Efficiency, energy cultures and the low-carbon grid

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Perspectives on efficiency

Technologies

- Reduce total consumption
  - e.g. insulation, efficient appliances

Energy cultures and efficiency
Energy cultures and efficiency
How many admirals does it take to change a lightbulb?

- Technical constraints?
- Weak incentives?
- Alternative priorities?
- Rational inattentiveness?
- Informational deficiencies?
- Capital constraints?
- Risk averseness?
- Status quo bias?
The energy cultures framework

An ‘actor-centred’ framework

Material culture
- Buildings
- Objects
- Software
- Appliances
- Values
- Beliefs
- Rationalisations
- Knowledge
- Skills

Norms
- Expectations
- Aspirations
- Personal & organisational norms

Practices
- Behaviours
- Activities
- Actions
Cultural attributes – interactive and dynamic
Outcomes of these dynamics

Material culture

Norms

Practices

Efficiency?
Fuel poverty?
Health?

etc
Internally consistent and thus habituated energy culture

**Material culture**
- Poor insulation
  - Single bar heater
- Knitted jerseys
  - Single glazing

**Norms**
- Low expectations of warmth
- Maintaining traditions from upbringing
  - A ‘luxury’ to heat the kitchen

**Practices**
- Uses heater sparingly
- Doesn’t heat bedroom
- Puts on more clothes when cold
  - Draws curtains & closes doors
Energy cultures with different efficiency outcomes

Lawson, R., Williams, J. (December 2012). Understanding Energy Cultures. Annual conference of the Australia and New Zealand Academy of Marketing (ANZMAC), University of New South Wales, Adelaide
Efficiency as a cultural change
New material culture

“Rebound effect”
New practices

Material culture

Norms

Practices
New norms, aspirations
US Navy’s inefficient energy culture: entrenched and self-reinforcing

Fig 2. Internal elements of U.S. Navy energy culture.
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Fig 2. Internal elements of U.S. Navy energy culture.
Navy also locked in by external influences

Fig. 1. External influences on U.S. Navy energy culture.
Demand peaks and efficiency of the electricity grid
Daily & annual peak electricity demand is driven by households

Every additional kW costs $150-$200/year (GW =10^6 kW)

Expensive infrastructure required


Dortans, C (2019) MSc Thesis, University of Otago
Increasing wind and solar will increase supply variability; grid-edge changes could increase peaks

Low-carbon grid will be shaped by changes at the grid edge ....
Pathways to NZ’s energy transition

New technologies

Bigger and less predictable peaks in demand

Inefficient over-supply needed to meet peaks

Centralised system requiring $50 billion + investment
New technologies & practices to reduce daily peaks

- Battery storage
- Vehicle to grid
- Smart appliances

Demand shifting, e.g. hot water

Passive houses, solar water heating

Winter

Demand shifting to reduce daily peaks

Hot water systems, heat pumps, fridges?

Figure 5: Estimated daily effects of the peak load shifting scenario on total electricity generation profile assuming 100% HW unit availability

Efficient lighting to reduce winter peak demand

Reducing daily and winter peaks
Time-sensitive efficiency and flexibility – a pathway to the low-carbon transition?

Wind and solar
New sources of demand
New business models

Bigger and less predictable peaks in supply & demand

Inefficient over-supply needed to meet peaks

Centralised system requiring $50 billion + investment

Reduced peaks and more flexibility

Less investment needed as demand variability aligned to supply variability

Decentralised system requiring less supply infrastructure

$???
Summary: the growing efficiency landscape

- Reduce total consumption
- Insulation, efficient appliances, etc ...

... and shifting focus from energy efficiency to carbon efficiency
Questions?