Quantifying the LFC counterfactual

6 August 2020

Study objectives

1) Evaluate the likely outcomes from two possible futures:

- Continuation with the low-fixed charge (LFC) regime
- Removal of the regime

Outcomes evaluated against three metrics:

Metric	Effect
Economic	Impact on technology uptake in the two futures (EVs, rooftop solar, gas heating, electricity conservation) and consequent cost of supplying energy services
Environmental	Impact on emissions from altered technology uptake
Social	Increases/decreases in electricity bills for consumers with different deprivation levels and demographics (children, elderly, etc.) (Note: Doesn't take account of change in other energy service costs)

2) Consider extent to which alternative network pricing approaches may alter outcomes from LFC continuation / removal

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Economic & environmental outcomes if LFC were to continue

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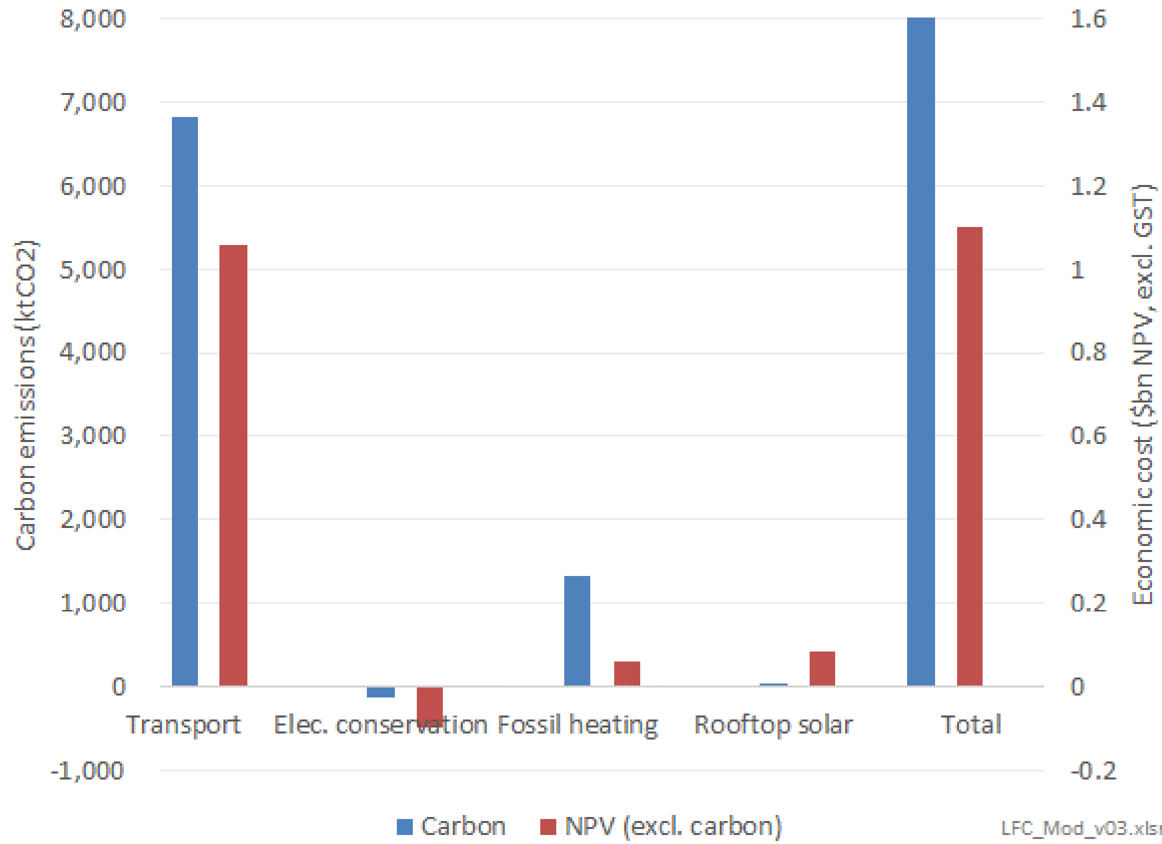
The flip-side of having a low-fixed charge, is a much higher variable charge.

This alters the costs to consumers of using electricity → altered consumer technology choices. Particularly: EVs, home heating, rooftop solar, and electricity conservation.

Modelling effect of altered technology choices indicates significant poor outcomes:

Economic: Cost* of approx. \$1 to 1.5bn over 30 years

Environmental: Approx. 8 $MtCO_2$ higher emissions out to 2050



* Economic cost excludes cost of NZ's international liabilities for carbon emissions

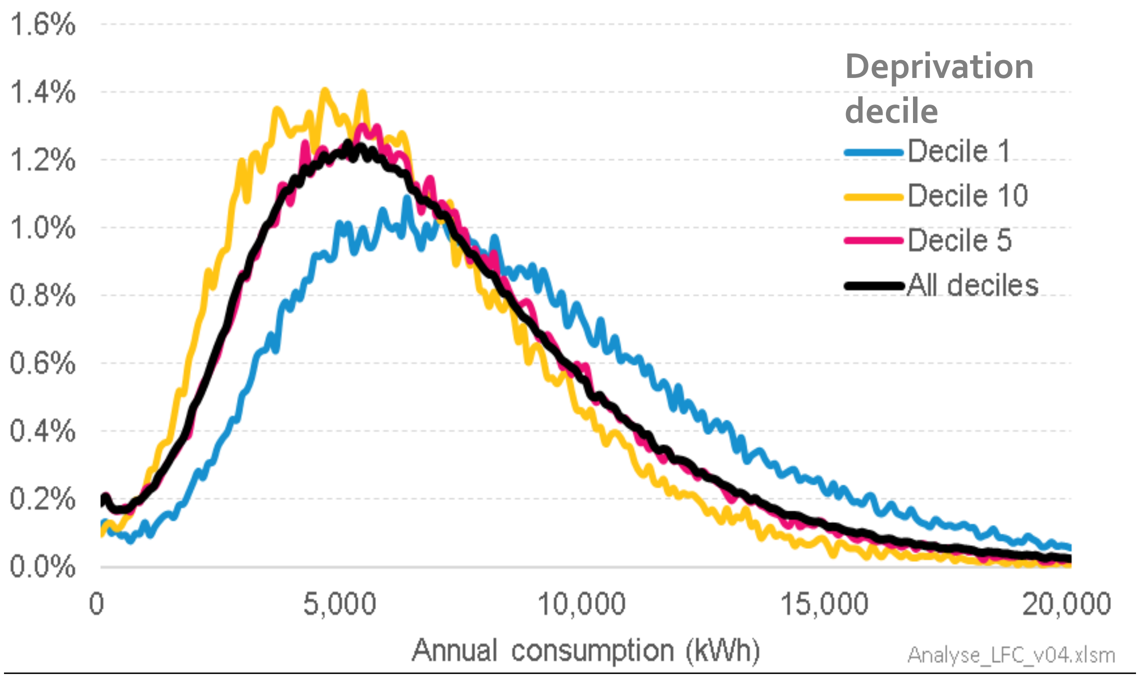
What about the social consequences of continuing with the LFC?

Principal social outcome arises from lower bills for low-consumption users, offset by higher bills for high-consumption users

This wealth transfer will deliver 'good' social outcomes if deprived consumers are low-users

Unfortunately,

- while deprived consumers generally consume less than wealthy consumers …
- …there are many high-consumption deprived consumers.
- (And low-consumption wealthy consumers)



Social outcomes if LFC were to continue

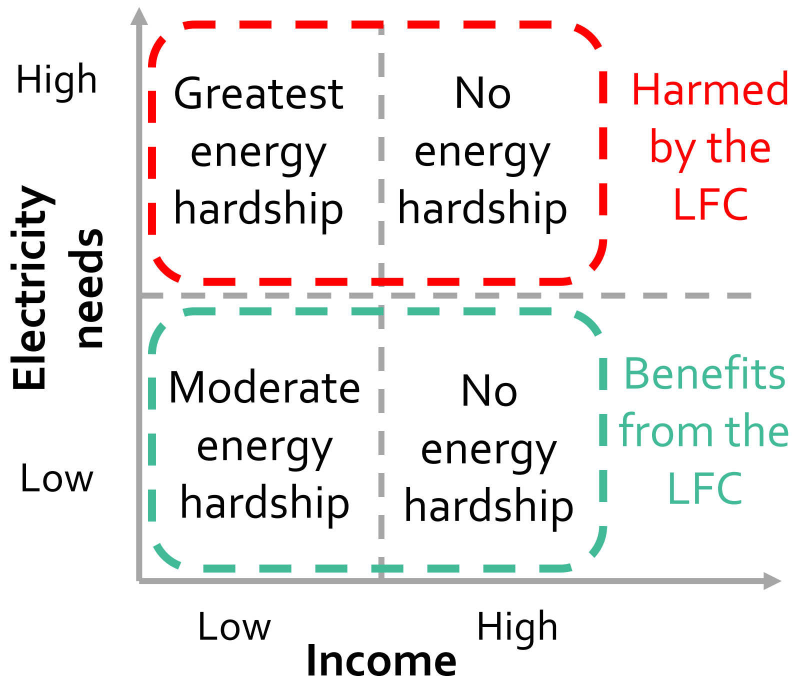
A continuation of many poor outcomes:

- Those in *greatest* energy hardship would continue to face higher electricity bills (approx. $200/annum for bottom quintile). Poor families with children over-represented.
- Incentive to under-heat homes to avoid high variable charge
- Cost-shifting from those who can afford solar, gas, and energy conservation measures onto those who can't

But, a continuation of some good outcomes:

- Some consumers facing deprivation – albeit those facing lesser energy hardship – would continue to enjoy lower electricity bills (approx. $400/annum for top quintile). Elderly more likely to be in this category.

The LFC gives support in inverse proportion to need



In many cases the LFC transfers money from poor to wealthy

The LFC is not fit-for-purpose as an energy-focussed social assistance mechanism

2017 study* identified key characteristics of an energy-focussed social assistance mechanism. The LFC fails against all criteria.

Policy requirement	LFC performance	
Support proportional to need	Fail	LFC gives support in inverse proportion to need – including harming those in greatest energy hardship.
Targeted at those in need	Fail	No targeting based on key metrics such as a household's income or energy circumstance (i.e. house & heating type). Many wealthy households are cross-subsidised by poor households.
Funded in a least-distortionary manner	Fail	Wealth transfers purely between residential consumers within individual network regions exacerbates outcomes.

* "*Options for assisting customers in energy hardship*", Concept Consulting, November 2017.
Available here: www.concept.co.nz/updates

Will moving to peak-cost-reflective pricing affect these conclusions?

Modelling indicates a move to peak-cost-reflective tariffs won't materially alter the bill-change outcomes from LFC removal as between high and low consumption groups

However, there will be 'longer tails'. i.e. a small groups of consumers who have unusual absolute consumption and relative peakiness will experience more significant bill changes

- Coincident peak demand (CPD) charges will particularly give rise to such 'tail shocks' due to much greater variance in CPD/AvgDemand than PeakTOUDemand / AvgDemand across consumers

Analysis indicates no systematic variation in peakiness between deprived and wealthy consumers → no major wealth transfers from moving to peak-cost-reflective tariffs

- If anything, the data indicates deprived consumers are slightly less peaky, and will thus relatively benefit from the introduction of peak-cost-reflective tariffs, thereby dampening the effect of LFC removal

What about the possible introduction of 'fixed-like' charges?

For the LFC continues scenario, Concept was asked to consider the impact of networks potentially introducing $/kW demand charges, or $/kVA capacity charges, as a means of recovering costs that they would otherwise recover from fixed charges if they weren't constrained by the LFC mechanism.

The rationale for such possible approaches is

- these charges would be LFC-compliant; but
- their properties are more similar to fixed charges than $/kWh variable charges.

Modelling was undertaken to evaluate potential effect on consumer bills

Evaluation of 'fixed-like' charging approaches

Similar distortive effects on technology choices (particularly for demand charges, but also to a significant extent from capacity charges) → similar economic and environmental impacts

None of the approaches materially address the over-charging to high-use consumers. As such, they will not address the harm caused to those consumers facing greatest energy hardship.

- Indeed, CPD and (to a lesser extent) Capacity approaches make this worse!

Capacity and demand charges are relatively complex to administer, and harder for customers to understand.

- This will tend to result in higher costs-to-serve and have a negative effect on retail competition, both of which will tend to increase consumer bills

CPD charges will also give rise to more volatile year-on-year bills

Capacity charges if they require installation of a fuse would be very expensive

None of these approaches would be appropriate for addressing the over-variablisation of retail cost recovery, and thus the effects from this aspect of the LFC would continue.

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The Low-Fixed Charge policy is better described as a High-Variable Charge policy!

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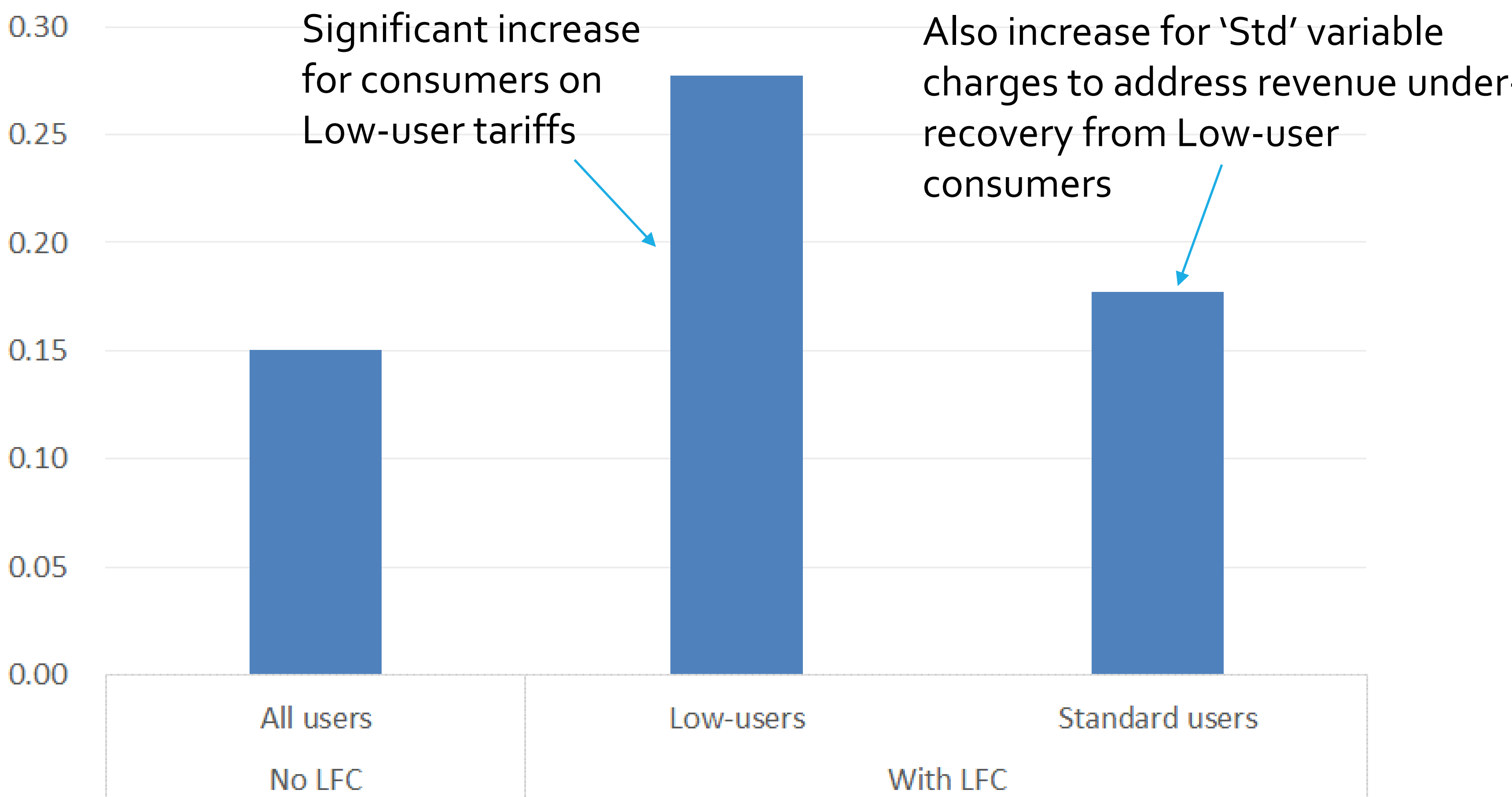
Estimated average $/kWh variable residential prices (incl. GST)



Higher variable charges will affect uptake of electricity technologies

Uptake of four main technologies was modelled in with / without LFC futures

Technology	Metric	2030 value		Notes
		No LFC	With LFC	
EVs	EVs per household	0.21	0.19	Used total cost of ownership uptake model
Rooftop solar	Households with solar	3.7%	4.9%	No LFC assumes continuation of current rate of uptake. With LFC assumes this rate grows to double by 2030.
Gas / LPG heating	Prop'n of households	22.7%	23.8%	With LFC assumes same proportion as today.
Electricity conservation	Red'n in demand	2.5%	3.1%	Excludes effect of above technologies

Calculated economic cost and emissions associated with altered technology outcomes.

Environmental and economic* impacts of continuing with the LFC (measured to 2050)

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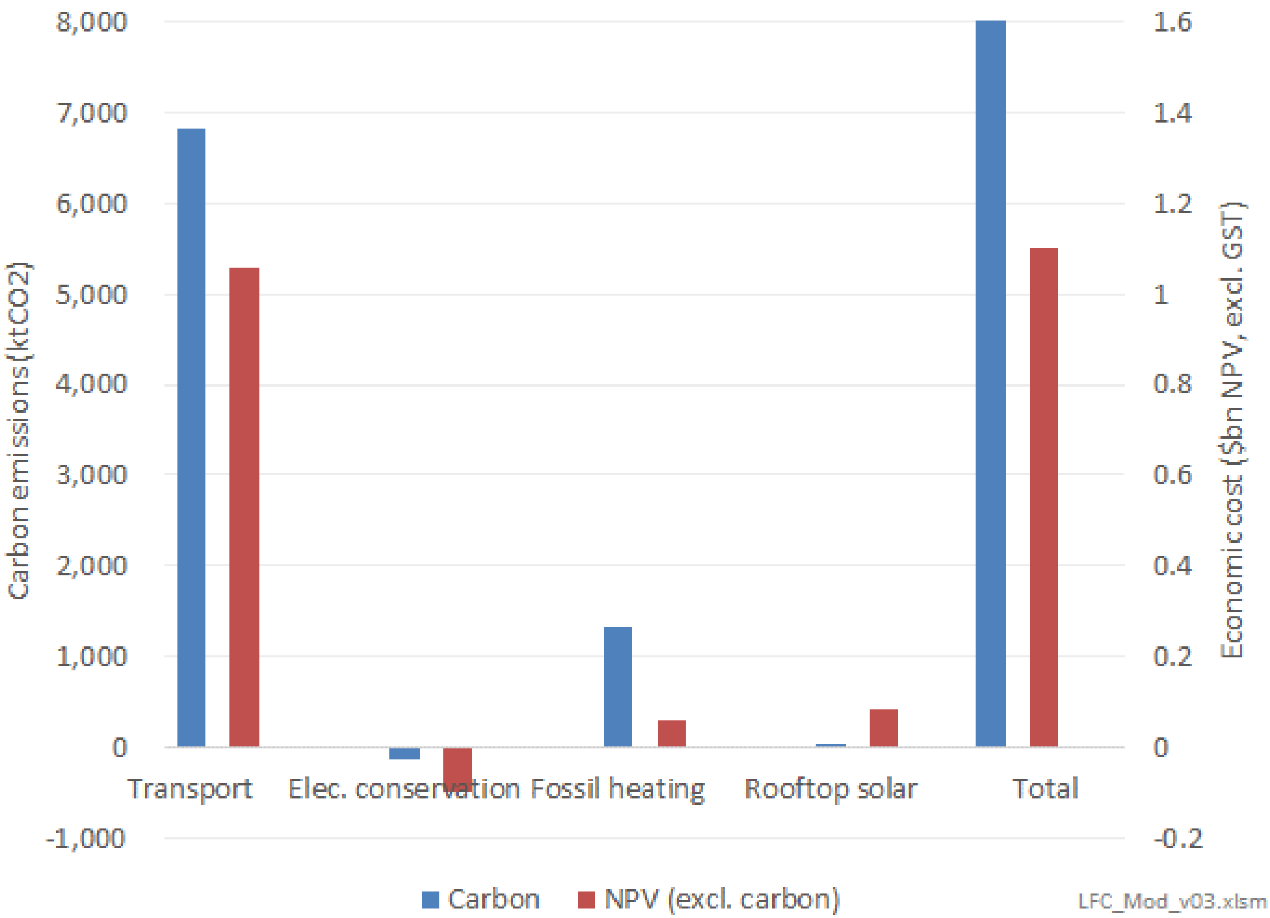

* Economic cost excludes cost of NZ’s international liabilities for carbon emissions

Note: Rooftop solar results in small increase in emissions because, although it displaces fossil generation in the early years of projection, in later years it is displacing utility-scale renewable generation that would otherwise be built to meet demand growth. Because rooftop solar has a much more extreme summer/winter demand profile, it gives rise to a greater requirement for fossil generation to perform winter peaking than would occur with this utility-scale renewable generation.

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Modelling steps

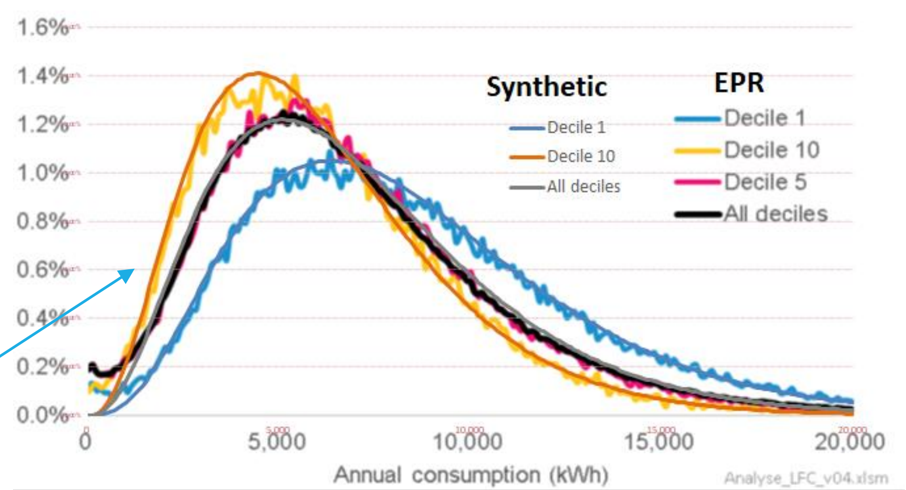
1) Model what tariffs would be in 10 years' time in a with/without LFC future

- Start with today's wholesale, network and retail costs
- Model effect of technology uptake on level and shape of average residential demand, and impact on supply costs and prices
- Incorporate moves to more peak-cost-reflective pricing – modelled through developing 2-rate Peak/Off-peak TOU structures

2) Model change in consumers' bills from today

- Look at effect on 'deprived' and 'wealthy' consumers due to:
  - Variations in today's levels of consumption
  - Variations in uptake of technologies over 10 years, and consequent impact on levels and shape of consumption

Synthetic distributions of today's consumption were developed based on published EPR distributions (as shown here), then factored to account for tighter distributions within a network area relative to published EPR's whole-of-NZ distribution



Modelled change in consumer bills

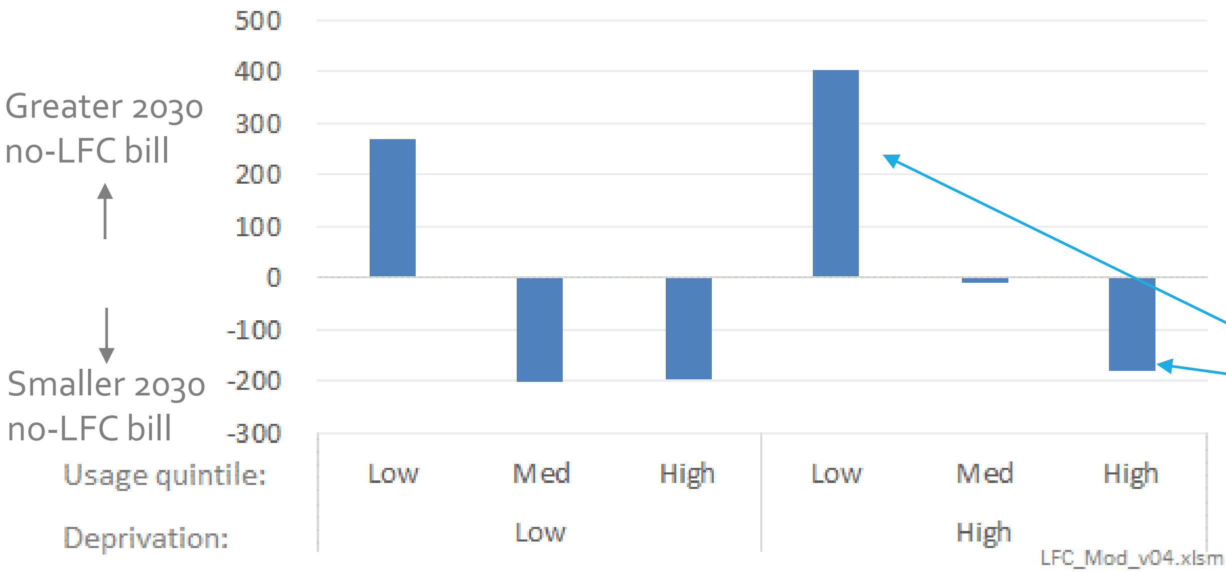
Average effect of removing LFC on electricity bills alone is relatively minor

- Average across all consumers: $22/yr increase
- Least-deprived decile: $53/yr decrease
- Most-deprived decile: $70/yr increase

Average electricity bill increase largely due to increased EV-related consumption. (More than offset by lower transport costs)

However, significant variation within deciles

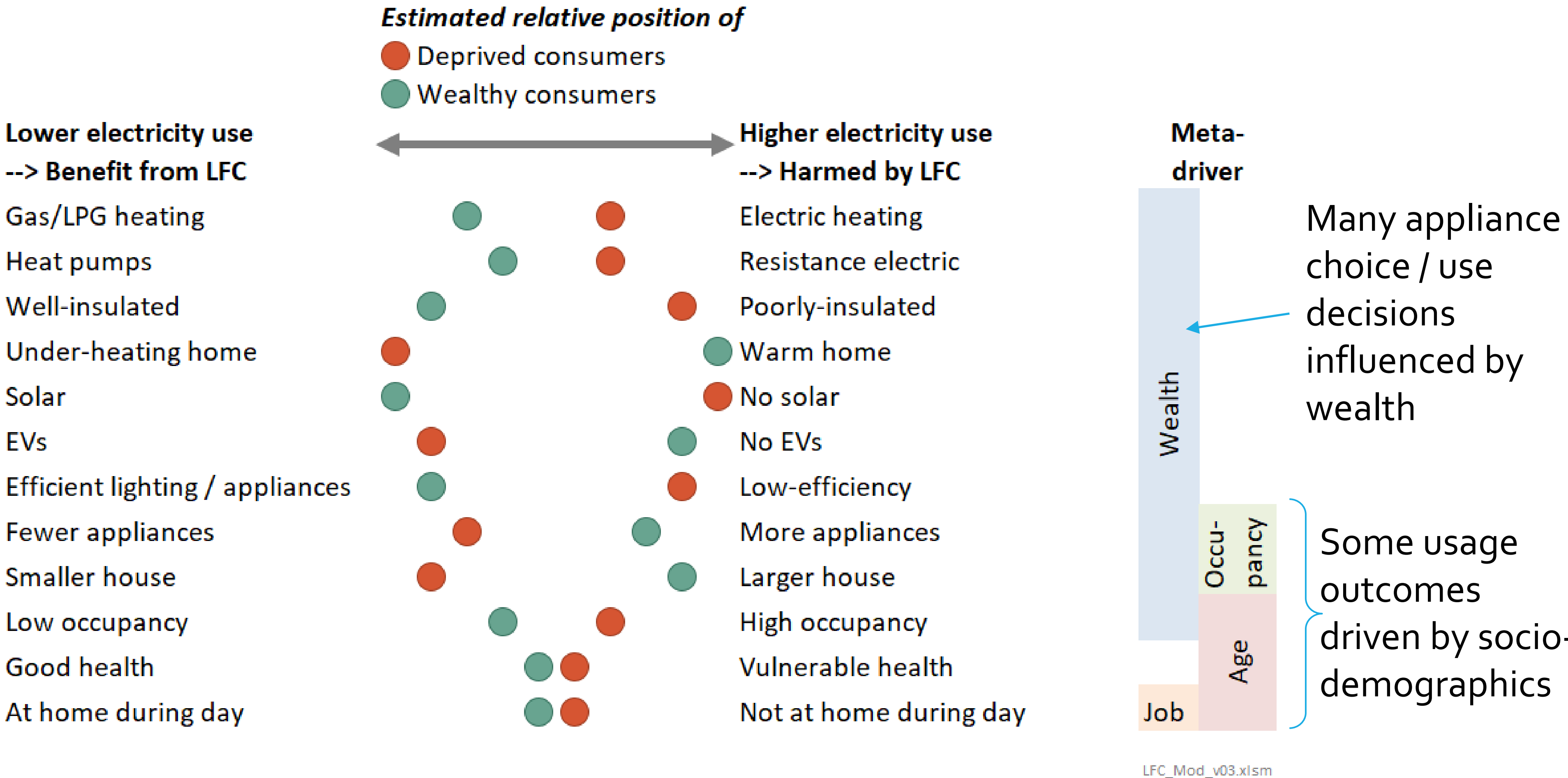
Difference between 2030 no-LFC bill and 2020 with-LFC bill



Low-usage consumers will face bill increases, and vice-versa for high-usage consumers

Who are these consumers?

What drives a deprived or wealthy consumer to have high or low electricity consumption?



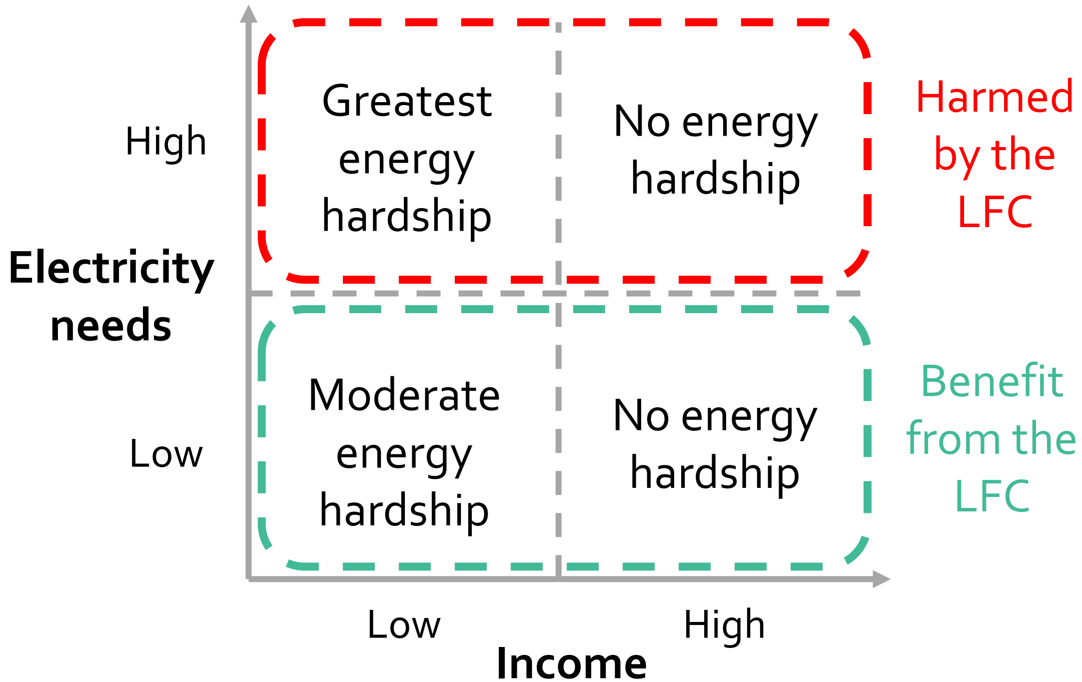
Many counter-balancing factors. While there are general trends between deprivation deciles, there is also significant variation within deprivation deciles

Similar wide range of electricity consumption outcomes between deciles, albeit with most deprived consumers, <u>on average</u>, consuming less

The LFC harms those who need the most support

The seminal UK 'Hills report' identified those consumers with the combination of low incomes and high energy needs as facing the *greatest* energy hardship.

But the LFC *harms* these consumers



The LFC gives support in inverse proportion to need

- Those who need least electricity get most assistance
- Those who need most electricity are harmed

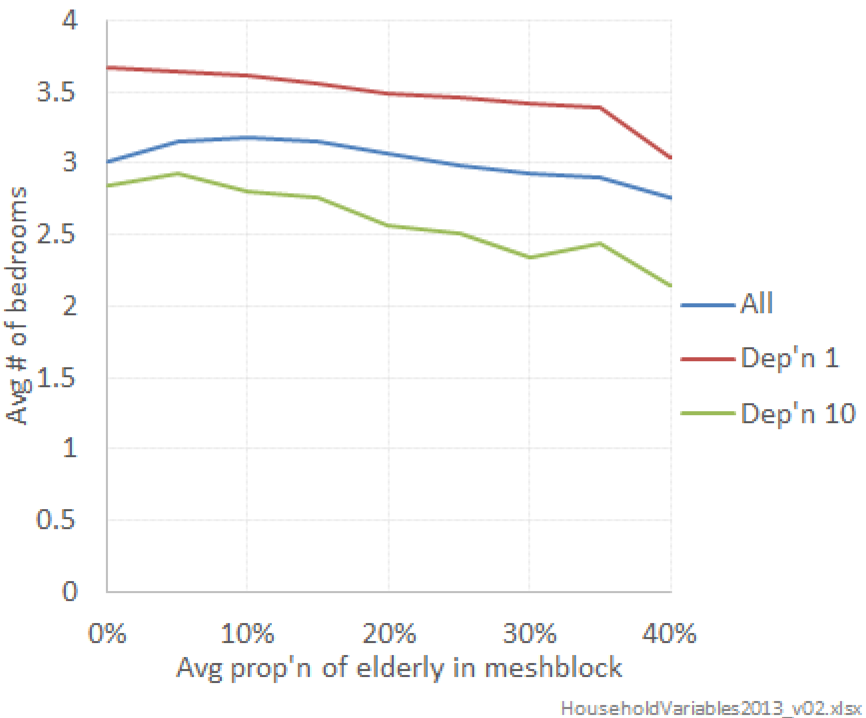
In many cases it transfers money from poor to wealthy

Might the LFC be exacerbating child poverty, even if it is generally helping the elderly?

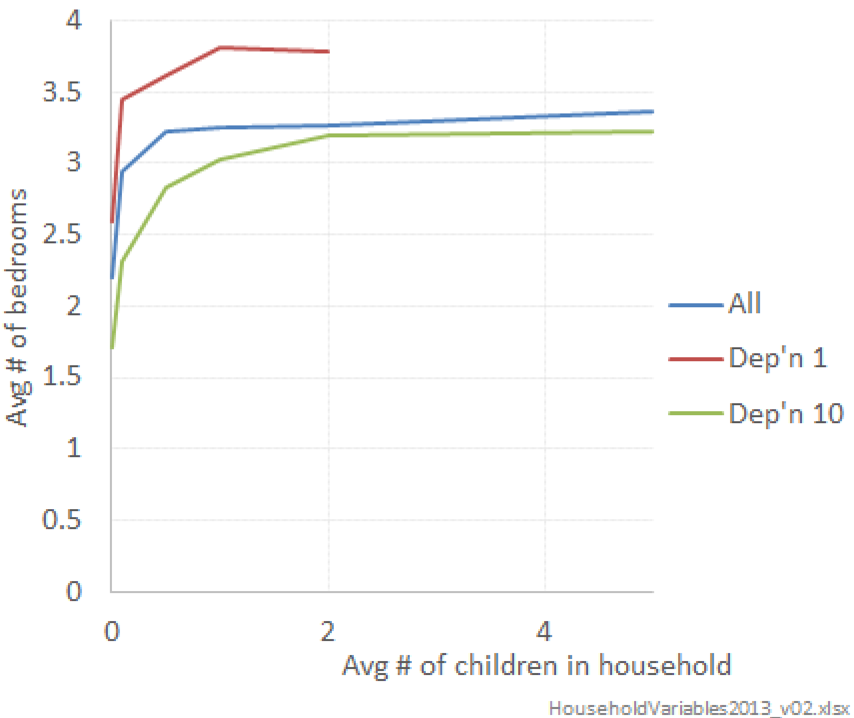
Larger houses give rise to greater energy needs → more likely to be harmed by LFC

Census data demonstrates the bleedin' obvious:

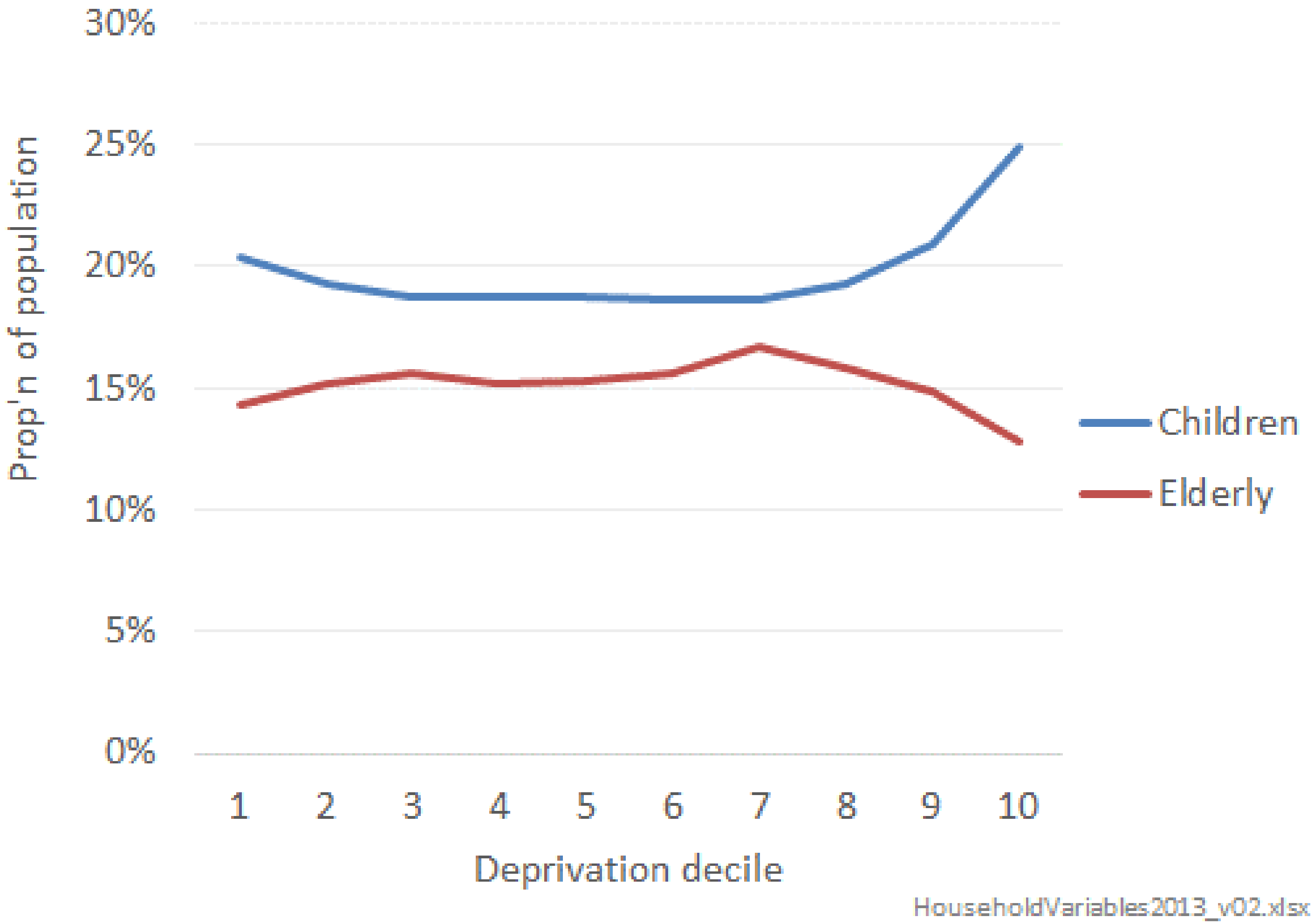
Elderly people tend to live in smaller houses



Households with children need larger houses



For the most deprived deciles, child welfare appears more pressing than elderly welfare



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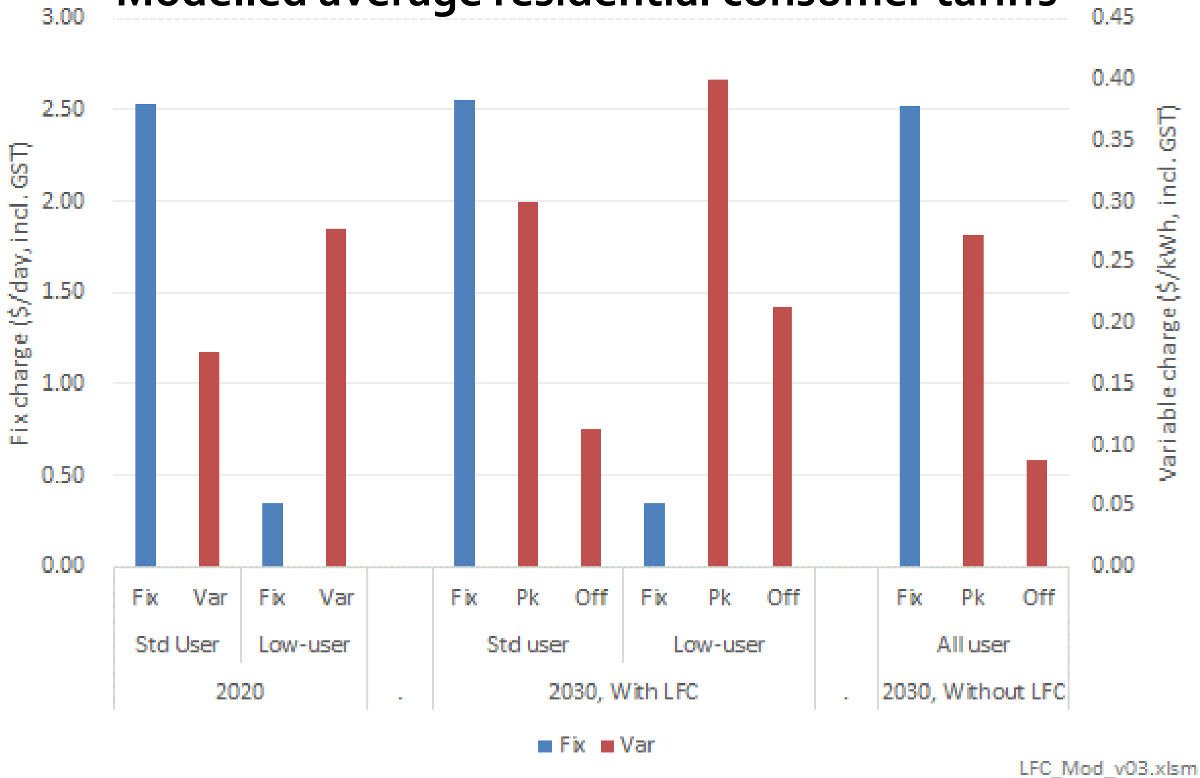
Moving to peak-cost-reflective pricing

The economic/environmental/social analysis in the main section assumed that network pricing would by 2030 have moved to more cost-reflective structures that better-signal peak supply costs. This was for both the with / without LFC futures.

A simple 2-rate Peak/Off-peak TOU structure was used to represent such a peak-cost-reflective pricing structure, with the rates shown below.

Modelled average residential consumer tariffs



Peak defined as 4 hrs in morning + 4 hrs in evening on weekdays

What if such peak-cost-reflective pricing doesn't occur?

It is possible that peak-cost-reflective pricing of the form modelled may not occur

- Networks may implement a different form of peak-cost-reflective pricing, such as coincident peak demand (CPD) pricing
- The politics of high peak prices may act as a constraint and cause networks not to implement such large Peak/Off-peak differentials, or not to implement peak-cost-reflective pricing at all.
  - This outcome is considered most-likely in a with-LFC future, as the LFC causes much higher peak pricing: 40 cents/kWh for Low-Users in the modelled example, and effectively higher still for CPD pricing or TOU with narrower definitions of peak (e.g. winter-only)

If such outcomes were to occur, would the modelled effects on consumers bills of removing the LFC be materially different – particularly as between consumers of different deprivation deciles or consumption levels?

To consider TOU pricing effects, consumer demand profiles were created

Some of the modelled bill changes by 2030 were due to the introduction of TOU charges.

To understand how much of the bill changes were due to removal of the LFC, and how much was due to introduction of TOU pricing, synthetic within-day and within-year demand profiles were constructed

- These synthetic profiles were developed using EECA Energy End Use Database data and BRANZ HEEP data to generate realistic profiles
- Profiles were created for different consumer types - particularly as between low and high use consumers, and between different deprivation deciles.

Tariffs modelled in two cost-reflectivity dimensions

		Recovery of non-demand-driven network & retail costs	
		Significantly via variable charges	Via fixed charges (fixed-cost-reflective)
Recovery of demand-driven costs	Flat per kWh variable charges	1. (Today)	2.
	TOU varying per kWh variable charges (peak-cost-reflective)	3. (Future with LFC)	4. (Future without LFC) – Fully cost-reflective

Using the synthetic demand profiles, and comparing bill changes for tariff scenarios 1→4 and 1→3, it is has been estimated that approximately 5% of the modelled bill increases for the low-consumption quintiles set out in the main analysis (tariff scenario 1→4) are due to the move to TOU pricing

Although TOU pricing won't materially change outcomes, there will be longer tails

While the average bill change outcome for a demand quintile may only marginally be increased beyond the LFC-removal-only effect, the introduction of a time dimension to charging increases the range of consumer demand outcomes beyond those due to variations in annual demand

As such, there will be longer 'tails' in the distribution of 2020→2030 bill change outcomes from the combination of removal of LFC <u>and</u> moving to more peak-cost-reflective tariffs

Further, the smaller the time period over which contribution to system peak is measured, the greater will be the variance in consumer outcomes, and thus the greater variance in bill changes from today's 2020 values.

- A TOU pricing approach with a relatively 'narrow' window of peak periods will have a greater variance in bill outcomes (and much higher peak prices) than a broader peak period definition.
- A coincident peak demand (CPD) pricing approach (which inherently has a much smaller number of peak periods than a TOU-based approach), will result in even greater variance and bigger 2020→2030 bill-change effects at the extremes

Possible variations between deprivation deciles due to moving to peak-cost-reflective tariffs

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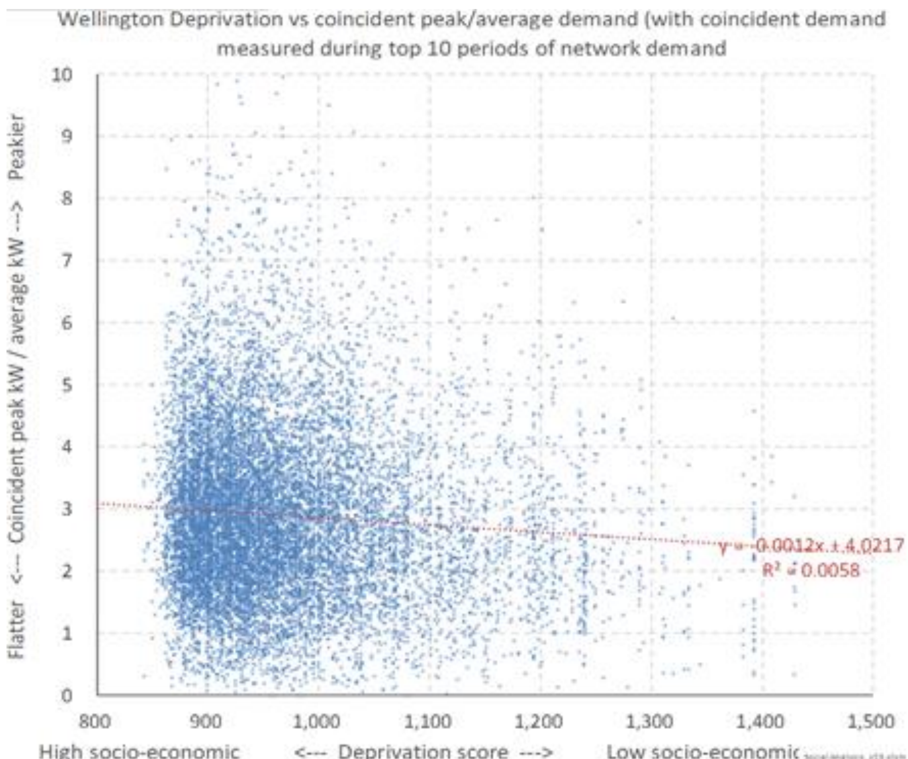
It is considered that moving to peak-cost-reflective pricing will not materially advantage or disadvantage different deprivation deciles, as there is no systematic variation in consumers' 'peakiness' between such deciles.

This conclusion is based on comparing the synthetic demand profiles, and also from the published analysis of actual half-hourly data for different deprivation deciles in our 2017 study* of the social effects of new technologies and tariffs.

- For example, this chart from that report illustrates there is no systemic difference in the relative peakiness of consumers in different deciles.
- Indeed, if anything, this data indicates that deprived consumers are slightly less peaky. As such, relatively fewer of them will experience an increase in bills, and relatively more will experience a decrease in bills, due to the introduction of peak-cost-reflective tariffs



* *"Electric cars, solar panels, and batteries in New Zealand Vol 3: The social impact"*, Concept Consulting, March 2017. Available here: http://www.concept.co.nz/publications.html

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- Social impacts from removal of the LFC
- Sensitivity of results to:
  - Possible different future network charging approaches
    - Variations in peak-cost-reflective pricing approaches
    - Introduction of 'fixed-like' charges if the LFC remains
  - Variations in network circumstance
- Conclusion

What about the possible introduction of 'fixed-like' charges?

Concept was asked to consider the impact of networks potentially introducing $/kW demand charges, or $/kVA capacity charges, as a means of recovering costs that they would otherwise recover from fixed charges if they weren't constrained by the LFC mechanism.

The rationale for such possible approaches is that their properties are more similar to fixed charges than $/kWh variable charges

Note: Such approaches wouldn't apply to recovery of retail costs, which would continue to require the same variablisation via $/kWh charges to meet LFC requirements.

How would these 'fixed-like' approaches work?

All residential consumers would have the same network charges (i.e. there would no-longer be low-user and standard variants)

Variable network costs would be recovered via a peak-cost-reflective tariff structure (e.g. TOU, or coincident peak demand)

All fixed charges would be set at the low-user 15 c/day value

The revenue that would otherwise be recovered from fixed charges would be recovered via capacity or demand charges.

- Capacity charges would require consumers to choose a certain connection capacity (e.g. 8 kVA or 15 kVA) with higher capacities facing higher $/kVA charges.
  - This could be put into effect physically through installing a fuse of an appropriate size at a property, or through use of advanced meter functionality which would throttle or disconnect a consumer if their demand rises above this capacity level.
- Demand charges are $/kW charges, with consumers charged based on a measured kW quantity. There are two main approaches to measuring this kW value
  - Anytime maximum demand (AMD) approaches measure the maximum demand of a consumer, irrespective of when this occurs during the year.
  - Coincident peak demand (CPD) charges measure a consumer's demand during periods of system peak.

What might be the effect of such approaches on technology uptake?

In terms of technology uptake effects (and consequent economic and environmental outcomes), there may be some improvement relative to the modelled effects of the LFC in the main section, but these could be relatively modest, and in some cases could make things worse.

This is because:

- Such approaches would not address the recovery of retail costs which account for almost half of the impact of variablising fixed costs.
- There are similar distortions for technology uptake as from increased $/kWh variable charges, because both capacity and demand charges result in higher bills for consumers who consume more.
  - This relationship is very strong for demand charges which are based on measured consumption, with CMD approaches particularly making things worse
  - It is also true for capacity charges which may have similar effects on technology choices.
    - For example, it is highly likely that in many cases, purchase of an electric vehicle, or switching from gas to electric heating, would require a household to move to a higher connection capacity

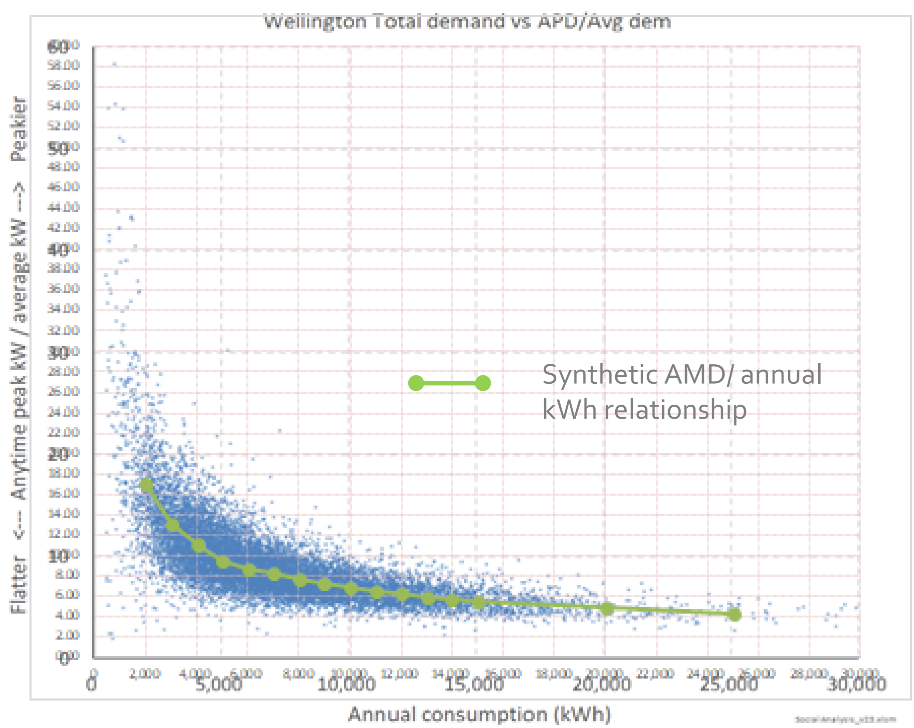
What might be the effect of such approaches on consumers' bills?

Proper consideration would require half-hourly data. However, synthetic distributions of consumer demands were developed, building on EPR-derived synthetic annual demand distributions and also using:

- The synthetic within-day & within-year profiles. These were used for consideration of CPD outcomes
- A synthetic curve of the average AMD / annual kWh relationship using published data from Concept 2017 study*. This was used for consideration of AMD approach.

Network tariffs were developed for the different approaches which ensured revenue neutrality.

For the capacity option, it assumed simple 8 or 15 kVA capacity choices, with customers > 8,000 kWh/yr choosing 15 kVA



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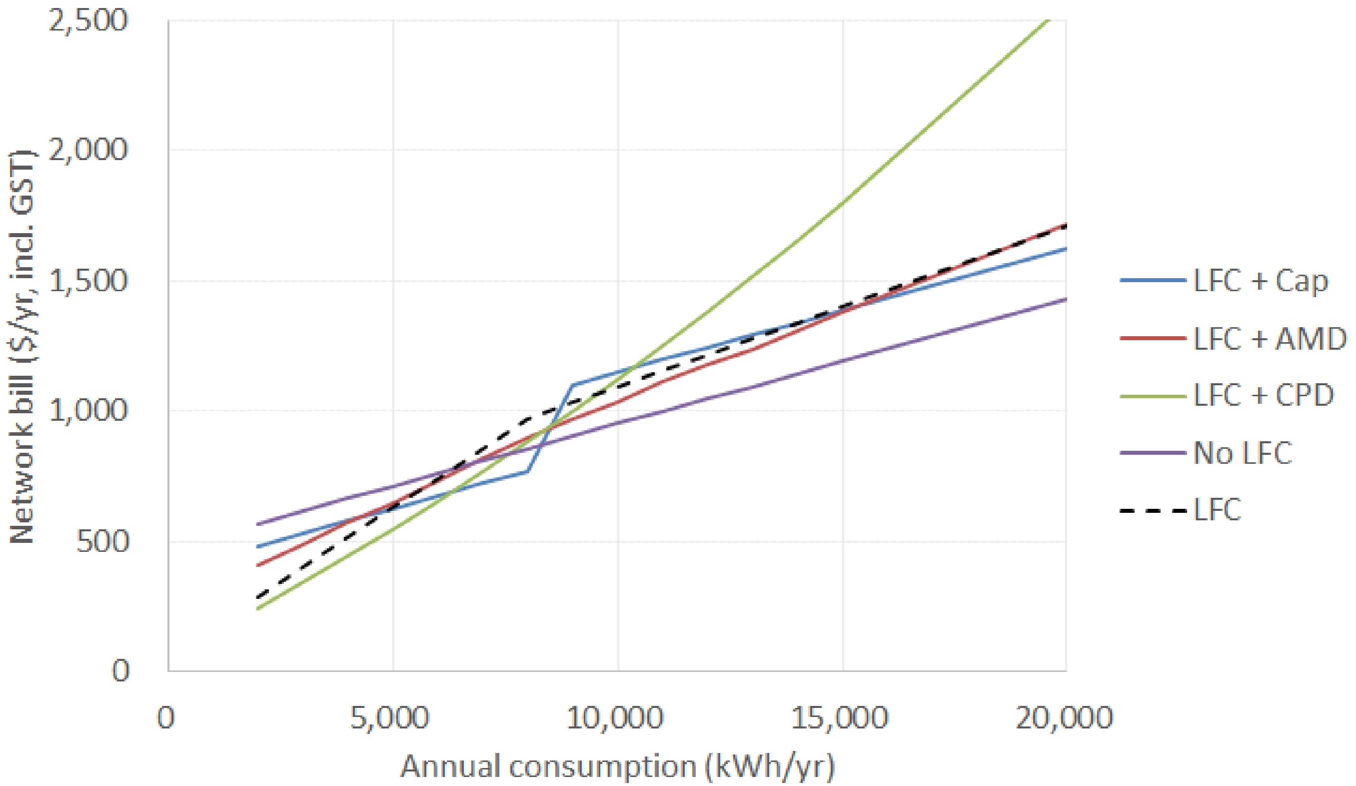
Modelled consumer network* bills from different network charging approaches

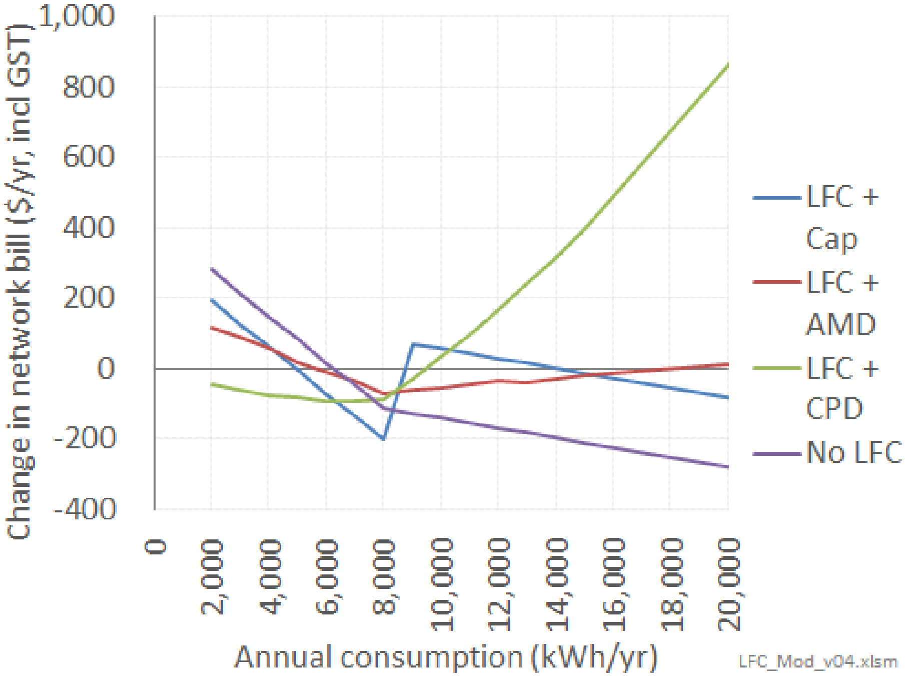


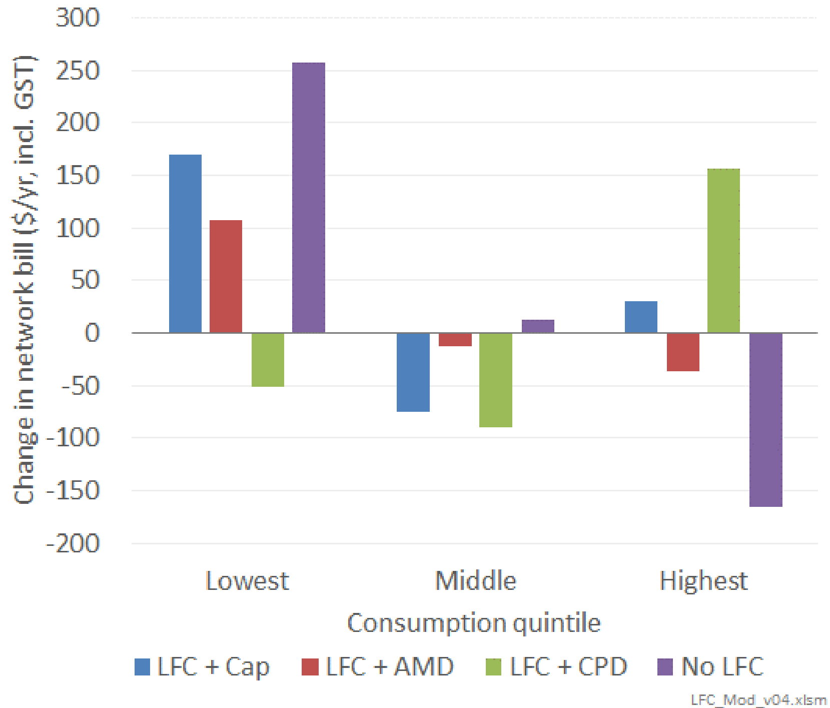
* Wholesale energy and retail costs not included

Note: These reflect average outcomes for a given level of consumer annual consumption. There would be wide variations around these averages for different consumer circumstance.

To understand the extent of such variations would require half-hourly consumer data

Change in average consumer network* bills from moving from LFC





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Evaluation of alternative charging approaches

None of the approaches materially address the over-charging to high-use consumers. As such, they will not address the harm caused to those consumers facing greatest energy hardship.

- Indeed, CPD and (to a lesser extent) Capacity approaches make this worse!

Capacity and demand charges are relatively complex to administer, and harder for customers to understand.

- This will tend to result in higher costs-to-serve and have a negative effect on retail competition, both of which will tend to increase consumer bills

CPD charges will also give rise to more volatile year-on-year bills

Capacity charges if they require installation of a fuse would be very expensive.

None of these approaches would be appropriate for addressing the over-variablisation of retail cost recovery, and thus the effects from this aspect of the LFC would continue.

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Will variations in network circumstance materially change LFC removal effects?

The analysis in this study has been based on an average network situation, using

- MBIE data on average residential network charges
- MBIE data on average residential demand
- Concept-derived data on the proportion of network costs to recover from fixed charges*

However, variations in all three elements will affect the extent of bill-change arising from removal of the LFC

To what extent might such variations materially affect the conclusions of this analysis based on average situations?

* Based on the ICP-weighted average of observed proportions of such costs for an average sized consumer in each network and assuming the standard fixed charge was cost-reflective.

Variations between networks unlikely to materially change results of this analysis

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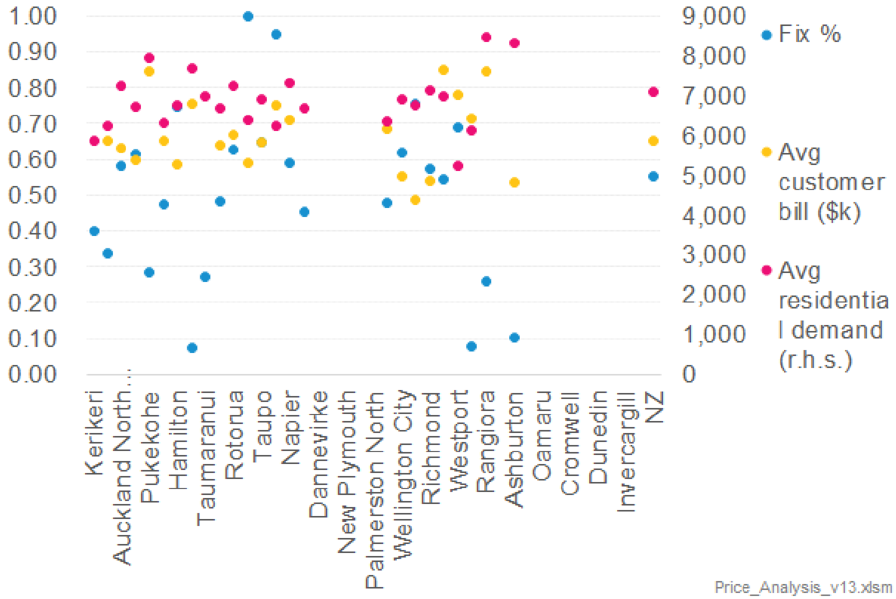
Variations in residential consumer outcomes



Graph commentary:

- Only network pricing outcomes shown (i.e. no wholesale energy or retail pricing outcomes)
- Outcomes for networks with less-usual pricing (GXP pricing or D/N or Sum/Win) not calculated for this exercise
- Observed variations in all factors reflect differences in network circumstance and (in the case of % of network costs recovered from fixed charges, and average residential bill) differences in pricing methodology.

Because there is no observed correlation between these different factors, their effect on LFC-removal outcomes will generally tend to cancel each other out. Further, the LFC effects due to retail cost variablisation are not so affected by these factors.

As such, the broad results for levels and distributions of consumer bill outcomes for demand quintiles are considered reasonably robust.

That said, there will likely be ‘tails’ of greater outcomes where network circumstances giving rise to high LFC-removal effects happen to combine. In particular, for those networks who have chosen to recover an unusually large or small proportion of costs for standard consumers via fixed charges.

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Outcomes if LFC were to continue

Economic: Cost* of approx. $1 to 1.5bn over 30 years due to poor technology uptake

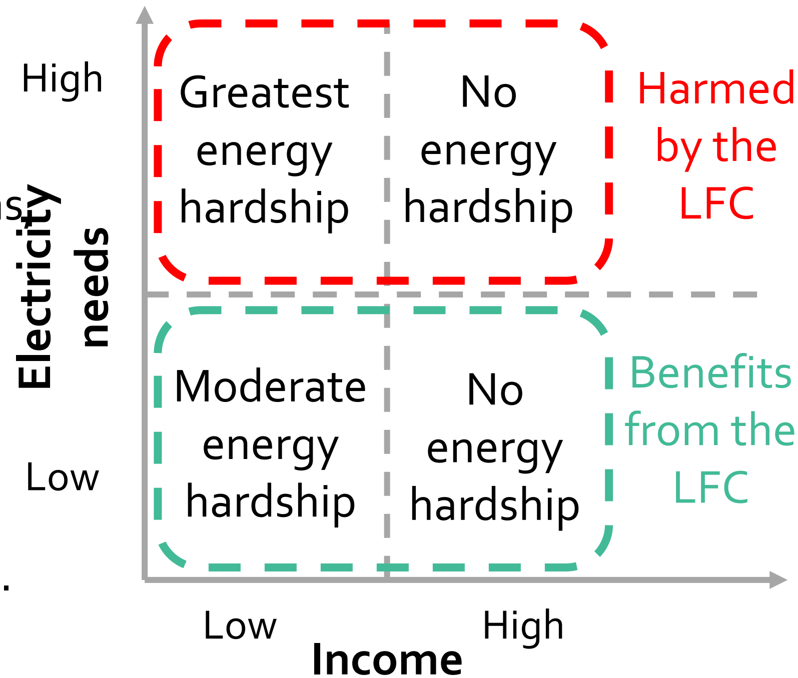
Environmental: Approx. 8 $MtCO_2$ higher emissions out to 2050

Particularly due to frustrated EV uptake and continuation of fossil home heating

Social: A continuation of many poor outcomes:

- Those in *greatest* energy hardship would continue to face higher electricity bills (approx. $200/annum for bottom quintile). Poor families with children over-represented.
- Incentive to under-heat homes to avoid high variable charge
- Cost-shifting from those who can afford solar, gas and energy conservation measures onto those who can't
- But, a continuation of some good outcomes:
  - Some consumers facing deprivation – albeit those facing lesser energy hardship – would continue to enjoy lower electricity bills (approx. $400/annum for top quintile). Elderly more likely to be in this category.

The LFC gives support in inverse proportion to need



* Economic cost excludes cost of NZ's international liabilities for carbon emissions

Although LFC does more harm than good, removing it will involve tricky trade-offs

Although those in greatest energy hardship are harmed by the LFC, there are slightly more deprived households who benefit from the LFC

- Is it better to continue harming the approx. 43% of deprived households suffering greater energy hardship in order to benefit the approx. 57% of deprived households suffering lesser energy hardship?

Further, elderly low-income households generally benefit more from the LFC than the 'average' low-income household.

However, the flip-side of this is that low-income households with children are harmed more from the LFC than the 'average' low-income household.

Is it appropriate to have a mechanism which exacerbates child poverty, even if it helps some other consumer segments?

Surely the appropriate LFC 'counterfactual' is removal and replacement with a fit-for-purpose energy social assistance mechanism?

The LFC is not fit-for-purpose as an energy-focussed social assistance mechanism

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2017 study* identified key characteristics of an energy-focussed social assistance mechanism. The LFC fails against all criteria.

Policy requirement	LFC performance	
Support proportional to need	Fail	LFC gives support in inverse proportion to need – including harming those in greatest energy hardship.
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