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Trapped in the transition: result controls and social inequity in long-term energy agreements

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Abstract

Purpose – This article aims to examine the role of long-term energy service agreements (LESAs) as a calculative practice and a form of control over an organisation's results in the world's transition toward sustainability and renewable energy. Within this context, we illustrate how calculative practices in the form of results controls can impact the social elements of such transitions.

Design/methodology/approach – Using a case study, we explore the calculative practices that underpin LESAs and their implications for achieving equitable energy outcomes in the drive toward zero carbon. We also apply a management control framework to understand how LESAs are structured and how they impact different consumer groups.

Findings – We find that the kinds of LESAs that provide certainty over the revenue directed toward renewable energy developers can disadvantage consumers, largely by way of higher energy prices. We also find that energy retailers are not disclosing details about the reasons for higher energy bills.

Originality/value – While prior work concerning the world's transition to sustainability often advocates for results controls that minimise risk exposure for the private sector, we demonstrate that this can lead to unforeseen and potentially unintended consequences. We use this insight to highlight a path forward for future research on management controls, calculative practices and sustainability transitions.

Keywords Calculative practices, Energy justice, Long-term energy service agreements, Management controls, Renewable energy

Paper type Research paper

1. Introduction

Society urgently needs to transition to zero-carbon energy as part of a broader sustainability transition (Baker *et al.*, 2023; Geels, 2010; Kemp *et al.*, 2007). The dual energy challenge—i.e. balancing environmental sustainability goals with social equity— forms a critical backdrop for this transition (United Nations, 2023). Sustainability transitions refer to actions designed to align economies with the Brundtland Commission's definition of sustainable development, namely "meeting the needs of the present without compromising the ability of future

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generations to meet theirs" (Geels, 2011; Loorbach and Rotmans, 2006; World Commission on Environment and Development, 1987, p. 43).

Sustainability transitions, including the shift toward zero-carbon energy, have been associated with accounting practices that can lead to undesirable social consequences. For instance, governments worldwide are using long-term energy service agreements (LESAs) to attract investments into renewable energy (REN21, 2023). However, stakeholders criticise these agreements for potentially "trapping" energy consumers into paying higher prices (Taylor, 2023, p. 1; van Leeuwen, 2023). As such, some stakeholders refer to these practices as "criminal" (Bermingham, 2022, p. 6).

Globally, LESAs are an important mechanism for promoting the transition to zero-carbon energy (Ason and Dal Poz, 2024; REN21, 2023; Schlecht *et al.*, 2024). Yet, there are some critical concerns about LESAs, many of which relate to the economic efficiency, equity, and social consequences of such a transition (van Leeuwen, 2023). For example, while zero-carbon energy is now more affordable than fossil fuels in many regions (e.g. Australian Energy Market Operator [AEMO], 2024a), LESAs result in higher costs for renewable energy than existing, fully depreciated, emissions-intensive generation because they guarantee renewable energy developers get paid a certain price for the energy they provide (Australian Capital Territory Government, 2022). This guaranteed price arguably increases costs because renewable energy developers lack an incentive to build assets optimised for energy production through, say, solar and wind (Ason and Dal Poz, 2024; Nolden and Sorrell, 2016; World Economic Forum, 2023).

Such pricing discrepancies raise questions about the calculative practices underpinning LESAs and sustainability transitions more generally (Loorbach and Rotmans, 2006; Nelson *et al.*, 2022). Calculative practices—methods to translate complex interactions into financial metrics—are central to sustainability transitions (Holmgren Caicedo *et al.*, 2019; Lazarevic and Martin, 2018; Miller, 2004; Semenova, 2021). For example, Lazarevic and Martin (2018) highlight how biofuel producers use life cycle assessments to align with the European Union's Renewable Energy Directive. These assessments often prioritise metrics like greenhouse gas emissions while overlooking broader impacts, such as biodiversity loss and land-use changes, leading to consequences like deforestation.

Indeed, calculative practices within sustainability transitions are often skewed toward minimising private sector risk exposure and can ignore critical environmental and social considerations (Geels, 2002; Loorbach and Rotmans, 2006; Merchant and Van der Stede, 2023). We therefore investigate calculative practices within LESAs as an example of the kinds of complexities that can arise in sustainability transitions.

Using a case study approach (Flyvbjerg, 2006), we apply a management control framework to understand the calculative practices associated with LESAs. LESAs are a form of management control because they provide a structured mechanism for ensuring that developers deliver renewable energy in specific geographic areas for an agreed price (New South Wales [NSW] Government, 2020a). Our specific focus is on result controls, which focus on measuring and evaluating the outcomes of an organisation's actions, including the decisions of its managers and employees (Kihn *et al.*, 2024). Result controls often concern outcomes where agreed measures exist and clear goals have been established, rewarding or penalising actions that either achieve or detract from those goals (Merchant and Van der Stede, 2023). A fixed-price contract is an example of a results control because it sets a clear financial outcome that the contractor must achieve (i.e. the fixed price) based on their performance against an agreed measure, such as providing renewable energy (AEMO, 2024b; REN21, 2023).

Management controls are increasingly being recognised as crucial to aligning corporate objectives with "sustainability" imperatives (see Merchant and Van der Stede, 2023, p. 559). These systems offer frameworks to address the behavioural and calculative dimensions of managing sustainability and linking an organisation's strategies to actionable performance measures (Dodd *et al.*, 2024; Eyring and Van der Stede, 2024; Kihn *et al.*, 2024). For instance, Schulze and Heidenreich (2017, p. 1506) argue that price volatility in the energy market can "lower the ability of a company to adapt to energy-related environmental changes". Tekathen *et al.* (2019, p. 1175) also show that other result controls can incentivise sustainability transitions—a "carbon tax" is one example. Thus, management controls are integral to helping firms become more sustainable.

Like LESAs, agreements to purchase power are management control mechanisms that aim to provide predictable revenue streams in a volatile energy market. These contracts help private organisations secure financing for renewable energy projects by reducing uncertainty and aligning stakeholder risk-sharing arrangements (Dodd *et al.*, 2018; Dodd and Yengin, 2021). Notably, these can also extend to other sectors, like aviation and shipping. From an accounting perspective, revenue certainty is vital to a sustainable financial performance. As Tekathen *et al*. (2019) show, organisations can reframe sustainability goals to focus on financial rather than ecological or social sustainability when financial certainty is at risk. By embedding revenue certainty into accounting practices, organisations can align their strategies with decarbonisation goals (Lazarevic and Martin, 2018).

However, LESAs are far from the perfect solution. For instance, South Australia's Minister for Energy and Mining, the Hon. Tom Koutsantonis MP, has described LESAs as "economic vandalism" (Bermingham, 2022, p. 6). He cites concerns over their potential to distort the energy market by paying above-market rates for renewable energy. Similarly, Ason and Dal Poz (2024, p. 19) caution against viewing LESAs as a "silver bullet" for decarbonisation, highlighting their capacity to suppress other market-driven innovations (also see Bowden, 2023; Simshauser, 2019). Compounding these issues are allegations of unethical practices by some energy companies, accused of super profits through concealed profiteering and "ripping off households" (Richardson, 2024, para 1). Thus, while LESAs may bring investors stable prices throughout their investment, there is evidence that LESAs can disadvantage consumers and distort energy markets.

We, therefore, explore LESAs as a form of results control to first understand how they are structured and, second, how they impact consumers and energy markets. As part of this investigation, we undertook a content analysis of associated material, including government policy documents and energy market regulations, finding that many of the calculative practices associated with results controls are designed to ensure profits and revenue stability for renewable energy developers while imposing higher energy costs on consumers. We also find that energy retailers do not disclose these impacts to consumers.

Accordingly, this paper makes three contributions to the accounting literature. First, we show how governments and the energy industry are using results controls and calculative practices to accelerate the energy industry's transition to zero-carbon energy. Second, we illustrate some previously unseen and potentially unintended consequences of LESAs, additionally showing how policymakers might amend the offending calculative practices to address the inequities we uncovered. Last, we explore some possible avenues for expanding future research on management controls to consider these unforeseen and potentially unintended consequences, especially in relation to sustainability transitions.

The rest of this paper is structured as follows. First, we examine the conceptual background relevant to sustainability transitions, management controls, and calculative practices, including their relationships to the zero-carbon energy transition. We then present the case study and methods. Finally, we present the findings, discussion, and conclusion, which cover our main contributions, limitations, and areas for future research.

2. Context and conceptual background

As mentioned, the purpose of this paper is to examine the role of LESAs as an example of a result control/calculative practice that is often used to effect a transition toward sustainability. More specifically, we seek to advance accounting research as it relates to the world's transition toward zero-carbon energy and the dual energy challenge of achieving sustainability while ensuring affordability and equity. This will be done through the lens of management controls and calculative practices. This section of the paper therefore outlines existing work on sustainability transitions, management controls, and calculative practices related to zero-carbon energy.

2.1 Sustainability transitions, management controls, and calculative practices in the context of zero-carbon energy

Accounting research has increasingly contributed to understanding how sustainability transitions shape organisational strategies and practices. These transitions, which generally involve some kind of fundamental shift towards sustainable development (Geels, 2011; Loorbach and Rotmans, 2006), are inherently complex. They require accounting scholars to develop an advanced understanding of how organisations can and do adapt their behaviours and strategies to address interrelated environmental, economic, and social elements (Geels, 2011; Kemp *et al*., 2007; Loorbach and Rotmans, 2006).

In the energy industry, businesses are increasingly recognising management controls as essential for bridging the gap between high-level sustainability goals and their practical implementation (Merchant and Van der Stede, 2023; Tekathen *et al*., 2019). By addressing both behaviours and results, these controls are helping organisations integrate sustainability considerations into their strategic decision-making processes (Slacik *et al*., 2022). Moreover, this structured approach tends to align industry strategies with actionable performance measures, providing organisations with the tools to navigate the complexities of sustainability challenges (Eyring and Van der Stede, 2024; Kihn *et al*., 2024).

Many debates and controversies surround the accounting practices associated with sustainability transitions (Schaltegger *et al*., 2023). A key controversy concerns the use of result controls to encourage new zero-carbon energy investments, as these provisions can distort markets, create economic inefficiencies, and even partially cover up the full impacts of a transition (Ason and Dal Poz, 2024; Bermingham, 2022; Lazarevic and Martin, 2018). Central to this debate is the critical sustainability challenge of achieving an urgent shift to zero-carbon energy while maintaining affordable energy—often referred to as the dual energy challenge (Baker *et al*., 2023; Geels, 2010; Kemp *et al*., 2007; United Nations, 2023).

We therefore need further research on the dual energy challenge and sustainability transitions, including the shift towards zero-carbon energy (Dodd *et al*., 2020; Dodd and Nelson, 2022; Jenkins *et al*., 2016). While the transition to zero-carbon energy offers significant environmental benefits, if it fails to achieve economic efficiency and social equity, it may not progress quickly enough to address climate change and the broader sustainability agenda (Chapman *et al*., 2016; Senkl and Cooper, 2023).

Results controls, such as the secured energy pricing found in LESAs, while effective in motivating performance, also present challenges, especially when defining success involves balancing environmental, social, and economic outcomes (Ason and Dal Poz, 2024; Merchant and Van der Stede, 2023). Metrics that fail to capture this complexity risk prioritising financial efficiency over social fairness, potentially exacerbating inequalities and undermining sustainability goals (Heffron, 2021; Heffron and McCauley, 2017; United Nations, 2023). The challenge lies in the visibility of outcomes because some aspects of performance are more easily observed and measured than others (Dodd *et al*., 2024; Kerr, 1995). This paper responds to calls for more nuanced management controls that account for measurable outcomes and the less visible contributions essential for driving sustainability transitions (Ciplet, 2021; Slacik *et al*., 2022; Tekathen *et al*., 2019).

2.2 Calculative practices and the dual energy challenge

Prior research highlights the need for a deeper examination of both results controls and calculative practices (Merchant and Van der Stede, 2023). Within the management controls literature, calculative practices are pivotal (Argento *et al*., 2020; Miller, 2004; Robson and Ezzamel, 2023). In accounting research, calculative practices are often negatively associated with shaping "messages to suit" organisational agendas or to "mislead" stakeholders (Merkl-Davies and Brennan, 2017, p. 2; Ben-Amar *et al*., 2021). Yet, calculative practices can also positively translate complex information into financial data to support decision-making (Miller, 2004).

However, calculative practices surrounding the zero-carbon energy transition are often skewed towards assuring a certain amount of revenue for private sector organisations while overlooking the broader social implications of such arrangements (Dodd and Harvey, 2023; Nelson *et al.*, 2019, 2022). Examining the social implications of results controls within energy contracts is essential, as the calculative practices within these agreements directly affect how equitably the contract's costs and benefits are distributed. They also influence the affordability and accessibility of energy, in turn impacting fairness, particularly for vulnerable and disadvantaged groups (Dodd and Harvey, 2023; Heffron, 2021; Heffron and McCauley, 2017).

Further, the role of calculative practices in the zero-carbon transition extends beyond the purely technical. It also encompasses social and organisational elements (Geels, 2011; Kemp *et al.*, 2007). Scholars such as Carnegie *et al.* (2021), Hopwood (2009), and Merkl-Davies and Brennan (2017) contend that accounting calculations are socially constructed tools that reflect and shape organisational values (also see Ben-Amar *et al.*, 2021). Calculative practices, such as carbon accounting, lifecycle assessments, and environmental impact analyses, enable organisations to quantify and manage their sustainability efforts, facilitating compliance with regulatory standards while constructing new organisational narratives focused on sustainability. Scholars argue that these calculative practices help establish norms and expectations, embedding sustainability into governance structures and reinforcing accountability (Bui *et al.*, 2022; Bui and de Villiers, 2017)

As highlighted above, addressing the dual energy challenge when developing new systems requires one to carefully consider both results controls and calculative practices. Successfully transitioning to zero-carbon energy will also require substantial investments into infrastructure, often leading to higher energy prices in certain regions and for specific consumer groups (Australian Capital Territory Government, 2022; Dodd and Nelson, 2022; Jenkins *et al.*, 2016). Today, accounting scholars and practitioners play a key role in evaluating how the costs and benefits of public-sector interactions are distributed. This includes considering how the private sector can support governments to achieve policy objectives, such as building public infrastructure (English *et al.*, 2010). While considerable research has examined public-private partnerships in detail (e.g. see Andon, 2012; Beelitz and Merkl-Davies, 2019), further investigation is needed to unpack the complex social implications of sustainability transitions, including the shift toward zero-carbon energy, to assess how stakeholders are impacted and whether equitable outcomes are being sought and achieved (Heffron, 2021).

Importantly, while zero-carbon energy offers opportunities to reduce greenhouse gas emissions, it also creates unique challenges for disadvantaged communities (Heffron and McCauley, 2017). The United Nations' Sustainable Development Goal (SDG) 7 emphasises the importance of providing affordable, reliable, sustainable, and modern energy access (United Nations, 2023). However, research shows that low-income households frequently bear a disproportionate share of energy costs due to factors such as inadequate housing quality, limited access to energy-efficient technologies, and exclusion from distributed generation schemes like solar photovoltaic (PV) systems (Sovacool and Dworkin, 2014). Moreover, the transition from fossil fuels often exacerbates economic hardship and social inequality, particularly in communities reliant on coal-fired power stations, where closures lead to significant job losses (Carley and Konisky, 2020; International Labour Organization, 2016).

To address these issues, scholars advocate for a "just transition" that seeks to minimise the adverse effects of the zero-carbon energy shift on disadvantaged populations (Heffron, 2021, p. 1). Energy justice, which focuses on the fair distribution of costs and benefits among stakeholders, is a crucial component of this approach (Boardman, 2013; Sovacool and Dworkin, 2014). A just transition aims to ensure that all of society's groups can share the benefits of energy policies while mitigating the negative impacts on vulnerable communities (Ciplet, 2021). This transition is particularly critical in regions with unequal access to renewable energy infrastructure, especially where energy poverty—the inability to afford adequate energy services—remains a significant challenge. For instance, the literature reveals that one in five people in developed nations like Australia cannot adequately heat or cool their homes (University of Melbourne, 2023). Hence, energy poverty is a worldwide issue, highlighted by the United Nations through SDG 7 (United Nations, 2023).

The role of LESAs in this context is particularly pertinent. Despite the many criticisms of LESAs, the literature on their impact on various consumer groups is not particularly clear (Abada *et al.*, 2019; Nelson *et al.*, 2019, 2022). This lack of clarity highlights the potential of management controls and calculative practice frameworks to help illuminate the effects of LESAs and their implications for accounting practices. That said, key questions remain about how managers might design or implement these systems to support a sustainable and just transition to zero-carbon energy. We therefore ask:

> How do LESAs affect different consumers, and what are the broader implications for understanding how management controls and calculative practices influence sustainability transitions?

3. Methodology

To answer our research question, we examined the LESAs proposed under the New South Wales (NSW) Government's 2020 Electricity Infrastructure Roadmap (hereafter the NSW Roadmap). NSW was selected as our case study because the NSW Government plans to use LESAs to facilitate the transition from coal to renewable energy (NSW Government, 2020c). We analysed the NSW Roadmap alongside key documents, like the NSW Electricity Infrastructure Investment Act (2020), NSW Government (2020a) and the NSW Electricity Infrastructure Fund – Contribution Determination Guideline (AER, 2022b). These documents detail the operationalisation of results controls within these energy service agreements. However, given that the NSW Roadmap does not specify how energy providers should allocate the costs associated with LESAs, we inferred this information from information published by the Australian Energy Regulator (AER) (2022b). Specifically, the AER (2022b, p. 6) notes that consumers ultimately fund the costs of LESAs through "volumetric (variable) energy usage charges".

To model how LESAs impact different consumers, we established a variable charge for LESA costs, set at $0.01/kWh (the assumptions underpinning this model are explained in the Appendix). Figure 1 and Tables 1 and 2 illustrate this model, showing the distribution of costs among consumers based on their energy usage.

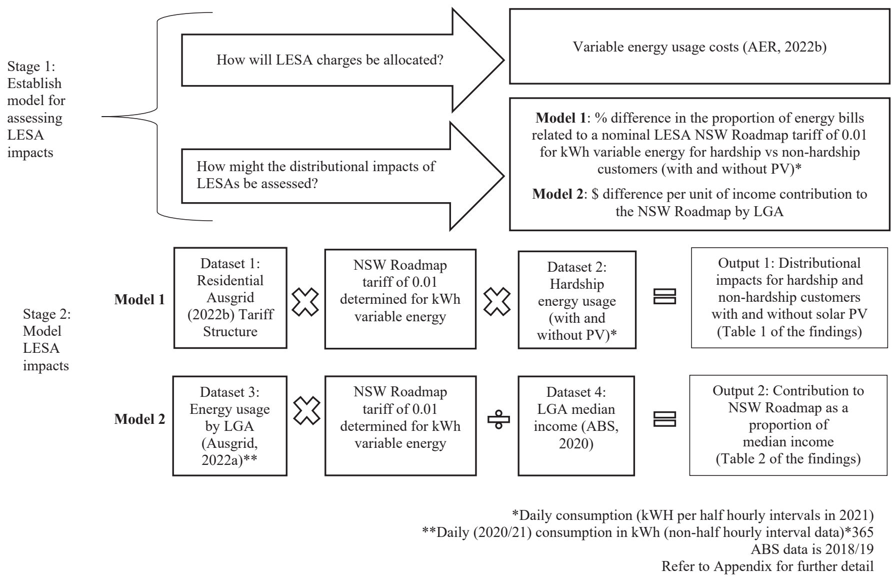


Figure 1. Theoretical model to illustrate how the Australian Energy Regulator (2022b) distributes LESA costs across consumers

Table 1. Residential Ausgrid (2022b) network prices

	Non-TOU	Peak	Shoulder	Off-peak	Demand high	Demand low
Non-TOU	8.805					
Transitional TOU		8.805	8.805	8.805		
TOU		27.8	4.794	3.3095		
Demand (intro)		8.337	8.337	8.3374	1.0105	1.011
ToU w/Demand		25	3.657	2.9253	4.1286	4.129
Demand		2.24	2.24	2.2402	23.374	13.81
Controlled Load 1	1.7486					
Controlled Load 2	4.0093					

Note(s): *These are the exact tariffs (Ausgrid, 2022b), including cents/kWh, TOU = Time of Use Tariff, and Fixed charges = 32.6162 per day per kWh

Table 2. Model 2 results

	Total average consumption (kWh/day)*365*0.01 Additional cost per annum ($)	Total median income ($ per year)	Relative impact in comparison to income*
Upper Hunter	73.46334865	48,941	0.150105941
Singleton	78.34701958	56,532	0.138588799
Muswellbrook	73.71495007	55,283	0.133341081
Port Stephens	61.74299437	46,338	0.133244841
Cessnock	65.73373042	49,744	0.132144038
Ku-Ring-Gai	79.89712729	62,263	0.128322001
Central Coast	60.25516735	49,022	0.122914543
Canterbury-Bankstown	54.91130741	45,160	0.121592798
Lake Macquarie	61.73472382	51,547	0.119763951
Hornsby	66.95428362	56,974	0.11751726
Sutherland	69.24508971	60,106	0.115204954
Maitland	61.36405022	54,255	0.113103032
Georges River	53.62580884	47,928	0.111888267
Burwood	45.36852753	41,051	0.110517472
Strathfield	51.25938177	46,719	0.109718491
Cumberland	46.83125834	42,992	0.108930169
Hunters Hill	78.94600192	73,705	0.107110782
Northern Beaches	59.03709774	59,676	0.098929382
Newcastle	49.89903032	54,608	0.091376777
Ryde	50.02419603	54,872	0.09116525
Bayside	45.42670041	50,953	0.089154123
Woollahra	69.20646448	80,245	0.086243958
Willoughby	54.31554191	63,257	0.085864872
Mosman	65.69736903	77,945	0.084286829
Canada Bay	48.73092021	60,171	0.080987386
Parramatta	42.04575065	52,364	0.080295147
Lane Cove	56.93633659	73,707	0.077246851
Randwick	46.20283423	62,478	0.073950565
Waverley	47.58900778	66,137	0.071955196
Inner West	42.67805384	65,245	0.065411991
Sydney	35.69036776	57,331	0.062253175
North Sydney	42.51212488	79,369	0.053562631

Note(s): *Total average consumption divided by median income
Source(s): Compiled from Australian Bureau of Statistics (2020) and Ausgrid (2022a)

We also reviewed key documents, including the NSW Roadmap, the Act, and the supporting guidelines to examine results controls and calculative practices related to disclosures (e.g. Australian Energy Market Commission, 2022; AER, 2022b). We imported these documents into NVivo12 for coding. The first author identified 13 initial themes from the documents, which she discussed with the second author. After reviewing the codes and documents, the second author agreed with the identified key themes. Through iterative analysis, together we distilled the initial list of themes down to seven, including concepts such as ‘disclosures related to calculative practices’ (e.g. Miller, 2004; Revellino and Mouritsen, 2015) and ‘themes related to energy justice’ (e.g. Dodd and Nelson, 2022; Heffron, 2021; McCauley and Heffron, 2018). These themes, shown in Table 3, were used to interpret the implications of accounting practices as they relate to LESAs and the transition to renewable energy.

This case is qualitatively generalisable for several reasons (Flyvbjerg, 2006; Parker and Northcott, 2016). First, LESAs are used globally as a policy tool for facilitating the transition to zero-carbon energy, making the findings applicable to other regions facing similar energy transitions (REN21, 2023). Second, the methodological approach—combining quantitative models and content analysis of policy documents—can be adapted to other sectors and geographical areas, enhancing the transferability of the insights (Flyvbjerg, 2006). Finally, the issues of transparency, accountability, and measurement in LESAs are central to the global discourse on corporate sustainability and governance, particularly in sectors undergoing large-scale transitions (Abada *et al*., 2019; Geels, 2010; Kihn *et al*., 2024). We use these insights to point to promising areas for future research into management controls and sustainability transitions.

4. Findings

The findings presented here build on the above context, offering a nuanced understanding of how results controls and calculative practices operate within the framework of LESAs to support the move toward zero-carbon energy as an example of a sustainability transition. This section details the key findings of our illustrative models and document analysis, with the contributions and practical applications provided in the discussion.

4.1 Result controls and calculative practices: impacts and LESAs

Our analysis reveals that the result controls and calculative practices embedded in LESAs significantly impact consumers, particularly by transferring the costs associated with renewable energy investments to them (AER, 2022b). We find that, under LESAs, all customers are likely to face higher energy costs, with hardship customers without solar panels bearing the highest costs and non-hardship customers with access to solar experiencing the lowest costs. Table 4 below illustrates the stark differences between hardship and non-hardship consumers based on their grid energy consumption. Even with a nominal \$0.01/kWh tariff under the NSW Roadmap, where energy prices in the agreements are \$0.01/kWh higher than market prices, households without solar panels, including hardship customers, bear the brunt of the LESA fees.

In Model 1, hardship customers without solar PV contribute \$93.30 annually to LESA fees based on grid energy use, while those with solar PV will contribute \$58.72 annually. For non-hardship customers without solar PV, the LESA fees amount to \$56.09 annually, whereas those with solar PV will incur an additional \$52.00 annually. The Australian Energy Regulator (AER, 2022b) supports our prediction and forecasts that LESAs will result in higher energy prices, which means these costs are likely to be passed on to consumers, as our model reflects. If this occurs, hardship customers without solar PV will pay nearly 80% more toward LESA costs than non-hardship customers with solar PV.

Model 1 also highlights that hardship customers bear about 30% greater LESA-related expenses due to their higher energy consumption than non-hardship customers. Additionally, the model indicates that households can mitigate their exposure to these costs by installing solar PV, which dramatically reduces LESA-related costs, particularly for hardship customers (if they can in fact avail themselves of this remedy).

Table 3. Text analysis

Themes	Illustrative quotes
Consumers	Australian Energy Market Commission (AEMC) (2022) "seeks to promote efficient investment in, and efficient operation and use of, electricity services for the long-term interests of consumers of electricity with respect to price, quality, safety and reliability and security of supply of electricity" Consumer "terms and conditions" should be "fair and reasonable" AEMC (2022). The word "just" is used once by the NSW Government (2020b) in a different context: "A green steel industry in just one NSW region has the potential to support an expected 10,000 jobs" (p. 40) Consumers must receive "details of the connection charges (or the basis on which they will be calculated)" (AEMC, 2022) "The NSW Government will reform the electricity infrastructure investment market by creating the Electricity Infrastructure Investment Safeguard. A Consumer Trustee will be appointed to protect the long-term interests of consumers. The Consumer Trustee will run competitive processes on behalf of consumers to award Long-term Energy Services Agreements. These Agreements will provide investors with the long-term certainty they need to lower the cost of electricity" (NSW Government, 2020c, p. 22)
Consultation	Through renewable energy zones, the NSW Government seeks to create "community partnership from strategic planning and best practice engagement and benefit sharing" (NSW Government, 2020c, p. 27) "We will engage with the financial trustee about the process for this consultation once a financial trustee has been appointed" (AER, 2022b, p. 4)
Disclosure	[Information relating to LESAs] "must remain confidential as its disclosure may compromise competitive tender processes in relation to network infrastructure projects and long-term energy service agreements, respectively. We also note that disclosure of the Data Point outside the "exemptions data administration unit" may constitute a breach of the information disclosure provisions in section 75, EII Act" (AER, 2022b, p. 38)
Hardship customers	The AEMC (2022) requires retailers to have a hardship program (that is, the availability of payment plans for people who have trouble paying their energy bills)
Impact	"We can locate these projects in places that help our rural and regional communities" (NSW Government, 2020c, p. 4) "Even with transmission, generators still need revenue certainty. This creates a "chicken and egg" problem that is stifling investment in our energy sector. If left to existing market signals, investment could come too late to prevent price spikes and reliability issues. It is also likely to occur ad-hoc, negatively impacting local communities. Coordination will ensure that investment is orderly, timely, optimised and efficient. It also allows for careful and deliberate consideration of community priorities and concerns" (NSW Government, 2020c, p. 27) The objects of this Act are "(a) to improve the affordability, reliability, security and sustainability of electricity supply, and; (b) to co-ordinate investment in new generation, storage, network and related infrastructure, (c) to encourage investment in new generation, storage, network and related infrastructure by reducing risk for investors, (d) to foster local community support for investment in new generation, storage, network and related infrastructure, to support economic development and manufacturing; (f) to create employment, including employment for Aboriginal and Torres Strait Islander people, (g) to invest in education and training, (h) to promote local industry, manufacturing and jobs, (i) to promote export opportunities for generation, storage and network technology" (NSW Government, 2020a)
Low-income	"The Roadmap complements other NSW Government initiatives that are already helping NSW households and businesses to reduce their energy use and save money on energy bills, including the Energy Security Safeguard, Solar for Low-Income Households and Empowering Homes programs" (NSW Government, 2020c, p. 12)
Report	All discussion around "Report" relates to requiring retailers to report against their licence requirements. For example, the AER (2022b, p. 13) states, "The relevant reporting year for the purposes of this volumetric data will be the previous financial year, i.e. as of January 2023, the relevant year will be FY 21–22" There is no requirement for the AEMC (2022) or any other government body to report on the distributional impacts of government energy and environmental policies

Note(s): Sources for AEMC (2022) quotes include https://www.aemc.gov.au/regulation/neo#NERO and https://energy-rules.aemc.gov.au/ner/431 (Chapter 5A: Electricity connection for retail customers)

Table 4. Distributional impacts for hardship customers with and without solar PV

	Total consumption (kWh)	Variable charges	NSW Roadmap tariff impact per year
Hardship without PV	9,330.23 (kWh)	$751.08	$93.30
Hardship with PV	5,871.89 (kWh)	$472.69	$58.72
Non-hardship without PV	5,609.15 (kWh)	$451.54	$56.09
Non-hardship with PV	5,199.87 (kWh)	$418.59	$52.00

Note(s): Variable charges = $ per kWh peak, shoulder, and non-peak. Fixed charges = $119.04 for all customers (32.6162 per day per kWh); NSW Roadmap impact is calculated as $0.01 levied per kWh of variable charges to determine the rate of cost pass-through

Turning to the regional cost distribution in Model 2, we find that socio-economically disadvantaged areas, particularly those in coal mining communities already facing economic disruption due to the energy transition, use more grid energy relative to their income. If LESAs lead to energy prices of $0.01/kWh higher than market prices, these regions will bear a disproportionately higher burden than wealthier regions. For instance, Table 5 shows that an average household in the Upper Hunter local government area (LGA), with a median income of $48,941, will pay an additional $73 per annum for energy. By contrast, an average household in North Sydney (median income of $79,369) will pay only $42 per annum. The results show a 74% difference in energy prices and a 180% greater relative impact for low-income vs high-income households.

In Table 5, data from the Australian Bureau of Statistics (2021) indicates that low-to-median-income LGAs, such as Cessnock, Muswellbrook, and Singleton, experience the highest grid energy use relative to their income. Thus, these regions will bear more LESA costs than high-income LGAs like North Sydney or Randwick. Our analysis shows that the cost recovery model for LESAs could exacerbate existing socio-economic disparities, with disadvantaged regions facing higher costs relative to their income.

4.2 Calculative practices and results control: reporting related to LESAs

Our examination of calculative and reporting practices related to LESAs reveals significant opacity around consumer costs. Public statements published by the NSW Government (2020c)

Table 5. Model 2 results (summary): highest and lowest impacted LGAs

LGA	Additional cost per annum ($)#	Total median income ($ per year)	Relative impact in comparison to income (%)
Highest			
Upper Hunter	73.46	48,941	0.15
Singleton	78.35	56,532	0.14
Muswellbrook	73.71	55,283	0.13
Port Stephens	61.74	46,338	0.13
Cessnock	65.73	49,744	0.13
Lowest			
Randwick	46.20	62,478	0.07
Waverley	47.59	66,137	0.07
Inner West	42.68	65,245	0.07
Sydney	35.69	57,331	0.06
North Sydney	42.51	79,369	0.05

Note(s): #Total average consumption (kWh/day)*365*0.01/Total median income. Table 2 provides the results for all NSW LGAs emphasise the positive environmental and regional development benefits of LESAs, such as the creation of "12 gigawatts of new renewable electricity generation" and the injection of over $32 billion in private sector investment by 2030. However, the AER (2022b) cautions that LESAs will result in higher energy prices than market rates, which can be passed on to consumers through variable charges.

While the AER (2022b) acknowledges these impacts on energy prices, the NSW Government (2020c) does not mention them in its public communications nor does it provide detailed information on how energy retailers distribute LESA costs among different customer cohorts. Furthermore, energy retailers are not required to make transparent disclosures regarding the impact of LESA-related costs on individual consumers. According to the AER (2022b), the only required disclosures are the total LESA payments made to network operators. Energy retailers are not obliged to disclose any price differences on energy bills, nor do they have to itemise the costs associated with LESAs, leaving consumers unable to identify the specific impact of these charges. The National Energy Customer Framework only requires energy retailers to provide aggregate information on their billing practices, meaning they can hide the LESA costs in general energy charges.

The NSW Roadmap (NSW Government, 2020c) makes several claims regarding the benefits of LESAs, such as facilitating "lower energy prices". However, it fails to provide the full context, especially concerning the impact on different consumer groups. This lack of transparency regarding the distributional impacts could lead consumers to believe that LESAs will result in lower prices when, in actuality, they will likely result in higher prices. In addition, the policy documents fail to adequately address the needs of low-income and hardship customers. Although the policy mentions initiatives to assist low-income households, such as the Energy Security Safeguard and the Solar for Low-Income Households programme, it does not clarify how these initiatives interact with LESAs, nor does it provide specific information on how hardship customers will be affected.

Finally, while the NSW Government highlights the potential regional economic benefits of LESAs for rural and regional communities, it fails to provide a comprehensive analysis of the net social costs. The policy documents neither address the social costs nor the long-term investment returns of LESAs. In fact, they mention economic opportunities without fully accounting for the distributional impacts on regional communities. Moreover, while the NSW Roadmap (NSW Government, 2020c) mentions the appointment of a "Consumer Trustee" to safeguard the interests of consumers, the trustee's primary responsibility is to ensure long-term investment certainty rather than address the specific needs of disadvantaged consumer cohorts.

In summary, while the NSW Roadmap presents LESAs as a beneficial initiative, it lacks transparency regarding the financial burden on different consumer groups, particularly those in socio-economically disadvantaged regions and low-income households. The failure to disclose the full impact of LESAs on these groups could lead to entrenched inequity and increased financial strain on vulnerable consumers.

5. Discussion

Our research highlights several previously unseen and potentially unintended consequences of results controls and calculative practices associated with LESAs. Although specific to this case study, these findings do offer several broader insights. First, we advance existing work by examining results controls and calculative practices in the transition to zero carbon energy. Second, we identify limitations in current practice and propose solutions. Finally, we illustrate future research opportunities.

5.1 Advancing knowledge of sustainability transitions and management controls and calculative practices

Our first contribution highlights how governments and the energy industry employ results controls and calculative practices to accelerate a region's transition to zero-carbon energy.

By linking financial incentives to renewable energy supply rather than building renewable energy facilities in optimal locations for wind and solar, we demonstrate that the results controls and calculative practices embedded in LESAs can inadvertently result in higher energy prices for consumers reliant on grid energy. This pricing dynamic disproportionately impacts vulnerable populations who cannot access renewable energy solutions.

More broadly, our research contributes to the work of accounting scholars who have critically examined public-private collaborations. For instance, as introduced in Section 2.1, we build on research into how governments incentivise private industry to achieve public policy outcomes, such as constructing public infrastructure (Andon, 2012). Specifically, we advance the work of scholars such as Beelitz and Merkl-Davies (2019) and English *et al*. (2010), who examine public-private partnerships and emphasise the need for broader evaluative approaches (also see Pelz *et al*., 2021; Santika *et al*., 2019).

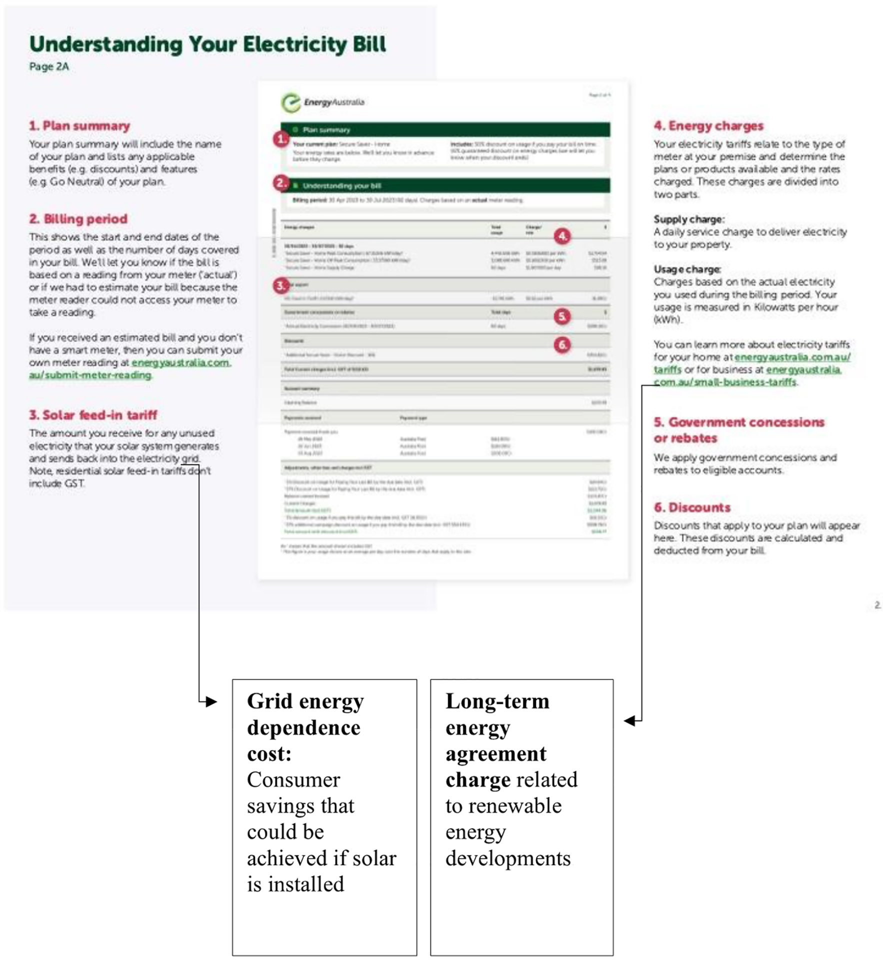
Our findings reveal that, while price certainty for renewable developers fosters investment, it can also produce unforeseen consequences, such as shifting financial burdens to socio-economically disadvantaged groups. This insight underscores the need for results controls to balance decarbonisation with social equity. By illustrating how LESAs interact with broader social and environmental dynamics, this research advances our understanding of management controls by situating them within the context of sustainability transitions. Specifically, we highlight the potential for results controls to generate tensions between financial viability and social inclusivity, necessitating a re-examination of how management controls are designed and implemented (Eyring and Van der Stede, 2024). This contribution aligns with emerging calls in the literature for multi-dimensional performance measures that better capture the interplay between financial, social, and environmental outcomes in sustainability-focused transitions and public-private collaborations more generally (Andon, 2012; Merchant and Van der Stede, 2023).

Qualitative studies could expand on our work by exploring decision-making processes related to sustainability transitions, including developing and adopting LESAs. For example, we wonder: Were policymakers and renewable energy developers aware of the potential inequities associated with these agreements? If so, how have they responded? Future research could also explore the longitudinal effects of increased transparency in LESAs on consumer behaviour and policymaking. For instance, will clearer cost breakdowns in energy bills prompt consumers to advocate for policy changes that reduce the financial burden on low-income households?

5.2 The role of calculative practices in addressing the dual energy challenge

Our second contribution relates to how policymakers can refine results controls and calculative practices to mitigate inequities. Specifically, our study reveals a gap in the transparency of energy bills, which fail to adequately disclose the cost implications of LESAs for consumers. Despite calls for greater transparency, we find that disclosures primarily focus on the environmental benefits and employment impacts of the ventures, but neglect to clarify how these agreements affect individual energy bills (Energy Australia, 2023; Origin, 2022). Current practices produce unintended negative consequences in renewable energy developments funded through LESAs, particularly regarding their distributional impacts on disadvantaged consumer groups. Given the insight provided through our illustrative models and document analysis, we argue that energy retailers and policymakers should recalibrate their financial and pricing disclosures to reflect the broader societal impacts of LESAs, particularly on marginalised communities.

Consider Figure 2, which pictures the standard energy bill format currently used by several energy retailers. We argue that energy companies should improve these disclosures by specifying the proportion of bills attributed to fixed versus variable charges, including a line item for LESA charges in energy bills. We present this opportunity for disclosure as an example of refining current calculative practices, as shown in the two additional boxes in



Source(s): Energy Australia (2023)

Figure 2. Consumer energy bill results

Figure 2. Such recalibration would enable consumers to make informed decisions and advocate for policies addressing the disproportionate energy transition burdens on disadvantaged populations.

While enhanced transparency in billing practices is a necessary first step, it alone cannot address the underlying inequities in LESAs. Rather, transparency serves as a foundation for developing more comprehensive accounting frameworks that can better capture and address the social costs and benefits of sustainability transitions. These frameworks must go beyond mere disclosure to actively integrate social equity metrics into decision-making processes and policy design.

This insight into calculative practices has broader implications for other sectors transitioning to sustainable practices. For instance, researchers and policymakers can apply our findings to other sustainability transition mechanisms, such as Climate Contracts for Difference (Amelang and Wehrmann, 2024) or waste-to-energy initiatives (Mission Zero Academy, 2025). These mechanisms often aim to compensate companies for the additional costs of addressing externalities, such as decarbonisation or waste management, to ensure financial viability while promoting zero-carbon solutions.

In this way, we deepen our understanding of how mechanisms intended to advance sustainability transitions can disproportionately disadvantage certain groups or harm the environment (Amelang and Wehrmann, 2024). For example, as introduced earlier, Lazarevic and Martin (2018) demonstrate how biofuel producers use calculative practices to obscure broader impacts, such as biodiversity loss. Another example by Dodd and Nelson (2022) shows how results controls and calculative practices associated with solar PV rebates in Australia primarily benefit high-income homeowners, leaving lower-income groups reliant on grid energy and excluded from zero carbon solutions (see also Heredia *et al*., 2024). This study illustrates how results controls within large-scale renewable energy contracts disadvantage vulnerable consumers who cannot afford solar PV.

Future studies could investigate alternative funding models to support low-income households in accessing solar energy. As Dodd and Nelson (2022) argue, non-profit organisations could facilitate solar energy access for renters, a group often excluded from traditional solar adoption models. Scholars should examine how the uptake of lower-cost zero-carbon technologies, such as household solar PV, can be increased to mitigate the financial challenges disadvantaged communities face. Emerging solutions, such as balcony solar systems, offer potential alternatives but are still in their infancy (Limb, 2024). Future research could explore how the renewables sector can scale such innovations to effectively address low-income households' energy needs. Such studies could extend beyond the energy sector to other industries undergoing sustainability transitions, enabling cross-sectoral insights.

5.3 Expanding future research on management controls and calculative practices

Our third contribution emphasises the need for further research on the broader examination of management controls and calculative practices. Specifically, we highlight the potential of results controls and calculative practices to lead to unforeseen and potentially unintended consequences. In doing so, we build on earlier work by Kerr (1995), who highlights the potential for some unintended consequences due to results controls. We provide an empirical case and argue that management controls and calculative practices must evolve. Our results demonstrate that management controls and calculative practices need to capture and respond to a range of outcomes, such as decarbonisation and social equity.

Furthermore, we argue that organisations involved in sustainability transitions must communicate the costs, benefits, and trade-offs of such transitions in comprehensible and actionable ways to a diverse range of stakeholders. Future research into management controls could explore how organisations develop more transparent performance indicators that include financial performance alongside social and environmental impacts (e.g. see Dodd *et al*., 2023, 2024).

Several research questions arise from this analysis, including how governments can adapt results controls to measure and reward multi-dimensional performance indicators within a unified framework. For example, our research shows that it is crucial for scholars to more closely examine the extent to which other result controls perpetuate inequities in our transitions toward better energy solutions. Further, scholars must also explore potential policy interventions that ensure fairer outcomes.

Future researchers could also examine how standard accounting practices can change to systematically measure distributional impacts across different socioeconomic groups. This could include developing new metrics that integrate social equity considerations into standard sustainability accounting practices. This would ensure that distributional effects are not merely reported but, rather, become central to how organisations evaluate their sustainability initiatives. Such research could also explore how accounting practices might provide insights into distributional outcomes, such as how sustainability initiatives affect different demographic groups, instead of simply reporting aggregate measures. This would advance the field by establishing methodologies for embedding social equity into core accounting frameworks rather than treating these statistics as supplements to the meat of the figures.

Another important avenue of research in addressing sustainability challenges across sectors and regions is understanding how organisational and cultural contexts influence the way in which policymakers design effective results controls. For instance, researchers could examine how action controls, such as sustainability-oriented processes, influence corporate and managerial behaviour and decision-making in organisations undergoing sustainability transitions. Understanding the effectiveness of these controls in aligning organisational practices with sustainability goals would provide valuable insights.

Researchers might also investigate how results controls can better capture the complex interdependencies of sustainability transitions, such as the trade-offs among energy affordability, environmental impact, and social equity. Longitudinal studies could provide insights into the long-term effectiveness of policy-related results controls in achieving sustainable outcomes, offering guidance for policymakers and practitioners. Moreover, future research could consider the social justice dimensions of the energy transition, extending the focus to include the impacts on Indigenous communities, women, and people with intersectional identities, as achieving an equitable energy transition is essential for fostering broader societal acceptance (Sidhu and Gibbon, 2021).

6. Conclusion, implications, and limitations

Building on existing research in management controls and calculative practices, we highlight an urgent need to further consider results controls in sustainability transitions. Our study demonstrates how embedding equity considerations into management controls and calculative practices can reveal whether and how vulnerable zero-carbon energy investments disproportionately burden particular groups. For accounting scholars, we emphasise that evolving management controls and calculative practices are essential to accurately capturing the multifaceted financial, social, and environmental dimensions of transitioning to more sustainable energy options. Although our prime focus has been on addressing the dual energy challenge of balancing emissions reduction with energy affordability, our research does have broader implications. Specifically, we show how policymakers and the energy industry can enhance their management controls and calculative practices to address the trade-offs between environmental and social objectives.

6.1 Implications

Our insights have several implications for research, practice, and policy. First, our findings highlight the need for further research into how management controls and calculative practices can support sustainability transitions across sectors. To this end, we have provided several avenues for future inquiry in Section 5. In practical terms, this study addresses some of the most significant concerns associated with LESAs. Governments are using LESAs to accelerate society’s transition to zero carbon energy, with the aim of providing revenue certainty for private investments into renewable energy generation, firming, and long-duration storage (EnergyCo, 2024; REN21, 2023). While LESAs have been successful at securing finance for project construction, critics argue that they can lead to suboptimal outcomes, such as locating assets in areas with limited natural energy potential (e.g. regions with little sun or wind) (Nelson and Dodd, 2023; Taylor, 2023; van Leeuwen, 2023). Our findings support this claim about suboptimal outcomes, indicating that LESAs reduce incentives for developers to innovate or invest in new technologies, which is critical for ensuring that zero-carbon energy becomes cost-competitive to fossil fuels (Aflaki *et al.*, 2024; Nelson *et al.*, 2022). Additionally, the fixed pricing structure inherent in LESAs creates a financial gap between the agreed-upon price and market rates, a burden which, as we show, is ultimately borne by consumers (Australian Capital Territory Government, 2022)

This financial gap underscores the need to shift from merely reporting financial and environmental outcomes to implementing actionable strategies that prioritise equity. Based on our results, we argue that accounting systems must evolve to reflect the multifaceted nature of sustainability transitions. More specifically, we argue that they must incorporate both the financial and the social elements of sustainability transitions. For instance, policymakers could force sustainability reporting frameworks to integrate equity-focused metrics such that they allow users to evaluate how renewable energy policies impact different socio-economic groups. Managers and accountants could also design calculative practices to enhance accountability by requiring energy providers to track and disclose the distributional impacts of sustainability transition mechanisms, like LESAs, particularly for vulnerable consumer segments.

While transparency in reporting is essential, our findings demonstrate that it must be coupled with structural changes to how accounting frameworks measure social equity. Enhanced disclosures alone cannot address the fundamental inequities built into current LESA structures; rather, they should serve as a catalyst for developing more comprehensive accounting practices that actively promote social justice outcomes in sustainability transitions.

We also show that current zero-carbon policies can exacerbate existing social and economic disparities by imposing higher costs on vulnerable groups or excluding them from the benefits of adopting renewable energy. To address these inequities, we propose amendments to calculative practices, including equity-based metrics and transparency mechanisms. These adjustments can reimagine results controls to promote fairer outcomes. For example, accounting frameworks could incorporate measures that ensure equitable access to renewable energy technologies or redistribute costs more evenly among stakeholders. Our proposal aligns with the principles of energy justice, which emphasise the importance of inclusivity and fairness in sustainability transitions.

For policy, our research also shows that governments can step in to address key areas where current management controls and calculative practices fall short. First, we demonstrate that management controls within zero carbon policies must evolve to capture the multifaceted nature of sustainability transitions, incorporating environmental and social impacts alongside financial performance to enable more holistic decision-making and reporting. Second, we show that policymakers should embed equity considerations into management controls to support the dual energy transition and ensure that the disproportionate impacts of energy transitions on vulnerable groups are recognised and addressed. The embedding includes reforms to action and results controls to integrate equity-focused metrics into reporting and implementing targeted measures, such as subsidies or financial assistance, to alleviate the burden on disadvantaged households. Finally, lessons from the zero-carbon energy transition can inform broader sustainability practices across industries. We show that accounting, specifically management controls and calculative practices, should evolve to capture the hidden costs and benefits of sustainability transitions, ensuring that they embed transparency, equity, and accountability across organisational processes.

6.2 Limitations

While this study provides valuable insights, several limitations suggest directions for future research. First, we cannot determine whether policymakers and renewable energy developers are aware of the inequities associated with LESAs that we have uncovered in our research. Therefore, scholars could examine the decision-making processes behind implementing LESAs and investigate whether the identified inequities are or were foreseeable and addressable. This includes research in other countries where LESAs are used, such as China and Norway (REN21, 2023).

Another limitation is our focus on the economic impacts of LESAs. Future studies could adopt a more comprehensive approach, incorporating frameworks such as Total Cost of Ownership or Total Cost of Life, which account for the full lifecycle of renewable energy projects, including maintenance and operational savings over time. Such approaches could offer a more holistic view of the economic benefits of renewable energy investments, potentially leading to more equitable and sustainable energy policies.

Additionally, our study centres on grid-supplied electricity, but the rise of distributed energy generation presents new challenges and opportunities. Future research could examine how different models of distributed energy generation—such as solar PV on apartment balconies—could be scaled to reach more consumers, especially those in detached dwellings who face barriers to rooftop solar adoption. Our research shows policymakers should explore innovative models for financing distributed generation, including leasing and credit support for low-income households.

Finally, this research primarily focuses on the hardship vs non-hardship divide in energy transitions. Future studies could extend our analysis by examining other categories of disadvantaged populations, such as those in social or affordable housing. Given the link between energy costs and housing affordability (McCabe *et al.*, 2018), understanding how renewable energy projects impact these groups will be vital for shaping policies that support their energy needs.

In conclusion, while our study sheds light on the challenges and opportunities in the transition to zero-carbon energy, much remains to be explored. Future research can build on our findings to develop more equitable and transparent mechanisms for supporting sustainability transitions, ensuring that funding policies do not leave marginalised groups, such as low-income individuals, behind in the move toward sustainable development.

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Appendix

Method for modelling action controls associated with LESAs as shown in Figure 1

As shown in Figure 1, we estimated two models using four datasets: the Ausgrid (2022b) Tariff Structure, which contains consumer electricity fees (fixed and variable) for every kWh of energy used (as shown in Table 1); energy use patterns across four types of consumers: (1) hardship customers with solar PV, (2) hardship customers without solar PV, (3) non-hardship customers with solar PV, and (4) non-hardship customers without solar PV; NSW energy use by Local Government Area (LGA) (Ausgrid, 2022b); and medium-income consumers by LGA (Australian Bureau of Statistics, 2020) (as shown in Table 2).

We selected the consumer groups to estimate purposively. For the first model, we selected hardship customers with and without solar PV as a proxy for low-income individuals. Hardship customers in Australia are willing to pay their electricity bills but are unable to do so, and many studies have adopted this distinction (Nelson *et al*., 2019; Simshauser and Nelson, 2012). Prior research also shows hardship customers are mostly low-income (see Simshauser and Nelson, 2012). Other studies have shown hardship customers (e.g. Dodd and Nelson, 2022) tend to use more grid electricity than non-hardship customers due to their limited access to solar PV and living conditions (e.g. less energy-efficient dwellings and larger households). Energy use data for hardship and non-hardship customers come from two NSW energy retailers who provided de-identified data for 2021. Further, we analysed consumer access to solar PV, rather than having energy-efficient appliances, as this is the most effective way to reduce reliance on grid energy (Commonwealth of Australia, 2022).

Model 2 uses data on reported median income and grid energy use, which we acquired from the Australian Bureau of Statistics (2020). These data come from the LGA instead of individual consumer accounts. Further, the data do not include information on solar PV access by region. Model 2 is appropriate as it examines grid energy use. It allows us to assess whether patterns emerged at the local government level, such as whether higher-income regions used more energy. The model builds on earlier studies demonstrating that the most vulnerable customers are those with high energy use relative to income (see Simshauser and Nelson, 2012). Model 2 also allows us to examine whether other trends are occurring, such as an aggregation of higher energy use in some regions. Our analysis indicates that certain low-income regions might bear a higher proportion of the costs associated with LESAs.

As noted above, to illustrate the percentage difference in costs relating to the NSW Roadmap, we assigned a nominal LESA (NSW Roadmap) tariff of $0.01 for every kWh of variable energy use. Most renewable energy providers tend to have significantly coincident production profiles, i.e. they primarily generate energy when it is windy or sunny. Thus, there tends to be an oversupply of renewables when generating electricity, supporting our assumption that LESAs will increase energy prices. AEMO (2023) shows that by illustrating the market price versus the cost of building wind farms and the prices received by wind farms since 2010. In most years, this research illustrates that the gap between wind generation revenues and the market price is not dissimilar from $0.01/kWh (or $10 per MWh). We use this period as Australia's most historical investment in renewables, stimulated by the 20% Renewable Energy Target legislation of 2010. The prices received by solar PV plants are significantly lower, with out-of-market subsidies likely to be significantly higher. For example, in 2023, the price received by solar plants in South Australia was $10.36/MWh despite the market price being $80.07/MWh.

This nominal (theoretical) tariff aims to illustrate the percentage difference in the costs of different consumer groups based on reported energy use. Through this nominal tariff, we seek to illustrate consumer energy bills, which, under the NSW Roadmap, will include a fixed fee assigned to every kWh of energy used, along with standard variable usage charges (based on market prices), plus a new fee, labelled "the NSW Roadmap tariff". We chose a $0.01/kWh tariff to build an illustrative model of how much different customers would pay if there was a small tariff between the market and the agreed-upon energy price. This nominal tariff helps to answer our research question as it illustrates the scale of difference between various consumers.

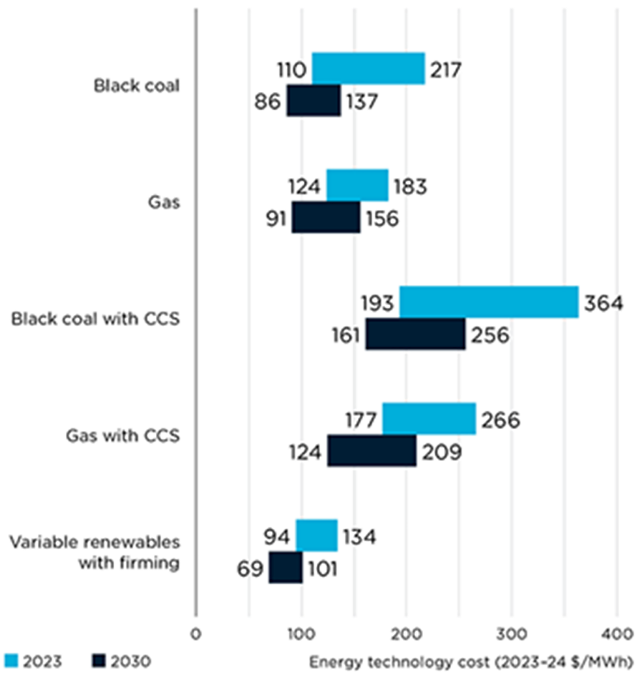
We then performed a series of calculations using the two models. In Model 1 (in Figure 1), we examined how hardship and non-hardship customers are (differently) impacted. This model examines 350,000 non-hardship half-hourly consumption customer profiles, both with and without solar PV, alongside 1,000 hardship half-hourly consumption profiles, also with and without solar PV, for the 2021 calendar year. The model reflects the complete and combined dataset the two NSW energy retailers provided. Costs were determined using existing energy tariffs published by Ausgrid (2022b) plus the $0.01/kWh NSW Roadmap tariff.

In the second model (Model 2 shown in Figure 1), we sought to show contributions to LESA costs as a proportion of income. To determine this, we examined energy use and income data by region. As Ausgrid (2022b) reports energy use by day and omits LESA impacts, the model multiplies the daily use by 365 and

$0.01/kWh (the hypothetical NSW Roadmap tariff) to gain an annual amount that factors in an increased variable charge. This figure is then divided by NSW's median income to show a unit cost per income that a median income household would incur if market prices were $0.01/kWh lower than the agreed LESA price.

As the prior research establishes that household demand for energy is highly price inelastic in the short-term (e.g. to induce a 4% decrease in electricity demand, a price adjustment of 30–40% is needed (see Ausgrid, 2015; Nelson *et al*., 2018). Therefore, our model can be used to scale the impacts. The tariff simply increases or decreases linearly, meaning that the difference between consumer cohorts will likely remain proportional, i.e. the $0.01 tariff would increase to $0.02 if the price difference were to double.

While we could model other cost recovery forms, the AER (2022a) confirms that costs are recoverable from variable charges (as opposed to fixed or capacity tariffs). Further energy price projections, including those by Graham *et al*. (2023) shown in the figure below, illustrate that there is a current and expected continued cost decline of solar and wind (firmed renewables) (Graham *et al*., 2023). The figure below shows that the projected costs of firmed renewables will fall materially between today and 2030. Consequently, consumers locked into LESAs at current wind and solar costs will continue to pay a higher energy price even though costs will decline (Commonwealth Scientific and Industrial Research, 2023).



Source(s): Graham *et al.* (2023) in Commonwealth Scientific and Industrial Research (CSIRO) (2003)

Figure A1. Electricity costs 2023 to 2030

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