Professional Engineers Register, Australia NPER
- APEC Engineer, Australia APEC
- Institute of Engineering and Technology UK MIET
- International Council on Large Electric Systems Cigre
- Project Management Professional PMP

PROFESSIONAL EXPERIENCE

Advisory

- **Vector, Auckland, New Zealand 2018-ongoing**
  On-going support with asset management and project teams within Vector. Provision of regulatory compliance advice – details confidential.
- **DNO pricing methodology, Counties Energy, Auckland, New Zealand 2022**
  Part of multidisciplinary team tasked with assessing tariff pricing to encourage distributed energy resources (DERS) on the Counties Energy network.
- **CPP information disclosure review, Aurora Energy, Dunedin, New Zealand 2022**
  Technical reviewer for an independent review for information disclosures relating to CPP submissions.
- **ENA future networks measures, ENA, New Zealand 2022**
  Independent report to the ENA group advising of regulatory network measure for future network challenges based on international case studies.
- **Transpower, Auckland, New Zealand 2016-2018**
  Part of multi-disciplinary team formed to produce an enduring blueprint for the transmission system in Auckland and deliver high-profile customer projects in the region. Refer to: https://www.transpower.co.nz/sites/default/files/publications/resources/AKLDEmergingStrategy.pdf
- **State of the Network report Vector, Auckland, New Zealand 2020 & 2022**
  Author of Vector's State of the Network report produced on behalf of Entrust. The report assessed and reported on the adequacy on Vector's asset management practices and the prudency and efficiency of its capital and operational expenditure in relation network performance.

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- **Independent report on network, Aurora Energy, Dunedin, New Zealand 2018**
  Part of a multi-disciplinary team assessing the Aurora Energy's network performance and asset management practices on behalf of the regulator (Commerce Commission). https://www.auroraenergy.co.nz/about/independent-review/

- **Barangaroo Engineering Audit, Lend Lease, Sydney, Australia, 2015**

- November 2015 Lead Engineering Auditor. Conducted independent internal engineering audits on the MV reticulation design, switchgear assessment and protection review for the Barangaroo building project in Sydney.

- **Ausgrid Engineering Audit, Ausgrid, Sydney, Australia, 2012 –2014**

- Lead Engineering Auditor. Conducted independent internal engineering audits on engineering planning, design and processes on various departments within Ausgrid. Outcome was an audit report where areas for improvement were highlighted and recommendations were made for applying industry best practices where needed.

- **Auckland Airport Tariff Review, Auckland International Airport, Auckland, New Zealand, 2007 – 2009**

- Part of the consulting team working with Auckland Airport senior management to annually review and produce the asset management plan and strategic vision report for the embedded 33 kV/11 kV network. Tasks included assessing the condition of assets, reviewing the value of assets, network costs, income streams and the returns on current and the forecasted levels of invested capital. Short, medium and long term development plans for the network was assessed against the impact on returns, network load forecast and network capacity. This on-going project also involved an evaluation of the electricity network tariff to ensure the network remains competitive in industry. This involved an audit of business revenue, cost streams and rates of return against industry guidelines and a full review of the tariff levels and structure. Assistance was also given to the client during the implementation stage and involvement in the consultation with stakeholders.

Asset Management

- **Asset Forecasting Modelling, Northpower, Northland, New Zealand 2022**
  Review of asset models for five asset classes. Work included checking inputs, assumptions and integrity of models based on survivor curves.

- **Asset Forecasting Modelling, Vector, Auckland, New Zealand 2020**
  Review of CBARM asset models. Work included checking inputs, assumptions and integrity of models and recommending improvements.

- **Transpower, Auckland, New Zealand 2016-2018**
  Contribute to the development and integration of asset management plans for substations and cables asset portfolios, including capital expenditure (CAPEX) and maintenance operational expenditure (OPEX)
  Use whole of life cost principles to develop business cases for the substation and cables asset portfolios.
  Oversee and direct the development of business cases and on asset expenditure for approval.

Project and design management

- **Hamilton substation 110 kV circuit breaker and bus protection replacement, Hamilton, New Zealand, 2016 –2018**
  Total project value: $ 6M (NZD) Technical Lead Engineer for major substation upgrade at Hamilton substation from design to commissioning. The project involved replacing all 110 kV bulk oil circuit breakers with modern disconnecting circuit breakers and replacing the existing low impedance bus protection with a duplicate high impedance bus protection scheme.

- **Waikato and Upper North Island Voltage Management Project, Auckland, New Zealand, 2016 – 2018**
  Total project value: $ 100M+ (NZD) Project Engineer for a voltage stability improvement project in the Waikato and Upper North Island region. The project involved installing static and dynamic reactive plant at multiple sites including New Zealand's first 400 kV series capacitor installation. This role involves collaborating with equipment manufacturers, consultants and internal project stakeholders.

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- **Cobram 66/22 kV substation and site HV upgrade, Murray Goulburn Cooperative, Victoria, Australia, 2014 –2015**
  Total project value: $ 12 M (AUD) Design Manager for a major infrastructure upgrade at the Cobram diary processing plant. This was an owner's engineer role and included all conceptual and detailed design to produce an Engineering Procurement Construction (EPC) contract what was issued to the market for competitive tender. This role included producing, budgetary estimates, switchboard schematics, protection and instrumentation diagrams, substation layouts, Transformer Management System (TMS) panel design, Fire protection specification, LVAC design, DC system and battery banks, switchroom building, Ring Main Unit (RMUs), SCADA design (IEC 61850) and all equipment and testing/commissioning specifications. The project involved design coordination with civil, structural, environmental engineer as well as other external project stakeholders.

- **TraCa Alliance, Ausgrid, Sydney, Australia, 2011 –2012**
  Total project portfolio value: $ 32 M (AUD). Design Delivery Manager responsible for the design and delivery of multiple 132 kV underground cable connections within New South Wales. This role involves managing multi-disciplinary design teams and construction managers to deliver projects from a conceptual design to the construction stage. The role involved a strong focus on managing the interface between the client and the design team. Risk management, business development, process optimisation, safety in design, resource management, construction support, project budget, monitoring and reporting was also part of this position. Other responsibilities include resource management, staff performance reviews, mentoring and professional development of junior staff

Primary system design

- **Rozelle Interchange, Sydney, Australia 2019-onoing**
  Lead HV engineer on one of the world's most complex road tunnel projects. Involves 22 above and below ground 33 kV substations.

- **City Rail Link Auckland, New Zealand 2019-onoing**
  Lead HV engineer for the 22 kV stations reticulation. Design manager for Traction Power supply.

- **Kawrau substation 110 kV site development, Kawrau, New Zealand, 2016**
  Technical Lead Engineer for an investigation project that produced a staged development plan for the ultimate 110 kV bus layout at Kawrau substation. Challenges including optimising the site development path to allow for gradual and modular construction whilst remediating existing safety issues and site constraints.

- **Ross-on-Wye 400 kV Upgrade, National Grid, Wales, UK, 2009 –2011**
  Lead Substation Engineer for a 400 kV cable sealing end compound upgrade consisting of OHL gantries, surge arrestors, earth switch disconnectors, cable terminations, protection relay room and ancillary equipment. Project involves an upgrade of a double circuit mid-line 5km cable section from one core to two cores per phase and subsequent augmentation at the cable sealing end compounds. Tasks included conceptual to detailed design of substations including the production of technical tender documents, construction programming and managing a multi-disciplinary project delivery team. Responsibility also extended to include cables thermal rating calculations and cable crossing design for a 50 m river crossing using horizontal directional drill.

- **Baglan Bay 275 kV Upgrade, National Grid, Wales, UK, 2009 –2011**
  Lead Substation Engineer for a 275 kV cable sealing end compound upgrade. Feasibility study and conceptual design for primary equipment layout at 275 kV cable sealing end compounds to accommodate new switch-gear and safety regulations. Tasks included, design, equipment specification, design report and cost estimates.

- **Hume Coal Mine Options Study, Hume Coal, New South Wales, Australia, 2013 –2014**
  Senior Electrical Engineer. Responsible for the critical review of the feasibility study design and high voltage systems design in the options study phase of the coal mine development. Tasks included liaison with electricity supply utility and submission on connection request documentation, conceptual layout drawings for transmission lines and substations, single line diagrams, power systems study, options study report and project management.

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- **Hinksey 400 kV Cable Upgrade, National Grid, Wales, UK, 2009 –2011**
  Lead Substation Engineer for the 400 kV cable sealing end augmentation. Project involved an upgrade of a double circuit mid-line cable section from one core to two cores per phase and subsequent alterations at the cable sealing end compound to meet current National Grid policy. Existing fluid filled cables were paralleled with new XLPE cables whilst retaining one set of oil cable sealing ends using new 400 kV transition joints. Tasks included conceptual and detailed design, coordination with OHL designers and cable contractors and other project managers, construction programming and supervision, and documentation.

- **McArthur River Power Station, McArthur River Mine, Northern Territory, Australia, 2012**
  Lead Electrical Engineer. This project involved the detailed design of a new 80 MVA power station including installation of six new Diesel/Gas Turbines and the upgrade of the existing HV infrastructure on site. Responsibilities included the detailed spatial design for three indoor 11 kV switchboards and associated cable installation design.

Secondary system design

- **Instrument transformer replacement programme, Transpower, New Zealand, 2016 – 2018**
  Lead Technical Engineer for multiple CT/CVT/NCT age/condition based replacement at various Transpower sites around New Zealand. Project involved site assessment, design, construction and commissioning.

- **Opunake Hydro, Cheal A Generator 4 installation, New Plymouth, New Zealand, 2014 –2014**
  Lead/Senior Electrical Engineer. This project involved the installation of one new gas generator unit to function as an islanded generation unit and export power back to the grid. The project included concept and detailed secondary systems design involving integration to the generator controller, PLC, SCADA, protection relay and station HMI. All design drawings issued using IEC drawing standards.

- **McArthur River Power Station, McArthur River Mine, Northern Territory, Australia, 2012 – 2013.**
  Lead/Senior Electrical Engineer. This project involved the installation of six new Diesel/Gas Turbines and the upgrade of the existing HV infrastructure on site. Responsibilities included the concept and tender design for the 11 kV new switchboards and integration in the existing HV infrastructure; the design for the integration of existing turbine systems into new switchboards and the overall HVAC secondary systems, LVAC, DC and HV cables systems design. The deliverables included tender specification material for equipment and tender design drawings. Responsibilities included the development of the concept, detailed design and construction drawings, tender documentation, technical specification documents and tender evaluation.

- **Transpower RTU Tactical, Transpower NZ, North Island, New Zealand, 2007 –2007**
  Part of secondary design team providing detailed design solution and specification reports for the upgrade of RTU units and various Transpower in New Zealand. Project involved site visits and surveying of SCADA systems of sites and design of RTU upgrades. Sites were retrofitted with modern RTU hardware to improve SCADA network and accommodate future expansion. South Morang Terminal Station 220 kV/66 kV Augmentation, SP Ausnet, Victoria, Australia, April 2007 – March 2008 Part of design team providing assistance in detailed secondary deign for a transformer replacement and addition of new bay feeders at an existing substation in Victoria.

HV cable design

- **Star of the South Windfarm, Victoria, Australia, 2019-ongoing**
  Lead HV cable designer for onshore 275 kV cable connections with a combined route length of approximately 270 km.

- **Northern Corridor Improvements (NCI), NZTA, Auckland, New Zealand, 2016 –2018**
  Lead Technical Engineer responsible for delivering a solution to protect the existing and future 220 kV Transpower cables that are being impacted by the development of major road construction by the NZTA. This work involved 3D design, dynamic cable rating studies, CFD modelling and solar absorption

A2 Team Members/ RAJ CHAND

studies. The project was particularly challenging due to the interface with multiple external stakeholders and project time constraints.

- **·Distributed Temperature Sensing Trial, Transpower, Auckland, New Zealand, 2017 –2018**
  Lead Technical Engineer responsible for a delivering the trial of a single mode DTS system (first in New Zealand). The trail focused on testing the system for spatial resolution, temperature accuracy, repeatability and compatibility with existing fibre optic cables.

- **Beaconsfield 132 kV cable design peer review, Transgrid, Sydney, Australia, 2015 –2015**
  Lead Electrical Engineer responsible for a peer review on the 132 kV cable design at Beaconsfield 330 kV/ 132 kV substation. This work included, cable thermal modelling using CYMCAP, short circuit calculations, thermo-mechanical force calculations and recommendations on the installation and constructability design. The findings of the peer review were presented in a report used to justify changes to the design resulting in significant cost savings for the client.

- **Melter 2 dynamic cable monitoring and control, NZ Steel, Auckland, New Zealand, 2015 –2015**
  Lead Electrical Engineer responsible for investigating, modelling and implementing an innovative dynamic cable rating system for the Melter 2 33 kV cables. The system allows the operator to dynamically select short term cable ratings based on transient modelling analysis and real-time preload conditions enabling the client to increase production when needed without damaging the cable system. The system is protected against thermal overload using a set of resistive temperature devices installed in the field which sets alarms and trips if threshold is exceeded.

- **The Terrace and Moore Street 33kV sub-transmission cable study, Wellington Electricity, Wellington, New Zealand, 2015 –2015**
  Lead electrical engineer responsible for assessing all the cable ratings for the The Terrace and Moore Street 33 kV sub-transmission circuits in Wellington Electricity's network. CYMCAP modelling software used to conduct steady state and transient analysis.

- **Ormonde Windfarm 33 kV Cables, Areva, Lancaster, UK, 2010 –2010**
  Cable system design engineer for the HV cables within a 33 kV reactive compensation unit for an offshore wind-farm connection. Project included cable route design, bonding scheme design, thermomechanical study, thermal rating study and allowances for harmonic distortion.

- **Thermo-Mechanical Forces Cable Study, National Grid, London, UK, 2010 –2011**
  Research role as part of nation-wide research group for a study assessing cable thermo-mechanical forces and calculation methodologies to apply towards the design of HV cable civil installations in termination areas with particular regard to GIS terminations. The study involves a review of industry practices, laboratory mechanical testing, finite-element analysis and field validation. The study aims to standardise calculation methodologies and design practices used in National Grid installations in the UK.

- **Finsbury Market 132 kV Cable Study, EDF Energy, London, UK, 2010 –2010**
  Cables engineer for a study assessing the current capacity of an existing installation through central London and producing recommendations to maximise capacity. The project involved route analysis, cable modelling, an investigation into special bonding arrangements and consideration of urban load cycles.

- **Halyvourgiki, 400 kV Cable Study, Halyvourgiki, Athens, Greece, 2009 –2009**
  Cables engineer on a project for a CCGT power generator. The feasibility study involved modelling the 10km cable route adjacent an existing rail line to produce a solution that fulfils the client's security requirements. Technical challenges involved both thermal and civil obstacles at a number of areas along the route.

- **Hinkley Point 400 kV Cabling Works, National Grid, Bristol, UK, 2009 – 2011**
  Cable and substation engineer for the conceptual design for the undergrounding of an existing OHL route through the Seabank area. The design required innovative solutions to achieve the required ratings through

A2 Team Members/ RAJ CHAND

a densely populated and developed area in accordance to policy and public consultation. The design involved an optioneering and feasibility exercise exploring different cable routes and conceptual designs for a 3 cores/phase cable sealing end compound.

PROFESSIONAL HISTORY

- WSP Opus, New Zealand, Principal Electrical Engineer
  2018 – Current
- Transpower NZ, New Zealand, Senior Project Engineer
  2015 – 2018
- Ergo Consulting, New Zealand, Senior Engineer
  2014 - 2015
- WSP (formally Parsons Brinckerhoff), Australia, Senior Engineer
  2011 - 2014
- Mott MacDonald Group, United Kingdom, Project Engineer
  2009 - 2011
- Beca, New Zealand, Power Systems Engineer
  2006 - 2009

CONFERENCE PROCEEDINGS

- Chand R, 2017, 'Dynamic Thermal Monitoring and Control of MV Cables' paper presented at Electrical Engineers Association Conference, Wellington, 21st to 23rd June 2017.

A3 Team Members

MICHAEL VAN DOORNIK

PRINCIPAL CONSULTANT

Michael is currently director for Energy Networks Consulting Pty Ltd which focuses on assisting electricity networks across Australia and New Zealand manage their assets, comply with regulations and make robust investment decisions.

He has over 18 years' experience working as both an engineer and management consultant with extensive experience in delivering strategy, due diligence, business cases, asset management and regulatory advice across a range of energy and infrastructure assets.

Michael's advice is underpinned by a strong engineering and commercial background gained from working as National Executive for the Strategic Asset Management at WSP, post graduate studies and operating his own consulting business. Michael has a track record of working across Australia, New Zealand and South East Asia and has managed national teams of up to 60 professionals.

Michael has significant industry experience in strategic asset management, risk analysis and management, financial modelling, data analysis, audit of non-financial information, developing business cases and power systems engineering.

Education

- Director, Energy Networks Consulting 2021 - Present
- WSP, National Executive 2017 - 2021
- van Doornik Consulting, Director 2014 - 2017
- Parsons Brinckerhoff, Senior Consultant 2005 - 2014
- Australian Defence Force, Rifleman 2000 - 2004

Education

- Master of Applied Finance, University of Melbourne 2010
- Bachelor of Electrical and Computer Systems Engineering (Hons), Monash University 2006
- Bachelor of Science (Mathematics/Physics), Monash University 2001

Professional Qualifications

- Chartered Professional Engineer (CPEng NER), Engineers Australia 2011
- Lead Auditor in Quality Management Systems, SAI Global 2012
- Certified Asset Management Assessor, WPiAM 2022

Professional Experience

Asset Management

- **Developing the capital expenditure forecast for the 2024-29 regulatory submission (2021-23): Power and Water Corporation**

  Assisted Power and Water develop the expenditure forecast for replacement and augmentation network expenditure for the 2024-29 regulatory determination. Key tasks included developing a risk quantification procedure and template, investigating and analysing network issues to define remediation works, developing a business case template and completing the business case and cost benefit analysis, contribution to and review of business documents and general advice to the business regarding the capital expenditure forecast.

- **Asset management plan, Auckland, New Zealand (2020-2021): Vector Limited, Principal Consultant**

  Assisted Vector develop their Asset Management Plan (AMP) to comply with regulatory requirements. Our focus was on the section of the AMP that described the asset management framework, asset replacement, network growth and network reliability. Ensured the AMP complied with the relevant

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disclosure requirements contained in the regulations.

- **Network Security Report, Auckland, New Zealand (2020-2021, 2022): Vector Limited, Principal Consultant**

  Completed and assessment of Vector's asset management and network planning processes in response to a request from Vector's owners. The review involved assessment of asset management practices, approaches to risk assessment and management, demand forecasting, network planning and data systems.

- **Asset management maturity assessment of TransGrid, New South Wales, Australia (2020), TransGrid, Principal Consultant**

  Undertook a review of the maturity of TransGrid's asset management systems against ISO 55001 to quantify, financially and reputationally, the benefit delivered to the business by exceeding the minimum requirements of ISO 55001.

- **Transmission and Distribution Annual Planning Report, NT, Australia (2020): Power and Water Corporation, Principal Consultant**

  Assisted Power and Water Corporation in the development of their first Transmission and Distribution Annual Planning Report, published as a requirement of the National Electricity Rules (NT).

- **Network reliability review, Auckland, New Zealand (2019): Vector Limited, Principal Consultant**

  Undertook a review of Vector's reliability performance and proposed improvement plans to assess whether the initiatives being implemented would generate sufficient network performance improvement. The assessment considered the business structure, asset management maturity and detailed analysis of performance data.

- **REFCL Joint Planning Report, Victoria, Australia (2019): AusNet Services and Jemena Electricity Networks, Principal consultant**

  AusNet Services and Jemena Electricity network required a joint network planning report for the most economic and technically feasible option to maintain the long term compliance of Kalkallo and Coolaroo Zone Substations with the Electricity Safety Amendment (Bushfire Mitigation Civil Penalties Scheme) Act 2017, the Electricity Safety (Bushfire Mitigation) Regulations 2013. Sarah developed the options in collaboration with the project team. She also developed a coherent report to set out the justification of the recommended option based on cost, regulatory and technical feasibility of the various options. This required an understanding of the Acts and Regulation, electricity regulatory framework, rapid earth fault current limiter (REFCL) technology constraints and network characteristics.

- **Capital expenditure justifications for Regulatory Submission, Darwin, NT, Australia (2018): Power and Water Corporation, Consultant**

  Development of capital justifications for three key replacement and augmentation projects to assist PWC respond to questions from the AER and prepare their revised proposal.

- **Network Risk Review, Dunedin, New Zealand (2018): Aurora Energy, Principal Consultant**

  Led a team to review the risk posed to safety, reliability and the environment by Aurora Energy's network. The review also assessed network resilience to high impact low frequency events. The review involved data analysis, spatial analysis and stakeholder engagement to identify the key risks and provide a prioritised list of recommended mitigations.

- **Asset Management Plan Development, Darwin, NT, Australia (2017): Power and Water Corporation, Consultant**

  Development of asset management plans and other AM documentation in support of PWC's initial pricing submission to the Australian Energy Regulator.

- **Development of five asset lifecycle management strategies, Melbourne, VIC, Australia (2016): United Energy, Senior Consultant**

  Completed a gap analysis of the existing documentation to ensure all client requirements were included and for alignment to ISO 55,000. Gathered asset performance data from multiple business systems and completed analysis to determine how the assets were performing and what needed to be done to ensure compliance with regulations and business requirements.

- **Assisting United Energy to prepare for the 2016-20 price review, Melbourne, VIC, Australia (2014 - 2015): United Energy, Senior**

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- **Consultant**

  Assisted United Energy prepare for the 2016-20 Electricity Distribution Price Review by undertaking a number of tasks to develop and support their forecast expenditure proposal including: analysis of historical expenditure; analysis of the Repex model outputs and internal model outputs, and writing Life Cycle Management Plans for distribution assets.

- **Network Management Plan, Perth, WA, Australia (2011): Western Power, Consultant**

  Developed Western Power's Network Management Plan and life cycle management plans for individual high value assets.

- **CitiPower and Powercor regulatory review, Melbourne, VIC, Australia (2009): CitiPower and Powercor, Consultant**

  Reviewed the capital expenditure of CP/PAL to assist with their pricing review submission to the AER. This involved a high-level review of their overall expenditure, procedure and policies, historical expenditure and detailed review of a number of specific projects.

Regulation

- **Customer connection policy review (2022): SAPN**

  Reviewed SAPN's customer connection policy and made updates to reflect the AEMC rule change in 2021 regarding distributed energy resources and the allowance for charging for export services.

- **Statistical analysis of PowerLink's performance data, Queensland, Australia (2020-2021): Powerlink, Principal Consultant**

  Completed statistical analysis of five years of performance data as independent validation of PowerLink's propose incentive scheme targets.

- **Benchmarking to support Aurora Energy's Customised Price Path submission, Dunedin, New Zealand (2020): Aurora Energy, Principal Consultant**

  Critically reviewed the regulators benchmarking report to identify weaknesses in the use of data, assumptions and benchmarking practices.

- **Initial Gap Analysis of CPP application, Dunedin, New Zealand (2019): Aurora Energy, Principal Consultant**

  Completed an initial high-level review and gap analysis of the existing materials available to Aurora Energy when they commenced the development of their CPP application compared to what is required by the regulations and the standard of information delivered by peer organisations.

- **High Level Review of CPP application, Dunedin, New Zealand (2019 - 2020): Aurora Energy, Principal Consultant**

  Following from a previous assessment, we undertook a high-level review of Aurora Energy's CPP application to identify remaining high-risk items and to prioritise where they should focus their effort for maximum impact. A number of models, including the reliability forecast and cost benefit models, were reviewed and recommendations made for improvement. In addition, we undertook some benchmarking and drafted the Quality Price Path submission document.

- **Regulatory Investment Test for Distribution, Melbourne, Victoria, Australia (2018 - 2019): Jemena, Principal Consultant**

  Contributed to the development of two Regulatory Investment Test for Distribution for Jemena's network. This included the non-network options screening report as well as the draft project assessment report. Key inputs included advice on the financial model, technical input on the electricity network and regulations, and quality review.

- **Powerco CPP Verifier, New Zealand (2016 - 2017): Powerco/Commerce Commission, Principal Consultant**

  Under a tripartite arrangement our team was engaged by Powerco and the Commerce Commission to verify Powerco's customised price-quality path (CPP) application. This will include verifying the assumptions and logic underpinning all proposed capital and operational expenditure, particularly where step changes are proposed compared to past actuals.

- **Critical review of Ausgrid's 2014-19 submission, Sydney, NSW, Australia (2014 - 2019): AusGrid, Consultant**

  Provided analysis, critical review and recommendations for improvement of key documents and methodologies that were to be included as part of the pricing submission.

- **Western Australian electricity industry reliability code issues paper, Perth, WA, Australia (2012): Western Power, Consultant**

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Critiqued the electricity industry code to highlight inconsistencies with other regulation applicable to Western Power and reliability codes from other Australian jurisdictions.

- **Bushfire mitigation investigation, VIC, Australia (2011): ESV, Consultant**

  Review of specified areas of Victoria to assess the existing electricity infrastructure and estimate a cost or replacement and impact of the risk of bushfires.

- **Bushfire asset replacement cost estimate, Melbourne, VIC, Australia (2009): Department of Primary Industry, Consultant**

  High level review, design and costing for various SWER distribution line replacement topologies.

Audit

- **Independent audit of the Regulatory Information Notice Non-Financial Information, QLD, Australia (2017 - 2020): Multiple Clients, Principal Consultant**

  Audited non-financial performance information, for multiple distribution network service providers, as required by the Australian Energy Regulator. Involved interviewing staff, data analysis, reporting and presenting to the executive group.

- **Distribution Loss Factor certification, Melbourne, VIC, Australia (2017 - 2021): Victorian Distributors, Principal Consultant**

  Provided independent certification of the calculation method and data used by all Victorian distribution utilities to calculate the Distribution Loss Factors. The certification is required by regulation and is provided by the utilities to the Australian Energy Market Operator (AEMO). The project involved reviewing data, reports and interviewing personnel from the utilities to establish that the loss factors had been calculated correctly.

- **Essential Services Commission (ESC) Compliance Audits, VIC, Australia (2017): Westernport Water, Principal Consultant**

  Audit to determine the extent to which the water businesses have fulfilled their regulatory obligations with respect to Performance Information, Customer Service and Trade Waste Customer Service Codes.

- **Follow up audit of asset management systems, Darwin, NT, Australia (2017): Northern Territory Utilities Commission, Principal Consultant**

  Audited the asset management systems, procedures and processes used by the electricity utility for compliance with their distribution licence to assess progress since the initial audit in 2014.

- **Independent audit of asset management systems, Darwin, NT, Australia (2014): Northern Territory Utilities Commission, Senior Consultant**

  Audited the asset management systems, procedures and processes used by the electricity utility for compliance with their distribution licence.

- **Independent audit of the F-Factor Regulatory Information Notice, Melbourne, VIC, Australia (2013): Jemena Electricity Networks and SP AusNet, Consultant**

  Audited the information required to be supplied to the Australian Energy Regulator. Involved interviewing staff, data analysis, reporting and presenting to the executive group.

- **Independent audit of the Regulatory Information Notice Non-Financial Information, VIC, Australia (2011 - 2014): Multiple Clients, Principal Consultant**

  Audited non-financial performance information, for multiple distribution network service providers, as required by the Australian Energy Regulator. Involved interviewing staff, data analysis, reporting and presenting to the executive group.

- **Distribution Loss Factor certification, Melbourne, VIC, Australia (2011 - 2014): Victorian Distributors, Principal Consultant**

  Provided independent certification of the calculation method and data used by all Victorian distribution utilities to calculate the Distribution Loss Factors. The certification is required by regulation and is provided by the utilities to the Australian Energy Market Operator (AEMO). The project involved reviewing data, reports and interviewing personnel from the utilities to establish that the loss factors had been calculated correctly.

- **Technical audit of D-Factor submission, Sydney, NSW, Australia (2011): NSW Distributors, Consultant**

  Reviewed documentation proving that a network constraint existed, the

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demand management scheme implemented was appropriate and the cash flow analysis had been completed according to the correct methodology.

- **Business Case Assistance, Perth, WA, Australia (2011 - 2012): Western Power, Consultant**

  Assisted Western Power write business cases and strategic documents to assist with their submission to the economic regulator. The key business cases were for transformer and switchgear replacement projects and minor transmission asset replacement programmes. This involved financial analysis to establish optimum timing of replacement, developing project costs and ensuring the projects complied with the relevant regulation.

- **Business Case Review, Perth, WA, Australia (2011): Western Power, Consultant**

  Reviewed and critiqued Western Power's business cases and strategic documents to assist with improving the quality of their submission to the economic regulator. There was specific consideration given to the New Facilities Investment Test and other requirements of the regulation.

- **Business Case Development, Melbourne, VIC, Australia (2009 - 2010): Jemena, Consultant**

  Developed a number of business cases including the scope of works, options evaluation and risk assessments to assist Jemena Electricity Networks build a forecast program of works for the 2010 financial year.

Financial Modelling & Data Analysis

- **Windfarm modelling for valuation, Melbourne, Victoria, Australia (2021-22, 2023): Confidential client, Principal Consultant**

  Reviewed a financial model to identify and correct errors. Then assisted the client identify gaps in information, provided electricity industry specific advice, updated and ran the model to derive the windfarm financial performance, assisted with developing board presentations.

- **Due diligence of a rail business, Melbourne, Victoria, Australia (2019): Confidential client, Principal Consultant**

  Developed the financial model that input information from rail engineers to develop a forecast or capex and opex required to operate an existing rail business. The business included above ground (rolling stock) and below ground (track) assets across Australia.

- **Audit of asset replacement forecasting model, Melbourne, VIC, Australia (2016): Confidential Client, Principal Consultant**

  Detailed audit of an asset replacement forecasting model including the structure, assumptions underlying the calculations, macros, and use and implementation of appropriate formulae. The audit identified any errors in the model and provided recommendations for corrections, improvements in structure, and application of formulae and macros.

- **2015 Category Analysis RIN, Melbourne, VIC, Australia (2015 - 2016): United energy, Principal Consultant**

  Analysed historical actual expenditure and quantities of assets installed during the 2015 calendar to be reported to the AER.

- **Power transformer replacement modelling, Melbourne, VIC, Australia (2015): WSP | Parsons Brinckerhoff, Financial Modeller**

  Built a financial model to support WSP Parsons Brinckerhoff develop business cases for asset replacement on the Jemena Electricity Network.

- **Electricity Network Assets Privatisation, Sydney, NSW, Australia (2015): Confidential Client, Financial Modeller**

  Built the business optimisation financial model for the due diligence process conduction by a consortium bidding to buy TransGrid, the electricity transmission business in NSW. Key tasks included modelling business optimisation initiatives and providing advice regarding the regulated electricity industry.

- **Data analysis for the AER's Category Analysis RIN, Melbourne, VIC, Australia (2013 - 2014): United Energy, Senior Consultant**

  Analysing data to identify and calculate specific data required to populate the AER Category Analysis RIN, including asset type populations, asset age profiles and other metrics. It required extracting data from information systems, then developing rules to identify and resolve gaps in the raw data.

- **Waste to Energy Project, Melbourne, VIC, Australia (2012 - 2013): Confidential Client, Financial Analyst**

  Completed financial analysis of a clean energy project which involved

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developing a DCF model to evaluate multiple options, conducting sensitivity and scenario analysis, assessing financial parameters and presenting the model and findings to the client and writing the financial business case.

- **Bowen power station expansion and Surat Basin CSG, QLD, Australia (2012): Arrow Energy, Financial Analyst**

  Completed financial analysis to assess multiple options for expansion of the Bowen gas fire power station and options for the electricity network topology to connect their coal seam gas plant in the Surat Basin. This involved developing a DCF model, conducting sensitivity, scenario and Monte Carlo analysis, assessing financial parameters, and writing the financial business case.

Business Efficiency Review

- **Efficiency review of Network Planning and Asset Performance functions, Perth, WA, Australia (2017): Western Power, Consultant**

  Reviewing the efficiency of Western Power's Network Planning and Asset Performance functions to identify opportunities to improve business processes, business structure, systems and tools that deliver significant operating cost savings. Work involves a national peer organisation review with six major network service providers to benchmark Western Power's current performance and identify areas of good practice, a current state review of performance (size/shape/complexity, workloads and volumes, structure, processes, resourcing model, skills and capability, systems and tools), and to redesign the business model to meet future business objectives and changes to work types and volumes.

Power System Engineering

- **Feasibility and connection studies, VIC, Australia (2009): Multiple Clients, Electrical Engineer**

  Feasibility and connection studies for multiple generation sites throughout Victoria. It involved investigation into the Victorian network to determine suitable connection points and network characteristics, developing high level site layouts, understanding environmental and planning issue associated with easements and writing connection enquiries to the NSPs.

- **BlueScope Steel Cogeneration Plant, Wollongong, NSW, Australia (2007 - 2009): BlueScope Steel, Electrical Engineer**

  Preliminary design and costing of a Cogeneration Power Plant. This included high level and detailed design of plant layouts, specifying electrical plant requirements and co-ordination amongst the relevant design groups. There was a very high emphasis placed on safety in design and conducting on site safety audits.

- **Darajat 3 Geothermal Power Station, Garut, Indonesia (2007): Theiss Contractors Indonesia, Electrical Engineer**

  On site engineer during construction, testing and commissioning of the Darajat Unit 3 Geothermal Power Station in Indonesia. Led a team during testing and commissioning of switchgear and an investigation into the synchronisation and metering systems. Michael also completed the design of the 6.6 kV bus transfer system.

- **United Nations Development Program Kazakhstan Wind Power Market Development Initiative, Kazakhstan (2006): United Nations Development Program, Electrical Engineer**

  Installing wind monitoring towers in eight locations around Kazakhstan to set up wind measurement equipment, data logger and train local meteorologists to download data and submit to the UNDP office.

- **Springvale West Substation, Melbourne, VIC, Australia (2006): Jemena, Electrical Engineer**

  Detailed primary and civil design for the establishment of a new Springvale West zone substation, and the modification of the existing Springvale Substation. Responsibilities included design of 22 kV and 66 kV switchyards, on-site inspections, sourcing information, solving problems construction issues and liaison with stakeholders.

WSP is one of the world's leading engineering professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, planners, surveyors, environmental specialists, as well as other design, program and construction management professionals. We design lasting Property & Buildings, Transportation & Infrastructure, Resources (including Mining and Industry), Water, Power and Environmental solutions, as well as provide project and program delivery and advisory services. With approximately 50,000 talented people globally, we engineer projects that will help societies grow for lifetimes to come.

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