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Abstract

Inequalities in income, housing, and health between Indigenous and non-Indigenous Australians are well documented, yet differences in energy outcomes remain understudied. While prior research has largely focused on remote areas or specific aspects, this paper provides the first national-level analysis of Indigenous households' experiences in the energy market, measuring the existence, scale, and structural drivers of energy inequality. Two indicators are examined: difficulties in paying energy bills on time and self-reported inability to heat homes adequately.

Across two decades and independent datasets, Indigenous households are 9–10 percentage points more likely to experience energy stress, a difference that persists after accounting for income. Wealth emerges as the strongest explanatory factor, with housing tenure, education, and financial resilience also contributing substantially. Objective measures—arrears, disconnections, and hardship program participation—account for around 43% of the observed gap and provide practical means of identifying households at risk of energy stress. Energy stress is highly persistent, with households that had prior bill payment difficulties 47 percentage points more likely to encounter similar challenges again in 2023.

These findings show that energy inequality is not merely a matter of short-term affordability but reflects deeper structural dimensions of economic inequality. Policies centred on income support alone are unlikely to eliminate these disparities. Access to modest emergency funds of only a few thousand dollars reduces the observed gap by about 73%, highlighting the potential of targeted, government-backed assistance to strengthen household resilience and prevent disconnections.

Keywords: Indigenous Australians; First Nations; Energy inequality; Financial resilience; HILDA Survey

1. Introduction

Persistent disparities between Aboriginal and Torres Strait Islander (hereafter, respectfully, 'Indigenous') Australians and non-Indigenous Australians remain a defining feature of Australia's socio-economic landscape. These gaps span income (Australian Institute of Health and Welfare [AIHW], 2023a; AIHW, 2023b), wealth (AIHW, 2025), health (AIHW, 2025), housing (Moskos et al., 2025; Quilty et al., 2022), and educational participation (AIHW, 2023c), and reflect the cumulative effects of structural disadvantage and material deprivation throughout the life course (Productivity Commission, 2024).

Since 2009, the national Closing the Gap policy agenda in Australia has sought to eliminate disparities across domains, including education, employment, income, housing, and life expectancy (National Indigenous Australians Agency, 2025). Yet progress has been uneven. As of 2020–2022, the life expectancy gap remains 8.8 years for Indigenous men and 8.1 years for Indigenous women (AIHW, 2024).[1] For many Indigenous households, energy hardship compounds other forms of material deprivation, constrains everyday life, and undermines wellbeing (Fry et al., 2023). Energy poverty restricts the ability to maintain safe indoor temperatures or meet basic energy needs. Nearly all households (91%) in some Northern Territory communities experience disconnections within a single year (Longden et al., 2021). Such insecurity is linked to diminished physical and mental health, reduced capacity to work or study, and broader life stress such as food poverty (Ballesteros-Arjona, C., Herrero, & Gómez-Tagle Rangel, 2022; Welsch & Biermann, 2017; Fry et al., 2023). These findings demonstrate that energy poverty exacerbates existing social and health inequities, and contributes to life expectancy disparities. While income and health disparities have received sustained attention in research and public policy, energy poverty, broadly defined as a household's inability to afford adequate energy services (Simcock, 2020), has received far less.

[1] Being a summary statistic, life expectancy captures collective impacts from the social determinants of health on mortality. It reflects the mean age that a person can expect to live at birth, as well as the number of years left to live from age x.

We address this gap by examining the extent and drivers of Indigenous–non-Indigenous energy poverty disparities in Australia. We focus on Indigenous households' experiences of energy poverty as a *missing but consequential dimension of economic inequality*, one that warrants closer integration into efforts to *close the gap*. We ask: what are the key drivers of the energy poverty and energy gaps experienced by Indigenous Australians? Our analysis moves beyond income-based models to consider the role of wealth, tenure, financial resilience, and other relevant socio-economic characteristics, as well as self-reported experiences of energy stress. We reframe energy poverty as a structural manifestation of broader economic inequality and identify the factors that most contribute to energy stress. This approach informs more effective and equitable policy design while providing a foundation for targeted and lasting interventions to close the gap.

Research on Indigenous energy issues in Australia has largely focused on remote areas, where energy insecurity is driven by prepayment systems, poor infrastructure, and exposure to extreme climate conditions (Longden et al., 2021). Yet 85% of Indigenous Australians live in urban or regional areas (AIHW, 2025), where energy poverty may manifest differently, through bill arrears, energy debt, or limiting appliance use. Despite this, little is known about the prevalence or drivers of energy poverty among Indigenous households outside remote communities, which our paper addresses.

In this paper, we investigate the extent, persistence, and structure of energy poverty among Indigenous Australians using nationally representative microdata from the Household, Income and Labour Dynamics in Australia (HILDA) Survey from 2003-2023. We examine the structural socio-economic drivers of energy hardship for Indigenous and non-Indigenous households. Wealth, education, housing tenure, and financial resilience stand out as the most significant. We begin with linear probability models to identify key influences on energy poverty for both groups. We then use Oaxaca and Fairlie decompositions to measure how much each factor explains the Indigenous–non-Indigenous gap. This approach clarifies the complex dynamics behind energy hardship and informs targeted, equity-driven policy design.

Traditional models of energy poverty have primarily focused on income and energy prices as the central determinants (Simões & Leder, 2022; Simionescu & Cifuentes-Faura, 2024). The most common approach defines energy poverty as a condition in which a household cannot afford adequate energy services due to low income or high energy costs. Metrics such as the "energy burden", the share of income spent on energy, reflect this narrow framing. However, such income-based models risk overlooking deeper structural drivers of household vulnerability to energy stress (Cong et al., 2022). In this paper, we extend the conceptual foundations of energy poverty by repositioning it as a *manifestation of broader economic inequality*. Our decomposition analysis shows that income explains only a modest share of the observed energy hardship gap between Indigenous and non-Indigenous households. In contrast, *wealth emerges as the largest contributor*, alongside other structural factors such as housing tenure, education, and the capacity to raise emergency funds. This shift in theoretical emphasis matters. Whereas income fluctuates and is often targeted through short-term support, wealth captures a household's longer-run capacity to absorb shocks and make energy-sustaining investments. By foregrounding wealth, we move beyond the standard framing of affordability to one that highlights enduring inequality in assets and opportunity. In doing so, we offer a theoretical and empirical basis for policy designs that are not only more equitable, but also more durable in addressing the roots of energy poverty.

We measure energy poverty through two main indicators: self-reported inability to pay energy bills on time, and the experience of being unable to heat the home. We focus on three waves of HILDA (2003, 2013, and 2023) to examine persistence over time. We then conduct a detailed decomposition using the most recent wave (2023), where explanatory variables are lagged one year. As a robustness check, we supplement this analysis with five pooled waves (2022–2024) of the Energy Consumer Sentiment Survey (ECSS) administered by Energy Consumers Australia, which also identifies Indigenous respondents. In this analysis, we take bill pressure as our energy poverty indicator.

Our results show a persistent 9–10 percentage point gap in energy poverty between Indigenous and non-Indigenous Australians. We find that 70% of Indigenous households report high energy bill pressure; 27% could not pay on time, and 14% were unable to adequately heat their home. The ability to raise emergency funds emerges as a key explanatory factor. Wealth is the largest contributor to the observed gap, while income, education, and renting status contribute more modestly.

Our study makes three key contributions. First, we provide new empirical evidence on the extent, persistence, and drivers of Indigenous-non-Indigenous energy poverty gaps in Australia, drawing on nationally representative data from the HILDA Survey and the ECCS. We make a significant contribution to the understanding of Indigenous energy poverty in urban and regional areas, where previous analysis has been lacking. Second, we move beyond conventional income-based models by demonstrating that wealth, housing tenure, and financial resilience, particularly the ability to access emergency funds, are more consequential drivers of Indigenous energy hardship than income alone. This reframing positions energy poverty within the broader architecture of economic inequality. Third, by decomposing the observed gaps into policy-relevant variables, we offer a framework for designing more durable and equitable energy interventions. In doing so, we respond to a gap in the literature on urban Indigenous disadvantage and highlight the need to address structural economic vulnerability as a core component of energy policy.

1.1 Literature Review

Energy Poverty and Structural Inequality

Energy poverty is commonly understood as the inability to afford adequate energy services such as heating, cooling, lighting, or appliance use. Traditional metrics, such as Boardman's definition of spending 10% or more of your income on energy (Chester & Morris, 2011), capture financial burden, while others, like Bouzarovski and Petrova (2015), emphasise the inability to access and secure energy, reflecting housing and other infrastructural and institutional barriers to energy access.

Energy poverty is increasingly recognised not just as a technical or economic problem but as a multidimensional form of injustice: procedural, distributional, and recognitional (Fabienne Rioux-Gobeil & Thomassin, 2024; Hoicka et al., 2025; Longden et al., 2021; Tarekegne, 2020). It reflects deeper systems of inequality, particularly for Indigenous households, who face intersecting disadvantages in income, wealth, housing, and infrastructure (AIHW, 2025; Moskos et al., 2025). While there is growing international focus on energy poverty and inequality, its specific drivers and impacts for Indigenous peoples remain underexplored. This gap is troubling, given the disproportionate energy stress experienced by Indigenous communities, shaped by historical and ongoing forms of structural exclusion (Hoicka et al., 2021).

Rising energy costs in Australia have placed additional pressure on low-income households (Brown & Vera-Toscano, 2022). At the same time, climate change is increasing household vulnerability, with more frequent heatwaves, bushfires, and droughts (Crowley & Jayawardena, 2017; Fry et al., 2023). Those who are already socially and economically marginalised, including many Indigenous households, are both more exposed to energy hardship and less equipped to adapt (Quilty et al., 2022; Crowley & Jayawardena, 2017).

International Perspectives and Diversity in Indigenous Communities

Carpenter & Jampolsky (2016) stress the diversity of Indigenous experiences with energy poverty across nations. Community-level differences in law, geography, governance, and livelihoods shape energy vulnerability. For example, in the U.S., 566 federally recognised tribes exhibit significant heterogeneity in economic resources and land use, with implications for energy access Carpenter & Jampolsky (2016). In Australia, similar variation exists. While some Indigenous households enjoy urban living standards, others reside in remote areas lacking electricity or piped water, sometimes voluntarily to maintain customary lifestyles (Davidson et al., 2024).

Such diversity calls for locally grounded approaches. Current literature on Australian Indigenous communities focus on energy challenges in remote and very remote areas, where searing heat and substandard housing conditions compound vulnerability (Longden et al., 2021). However, the majority (85%) of Indigenous Australians reside in urban and regional areas (AIHW, 2025), where energy poverty manifests differently, through bill arrears, restricted appliance use, or fear of disconnection. Lack of evidence regarding the energy poverty of urban and regional Indigenous households creates significant knowledge gaps about these households.

Remote communities face barriers to energy transition including poor infrastructure, limited financing, weak institutional coordination, and low community trust (Quail et al., 2025). Meanwhile, many still rely on diesel generation, which is expensive and environmentally damaging (Hunt et al., 2021; Karanasios & Parker, 2018). Prepaid electricity meters are prevalent in remote Australia, particularly in the Northern Territory (NT), far north Queensland, the Kimberley, and the APY Lands (First Nations Clean Energy Network, 2025). While sometimes framed as tools of energy budgeting, they often exacerbate hardship by causing frequent disconnections due to inability to top up credit (Rasanga et al., 2024; Riley et al., 2023). Internationally, disconnection rates among prepay users range from 10% to 53% (O'Sullivan et al., 2013; Brutscher, 2012; Wagner & Wiegand, 2018). In remote Indigenous communities in the NT, rates are far higher: Tangentyere Council (2021) reports 59% to 91% annually; Longden et al. (2021) find 91% of households were disconnected at least once in 2018–2019. A recent report

Closing the Gap for Indigenous People

The Closing the Gap policy framework aims to eliminate disparities across domains, including education, income, housing, and life expectancy (NIAA, 2025). Yet progress remains uneven. The 2020–2022 life expectancy gap remains at 8.8 years for men and 8.1 years for women (AIHW, 2024). Insofar as thermal comfort, household function, and energy insecurity affect daily life and long-term health, energy poverty may be considered a structural contributor to these enduring gaps.

The link between energy poverty and health and well-being is well documented. Inadequate energy access has a negative impact on physical and mental health, work productivity, and educational outcomes (Welsch & Biermann, 2017; Ballesteros-Arjona, V., Oliveras, et al., 2022b). Energy-related deprivation often intersects with other forms of material hardship. For example, the "heat or eat" trade-off forces low-income households to sacrifice food for thermal comfort, amplifying nutrition insecurity and health risks (Fry et al., 2023). In this sense, energy poverty operates as a lens through which enduring material inequalities are made visible and experienced daily.

Despite this, energy poverty has not been explicitly included as a target within the Closing the Gap framework. Given its clear impact on well-being and social participation, *there is a strong case for integrating energy affordability as a specific target* alongside other structural determinants of Indigenous disadvantage.

This national focus aligns with global commitments. The United Nations' 2030 Agenda for Sustainable Development affirms a commitment to ending poverty in all its forms and ensuring access to affordable, reliable, and sustainable energy (SDGs 1 and 7), with multiple targets specifically referencing Indigenous peoples (United Nations, 2015; UN DESA, 2024). Globally, Indigenous populations, who comprise around 5% of the world's population, represent approximately 15% of those living in extreme poverty (UN Sustainable Development Group, 2019). The Agenda emphasizes that development and energy projects in Indigenous areas must respect Indigenous rights, as outlined in the UN Declaration on the Rights of Indigenous Peoples (UNDRIP), to avoid exacerbating marginalisation (OHCHR, 2024). Aligning Australia's Closing the Gap framework with these international commitments would recognize energy affordability as a core dimension of Indigenous well-being and social equity.

Energy Poverty, Housing Tenure, and Climate Risk

Climate change is intensifying energy stress. Rising temperatures and more frequent heatwaves increase household demand for cooling and exacerbate financial strain, particularly for those already experiencing socio-economic disadvantage (Crowley and Jayawardena, 2017, Fry et al., 2023). These pressures fall disproportionately on Indigenous Australians, who are more likely to live in thermally inefficient homes, face financial precarity, and lack the capacity to respond to climate-related shocks (Brown and Vera-Toscano, 2022, Quilty et al., 2022).

Energy poverty is strongly shaped by housing tenure. A large body of research links energy hardship to housing characteristics (including quality of housing and appliances (Jayasinghe et al., 2025, Konzen et al., 2024; Best et al., 2023, 2024; Daniel et al, 2020; Race et al., 2016). Renters, particularly in social housing, are among the most exposed to energy stress, with limited ability to improve insulation or install solar (Daniel et al, 2020). While government subsidies have driven solar uptake among owner-occupiers, renters remain locked out. Solar access for public housing tenants is especially low (Australian Council of Social Service, 2024). Anglicare (2023) estimates energy bills are up to 20 percent higher for these tenants. The Climate Council Australia (2024) suggests rooftop solar could reduce bills by $600 to $1,200 per year, easing the burden for low-income households.

These patterns are particularly relevant for First Nations households, 35 percent of whom rent privately and 18 percent of whom live in social housing (Australian Bureau of Statistics [ABS], 2022b). Over time, the proportion living in private rental has risen, while the share in social housing has declined (ABS, 2022a). These changes intersect with persistent exclusion from energy-efficient infrastructure. Indigenous renters lack the legal right to retrofit homes and are systematically excluded from solar upgrades, reinforcing structural disadvantage in the energy transition.

Barriers are even more acute in remote Indigenous communities. These regions face higher baseline temperatures, limited infrastructure, and widespread use of prepayment systems (Longden et al., 2021, First Nations Clean Energy Network, 2025). Prepay households are more likely to be disconnected, often during periods of extreme heat, due to lack of credit (Hunt et al., 2021). In the Northern Territory, disconnection rates reached 91 percent in some communities within a single year (Longden et al., 2021). These systems, concentrated in regions such as the Northern Territory, far north Queensland, the Kimberley, and the APY lands, entrench household vulnerability rather than reducing it.

Despite policy support, barriers remain for *just energy transition* in Australia. Remote communities face high capital costs, regulatory uncertainty, and cultural resistance to solar (O'Neill et al., 2021; O'Neill & Thorburn, 2022). Hunt et al. (2021) found rooftop solar on prepay systems reduced disconnections and improved reliability for Northern Territory households. Yet large-scale deployment is limited. Raily et al. (2023) emphasize the need for stronger policy mechanisms to ensure that First Nations households, particularly those in public housing, are not left behind in the energy transition.

Nearly 30–43% of land identified for Australia's renewable energy expansion overlaps with Indigenous lands (Pascale et al., 2023), yet clean energy development has not translated into widespread household benefits. First Nations involvement in the renewable energy transition has been limited and the benefits has not flowed to these communities (Norman, et al, 2025).

1.3 Research Gaps and Motivation for This Study

This study responds to several important gaps in the energy poverty literature. Most existing work focuses on remote Indigenous communities or on technical and supply-side interventions. Yet 84.6 percent of Indigenous Australians live in non-remote areas (AIHW, 2025). Using nationally representative HILDA data, we provide the first systematic analysis of energy poverty among Indigenous households in these settings. Although HILDA includes some remote and very remote households, they are a small share of the sample, consistent with population distribution, and our analysis predominantly reflects urban and regional dynamics without excluding others.

Second, there is limited research on the structural and socio-economic drivers of Indigenous energy poverty. Most studies focus narrowly on income and energy prices. We take a broader approach by examining how wealth, housing tenure, education, and financial resilience contribute to the observed energy poverty gap between Indigenous and non-Indigenous Australians. Our decomposition analysis shows that wealth explains more of the gap than income, and that the ability to access modest emergency funds is a key factor. Renting and lower levels of education also play a role. These are policy-relevant variables that have been largely overlooked.

Third, we highlight the importance of subjective indicators, such as self-reported bill stress and inability to heat the home. These dimensions capture the lived experience of energy poverty, which cannot be fully understood through income-based metrics alone. By linking these experiences to structural and socioeconomic inequalities, we offer a richer account of energy poverty as a lived condition rather than a static threshold.

More broadly, we propose a reconceptualization of energy poverty as a key dimension of structural inequality that compounds other forms of disadvantage. In doing so, we offer a new lens through which to extend Australia's Closing the Gap agenda.

Despite rising attention to energy poverty, to our knowledge, there is no study in Australia which has systematically examined how these dynamics play out for urban and regional Indigenous households. Existing literature is weighted toward remote contexts and technological interventions. Our study fills this gap by offering new evidence on the extent, persistence, and structure of energy poverty among Indigenous Australians using nationally representative data. Note that our data covers remote households, but since only 15% of Indigenous people are remote and very remote, they are less represented in the HILDA data.

2. Data sources and methods

2.1 Data

We use data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. This is a nationally representative household-based survey with variables for a range of socio-demographic and economic aspects. We initially focus on waves from 2003, 2013, and 2023 to give an indication of persistent Indigenous energy poverty. We then focus on the most recent wave of 2023, with explanatory variables lagged one year.

For our research focus on Indigenous energy poverty gaps, HILDA has several advantages and disadvantages. One advantage is the availability of comprehensive data on wealth. This covers both housing and financial assets. A disadvantage is that this wealth information is only available every four years, rather than annually. An advantage of HILDA data is the identification of Aboriginal or Torres Strait Islander people. However, a drawback is that remote Indigenous communities are not covered. Another advantage is the coverage of energy related variables, such as for households who could not pay bills on time and who were unable to heat their home. The related drawback for our energy focus is that the bill paying variable includes phone bills and there is an absence of data on energy investments like solar panels. The advantages of HILDA data will be shown to be appropriate for our research question through our analysis in Section 3.

To address the drawbacks of HILDA data and provide a robustness check, we also use data from the Energy Consumers Australia (ECA) Energy Consumer Sentiment Survey. This survey covered each of Australia's eight states/territories for just over 2,000 households in each of the bi-annual waves. We use the five waves between June 2022 and June 2024 as these waves identified Aboriginal and Torres Strait Islander people. We append the five waves, given that the survey is not a repeated panel of the same households, and the five waves were conducted within a relatively short two-year period. We also control for the wave with binary variables.

The ECA data also has some advantages and disadvantages for our research focus. A key advantage is that ECA has many energy variables as part of their specific focus on energy. For example, they collect data on solar panels, grid disconnections, disconnection notices, and hardship payment plans. Another advantage is that recent data is available up to June 2024, although ECA has since changed its data collection approach. A disadvantage is that ECA do not collect an explicit wealth variable. However, they do ask a categorical question about financial pressure, and this appears to be a good proxy for assets (Best et al., 2021). ECA data is also categorical, so we use income category thresholds from the data. Another drawback is that probability weights are not available for use in regressions or decompositions. However, probability weights are less relevant for systematic regression-based analysis, compared to their value for calculating nationally representative descriptive statistics.

A comparison of HILDA and ECA data in Table 1 reveals some similarities, as well as differences in certain variables. There are similar proportions for identifying as Aboriginal or Torres Strait Islander, separate housing, the number of people per household, university education, and renters. The dependent variables differ substantially in terms of their definitions, which is reflected in the proportions. According to HILDA data, approximately 12% of households were unable to pay their bills on time in 2023. This includes electricity, gas, and phone bills. For the ECA data, the dependent variable is defined as households experiencing energy bill pressure, which was reported by 55% of households. This is evidently a more inclusive explanatory variable, as many households who feel pressure can still pay the bills on time. For the HILDA data, we use terciles for net worth, household income, and the age of the respondent. The ECA data is categorical, and so we split households according to available thresholds.

Table 1. Variables and proportions

HILDA variable	Proportion General	Proportion ATSI	ECA variable	Proportion General	Proportion ATSI
Could not pay bills on time	0.12	0.27	Bill pressure	0.55	0.70
Unable to heat home	0.05	0.14			
Explanatory			*Explanatory*		
ATSI	0.03	1	ATSI	0.03	1
Low wealth	0.33	0.70	High financial pressure	0.19	0.29
Mid wealth	0.33	0.19	Mid financial pressure	0.44	0.42
High wealth	0.33	0.11	Low financial pressure	0.37	0.29
Low income	0.33	0.44	Income <$60,000	0.43	0.53
Mid income	0.33	0.34	Income $60,000-$120,000	0.30	0.28
High income	0.33	0.22	Income >$120,000	0.20	0.16
Separate house	0.76	0.74	Separate house	0.73	0.64
Bedrooms	Mean=3.16	=2.95			
Persons	Mean=2.43	=2.98	Persons	Mean=2.42	=2.92
Dependent children (<15 years)	Mean=0.49	=0.96	Dependent children	0.23	0.46
University	0.33	0.12	University	0.32	0.25
Low age	0.34	0.57	Age <35	0.13	0.28
Medium age	0.35	0.32	Age 35-64	0.52	0.62
High age	0.32	0.11	Age 65+	0.35	0.10
Rent	0.31	0.62	Rent	0.29	0.55
			Solar panels	0.35	0.36
Could not pay bills on time (lag)	0.10	0.28	Disconnected	0.02	0.13
Unable to heat home (lag)	0.03	0.08	Disconnection notice	0.05	0.20
Couldn't raise emergency funds	0.11	0.35	Hardship	0.10	0.38

Notes: Explanatory variables also include state and section of state for both sources. The HILDA proportions are for dependent variables from 2023, and explanatory variables lagged one year and covering 7127 observations except for the variable "unable to heat home" which has 7117 observations. The ECA proportions are for 2022–2024 and covering 10,560 responses, excluding 137 respondents/households who stated "prefer not to say" for whether they identify as Aboriginal or Torres Strait Islander. Responses are not given in the ECA data for income by 8% of households, and for age by 0.03% of households. These households are included in our analysis as additional categories of the respective categorical variables.

The large gap between Indigenous and non-Indigenous Australians in terms of energy poverty is partly evident through the three dependent variables in this study. Figure 1 shows that Indigenous Australians are substantially more likely to experience each of these three dimensions of energy poverty.

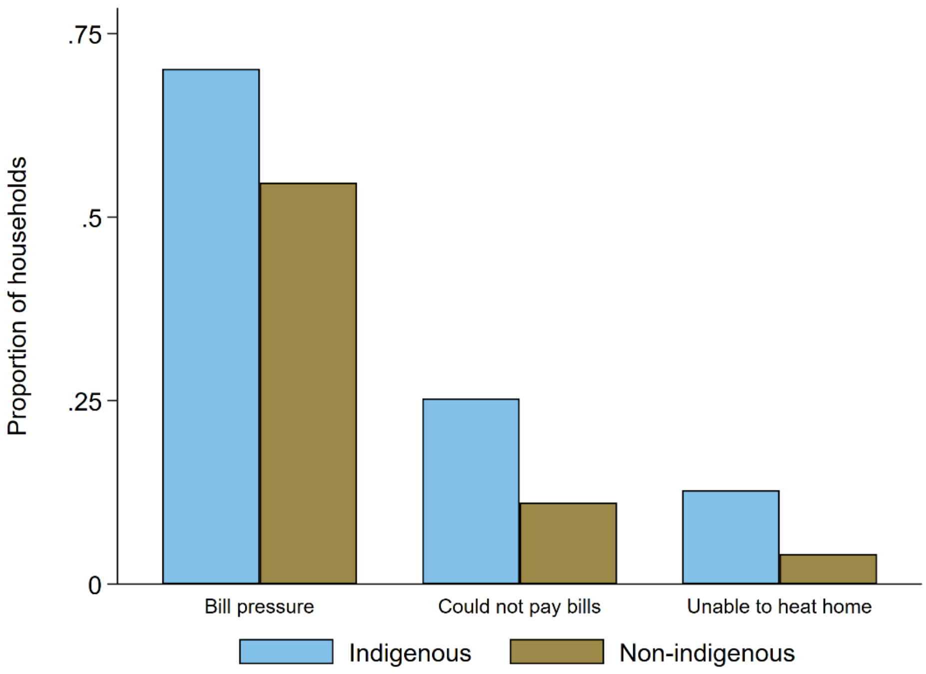

Fig. 1. Dependent variables split by Indigenous status. Data: ECA (2024); HILDA (2024)

There are also substantial differences between Indigenous and non-Indigenous Australians with respect to financial variables. Using the HILDA data in Figure 2, Indigenous Australians report being much more likely to be unable to raise emergency funds. We subsequently focus on a binary distinction between being unable to raise emergency fund or not, rather than the categorical approach in Figure 2. In Figure 3, the proportion of households feeling more financial pressure is substantially elevated for the Indigenous group compared to the non-Indigenous group. The gap is around 10 percentage points for experiencing a high level of financial pressure, with just below 30% of Indigenous and 20% of non-indigenous households in this category.

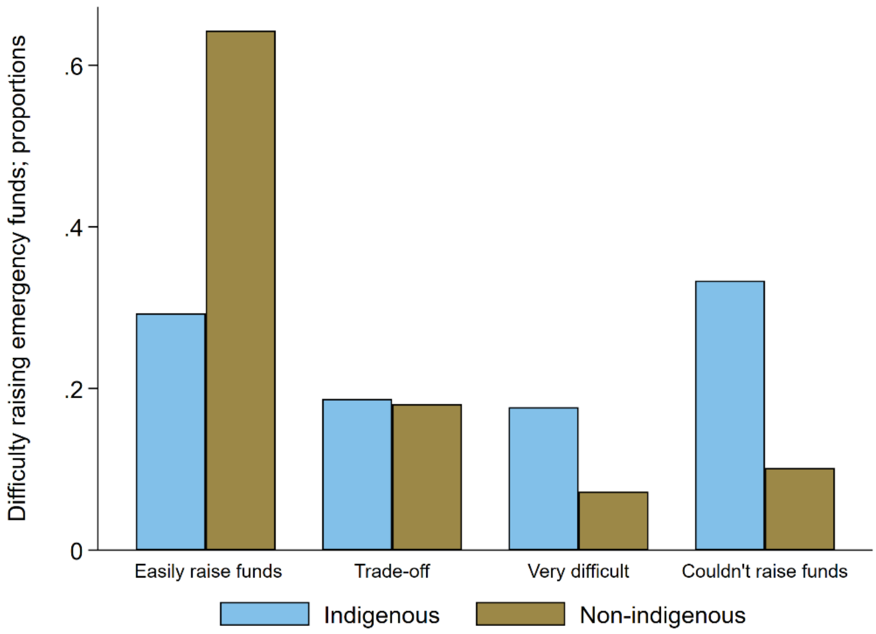

Fig. 2. Emergency money explanatory variable split by Indigenous status. Data: HILDA (2024)

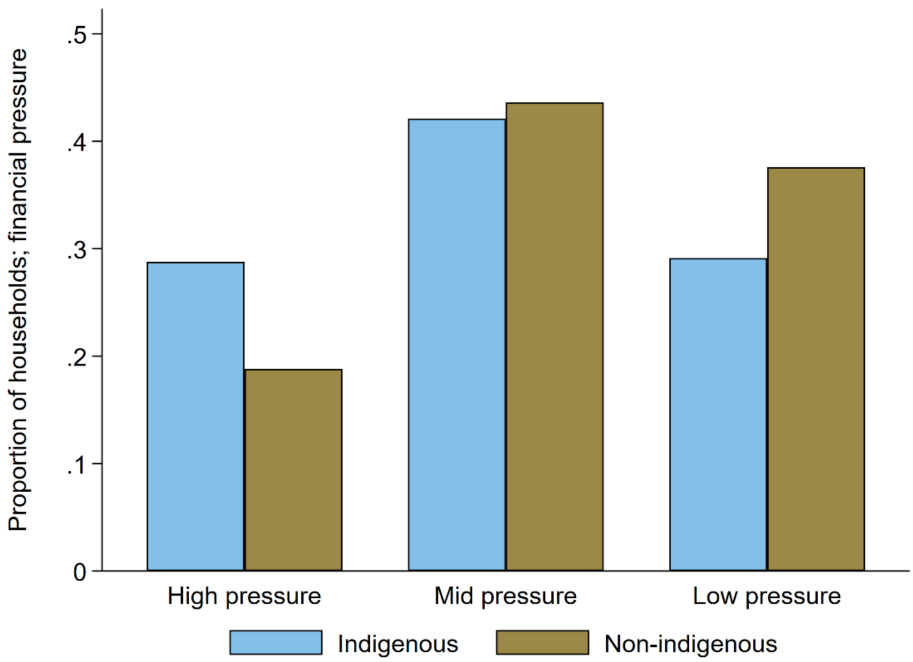

Fig.3. Financial pressure split by Indigenous status. Data: ECA (2024)

2.2 Methods

2.2.1 Cross-sectional focus

This paper follows a cross-sectional approach for several reasons. Our research focus is on understanding and decomposing Indigenous energy poverty gaps rather than suggesting or quantifying an unavoidable causal effect related to being Indigenous. In addition, key variables have little or no change over time. For example, there is substantial persistence in wealth distributions over time, and Indigenous status is based on characteristics which are fixed at birth. In contrast, there is major cross-sectional variation for key variables. For example, the standard deviation of household wealth from the 2022 HILDA wave at A$1.8 million is substantially larger than the mean of A$1.3million. There is also an absence of a panel structure for the ECA data, and key wealth variables from HILDA are only available every four years. We also present a persistent Indigenous energy poverty gap in Section 3, motivating attempts to understand the difference between Indigenous and non-Indigenous Australians rather than minor changes over time.

We subsequently use (cross-sectional) probability weights which are available for HILDA data, as specified in Section 3. This applies to both regressions and decompositions described in the following sub-sections. Probability weights are not available for ECA data.

2.2.2 Regressions

Our regressions use a linear probability model (LPM) approach. LPMs produce convenient coefficients which are directly interpreted as marginal effects. While outliers from continuous explanatory distributions can produce predicted probabilities outside the unit interval, our explanatory variables are nearly all categorical. We also produce marginal effects from a probit model as a robustness test in the Stata code to show probit results which are similar to LPM results.

Our regression approaches in Section 3 focus on the link between being Indigenous and reporting energy poverty dimensions. We start with concise regressions with small numbers of control variables. This helps in understanding that the large unconditional gaps between Indigenous and non-Indigenous Australians are largely explained by a small number of key variables. Repeated cross-sectional regressions reveal persistence in terms of the energy poverty outcomes and the key variables which are related to these outcomes. We also produce regressions which drop some subjectively reported explanatory variables to focus on objectively observable socio-demographic and economic variables. This is useful from a policy perspective, as it shows that energy poverty gaps can mostly be explained by observable variables which can feature in policy eligibility designs.

The key groups of explanatory variables are shown in equation (1). The subscript is *i*, representing respondents in our first regressions, and then households when we introduce household-level explanatory variables. The dependent variable is shown as *P* for energy poverty. We separately assess three dimensions of energy poverty, as evident in Table 1. The key explanatory variable is *A* for Aboriginal or Torres Strait Islander (Indigenous) people. Subjective or hypothetical explanatory variables are shown as *S*. These include households reporting feeling unable to raise emergency funds and the lagged experience of either feeling unable to pay bills on time or feeling unable to heat their homes. The objective variables are shown as *O*. These include observable characteristics such as socio-demographic and economic characteristics, along with objective or observable energy variables like having solar panels or when an energy company disconnects a household from energy supply. The constant is *c*, and the error term is ε.

$$P_i = c + \alpha A_i + \beta S_i + \gamma O_i + \varepsilon_i \quad (1)$$

2.2.3 Decompositions

We also use decompositions as a further regression-based approach. Decompositions are useful extensions beyond regression output because they allow for consideration of the different average levels for explanatory variables for key groups, in addition to the influence of an explanatory variable on an outcome variable. This is useful for our research focus on understanding the gaps between Indigenous and non-Indigenous Australians since these gaps are a function of both the difference in explanatory variables between the groups and then the extent of influence of each explanatory variable.

We start with Oaxaca-Blinder decompositions. Equation (2) has the difference between the mean value for energy poverty (*P*) for non-Indigenous (*N*) households and for Indigenous (*A*) households. On the right-hand side of equation (2), the term before the (first) addition sign is the explained variation, while the term inside the curved parentheses ({.}) is the unexplained part. The explained variation is the difference between the mean values for the explanatory variable (*X*) for non-Indigenous and Indigenous households, multiplied by the coefficient vector (ξ) from a pooled (*) regression which covers both non-Indigenous and Indigenous households. This shows how the left-hand side gap is a function of both the difference between explanatory variables for the two groups ([.]), and the influence of the variables on energy poverty (ξ). We also break down the explained variation into its component parts, one for each explanatory variable or group of explanatory variables. An example of a group of explanatory variables is the summed influence from the eight states/territories, rather than independent contributions from each state or territory.

$$E(P_N) - E(P_A) = [E(X_N) - E(X_A)]'\xi^* + \{E(X_N)'(\xi_N - \xi^*) + E(X_A)'(\xi^* - \xi_A)\} \qquad (2)$$

We also use Fairlie decompositions to check for robustness. The Fairlie approach aligns with the non-linear (i.e. binary) nature of the dependent variable of households either reporting experience of an energy poverty dimension or not. We use a probit model and 100 replications in each case, where these replications account for the dependence of explanatory variable contributions on each other as probabilities need to be predicted in this non-linear context. We employ random ordering of the explanatory variables in case there is sensitivity to decomposition order. While there is potential for different results between different types of decompositions, our results in Section 3 are similar regardless of the distinction between Oaxaca-Blinder and Fairlie decompositions.

3. Results

3.1 Results with the Linear Probability Model

Table 2 has results exploring two dimensions of energy poverty for three waves of HILDA data spanning two decades. The first energy poverty dimension is households stating that they could not pay their energy and phone bills on time and the second is households feeling unable to heat their home. These initial exploratory results are not seeking to be precise causal magnitudes. Rather, these results help to establish some key themes to guide our subsequent analysis, aligning with our research question of how best to reduce the Indigenous energy poverty gap.

We initially use the largest possible sample of HILDA data by using responses at the person level. This is useful to maximize the number of Indigenous responses in our analysis. After discussing the relevance of this exploratory person-level analysis, we later switch to an investigation with household-level variables.

3.1.1 Individual Level

One key theme from Table 2 is that there tends to be large coefficients for the Aboriginal and Torres Strait Islander (ATSI) variable. For example, this variable ranges between nine and 18 percentage points in column (1), explaining households that could not pay bills on time, when there are no control variables. In column (2) with the single control variable for access to emergency money, the ATSI coefficients are between two and 12 percentage points. In column (3), ATSI coefficients are up to 6 percentage points when explaining being unable to heat homes. However, the ATSI coefficients are closer to zero and insignificant in column (4) when controlling for emergency money.

Another key aspect from Table 2 is that there tends to be persistence in an energy poverty gap for ATSI respondents. For households who could not pay energy bills on time, the ATSI coefficients are larger in 2013 compared to 2003. In 2023, the unconditional gap is still large at over nine percentage points. For feeling unable to heat homes, the unconditional gap is similar at around five percentage points in both 2013 and 2023.

Table 2 also shows that the ATSI coefficients have larger point estimates when explaining households who could not pay bills on time, compared to explaining feeling unable to heat homes. This is true when comparing each corresponding column and for each year.

There is a large and consistent influence of the control variable for access to emergency money in Table 2. Respondents who state that they are unable to obtain emergency money are around 22 to 24 percentage points more likely to be unable to pay their energy or phone bills on time. When explaining respondents feeling unable to heat their home, the magnitudes range from nine to 14 percentage points.

Table 2 indicates a policy-relevant feature through comparison of columns (1) and (2), and columns (3) and (4). Specifically, in the 2023 data, the raw (unadjusted) difference in ability to pay energy bills on time between ATSI and non-Indigenous respondents is quite large, a 9.0 percentage point gap in column (1). However, when the analysis accounts for whether someone has access to emergency money (column (2)), this gap drops sharply to just 2.4 percentage points and is no longer statistically significant. This means that a substantial part of the observed disparity can be attributed to differences in financial resilience, rather than to Indigenous status alone.

A similar pattern appears in columns (3) and (4): an initial gap of 4.5 percentage points shrinks to only 0.4 percentage points, again, statistically insignificant, once emergency money access is taken into account. These results suggest that a policy intervention related to emergency money, or some lump sum amount, in other words, could be influential in substantially closing parts of the Indigenous energy poverty gap.

Table 2. LPM regression results spanning two decades.

	(1) Pay	(2) Pay	(3) Heat	(4) Heat
Panel A: 2003				
ATSI	0.163***	0.107**	0.006	-0.020
	(0.042)	(0.041)	(0.011)	(0.012)
No emergency money		0.219***		0.097***
		(0.015)		(0.011)
Observations	11,358	11,358	11,297	11,297
Adjusted R^2	0.003	0.048	0.000	0.044
Panel B: 2013				
ATSI	0.183***	0.116***	0.055***	0.028
	(0.029)	(0.030)	(0.016)	(0.017)
No emergency money		0.239***		0.094***
		(0.015)		(0.009)
Observations	14,905	14,905	14,870	14,870
Adjusted R^2	0.007	0.071	0.002	0.037
Panel C: 2023				
ATSI	0.090***	0.024	0.045***	0.004
	(0.024)	(0.026)	(0.014)	(0.015)
No emergency money		0.224***		0.139***
		(0.016)		(0.013)
Observations	14,464	14,464	14,441	14,441
Adjusted R^2	0.002	0.058	0.001	0.055

Notes: *, **, *** represent 10, 5, and 1 % levels of significance respectively. Responding person probability weights are used in each case for Table 2 which uses data for responding persons. The constant is not shown to save space in each case. Robust standard errors are in brackets.

3.1.2 Household Level

The results in Table 3 incorporate household-level variables such as wealth and are based on ‘person 1’ so that there is now one response per household. Key results are similar based on ‘person 2’, but with a smaller sample and larger standard errors. Table 3 explores why some households state that they could not pay their bills on time, while Table 4 investigates why some households report being unable heat their home. While the sample sizes are different to Table 2, similar themes are evident. There are large unconditional

ATSI coefficients, especially for regressions explaining households who could not pay bills, but the ATSI gaps are substantially less when controlling for just one variable for emergency money access.

The explanatory variables in Table 3 and subsequent tables are now lagged by one year. This approach helps reduce *simultaneity bias*, which may arise if current outcomes (such as difficulty paying bills) influence contemporaneous measures of explanatory variables (such as household wealth). Using lagged values of key household-level variables, including wealth and emergency money access, mitigates this concern by ensuring that the predictors precede the outcome. In addition, lagging the covariates enables the inclusion of a *lagged dependent variable* (in this cross-sectional context), allowing us to account for persistence in financial hardship, specifically, whether households that reported difficulties in paying bills in the previous wave continue to experience the same issue in the current period.

Column (3) of Table 3 introduces the lagged dependent variable. Households who state that they could not pay their bills on time in the previous survey were much more likely to report the same experience in the 2023 survey. The coefficient magnitude is large, at around 47 percentage points. The inclusion of the lagged dependent variable leads to the ATSI coefficient being closer to zero and insignificant. The emergency money variable is also closer to zero in column (3), but still highly significant.

The policy-relevant socioeconomic controls are added in column (4) of Table 3. We focus on wealth, income, education, and renting. The coefficients for the wealth categories are both statistically significant, relative to the reference of the lower wealth households. High-wealth households are less likely to be unable to pay their bills by 5.6 percentage points, compared to the low-wealth reference group. For income, the magnitudes are closer to zero and the medium-income coefficient is not statistically different to zero. The university education variable is significant at 1% level. Households with a respondent who has completed university are 2.7 percentage points less likely to state that they could not pay their bills on time.

We drop the emergency money and lagged dependent variables in column (5) to focus on policy relevant variables. This has practical relevance, because it may not be possible to implement a policy which requires asking households whether they feel unable to access emergency money, and whether they have felt unable to pay their previous energy bills. There are some similar outcomes in column (5) compared to column

(4). The ATSI coefficient is still insignificantly different to zero in column (5). Hence, socioeconomic controls can still explain a large part of the unconditional 14.2 percentage point gap from column (1), even without the emergency money and lagged dependent variables. The result of the corresponding wealth coefficients being further from zero, compared to the income coefficients, is maintained in column (5). The university variable is again negative and significant, with a larger difference from zero in column (5). The renting coefficient becomes statistically significant in column (5). When not controlling for emergency money and the lagged dependent variable, renters are more likely by 3.9 percentage points to state that they could not pay their bills on time.

Table 3. LPM results for ‘could not pay electricity, gas or telephone bills on time,’ 2023.

	(1)	(2)	(3)	(4)	(5)
ATSI	0.142***	0.065*	0.019	-0.009	0.052
	(0.037)	(0.036)	(0.031)	(0.031)	(0.037)
No emergency money		0.276***	0.138***	0.107***	
		(0.027)	(0.020)	(0.021)	
Lag, can’t pay			0.474***	0.454***	
			(0.024)	(0.024)	
Ref: low wealth					
Med. wealth				-0.038**	-0.081***
				(0.015)	(0.017)
High wealth				-0.056***	-0.113***
				(0.014)	(0.020)
Ref: low income					
Med. income				0.002	-0.031**
				(0.011)	(0.013)
High income				-0.034*	-0.076***
				(0.019)	(0.021)
University				-0.027***	-0.056***
				(0.008)	(0.009)
Rent				-0.000	0.039**
				(0.012)	(0.016)
Other controls	No	No	No	Yes	Yes
Probability weights	Yes	Yes	Yes	Yes	Yes
Observations	7,127	7,127	7,127	7,127	7,127
Adjusted R^2	0.004	0.074	0.252	0.268	0.074

Notes: *, **, *** represent 10, 5, and 1 % levels of significance respectively. Other controls are the number of bedrooms, state/territory, section of state/territory (3 sections and an undisclosed category versus the reference of major urban), the number of people, the number of children, age terciles, and a constant. Probability weights are at the household level. Robust standard errors are in brackets.

Table 4 investigates households who state being unable to heat their homes due to a shortage of money and has some similarities to Table 3. There is again a substantial unconditional gap which disappears when adding the emergency money and lagged dependent variables. There are again large and highly significant coefficients for the emergency money and lagged dependent variables. The renting coefficient in column (5) of 2.9 percentage points is quite like the 3.9 percentage points in the corresponding column of Table 3.

There are also some differences between Table 4 and Table 3. One is that the ATSI coefficient is statistically different to zero in column (5). The socioeconomic controls do reduce the unconditional gap of 8.6 percentage points from column (1) to some extent although the gap is still 5.6 percentage points in column (5). Wealth and income coefficients are quite similar to each other in column (5) of Table 4, in contrast to the disparity between them in Table 4. The university coefficient is insignificantly different to zero in Table 4. Thus, education may not have a large influence on whether households are unable to heat their home. This lack of significance is intuitive as university education is not required for using heating. However, education is intuitively useful for managing budgets and paying bills, so the significant coefficient in Table 3 is reasonable.

Table 4. LPM results for being unable to heat home due to a shortage of money, 2023.

	(1)	(2)	(3)	(4)	(5)
ATSI	0.087***	0.039	0.035	0.031	0.056**
	(0.026)	(0.026)	(0.028)	(0.028)	(0.026)
No emergency money		0.171***	0.099***	0.084***	
		(0.018)	(0.016)	(0.016)	
Lag, unable to heat			0.461***	0.453***	
			(0.040)	(0.040)	
Ref: low wealth					
Med. wealth				-0.008	-0.036***
				(0.008)	(0.009)
High wealth				-0.012	-0.046***
				(0.010)	(0.012)
Ref: low income					
Med. income				-0.014*	-0.040***
				(0.008)	(0.009)
High income				-0.026***	-0.056***
				(0.009)	(0.010)
University				0.004	-0.003
				(0.005)	(0.006)
Rent				0.017**	0.029***
				(0.008)	(0.010)
Other controls	No	No	No	Yes	Yes
Probability weights	Yes	Yes	Yes	Yes	Yes
Observations	7,106	7,106	7,106	7,106	7,106
Adjusted R^2	0.004	0.069	0.228	0.233	0.040

Notes: *, **, *** represent 10, 5, and 1 % levels of significance respectively. Other controls are the number of bedrooms, state/territory, section of state/territory (3 sections and an undisclosed category versus the reference of major urban), the number of people, the number of children, age terciles, and a constant. Probability weights are at the household level. Robust standard errors are in brackets.

3.2 Decomposition Results

Table 5 decomposes the unconditional gaps that were evident in Tables 3 and 4. For example, the 14.2 percentage point gap from Table 3 is evident in Table 5 as the difference between the 11.1 percent of non-ATSI households and the 25.3 percent of ATSI households who stated that they could not pay bills on time. Our Oaxaca-Blinder decomposition breaks down this gap into an explained part of 9.0 percentage points and an unexplained part of 5.2 percentage points. This unexplained part is insignificantly different from zero. We note that the unexplained part is close to zero when emergency money and lagged dependent variables are included; however, we maintain our focus here on objectively identifiable variables that can be used in policy design.

The bottom of Table 5 splits the explained part into components. The four biggest contributors are the four socio-economic variables discussed previously. Wealth accounts for the largest part of the explained component, with 3.8 out of 9.0 percentage points. Income, renting, and university education each contribute around one percentage point, as does the number of people in the household.

Table 5. Oaxaca-Blinder decomposition using HILDA data.

	Could not pay		Unable to heat	
	Coefficient	St. Error	Coefficient	St. Error
Non-ATSI	0.111	0.005	0.041	0.003
ATSI	0.253	0.035	0.128	0.026
Difference	-0.142***	0.035	-0.087***	0.026
Explained	-0.090***	0.010	-0.031***	0.005
Unexplained	-0.052	0.035	-0.056**	0.026
Explained:				
Wealth	-0.038***	0.008	-0.016***	0.004
Income	-0.011***	0.004	-0.008***	0.003
Separate house	0.001	0.001	0.001	0.001
Bedrooms	0.000	0.001	-0.001	0.001
State	-0.002	0.003	0.002	0.002
Section of state	0.000	0.002	0.001	0.001
Persons	-0.012*	0.007	-0.002	0.002
Children	0.001	0.006	0.001	0.002
University	-0.014***	0.003	-0.001	0.001
Age	-0.004	0.004	0.001	0.002
Renting	-0.012**	0.005	-0.009***	0.003
Observations	7,127		7,106	

Notes: *, **, *** represent 10, 5, and 1 % levels of significance respectively. The outcome variables (could not pay; unable to heat) are from 2023 and the explanatory variables are from 2022.

Table 5 also decomposes the unconditional difference of 8.7 percentage points between the 4.1 percent for non-ATSI and 12.8 for ATSI households who were unable to heat their home. The three main contributors are wealth, income, and renting. Even though wealth coefficients were slightly closer to zero in Table 4, there is a larger contribution to explaining the difference between non-ATSI and ATSI households from wealth of 1.6 percentage points compared to 0.8 percentage points for income. The larger wealth contribution to the decomposition can be attributed to the larger difference wealth difference between non-ATSI and ATSI households, relative to income. Wealth of non-ATSI households is more than double ATSI households, while the income ratio is much smaller. The renting contribution is also around one percentage point.

We also repeat the analysis in Table 5 using non-linear Fairlie decompositions, to assess the robustness of our results. The coefficients, and the sum of the coefficients, are similar between Oaxaca-Blinder and Fairlie decompositions. For example, the wealth contribution using a Fairlie decomposition is 4.1 percentage points, compared to the 3.8 percentage points in the first column of Table 5. The similarities suggest that the choice of methods is not a major factor for our analysis. The explained parts of the gaps are larger when using Fairlie decompositions, suggesting that this more advanced approach explains slightly more of the variation for our binary (i.e. non-linear) dependent variables.

While substantial parts of the difference between non-ATSI and ATSI households remained unexplained in Table 5, such as 5.6 percentage points for households being unable to heat their homes, these parts can be reduced substantially. For example, the 5.6 percentage point difference reduces to an insignificant 3.1 percentage points if the emergency money and lagged dependent variables are included. This suggests value in policymakers being able to identify households based on their experience and behaviours, beyond their socioeconomic characteristics. However subjective variables asking households about their experiences would be prone to problems if used for implementing a policy. This makes it useful to have information on other more objective measures such as receipt of disconnection notices. We investigate this with Energy Consumers Australia data.

Table 6 has decompositions using Energy Consumers Australia data. The ECA data has a variable which asks about the experience of feeling pressure related to energy bills, rather than the more intense variable from HILDA about being unable to pay bills. In Table 6, the non-ATSI group has 54.7% of households feeling pressure, whilst 70.2% of ATSI households reported feeling pressure in paying their energy bills (electricity and gas for heating, cooking, and hot water). This gives a gap of 15.5 percentage points. The explanatory variables that we include in the model help to account for 13.8 percentage points. This leaves an insignificant 1.7 percentage points of the difference between ATSI and non-ATSI households when using an Oaxaca-Blinder decomposition.

The biggest single contributor to the 13.8 percentage points of the explained difference in the first column of Table 6 is the financial pressure variable. We interpret this variable as a proxy for wealth. The ECA data does not have an explicit wealth variable, but this general financial pressure variable is a useful wealth proxy as it asks about whether households can afford to buy any goods or services. This intuitively includes investments, such as energy investments which can reduce energy bills.

Table 6 also has the extra energy variables which help to explain the difference between ATSI and non-ATSI households. For example, households which have either been notified about potential disconnection in the past, or who have already been disconnected from energy supply, provide objective variables which help to explain feeling pressure for paying bills going forward. Together, these variables explain 3.5 percentage points of the difference between ATSI and non- ATSI households. ATSI households are much more likely to have already been disconnected in the past or received a notification and are therefore more likely to feel bill-paying pressure going forward. Similarly, ATSI households are also more likely to be on a hardship plan, which also identifies households who are more susceptible to feeling pressure for energy bills. While these three energy variables are closely related, multicollinearity does not appear to be an issue. Following a robustness regression available through the Stata code, we find a mean variance inflation factor of only 1.49, and a maximum of only 3.27 for an age coefficient.

More of the difference is explained when using the non-linear Fairlie decomposition. Table 6 shows that 14.5 out of 15.5 percentage points is explained. The explained contributions from each variable are similar when comparing the two decomposition types in Table 6. The financial pressure variable is again the leading contributor, explaining 5.4 percentage points of the gap.

Table 6. Decompositions of bill pressure using ECA data, 2022–2024

	Oaxaca-Blinder		Fairlie	
	Coefficient	St. Error	Coefficient	St. Error
Non-ATSI	0.547***	0.005	0.547	
ATSI	0.702***	0.027	0.702	
Difference	-0.155***	0.028	-0.155	
Explained	-0.138***	0.017	-0.145	
Unexplained	-0.017	0.025	-0.010	
Explained:				
Financial pressure	-0.052***	0.013	-0.054***	0.001
Income	0.003**	0.001	0.002	0.001
Separate house	0.005***	0.002	0.005***	0.001
State	0.007***	0.002	0.007***	0.002
Section of state	0.001	0.001	0.001	0.001
People	-0.014***	0.004	-0.014***	0.002
Dependent children	-0.007**	0.003	-0.006**	0.003

Education	-0.000	0.001	-0.000	0.001
Age	-0.017***	0.003	-0.015***	0.003
Rent	-0.001	0.003	-0.001	0.003
Solar panels	0.001	0.003	0.002***	0.000
Disconnected	-0.020***	0.005	-0.018***	0.004
Disconnection notice	-0.015***	0.004	-0.019***	0.003
Hardship	-0.032***	0.005	-0.039***	0.004
Wave	0.004**	0.002	0.005***	0.001
Observations	10,560		10,560	

Notes: *, **, *** represent 10, 5, and 1 % levels of significance respectively.

4. Discussion

This study demonstrates that energy poverty gaps between Indigenous and non-Indigenous Australians are large, persistent, and evident across multiple data sources, including HILDA (2003–2023) and ECSS (2022–2024). Given the persistent gap in energy poverty outcomes between Indigenous and non-Indigenous households, we focus primarily on the most recent data. In 2023 (HILDA), Indigenous households were 9 percentage points more likely to struggle with paying their energy bills on time (Table 2). ECSS data illustrates an even stronger gap: over 70% of Indigenous households report feeling pressure to pay energy bills, compared with just under 55% of non-Indigenous households, a gap of 15.5 percentage points (Table 6).

Our analysis shows that some of these gaps are amenable to policy intervention. A household's ability to access emergency funds, a few thousand dollars from savings or family support, is a key factor in explaining disparities. Accounting for emergency money, the 9-point gap in HILDA bill-paying ability shrinks to 2.4 percentage points, no longer statistically significant (Table 2). Around three-quarters of the observed disadvantage is therefore due to differences in financial security rather than Indigenous status itself. Similarly, in ECSS data, 5.5 percentage points of the gap is linked to financial pressure (Table 6).

Decomposing energy poverty gaps into socio-economic contributions highlights structural inequalities. Wealth is the most substantial factor; in 2023 (HILDA), it explains 3.8 of the 9.0 percentage point difference in bill-paying ability (Table 2). Households in the highest wealth category are 5.6 percentage points less likely to report payment difficulties. As Indigenous households tend to have lower wealth, they are more likely to experience energy poverty, as they are less able to afford energy-improving investments or draw on accumulated resources to pay energy bills.

Other socio-economic variables also have an influence, but to a lesser extent, as we demonstrate in Table 5. Education appears to be important for paying bills, while renting is important for feeling unable to heat homes. Households having a university-educated respondent are 2.7 percentage points less likely to struggle, while renters are 3.9 percentage points more likely to report difficulties. Overall, these socio-economic factors explain much of the 14.2-point gap in bill-paying difficulties, even before considering emergency funds or past arrears.

We also found that objective energy experience variables, such as disconnections and hardship program enrolments, can explain about 43 percent of Indigenous energy poverty gaps (Table 6). Households that previously struggled to pay bills were about 47 percentage points more likely to struggle again in 2023 (Table 3), showing the persistent nature of energy stress and the difficulty of recovery from hardship.

Closing Indigenous energy poverty gaps will require a multifaceted approach. Targeted Indigenous-led policies remain crucial, particularly for remote communities, but general policy settings that address financial resilience, wealth inequality, housing insecurity, and hardship protections are also essential for the majority of Indigenous households in urban and regional areas. These findings provide a foundation for embedding energy justice within broader equity goals and underscore the importance of recognizing energy poverty as a core dimension of socioeconomic disadvantage.

4.1 Policy implications

Our analysis highlights several directions for policy reform. First, *wealth, rather than income, is the key driver* of Indigenous energy poverty gaps, explaining about 43 percent of the gap in bill-paying difficulties (Table 5). Indigenous households, with systematically lower wealth, are less able to draw on savings or assets to manage energy shocks. Investment in programs supporting Indigenous home ownership and asset accumulation would reduce long-term vulnerability by enabling access to energy-efficient housing and buffers against arrears. Assistance schemes should therefore also target low-wealth households, not just low-income ones. While Australia's broader social security system, such as the Age Pension, does include asset tests for eligibility, energy-specific assistance programs primarily use income eligibility or concession card holding as the key qualifying factors. International examples exist, such as the US federal Low-Income Home Energy Assistance Program (LIHEAP) and the UK Warm Home Discount, that incorporate household assets or circumstances beyond income in eligibility criteria in energy assistance.

Our finding that gaps in energy poverty decrease by approximately 73% (Table 2) when accounting for access to *emergency funds* indicates that interventions should prioritize enhancing financial resilience. The emergency money variable is defined in the HILDA data as an amount of a few thousand dollars. Specifically, this amount is $2000 in the 2003 wave but rises to $3000 in 2013 and $4000 in 2023. Policies limited to small, frequent bill relief payments (such as the $150–$350 subsidies in 2024, 2025 Australian federal budgets) are unlikely to address underlying vulnerability. Larger, less frequent lump-sum payments could help households make energy-related investments or cover acute hardship. Lump-sum payments, however, face practical challenges. They can be poorly targeted, arrive irregularly relative to need, and be rapidly depleted without addressing ongoing affordability. Direct bill credits during peak cost periods, automatic pre-paid energy top-ups triggered by extreme weather, and deferred payment plans for households experiencing repeated disconnections can provide timely relief without penalties.

Objective indicators such as *past disconnections or notices, arrears, or enrolment in hardship programs* are strong predictors of ongoing vulnerability. Our findings show that households with prior bill payment difficulties were about 47 percentage points more likely to struggle again in 2023 (Table 3), while disconnections and enrolment in hardship plans accounted for about 43 percent of the Indigenous–non-Indigenous gap (Table 6). Thus, objective experience indicators as above can be utilized for targeted support, such as automatic enrolment in hardship programs triggered by arrears or repeated disconnections, guaranteed access to discounted tariffs, and payment freezes. For households with accumulated debt, partial electricity cuts could be applied gradually during milder periods once emergency support has ensured basic thermal comfort.

Policy support should also be flexible. Our results suggest that solar panels or batteries alone may not explain Indigenous energy poverty gaps (Tables 5 and 6). Households should have the autonomy to invest in solutions most appropriate for their circumstances: renters may benefit more from mobile technologies or efficient appliances than property-fixed investments. Allowing households to accumulate unspent support increases flexibility and avoids inequities arising from rigid schemes.

Non-financial measures also matter. Education and budgeting skills influence households' ability to pay bills (Table 5). Education-related interventions, such as subsidies for energy literacy programs and targeted training, can enhance bill management and uptake of assistance. Tenure-specific policies, including landlord incentives or requirements for rental property efficiency upgrades, would address the disadvantage faced by renters, who are nearly 4 percentage points more likely to struggle with bills. International evidence underscores the effectiveness of combining income supplements with structural housing and efficiency measures; for example, the UK's Warm Home Discount is paired with efficiency schemes targeting low-income and rental households.

European countries offer a range of energy interventions (Bouzarovski et al., 2021). Seasonal disconnection bans are in place in France, Belgium, Ireland, Spain, and Greece, prohibiting energy cut-offs during the winter months or specific crises such as the pandemic (Agency for the

Cooperation of Energy Regulators & Council of European Energy Regulators, 2023). Minimum supply guarantees are enforced in France and parts of Belgium, where even authorised disconnections must maintain a basic level of service at a regulated social tariff. Emergency credit mechanisms, such as the increase in Ireland's prepayment meter emergency credit from €10 to €100, prevent disconnections during periods of acute financial stress (Electric Ireland, n.d.). Direct cash payments in Belgium and automatic income-based vouchers ranging from €48 to €277 in France, depending on income and household size, further reduce household burdens. France[2] offers automatic energy vouchers, delivered annually to low-income households without requiring an application, and can be used to pay energy bills or finance home energy renovation. The vouchers are accepted by all energy suppliers and integrated into a broader social tariff system. An Australian scheme could combine these approaches and deliver immediate financial support while maintaining equity through means testing.

4.2 Limitations and future research

One limitation of our analysis is that we likely only address part of a broader Indigenous energy poverty gap. The HILDA and ECA data only have modest samples of Indigenous households and remote Indigenous communities are largely not included. It is likely that additional approaches are required to fully address Indigenous energy poverty gaps. We also only assess energy poverty gaps as opposed to addressing the broader Indigenous gaps which include other socio-economic aspects beyond energy.

Another limitation is our use of cross-sectional data rather than a panel. However, the advantages of panel data can be exaggerated (Spector, 2019). Also, our research question focuses on policy approaches to explain and reduce persistence gaps. Key explanatory and dependent variables exhibit either no variation or little variation, making a panel less relevant. ECA data is also not

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[2] https://www.interregeurope.eu/good-practices/the-energy-voucher-an-automatic-aid-for-vulnerable-households

available in a panel, and the key HILDA variables related to wealth are only available every four years. We do not intend to quantify precise causal effects, such as a causal effect from being Indigenous on experiencing energy poverty, because it should be possible for the existing gaps to be removed with carefully designed policies.

Future research can consider applying our approach to other gaps in a range of contexts. For example, similar analysis could be done for other parts of the broader Indigenous gaps. This could include health or financial outcomes. Similar analysis could also be completed for gaps between ethnicities in many other countries. We note that analysis of other components of Indigenous gaps might need to be different, especially where there are substantial differences between urban and remote communities.

5. Conclusion

This paper has shown that energy poverty constitutes a significant and persistent dimension of socioeconomic inequality between Indigenous and non-Indigenous Australians. By analysing two decades of national survey data, we provide new evidence that financial security, wealth, and past experiences of hardship account for most of the observed disparities. Importantly, the results demonstrate that Indigenous disadvantage in energy outcomes is not intrinsic, but is rooted in structural factors such as limited assets, vulnerability to disconnection, and restricted access to emergency funds.

Recognising energy poverty as a barrier to health, well-being, and economic participation demonstrates its relevance to national equity agendas. Policies designed to reduce energy hardship must therefore go beyond universal bill relief and instead target structural drivers through measures that build financial resilience, expand asset-based support, and strengthen protections against disconnection.

Integrating energy poverty into Closing the Gap targets, and aligning this effort with global commitments under the United Nations' 2030 Agenda, would represent an important step in ensuring that Indigenous Australians are not left behind in the transition to affordable and sustainable energy. Our findings provide a foundation for such reforms and highlight the need for further Indigenous-led research and policy innovation to embed energy justice within broader strategies for equity.

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