Report investigates 'shifting the peaks' of electricity consumption via three residential appliances

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Dr Michael Jack of Otago's Department of Physics. Credit: University of Otago

A University of Otago study has examined the potential for New Zealand residential electricity consumption to be shifted to reduce costs

for consumers, demand on infrastructure and avoid future carbon emissions.

The study focused on shifting demand for three home appliances; heat pumps, electric hot-water cylinders, and refrigeration, because they are high use appliances and their energy demand can in principle be shifted out of peak demand periods (6-10am and 5-9pm). At these times generation, transmission and distribution infrastructures run close to or even at full capacity, especially in winter.

Co-author, Dr Michael Jack of Otago's Department of Physics, says the challenge of implementing a 100 percent renewable electricity system in the face of a projected 150-200 percent increase in demand is a significant one for New Zealand, and needs innovative approaches. This is especially true for dry years when hydro power will not be sufficient to meet demand creating a risk that New Zealand would have to invest in new fossil fuel-based generation.

"Power generators, Transpower and electricity network companies build infrastructure to cope with peak demand. If we can reduce peak consumption by shifting use out of peaks we will be taking a big step towards achieving our future targets without burdening households and the country with extra costs, and without increasing carbon emissions," Dr Jack says.

Hot-water cylinders, heat pumps, and refrigerators constitute 50 percent of the total residential electricity consumption in New Zealand. Co-author of the study, Dr Ben Anderson, a visiting Marie-Curie Research Fellow from the University of Southampton, says there are strong potential gains if the operating times of these appliances could be shifted.

"If well managed, the energy services these appliances provide would

remain the same; water will stay hot in the cylinder for people's morning showers, living spaces could be pre-warmed before 6am via smart thermostats, and fridges could remain cold despite being switched off for a short time during peak. The combined result of these interventions across millions of New Zealand households could be substantial," Dr Anderson suggests.

The results of analysis of peak-load shifting suggest that New Zealand's total electricity demand could be reduced by up to 20 percent during winter. This could equate to a reduction of national power demand during peak periods of up to 700 megawatts (MW) for hot-water cylinders, 400MW for heat pumps, and 200 MW for refrigerators, providing a total of 1.3 gigawatts(GW), or 0.9 kilowatts(KW) per household.

Report co-author, Associate Professor Janet Stephenson, Director of Otago's Centre for Sustainability, says these projections are the first stage in determining what would be achievable in reality.

"Future work will need to consider the market systems, technologies and consumer behavioural change necessary to achieve residential demand response in practice, and how consumers would respond to the opportunity to shift their demand," says Associate Professor Stephenson.

The report, Estimating the Technical Potential of Residential Demand Response in New Zealand: A Summary of Results, has been prepared by researchers at the University of Otago as part of the GREEN Grid Project funded by the Ministry of Business, Innovation and Employment.

More information: Estimating the Technical Potential of Residential Demand Response in New Zealand: A Summary of Results. hdl.handle.net/10523/8616

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