Dynamic Pricing and the Peak Load Problem

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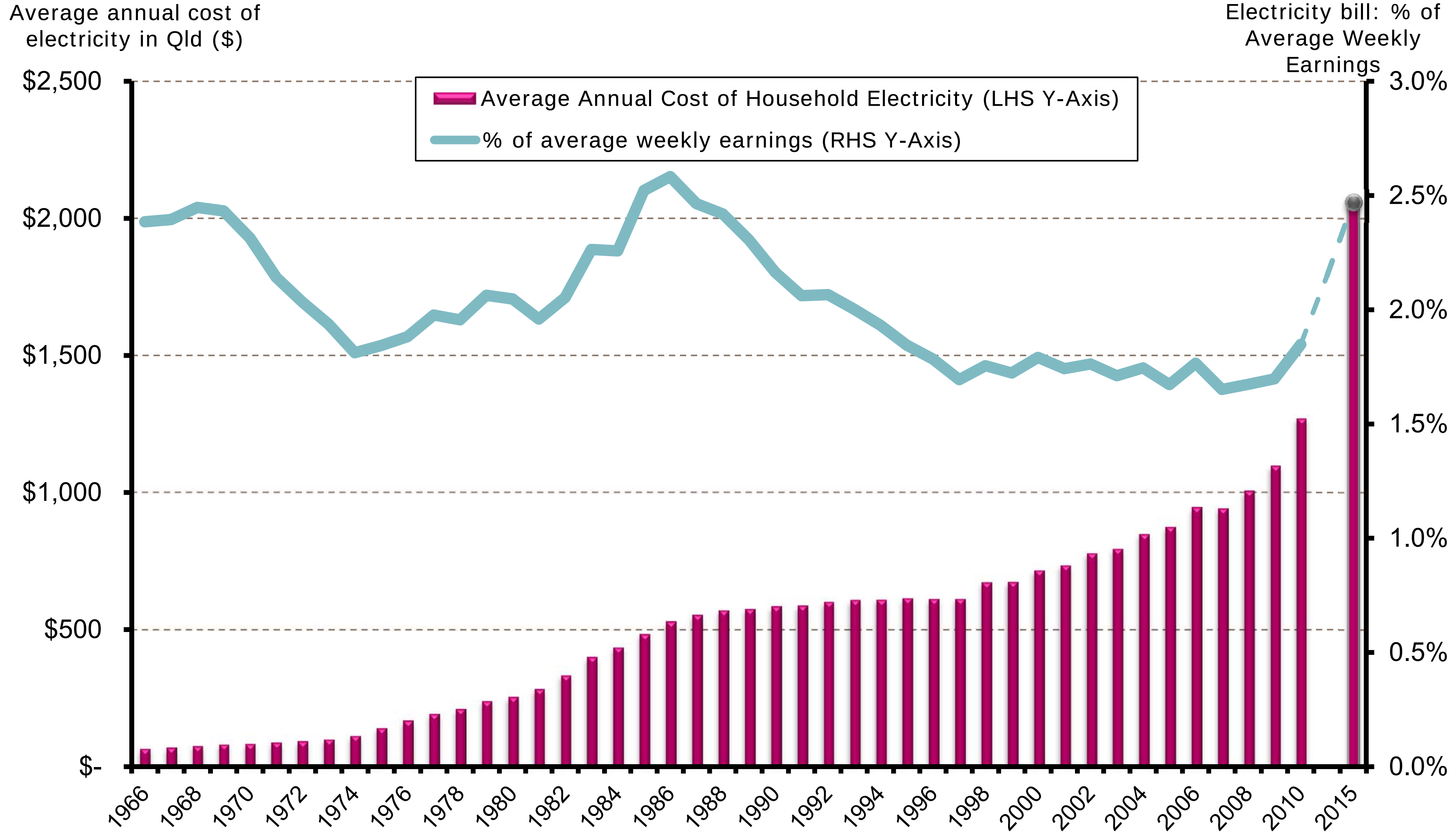
Sharply rising costs, more reform required…



The peak load problem has a long history

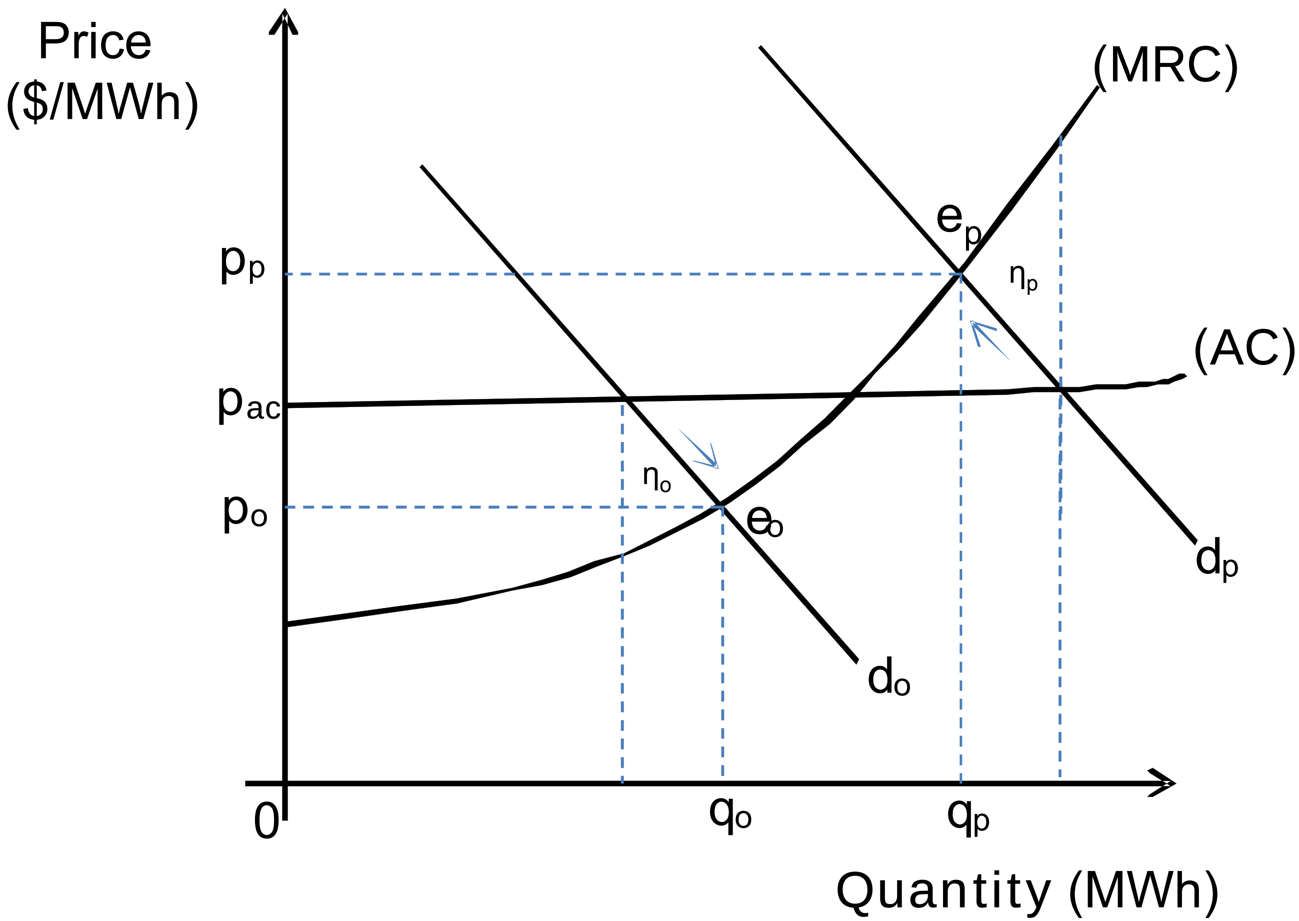
Almost simultaneously, EdF Chief Economist (Marcel Boiteux, 1949) and American economist (Hendrik Houthakker, 1951 – analysing the the British system) identified the peak load problem in the context of post WWII Europe.

- In the late-1940s, the 12000MW British system in particular was experiencing rapidly rising peak loads with chronic load-shedding events
- Budget resources were focused on the rearmament program and the housing shortage
- Clow Differential pricing had failed:

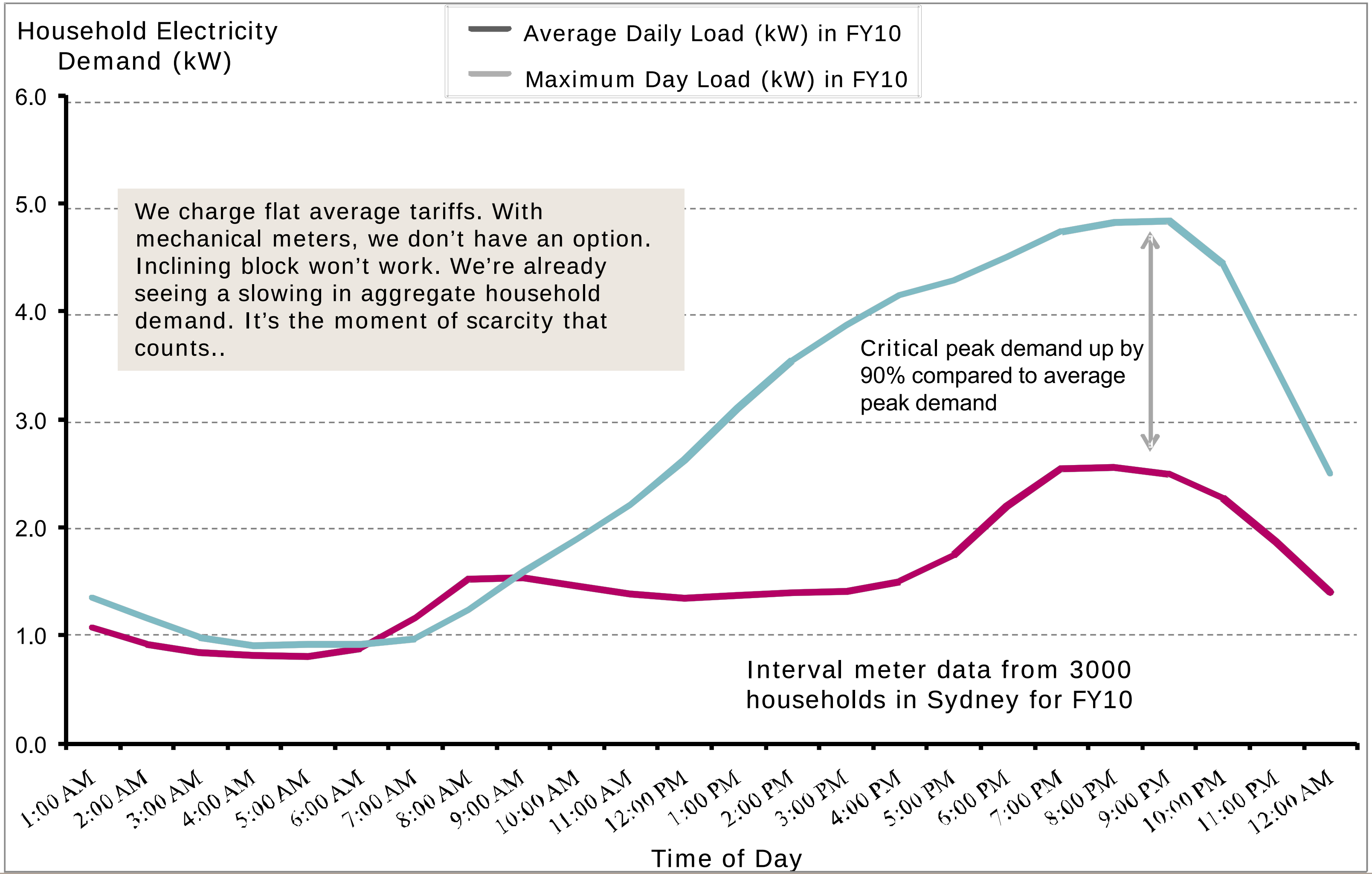
Clow Differential Tariffs

- *...seasonal [and/or inclining block] tariffs are a very crude method for limiting peak demand, as demand approaches its maximum only within short periods of the day, and these are precisely the periods when the relatively inelastic lighting component is important. Space heating, which has a special responsibility for the present peaks on cold mornings, is probably more sensitive to price changes than lighting but the elasticity varies with the time of day, and may be small on such mornings. Consumers will naturally economise at the times least convenient to them, and these are likely to be off-peak periods when no reduction of demand is required... More promising is the time-of-day tariff with a high unit rate for consumption during peak hours and a low rate for off-peak consumption...*
- Boiteux (1949) clearly set out the problem and solution using a conventional economic framework →

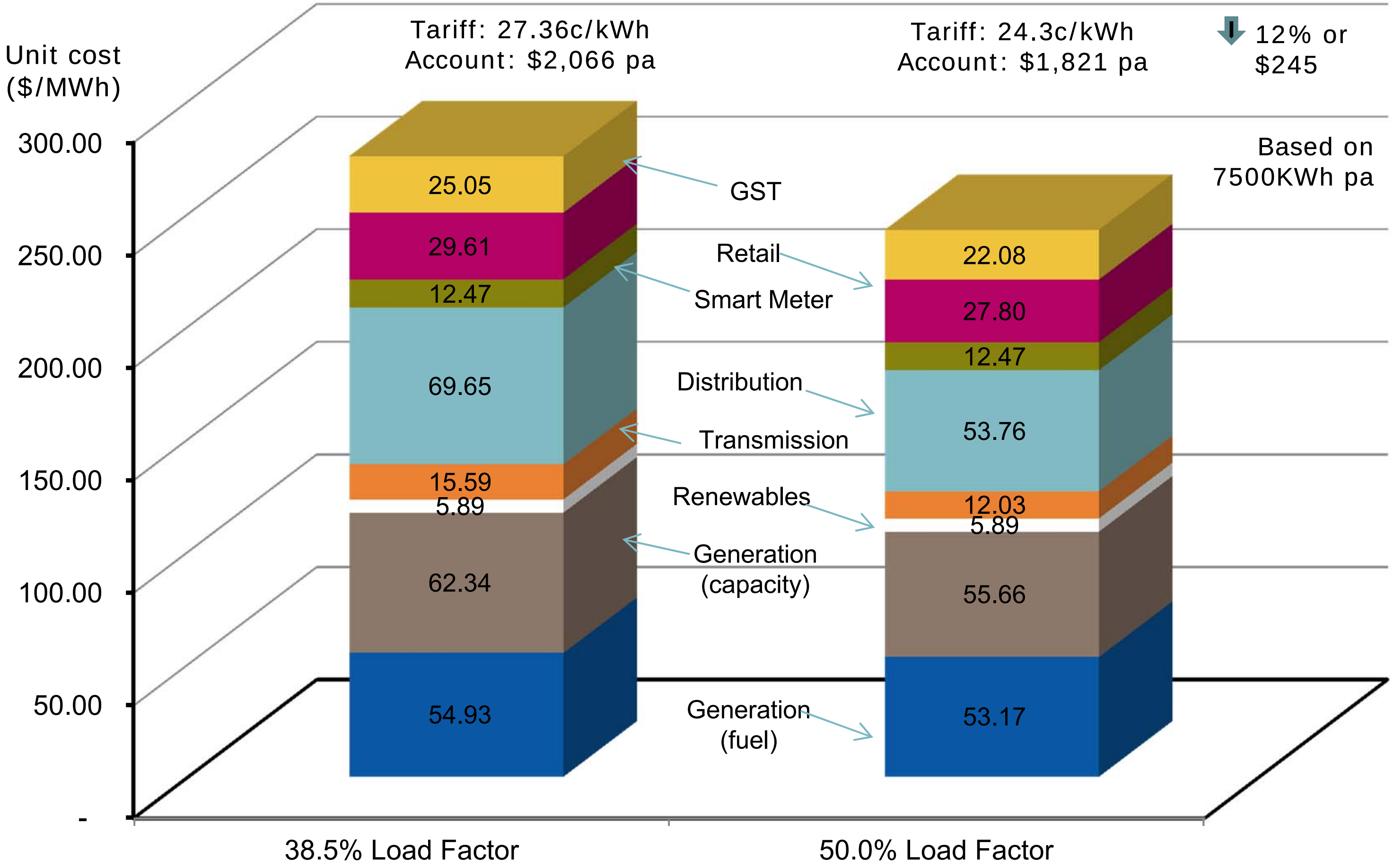
Boiteux (1949)



Peak demand growth: the prime target



Otherwise cost increases will intensify



Our Boomerang Paradox scenario flagged the possibility of a doubling of unit prices between 2008 and 2015.

The media is focused on cost of living. We believe this thematic will run for years, not weeks or months.

A smart grid, and what it can do for power system load factor *is a genuinely good story* for our industry, and our customers.

AMI is fundamental...

Imagine a world in which Joe Smith drives up to the gas pump in his large SUV, fills up his truck, and drives away without paying a dime. The gasoline is not free, but Smith won't know how much he has purchased or how much he owes until 3 months later because he has a quarterly account with the gas station. When his wife drives up to the pump in the family sedan, she goes through the same procedure; as does their high school senior, who drives up to the pump in her compact coupe. The Smith's get a combined bill and don't know how the charges accumulated. Was it Joe's driving, his wife's driving or their daughter's driving that accounted for the lion's share of the bill? What makes life even more interesting for the Smiths is that none of their cars have a speedometer or a gas gauge. They get no feedback at all on how to manage their gas bill. Are the Smith's living in some type of parallel universe? No, if we were to change the gas station to an electric utility, the Smith's are living in the world as we know it today... But this may be about to change. Courtesy of the digital revolution, new devices are being introduced that would allow electricity customers to know where their power is going and what they can do to control usage, lower their bills and also help reduce their carbon footprint... (Faruqui et al, 2010)

Prices play a central role...

Suppose the flat tariff principles currently used in the electricity industry were accepted by policymakers in the halls of government, who then proceeded to apply them to the entire economy...

- Parking meters in inner cities would charge the same hourly rate all day long,
- Airline prices would be the same regardless of when you booked your flight or when you flew,
- The same uniformity would be applied to hotel rates and car rentals,
- Grocery shoppers would expect to pay the same price for produce regardless of whether it is in-season or out-of-season,
- Would prices for various goods and services be higher or lower, on average, in this alternative reality? Prices would no longer be used to spread out periods of intense demand. As a result, the alternative reality would be a world of poor load factors and higher prices. (Faruqui, 2010)

Dominant Thought: Californian Experience

Reiss and White (2008) examined the Californian Crisis over a 5 year period either side of the crisis (70,000 households).

› Stable Period: US$110/MWh. Households consumed 6.1MWh pa

› Price Shock Period: Tariffs were raised to US$230/MWh. Genuine price-shock. Average household consumption declined by 13%.

› Price Suppression Period: due to public outrage, tariffs re-set at US$135/MWh by the Californian Legislature. Electricity demand rebounded 8%.

› Public Education Period: following the rebound in demand, a public campaign to reduce energy consumption was initiated at a cost of US$65 million, demand reduced by 7%.

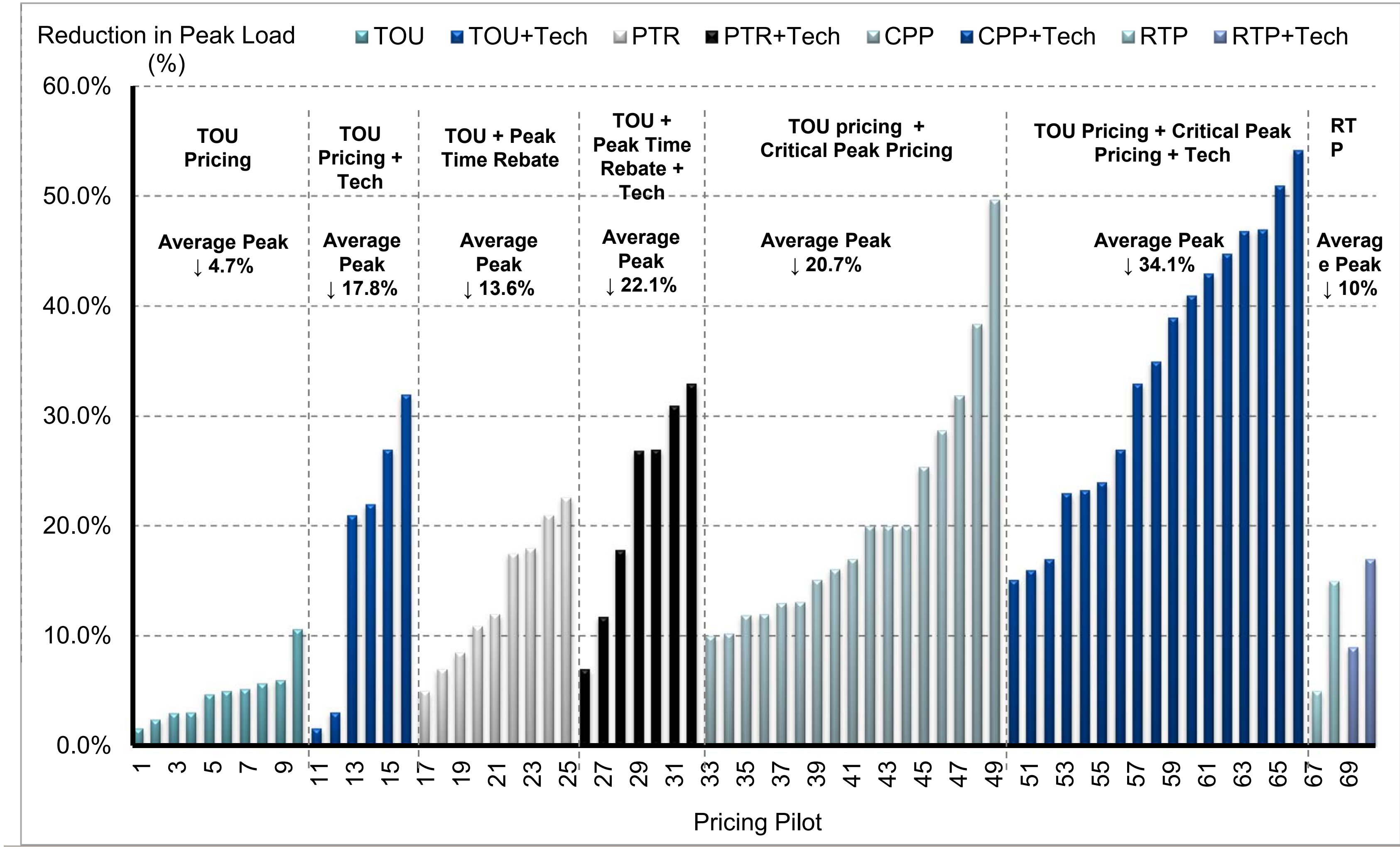
The opportunity for Demand Response is large

Peak

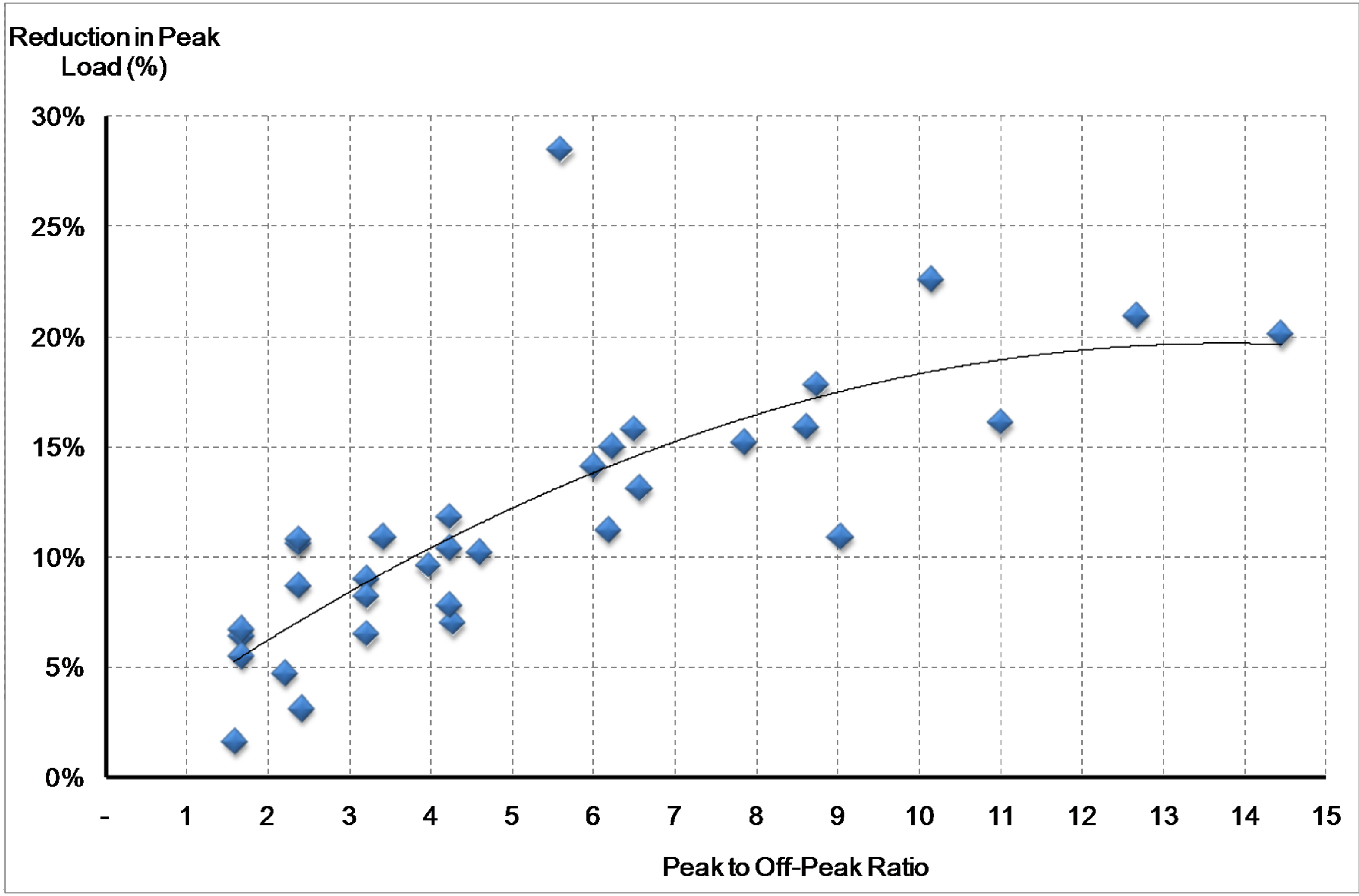
High Usage 10+ kWh per day	High Peak Low Off-Peak 3%	High Peak Medium Off-Peak 18%	High Peak High Off-Peak 44%
Medium Usage 5-9 kWh per day	Medium Peak Low Off-Peak 7%	Medium Peak Medium Off-Peak 10%	Medium Peak High Off-Peak 1%
Low Usage 0-4 kWh per day	Low Peak Low Off-Peak 16%	Low Peak Medium Off-Peak 1%	Low Peak High Off-Peak 0.1%
Interval meter data from 1000 households in Melbourne for FY10	Low Usage 0-4 kWh per day	Medium Usage 5-9 kWh per day	High Usage 10+ kWh per day

Off-Peak

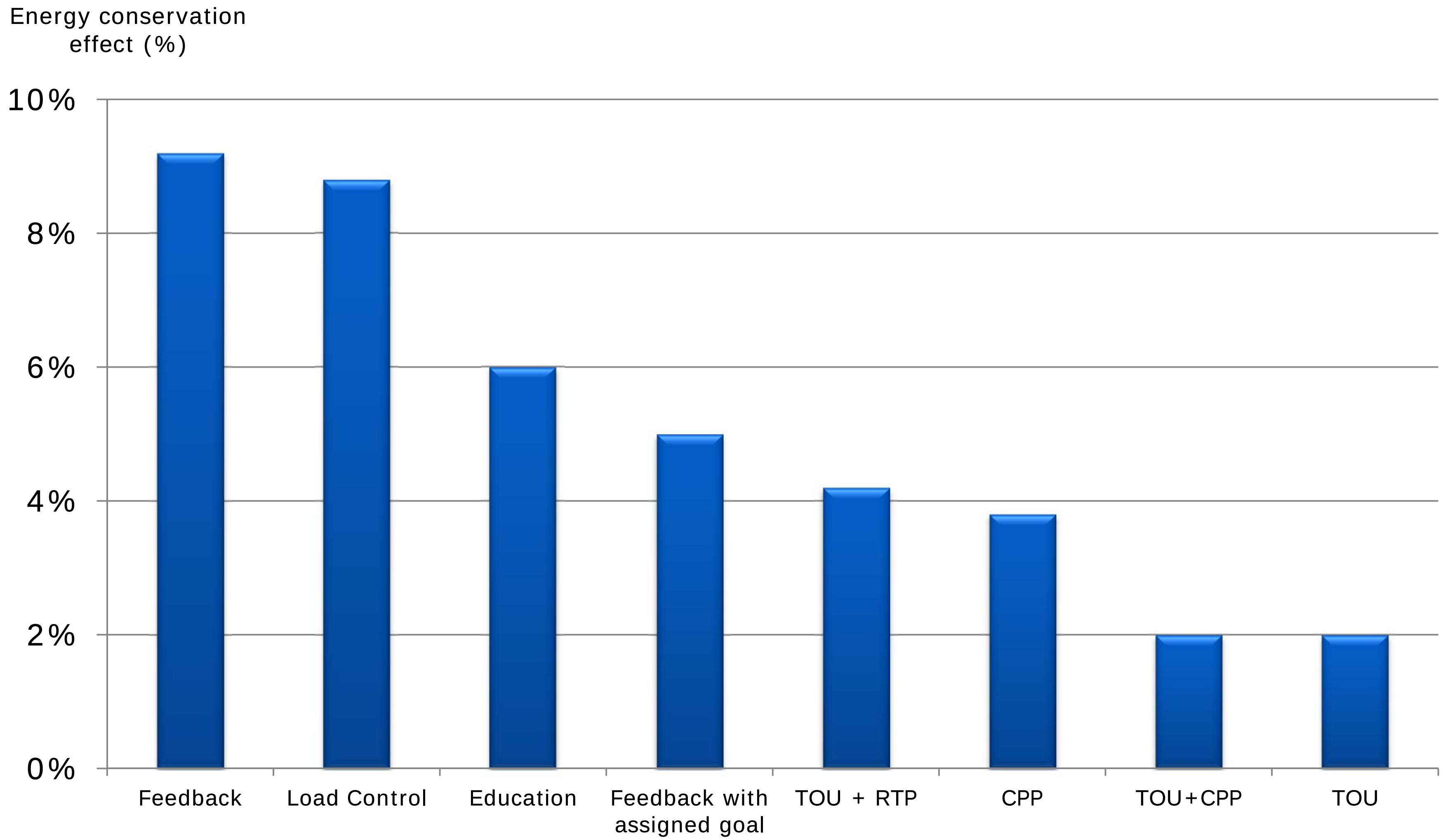
Customers *will* respond



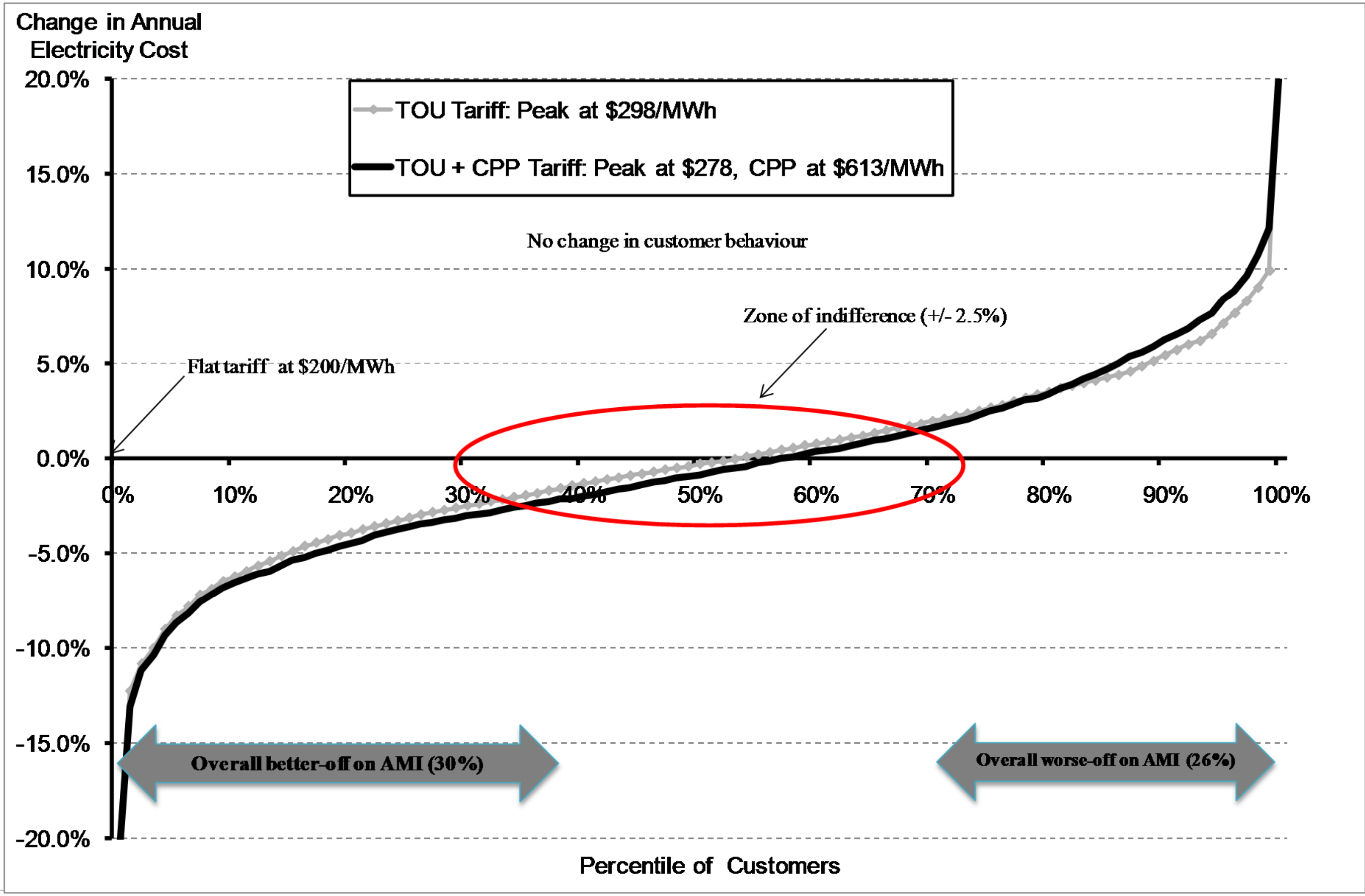
Albeit with diminishing returns...



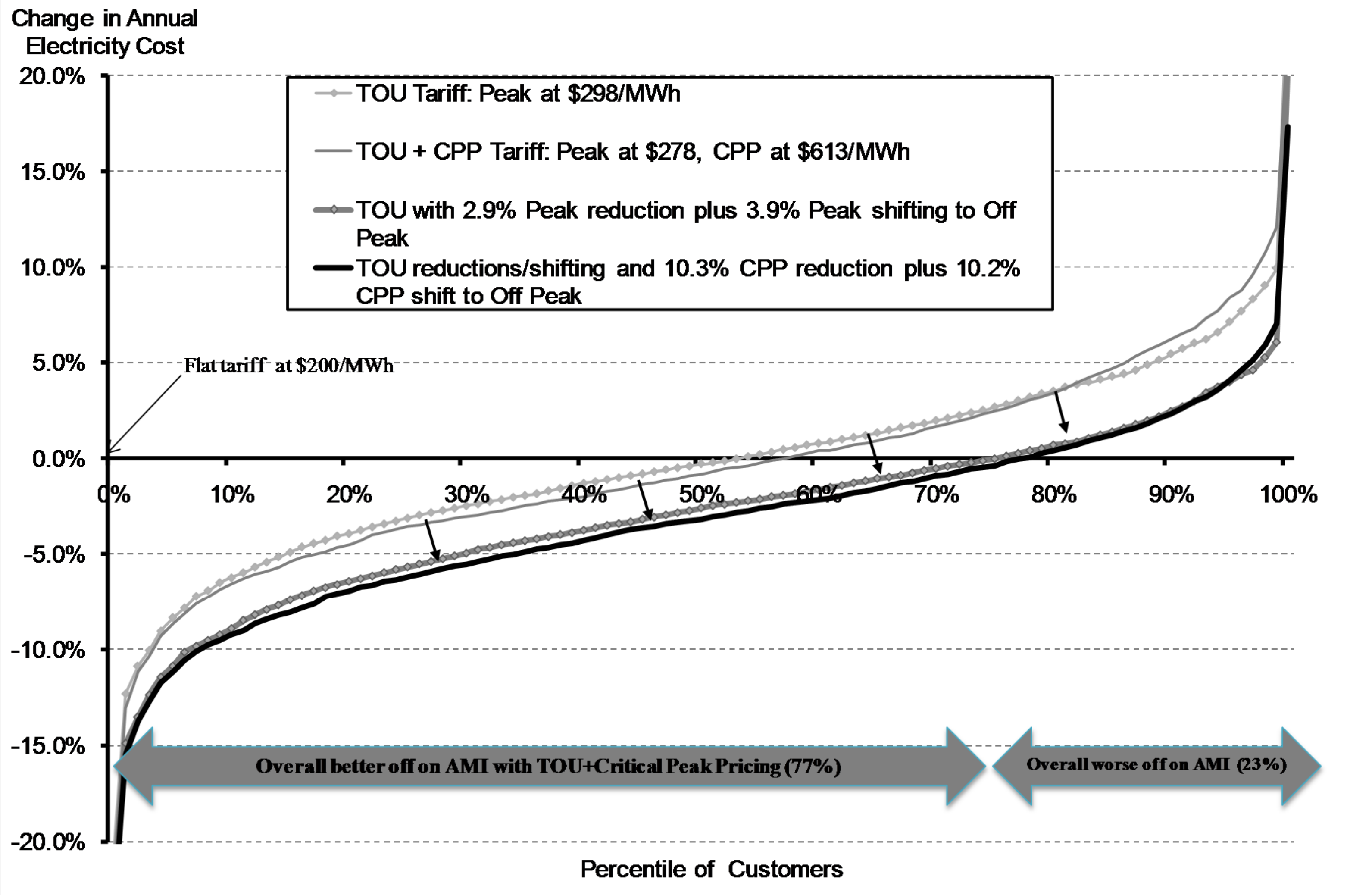
Energy Conservation (vs. load shifting)



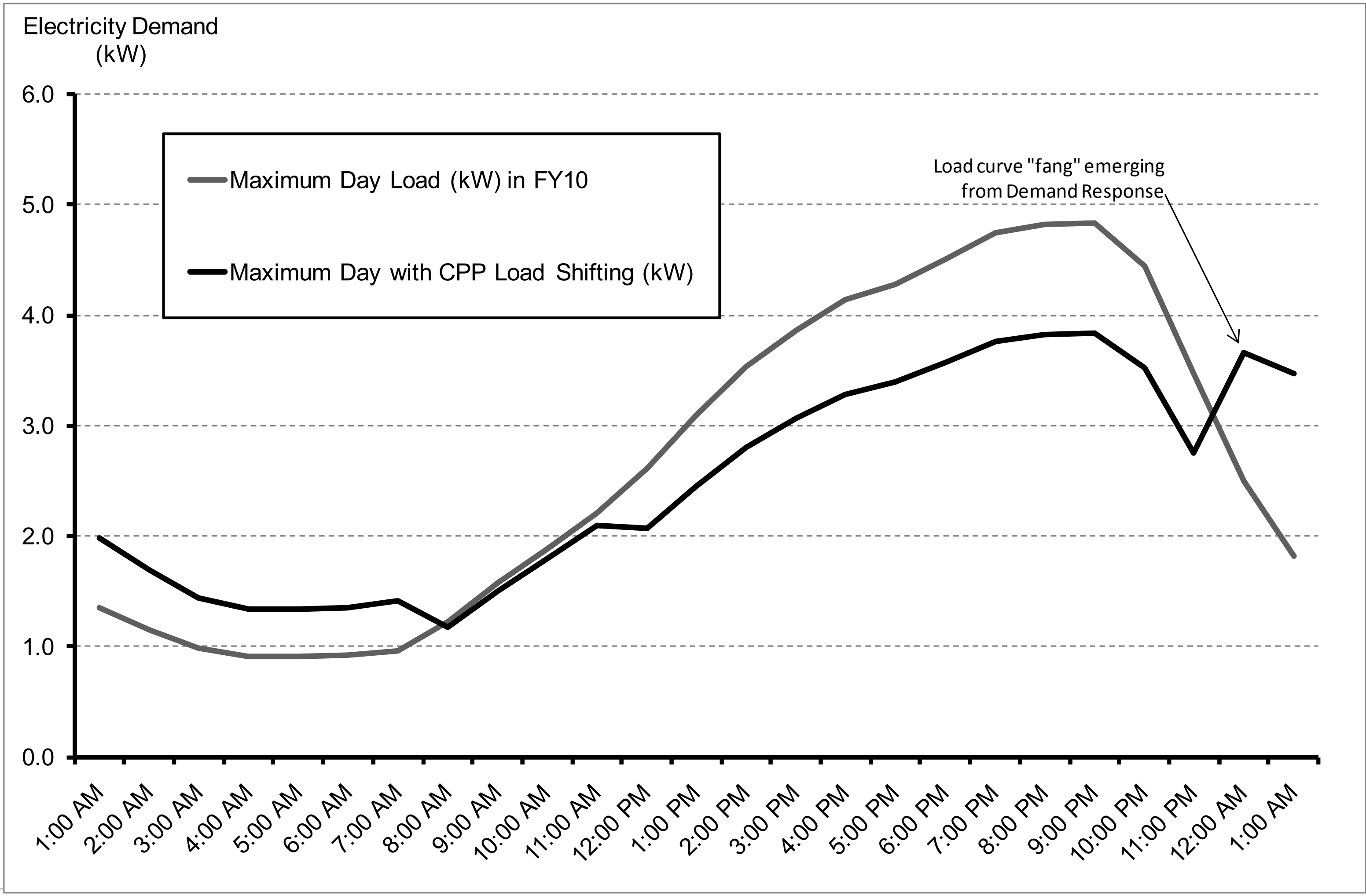
Holding demand constant, there will be losers



But with Demand Response, gains are material



But results can’t be extrapolated…



On the Equity of Dynamic Pricing

- The welfare implications of a default shift to Dynamic Pricing are material because there will be winners and losers
- Concession card holders with peaky loads (i.e. who are at home during the day may struggle to pay peak rates or may not have the disposable income to automate response
- While benefits of smart meters and dynamic pricing will almost certainly outweigh the costs over the long run, the long run could be quite long
- Moving ‘quickly’ to dynamic pricing as a default option would be fraught with danger due to bill shock
- Requires a substantive education campaign, and a commencement date outside of summer or winter peaks

On the Equity of Dynamic Pricing

- Policy needs to be set in the context of Rawls' veil of ignorance:
  - I would do well to decide policy with an eye on making the worst-case alternative the best of all possible worst-case scenarios; I ought to focus on being both poor and having a peakier load than average
- 4 threshold criteria should be met:
  1. Provision of accurate information on tariff design and usage
  2. Customer education (critical)
  3. Ability to change behaviour (i.e. elastic demand), and
  4. Expected aggregate benefits exceed expected aggregate costs

Concluding Remarks

› The ethics and fairness of shifting to dynamic pricing is complex, as is the incidence of smart meter costs (i.e. and are different issues)

› But the counterfactual is also important. Flat tariffs lead to overconsumption when it counts. Welfare organisations understand this (vulnerable households almost certainly bear a disproportionate share of augmentation costs)

› Incorrect sequencing and pacing of reforms in the Smart Meter and Dynamic Pricing space could clearly do much more damage than good (e.g. Puget Light & Sound)

› Carve-outs will therefore be important

› If done well, the shift in demand and the size of the prize could be substantial; moving from 38% to 50% load factor reduces an average 2015 bill by $32/MWh, or $1.6 billion pa across the NEM

› But it all starts with Smart Meters & Dynamic Pricing