Energy Poverty

Paul Ward

paul.ward@tueor.net

+353 85 241 5085

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# Abbreviations, Acronyms, Initialisms, or Terms

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| **Abbreviation, Acronym, Initialism, or Term** | **Definition** |
| NSW | New South Wales |
| CPI | Consumer Price Index |
| LIH | low-income households |
| HIH | High-income households |
| AER | Australian Energy Regulator |
| ABS | Australian Bureau of Statistics |
| EPI | Electrical Price Index |
| CPI | Consumer Price Index |
| NEM | National Energy Market |
| EP | Energy Poverty |
| #/100k | number per 100,000 |
|  |  |

# Abstract

Summarise the paper and finding (300 words MAX)

# Introduction

In 2017, the Australian Financial Review reported that Australian households pay the highest electricity prices in the world (Potter and Tillett 2017). While retail electricity prices in New South Wales (NSW) were reported as the fourth highest in the world. Furthermore, in the decade leading up to this report, annualised retail electricity prices increased at a faster rate than the Consumer Price Index (CPI) or wages growth: approximately 8% per annum, compared to CPI at 2.4% and wages growth at 3.1% (ABS 2023a; 2023b).



Figure 1: Retail Electrical Price Index versus Consumer Price Index and Wage Index: NSW 2010 – 2023

*Data source:* (ABS 2023a; 2023b)

In this context of rapid electricity price increases, this paper seeks to quantify the relationship between electricity prices and households experiencing energy poverty (EP) in New South Wales (NSW). Firstly, energy poverty in Australia and its impacts will be assessed by reviewing the current literature. This is followed by discussion of the data acquisition strategy and the model used for this paper’s analysis. Then an analysis of the results and their broader implications.

# Energy Poverty

## Background

Energy poverty differs from normalised definitions of poverty. Structural differences ensure that low-income households (LIH) pay more for the same energy outcomes as higher-income households (HIH). Boardman (1991) discussed how low-income housing stock was less energy efficient, which meant LIH had to buy more energy for heating. Nelson et al. (2019). noted that LIH in NSW consume 58% more energy on average than the rest of the population (Nelson et al. 2019, 267), which confirms Boardman’s original thesis regarding the structural differences between EP and normalised definitions of poverty. Additionally, because LIH were considered a greater credit risk, they were more likely to be forced to use higher-cost plans (Nelson et al. 2019, 268) or pre-paid electricity plans, which preclude cost smoothing between high and lower expenditure periods (Boardman 2015, 274).

Differing definitions of EP exist. Boardman defined it as spending more than 10% of household expenditure on energy, while Chai et al. set the expenditure threshold at 7% (Boardman 1991, 32; 2015, 271; Chai, Ratnasiri, and Wagner 2021, 57). In comparison, Churchill and Smyth (2020, 1) defines it as “…the inability of households to remain connected to energy-related basic utilities…”. For the sake of this study, Churchill and Smyth’s definition will be adapted, and energy poverty will mean households experiencing financial stress related to energy expenditure.

## Price Elasticity and Demand

The problem with electricity is that it is not an easily substitutable good. For this reason, price elasticity, or a consumer's ability to reduce demand when prices increase, is very low. Chai, Ratnasiri, and Wagner (2021, 64–68) noted that price elasticity for LIH was approximately 0.647[[1]](#footnote-1). They also noted that HIH had a greater ability to reduce demand through more efficient appliances and housing, and the purchase of solar photovoltaic panels.

Chester (2013) noted that LIH had already reduced demand as much as possible and responded to price increases through other means. This included not using appliances like water heaters, refrigerators, or space heating, or forgoing other purchases like food and medication. Chester also noted that these decisions often lead to further costs, especially regarding health and mental well-being (Chester 2013, 67–101).

Because electricity is an essential service, and the inability of LIH to reduce demand further, increasing prices have a deleterious impact on household budgets and financial stress.

## Hardship Programs and Government Assistance

Because electricity is considered an essential service, all Australian energy retailers are mandated to maintain customer hardship policies. They aim to prevent disconnection by providing flexible payment options for households experiencing financial stress (AER 2014).

A study of households on hardship programs in 2019 found that: 14% of hardship program consumers are on plans that pay for both ongoing energy use and accrued debt, whereas 20% are on plans that only cover the cost of ongoing consumption, but do not pay off any debt. Further, over 60% of hardship program consumers are on plans that account for neither consumption nor accrued debt, meaning these households continue to increase energy-related debt (Nelson et al. 2019, 266–67).

Direct government support through rebates and transfer payments is another way to assist LIH experiencing EP. As the inclusion criteria in these programs are usually income-based, inclusion and exclusion error is a problem. Nelson (2019) noted that only ~25% of hardship program customers were eligible for government assistance. They concluded that income might not be the only factor determining EP (Nelson et al. 2019, 266). Other studies supported this, concluding a range of determinants for EP, such as ethnicity, household size and type, residential mode[[2]](#footnote-2), and other factors (Churchill and Smyth 2020; Chester 2013; Chester and Elliot 2019; Best and Burke 2019; Best et al. 2021; Nance 2017). Another study by Simshauser (2023) found exclusion error for government assistance for Queensland households experiencing EP was ~5.4% (Simshauser 2023, 10).

Hardship programs and government assistance alleviate the impacts of EP. However, rapidly rising electricity prices result in a larger cohort of households experiencing EP, especially in households excluded from current policy settings.

# Method

This paper uses data from The Australian Energy Regulator (AER) and the Australian Bureau of Statistics (ABS) to measure the impact of electricity price rises on NSW households experiencing energy-related financial stress. After the data was extracted, a log-log regression model was used to understand and predict the impact of electricity price rises.

## Data

Data was extracted from two sources for this study. The AER releases a quarterly market performance report, including Hardship Program metrics. While the ABS releases quarterly price data, including an electrical price index (EPI) and a consumer price index (CPI) (ABS 2023b; AER 2023a).

The AER started reporting Hardship Program metrics in the second quarter of 2015. The data covers all states[[3]](#footnote-3) in the National Energy Market (NEM) and reports numerically and as a percentage of total households. The Hardship Program data was chosen as the dependent variable for EP because it indicates households experiencing energy-related financial stress; also, it is consistent longitudinal data reported in the same time increments as the CPI and EPI data. The NSW percentage data was used to create a number per 100,000 (#/100k) NSW households in Hardship Programs.

The ABS price index data is also reported quarterly, as an index and as a percentage change to the previous quarter. Because the indexes for electrical and consumer prices have different starting years[[4]](#footnote-4), it was decided to use the percentage change from the previous quarter to devise index data with a common starting point. This obviated any potential issues with scale and using natural logs. The CPI was included in the model, as there is a high probability that CPI is also statistically significant in measuring poverty.

Another issue with the data was population size. The ABS data for NSW covers only the Sydney metropolitan region, whereas the AER data covers all of NSW. However, the ABS National and Sydney CPI and EPI are highly correlated:

Therefore, this study will assume that the Sydney indexes sufficiently correlate with the rest of NSW for measuring the relationship between electrical prices and energy poverty.

A COVID-19 binary variable explanatory variable was also included in the model. Where 1 is the period covering the Federal Government's special financial measures during the COVID-19 pandemic.

## Model

A log-log linear model was used to determine the relationship between electrical prices and energy-related household financial stress in percentage terms. The dependent variable[[5]](#footnote-5) was lagged by one quarter. This accounts for a delay between using the electricity, receiving the bill, and requesting assistance through retailer Hardship Programs.

Where:

h is the #/100k NSW households in Hardship Programs

n is the NSW consumer price index

e is the NSW electrical price index

c is the COVID-19 binary variable

The model used a Newey-West estimator to account for autocorrelation within the data.

The R code and data table used for the study are in Appendix One.

# Analysis and Discussion

The results indicated that all explanatory variables were statistically significant.

## Results

Figure 2: Regression Summary

*Time series regression: Start = 2015(4), End = 2023(2)*

*Call: dynlm(formula = log(h) ~ log(n) + log(e) + c, data = df.ts)*

*Residuals:*

*Min 1Q Median 3Q Max*

*-0.11840 -0.04420 0.00570 0.03500 0.14263*

*Coefficients: Estimate Std.Error t value Pr(>|t|)*

*(Intercept) -5.73731 1.22318 -4.69049 7.61E-05 \*\*\**

*log(n) 1.64922 0.28181 5.85222 3.61E-06 \*\*\**

*log(e) 0.84143 0.14545 5.78514 4.29E-06 \*\*\**

*c -0.09114 0.03204 -2.84461 0.00855 \*\**

*Signif. codes: \*\*\* 0.001 \*\* 0.01 \* 0.05 . 0.1*

*Residual standard error: 0.05909 on 26 degrees of freedom*

*Multiple R-squared: 0.83271*

*Adjusted R-squared: 0.81341*

*F-statistic: 43.13936 o 3 and 26 degrees of freedom*

*p-value: 3.091059E-10*

The results indicate a strong relationship between CPI and EPI and EP and a weaker negative relationship between the Government’s COVID-19 financial measure and EP. The adjusted indicates a high Coefficient of Determination of 81.3%.

The regression estimates that in NSW, for every 1% increase in EPI, there is a 0.64% increase in EP. Additionally, for every 1% increase in CPI, there is a 2.26% increase in EP.

While the relationship between EPI and EP is smaller than between CPI and EP, electricity price increases are more significant than CPI. Therefore the accumulated impact is greater (ABS 2023b; AER 2023b; The Treasury of Australia 2023, 66–67).

## Prediction

The AER determined that NSW electricity price increases would be between 19.6 and 24.9% for the 2023-24 financial year (AER 2023b, 5). However, on 11 June 2023, Origin Energy and AGL announced price increases for NSW of 21.1% and 29.7%, respectively, starting in July 2023 (ABC News 2023).

The prediction numbers were drawn from The Treasury annual inflation forecasts divided by four[[6]](#footnote-6), and the mean of the two announced NSW price rises:

CPI increase = 0.81%

EPI increase = 25.4%

(The Treasury of Australia 2023, 66; AER 2023b, 5; ABC News 2023)

The prediction was calculated with a 95% confidence interval. Because the model is a log-log regression, the prediction’s exponential provided a predicted number of NSW households experiencing energy-related financial stress under the abovementioned conditions.

The prediction showed that with a quarterly 0.81% CPI increase and a 25.4% EPI increase, the #/100K households experiencing EP would be: 2365, 95% CI[1980, 2825]. This represents a significant increase from the last reported[[7]](#footnote-7) data of 1271 households per 100,000.

## Discussion

# Recommendations

Debt relief

% of bill alleviation

Maintain energy bill at % of income.

# Conclusion

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# Appendix One: R Code and Data Table

1. This translates to a 0.647% fall in demand for every 1% increase in price. [↑](#footnote-ref-1)
2. Home-owner, private renter, or government housing [↑](#footnote-ref-2)
3. Australian Capital Territory, New South Wales, Queensland, Sourth Australia, and Tasmania [↑](#footnote-ref-3)
4. CPI started in 1949: Quarter 3, and the EPI started in 1980: Quarter 4 [↑](#footnote-ref-4)
5. #/100k NSW households in Hardship Programs [↑](#footnote-ref-5)
6. To produce a quarterly CPI prediction [↑](#footnote-ref-6)
7. Quarter 4 2022 [↑](#footnote-ref-7)