GAS INDUSTRY COMPANY LIMITED


**Presenter** Simon Coates, Concept Consulting

**Title** Summary of direct use of gas analysis

February 2010

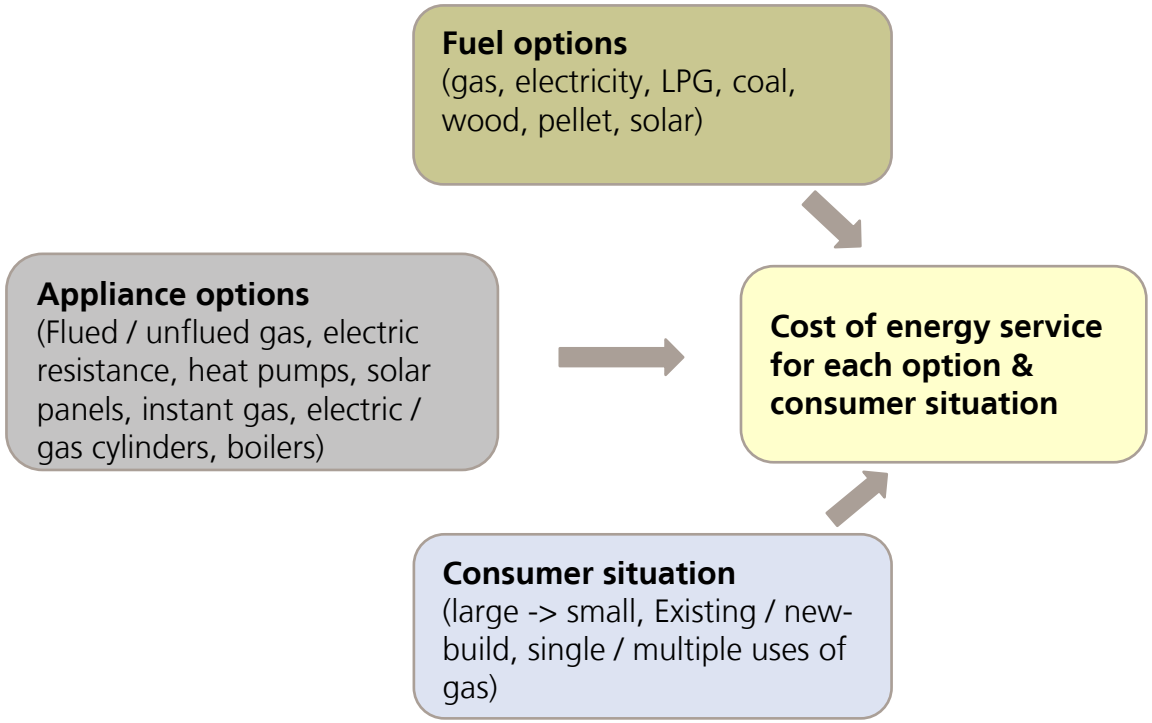
# CONTENTS

- Objectives & scope of study
- Key findings
- Methodology & assumptions
- Results
- Conclusions

# The study is an input to help GIC fulfil a GPS objective

*"... to provide advice on the extent to which policies to enhance the direct use of gas in industrial, commercial and residential applications would mitigate greenhouse gas emissions, and the likely costs of implementing those policies."*

# Objective is to identify best option for delivering energy services for different consumer situations



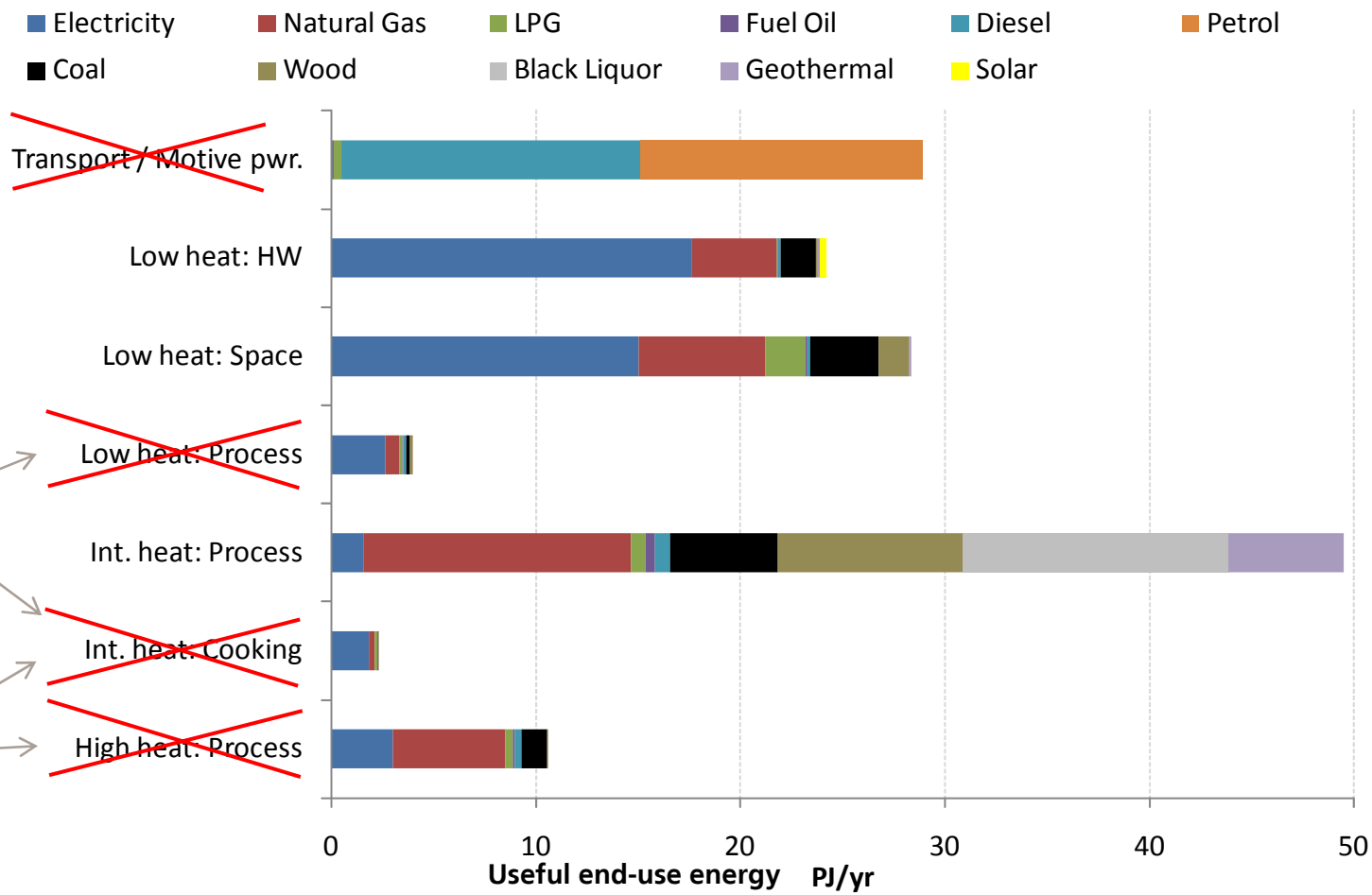

- Assess from a private perspective based on prices to consumers and a public perspective based on resource costs to NZ Inc, and identify differences
- Are there energy services where gas is clearly the best option?
- Is the observed level of uptake consistent with national best interest?

# End-use energy stats were used to identify applications for detailed analysis

Excluded because it would require a major study considering, amongst other things, public transport, electric vehicles, and CNG infrastructure

Excluded on grounds of being de-minimis

Excluded on grounds of process specific considerations dominating fuel choice



# KEY FINDINGS

# The best space heating option is very situation specific, but generally gas does not appear to be the best option

<table>
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- Gas does not appear to be the best option for space heating from both a private & public perspective
- This is consistent with observed levels of uptake of gas space heating

# The best water heating option is also situation specific, but instant gas appears to be the best option in many situations

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- Observed consumer behaviour (50-65% of new properties choosing instant gas, but few conversions from existing electric cylinders) appears to be consistent with these results

# Recent gas price rises are increasing the prospect of industrial consumers switching *away* from gas for boilers

- The current cap on domestic CO2 prices may create a wedge between private & public benefits, causing a risk of gas to coal switching
- However, given that the cap is due to expire in 2012, the risk is considered small

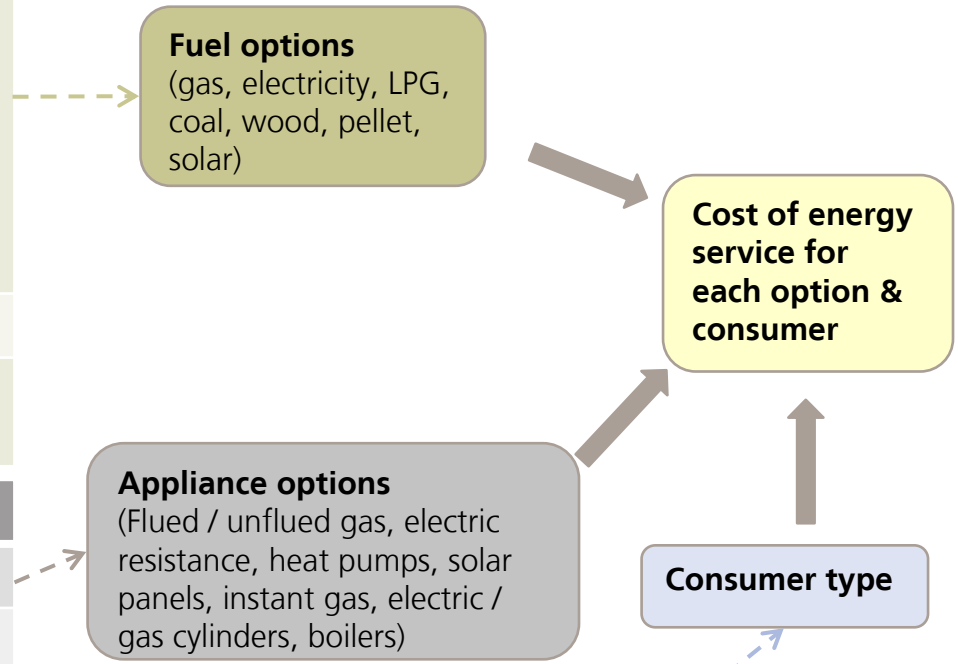
- Gas network companies appear to be appropriately discounting the sunk costs of gas networks to prevent uneconomic fuel switching away from gas

# METHODOLOGY & ASSUMPTIONS

# Model developed to examine key drivers & issues determining outcomes

| Attribute | Issue |
|---|---|
| Cost | • Difference between time-of-use resource cost driver to NZ Inc, and (lack of) time-of-use consumer prices<br>• Consumer vs. NZ Inc treatment of :<br>  • Sunk costs<br>  • Fixed costs<br>• Future projections |
| Emissions | • Electricity emissions intensity |
| CO2 price | • Difference between NZ ETS cost to consumer & international cost to NZ |

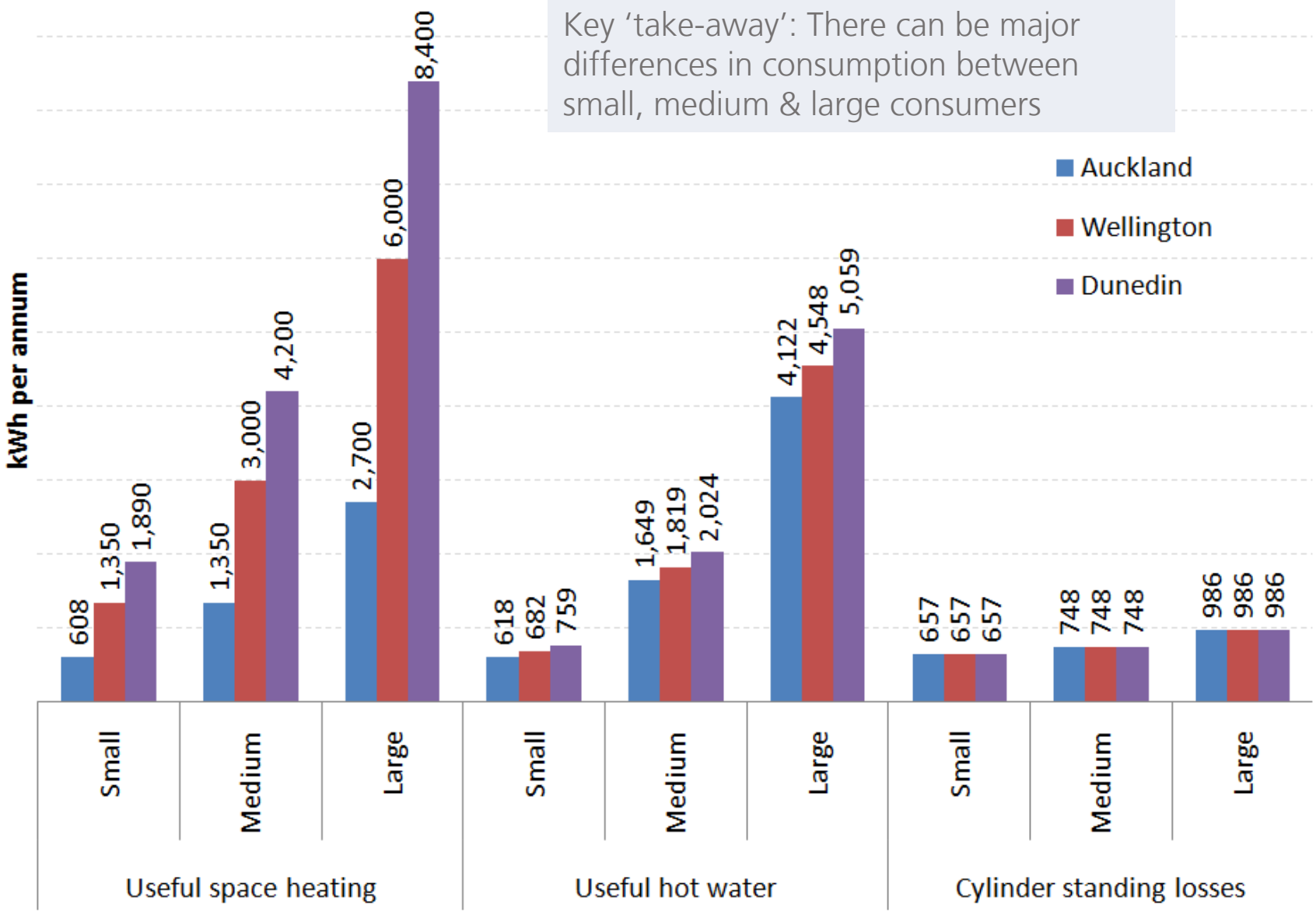
| Attribute | Issue |
|---|---|
| Capital cost | |
| Efficiency | Calculation of heat pump efficiencies |



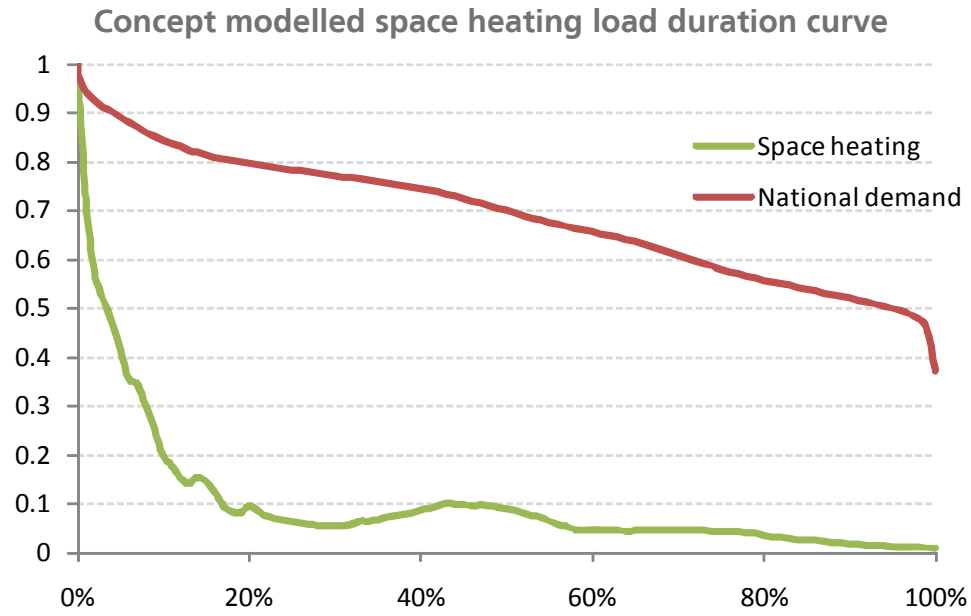

| Attribute | Issue / implication |
|---|---|
| Size of heating load | • Size of appliance |
| Time-of-use of consumption | |
| New-build or existing appliance | • Treatment of capital costs<br>• Gas connection costs |
| Single or multiple uses of gas | • Treatment of gas fixed costs |
| Location | • Availability of gas<br>• Heat pump efficiencies |

# Annual heating loads were derived from HEEP analysis, and differentiated by location and consumer 'size'

Key 'take-away': There can be major differences in consumption between small, medium & large consumers

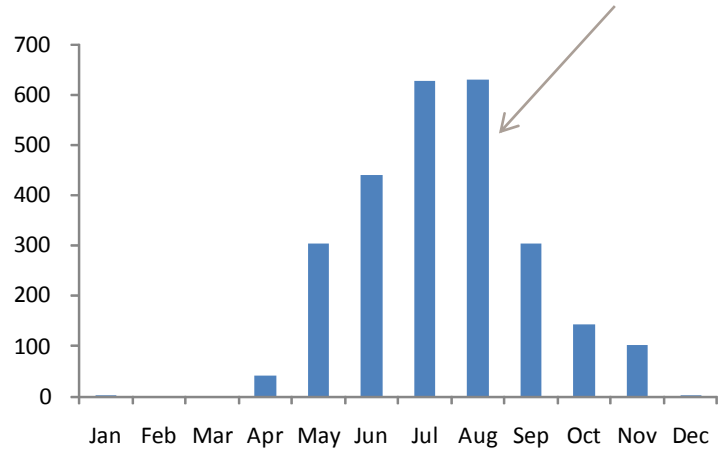


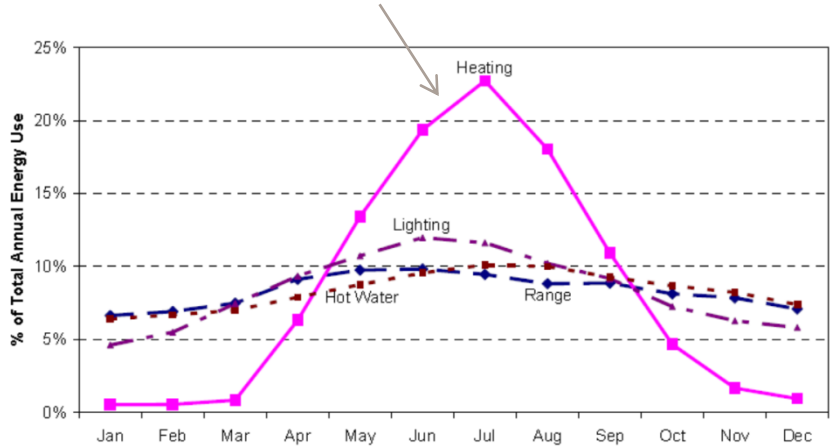
# A model was developed to derive the time-of-use space heating profile. Outputs were cross-checked with HEEP




Key take-away: Space heating is very peaky

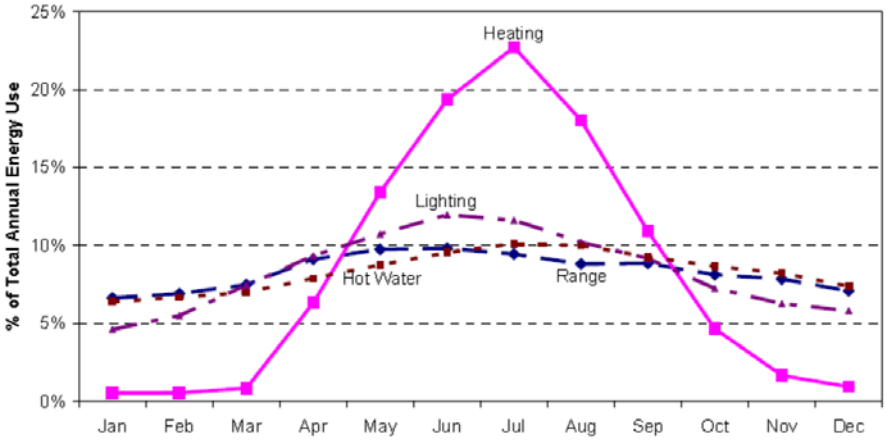
The modelled within-year heating profile showed close correlation to observed HEEP data



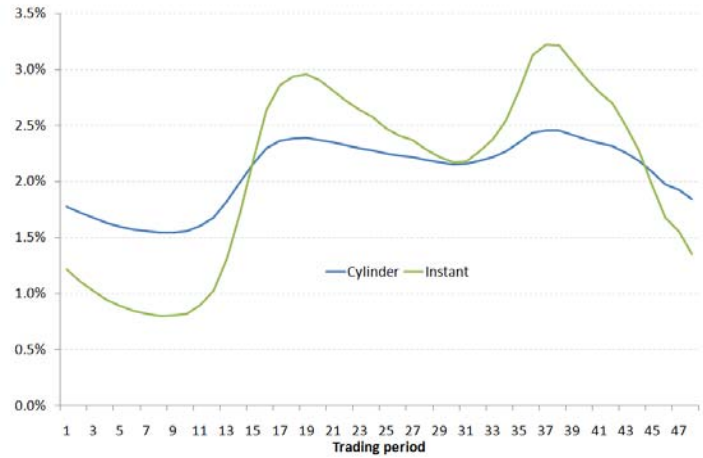



# The water-heating demand profile was based on HEEP, observed industry data, and a model of solar water heating

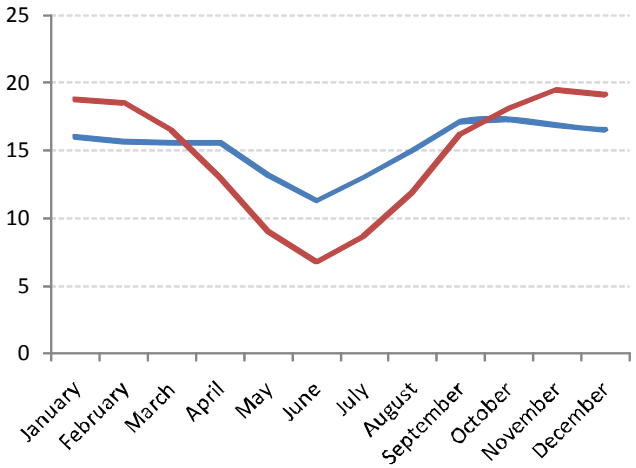
## HEEP data

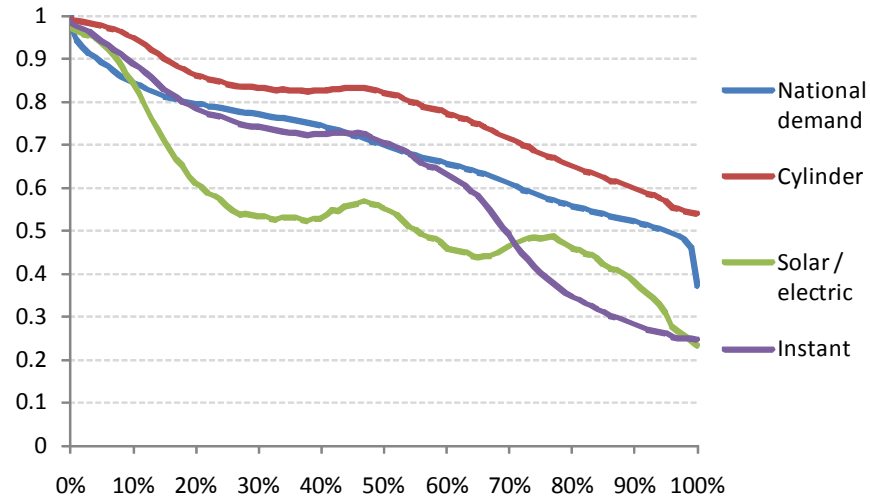



## Observed industry profiles



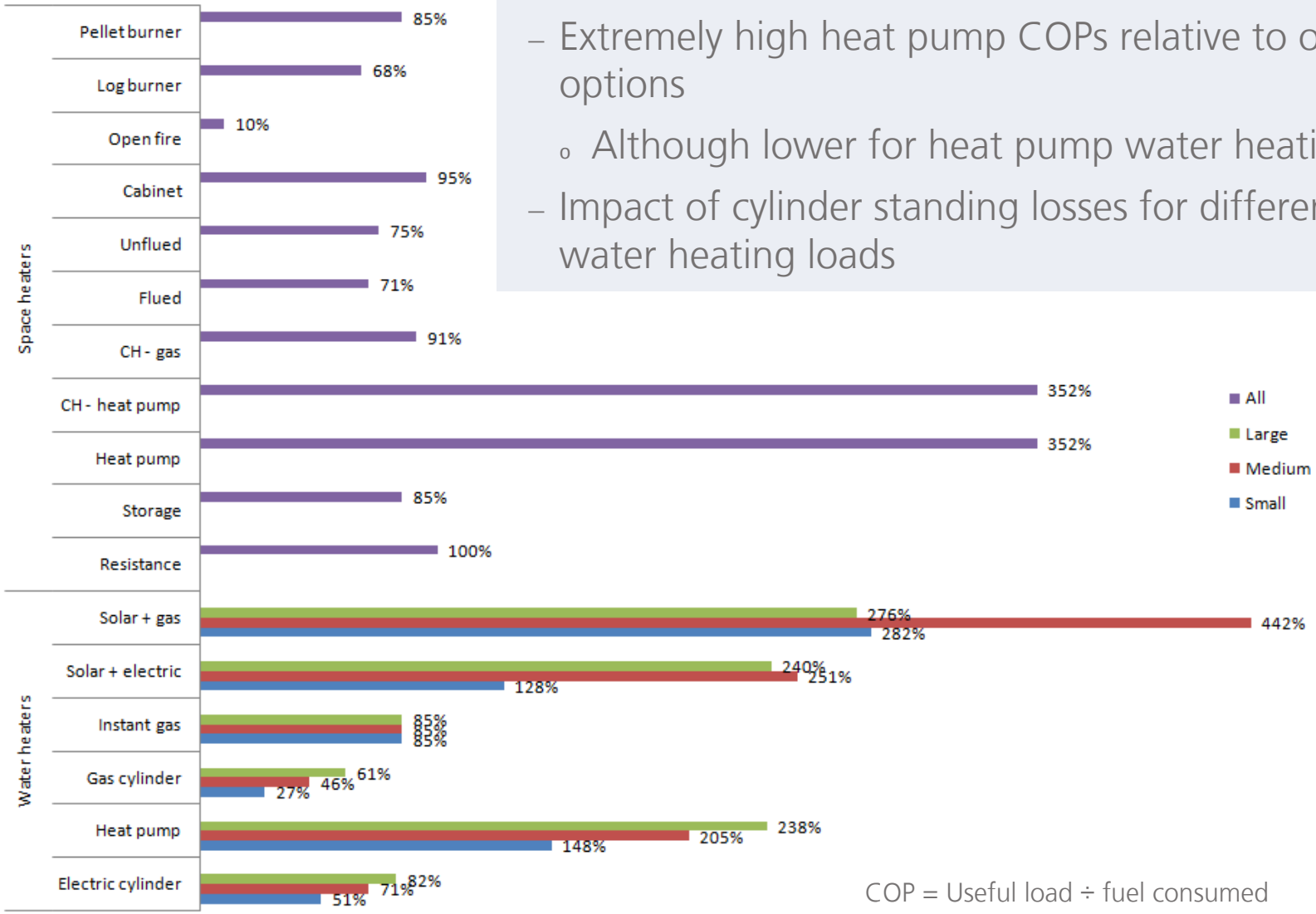

## Retscreen solar water heating model



# Appliance efficiencies were expressed as coefficients of performance. Water heating COPs include cylinder losses

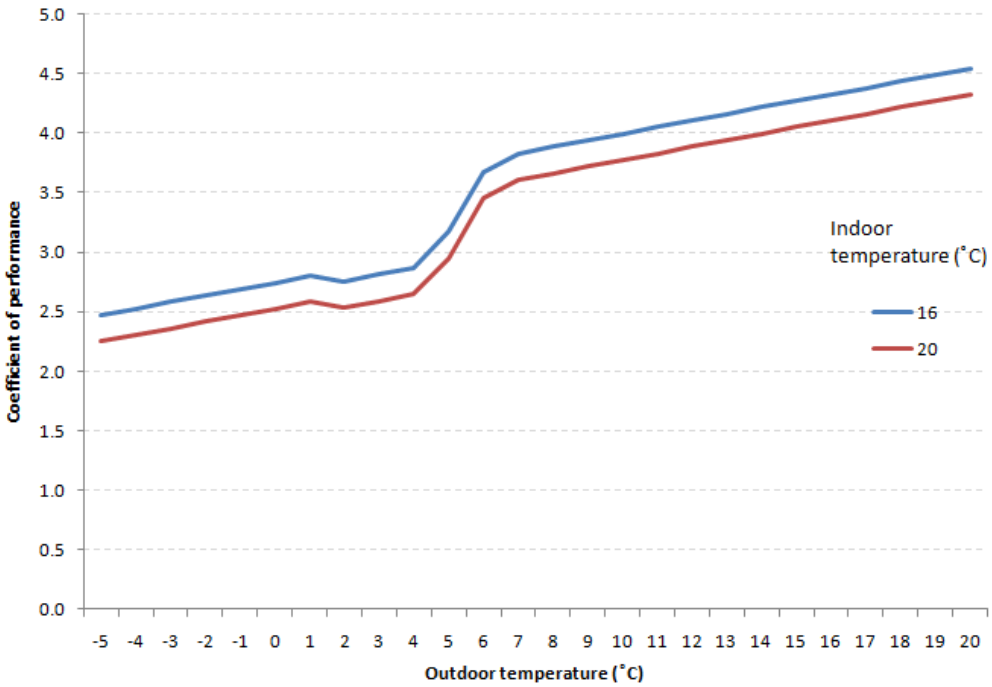
- Key take-aways
  - Extremely high heat pump COPs relative to other options
    - Although lower for heat pump water heating
  - Impact of cylinder standing losses for different sized water heating loads




COP = Useful load ÷ fuel consumed

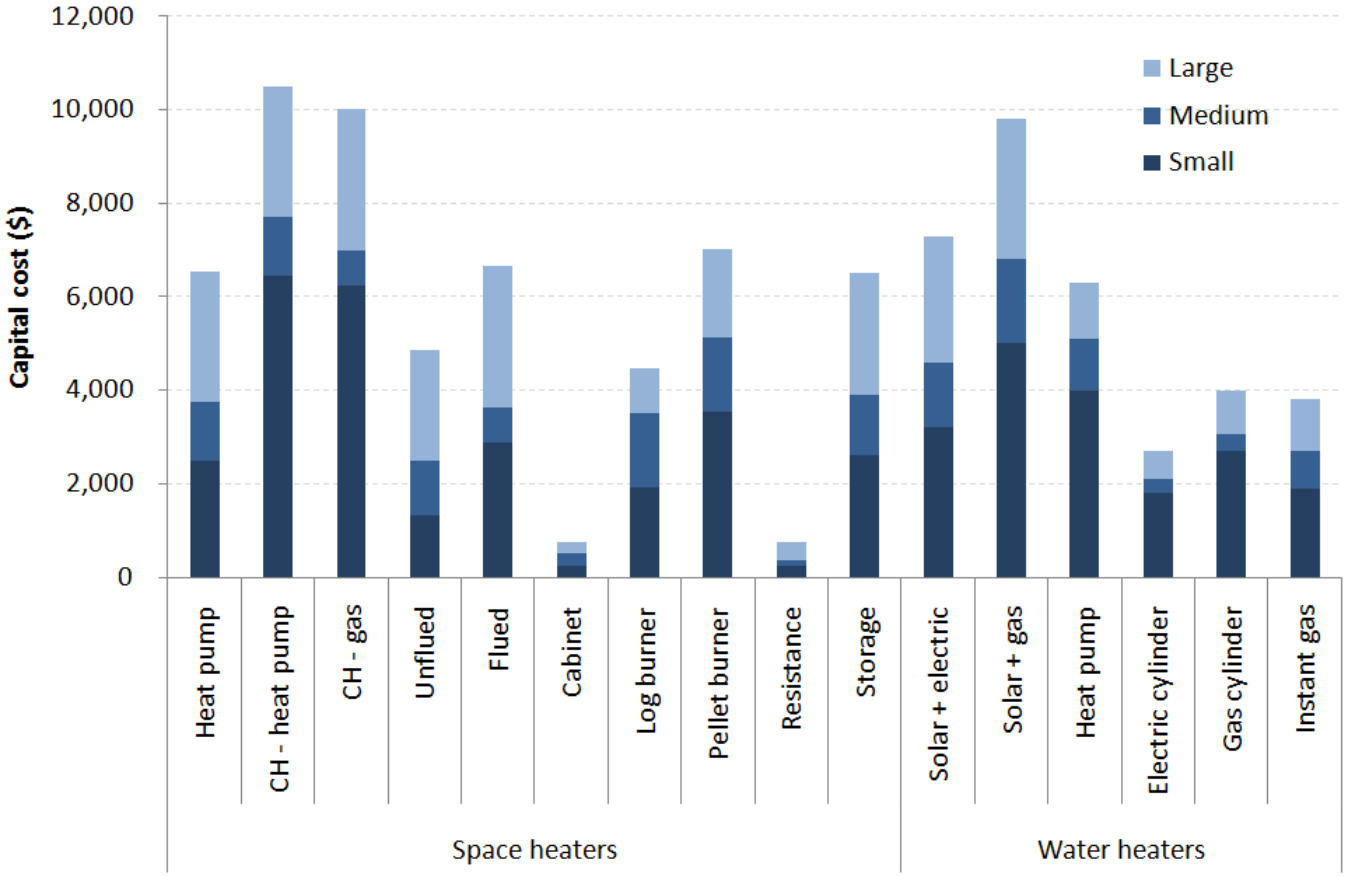
Note: Heat pump COPs are for a Wellington location

# Space heating heat pump COPs were derived using the Concept space heating model




- Heat pump performance curves were fed into the Concept model which used a year's worth of NIWA hourly ambient temperature data to derive a load-weighted average heat pump COP for different locations

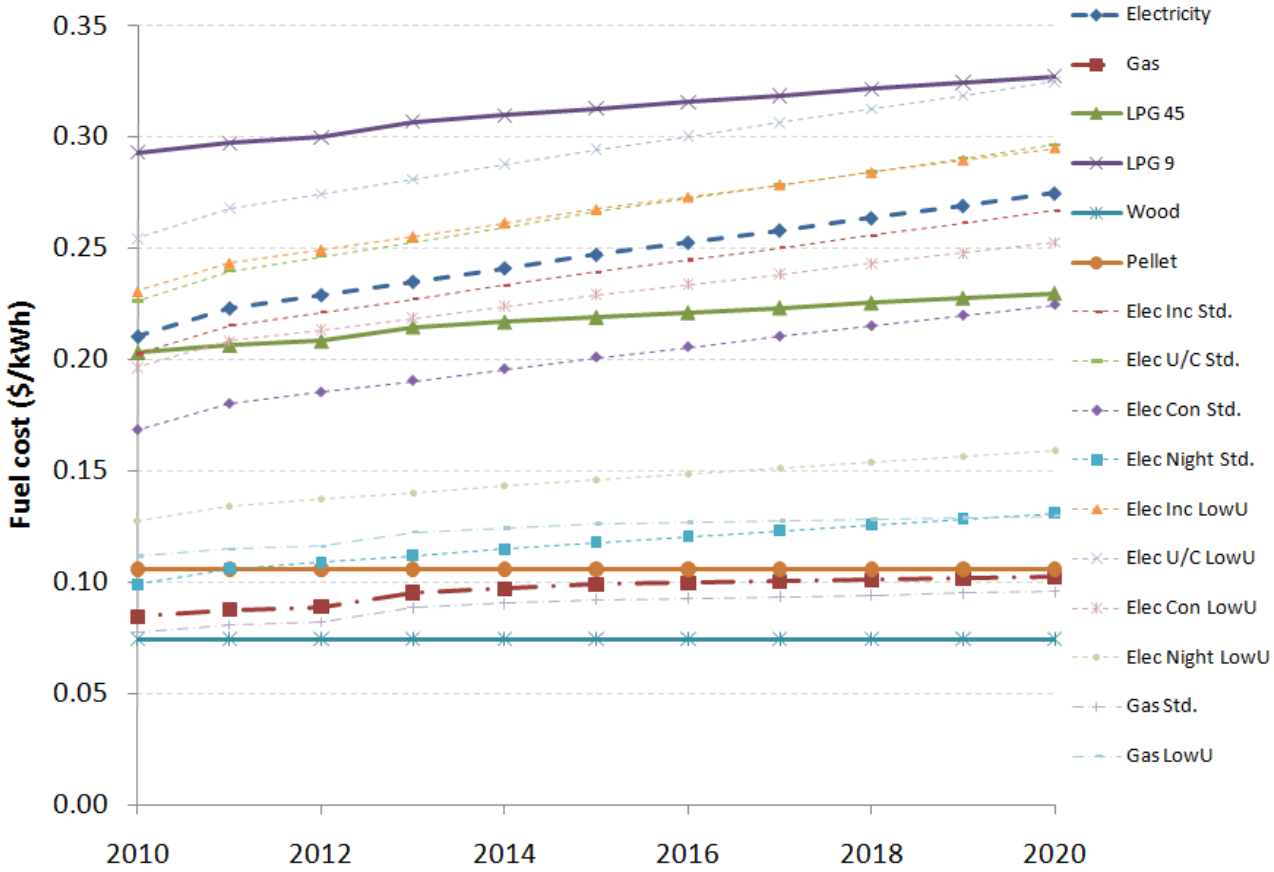
# Appliance capital costs were sized to the heating load




Key take aways:

- The very low capital cost of LPG cabinet and electric resistance heaters
- The very high capital costs of central heating, and solar water heating
- The relatively high capital cost of heat pump water heaters
- The very similar capital costs of space heating heat pumps and flued gas (c.f. five years ago where heat pumps were significantly costlier)

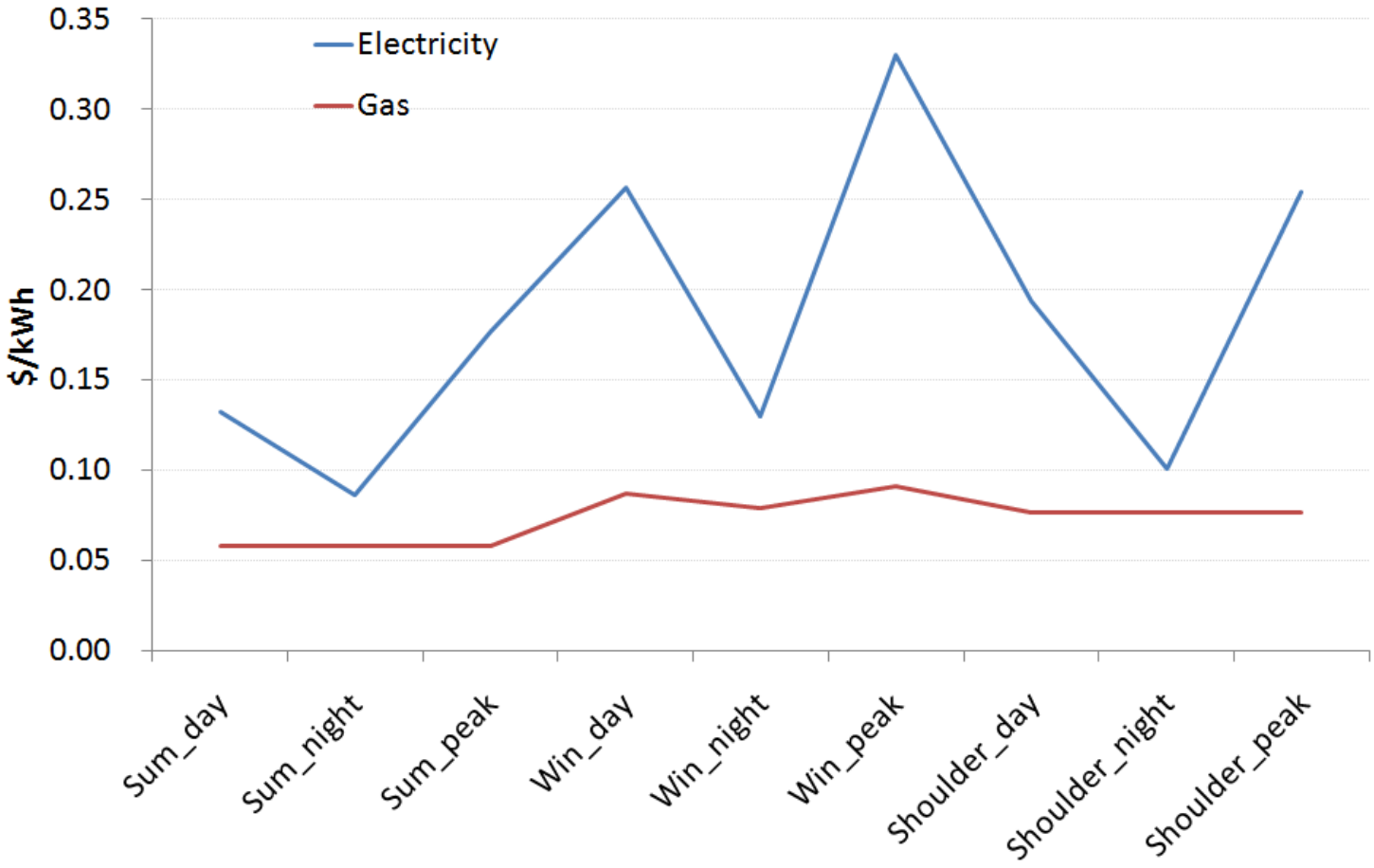
# Today's fuel prices were projected forward based on a number of simple assumptions




- Key take-aways:
  - Relatively high cost of electricity & LPG
  - Faster projected rate of increase in electricity costs
  - Variety of different electricity tariffs

- Key assumptions:
  - Electricity wholesale costs rise from $78/MWh in 2010 to $105/MWh in 2020
  - Electricity network costs rise by 25% over same period
  - Gas wholesale costs rise from $8.10/GJ in 2010 to $11.40/GJ in 2020
  - Gas network costs rise by 5% over same period
  - LPG wholesale cost rises from $2.50/kg in 2010 to $2.90 in 2020

# The time-of-use driven underlying resource costs are assumed to be much peakier for electricity than gas

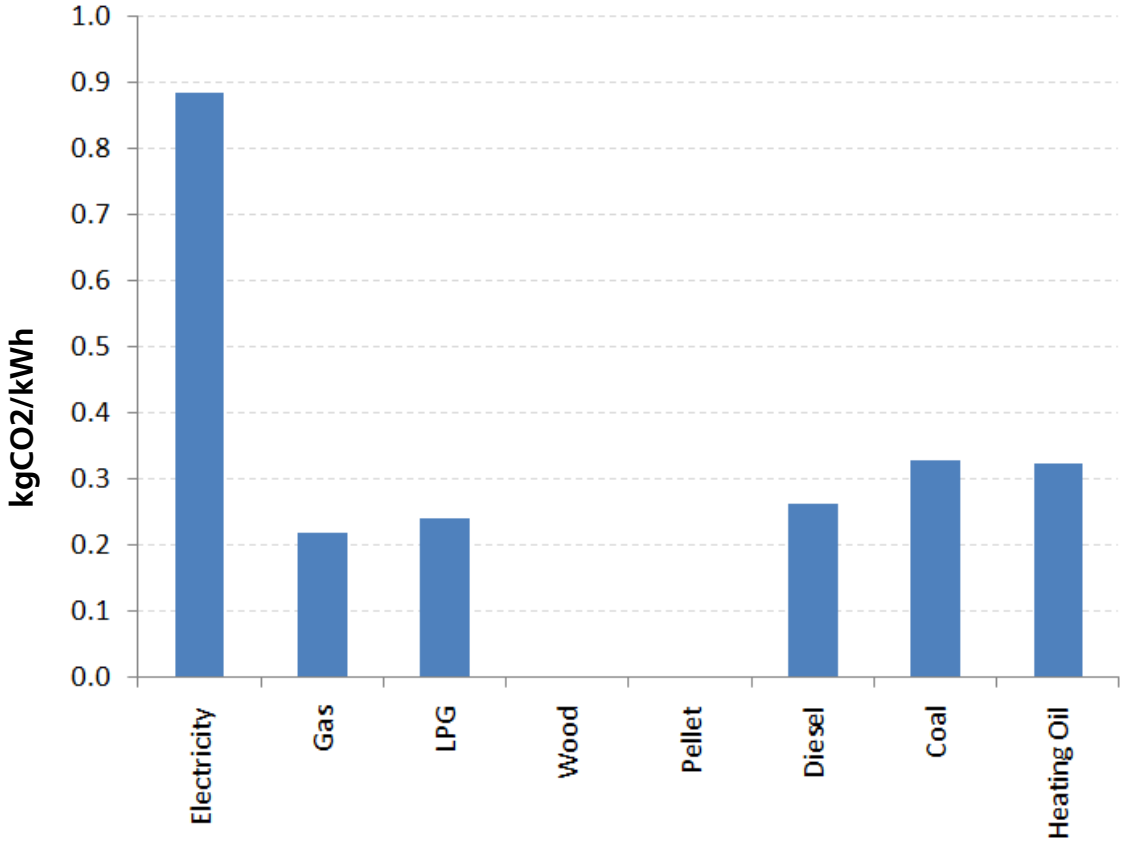



- Electricity network costs in particular are assumed to be strongly driven by peak compared with gas network costs

# The relative economics of options were based on avoidable costs, requiring consideration of fixed & sunk costs

- For electricity, fixed costs were regarded as unavoidable from both a public & private perspective
- For gas, fixed costs were considered avoidable if gas were only to be used for one application
  - 44% of retail cost-to-serve costs are deemed avoidable
  - From an NZ Inc perspective, fixed network costs are unavoidable
- Gas connection costs are assumed to be $1,000 per connection for new-build situations and $2,000 for switching from an existing appliance
- A proportion of variable network costs are for the recovery of sunk assets. From an NZ Inc perspective, these should be considered unavoidable. The avoidable network costs are assumed to be much greater for electricity than gas, given the increasingly capacity constrained nature of electricity networks versus the significant spare capacity in gas networks.
- From an NZ Inc perspective, the avoidability of variable network costs are:
  - 53% for electricity
  - 13% for gas (i.e. ¼ of electricity network costs)

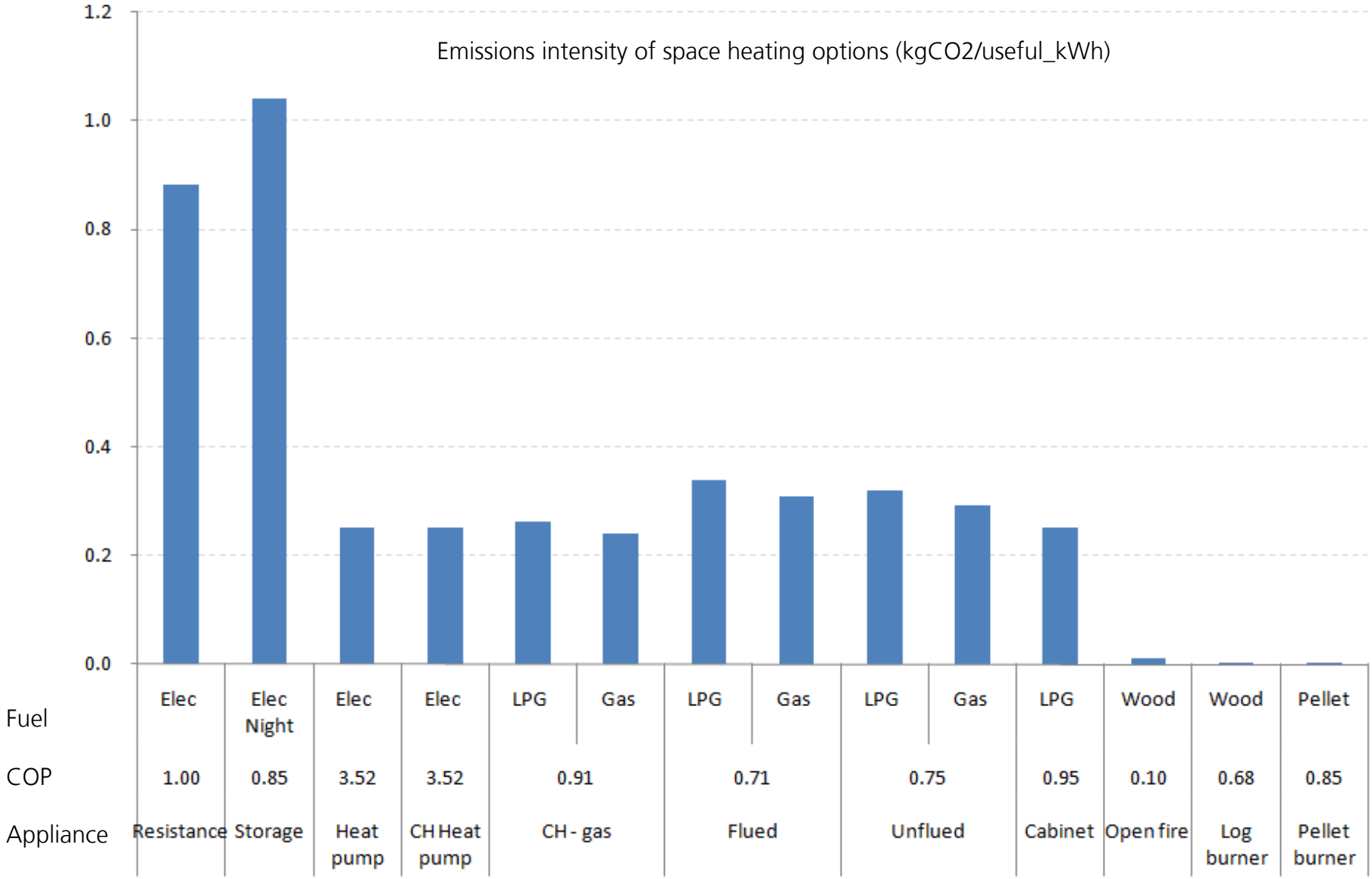
# Input fuel emission intensities were based on CAENZ data except for electricity where Concept modelling was used



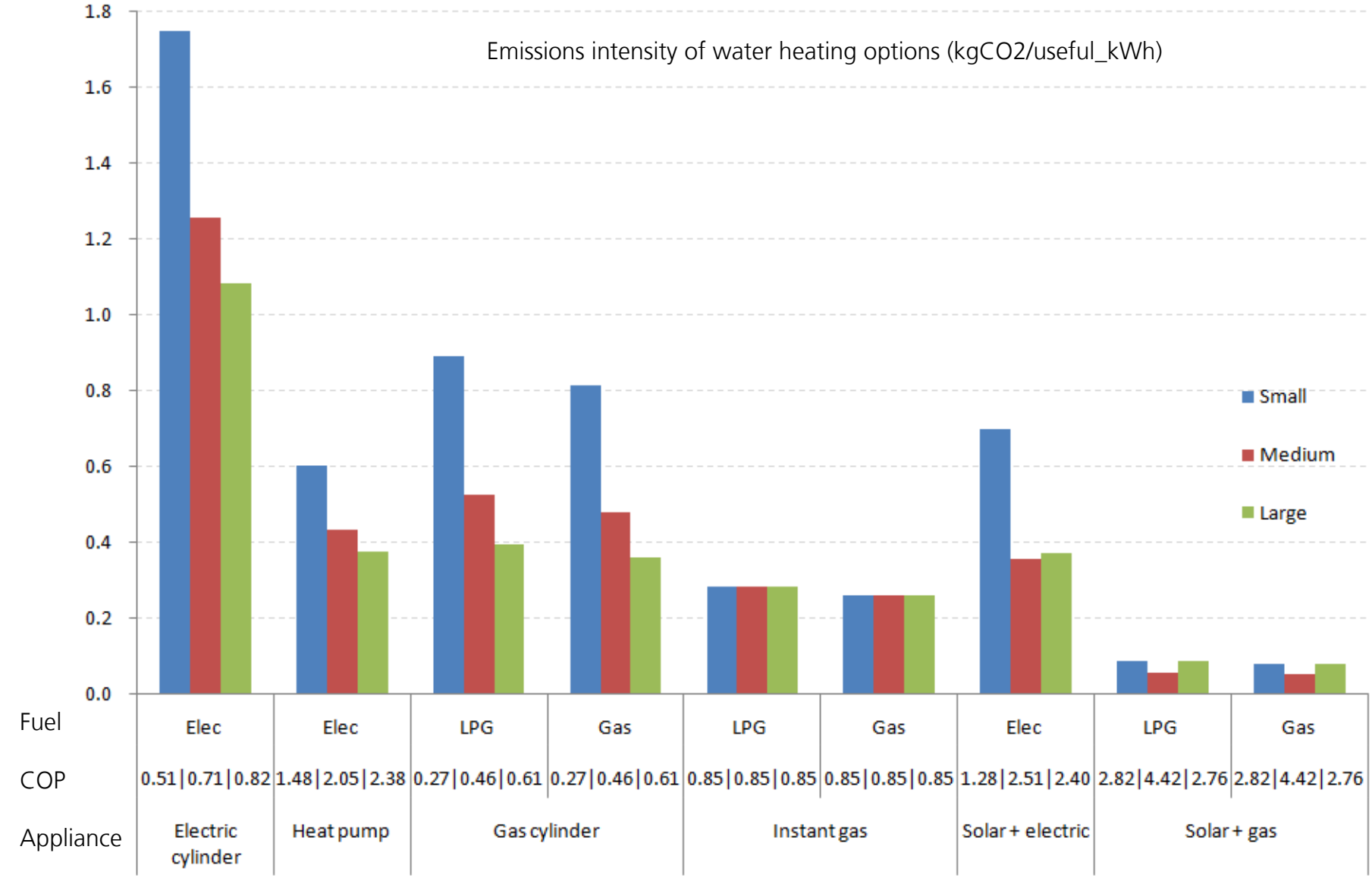

Note: This may be an over-estimate for electricity for water heating use. However, this is unlikely to materially alter the conclusions

- The high electricity emissions factor is because the economics of meeting a peaky load shape are best served by Huntly on coal, rather than a new renewable plant
- The electricity emissions factor for a *baseload* demand shape would be a lot lower

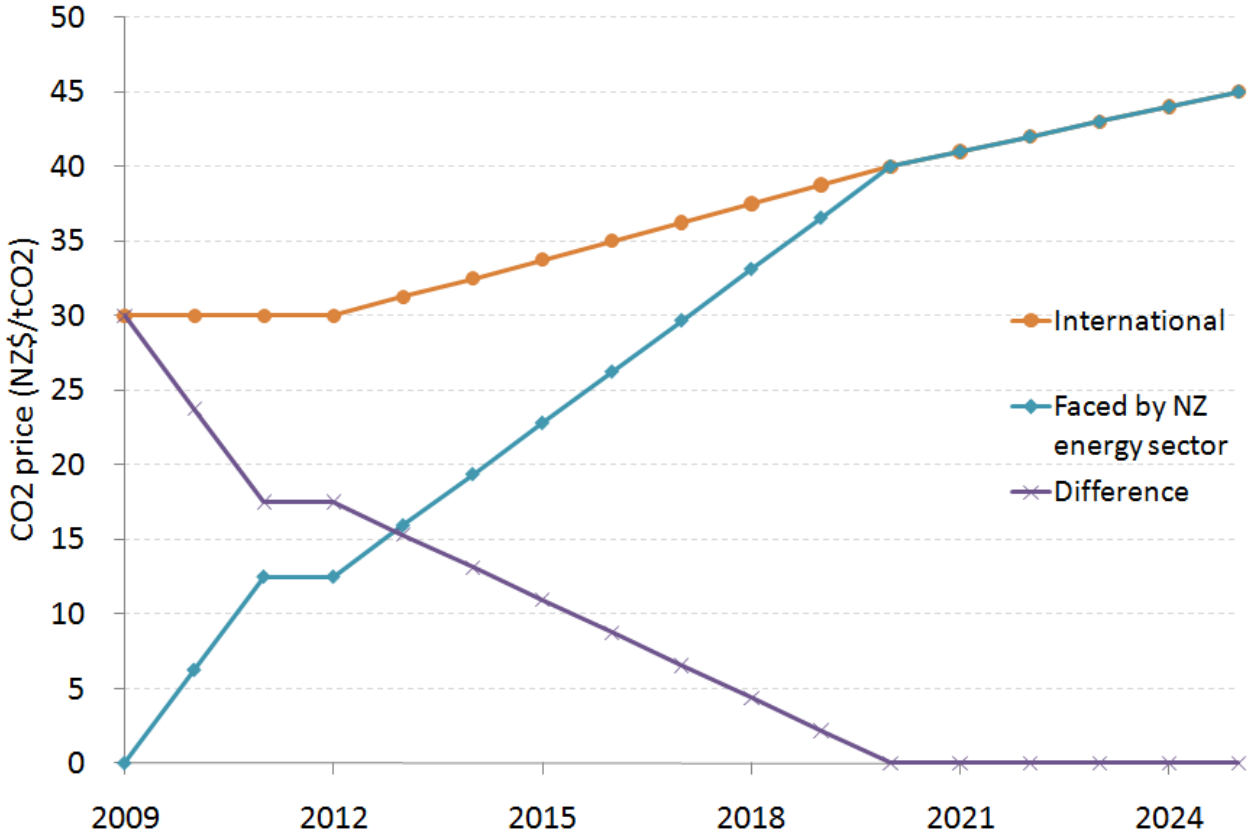
# The high COP of electric heat pumps has a major impact on the effective appliance emissions intensity (1)



# The high COP of electric heat pumps has a major impact on the effective appliance emissions intensity (2)



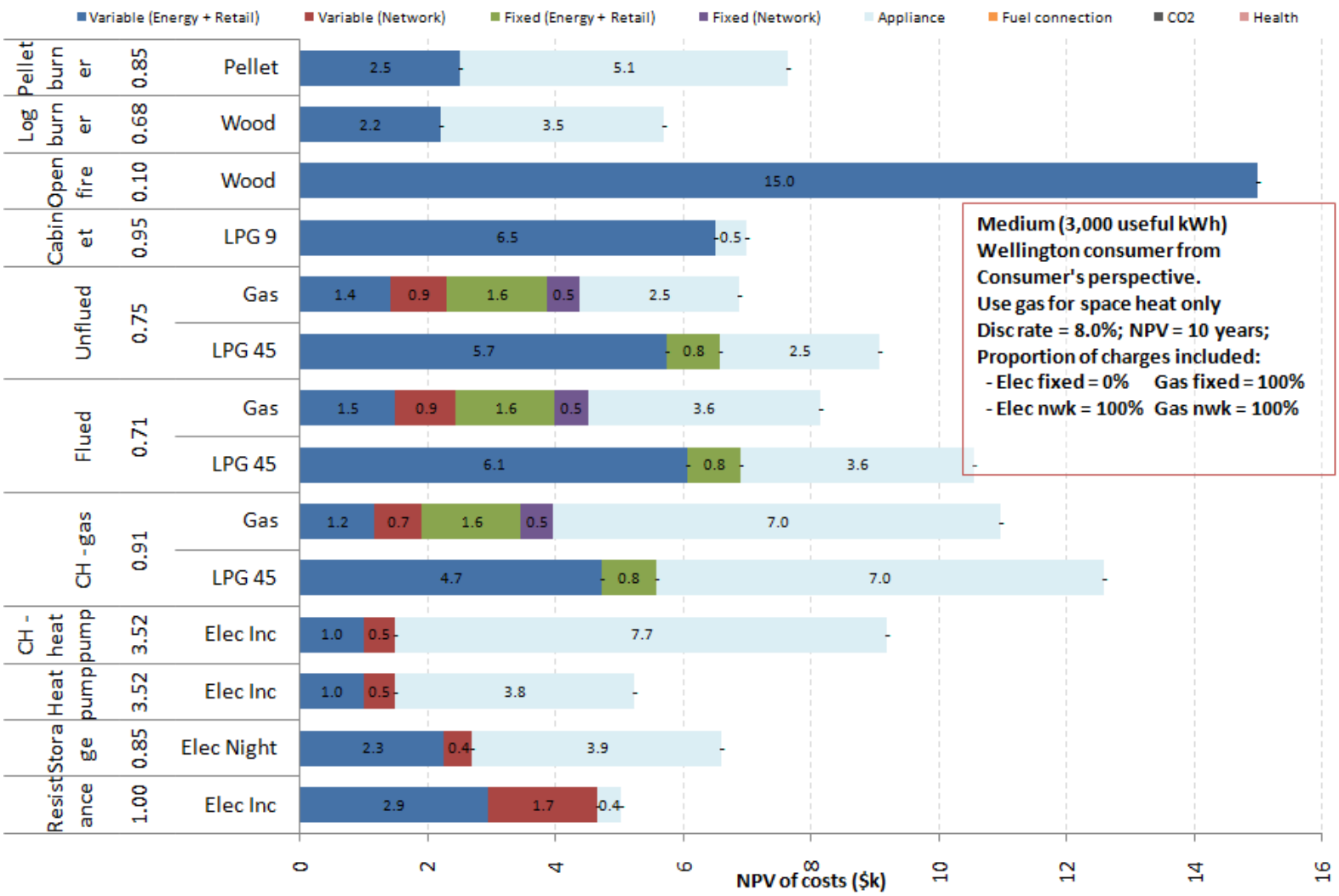
# The difference between an international cost of CO2 and the NZ ETS price was projected



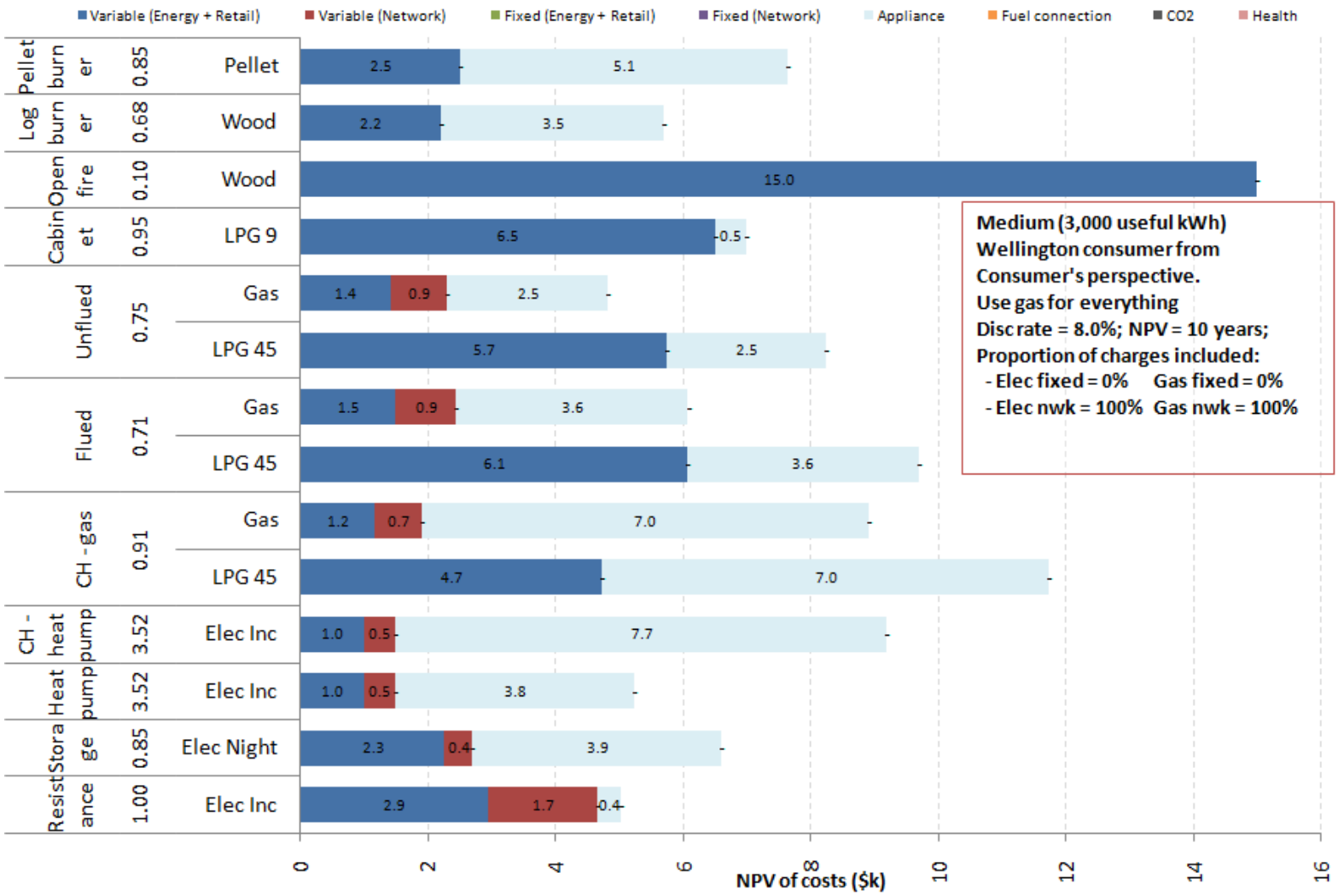

Note: This is likely to be an over-estimate of the difference post-2012. However, this will be unlikely to materially alter the results.

- Only the <u>difference</u> between the international price of CO2 and the domestic price under the NZ ETS should be considered for the CO2 externality for NZ Inc cost
  - The NZ ETS cost has already been factored into fuel prices (incl. electricity)

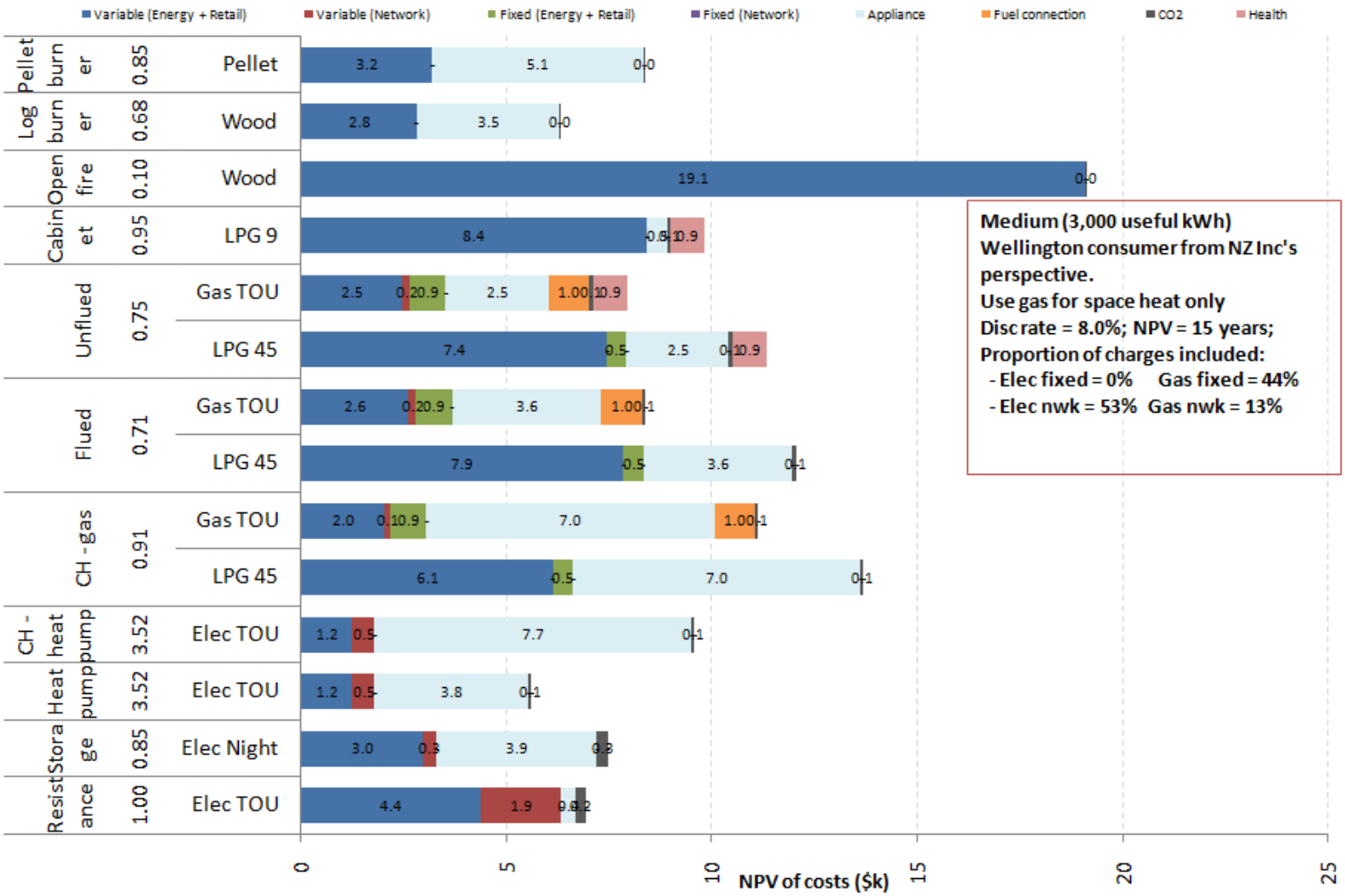
# Example of cost build-up (1): Consumer, Gas for SH only



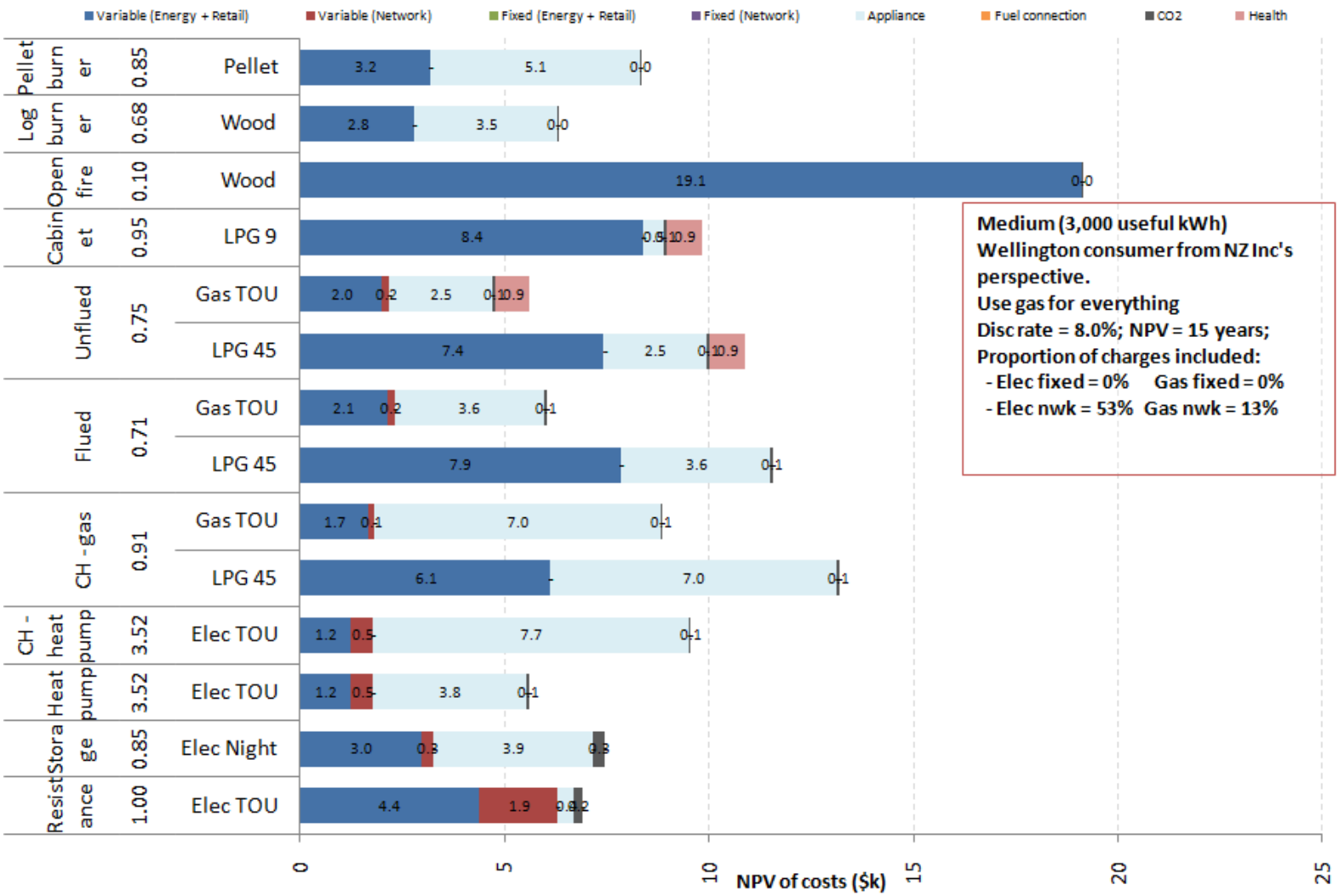
# Example of cost build-up (2): Consumer, Gas for everything



# Example of cost build-up (3): NZ Inc, Gas for SH only



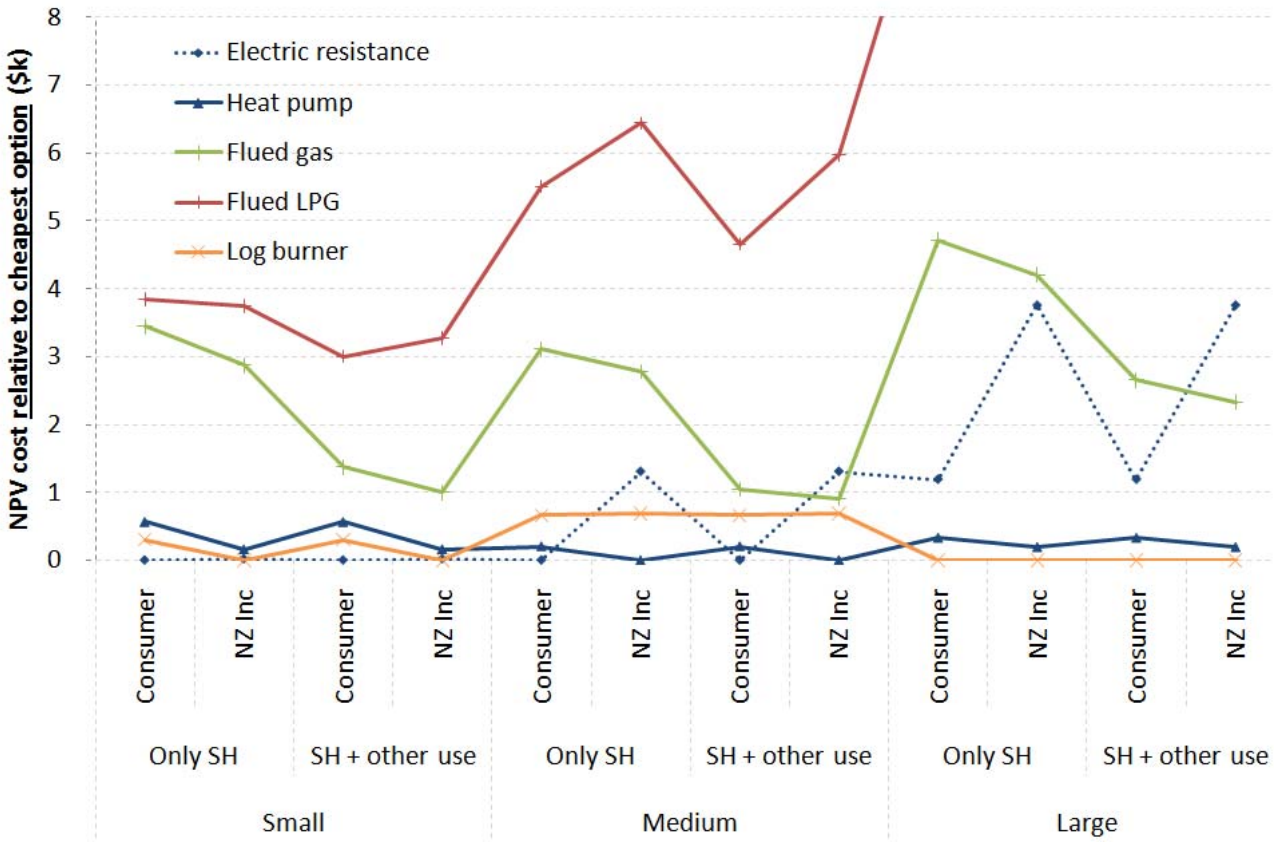
# Example of cost build-up (4): NZ Inc, Gas for everything



# RESULTS

- Space heating
- Water heating
- Industrial boilers

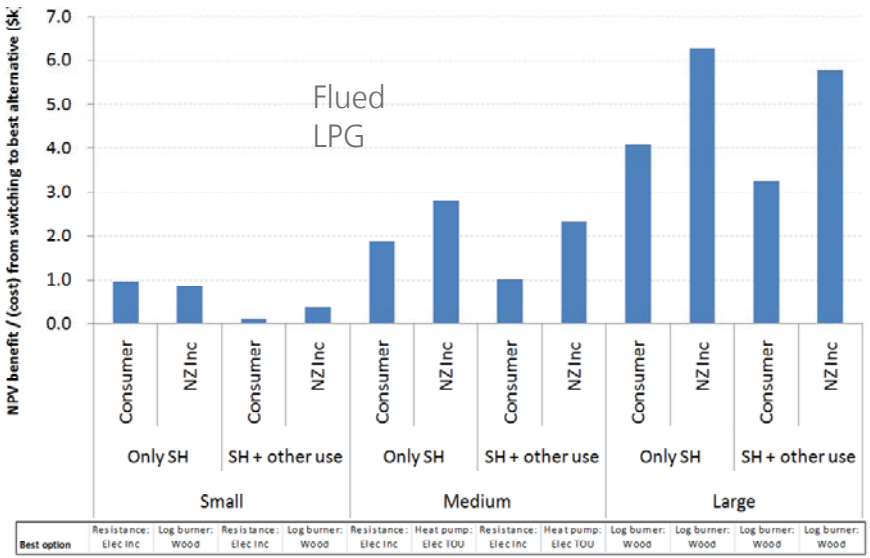
# Gas does not appear to be the best new-build option for space heating

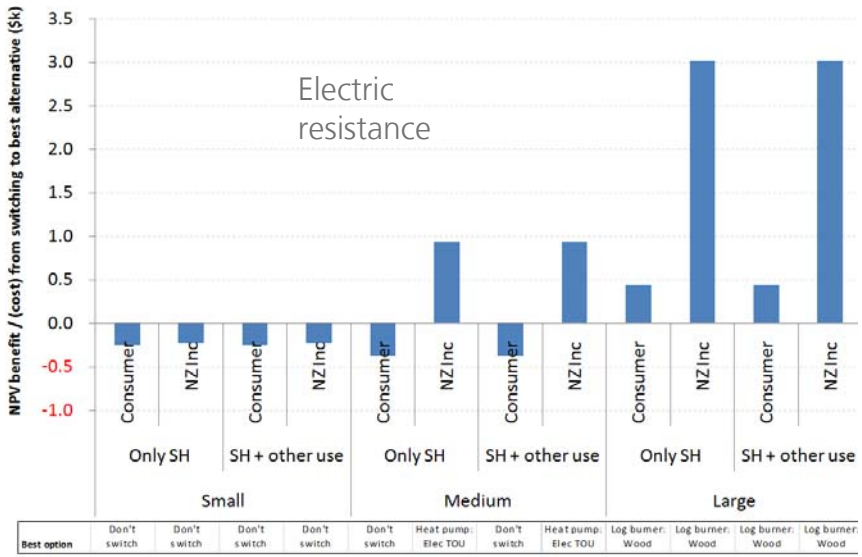



- For small users, appliance capital costs dominate the economics
- For medium & large users, the best options are heat pumps (due to high COP) and log burners (due to low fuel and medium capital costs)
- Gas fixed costs severely hamper single gas application economics
- Only the economics of electric resistance heaters appear to exhibit major dislocations between public and private benefits (largely due to the time-of-use nature of electricity costs not properly featuring in consumer prices)

# Only for people with certain types of existing space heater does it make sense to switch away

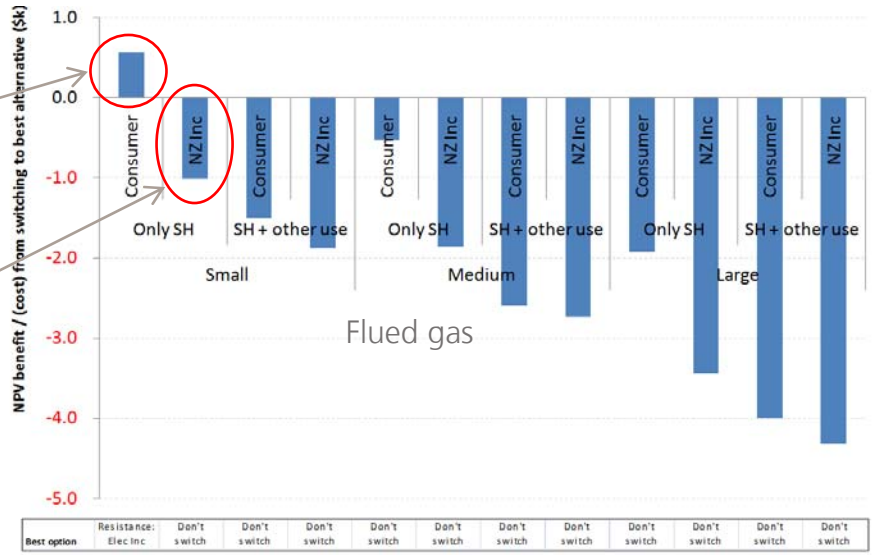
The high variable fuel costs of LPG and electric resistance heaters make it economic for larger consumers to switch away to the best alternative option




The high fixed charges of gas make it economic for small consumers who only use gas for space heating to switch away....

... although from an NZ Inc perspective, the sunk gas network costs make such switching uneconomic



# The best space heating option is very situation specific

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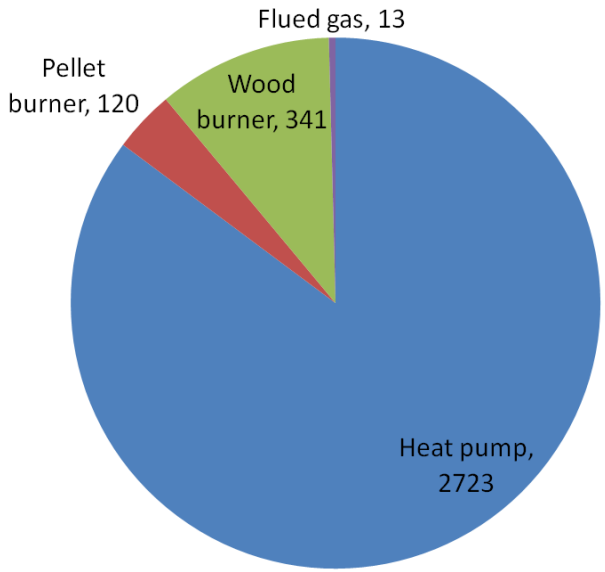
# Observed consumer behaviour appears consistent with these results

- Very few people have taken advantage of the EECA clean heat subsidy for gas heating compared to heat pumps

Level of uptake during 1st quarter of EECA's warm-up NZ programme




- The majority of instances of people switching away from gas are where they only use it for space heating

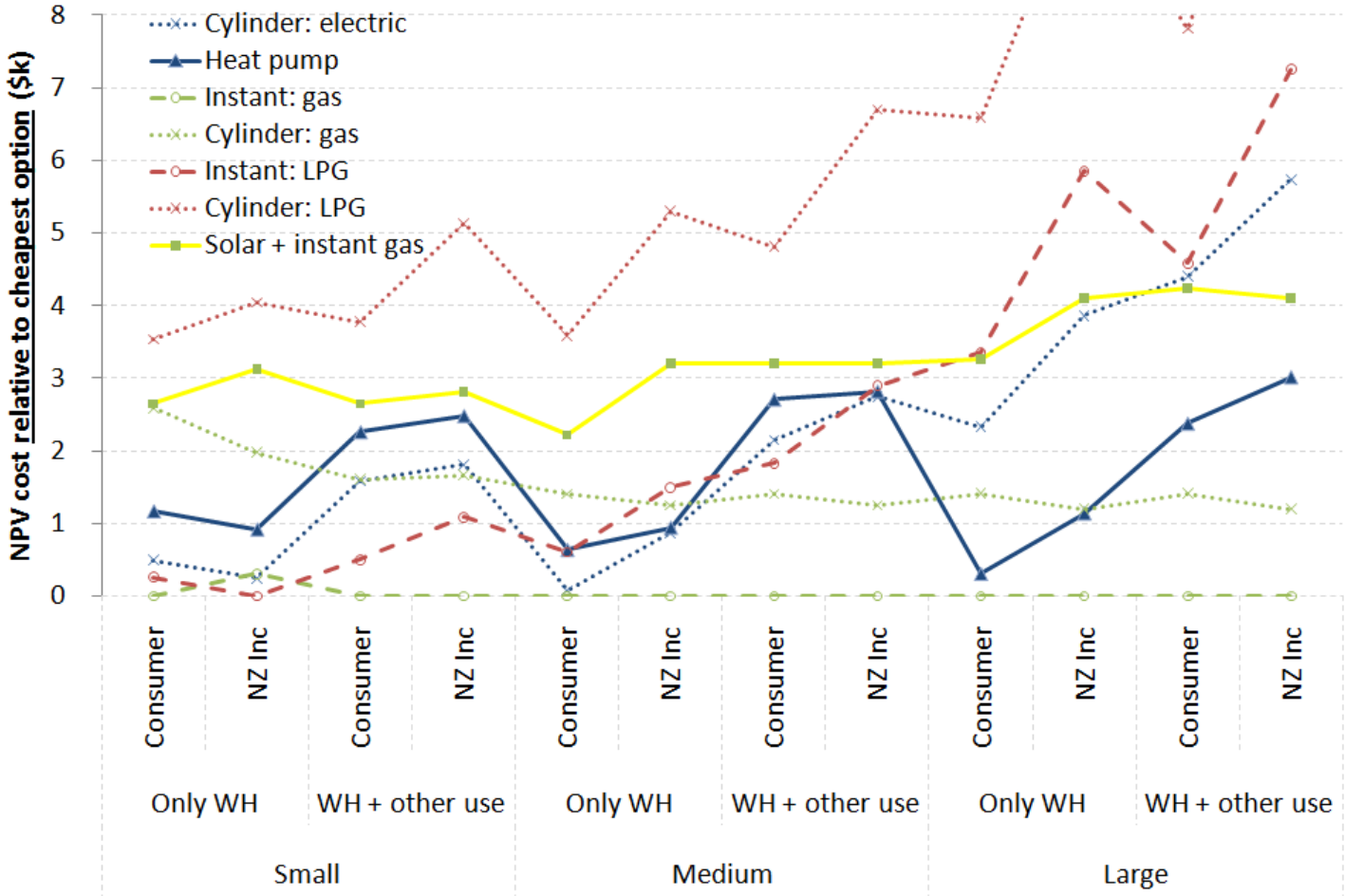
# What about utility-type factors, and possible long-term trends?

- Lack of controllability of log burners may materially affect their economics (and utility)
- Publicised concerns about heat pumps not performing as required appear largely to be due to people installing under-sized heat pumps, and predominantly be in the South Island (where gas is not an option)
- Gas heating can heat up a home quicker. However, for a properly insulated home this should be less of an issue
- Heat pumps also deliver space cooling benefits which haven't been factored into the analysis. This should improve their net benefit
- In the long-term, it is likely that improvements in appliance efficiency and reductions in appliance cost are likely to occur at a faster rate for heat pumps than other appliances, further increasing their relative benefit

# RESULTS

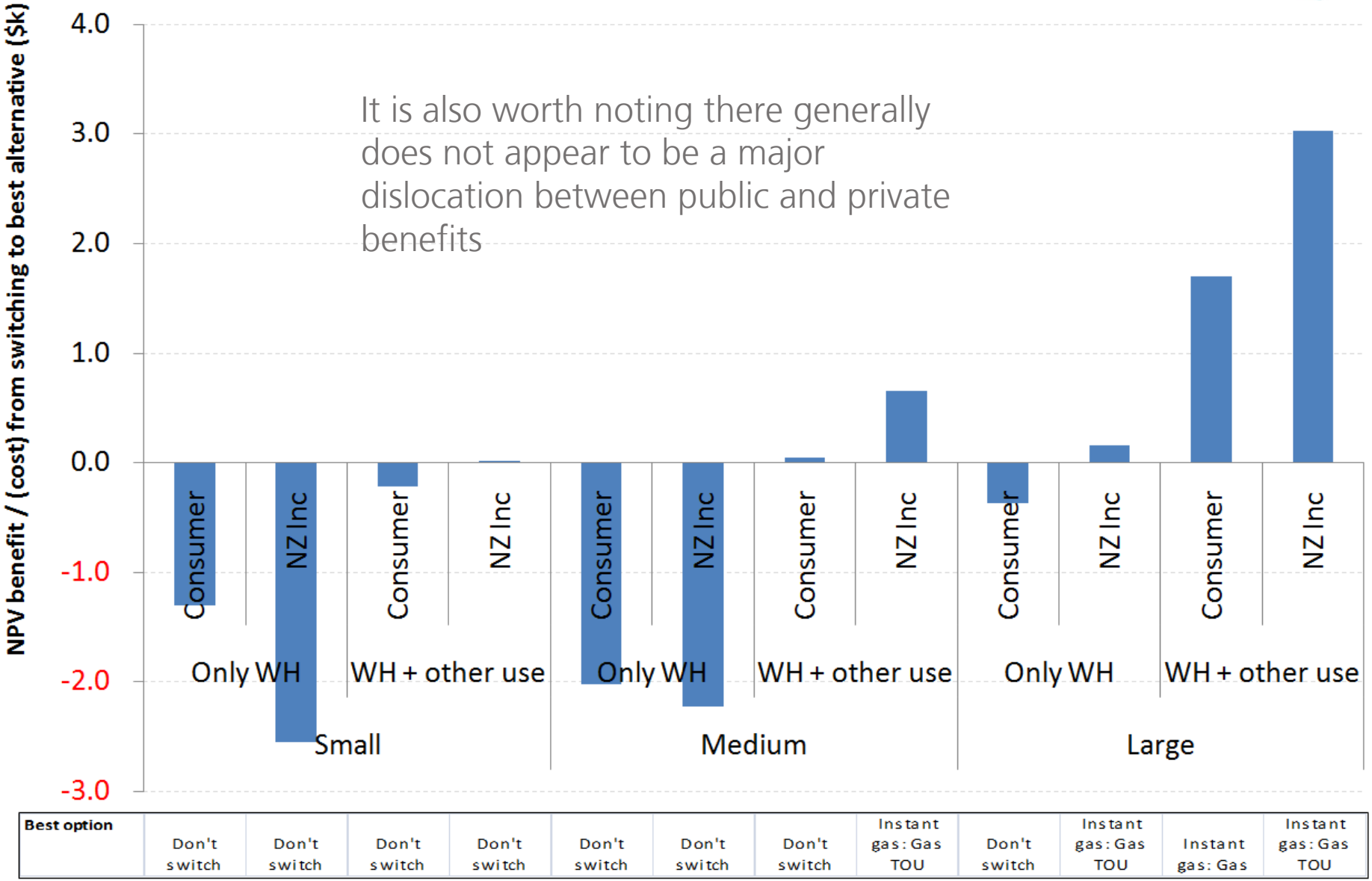
- Space heating
- Water heating
- Industrial boilers

# The best new-build water heating option is predominantly instant gas




- Where gas is used for other appliances as well it is the clear winner
- Where gas is only going to be used for water heating, electric cylinders and heat pumps get close to instant gas
- The high capital cost of solar is the main negative factor for its economics

# Switching from an existing electric cylinder only works for large consumers who will use gas for other applications




| Best option | Don't switch | Don't switch | Don't switch | Don't switch | Don't switch | Don't switch | Don't switch | Instant gas: Gas TOU | Don't switch | Instant gas: Gas TOU | Instant gas: Gas | Instant gas: Gas TOU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

# The best water heating option is also situation specific

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<tr><td>NZ Inc</td><td>Instant gas</td></tr>
</table>

- Observed consumer behaviour (50-65% of new properties choosing instant gas, but few conversions from existing electric cylinders) appears to be consistent with these results

# What about utility-type factors, and possible long-term trends?

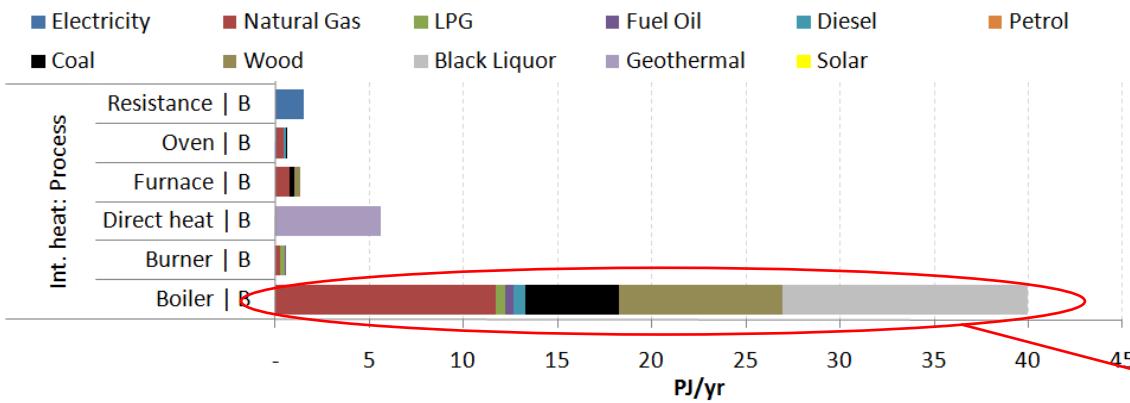
- The fact that instant gas water heaters never ‘run out’ may provide considerable utility to some consumers
- However, from a public policy perspective this does appear to result in significantly greater water consumption (approximately 2x according to HEEP data)

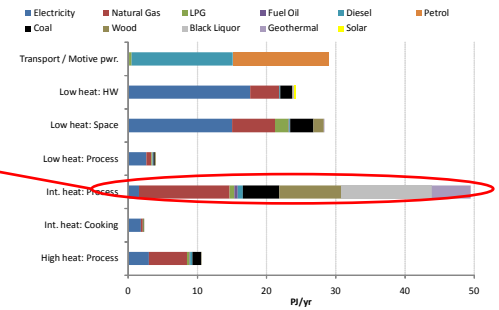
- In the long-term, it is likely that improvements in appliance efficiency and reductions in appliance cost are likely to occur at a faster rate for heat pumps and solar water heaters than other appliances
- This may make heat pumps more cost-effective than instant gas for some new-build situations in the future

# RESULTS

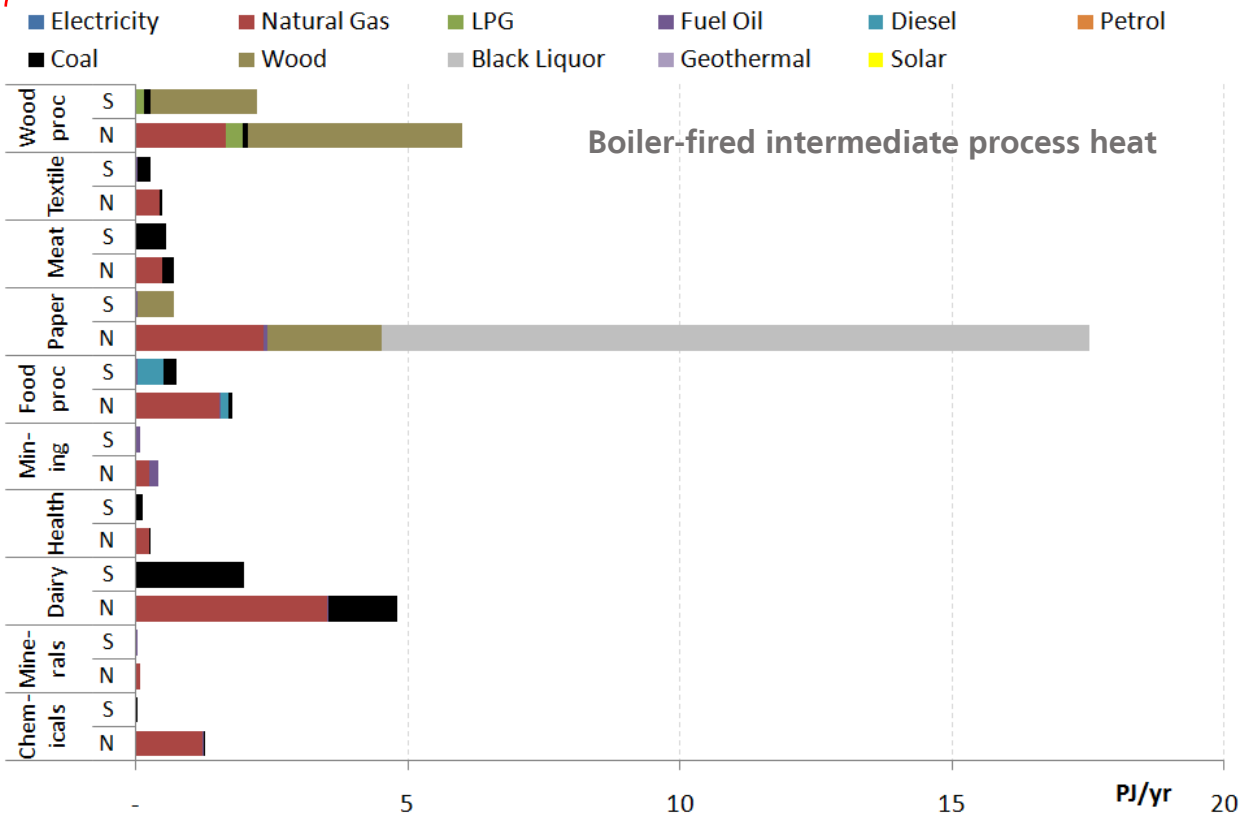
- Space heating
- Water heating
- Industrial boilers

# The fuel switching focus for intermediate process heat is boilers for a few North Island industrial sectors

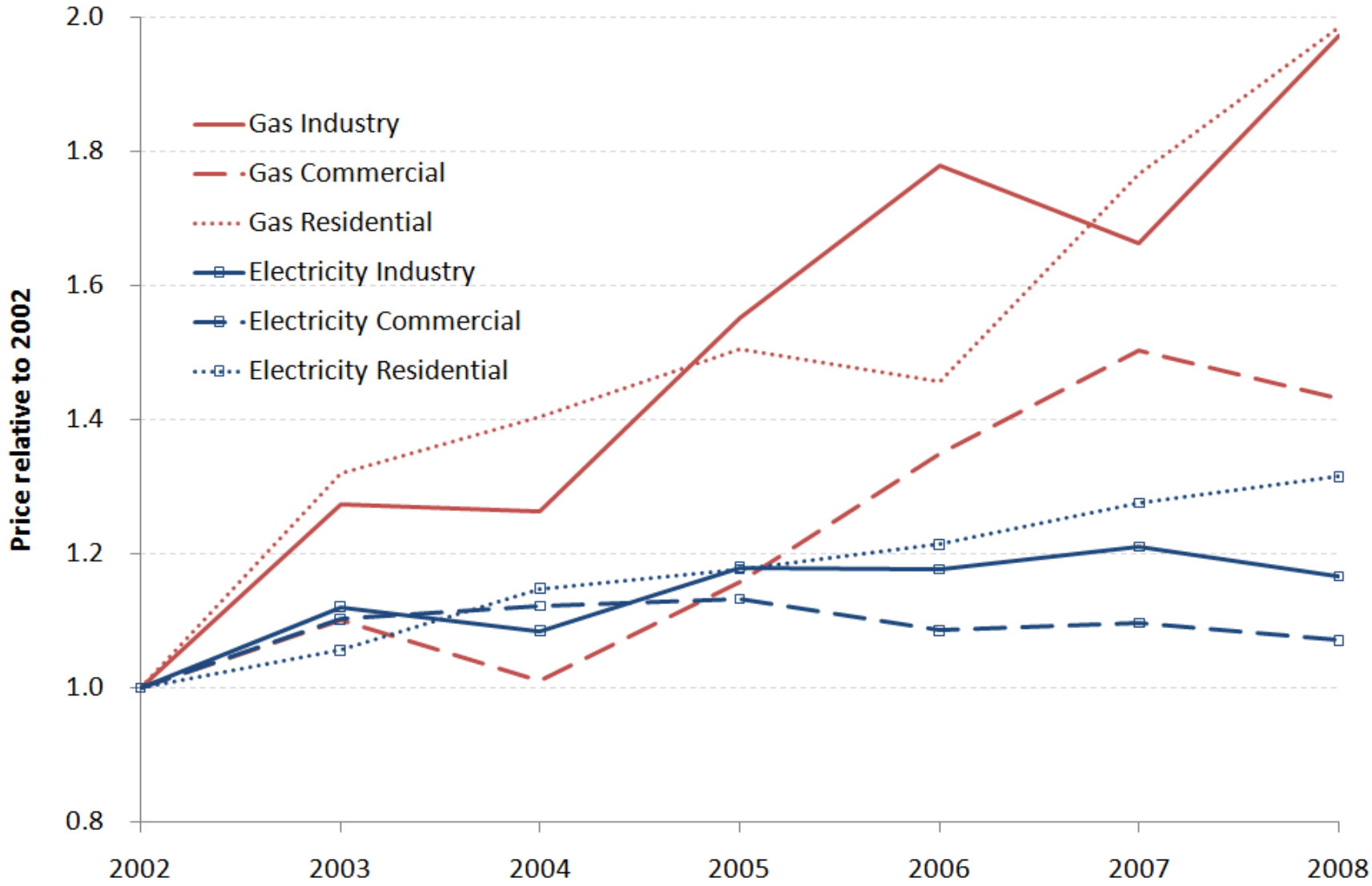


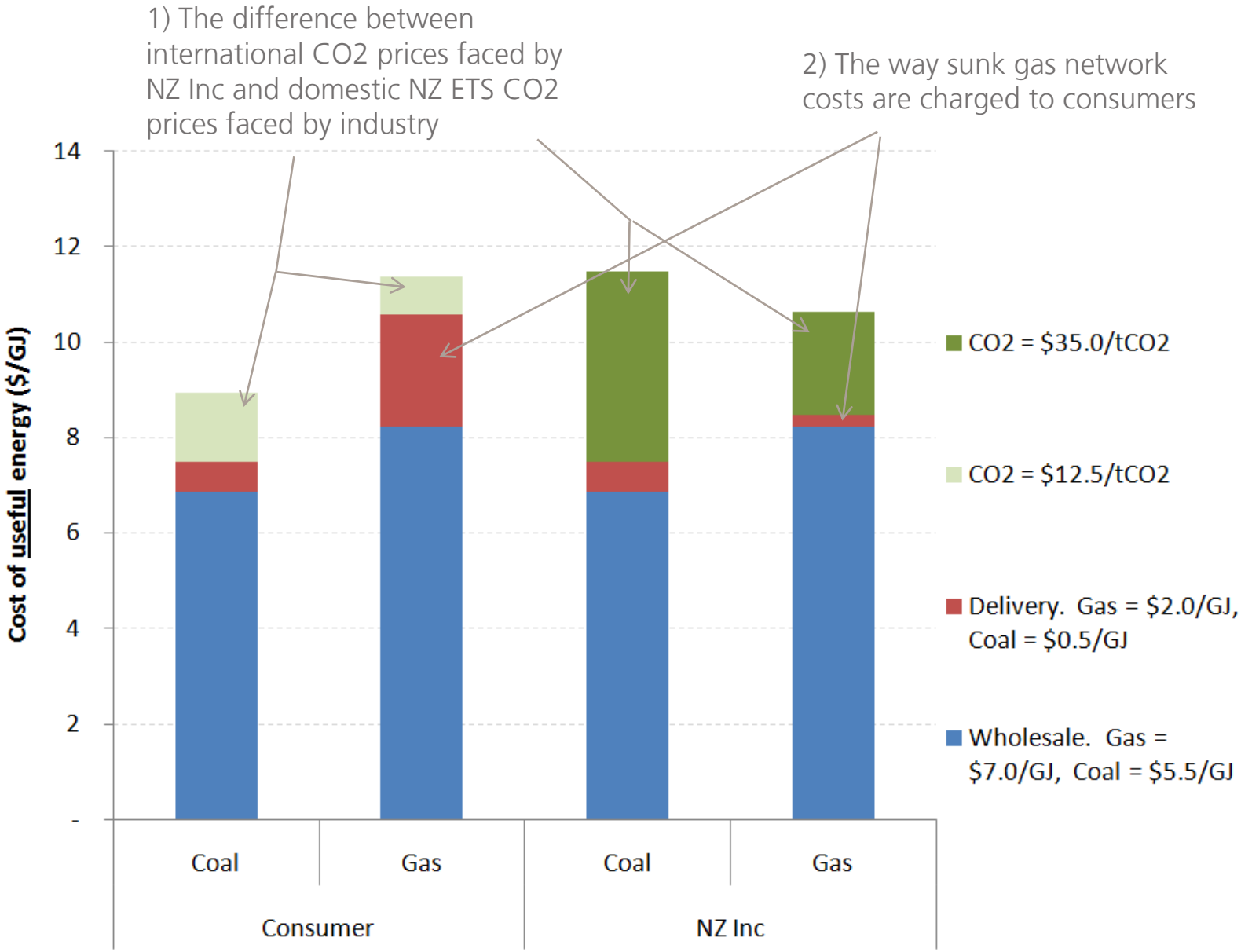

- In the paper & wood sectors, gas' main competition is biomass
- For other sectors it is coal



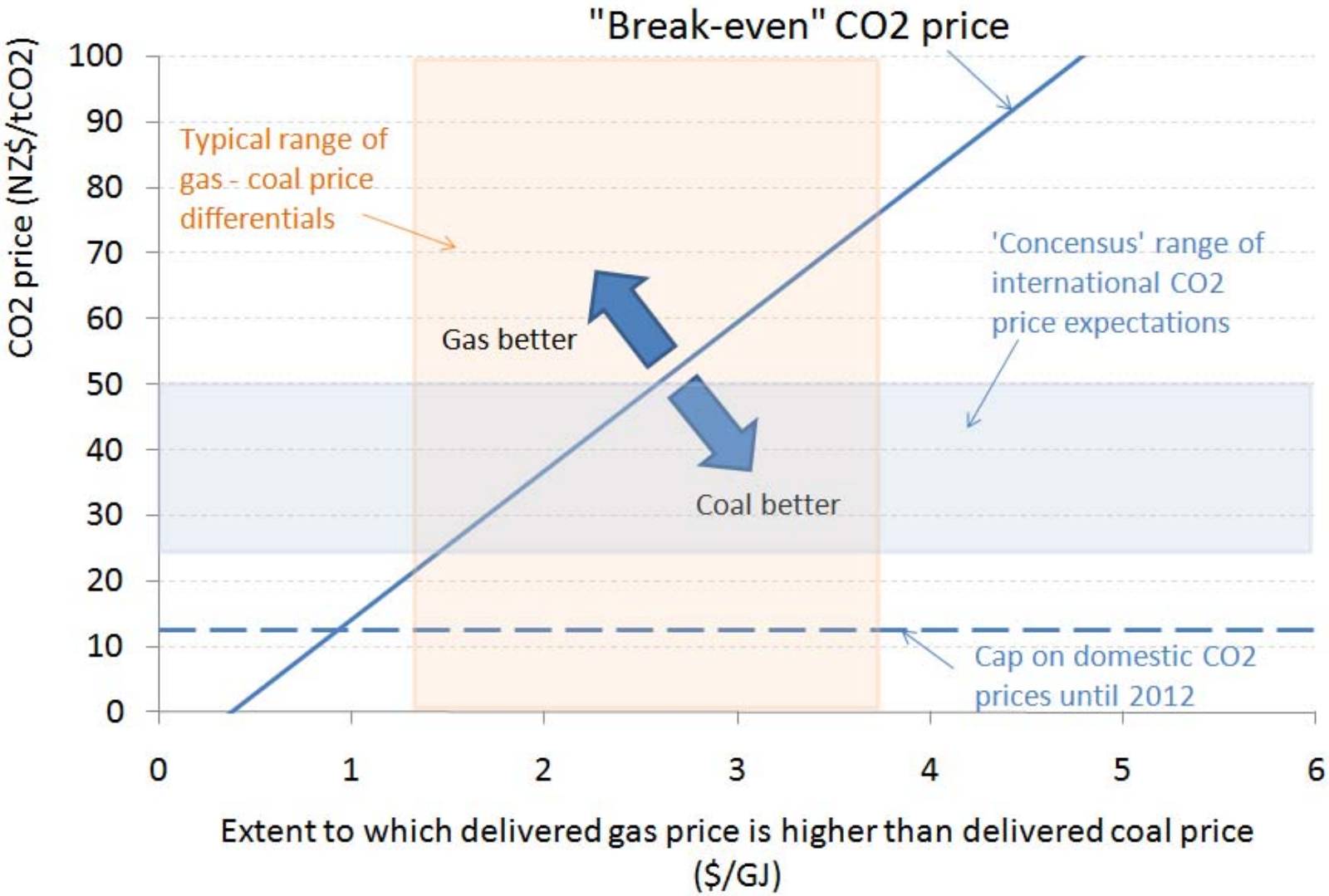
# Recent gas price movements are causing some industrial users to consider switching *away* from gas



# Two factors have the potential to create a dislocation between public and private benefits for gas / coal choices



# The cap on CO2 prices may have some negative impact in the short term



# However, the danger of poor outcomes appears to be relatively small

- The previous analysis ignored the significant capital costs associated with switching boiler technologies
- The CO2 price cap is due to expire after 2012
- Coal prices are forecast to have some upwards price pressure over the next 5 years
- Network companies can and do apply special discounts of network sunk costs to customers for whom uneconomic fuel switching is a credible prospect

# CONCLUSIONS

# Conclusions

- There are some factors which cause dislocations between the price signals consumers receive and the public benefit based on underlying resource costs, although some of these are likely to be removed over time:
  - Removal of the NZ ETS CO2 price cap post-2012
  - Increasing time-of-use pricing through advanced meters

- The complexity and situation-specific nature of heating options may also make information a significant barrier

- Principal agent problems (eg decisions about domestic heating options being taken by builders rather than home owners) may also cause some barriers

- However, the level of uptake of gas heating technologies appears broadly consistent with what you might expect, and what might be in the national interest