Battery Storage and Grid Integration Program

An initiative of The Australian National University

REVS

Creating value from V2G

A report on business models

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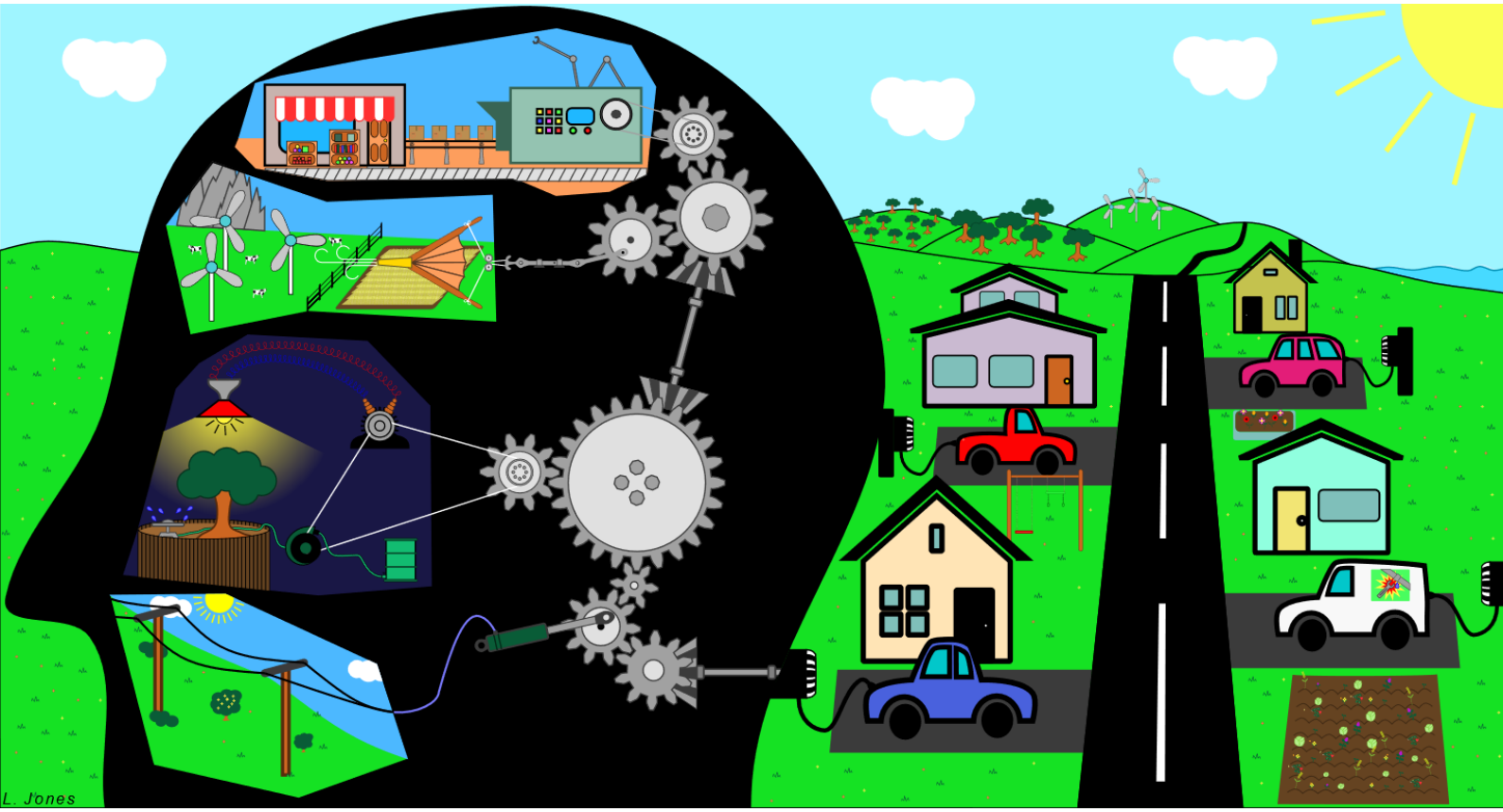

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Executive Summary

Business models are important. They describe how organisations deliver value, to whom, and how they make money [1]. The aim of this report is to create a set of “fully worked” business models for Vehicle to Grid (V2G).

This report focusses on V2G, where vehicles provide services directly to the energy system. Vehicle to home (V2H) is closely related but focusses on managing behind the meter consumption instead. Implementing V2H is likely simpler because there are less relationships needed to create value. It is impossible to discuss one entirely without consideration of the other though. For example, as discussed in section 3 the future may see a convergence between V2G and V2H as pricing and connection models evolve. V2G is more complex than V2H. Whether the additional complexity is warranted remains to be seen.

Every business, including those who create value from V2G, have a unique business model specific to their situation and capabilities. Businesses create points that differentiate them from their competition to give themselves and advantage in the market [1]. These parameters are unique to individual businesses, their situation, strategy, and capabilities. This report can’t tell individual organisations their differentiation. Instead, this report presents insight and components that can help businesses considering V2G find their own unique business model.

This report considers business models for a hypothetical intermediary that sits at the nexus between different energy and transport market players, as shown in Figure 14. It describes who their customers could be, what sort of value these customers desire, and what capabilities both customers and the intermediary need to create this value.

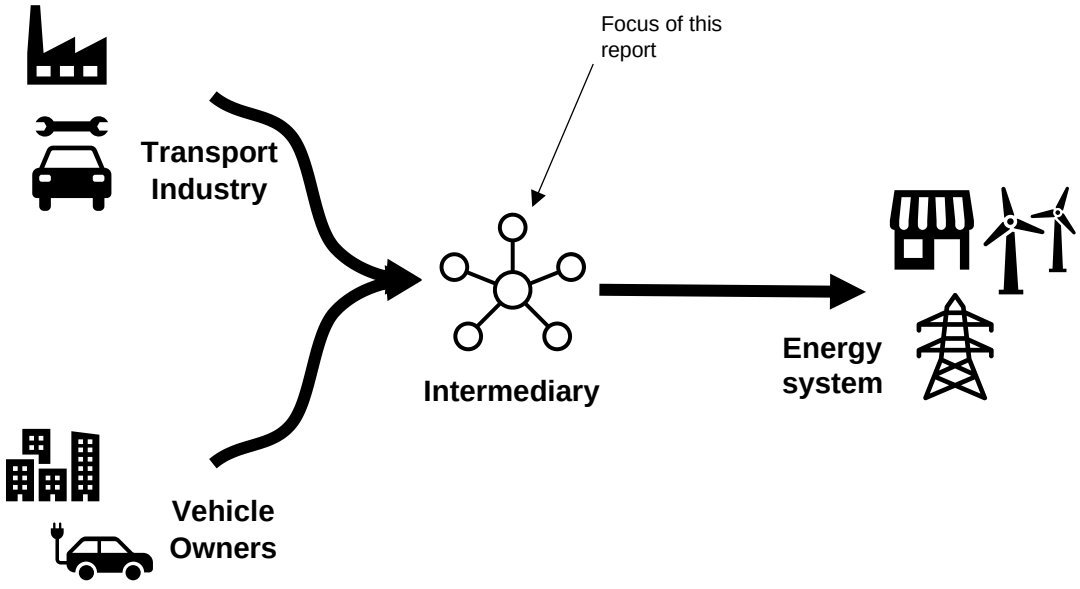


Figure 1 Conceptual framework and report focus

The “service model canvas” is used as a descriptive tool in this report. The service model canvas is an evolution of the Osterwalter and Pigneur’s original business model canvas [2] proposed by Ojasalo and Ojasalo [3]. This is further described in Appendix A.

Findings are based on a series of 32 semi-structured interviews with energy and transport experts and 35 interviews with end users. These are described in Appendix B.

There are two key questions for intermediaries in defining business models for V2G:

- Who are the customers of this intermediary and what is important to them?
- What do intermediaries and customers need to do to create value?

Who are the intermediary's customers?

For more details see: Chapter 3

The intermediary has three main groups of customers: EV owners, Grid Operators, and Market Participants. Several other groups of customers were also described (called "Other Groups" in this report). A summary is shown in Figure 2.

EV owners are people who own EVs. They can be fleets or private EV owners. There were several challenges for these customers to which V2G may be a solution. For example, fleet managers are commonly faced with the challenge of electrifying their fleet without the associated budget increases required to meet the (currently) higher cost of electric vehicles. V2G is a means to reduce the cost of electrification because vehicles can create value when they are not driving. Similarly, V2G can assist in reducing energy costs and emissions which helps facilities and sustainability managers meet their goals. V2G can also fit within other objectives too. For example, EV owners may want to show leadership within their communities or help their neighbours during electricity outages.

Grid Operators are those who are tasked with stewardship of the grid. This group includes electricity networks, market operators, and microgrid operators. For grid operators, EVs are a coming threat to the stability of the grid. V2G is a means of reducing this impact. However, their needs are high. For V2G to be a part of grid management it needs to deliver its services with extremely high reliability. This is coupled with the fact that there is only a small financial benefit to grid operators for these services. Long term, grid operators would prefer to signal their needs to EV drivers who are energy users instead of intermediaries using existing mechanisms such as connection agreements and network pricing.

Market Participants are organisations who participate in energy markets such as energy retailers, aggregators, and generators. These organisations commonly are already offering energy services to EV drivers. V2G is a business opportunity for them, and intermediaries could be partners or competitors in pursuit of this. As well as being a business opportunity, V2G can help them manage peaks and troughs in their demand and market prices.

Many people were sceptical of V2G and intermediaries. Their concerns were technical, commercial, and social. People were sceptical that intermediaries could simultaneously meet transport and energy system needs. Both transport and energy system require certain access to the vehicle's battery, which makes co-optimising these needs complex. Participants also were concerned that intermediaries would not provide EV owners with a fair share of their earnings from the energy system. This is compounded by the fact that intermediaries are not regulated to the same extent as other energy system participants such as energy retailers or electricity networks. Similarly, some participants felt that working with intermediaries was against their commercial interest or that the services they needed would be procured directly from EV owners instead.

What do intermediaries and customers need to do to create value?

For more details see: Chapters 4, 5, and 6.

In the Service Dominant Logic (SDL) frame, customers and intermediaries create value using their competencies. For example, reducing emissions with V2G could mean that intermediaries optimise charging to low-emissions periods within cost constraints set by customers, and report equivalent gCO_2/km so that customers can monitor and understand progress toward zero-emissions goals. The value (meeting goals) occurs because intermediaries use their optimisation and translation skills to meet goals customers have communicated to them.

There were seven competencies identified for intermediaries, and one for customers.

Translation is the most fundamental skill for intermediaries. Intermediaries need to be able to make V2G relevant for multiple customer types simultaneously. Similarly, they need to translate customer's diverse needs to enable other functions such as optimisation, where needs are converted to requirements and constraints.

Generating revenue and **taking risks** are key generators of value. In many cases intermediaries generate revenue by taking risks on behalf of their customers. This means that intermediaries need to be adept risk takers. They need to understand what risks they must take and their impact and mitigation. A key part of knowing this **is understanding V2G's capabilities**.

Intermediaries are well placed to understand V2G's capabilities. They have access to data and combined with analytics skills they can translate V2G into the customer's terms. This also enables them to understand risk and revenue trade-offs.

At a technical level, a single asset (a vehicle and associated charger) is generating revenue and managing risk by providing several high-certainty services simultaneously. This means intermediaries need to **optimise** all these factors. Optimisation is managing chargers in real time based on data and customer expectations. Understanding customer expectations will be very important. The intermediary needs to convert requirements like "seamless" transport provision and "certain" grid services provision to technical optimisation targets and constraints.

In some cases, intermediaries may have a deeper relationship with their customers – they may become **partners**. There were several cases where this may be the case. For example, financial participants may wish to use V2G to enter transport markets. In this case, the capabilities of the intermediary complement those of the customer to enable the customer's desired outcomes.

As experienced during REVS, **installation** of V2G chargers is a complex process [42], [45]. Intermediaries can create value by helping their customers navigate this process.

SDL principles state that value is co-created with customers. Customers also use skills in the value creation process. The most fundamental of these is **communication**. This means understanding their drivers, expectations, and desired outcomes from V2G. For organisations this can be a complex internal negotiation process. Multiple stakeholders can have different expectations of V2G which may be challenging to meet simultaneously. For example, a desire by fleet managers for V2G to have no impact on vehicle usage can reduce the revenue that energy managers desire from V2G.

It is not clear whether a viable model for V2G can be found. This report has provided an analysis of what creating this model could entail. Clearly people such as intermediaries, who create this value, will need to be skilled in multiple dimensions. They must be immersed in the transport and energy industries simultaneously. They must manage diverse needs of vehicles. And they must communicate clearly. Customers need to understand their own needs too. V2G has many diverse promises, and only customers can understand how these promises should be implemented in their own circumstances. The project's key findings are described in Figure 3 and Figure 4 below.

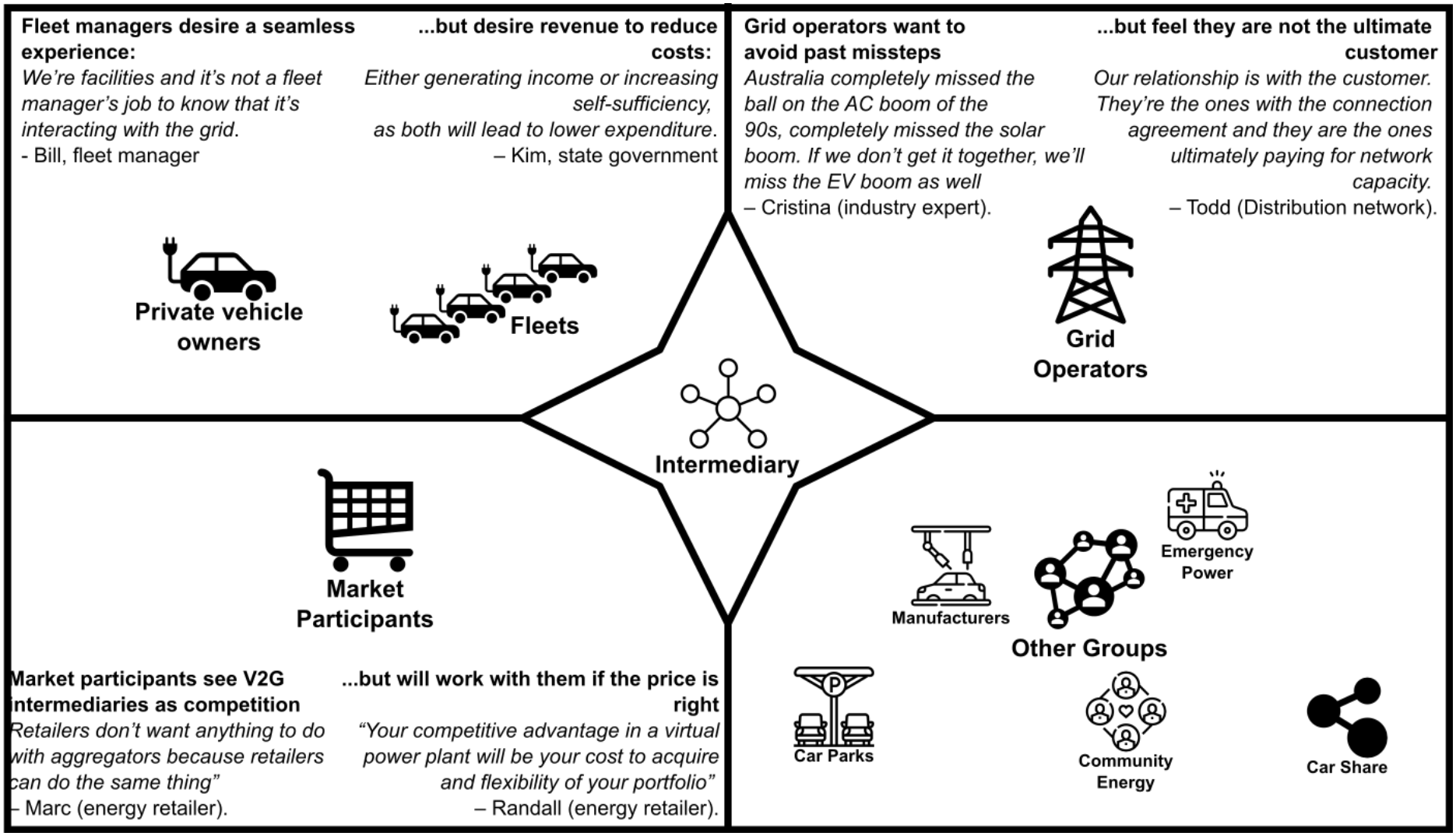


Figure 2 The intermediary needs to meet diverse customer requirements

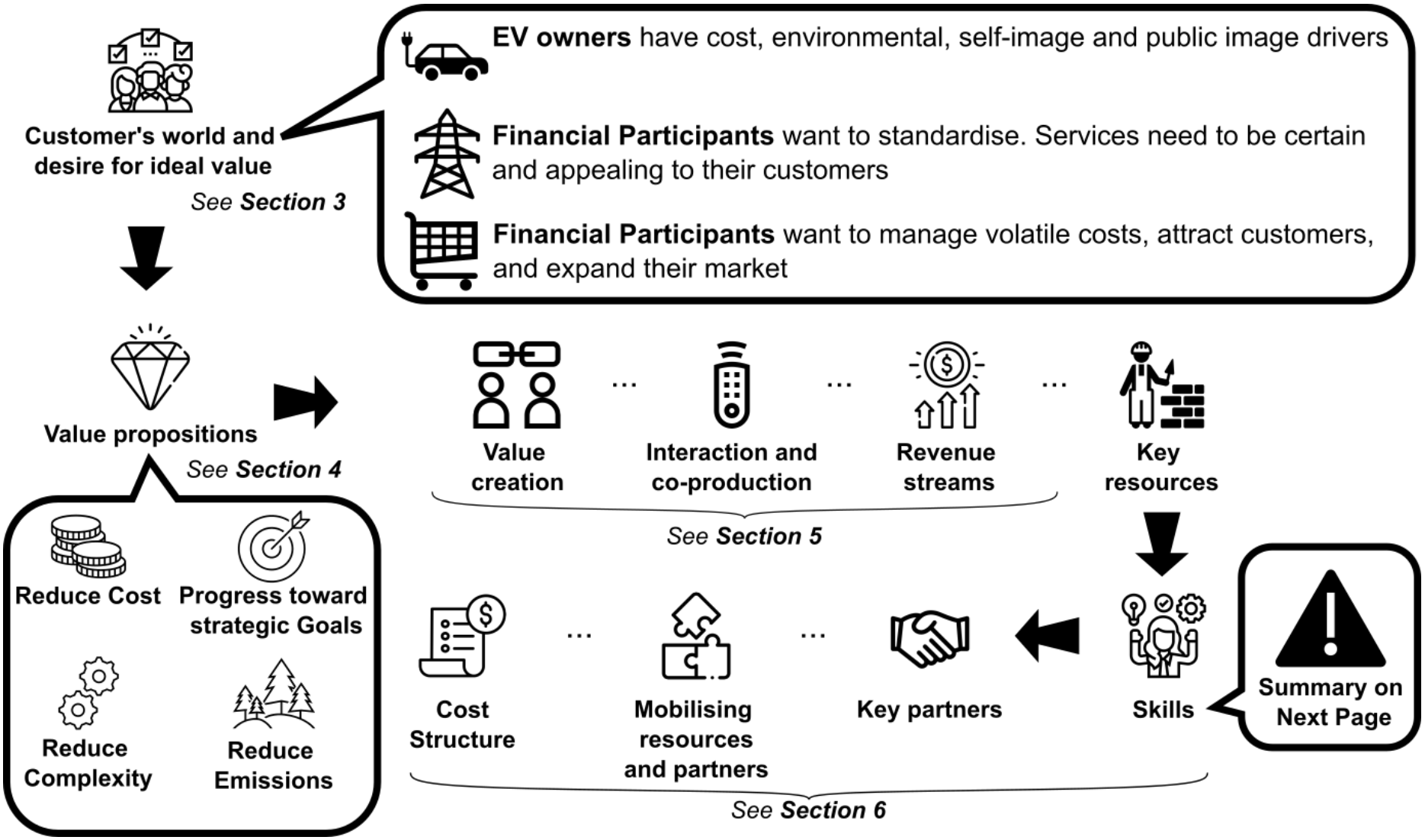


Figure 3 Summary of findings – overall

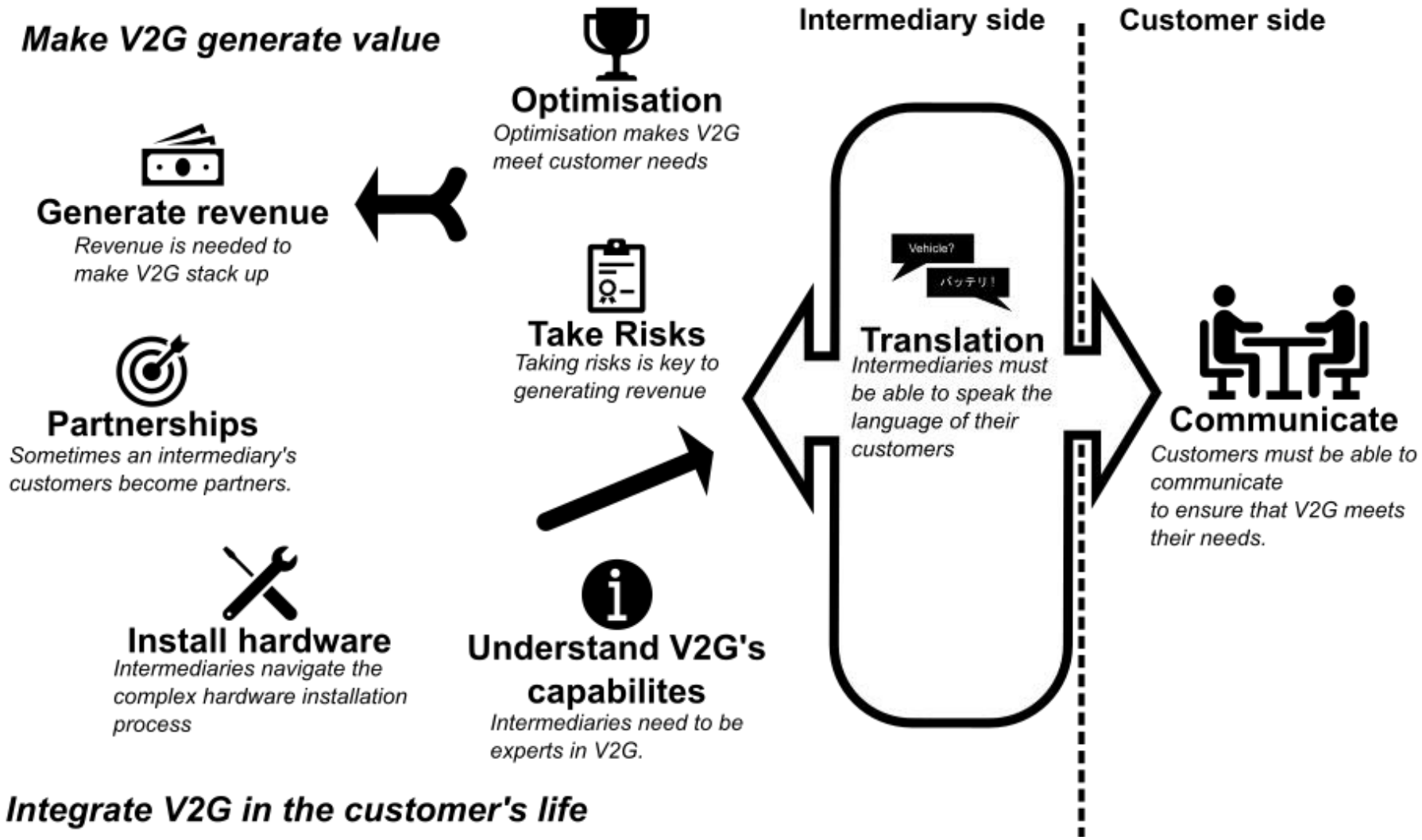


Figure 4 Summary of findings - Resources map

Contents

1 Introduction

This report discusses the findings from a package of research that aims to understand business models for V2G. It aims to understand how V2G could create value through the lens of the business model canvas. It has been based on a series of semi-structured 1:1 interviews with experts in the energy and transport sectors.

This work package is part of the Realising Electric Vehicle-to-Grid Services (REVS) project. The REVS project is described further in Box 1. REVS has been a test of a single use case for vehicle to grid (V2G). It created a resource (51 V2G equipped electric vehicles), leveraged through a set of organisational relationships to create value (contingency frequency control ancillary services (FCAS) which can be traded on the electricity market). As a trial, it can be considered as a prototype. Scaling V2G beyond trial will require these relationships to evolve. This report aims to show how a business that creates value from V2G could operate.

A key deliverable of this project is a (set of) business model(s) for V2G. Business models define the “business logic” of an organisation: Who it provides value to and how the organisation makes money from the transactions [1]. This report presents the outcomes of two sets of semi-structured interviews with V2G stakeholders in the form of a business model canvas.

This report focusses on V2G, where vehicles provide services directly to the energy system. Vehicle to home (V2H) is closely related but focusses on managing behind the meter consumption instead. Implementing V2H is likely simpler because there are less relationships needed to create value. It is impossible to discuss one entirely without consideration of the other though.

The report framed using the “service model canvas” as defined by Ojasalo and Ojasalo [3]. How the canvas maps to report sections are shown in Figure 5.

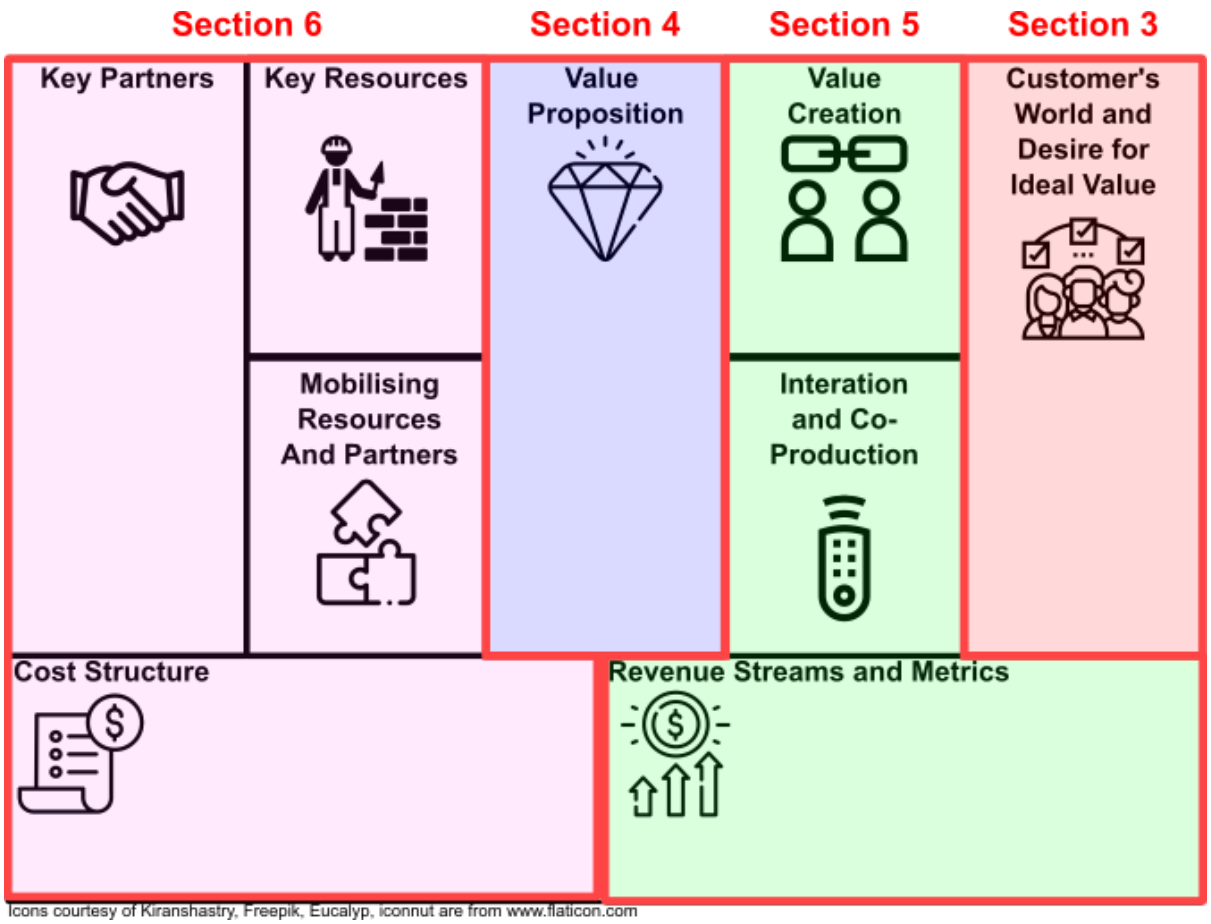


Figure 5 Report section mapping to service model canvas

Additionally, Appendix A frames this work in the theoretical landscape. It provides background to the service model canvas and describes why it was chosen to frame this report. Section Appendix B similarly describes how the data that is the basis of this report was collected.

This report should be read in conjunction with the associated business model worksheet. This report describes themes and methodology in detail. The spreadsheet completes the business model canvas in detail. This spreadsheet is described in Box 2

Box 1 About the REVS trial

Introducing the Realising Electric Vehicle-to-grid Services (REVS) trial

This report has been developed as part of the REVS trial. In an Australian first, the Realising Electric Vehicles-to-grid Services (REVS) project demonstrates how commercially available electric vehicles (EVs) and chargers can contribute to energy stability by transferring power back and forth into the grid, as required.

EVs will inject power back into the grid during rare events (to avoid possibility of blackouts) and EV owners will be paid when their vehicles are used for this service.

Employing 51 Nissan LEAF EVs across the ACT as part of the ACT government and ActewAGL fleet, the REVS project seeks to support the reliability and resilience of the electricity grid, unlocking economic benefits making electric vehicles a more viable and appealing transport option for fleet operators.

The REVS consortium covers the whole electricity and transport supply chains including ActewAGL, Evoenergy, Nissan, SG Fleet, JET Charge, ACT Government and the Australian National University. Together the consortium will produce a roadmap with recommendations that will accelerate the deployment of V2G nationally.

The project has been endorsed by the Australian Renewable Energy Agency (ARENA) and has received funding as part of ARENA's Advancing Renewables Program.

REVS is underway and will publish a final report in late 2022.

https://secs.accenture.com/accenturems/revs/

Box 2 The Business model worksheet

The business model worksheet

This report should be read in conjunction with the business model worksheet. This worksheet describes the findings in more detail, while this report summarises and analyses its contents. The worksheet can be found here.

2 Framing

As stated in section 1, this report presents findings from two sets of semi-structured interviews (described in Appendix B) in the form of a business model canvas. It builds these on a modified version of the business model canvas defined by Ojasalo and Ojasalo [3]. This canvas is described in Appendix A. The canvas is shown in Figure 6.

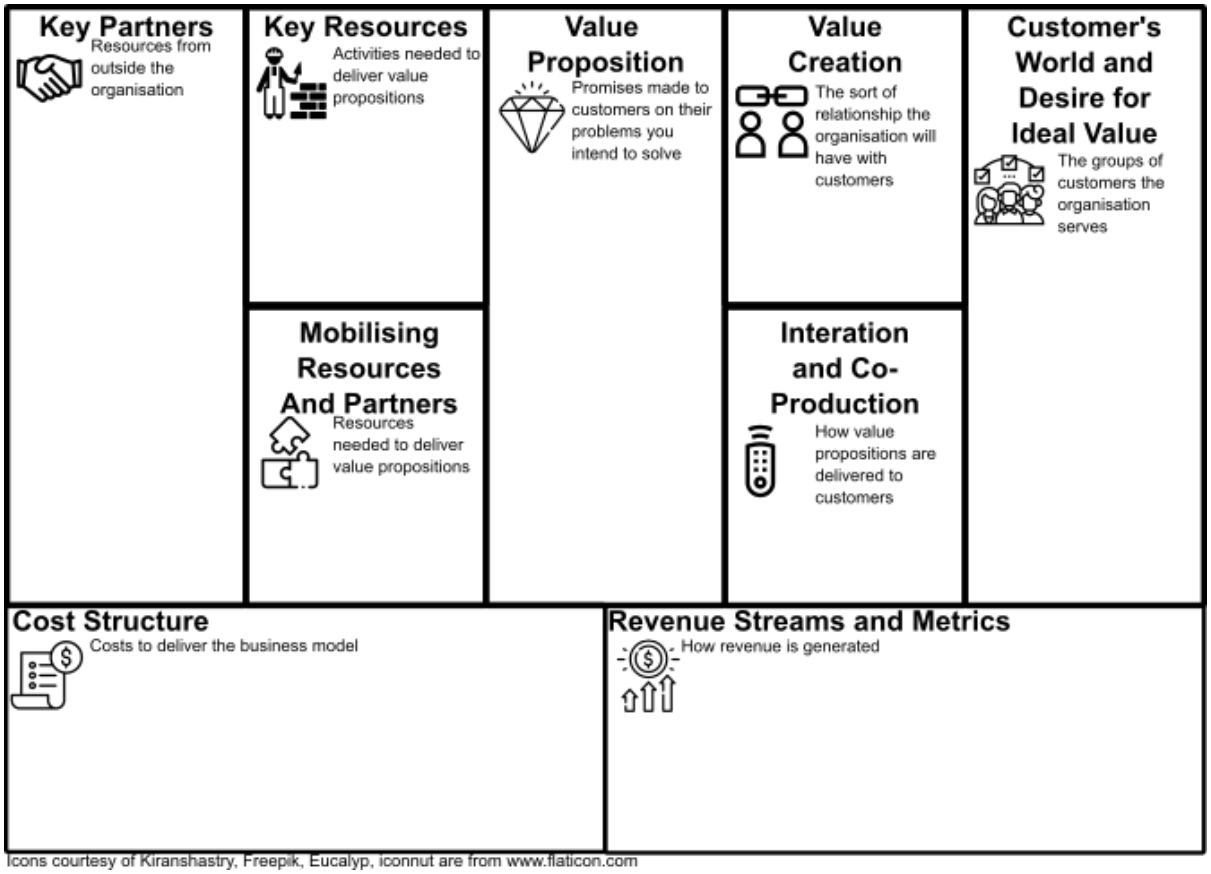


Figure 6 The service model canvas [3]

The business model was completed in the way proposed by Ojasalo and Ojasalo [3]. This process is shown in Figure 7.

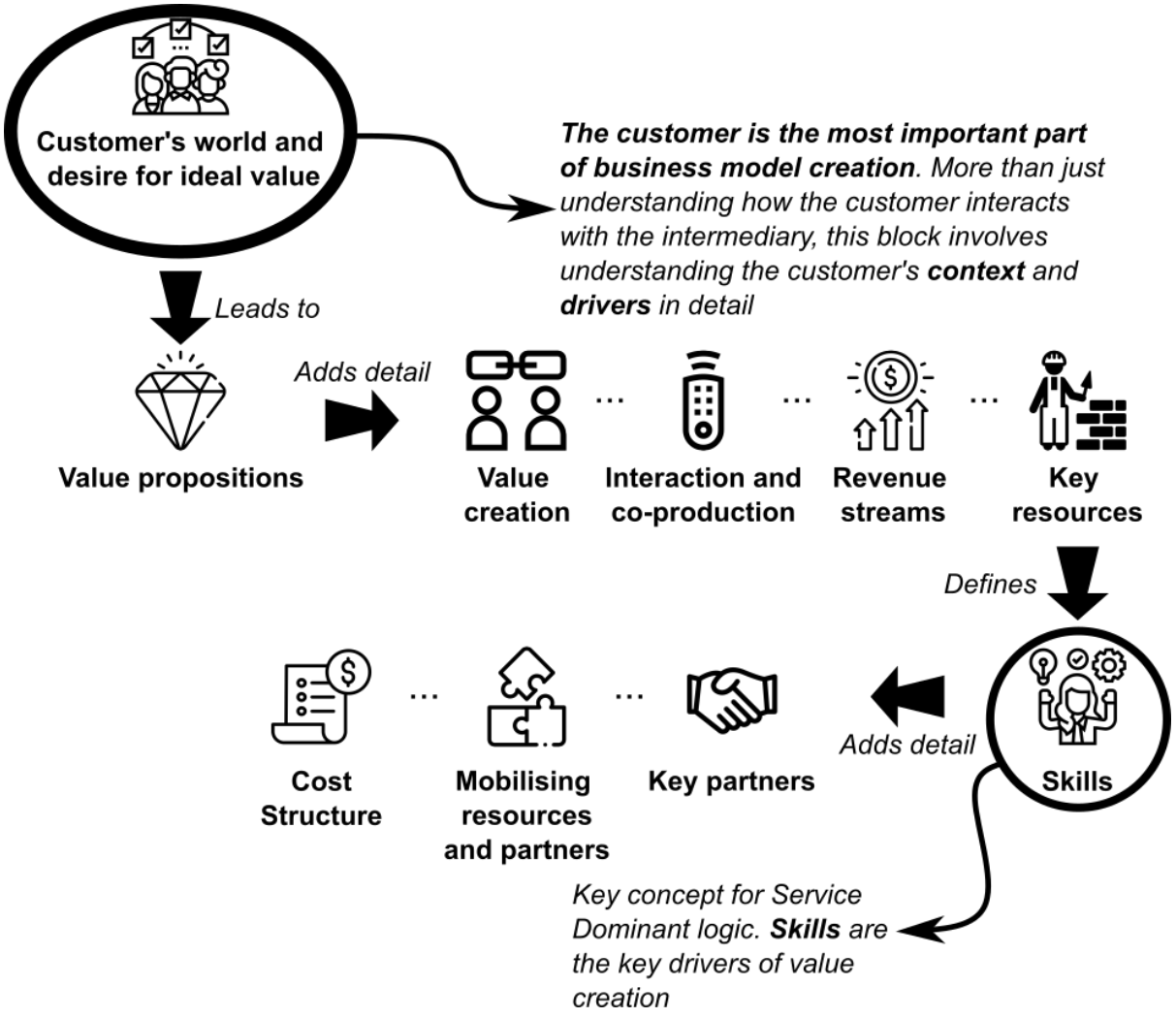
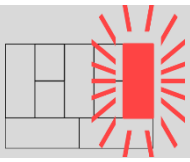


Figure 7 Canvas completion process overview

3. The customer's world



"The customers world is a prompt for intermediaries to empathise with customers"

The most important job for any business is to define who its customers are, and what sort of services they want. This chapter explores the potential customers of a V2G intermediary. It aims to do three things:

1. Define who the customers could be.
2. Explore their life in depth in terms of context, activities, practices and experiences.
3. Define what value they desire.

V2G's use cases are wide and varied. Interview participants spoke of many potential users and use cases. This chapter categorises these users into four groups, shown in Table 18.

3.1 EV Owners

A key question regarding V2G is why vehicle and energy users might become users of the technology. This question is particularly pertinent in the context of views (among some) that V2G is "a technology for the electricity market and by the electricity market" [16] or, perhaps less cynically, where the main benefits are public rather than private [17], [18]. There is good body of research on the barriers to V2G adoption among private EV owners, but little on fleets [19]. Most of the research tends to approach the question from the perspective of 'why not?' and accordingly aims to reduce the barriers to participation. In contrast, the 'customer's world' prompts in Ojasalo and Ojasalo's business model canvas offer a more positive framing of 'why' [3]. This section will respond to these prompts.

3.1.1 Fleets

Some argue that organisations are more likely to adopt V2G for their fleet vehicles than are private EV owners. They argue that organisations make more rational decisions and unlike private EV owners are less influenced by other values such as freedom, trust, and similar issues [20], [21]. This is reflected in research on V2G in fleets which tends to focus on quantitative modelling and cost-benefit analysis. However, organisations are very diverse with their own cultures, strategies, limitations and decision-making processes. Organisations interviewed as part of this research stated many goals and challenges, many of which did not directly relate to economics or cost-benefit analysis. These are described in Table 1.

Table 1 Customer's world block - fleets

What value is the customer buying?	• Self-image (innovation) • Public image / leadership • Protect the environment
What customer challenges and problems need to be solved?	• Is the additional cost of V2G in comparison to managed charging (V1G) worth it? • How to navigate the complexity or realising value from V2G? • How to demonstrate innovation publicly? • How to know emissions have reduced? • How to increase vehicle battery utilisation? • How to enable peer-peer trading?
What is the customer trying to achieve?	• Reduce total cost of ownership of electric vehicles • Reduce energy costs • Maximise usage of locally generated energy • Meet climate goals • Demonstrate new technologies • Benefit the local community • Reduce cost of providing service to customers • Make energy cheaper to local residents • Support the electricity network

V2G might be interesting to an organisation if it fits within their broader goals and strategies regarding energy, greenhouse gas emissions and adjacent issues. These goals and strategies can be framed in various ways (e.g., with different metrics or governance accountabilities) and have different co-benefits. They might be enacted within the fleet alone or be broader and more holistic. Organisations will weigh up the relative benefits of bidirectional charging (V2G) against other technologies, particularly single directional charging (V1G). Organisations with integrated energy strategies that combine renewable energy, power purchase agreements, energy efficiency, zero emissions vehicles, demand management and/or other actions are more likely to consider V2G because of V2G's interaction with the energy system.

Our research has identified at least five reasons why V2G might be attractive to fleets. These include:

1. V2G helps the organisation maximise on-site use of rooftop solar;
2. V2G allows the organisation to offer cheaper services (e.g., parking) than its competitors (discussed in 3.4.2);
3. The organisation is interested in trialling new technologies—for the broader public benefit, or for reputational reasons;
4. V2G provides public benefits (such as supporting the network), and the organisation is interested in the public good (e.g., a government organisation);
5. V2G provides a new income stream.

In addition to desiring financial benefits, research has identified a wide range of additional benefits that were relevant to their adoption of V2G, EVs and other clean energy technologies. The challenge for V2G will therefore be to create these benefits better than other technologies can. These benefits include:

- Learning about new technologies and new modes of vehicle ownership;
- V2G assists the organisation to meet other goals – e.g., install a particular quantum of solar-generated energy, particularly in areas where grid electricity was more emissions-intensive;

- Create jobs in the local community;
- Improve the capacity of local residents and businesses to adopt these technologies;
- Improve the capacity of local infrastructure to provide services to people;
- Improve environmental outcomes, such as battery utilisation over its lifetime;
- Reduce maintenance and breakdown downtimes;
- Demonstrate visible action that will be viewed positively by the community and other important stakeholders.

The reality is that many organisations do not take every action that would result in net benefit, including co-benefits. This is a problem well-understood in energy efficiency policy, and which V2G shares. Our research has found relatively modest desires for their ideal worlds, including:

- Upgraded buildings and facilities to contemporary standards;
- National and jurisdictional policy and regulatory settings that would facilitate the shift to zero emissions vehicles and clean energy, including incentives and minimum standards;
- Maximise installation of renewable energy;
- Peer to peer trading of renewable energy, resulting in plentiful cheap energy and relegating bill shock to the past;
- Better public transport, and integrated and convenient multi-modal transport options.

It is notable that none of these necessarily include V2G. However, V2G intersects with all of them due to its position at the nexus of energy, transport, infrastructure, and planning.

3.1.2 Private EV owners

There is a considerable body of research that has investigated private citizens' interest in V2G. As noted earlier, these studies tend to focus on barriers to adoption rather than why a person may opt into using the technology.

Willingness to pay experiments have found that the most important factors in determining whether someone might pay more for a V2G-capable vehicle are the effect on range [22], [23], and the type of contract involved [22], [24]. Regarding contracts, studies have found a high implicit discount rate for V2G, indicating a strong preference among customers for pay in advance or pay as you go contract arrangements that avoid fixed commitments [24], [25]. It should be noted that results often varied between countries, and there are currently no Australian studies.

Variables which appear to influence people's priorities and willingness to participate in grid services include: gender, with women valuing safety and convenience over EV performance [26] geography, income and political leaning [27], [28] as well as familiarity with automated energy management technologies [29]. Unsurprisingly, those who can afford an EV, are comfortable with new technologies, and skew politically green/left are more likely to be amenable. The people interviewed in the research largely fell into these categories and can therefore be considered as possible early adopters of V2G.

Table 2 Customer's world block – private EV owners

What value is the customer buying?	• Leadership • Inclusion/excitement/newness • Reduce carbon footprint • Self-sufficiency
What customer challenges and problems need to be solved?	• How will V2G impact the convenience of my EV? • Do I trust the provider of this service? • How can I share with the community? • How do I know if I have made a positive environmental contribution?
What is the customer trying to achieve?	• Reach personal "net zero" carbon footprint • Procure energy storage • Increase local use of PV • Share with local community • Be part of the leading edge • Reduce cost • Reliability and resilience

Private users were much clearer in their motivations relating to V2G than the fleet owners. Generally, they were motivated by a desire to reduce their personal carbon footprint. Direct interest in V2G or V2H was attractive because they liked the prospect of having a much larger battery than a typical home battery, which could have multiple impacts: not having to buy the home battery, having a battery that catered for occasional energy usage (such as having guests over for dinner), or having a ready replacement option when the home battery reached the inevitable end of its life. The benefit was greater coverage of household energy use and on-site use of solar; however, the fact that vehicles are driven away from the house from time to time worked against this benefit.

Some of the participants were interested in selling grid services in a true V2G arrangement for various reasons, such as curiosity about participating in the "sharing economy" or for profit. However, this sentiment could at least partly be attributed to an interest in new technology and experimentation that might not necessarily translate to mainstream adoption of V2G unless the process of experimentation reduced their concerns about trust and convenience.

The participants aspired to a range of benefits. They were actively interested in reducing their personal carbon footprints through technology and lifestyle changes, within the limits of their financial means and housing. This motivated them to adopt new technologies like EVs, solar and batteries, and spurred their interest in nascent technologies like V2G. They saw batteries (be they stationary home batteries or EV batteries) as useful in balancing energy flows to maximise consumption of their own solar energy and, to a lesser extent, earn income or bill reduction. In this sense, energy autonomy was an appealing benefit.

The idea of using the EV battery for backup power during an outage was of interest for similar reasons of autonomy. The participants lived in metropolitan areas not prone to outages, so it was less of an issue, but being able to cater for one's own energy needs under a range of circumstances was seen as positive.

Some participants were very attracted to the idea of being able to provide backup power to others (by driving their car to where power was needed) as they welcomed the opportunity to support their community. Other participants, however, preferred to give their own needs priority and did not see this as a private responsibility. If it was an emergency, these participants would expect to be compensated fairly.

Regarding EVs generally, participants particularly valued the fact their vehicles produced zero tailpipe emissions. Some were also very concerned about air quality since their recent experience living with intense bushfire smoke.

The participants' ideal world encompassed their house, appliances, energy technologies, garden, water, and transport, describing a lifestyle that was comfortable, low impact and convenient. They desired full electrification of their own energy consumption, powered by renewable energy. In terms of transport, some regretted needing to own a car at all and idealised a more walkable lifestyle. Other participants considered their car an important part of their family's lifestyle, particularly for long trips.

They described a sustainable lifestyle that was comprehensive and was enabled by their own private property. The lesson for V2G or V2X is to fit within this full picture in a way that improves on the alternatives, particularly stationary batteries and V1G.

3.2 Grid operators

Grid operators are a group of participants tasked with the stewardship of the grid. They manage day to day operation and make investment decisions. There were several organisation types within this group:

- Electricity networks
- Market operators
- Microgrid operators

Distribution networks were the largest group interviewed and the most common customer type mentioned both by the networks themselves and other participants. One microgrid operator was interviewed. No market operators responded to interview requests.

As the most common customer type mentioned, this section will focus most on the needs of distribution network. Other customer types are mentioned where relevant.

Grid operators largely considered use cases for V2G that were like a stationary battery. In this case mobility is detrimental to performance. It means the vehicle may not be there when it is needed. Mobility isn't always a detriment though. For example, one participant described the value of V2G for park and ride or large car parks:

> *"For example, if you know people are driving their cars into the city there is correlation between them being in the city and causing load" – Dylan (Microgrid operator).*

Table 3 shows a summary of the benefits.

Table 3 Customer's world - grid operators

What value is the customer buying?	• Confidence • Simplicity • Public and regulator image • Fairness and openness
What customer challenges and problems need to be solved?	• How do I standardise my grid services arrangements? • How do I get customers to accept more grid management responsibility? • How do I ensure there are adequate services to manage the grid? • How can demand response be cost-competitive with network investment? • How can I demonstrate my actions are addressing climate change? • How do I avoid repeating the issues caused by PV? • How do I stop EV charging from causing network peaks?
What is the customer trying to achieve?	• Meet grid performance standards • Reduce cost of providing grid services • Keep customers happy • Simplify procurement and day-to-day management of the system • Comply with regulatory requirements • Meet climate goals • Increase role of customer in managing grid

3.2.1 Manage technical grid performance

Grid operators primarily manage technical capacity. Their role is to ensure sufficient capacity is available as required. Capacity needs vary temporally and locationally depending on load and generation patterns, particularly in the case of distribution networks. Insufficient capacity can manifest in poorer power quality (e.g., frequency, voltage, and harmonics), poorer reliability (outages), or negative impacts on assets (overload). These challenges are expected to be exacerbated by the increasing adoption of electric vehicles. Interviewees felt that unmanaged charging loads would be highly co-incident, leading to congestion. They discussed this against the backdrop of the preceding air conditioning and solar booms and were keen to avoid these mistakes. As one participant put it:

> *"Australia completely missed the ball on the AC (Air-Conditioner) boom of the 90s, completely missed the solar boom. If we don't get it together, we'll miss the EV boom as well" – Cristina (industry expert).*

Flexible generation or demand provides capacity to grid operators. Critically though, this must be in an appropriate time and place, at a low cost, and have sufficient reliability.

Particularly for distribution networks, capacity needs are highly locational. Congestion can occur at any point in the network and may only impact a single low-voltage network. These networks may have as few as one to a few hundred energy consumers. There was significant scepticism that V2G could resolve local network issues due to the need for the congestion and the V2G resource to be at the same point in the network. As compared to other forms of demand response such as distributed storage, V2G was expected to have higher risk due to the vehicle's mobility.

Similarly, microgrids have specific needs. In small power systems fast control is more important due to faster changes in system state. Microgrid operators fill multiple power system roles therefore the services they require are all those that are distributed across multiple organisations in a larger grid. So, in this sense they have the role of grid operator and financial participant.

Energy market operators were not interviewed as part of this research; however, several energy retailer or aggregator participants had provided services to the energy market and were able to recount their experiences. They described their relationship with the energy market operator as being like their relationships with distribution networks. Markets are settled on a purely financial basis; however, as with connections to distribution networks, entry to markets is governed by technical standards. Market operators retain a gatekeeping role, particularly for system critical markets like frequency control.

Traditionally grid operators have met their needs with capital investment, particularly in the case of distribution network operators. Increasingly regulators are pushing grid operators to invest in more “non-network” or “non-wires” solutions. Demand response exchanges such as DeX [30], piclo [31], and nodes market [32] all make it easier for grid operators to strike bilateral contracts with demand response providers. Similarly, initiatives such as the Australian Energy Market Operator’s (AEMO’s) VPP demonstrations [33] program enables resources such as V2G-eqquiped EVs to participate in existing energy markets more easily.

Distribution network operators, however, largely felt that bilateral contracts were not the best outcome long-term. Rather they expected their role would largely be supplanted in the longer term by existing network pricing mechanisms and operating envelopes (see 3.2.3 for more discussion of this).

3.2.2 Minimise cost, risk, and complexity

Grid operators operate somewhat differently to other energy system participants. They are treated as “natural monopolies” and hence have some form of price control set by a regulator. This forces these organisations to justify the prudency of their investment decisions to regulators. Similarly, rules prevent grid operators from certain business activities such as direct ownership of behind the meter assets such as V2G chargers.

This means intermediaries fill a valuable role in enabling grid operators to access flexibility from resources such as V2G. Intermediaries were described as filling three key roles: Reducing the complexity of relationships, sharing risk, and reducing capacity management cost.

Reducing complexity is a key role for intermediaries. Flexibility services are highly technical. People who are providing services to distribution networks such as intermediaries must understand the service they are offering and what it means to them. There are many concepts and risks that impact service delivery, for example required response time and how levels of service are measured. Grid operators described the long journey required to educate prospective intermediaries of their needs. Most grid operator respondents felt educating their customers was a key service intermediaries provided, at least for the intermediary’s smaller customers. As described by one participant:

> *“They [intermediaries] should help bridge the requirements between our technical requirements and the market” – Jonathon (Distribution network).*

The relationship a grid operator has with flexibility service providers is different to what they traditionally have had with an energy customer. As one distribution network put it:

"In the [distribution] business we think of an [energy consumer] and a supplier very differently" – Julie (Distribution network).

In practice this means it is normal business practice to place commercial pressures on a supplier, whereas this would not be an appropriate way to interact with an energy consumer. Intermediaries allow grid operators to have commercial negotiations with fewer counterparties with specialised expertise. This removes the need for a change in relationships with energy consumers and reduces the education task.

Risk was a topic of discussion for several interviewees. Most of the services that may be transacted between intermediaries can be considered as a transfer of risk. For example, a demand response contract with a distribution network transfers some part of their congestion risk to the intermediary in exchange for a payment. The intermediary presumably has a lower-cost way of managing this risk than the distribution network, so the transaction is beneficial for both.

The discussion in risk was nuanced and covered several interrelated factors. For the purposes of this discussion, it is described in three domains: Asset investment, service delivery, and validation.

Asset investment was described as a "chicken and egg" problem:

"Possibly one of the largest barriers for VPPs is this chicken and egg scenarios where you are dealing with DNSPs who want to buy an aggregated service. They are typically dealing over a longer period of time. On the flip side of the coin, it's a key part of the value proposition for consumers making purchasing decisions" - Troy (Aggregator).

Simply this means that grid operators are unlikely to sign a services agreement unless there is capacity to meet their needs, but this means that intermediaries must procure this capacity in advance of revenue from the grid operator. There will be a delay between the intermediary acquiring customers and getting revenue to pay them with. Additionally, if the intermediary cannot procure enough capacity the grid operator may not elect to use their services at all. For the grid operator, procuring services from an intermediary in this way is more complex than investment decisions for traditional assets because if purchasing their own assets the grid operator controls the entire investment pipeline and can choose when, where and how much capacity they procure. This issue could be partially resolved if the grid operator pays the intermediary upfront for capacity through an equipment subsidy (e.g. for V2G chargers). Upfront subsidies transfer some investment risk from customers to grid operators because the grid operator then takes the risk of the service not being required if grid conditions change. This however introduces different risks. EV owners may be left with an uncertain impact on their vehicle due to the services they must provide to grid operators, and grid operators take on the risk of customers being unable to participate in the future when services are needed. These issues are important now as the flexibility market develops. These issues are exacerbated by the immaturity of the market. If there is a significant number of EV owners with V2G chargers installed already, grid operators can be confident enough capacity exists to meet their needs. Similarly, if grid operators routinely buy services from intermediaries, they can be confident they can offer a compelling value proposition to EV owners.

Risks also exist once investment decisions are made. Electric vehicles are different to other demand response asset types like stationary batteries or generators because they are also a means of transport. Interviewees felt they were more risky than other types of demand response because of these factors. This exacerbates the perception that other asset types like generators and batteries are already risky in themselves. Vehicles may not be plugged

in when needed and their capacity is limited by the energy that must be reserved for transport needs. Grid operator's demands for certainty are high:

> *"It's got to be closer to 80-90% reliable before that's something that I can realistically dispatch, and trust will manage to keep the network stable" - Julie (Distribution network).*

The impact of transport on service delivery was considered as the largest factor that may prevent V2G from being a credible solution to grid operator's needs, particularly distribution networks where the limited geographical area of need constrains the market size. Managing these risks was universally seen to lie with the intermediary. They were expected to use their access to data on the usage and intentions of their customers to present certain amounts of service to grid operators.

The way response is dispatched also has a significant impact on how risk is shared between grid operators and intermediaries. There were two commonly discussed alternatives: either as a dispatched service or as a continuous response to a control signal. Dispatched services place the responsibility on the grid operator to work out how much service is required and when. Intermediaries simply need to ensure that they have the capacity to respond at the required time. This is common in current distribution services markets. Alternatively, the job of managing a real-time control signal may be delegated to the intermediary. Markets where a very fast response is required such as frequency control ancillary services are an example of continuous response to a control signal. In this case the intermediary takes additional risk in measurement, dispatch, and forecast. Grid operator interviewees were implementing both dispatched services and continuous response depending on their needs. Micro-grid operators and market operators were more likely to expect intermediaries to manage real time signals while distribution networks were more likely to dispatch services as needed.

Risks also exist in how service delivery levels are validated. Validation relates to how demand response levels are assessed for payment. The signal and verification method used strongly impacted the level of risk assigned to intermediaries. Most commonly, some sort of baselining was used to measure response. Baselining compares a metric (e.g., site consumption) during a period when response was requested with an estimation of what the metric would have been had response not been requested. The measurement point and baselining methodology can dramatically alter the risk. For example, consider a domestic V2G-equipped vehicle. If the measurement point is the dwelling's connection point, the intermediary takes the risk of unusual home consumption. If the customer has higher than expected consumption during the event, the car is not there, the charger fails to respond, or the intermediary fails to act on the signal correctly. Alternatively, the activation signal itself may be the measurement point, in which case these risks fall on the grid operator.

Grid operator participants spoke in detail on the impact of these risks on their internal operations and business case. Most participants (including both those who were and weren't grid operators) felt that grid operator needs were more important than that of other users of services from V2G:

> *"The government has indicated that grid stability is the most important [requirement] because if you haven't got the grid no one else can do anything anyway" - Jamie (Distribution network).*

Grid operators are sceptical of V2G's capabilities to provide grid services, considering that vehicles primary use is for transport. They emphasised that intermediaries will need to demonstrate that vehicles are able to provide the required high level of certainty.

The value grid operators can transact with intermediaries may be relatively small overall. Although traditional network solutions are often relatively high cost, it is offset by their relatively large capacity, long lives, and well-understood risk profiles. Distribution networks felt that aggregators envisaged far higher value from demand response payments than was realistic. As one respondent put it:

> *"Ultimately with all this [flexibility services] the kind of value proposition for [asset] deferral is pretty low... we're generally talking of a value of five or six percent [of the total investment cost] for a year" - Jonathon (Distribution network).*

This contrasted with the viewpoint of aggregator interviewees who felt the large costs of network investment would lead to a larger source of revenue in the future.

Some participants felt that aggregation through intermediaries was too expensive for the service provided. Aggregator costs were high with too little benefit passed on to vehicle owners. As one participant put it: "

> *As yet... and it's very early days... it has been difficult to justify the kind of margin aggregators are typically looking for" - Julie (Distribution network).*

Similarly, participants raised issues around the transparency of revenue flows between the grid operator and vehicle owners.

3.2.3 Standardisation

Grid operator interviewees largely expected V2G fit within existing ways of managing the network. If services are procured through bilateral contracts, intermediaries must reform V2G to fit within their standard terms. However, particularly for distribution network participants, this was not seen as the goal.

Bilateral demand response contracts were largely seen as a transient solution by distribution network participants. In the longer term, they felt the need for these contracts would be supplanted through use of more advanced network pricing and connection agreements. These signals delegate the responsibility of responding to congestion to the customer:

> *"From the monopoly network point of view, we have the idea of technology neutral signals and cost reflective pricing for all. You are creating the value opportunity there and letting people respond how they want" - Jennifer (Other/Energy regulator).*

This means that distribution networks were largely not expecting to be customers of intermediaries in the future:

> *“Our relationship is with the energy consumer. They’re the ones with the connection agreement and they are the ones ultimately paying for network capacity. They might delegate some of that or have an aggregator acting as their agent” – Todd (Distribution network).*

Although this was the long-term aim, tariff reform was seen as a long process:

> *"Network pricing reform is notoriously slow right? So, we've just got to time of use pricing this year. Is that dynamic? Depends on your definition of dynamic." - Todd (Distribution network).*

This didn’t mean that there was no role for V2G intermediaries, simply that EV owners would be the ones who engaged them. One reason EV owners may elect to have an intermediary manage their connection agreement could be to unlock extra capacity that could become available due to the intermediary’s relationship with several EV owners nearby:

"[If the EV owner has appointed an intermediary as their agent] we could tell the intermediary 'do what you like, but for this group of EV Owners, their aggregate export must not exceed 50 kW'" - Todd (Distribution network).

In this sense, distribution network operators were looking to standardise their relationships as being with the energy consumer. These relationships are abstract from the technology (such as V2G) that is being used to respond to the distribution network's needs. This means that the question for V2G intermediaries is how V2G can help energy consumers meet the needs placed on them by distribution networks.

Microgrid operators in this context were unique in that they commonly also provide the functions of an energy retailer. This means they have closer relationship with their customers, which potentially necessitates a deeper engagement with the underlying technology providing them grid services. This challenges standardisation because of the more specialist services required.

3.2.4 Other services

There were other services mentioned by several participants. These included data, a desire to be innovative, and environmental drivers.

Data was described as a specific service more often by participants who were not grid operators. These participants described data provided by intermediaries from vehicles as equivalent (or almost equivalent) to smart meter data. Grid operators however mostly did not mention data as a specific service. They described the lack of smart meter data as a constraint to meeting their other needs:

"The vast majority of our customers aren't half hourly metered, so their consumption is presented to us through just a standard profile. The Distribution Network Operator bit has been set up, but the rest of the market isn't quite there yet" – Jonathan (distribution network).

This did not translate into a desire to procure data as a service however as it was expected metering would soon catch up. Some grid operator interviewees felt the mobility of EVs required more specific data than may be delivered by metering alone:

"It's different because the resources trundle around. If we need to manage network capacity, we are going to need some visibility as to where they are going" – Todd (Distribution network).

Data was still important, however. Forecasting and validation were discussed in detail. Both were not described as services per se, but more as a necessary part of delivery of other services. Forecasting is required to assess whether there are adequate reserves to manage the system in the future. This is a particular need for microgrid providers due to the smaller system size.

Several respondents discussed public image or innovation as a driver for grid operators. Largely these respondents were not grid operators themselves though. Distribution networks described their role as to create an environment where it is easier for others to innovate. This involved creating standard platforms (see 3.2.3) which made value transfer easier. Microgrid operators were an exception. As they also fill energy retail roles, they are directly responsible for offering customers services.

Environmental drivers were only specifically mentioned by the microgrid operator participant. Microgrids commonly are supplied by fossil fuel, usually diesel or gas. V2G is potentially a means of reducing emissions from supplying micro grids. Network participants largely did not

mention environmental drivers as an influence on their purchasing decisions. This may be reflective of the regulatory environment which (in Australia) does not currently explicitly consider environmental drivers.

3.3 Financial participants

Financial participants are those that buy and sell energy and energy services. This may be to create value (e.g., price arbitrage), to purchase energy on behalf of their customers, or to optimise their portfolio of other assets. There are two organisation types within this group:

- Energy retailers
- Aggregators

Generators were mentioned as another class of financial participant by some participants however none were interviewed and there was not sufficient information to individually discuss them. There were 9 financial participants interviewed: 4 aggregators and 5 energy retailers.

There was tension between the role of a separate V2G intermediary and that of a financial participant, particularly energy retailers, as there was a strong sense of ownership of the customer amongst most retailers. Retailers expected they would internally develop aggregation capability rather than procure services from an intermediary:

> *"Retailers don't want anything to do with aggregators because retailers can do the same thing" – Marc (energy retailer).*

Further discussion showed that retailers may wish to work with intermediaries in certain circumstances. This could be seen as three contexts: where there is a financial service they require, where there are demands from or an opportunity amongst their customers, and as a means of expanding scale.

Core drivers of value were financial risk management, economies of scale, and economies of scope.

Table 4 Customer's world - financial participants

What value is the customer buying?	• Confidence • Assurance • Opportunity
What customer challenges and problems need to be solved?	• How do I manage an increasingly peaky market price? • How do I manage an increasingly peaky customer demand? • How can I be sure V2G can provide the service I need? • What is V2G's place amongst all my other assets?
What is the customer trying to achieve?	• Reduce price exposure to extreme price events • Reduce peakiness in customer demand • Forecast customer consumption • Understand customer's energy needs • Attract more customers • Ensure customers are treated ethically • Offer more services to existing customers • Expand flexibility portfolio

3.3.1 Financial risk management

A large part of financial participants' role is managing increasingly volatile prices while customer demand is increasingly peaky. As one interviewee stated:

> *"Retailers have a pretty horrible load profile and it's getting worse as more people are getting solar and the evenings are getting spikier" – Adrienne (energy retailer).*

Solar hollows out midday demand, meaning that customers reduce consumption or begin generating at the time price is lowest. EVs potentially can increase evening peak demands, which has the effect of increasing demand when energy prices are the highest.

Currently volatile prices are managed either through various types of hedging contract, or through assets owned by the participant. Hedging contracts pass the pricing risks on to an organisation with a means to manage it (for example a generator). There are several types of hedging contracts commonly used. Resources the participant owns themselves (such as generators or forms of demand response) help them manage this risk. Where a participant has excess capacity to their needs, they can sell this excess capacity as a service to other financial participants. Intermediaries could be one of these sellers of excess capacity.

Certainty is critical; many participants were sceptical of V2G's capacity to deliver it. The interplay between customer's transport needs and the certainty of providing the V2G service was unknown. As one participant put it:

> *"The people want to have a car, the energy industry wants to have the battery… Maybe it's a bit hard to find out where these objectives meet?" – Adrienne (energy retailer).*

The certainty driver for a financial participant is like that of the grid operator as described in 3.2.2. The risk outcome of non-delivery is different though. Instead of asset damage or safety the impact is financial. As one participant described it:

> *"The outcomes from a risk perspective are a bit different. If you are working with a retailer and your service are less than committed, then there is a financial impact. But on the DNSP side of things there could be safety or reliability of supply implications" – Troy (aggregator).*

While V2G may potentially be able to provide the required certainty to provide financial hedging instruments, it is likely a challenging task. As Randall, an energy retailer, described it:

> *"Your competitive advantage in a virtual power plant will be your cost to acquire and flexibility of your portfolio" – Randall (energy retailer).*

This likely requires a financial participant (such as a larger aggregator) to have access to multiple types of assets. Financial participants may seek out V2G intermediaries to diversify their portfolio and access the intermediary's lower acquisition cost. In this case the aggregator may require more direct operational control of the intermediary's assets. The value of V2G in this respect will be how the asset fits within the portfolio of other asset types. For example, V2G may be less available, but is faster than a behavioural demand response program.

3.3.2 Economies of scale

Financial participants are competitive, customer facing organisations. With very few exceptions, all grid-connected energy users have a relationship with an energy retailer who manages purchase and retail of energy on their behalf. Aggregators have relationships with

their customers based on equipment or services revenue. Acquisition and retention of customers are strong drivers for these participants, as would be expected.

Customer acquisition and retention can be thought of as creating economies of scale: costs do not scale proportionally with numbers of customers therefore it is cheaper to serve more customers than less on a per-customer basis.

There was some difference between the responses of aggregator and energy retailer participants. Aggregators more often expected to be providing their services to energy retailers rather than forming agreements with other aggregators or intermediaries to offer additional services to their customers. Energy retailers were more likely to be considering offering V2G to their customers themselves or through partnering with other organisations such as intermediaries.

Participants were of the view that competitive pressure forces energy retailers to remain responsive to customer needs:

> *"If the customer base demands for a service, then the retailer will be forced to partner with an aggregator to offer it if they can't do it themselves" – Marc (Energy retailer).*

The key question in this context is around the relative merit of developing versus outsourcing aggregation. It will cost a retailer to internally develop a technology or service and it may be cheaper or easier to outsource it. Similarly, a retailer partnering with an aggregator may increase the retailer's attractiveness to customers. This approach can be seen through some BYO battery deals currently offered in Australia [7], [34].

There was some concern amongst participants that aggregators may not offer customers the same protection to which energy retailers are bound to provide by law. There was concern that unethical behaviour may cause damage to the customer's assets or produce poor financial outcomes. This would reflect badly on the financial participant and the industry as a whole.

3.3.3 Economies of scope

Economies of scope can deliver similar benefits to economies of scale. Economies of scope occur when the same organisation or platform delivers more services from the same infrastructure. Contemporary digital platforms such as Uber are an example of this. Initially Uber was about disrupting the taxi industry. Later they leveraged the same infrastructure to also deliver food and packages. With many drivers on the road always, the data became of value itself and could be packaged into traffic data for local governments or other organisations.

Financial participants (particularly energy retailers) described the additional services V2G would enable them to deliver around transport. Electric transport was seen as a logical increase in scope from energy, particularly vehicle leasing and mobility as a service:

> *"You could aggregate the platform around the vehicle lease, but you could have mobility as a service, which is a much bigger play" – Randall (energy retailer).*

These moves can be seen in the market with vehicle leasing or mobility products increasingly being offered by energy retailers [35]–[37].

A greater footprint across the electric transport landscape allows more control over vehicles, their charging, and the services provided from them. For example, the concept of public car parks providing V2G-like services throughout the day was discussed by several participants. Beyond simple V2G and grid services, the battery capacity can be used to form a microgrid

and provide charging services to other vehicles such as taxis throughout the day. These added services add revenue and further expansion opportunities.

3.4 Other groups

While most interviewees focussed on the types of participants discussed above, there were several other potential participants in the V2G landscape discussed. These included:

- Embedded networks and community energy schemes
- Emergency or event power
- Car parks
- Car share schemes
- Vehicle manufacturers

3.4.1 Embedded networks and community energy

Embedded networks and community energy was raised by several participants. One interviewee also had a role in an embedded network microgrid. Embedded networks are where a section of network connecting to multiple customers is managed by someone other than a distribution network. This is common in apartment buildings, caravan parks, and shopping centres. Embedded networks are also sometimes used in residential developments or communities to make better use of locally generated energy. Many customers in an embedded network receive an energy bill from the embedded network manager. Community energy schemes are in some ways similar, except they usually operate across the shared network managed by the distribution network service provider.

Embedded networks and community energy schemes can potentially benefit from energy management in a constrained geographical area. Energy management enables them to better use local generation and storage to offer customers energy in line with their values. In this context V2G is just another tool available to manage energy. As both a flexible load and generation source, V2G can provide similar energy services as can a battery. Depending on the context, mobility can increase or decrease the value of the vehicle over a battery. For example, V2G allows export or import of energy without a permanent physical electrical connection.

Community energy and embedded networks exist for a variety of reasons. Some are due to circumstance (such as a caravan park or shopping centre). In this case customers in the network may be driven similarly to those in the wider energy system. On the other hand, they may be formed around a common cause. For example, Narara ecovillage operates an embedded network to reduce infrastructure costs, balance and optimise the use of solar PV and battery storage, and produce a net carbon neutral village [38]. In these communities the environmental benefits of electric transport, and potentially V2G, may resonate more than they would elsewhere.

Community energy and embedded network operators have diverse ownership and operational models. There are several specialist embedded network operators who provide management services, including energy retail functions. Some (such as Narara) choose to operate the systems themselves. Commonly these organisations are smaller and have less capability to manage V2G themselves. Intermediaries can provide services to enable V2G on these small networks. These services are largely like those they might provide grid operators or financial participants. The locational nature of Community energy and embedded networks creates unique challenges and advantages. Getting sufficient density of

V2G-capable electric vehicles in a small area is challenging, but common cause may aid uptake where V2G aligns with community values.

Table 5 Customer's world - Embedded networks and community energy schemes

What value is the customer buying?	• Certainty • Innovation • Environmental impact • Reduce complexity
What customer challenges and problems need to be solved?	• How to I manage V2G to meet my goals? • How do I know I have made an environmental impact? • How do I ensure customers have control and choice? • How do enable participants to get EVs? • How do I mange vehicle availability?
What is the customer trying to achieve?	• Make most use of locally generated energy • Ensure local energy aligns with participants values • Generate revenue or reduce energy costs • Enable electric transport • Increase resilience and reliability of local area • Manage local network • Reduce environmental impact

3.4.2 Car parks

The value of V2G in car parks was discussed by several participants. The large collections of idle vehicles in a car park creates an opportunity for services to be provided from their batteries. Car parks have unique properties that make them attractive providers of grid services:

- Vehicles are often located in areas where demand is high
- Many vehicles in one place creates a large opportunity for services
- EV owners increasingly will expect charging to be provided at places where cars are parked

Participants spoke of several capabilities that may be important for this use case:

- Systems that ensure vehicles leave the car park with the correct state of charge
- Systems that collect customer preferences and manage them
- Systems to extract value from parked cars

The grid services revenue could be provided back to drivers in various ways such as free charging, reduced cost parking, or value add services such as car cleaning. Similarly, the flexibility capability of the parked vehicles could be used to provide other services such as fast charging for taxi fleets, managing local building demand, or maximising value of local generation.

Participants expected that car park operators would use an intermediary to enable these services. Individually car parks are unlikely to have the required scale, and car park operators are not experts in energy. Intermediaries can exploit economies of scale to provide these services at a lower cost.

Table 6 Customer's world - Car parks

What value is the customer buying?	• Assurance • Opportunity • Reduce complexity
What customer challenges and problems need to be solved?	• How do I ensure customer's preferences are met? • How do I manage vehicle capability? • How do I manage V2G to maximise revenue?
What is the customer trying to achieve?	• Offer a cheaper car parking service • Manage customer preference • Procure revenue • Manage local demand • Offer value-add services

3.4.3 Car share schemes

Car share schemes provide shared vehicles which can be used by subscribers as required. There are several examples of active car share schemes [39]–[41]. Most of these services currently use internal combustion engine vehicles, however some are beginning to transition to electric vehicles. Car share schemes can offer their users the lowest cost if they maximise the usage of their vehicles. Car usage is variable, with higher use at some times of the day than others. V2G is a way that the idle vehicles can still deliver value.

Car share schemes are operated in several different ways. For V2G a critical factor is the level of booking required for use of the vehicle. Some schemes are "turn up and go" while others require that users book vehicles. The latter scheme is more likely to be suitable for V2G as it's easier to anticipate energy needs. Certainty is important to car share scheme operators as vehicles are their source of revenue.

It is currently unclear how charging will be provided for electric car share vehicles. They may be within a building or on the street. In these situations, it may be challenging to manage cost or revenue allocation. This may be exacerbated with cars across several sites with different pricing structures and energy retailers. Intermediaries may be able to offer solutions to these issues.

Table 7 Customer's world - Car share schemes

What value is the customer buying?	• Certainty • Opportunity • Reduce complexity
What customer challenges and problems need to be solved?	• How do I manage state of charge of my vehicles? • How do I enable connection to the electricity network? • How do I reduce my costs?
What is the customer trying to achieve?	• Provide a low-cost car share service • Procure revenue • Enable connection of chargers • Use idle vehicles

3.4.4 Emergency or event power

For most interviewees the mobility of EVs was detrimental to its value for V2G. There were a few use cases that used mobility as an advantage. EVs have the potential to transport energy to locations it is needed. Emergency and event power were two of these cases.

Emergency power involves electric vehicles supplying small, islanded systems during blackouts or natural disasters. For example, V2G-equipped electric vehicles could be connected to existing solar arrays at community halls during bushfires to provide power to people sheltering there. These vehicles may be used for transport by community members normally.

Event power is where V2G-equipped vehicles are used to help supply energy for events such as music festivals. These events are episodic and often remote from grid infrastructure. The batteries in the organisers or patrons' vehicles could form a microgrid with other generation or storage sources. Participants were unsure how bidirectional charging would function with patrons' need for a charged EV when they depart the event.

Both cases have unclear commercial models. It is unclear if there is a role for an intermediary. Most participants felt that the more standard use cases would need proving before these would become credible.

3.4.5 Vehicle manufacturers

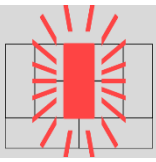
Vehicle manufacturers have a critical role to play in the V2G landscape. Without their support V2G is unlikely to happen. Interviewees described explicit support, both at a hardware and warranty level, as critical for successful uptake of V2G. In this series of interviews three vehicle manufacturers were interviewed.

Many vehicle manufacturers were participants in current V2G projects. Trials create a direct one-to-one relationship between vehicle manufacturers and V2G intermediaries (commonly energy retailers). This enables the two organisations to work in a coordinated fashion, which is particularly beneficial for their clients, the EV-using organisations participating in the trials, which tend to manage fleets and energy separately. Beyond trials, manufacturers agreed the relationship would need to change, however they expected to have an ongoing role connecting vehicle purchasers with V2G market offerings. They described a process where vehicle owners would be recommended a list of intermediaries who offered compatible V2G products. It was unclear at this early stage what would drive the recommendations that vehicle sales staff make.

Vehicle manufacturers already hold a gatekeeping role for V2G projects. For the REVS project Nissan explicitly approved the use case. Proponents of other trials mentioned similar processes. This approval is required so that Nissan can determine if the prospective use case will cause undue wear of the car's battery and/or void the warranty.

Even though vehicle manufacturers may not have a services relationship with intermediaries they are a critical stakeholder in the V2G landscape. V2G capabilities must be built into vehicles in the first instance, and their approval is important both for warranty support and connection between new vehicle owners and intermediaries.

4 Value propositions



"value propositions are suggestions of the value that a customer could get from the intermediary"

This section summarises the value propositions. However, summarising such diverse value propositions inherently loses a lot of detail. The much more detailed full set in the business model worksheet published with this document.

The interviews identified 4 classes of value propositions that an intermediary could make. These are described in Table 8.

These value propositions link back to customers as shown in Figure 8. Numbers in the diagram represent numbers of value propositions and don't indicate relative importance of each one.

Table 8 Classes of value propositions

Class	Description	Example value propositions
 Reduce cost	Reducing cost was important to most customers. Some examples are energy costs, vehicle ownership costs, investment costs, or lease costs.	• EV Owners reducing EV charging costs or total energy costs • Grid operators reducing grid management costs • Financial participants reducing costs to serve customers
 Progress toward strategic goals	V2G is not usually an end itself. This category of benefits relates to how V2G can help customers meet their goals. For example, emissions reduction, tariff reform, and entering new markets are all goals stated by customers.	• An EV owner who wants to reduce emissions • An EV owner who wants to share with their community • A Grid Operator who wants to reform energy pricing • A customer who wants to demonstrate emissions • A financial participant who wants to enter new markets
 Reduce complexity	Where the customer wishes to use V2G and the intermediary's value proposition is to reduce the complexity of doing so. These value propositions are around converting V2G into forms that fit customer needs better, such as standard network support or market price contracts.	• A financial participant who wants to reduce the complexity of adding V2G to their portfolio • A grid operator who wants to reduce complexity of managing their network • A car park operator who wants to reduce the complexity of adding V2G to their operations
 Reduce emissions	Many customers uptake V2G to reduce emissions. These value propositions are around helping customers reduce emissions and demonstrate their emissions have reduced.	• An EV owner who wants to ensure driving is emissions free • An EV Owner who wants to meet their net-zero objectives

		• A community energy scheme who wants to ensure local generated energy is used locally

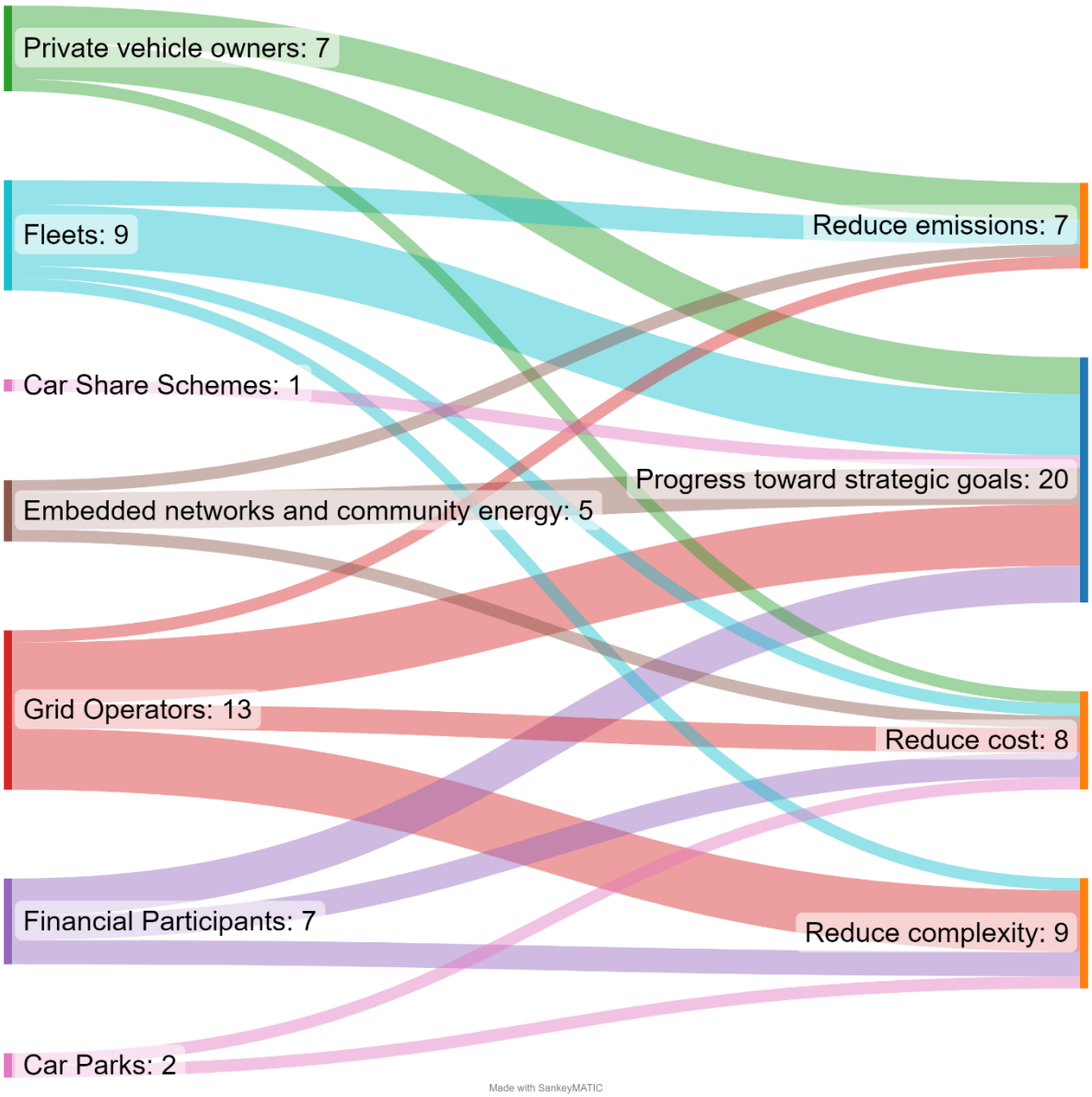
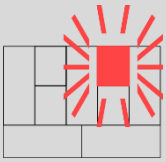
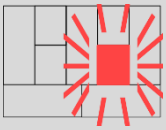


Figure 8 Value proposition linkage to customers. Numbers in the diagram represent numbers of value propositions and don't indicate relative importance of each one.

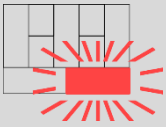
5 Making value propositions real



"Value creation is how value propositions are embedded in the life of the customers. It asks us to analyse how value is created and how the intermediary facilitates its creation."



"The interaction and co-production block describes how the customer interacts with the intermediary's activities. It asks what processes the customer is using to realise value and how the intermediary interacts with them."



"The revenue streams block analyses how revenue generation occurs. It is important that revenue generation is linked back to customer value. In other words, customers are most likely to pay for things they value."

The "value creation", "interaction and co-production", and "revenue streams and metrics" blocks in the service model canvas are about how value propositions are made real for customers, and how this value relates to revenue for intermediaries. These blocks ask business model designers questions to help them understand how value is created, how customers and intermediaries are involved in the creation process, how this relates to revenue for intermediaries, and how this relates to benefit for customers.

More detail on these blocks can be found in the business model worksheet. In this chapter we will discuss three example value propositions through the lens of these three blocks:

- A fleet manager who wants to electrify their fleet
- A grid operator who wants to transition to new pricing models on their network
- A financial participant who wants to offer their customers transport services

The way these value propositions are further defined and could be monetised are described in 5.1, 5.2, and 5.3.

5.1 A fleet manager who wants to electrify their fleet

Fleet managers are faced with problems electrifying their fleet due to higher upfront cost, uncertain operating cost benefits, and uncertain revenue from disposal.

Value from fleet managers' relationship with the intermediary occurs when they can electrify their fleet faster. Intermediaries make electrification business cases more favourable because of the V2G revenue.

Fleet managers commonly use Total Cost of Ownership (TCO) as an assessment tool. TCO is an estimate of the total cost of having a vehicle in the fleet. It includes purchase, operation, and resale of the vehicle. V2G generates revenue but may increase purchase costs and reduce resale value. This means that its impact on TCO is not clear. Intermediaries can help fleet managers make decisions if they present value in terms of TCO. This enables V2G to be included more easily in business cases. And as V2G is expected to be a net financial benefit, it enables fleet electrification to happen faster.

If V2G is a net TCO reduction, intermediaries can get revenue by sharing the TCO benefit with fleet managers. This guarantees to fleet managers that TCO will be reduced. It increases risk to intermediaries though because if they are not successful in reducing TCO they get no revenue.

Box 3 Fleet electrification

Value creation	**How is the offering embedded in the customer world?**	Revenue enables more electrification to "fit" in current budgets
	How can we facilitate customer to reach their goals?	Revenue delivered a reduction in TCO for fleet managers
	How does value emerge from the customer practices?	Reaches corporate goals faster Manages tight fleet budgets
	How are customer's long-term benefits accomplished?	more EVs that are economic more quickly enables organisation to progress on emissions reduction journey
Interaction and co-production	**How can we support customer co-production?**	Good assessment of the potential revenue from V2G End-to-end modelling of TCO
	What are the customer's activities during use and different use contexts?	Building transition plans
	What are the customer's mental models of interacting with us?	Lower TCO, presented and certain
Revenue streams and metrics	**What is our earnings logic?**	TCO guarantee for fleet managers - where TCO has been reduced benefit can be shared
	How can we apply customer value-based pricing?	Only receive payment when there is a TCO reduction
	What else do we get other than money?	Vehicles that can form VPPS Many vehicles in a single location
	What are the metrics of success?	Demonstrably lower TCO than ICE vehicles
	How are we following the customer's KPIs?	Track TCO of vehicles and fleet. Compare to expected performance of ICE vehicle
	Which benefits will customer pay for and how?	Total TCO must be lower than ICE vehicles Benefits can be shared
	How direct is the line between value and payment for it?	High
	What is the financial value they get?	Lower TCO improves Fleet manager's bottom line

5.2 A grid operator who wants to transition to new pricing models on their network

Grid operators are concerned with efficiency on their network. An efficient network is one where flows through the network are as high as possible without exceeding its capacity. Grid operators can improve how efficiently energy consumers use their network if they set prices accordingly: lower prices when there is excess capacity, higher when capacity is scarce.

Reforming pricing has been a challenging journey for grid operators. Customer acceptance has been slow.

Intermediaries can create value with grid operators if they help energy consumers (or at least those that are also EV owners) uptake new pricing models. Value is created when energy consumers uptake and respond to new pricing models, leading to a more efficient network.

Intermediaries help grid operators meet their goal by making new pricing models attractive to EV owners. This means EV owners transition to new pricing models. Similarly, success stories help grid operators encourage uptake among energy consumers who are not EV owners.

The line between this service and a grid operator paying for it is less clear. Clearly new pricing models benefit EV owners, which is helpful for intermediaries procuring new EV owner customers. Grid operators may not see a reason they should pay intermediaries for this service though – and doing so may cause regulatory issues. Instead, this value proposition may be seen as mutually beneficial for intermediaries and grid operators. Grid operators have a more efficient network; the intermediary has an attractive product they can offer EV owners

Box 4 Pricing models

Value creation	**How is the offering embedded in the customer world?**	Products that work with cost-reflective prices and deliver value to drivers (low cost) and networks (better demand at peaks)
	How can we facilitate customer to reach their goals?	Encourage vehicle owners to uptake new pricing products
	How does value emerge from the customer practices?	Make it easy for customers to choose cost-reflective pricing products
	How are customer's long-term benefits accomplished?	Uptake of cost-reflective prices meets regulatory needs, improves equity, and reduces network costs
Interaction and co-production	**How can we support customer co-production?**	Encourage uptake within customer base Visibly communicate the benefits of uptake with customer base and future customers
	What are the customer's activities during use and different use contexts?	Evolving the way customers interact with the network towards long-term objectives
	What are the customer's mental models of interacting with us?	Enable their customers to uptake new tariffs more easily

Revenue streams and metrics	**What is our earnings logic?**	"bounty" on transitioned customers Funding to build against new tariffs
	How can we apply customer value-based pricing?	Payments per customer actually transitioned
	What else do we get other than money?	Customers on platform
	What are the metrics of success?	Customers transitioned Customer benefits Network constraint reduction
	How are we following the customer's KPIs?	Map pack to uptake and change in customer network usage profiles
	Which benefits will customer pay for and how?	Number of customers on new pricing models
	How direct is the line between value and payment for it?	Low
	What is the financial value they get?	Improved image with regulator More efficient network

5.3 A financial participant who wants to offer their customers transport services

Financial participants are commercial organisations. Transport services promise additional revenue per customer, enhanced retention, and additional customers. This brings the financial participant better economies of scope and scale. Similarly, EV Owners with V2G and a relationship with the financial participant provide valuable grid services.

In this case value is created when the financial participant sees bottom-line improvements. Intermediaries need to be careful of commercial sensitivities as they navigate this process with financial participants. This may be through the intermediary offering “white label” products the financial participants can brand themselves. To be successful, intermediaries will need to consider how they integrate within the financial participant’s existing products and customer base.

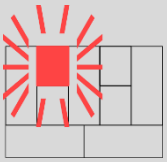
Intermediaries could have several associated revenue generation models. For example, if EV owner customer acquisition is important to financial participants then revenue can be connected to amount of customer acquisition.

Box 5 Entering new markets

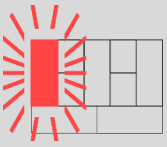
Value creation	**How is the offering embedded in the customer world?**	They can offer transport related products and services
	How can we facilitate customer to reach their goals?	White-labelled products Integration with existing services
	How does value emerge from the customer practices?	Transport-related products and services
	How are customer's long-term benefits accomplished?	Additional services enables more revenue per customer

Interaction and co-production	**How can we support customer co-production?**	Take time to understand customer base Customer-centric design of products and services
	What are the customer's activities during use and different use contexts?	Customer retention Response to customer demands
	What are the customer's mental models of interacting with us?	Access to new products to be offered to their customers
Revenue streams and metrics	**What is our earnings logic?**	"white label" products Co-branding
	How can we apply customer value-based pricing?	Align with drivers of organisation (e.g. cost scaling with participation)
	What else do we get other than money?	Branding, customers
	What are the metrics of success?	Number of customers Revenue of product
	How are we following the customer's KPIs?	Ensure intermediary cost drivers align with financial participant's
	Which benefits will customer pay for and how?	Lower cost means of offering additional products and services to customers
	How direct is the line between value and payment for it?	High
	What is the financial value they get?	More revenue Diversity in revenue sources

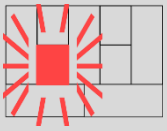
6 Key resources and delivery



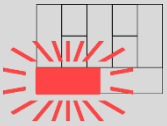
"The key resources block is where the skills, knowledge, material resources and immaterial resources required of the intermediary and customer are explored. It describes what the value propositions imply that the intermediary and customer can do"



"Key partners are the relationships the intermediary and customer have that enable delivery of the value. It includes how the other party experiences the partner (e.g., how customers experience the intermediary's partners)."



"The mobilising resources and partners block describes how intermediaries and customers co-ordinate value creation with their partners. It also describes how partners develop their own key resources, and how the other party can utilise and develop the partner's resources."



"The cost structure block analyses the costs of delivering the value propositions, from the point of view of both the intermediary and customer. It also analyses the other sacrifices the intermediary and customer must make."

As discussed in Appendix A, skills are a key unit of value in the SDL framing. Value exists because organisations use their skills to co-create value with other parties. This chapter describes the skills, knowledge, and material resources that are required by both intermediaries and their customers.

In line with the Service Dominant Logic framework presented in A.2, core competencies are the key unit of value creation for the intermediary. Competencies are a combination of knowledge and skills. They enable use of material resources to generate value.

There were seven competencies identified in the interviews for intermediaries, and one for their customers. They are summarised in Table 9 and Table 10.

Table 9 Competencies identified for intermediaries

Competency		Description
	**Translate**	Translate is about being able to make V2G relevant for different types of customers. This competency is about knowing customers and their context. For example, understanding how fleet managers manage vehicles and how V2G could impact their KPIs.
	**Optimise**	Optimise is where intermediaries use V2G to meet the customer's goals. For example, ensuring energy used to charge the vehicle has as little carbon content as possible for environmentally conscious customers.

Competency		Description
	**Generate Revenue**	This competency is in creating revenue from V2G capable vehicles by selling their services to other customers. This could be capacity, data, or any other service of value.
	**Partnerships**	While all value propositions involve alignment with customer objectives, intermediaries may collaborate with customers to co-create business activities. For example, enabling grid operators to meet their pricing reform objectives faster by enhancing customer uptake.
	**Understand V2G's capabilities**	V2G's capabilities and impacts are poorly understood. A key role of intermediaries is to build an understanding of the capabilities, limitations, and impacts of V2G. This helps customers determine if V2G can provide the service they require or whether to uptake V2G.
	**Take risks**	Many customers were concerned about the risks inherent in V2G, for example its impact on the use of a car for transport. This competency is intermediaries understanding what risks they can take, and how they can manage them.
	**Install hardware**	Hardware installation is a complex process, particularly in "brownfield" (existing) sites, due to technical constraints and approvals. Intermediaries may need to arrange installation or subcontract others to do so.

Table 10 Customer competencies

Competency		Description
	**Communicate**	Delivering many value propositions require the customer to communicate about their needs in a timely manner. This could be about preference (e.g. how they want to use their car) or the value they would want to see (e.g. site consumption or network loading).

This section of the report also describes the apparatus needed to create this value. This apparatus is described in three blocks of the canvas: key partners, mobilising resources and partners, and cost structure.

The key resources described in this section require a set of relationships, tools, and processes to deliver (called functions in this report). Some of these will be within the capabilities of the intermediary or customer to deliver internally, others will be delivered by an external partner. This can be seen in the REVS trial. SGFleet provide fleet management services to the ACT government. SGFleet collect and provide vehicle booking data to the energy retailer (who is acting as the intermediary in this project) on behalf of ACT government [42]. This doesn't have to be the case. If the ACT government had their own booking management system this relationship would not have been needed. But because SGFleet manages a very large fleet, these services are better for ACT government to procure externally rather than the expense of building the capability themselves.

Because this report does not analyse a specific intermediary or customer, it cannot say whether a particular function should be built internally or with an external partner or provide detailed guidance in how much it would cost. This report describes some functions, with a

more extensive list in the business model worksheet. This also means that analysis of these blocks is less in-depth than others in this report.

6.1 What are the intermediary's competencies?

6.1.1 Translate

Translation is the most common competency of an intermediary. This resource involves an intermediary being able to make V2G relevant for the different customers of a multi-sided platform. Fundamentally this value proposition is about the intermediary knowing their customers and their context, and framing the services offered to each customer around this understanding.

Translation is a task of packaging V2G or some of its elements into terms that resonate with customers. This can easily be seen when considering value propositions that span multiple customer types, as shown in Figure 9. A fleet manager may expect that they can present their vehicle usage needs to an intermediary and achieve a reduction in Total Cost of Ownership (TCO). This requires the intermediary to procure revenue from grid operators, who expect firm, guaranteed demand response capacity to manage their day-to-day needs. All sets of needs interact with each other. The fleet manager's vehicle usage needs impact the firm capacity that the intermediary can offer, but the way this is presented by the fleet manager is unlikely to resonate with the grid operator. Similarly, the impact of the grid operator's day-to-day needs on the vehicle (for example, state of charge) must be repackaged into a form that the fleet manager can use in their decision making and operationally.

A key part of translation is easing the customer's concerns around V2G. As described in section 3, customers were commonly sceptical that V2G can deliver the service they want, or that intermediaries are a part of delivering that service. Translation enables the intermediary to empathise with customers and resolve these concerns.

Translation is also a key enabler of other competencies. It makes them real by presenting them in the customer's terms. It also enables the intermediary to understand the customers' needs and how they influence how other competencies are used. For example, converting EV owner's needs around transport availability to constraints and targets on optimisation.

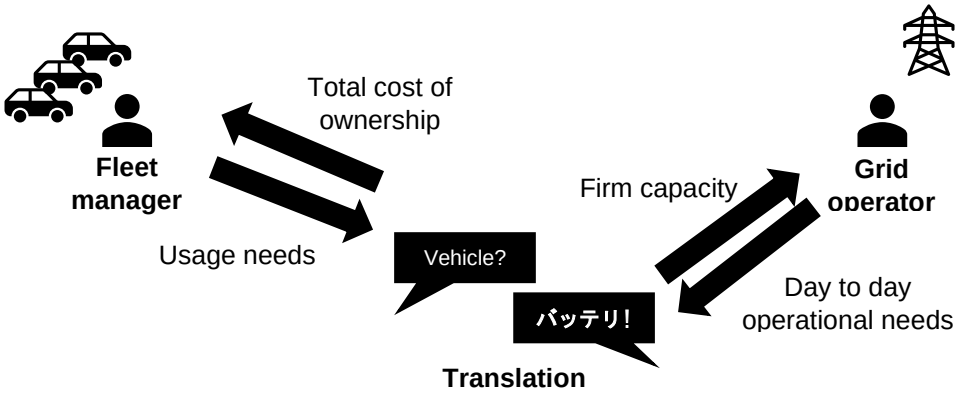


Figure 9 Translation between customer types example

An example of the different customer values an intermediary may need to express to deliver their value propositions are shown in Table 11.

Table 11 Translation: languages

Customer	Values
Fleets	Vehicle Total Cost of Ownership (TCO) V2G impact on vehicle usability
Energy/facilities managers	Energy cost and power purchasing strategy Local generation Installation and install management
Sustainability managers	Carbon emissions, environmental impact Energy system stewardship
Customer engagement managers	Impact on customer engagement metrics Customer engagement channels
EV owners	Energy costs/impact on local generation Carbon emissions, environmental impact Vehicle usability Innovation/leadership Community
Grid operators	Standard grid support contracts Risk management Operational integration Regulatory environment and reform objectives Carbon emissions, environmental impact
Financial participants	Standard grid support contracts Risk management Operational integration Customer engagement channels and stewardship Product development
Community energy	Local values Community engagement Energy cost and purchasing strategy Risk management Operational integration
Car parks	Energy costs/impact on local generation Vehicle usability Customer management Vehicle warranty management
Car Share	Vehicle Total Cost of Ownership (TCO) V2G impact on vehicle usability Energy cost and power purchasing strategy Installation and install management

As Table 11 shows there are several languages that the intermediary could need to speak. Competency in these languages could be delivered through partnerships or internally within the intermediary. For example, an energy focussed intermediary may partner with a vehicle manufacturer or fleet provider to gain the relevant transportation expertise. This means that in some cases customers might interact directly with the intermediary's partner instead of the intermediary themselves. For example, contact with a vehicle manufacturer partner may be the point where the EV owner is introduced to the concept of V2G. As described in 3.4.5, this model was proposed by vehicle manufacturer intermediaries as part of interviews.

There are two components of this resource that impact the cost structure of the intermediary: the cost of accessing expertise, and the tools and processes required to translate outcomes.

Accessing expertise requires the intermediary either to partner or build expertise in-house. Both impact the intermediary's cost base. Partners require payment for their services. Although in some cases the relationship may be mutually beneficial. V2G may enable vehicle manufacturers to sell more vehicles for example. In-house expertise requires the intermediary recruit the appropriate expertise which can be costly depending on the skill required.

The second part of translation is ensuring that the costs and value of V2G is presented in the customer's terms. For example, V2G's financial return may need to be presented in terms of the cost of energy for energy managers, and in TCO for car share schemes. These translations are a key part of value co-creation because they ensure the customer can integrate it into their world, such as mapping their progress toward zero emissions. The diversity of value translation needs results in more complex tools and processes in the intermediary, which increases their cost.

6.1.2 Optimise

V2G's value is in making better use of idle vehicles. Optimisation is used to maximise this value. Optimisation is where the intermediary makes operational decisions for the vehicle to manage its power delivery and state of charge to meet the customer's objectives.

Optimisation takes in a timeseries signal (for example local PV generation) and adjusts charger behaviour to meet an objective identified by the customer (e.g. maximise local use of generation). Most of the time there is more than one objective to be managed simultaneously (such as local PV generation and driving energy requirements). These must be co-optimised in a way that meets the needs of the customer. For example, how much local PV can be exported to the grid while the vehicles must plan for unexpected future trips? This will be defined through discussion with the customer based on their needs (see 6.2).

There were several objectives implicit in the value propositions, described in Table 12

Table 12 Optimisation: objectives

Objective	Input signal	Relevant customers
Ensure vehicles can meet driving energy needs	Expected vehicle usage	Organisations, individuals, fleets, car share, car parks
Maximise value of local generation (e.g. PV) Could be financial or carbon intensity based	Local generation and demand	Organisations, individuals, fleets, car share, car parks
Reduce emissions	Local generation, demand, emissions intensity of grid energy	Organisations, individuals, fleets, car share, grid operators, financial participants
Reduce energy costs	Local generation, demand, cost and structure of grid energy	Organisations, individuals, fleets, car share
Reduce fleet costs	Local generation, demand, Cost and structure of grid energy, vehicle usage	Organisations, individuals, fleets, car share
Manage grid constraints	Constraint variables (e.g. voltage, power flow, operating envelopes) or requests (date/time, amount, duration)	Grid operators, microgrid operators, organisations, individuals

Objective	Input signal	Relevant customers
Manage dynamic prices	Dynamic price or requests (date/time, amount, duration)	Financial participants, grid operators, microgrid operators

Optimisation is key to delivering value from V2G. Intermediaries must operationally manage the vehicle in a way that benefits all customers. Algorithms used in optimisation need to tune the parameters to ensure the appropriate weighting of each of the potential value streams. Trust in optimisation depends on how behaviour of the asset aligns with the expectations of the customer, while misalignment results in a loss of trust. Customers who do not trust an optimisation algorithm are unlikely to continue to procure services from it. For example, a customer is likely to lose trust in an V2G algorithm that does not manage state of charge to the customer's expectations and leaves them experiencing range anxiety.

Intermediaries clearly need optimisation tools. These tools could be built internally or externally. If built internally they themselves could become services, the intermediary could offer to others. In analysing resources, there were three functions related to optimisation, described in Table 13.

Table 13 Optimisation functions

Function	Details
Data ingestion and reformation	This function is collecting and reforming data for optimisation. Data can be real-time (such as site consumption or vehicle usage) or event based (such as preference or demand response requests).
Optimisation	Optimisation is converting input data into charger power commands, considering the various targets such as price signals preferences, and technical limits.
Enacting results	Once optimisation produces targets, the results must be enacted physically on the charger.

6.1.3 Generate revenue

For many customers, V2G is a means to create revenue from idle vehicles. This competency is in connecting these idle resources to other customers who have a use for them in exchange for a financial benefit. An example of this is shown in Figure 10.

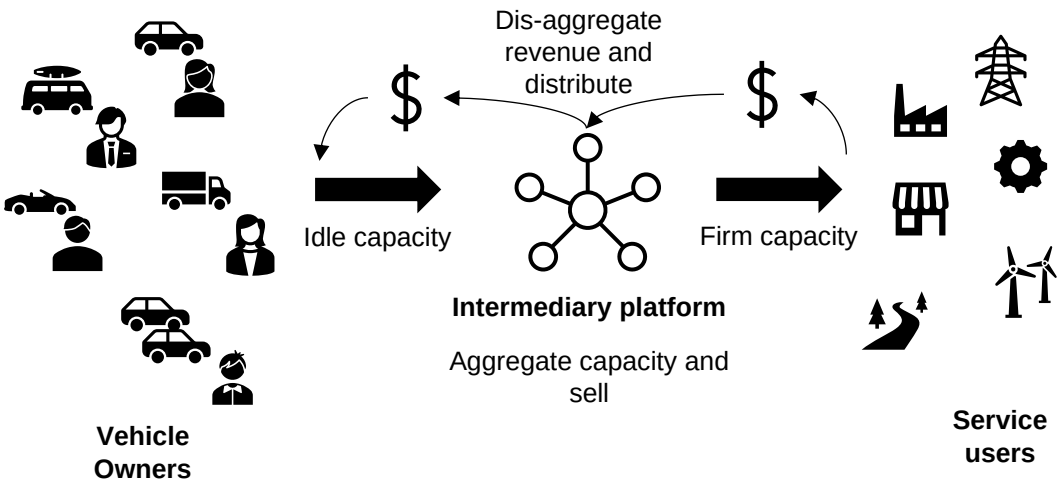


Figure 10 Procure revenue example

The competency is the ability to aggregate customers across multiple groups and link their services with a buyer. Having many vehicle owner customers gives the intermediary capacity which they can then sell to energy sector organisations (such as grid operators, financial participants, and microgrid operators). But in the absence of either customer there is no value to be shared. This is a common problem for multi-sided platforms, described as the "chicken and egg" problem [43].

This implies that a key function of the intermediary is the ability to:

- Identify and engage customers with idle assets to be shared
- Identify and engage potential customers of the asset's services
- Monetise and share revenue.

Not all services require V2G or charge/discharge of vehicles. For example, energy system participants require data and good forecasts to be able to operationally manage their network. This data is collected as part of an intermediary delivering their other value propositions and hence is an underutilised asset. Similarly, vehicle availability data could be used as modelling inputs such as for local government transport planning.

The intermediary cannot entirely decouple all ends of its platform though. Customers have ethical concerns that may limit the revenue streams of the intermediary. For example, vehicle owners may not want their vehicles used to support fossil-fuelled generation or may not want their data shared with third parties.

From a vehicle owner perspective, revenue improves the value of V2G and may reduce the cost of owning EV. This revenue may then enable further electrification or progress toward the customer's objectives.

This competency is closely related to taking risks. Revenue means that the intermediary is managing a risk on behalf of the customer. For example procuring demand response revenue means that the intermediary needs to manage availability risk.

The intermediary could generate revenue through a mix of building capability internally and partnering. For example, the intermediary could partner with other intermediaries to offer larger or more certain services to energy industry organisations such as grid operators or financial participants. Similarly, where markets for distribution services exist (such as piclo in

the United Kingdom [31]) intermediaries may operate on those. This skill interrelates strongly with translation, optimisation, and taking risks.

6.1.4 Partnerships

All value propositions must align with customer objectives, otherwise they would not be value propositions. This is explicitly called out in the “value creation” and “interaction and co-production” blocks of the business model canvas. For example, intermediaries could frame V2G financial benefits in terms of vehicle TCO impact to enable fleet managers to easily measure and build fleet electrification plans.

There are some cases where the co-creation of value involves closer collaboration. In these cases, the relationship between the intermediary and the customer may more closely resemble a partnership. They could undertake a project together, for example to build infrastructure or share resources for mutual benefit. Some examples are shown in Table 14.

Table 14 Aligning value with customer objectives

Customer	Objective	Example alignment of value
Organisations	Demonstrate innovation and share benefit with customers	Build shared channels with organisation to common or potential new customers.
Grid operators	Transition the energy system toward a future vision (e.g., tariff reform and operating envelopes)	Enable models with technology and co-create initiatives to boost uptake. Co-create regulatory submissions to enable vision to proceed from trial to implementation.
Financial participants	Begin offering transport related services to customers	Share customers, white labelling offerings, share expertise
Car parks	Generate revenue from parked cars	Co-branded product to offer patrons.
Car share	Transition fleet to EVs	Energy-related offerings for site owners where charging is installed

There are several ways that intermediaries can partner with their customers. For example, explicitly integrating new tariffs into pricing offers allows more customers to take them up and meets grid operators’ reform needs. The value in this case is assisting the grid operator to meet their goals, such as posing reform cases to regulators or demonstrating uptake.

There were two classes of value propositions which could be delivered through partnerships:

- Value oppositions where customer aims to **demonstrate values** commonly include activities such as building common platforms or channels. For example, to enable sharing between an organisation and their EV-owning customers.
- In supporting **progress towards goals**:
    - Value proposition where the customer aims to create **wide-scale reform** commonly include activities such as adopting new pricing schemes quickly and encouraging uptake within customers. For example, providing an easy path for customers to take up dynamic connection agreements enables grid operators to demonstrate their value and use to regulators.
    - Value propositions where the customer aims to **enter new markets** commonly include activities such as co-branding or white label products and sharing expertise (e.g. transport expertise with energy system organisations). For example, car park operators may want to transition to energy hubs using V2G from parked cars.

This skill is around intermediaries forming partnerships with their customers. This means the definition of customer and partner is blurred. The intermediary may be offering the same organisation services (such as demand response) as well as partnership (such as entering markets).

Entering these partnerships requires intermediaries to be able to offer their functions as services to external partners. This could, for instance, be through white labelling services [44].

6.1.5 Understand V2G's capabilities

While many potential customers of V2G and its services can see that there is potential value in V2G, it is difficult for them to understand how much and what the related costs are. This competency is understanding the capabilities, limitations and impacts of V2G. There are two parts to this competency discussed here: being able to make the case for V2G and demonstrating that V2G has met goals.

Value propositions are suggestions of value (as discussed in Appendix A). They describe to a customer the values and costs of V2G and how it could fit within their life. Making this proposition is a combination of two competencies: Understanding V2G's capabilities enables intermediaries to quantify the impact of V2G, and translation enables them to frame it in terms that have meaning to customers.

A key part of co-creating value is how it features in the customer's life. For example, if customers aim to reduce emissions, they need to know the extent to which emissions have been reduced in line with their own definition. This information can take a variety of forms and have different roles in the customers value-creation process. Emissions reduction could be emissions produced from driving, total emissions for a site, or emissions produced delivering demand response services depending on the customer. Some examples are described in Table 15.

Understanding V2G's capabilities involves analytics, which can be considered the data-driven equivalent to translation (described in 6.1.1). The use cases are diverse and result in different requirements in how data is presented and delivered. For example, emissions may be delivered continuously through an API and be created and shared in real-time or through reports to form part of the customer's internal business processes.

Intermediaries also must understand V2G's capabilities to understand risk. This enables them to understand how much risk they must manage based on the actual performance of EVs they are managing.

Table 15 Analysis and reporting needs

Co-created value	Analysis and reporting needs
Maximising the value of renewable assets (such as PV)	V2G's impact on local consumption of on-site generation. Forecasting of V2G availability to feed into local control
Emissions reduction	Tracking emissions attribution to different services (e.g. drive energy, grid services impact)
Community benefit	Level of community sharing Impact of sharing on community
Cost reduction	Reduction in cost Impact of V2G
Energy transition/reform	Uptake metrics Feedback from customers

Co-created value	Analysis and reporting needs
Ethical treatment of shared customers	How value provided to the intermediary by customers (such as grid operators or financial participants) is shared among the intermediary's other customers (such as EV owners)
Align energy content with drivers	Ensure energy content of value (e.g. driving energy, demand response) aligns with the customer's values. E.g. ensuring local energy use is prioritised for community energy.
Certainty of future adequacy	Forecasts
Enable charging in shared/rented sites	Energy impact of vehicle on site owner bills Value V2G has created

6.1.6 Take risks

Revenue (see 6.1.3) and risk are closely interlinked. In many cases revenue is generated because the intermediary takes risks on behalf of the customer. For example, providing demand response services means the intermediary bears the risk the vehicle is not available because the customer of these services expects certain capacity.

Taking risks relates to the guarantees that intermediaries must make to their customers for them to adopt V2G. These guarantees are critical to build customer's comfort that V2G can fit their needs, but they also influence the level of risk borne by the intermediary. Risks can have a financial impact (such as liquidated damages) or reputational impact (such as customer retention).

For the intermediary, this competency is around how they manage and take risk.

There were several risks that participants suggested the intermediary may need to manage, listed in Table 16, with some examples discussed further below.

Table 16 Types of risks

Risk	Guarantee	Key factors
Customers expect intermediaries ensure that there is sufficient energy for driving in vehicle batteries	Agreed metrics around how vehicle state of charge will be managed Appropriate actions when guarantee is not met	How to codify diverse vehicle usage patterns to state of charge requirements? What is the appropriate action if charge not managed well? How does intermediary control the cost of actions? How to manage the impact of energy services?
Customers may invest in V2G on the basis that it can manage local consumption in line with expectations	Change in energy costs. Change in the energy consumption patterns (e.g. locally consumed generation)	How to measure value provided (e.g. energy, cost, or emissions?) How to manage the impact of transport and other grid services? How to manage risks around site consumption?
Customers agree with intermediaries a level of demand response at critical times	Amount of demand response (e.g. kW demand reduction).	How to measure response? How to manage the impact of transport? What is the appropriate action if there is not enough capacity to meet agreed levels?

Risk	Guarantee	Key factors
Customers may expect that V2G can provide backup services during outages or times of energy scarcity	Amount (e.g. time, capacity) of backup service provided	How should backup be co-optimised with other services? How is service delivered if the vehicle is not there?
Intermediaries may commit to customers that they acquire, engage, or satisfy other types of customers (e.g. residential customers)	Customer satisfaction metrics Customer types Number of customers/vehicles	How does the intermediary ensure they acquire customers in line with metrics? How does the customer control the quality and type of interactions they have with customers?
Customers may expect that intermediaries take or influence other customers to take investment risks	Capacity acquisition and retention metrics Certainty of revenue streams	How to provide certainty to investors when customers may not want to provide certainty to intermediaries?

Managing risk has three key components:

- Identifying risks
- Evaluating the level of risk
- Determining and prioritising measures to reduce risk

For example, the risk that V2G could negatively impact the transportation use of vehicles was commonly discussed by participants. Primarily vehicles are for transport and maximising the value of a vehicle for transport would imply that the vehicle is never discharged by V2G. That, however, would prevent any grid revenue being generated from the vehicle. This tension will always result in some risk, which the intermediary must manage. Intermediaries can use data to reduce this risk. It enables them to understand the trade-off and offer an appropriate level of service to each party.

There were some risks discussed in depth by interview participants. Two of these were investment risk and response prioritisation.

V2G chargers are currently expensive. It is likely this will remain the case in the short term, as they are more complex devices than single-directional chargers. This means that a party must decide to invest the additional capital in a V2G charger, which carries the risk that it will not be recouped because revenues are not yet well understood. Intermediaries could reduce this risk by either creating the certainty for customers to invest or investing themselves. Either of these bring the risk that returns are lower than expected back to the intermediary. This may result in large capital requirements for the intermediary to manage this risk. Alternatively, they could partner with one of their other customers (such as financial participants) or financial services organisations who could wholly or partially fund the initial investment. This could be an upfront purchase of demand response capability from the charger, or a financial mechanism such as a loan or lease. Intermediaries will then need to pass this requirement on to EV owners who uptake these chargers.

The way that the intermediary's customers wish to transact with them is a key influence of this risk. For example, customers such as grid operators may want to procure services from intermediaries using tools such as dynamic locational prices. These prices are highly volatile. However, private vehicle owners may not understand or accept the uncertainty of high price volatility. One way an intermediary could handle that is to present their customers a smoother price signal that provides more certainty. The intermediary then bears the uncertainty risk, which could come at a significant cost. Depending on the extent to which this return is flexible this risk could be significant. Intermediaries may choose to partner with other organisations, such as financial participants, who manage volatile returns day-to-day already. Similarly other intermediaries – particularly those who control different types of assets – may be able to complement V2G's capabilities and reduce overall risk.

Response prioritisation was another risk discussed by several participants. It is likely that at some point intermediaries will have conflicting needs to prioritise. For example, it may be in a financial participant's interest that the vehicle should charge but a grid operator may request discharge. As discussed in 3.2, among energy organisations prioritisation was reasonably clear. Intermediaries should serve the needs of grid operators in preference to those of financial participants because the system security function is more important than responding to market prices. It is much less clear however how the needs of drivers need to be prioritised against those of the energy system. For example, meeting system security needs may mean the vehicle cannot meet its transport role. Some of these issues may be determined by contractual arrangements or decided at a policy level, however intermediaries are responsible for enacting day-to-day. This risk may become apparent in EV owner customer retention if not managed in a way that aligns with customer expectations.

6.1.7 Install hardware

Intermediaries may need to install or oversee the installation of V2G hardware in order to facilitate participation. As demonstrated in the REVS project [42], [45], installing V2G hardware is a complex process. There are many stakeholders and factors to manage. This competency is a learning from the REVS trial, more so than was raised in the interviews. Installation was a much longer and more complex process than expected. Some of this was due to the fact REVS was the first time V2G chargers had been installed outside of single examples in Australia. Some factors are more enduring though. For example, installing V2G charger is always likely to require managing both fleet and facilities management stakeholders because electric vehicles span both responsibilities. Furthermore, installation can be technically complex and involve several approval processes, particularly for existing sites.

This raises several possibilities for intermediaries to build capability internally or partner. Project management, physical installation, stakeholder management, integration with communications and information technology, and hardware procurement and support are all part of installation processes.

More detail on the actions involved in this process can be found in other project knowledge sharing documents (such as [42], [45])

6.2 What are the customer's competencies?

A key principle of service dominant logic is that value is co-created with customers. This means that customers are an active participant in the value creation process. Therefore they must also use competencies to create value. There were several competencies that were

identified as part of this work. While the competencies needed by customers were diverse, generally

Intermediaries create value by reforming V2G to meet customer's needs. This competency is customers communicating to the intermediary information needed to know how to reform V2G.

Communication needs are diverse. Communication needs can be thought of as a process, as shown in Table 17.

Table 17 Customer communication needs

Activity	Communication
Deciding if V2G is right	• Expected outcomes from V2G and relationship with intermediary such as emissions reduction) • Limitations and constrains on V2G's usage such as tie-in to transport needs • Relevant processes such as leased sites, linkages between fleet and building managers
Installing and commissioning V2G	• Linkages to relevant installation stakeholders, such as building managers, site (home) owners • Linkages to relevant data sources, such as home energy management platforms, fleet management systems • Processes or forms of output for the intermediary such as reports, mobile apps, web interface/APIs.
During operation	• Specific needs such as travel preferences, demand response needs • Ongoing needs such as battery state of charge limits
After operation	• Feedback on such as how operation must be changed to meet needs

A key part of communication is customers understanding their own needs. For value to be delivered, customers need to understand how V2G fits within their own context. This can be thought of in three dimensions: Understanding their own drivers, understanding their processes, and developing clear, actionable KPIs.

Customers consider V2G for a variety of reasons. As described in the reports from the REVS social science stream [15], V2G may fit within broader goals but is rarely an end in itself. This is consistent with the findings of the interviews undertaken as part of this report. V2G is a flexible technology and can serve multiple objectives. This competency is how the customer determines how V2G might fit within a broader program. This includes understanding success factors. For example, fleet managers commonly describe Total Cost of Ownership as a key KPI. This is a value that describes how much a vehicle has cost to purchase and run. V2G can be framed as a reduction in TCO, effectively counting as a revenue. However, knowing whether V2G has delivered desired benefits means customers need to understand what level of TCO they are striving for. Similarly, they must know how these needs interrelate with others such as impact on transport.

Goals may not be (at least wholly) internal. For example, as described in 3.2, grid operators are on a reform journey. They are transitioning how they price and present their services to better reflect their own cost drivers. V2G is proposed as a technology that can assist them to meet this need by making the new pricing and service models more attractive to their customers. However, for this to occur, grid operators need to understand the future model

they are striving for. This enables the intermediary to build products that help EV owners uptake these new products.

Customers must be the authorities on their own processes. This seems obvious, but V2G often spans stakeholders within organisations who don't usually need to interact. For example, V2G enables optimisation of local energy consumption and transport energy needs. This means that energy purchasing managers, site managers, fleet managers and vehicle users must collaborate to determine how this occurs. Organisations should not underestimate the complexity of this task.

Customers, like intermediaries, can deliver these resources themselves or through partnership. In the introduction to this section the role of SGFleet as a partner who delivered a vehicle and booking management data service to ACT government was described. Similarly, customers may use external providers to acquire and deliver real-time data to intermediaries. For example consumption data from an EV owner's site.

7 Conclusion

This report describes business models for V2G. Business models are a way of describing the “internal logic” of a business: what value it creates and how. In this report we explore the business model of an “intermediary” that sits between the users of V2G and its services, shown in Figure 14. The report starts with a detailed analysis of customers (in chapter 3), based on a series of interviews. It uses these to analyse what the value propositions for V2G could be (in chapter 4) and how they might be delivered (in chapters 5 and 6). More specific detail can be found in the business model worksheet associated with this report.

This report aims to provide generalisable insight into V2G business models without presupposing who the intermediary organisation might be and what their capabilities are. Accordingly, we have presented parts that can be selected and assembled into a working business model by organisations who want to provide V2G to customers. Implementation will require organisations to understand their own context, capabilities, and relationships and how they overlay with those presented in this report.

We have framed our business model using “Service Dominant Logic” (SDL). This frame asks business modellers to recognise that customers have an active role in value creation, which means their experience is as important as the intermediaries. It also frames the role of service providers (such as the intermediary) and customers in terms of the skills they use to create value. We have used the “service logic canvas”, a reframe of the traditional business model canvas, to present our findings. The service model canvas used in this report is presented in Figure 6.

We found a diverse customer landscape for V2G among interviewees. There were several types of customers with very different objectives and needs. This meant that the way they looked to V2G to integrate in their lives was quite different. Customer types included Fleets, private EV owners, grid operators such as distribution networks and market operators, financial participants such as energy retailers and aggregators, community energy, car parks, car share, and several other customer types. This is shown in Figure 11.

Interviewees described many ways in which V2G could create value. Primarily, it helps customers meet several goals such as cost reduction, emissions reduction, and other strategic goals including entry to markets, and industry reform. Intermediaries provide several services that help their customers create this value from V2G. Intermediaries reduce the complexity of V2G. They reform V2G into standard products and services that are familiar to their customers. They manage the risks of V2G, so its quality is palatable for customers. This includes managing availability risks, driving energy needs, and customer expectations.

While describing these use cases though, interviewees also were sceptical around V2G or the models of intermediaries themselves. There were several reasons interviewees gave for being sceptical including:

- Whether V2G could meet their reliability and transport needs
- Whether intermediaries were fairly sharing value with EV owners
- Whether working with an intermediary was in their commercial interests
- Whether working with an intermediary met their reform objectives

Creating value requires both the intermediary and the customer use a set of competencies: seven for intermediaries and one for customers. Competencies are an interlinking set of

skills, knowledge, and resources. Seven were identified for intermediaries, and one for customers. They are shown in Figure 13.

Translation is the most fundamental skill for intermediaries. Intermediaries need to be able to make V2G relevant for multiple customer types simultaneously. Similarly, they need to translate customer's diverse needs to enable other functions such as optimisation, where needs are converted to requirements and constraints.

Generating revenue and **taking risks** are key generators of value. In many cases intermediaries generate revenue by taking risks on behalf of their customers. This means that intermediaries need to be adept risk takers. They need to understand what risks they must take and their impact and mitigation. A key part of knowing this **is understanding V2G's capabilities**.

Intermediaries are well placed to understand V2G's capabilities. They have access to data and combined with analytics skills they can translate V2G into the customer's terms. This also enables them to understand risk and revenue trade-offs.

At a technical level, a single asset (a vehicle and associated charger) is generating revenue and managing risk by providing several high-certainty services simultaneously. This means intermediaries need to **optimise** all these factors. Optimisation is managing chargers in real time based on data and customer expectations. Understanding customer expectations will be very important. The intermediary needs to convert requirements like "seamless" transport provision and "certain" grid services provision to technical optimisation targets and constraints.

In some cases, intermediaries may have a deeper relationship with their customers – they may become **partners**. There were several cases where this may be the case. For example, financial participants may wish to use V2G to enter transport markets. In this case, the capabilities of the intermediary complement those of the customer to enable the customer's desired outcomes.

As experienced during REVS, **installation** of V2G chargers is a complex process [42], [45]. Intermediaries can create value by helping their customers navigate this process.

SDL principles are that value is co-created with customers. Customers also use skills in the value creation process. The most fundamental of these is **communication**. This means understanding their drivers, expectations, and desired outcomes from V2G. For organisations this can be a complex internal negotiation process. Multiple stakeholders can have different expectations of V2G which may be challenging to meet simultaneously. For example, a desire for no impact on vehicle usage can reduce the revenue that energy managers receive from V2G.

It is not clear whether a viable model for V2G can be found. This report has provided an analysis of what creating this model could entail. Clearly people such as intermediaries, who create this value, will need to be skilled in multiple dimensions. They must be immersed in the transport and energy industries simultaneously. They must manage diverse needs of vehicles. And they must communicate clearly. Customers need to understand their own needs too. V2G has many diverse promises, and only customers can understand how these promises should be implemented in their own circumstances. The project's key findings are described in Figure 3 and Figure 4 above.

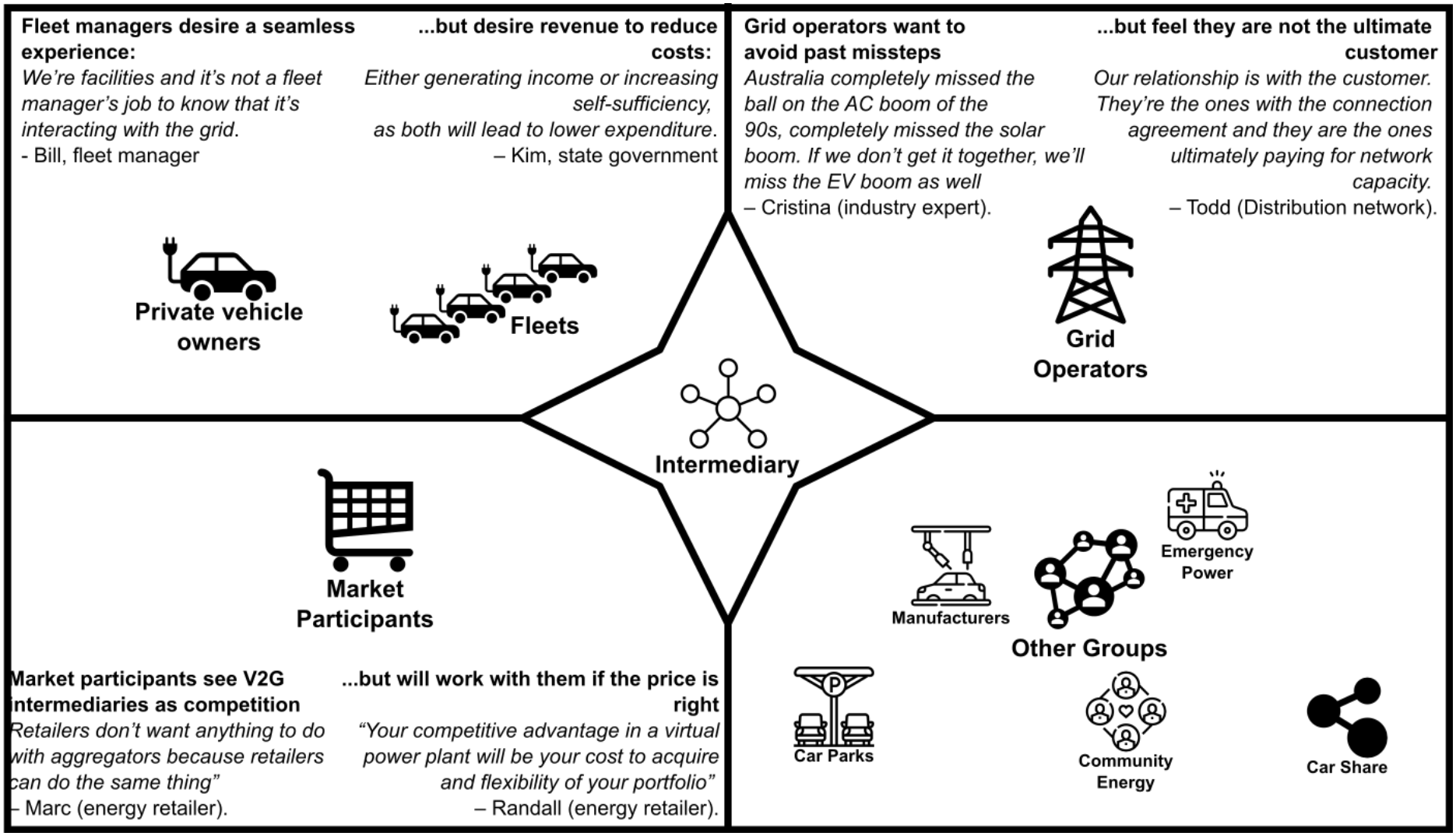


Figure 11 The intermediary needs to meet diverse customer requirements

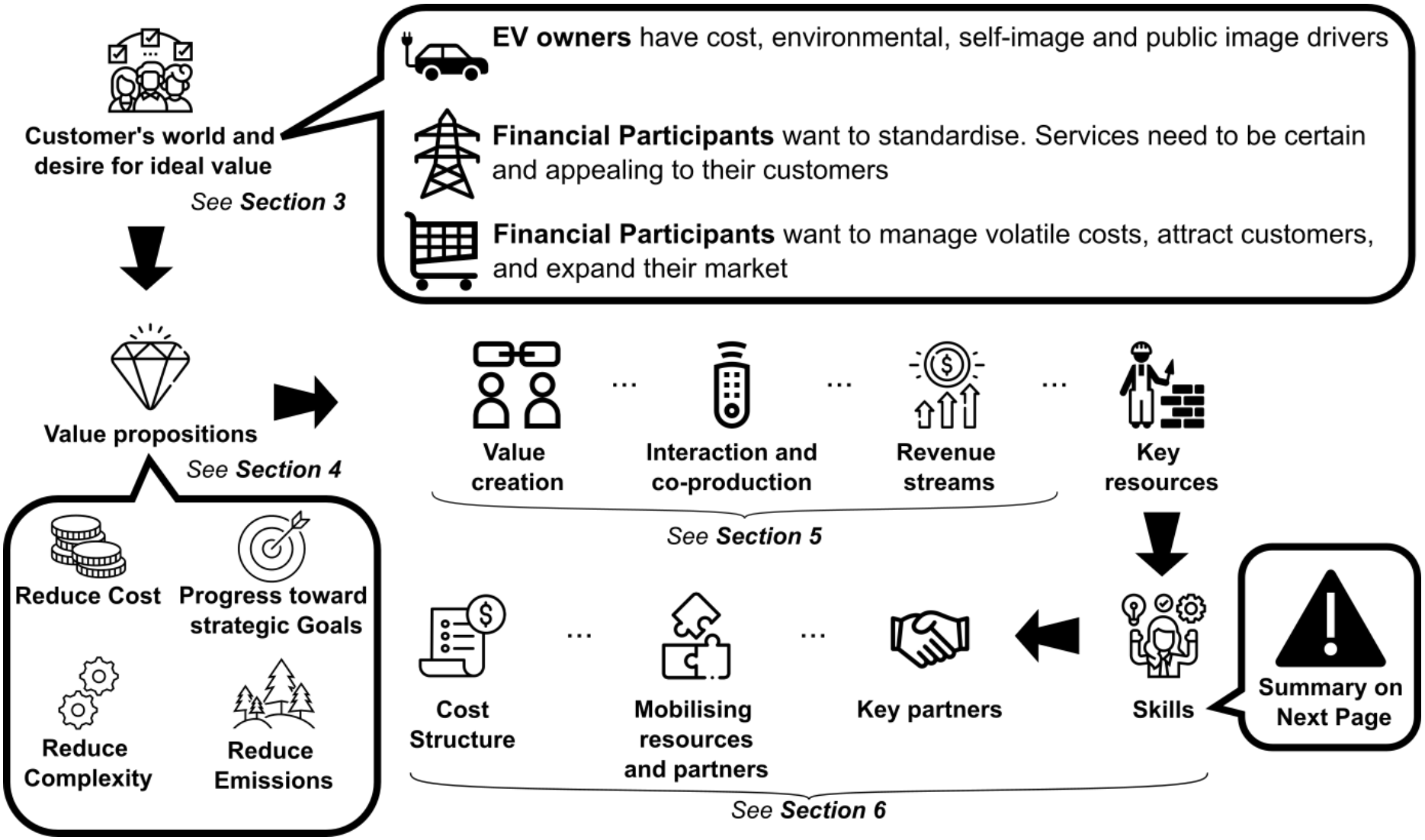


Figure 12 Business model canvas findings summary

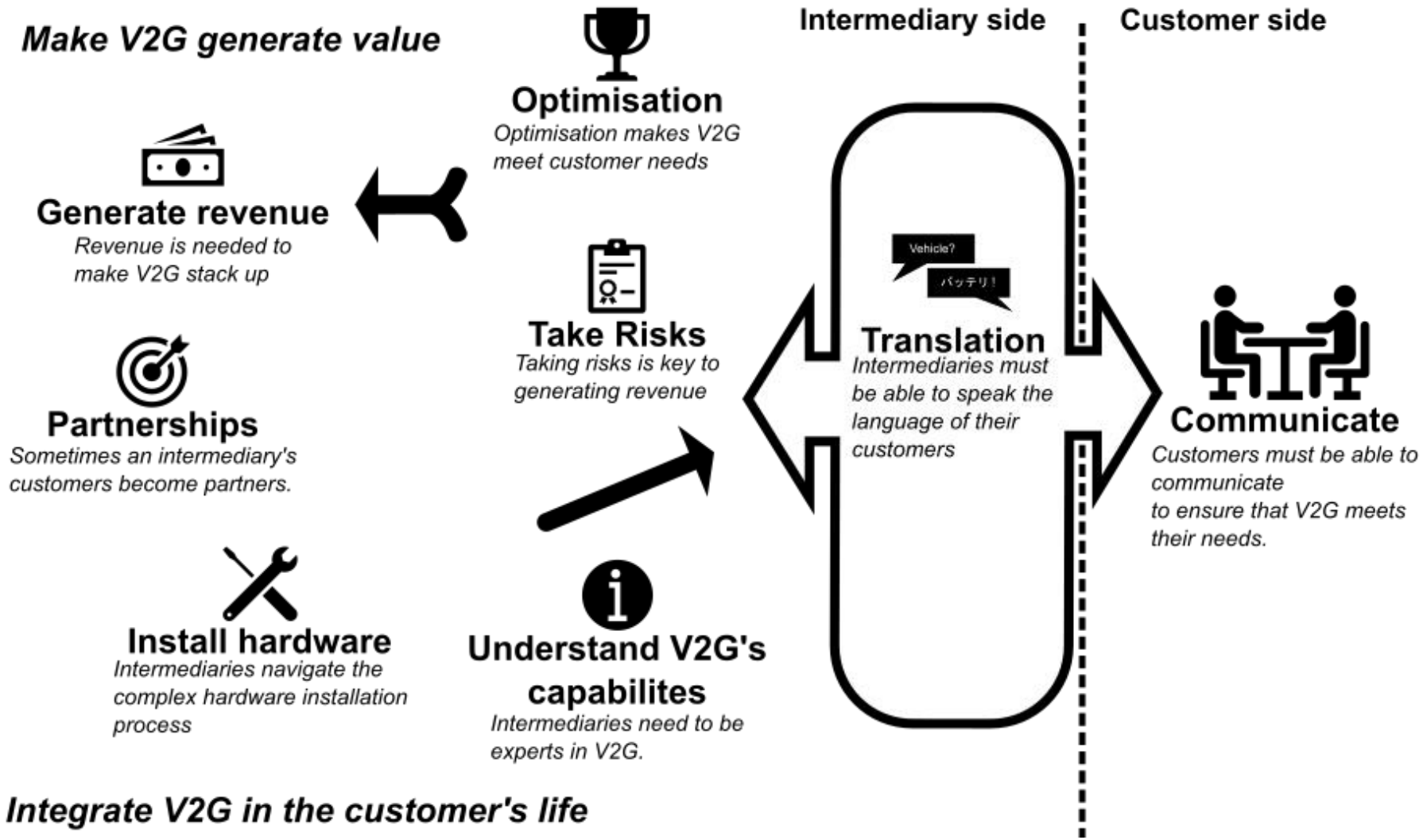


Figure 13 Key resources map

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Appendix A Business models

This chapter answers four fundamental questions around what this work package has delivered. It provides the literature background that defines what this report says and why. The questions it answers are:

1. What is a business model?
2. What sort of business model are we considering in this work?
3. What framing is used in this report?

A.1 What is a business model?

In simple terms a business model is a way of describing [1]:

- How an organisation delivers value to customers
- How it entices customers to pay for this value
- How the organisation creates the value
- How the organisation makes a profit

Business models have in recent years become sites of innovation. Business model innovation allows creation of new types of value, or new ways of delivering existing value [2]. A business model is a methodical way of mapping out how this works [2]. Business models apply equally to new and existing businesses. [1]

Business models are highly specific to each organisation. As described by Teece [1]

> *"Developing a successful business model is insufficient to assure competitive advantage as imitation is often easy: a differentiated (and hard to imitate) – yet effective and efficient – business model is more likely to yield profits"*

In other words, a successful business has a hard to imitate point of difference that creates competitive advantage. This also implies that a public report such as this cannot offer a differentiated business model. Instead, this report aims to present the generalisable building blocks of a V2G business model from which differentiation could then be considered.

A.2 What sort of business model are we building?

As can be seen in the organisations making up the REVS consortium, V2G involves a supply chain spanning the energy and transport sectors. This raises the question: what sort of business model is this report defining? V2G is commonly presented as a "nexus" between energy and transport [4], thus this report aims to explore that nexus. We propose a hypothetical intermediary that sits at the nexus between different energy and transport market players. This is shown in Figure 14. The report does not presuppose this organisation must exist. Instead asks what role it would have, were it to exist. Analysing this role enables the gap between the energy and transport sector to be explored.

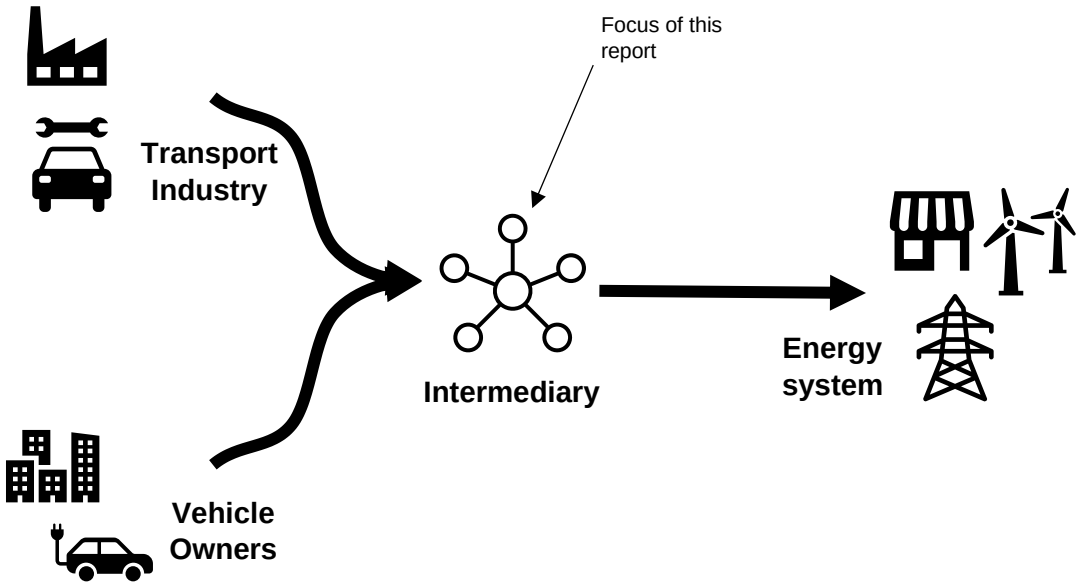


Figure 14 Conceptual framework and report focus

In this report, we describe four key groups of customers of intermediaries. They are shown in Table 18.

Table 18 Customer groups

Group	Description
EV owners	Vehicle and energy users are people or organisations who own or drive electric vehicles. Many of these people are also energy users, although this is not necessarily the case.
Grid Operators	People who manage the technical performance of the power system
Market Participants	People who are responsible for buying and selling energy and other grid services
Other groups	Customers that don't fit into any of the categories above.

The structure parallels that seen in virtual power plants (VPP) using home batteries. In that case, the intermediary role can be filled by aggregators [5], although that is not always the case. Conceptually it has many parallels to a class of organisations described as a "Multi-Sided Platform (MSP)". There are several definitions of an MSP. The most complete definition was presented by Hagiu et al [6], and defined an MSP as:

- An organisation with two or more groups of customers linked by cross-side externalities
- The allocation of fees between the multiple sides of the platform is non-neutral
- They enable direct interactions between the two or more distinct sides
- Each side is affiliated with the platform

Cross-side externalities are where the value of the platform is dependent on there being multiple groups of customers. For example, for the intermediary to procure grid services revenue on behalf of EV owners it must have grid-side relationships. But to form grid-side relationships the intermediary needs drivers whose capacity it can offer. Not all value

propositions offered by an intermediary have cross-side externalities. For example, managing EV owners' own energy consumption doesn't need grid-side relationships.

Non-neutral allocation of fees means that the ways in which costs are allocated across the sides of the platform influence the total volume traded across it. For example, increasing prices to grid-side participants enables a better value proposition for drivers and hence encourages uptake. Vice-versa is also true. This exploits the fact that one side may be less price sensitive than the other.

Direct interaction means that multiple sides of the platform retain control over the key terms of the interaction. For example, an aggregator may enable customers to form relationships with several energy retailers, bringing their platform-specific device for a more favourable price [7]. In this way, the customer and the energy retailer have a direct relationship, as well as each having one with the aggregator. These sorts of relationships could be a part of a V2G intermediary's business model.

Affiliation requires that participants make platform-specific investments. For example, drivers may need to purchase intermediary-specific controls for their V2G charger to enable participation. Similarly on the grid side participants may need to invest in software systems or hardware to integrate with the intermediary.

A V2G intermediary may meet the definition of an MSP. Even if this is not the case, it will almost certainly meet some of the requirements, such as the existence of cross-side externalities. In their discussion of business models for MSPs, Trabucci et. al. described how MSPs have led a shift in traditional thinking around how a business creates value [8]. Traditionally, business model designers took a resource-based view. In this view, businesses leverage internal resources to rework raw materials, and exchange this reworked raw material with customers for payment [9], [10]. The new MSP framing focusses on the customer. It proposes that value is only created via the customer's use of the business' outputs [9], [10]. This appears particularly applicable to MSPs because their purpose is in joining multiple types of customers. In fact, as demonstrated by their cross-side externalities, an MSP's main role is to transfer value between different groups of customers.

Vargo and Lusch term the traditional business model framing as goods-dominant logic (GDL) and the MSP framing as service-dominant logic (SDL) [9]. They describe these contrasting strategies as shown in Table 19.

Table 19 Goods vs Service dominant logic [9]

Goods-Dominant Logic (GDL)	Service-Dominant Logic (SDL)
• Frames the purpose of economic activity is to create goods that can be sold. • The role of a business is to embed goods with value and utility. • The aim of the business is to set variables (such as price and quality) to maximise profit from the sale of the output	• Frames core competencies (skills) as the fundamental unit of economic activity • The role of a business is to identify customers that could benefit from these skills • The aim of the business is to use these skills to co-create value with customers

For a V2G intermediary, their value is in their ability to create an environment that allows the energy system and EV owners to co-create value. A key property of SDL businesses is that they must be highly customer centric. Co-creation of value implies that customers are involved in the value creation process. Vargo and Lusch describe this as being "more than just consumer oriented, it means collaborating with and learning from customers and being

adaptive to their individual and dynamic needs" [9]. The next section describes how this will be framed into a business model.

A.3 The service model canvas

As described in section A.1, a business model is an "internal logic" that describes and creates a shared understanding of what an organisation does. Osterwalder and Pigneur penned one of the most common framings for business models in their book "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers" [2]. This book presents a business model canvas, which is a single-page summary of a business's internal workings that can be used to understand what the business does. It consists of 9 blocks:

- **Customer segments:** Who does the organisation serve?
- **Value propositions:** What value does the organisation create?
- **Channels:** How are value propositions delivered to customers?
- **Customer relationships:** How does the organisation relate to customers?
- **Revenue Streams:** How does the organisation make revenue?
- **Key resources:** What assets does the organisation need to deliver the value?
- **Key activities:** What activities does the organisation need to do to deliver the value?
- **Key partnerships:** What activities and resources are sourced from outside the organisation?
- **Cost structure:** What are the costs of delivering the value?

The original canvas as posed by Osterwalder and Pigneur has seen significant use in both industry and academia, particularly for recent "innovative" technologies such distributed generation, storage, and EVs [11], [12].

The original canvas has also been modified for application in different contexts. For example, Mayura proposed a modified version of the canvas for entrepreneurs called the lean canvas [13]. This canvas reframes the blocks in the original canvas to be more suitable for a fast-paced start-up environment. Sparviero reframed the business model canvas to be suitable for social enterprises [14]. This modified canvas adds explicit consideration of social and environmental benefits and costs, as factors that are commonly important to social enterprises. In this report, a version of the canvas described by Ojasalo and Ojasalo called the "service model canvas" will be used. This canvas reframes the original business model canvas as proposed by Osterwalder and Pigneur to align better with SDL [3].

The service model canvas was developed to rectify a lack of business modelling, design approaches and tools that implemented SDL [3]. It reframes the canvas to highlight the role of the customer as a creator of value. The modified canvas, including its changes from the traditional business model canvas is shown in Figure 15.

Other than the names of the blocks, the other key changes relate to how the blocks are completed. The original business model canvas is completed from the point of view of the business. It asks business model designers to consider what the business must do to deliver value propositions to customers. The service model canvas additionally asks business model designers how customers are involved or experience the elements in the blocks too. In this way the co-creation of value with customers is explicit.

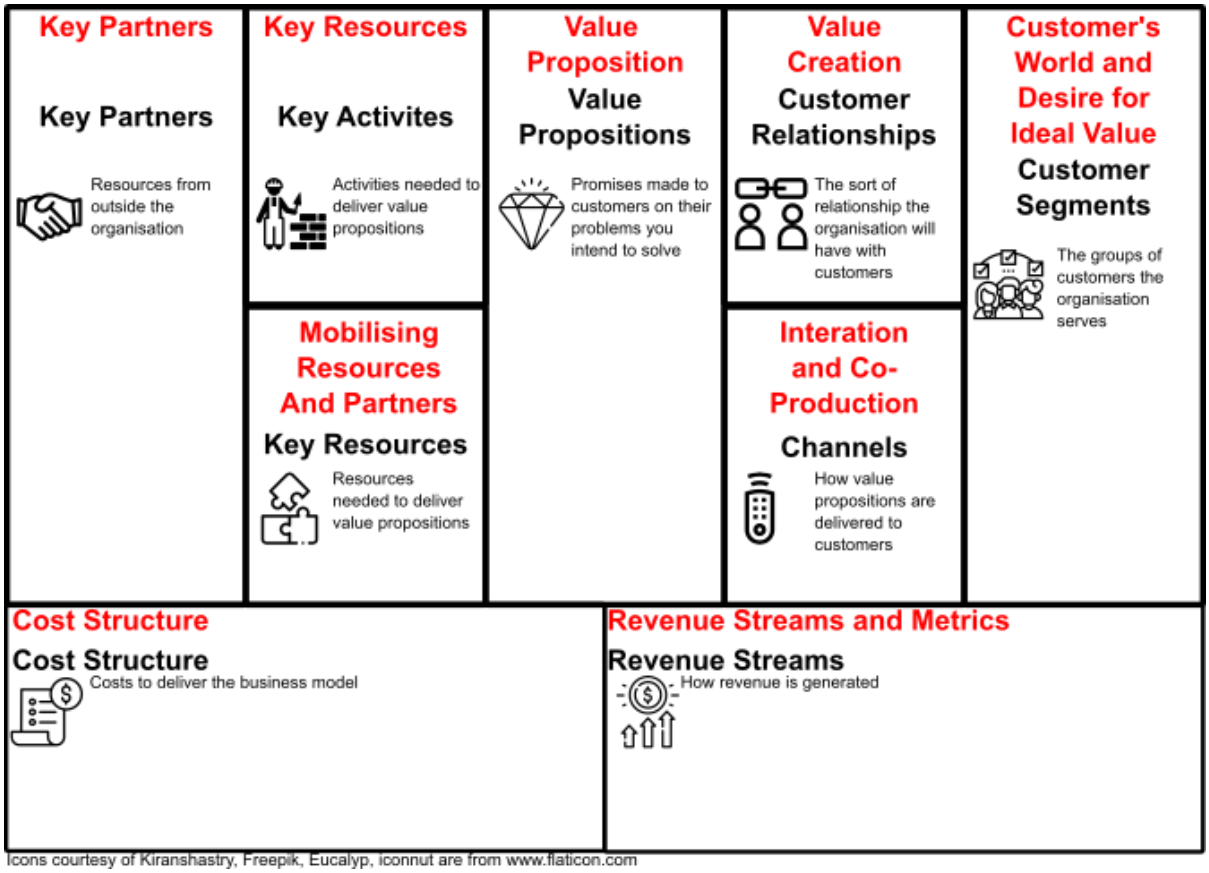


Figure 15 The business model canvas [2] and service model canvas (red) [3]

Each of the blocks is described below, presented in the same order that Ojasalo and Ojasalo recommends they are filled out [3].

Customer's world and desire for ideal value

This block is key to the SDL framing. Its purpose is to prompt the business model designer to empathise with customers. It goes beyond the specific business model the intermediary is building and aims to build a deep and holistic understanding of the customer's world comprising their context, activities, practices, and experiences. It also describes the benefits customers seek from their relationship with a V2G intermediary and factors that will be important to them in the relationship.

This block is presented for this study as an in-depth description of the interviews. More details on the interviews can be found in section 3.

Value propositions

Value propositions are suggestions of the value that a customer could get from the intermediary. Value propositions are built from an understanding of the customer's world. It is important to capture what the value is from the customer's point of view: What is the value they are buying? What problems do they have that need solving?

This block is presented in the business model explorer worksheet through a series of questions (shown in section A.4), with a summary in chapter 4.

Value creation

This block focusses on how value propositions are embedded in customer's lives. It describes how value creation occurs. In this block the intermediary understands how they facilitate the customer meeting their goals. This block differs from value propositions in that It describes which processes the intermediary integrates with and how these generate value.

This block is presented in the business model explorer worksheet through a series of questions (shown in section A.4), with a summary in chapter 5.

Interaction and co-production

This block describes how the customer interacts with the intermediary's activities. Its questions focus on how the intermediary can make this interaction easier or deliver more value.

This block is presented in the business model explorer worksheet through a series of questions (shown in section A.4), with a summary in chapter 5.

Revenue streams and metrics

This block describes how the intermediary will make money. It aims to understand how the intermediary's revenue generating logic can be linked back to the value the customer realises. It is important what the customer pays links back to realised value.

This block is presented in the business model explorer worksheet through a series of questions (shown in section A.4), with a summary in chapter 5.

Key Resources

This key block is where the skills, knowledge, material resources and immaterial resources required of the intermediary and customer are explored. It describes what the value propositions imply that the intermediary and customer can do. Importantly this block is completed from both the customer and intermediary perspective. Customers and intermediaries co-create value therefore it is important to understand both party's role in value creation.

This block is presented in the business model explorer worksheet through a series of questions (shown in section A.4), with a summary in chapter 5.

Key Partners

Key partners are the relationships the intermediary and customer have that enable delivery of the value. It includes how the other party experiences the partner (e.g., how customers experience the intermediary's partners).

Which partners an intermediary or customer works with is determined by the intermediary or customer's internal key resources and what must be sourced elsewhere. As this report is not focused on a particular organisation, it instead presents examples of the partners that could potentially provide some of the key resources needed.

This block is presented in the business model explorer worksheet through a series of questions (shown in section A.4), with a summary in chapter 6.

Mobilising resources and partners

This block describes how intermediaries and customers co-ordinate value creation with their partners. It also describes how partners develop their own key resources, and how the other party can utilise and develop the partner's resources.

This block is presented in the business model explorer worksheet through a series of questions (shown in section A.4), with a summary in chapter 6.

Cost Strucutre

This block analyses the costs of delivering the value propositions, from the point of view of both the intermediary and customer. It also analyses the other sacrifices the intermediary and customer must make.

This block is presented in the business model explorer worksheet through a series of questions (shown in section A.4), with a summary in chapter 6.

A.4 Building the business model

Building the business model involved completing the business model canvas. In this project the process used was based on that proposed by Ojasalo and Ojasalo in their paper that describes the service logic canvas [3]. This process is shown in Figure 16.

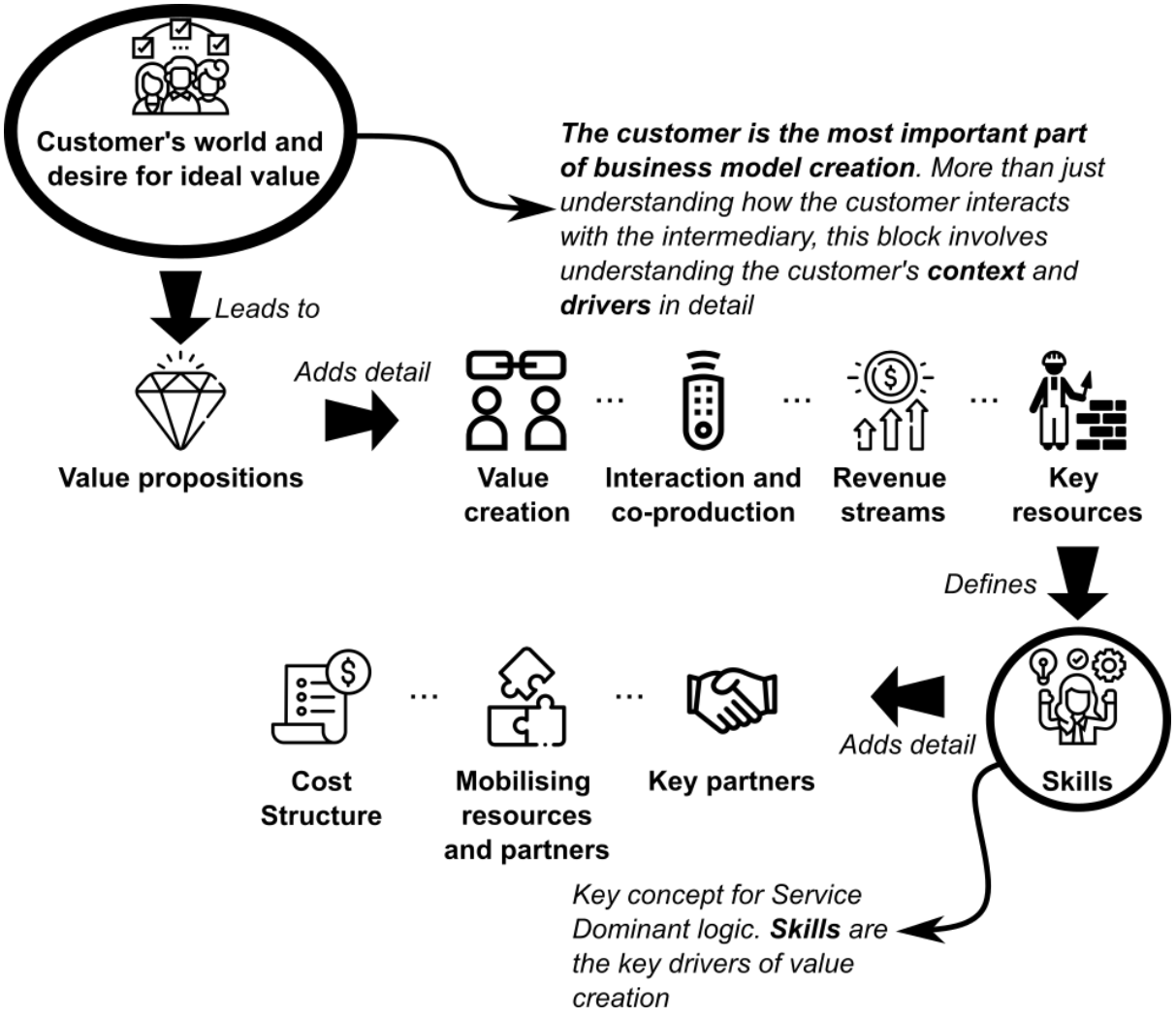
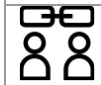


Figure 16 Canvas completion process overview

Each block was described by answering a series of questions, both from the customer and intermediary point of view. The questions used to complete the canvas are shown in Table 20. These questions are based on those posed by Ojasalo and Ojasalo. In some cases, questions have been modified to aid in completing the canvas. Where this is the case, it is noted in Table 20.

Table 20 Canvas blocks and questions [3]

Block	Questions from intermediary point of view	Questions from customer point of view
 **Customer's world and desire for ideal value** This block aims to analyse the customer's world in detail. It asks to analyse the customer's context, activities, practices, and experiences. This block is primarily answered by discussion in section 3.		• What value is the customer buying? • What customer challenges and problems need to be solved? • What is the customer trying to achieve?
 **Value propositions** Suggestions and projections of what the customer can expect from the intermediary Questions in this block have been modified to focus more clearly on the solution and how it answers the customer's problem.	• Why does this solution solve the problem? • How is the gap to be bridged?	• What is the customer doing? • What is the problem with the current solution? • What is the gap to be bridged?
 **Value creation** What is the customer doing with the intermediary's value proposition to meet their goals? These questions are as per Ojasalo and Ojasalo's paper	• How is the offering embedded in the customer world? • How can we facilitate customer to reach their goals?	• How does value emerge from the customer practices? • How are customer's long-term benefits accomplished?
 **Interaction and co-production** How does the customer participate in the itnemediary's activities? These questions are as per Ojasalo and Ojasalo's paper	• How can we support customer co-production?	• What are the customer's activities during use and different use contexts? • What are the customer's mental models of interacting with us?

Block	Questions from intermediary point of view	Questions from customer point of view
 **Revenue streams and metrics** What is the intermediary's earnings logic? How is this tied back to the customer's value? The question "How are we following the customer's KPIs" has been added to the intermediary's side to make clear how the intermediary's costs map to the customers' indicators of success as distinct to what the KPIs are on the customer side. This was asked in a single question on the customer side by Ojasalo and Ojasalo. The question "How direct is the line between value and payment for it?" has been added to indicate how easy it could be to monetise this revenue stream.	• What is our earnings logic? • How can we apply customer value-based pricing? • What else do we get other than money? • What are the metrics of success? • How are we following the customer's KPIs?	• Which benefits will customer pay for and how? • How direct is the line between value and payment for it? • What is the financial value they get? • What are the KPIs of the customer's business or life?
 **Key resources** In SDL this is the most fundamental block. It focusses on the skills that both the intermediary and customer need to deliver value. Skills and knowledge has been split into separate questions on both the customer and intermediary side where they were asked n one question by Ojasalo and Ojasalo..	• What skills do we need? • What knowledge do we need? • What other material or immaterial resources do we need?	• What skills does the customer need? • What knowledge does the customer need? • What other material or immaterial resources does the customer need?

Block	Questions from intermediary point of view	Questions from customer point of view
 **Key partners** Who could intermediaries or customers partner with? Why would parnters want to partner? This block has been modified to ask the same questions of both intermediaries and customers. This means that both intermediaries and customers consider their own and the other side's partners.	• Who are our key partners? • What is our partners role? • What do we need from our partners? • How do our partners benefit from co-operation? • How do we experience our customer's partners?	• Who are our key partners? • What is our partners role? • What do we need from our partners? • How do our partners benefit from co-operation? • How do we experience the intermediary's partners?
 **Mobilising partners and resources** How do we work with and develop partners? How do we link parkers to our customers? This block has been modified to ask the same questions of both intermediaries and customers. This means that both intermediaries and customers consider their own and the other side's partners.	• How do we co-ordinate multi-party value creation? • How do we utilise and develop partners and resources? • How can customers utilise and develop our partners and resources?	• How do we co-ordinate multi-party value creation? • How do we utilise and develop partners and resources? • How can the intermediaries utilise and develop our partners and resources?
 **Cost strucutre** What are the costs? What costs are we placing on customers? This block has been modified to tie costs back to the funcions they support more strongly. This block has also been modified to ask the same questions of both intermediaries and customers. This means that both intermediaries and customers consider their own and the other side's partners.	• What is the function? • What role does it have? • What are the costs inherent in our business model? • What are our other sacrifices? • What are the costs incurred by customers side to fill their end? • What other sacrifices must the customer make?	• What is the function? • What role does it have? • What are the costs inherent in our business model? • What are our other sacrifices? • What are the costs incurred by itnermediaries to fill their end? • What other sacrifices must the customer make?

Appendix B Data collection

Service dominant logic proposes customers as co-creators of value [3], [9]. Value only exists in customers' experience of V2G. This means that any V2G business model must start with the customer. This is illustrated in Ojasalo and Ojasalo's canvas, where they advise business modellers that "before moving to the value proposition and other blocks of the business model it is very important to get deep insight and holistic understanding of the customer's world: context, activities, practices, and experiences" [3]. This project reflects this by starting with a series of interviews with the customers of V2G and its services.

In engaging with this report, readers should keep in mind that the business model is intended for a hypothetical intermediary: an independent party that sits between and manages customers from transport and energy sectors (discussed in A.2). They connect these parties in a way that enables them all to see value from participating in V2G. It is not necessary that the intermediary is a separate, independent party, however: any number of existing organisations could fulfil its role. Presenting it as a separate organisation allows a cleaner analysis of its role in the landscape.

The most critical part of any business model is understanding its customers. As described in our earlier reports (such as our "A-Z of V2G" report [4]) there are several different customers for V2G or its services. This step involved interviewing a diverse set of potential customers of V2G to understand their world and perspectives on V2G. There were two types of interviews undertaken that form part of this business model work: industry and EV owner.

Industry and EV owner interviews covered different types of customers, shown in Table 21.

Table 21 Interview coverage of customer groups

Interview type	Customer groups interviewed
EV Owner	**EV Owners:** Private and fleet vehicle owners
Industry	**Grid Operators:** Distribution networks and microgrid operators **Market Participants**: Energy retailers and aggregators **Other groups:** Vehicle manufacturers, fleet providers, regulators, industry experts (such as academics and advocacy bodies)

B.1 Industry interviews

Industry interviews involved semi-structured interviews with transport and energy sector experts. These people were generally those most likely to inhabit the "transport industry" and "energy sector" parts of Figure 14. It included participants from Australia and the United Kingdom. This work was approved under human ethics protocol 2020/642.

The aim of the interviews was to analyse the intermediary's customers. Participants were asked to describe:

- Who the customers were
- What customers brought to the relationship with an intermediary
- What customers expected to get out of the relationship with an intermediary
- What sorts of information would be exchanged during the relationship

The discussion template for the interview is shown in Figure 17. Participants were encouraged to discuss issues that were important to them, so did not always follow the template. Customer types were divided into two groups for discussion:

- Customers (EV owners, including private and fleet)
- Partners (Grid operators, market participants, and other groups)

While these were discussed as “customers” and “partners” in interviews, during the research it became apparent that both groups were better described as customers of the intermediary therefore are presented as such in this report. Similarly, during interviews, the intermediary was described as an aggregator. However, in this report we refer to this organisation as an intermediary to distinguish them from the aggregator class of financial participant.

There were 32 participants with demographics described in Table 22.

The interviews were coded when complete to extract key themes from them. These coded outputs formed the basis of the customer segments block.

Table 22 Breakdown of participants

Interviewee type	Participants
End users Fleet managers	1
Financial participants Financial participants are those that participate in energy markets such as energy retailers, aggregators, and generators.	9
Grid Operators Grid operators are those that are responsible for the technical operation of the grid such as networks, market operators, and microgrid operators.	7
Other This category is for people who aren’t active participants in the energy or transport industry but have expertise or perspectives that enhance the projects findings. This includes stakeholder groups, academics, financiers, and consultants.	6
Energy Regulator Energy regulators are responsible for defining and enforcing rules in the energy system.	3
Transport industry People who were from the transport industry such as vehicle manufacturers, fleet providers, and charge platform providers.	6
Total	**32**

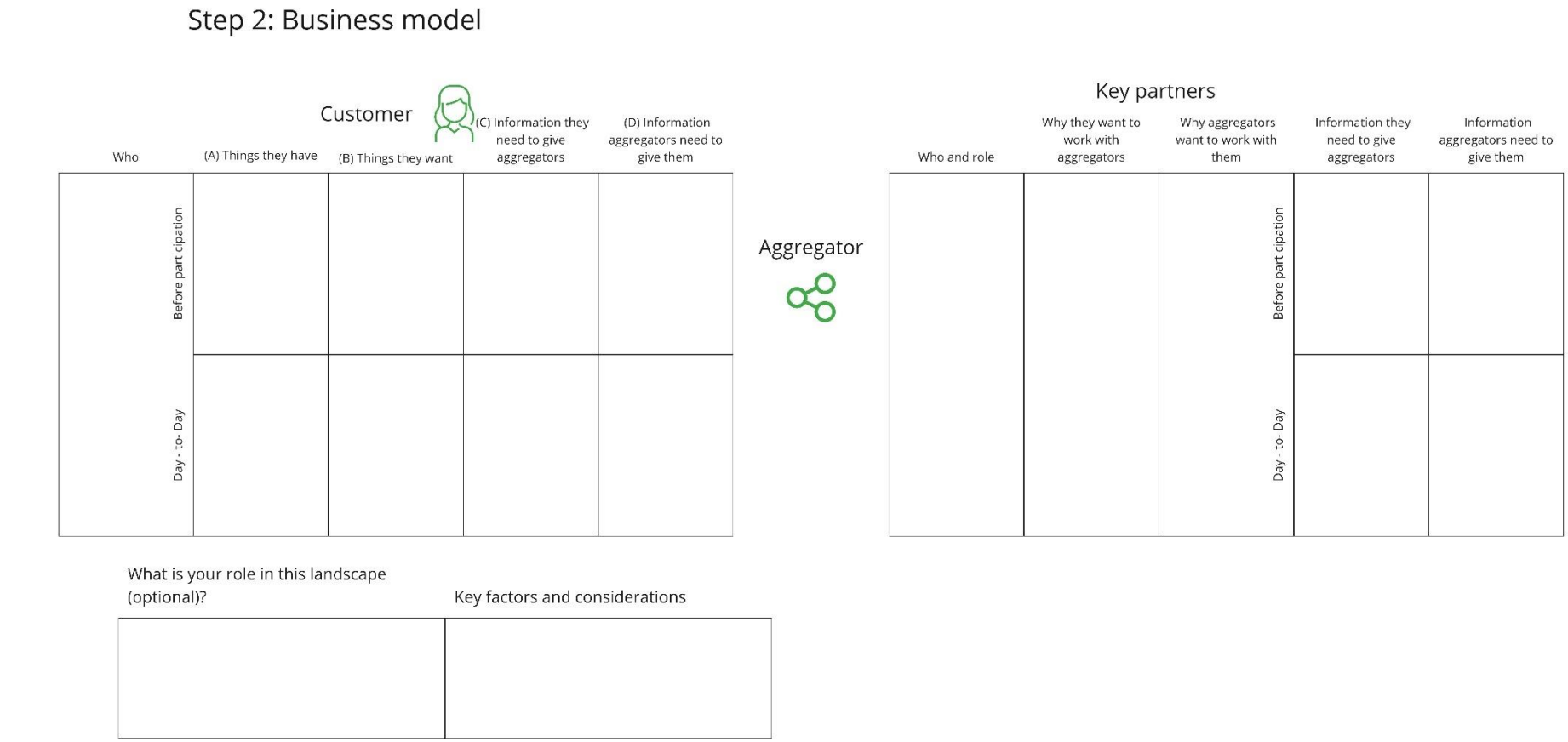


Figure 17 Template used in interviews

B.2 End user interviews

These interviews were completed as part of the social science stream of the REVS project. It is based on 35 interviews with the REVS consortium, fleet, and private end users, and industry leaders. More detail on these interviews can be found on our “interim social science report” [15].