

Why Aren't We All Living in Smart Homes?

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ABSTRACT

Visions of the Future, like the Jetsons cartoons, show homes which are smart and able to control household appliances, to make living easier and more comfortable. Although much research has been carried out into the effectiveness of different visualisation techniques for conveying useful energy consumption information to householders, and in techniques for controlling the timing and coordination of appliance use, these techniques have failed to achieve widespread penetration, and the vision still seems far from a reality. This paper examines the reasons why smart home technologies have so far failed to have any real impact, which is intricately intertwined with the design of visualisations in this context, and why we are not already living in Smart Homes. It examines these questions under four sections: Technology, Consumers, Electricity retailers and Government agencies, using examples from New Zealand's electricity sector.

1. INTRODUCTION

The Smart Home is defined as "a home that incorporates advanced automation systems to provide the inhabitants with sophisticated monitoring and control over the building's functions. For example a smart home may control lighting, temperature, multi-media, security, window and door operations, as well as many other functions" [1]. By controlling household appliances, the Smart Home has the opportunity to make living easier and increase energy efficiency at the same time. Examples for easier living could be; automating lights' usage depending on brightness levels, automating air conditioning systems to switch off and opening windows at appropriate times. Energy efficiency could be achieved by delaying appliances to use cheaper off-peak energy; this would save money and reduce the demand on peak hours. If these Smart Homes are capable of bringing benefits at a household level (making living easier and improving energy efficiency) and also on a nationwide level (reduce load on peak hours and perform load smoothing), why are we not living in them? This paper will provide answers to this question under four headings: Technology, Consumers, Electricity retailers and the Government agencies.

2. TECHNOLOGY

Home automation technology is used inside Smart Homes to automate devices and appliances, to add convenience, save money, to improve energy efficiency and make living easier. This technology has the task to monitor and control appliances within the home, monitor the environment within and outside the home, and provide information to household members. The technology used to perform these tasks might include motion sensors, temperature sensors, video cameras and programmable lights. These technologies have been available since the 1970s, and home automation systems have been around for over three decades. So it is surprising that not one system has been able to make it to the mainstream [2]. Brush et al [2] conducted semi-structured home visits to 14 households with home automation, and found four main barriers to acceptance that need to be overcome by these systems: high cost of ownership, inflexibility, poor manageability and difficulty in achieving security. However, the technology is still evolving and when solutions do overcome these barriers more acceptable and affordable Smart Homes will emerge.

3. CONSUMERS

The New Zealand residential sector is estimated to account for 33% of New Zealand's electricity consumption [3]. This sector also shows almost no change in energy efficiency with only a 0.003% pa energy efficiency improvement rate [4]. This is surprising as appliances for the home are becoming more energy efficient; for example, a 10 year old refrigerator could cost twice as much to run as a modern refrigerator [5]. This section will look into why consumers are not buying energy efficient appliances and Home Automation systems.



Figure 1: An Energy Rating Label which gives an indication on the appliances energy usage and energy efficiency. Image from [6]

3.1 Energy Efficient Appliances

In New Zealand it is mandatory for some appliances such as refrigerators, freezers and clothes dryers to have an Energy Rating label (see figure 1), this label is a good indication on how energy efficient this appliance is and how much energy it consumes per year. The Energy Efficiency and Conservation

Authority (EECA) performed a study with 750 New Zealanders and found that when buying electronic appliances, price, functionality and reliability were more important to them than energy efficiency [7]. This could indicate that Energy Rating labels do not provide enough incentive for consumers to purchase energy efficient appliances, especially when a lower rating appliance is cheaper to buy.

3.2 Home Automation Systems

Below are some common barriers that prevent consumers from buying Home Automation systems:

High Cost: Kerber (2012) found that 50 percent of consumers would only spend around \$60 for a device that could save them 10 percent of their electricity bill. If we look at the costs for home automation systems (approx. \$5,000 to \$15,000 USD) we can clearly see the price range for home automation systems is far beyond what consumers are willing to spend.

Awareness: Another reason these systems are not widely integrated is because more than half of the consumers do not know about them. This can be seen in a survey by the Consumer Electronics Association, where more than 64% of consumers said they are unaware of electricity management systems [8].

Time consuming: Most systems require configuration and installation which can be a hassle and can discourage consumers as they do not want to spend the time installing, learning and configuring a system.

Frightening: These systems may seem frightening to the consumer as it can monitor and control personal appliances automatically. This may be frightening as the consumer may feel the Home Automation system will take control and limit their usage. They may also be afraid hackers taking control of their appliances.

Incentive: There are no clear time-of-use electricity rates, so consumers have no financial incentive to shift their electricity consumption. Neither are there incentives by government/utility providers and obvious major comfort incentives. As a result, consumers are not willing to go through the pain of buying, installing, configuring and maintaining a home automation system.

If home automation systems were to overcome these barriers by being low cost, widely advertised, simplistic and have financial incentives, we may see more consumers willing to buy Home Automation systems.

4. ELECTRICITY RETAILERS

Electricity retailers are becoming more aware of the importance of energy efficiency, and most of these companies in New Zealand now provide tools for consumers to track their usage. Some tools, such as the Good Energy Monitor (GEM) from Mercury, go even further and allow goal setting, comparison, prediction, message alerts and also energy saving tips [9]. These tools are great as they promote energy awareness and efficiency. However, this report is more focused on why these electricity retailers are not promoting more energy efficient technology such as Home Automation systems to allow automated load shifting and reduction in appliance usage.

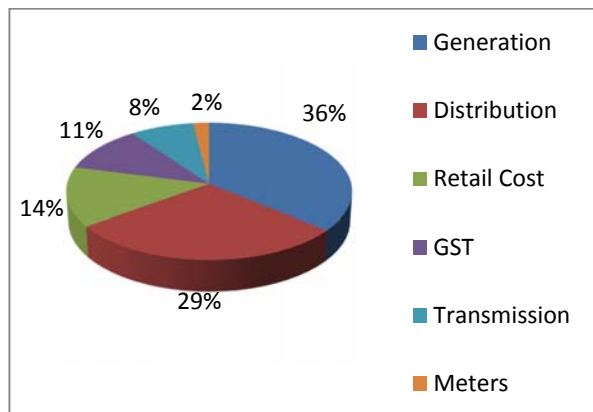


Figure 2: What the typical Residential Consumer pays for in electricity cost. Source [10]

To understand this we have to look at how consumers are paying electricity retailers for their electricity usage. Figure 2 shows that the money paid to the electricity retailers is split into shares paid to different agencies in the electricity sector. Electricity retailers typically receive only 14% of the price paid by consumers. The price the consumer pays is made up of two parts: a “fixed charge” and a “usage charge”. The “fixed charge” is to ensure the retailers do not lose money. It covers the costs of using the distribution and transmission power lines. Furthermore it is static as the distribution companies charge a fixed price (each day) to have the resources available to supply households with electricity, regardless of how much electricity is being used (this also covers what the distribution company pays the Transmission lines company to use their network) [11]. Electricity retailers make most of their profit through the “usage charge”, which is the charge for each unit of electricity being consumed. Generally, the more electricity one consumes, the more profit is returned to the retailer. This is why these retailers are hesitant in promoting technology such as Home Automation, as it could reduce electricity consumption, resulting in a lower profit.

However, since electricity retailers are competing to recruit and keep customers by catering to their needs, we may see more retailers promoting Home Automation systems when they are better known and more desirable.

5. GOVERNMENT AGENCIES

There are many different agencies which all play an important part in the electricity sector. This section will focus on the Energy Efficiency and Conservation Authority (EECA). The EECA is a government agency which is responsible for promoting energy efficiency. This includes improving energy use in New Zealand homes. EECA does this through a number of residential initiatives stated below [12]:

Product standards and labeling: Energy efficiency standards and labeling for certain products such as fridges and dryers are regulated in New Zealand by EECA. This allows consumers to compare energy use through labels (e.g. the Energy Rating label shown in figure 1) and to keep out non energy efficient products from the New Zealand Market.

The Energy Spot: A TV campaign that has aired series since 2009 which promotes energy efficiency to homeowners and businesses, by providing practical information and advice on energy use. Around 2.4 million New Zealanders have viewed

this series and 41% of these viewers have said it has influenced them in reducing energy consumption [12].

RightLight: RightLight is a website and an information campaign to encourage consumers to find energy efficient lighting alternatives. One of the approaches is a webpage tool which allows users to compare different light bulbs, to find the most energy efficient and cost effective alternative.

Energywise information: A programme which uses a website, brochures, advertising and media releases to provide information on energy-related decisions. This includes information on general home energy efficiency, government funding, energy choices and also energy labeling.

Warm up New Zealand – Heat Smart: A four year programme which ran from 2009-2013. It provided insulation subsidies for homeowners with houses built before 2000. This subsidy ranged from 33 to 60% of the total cost of insulating the house to a required standard. This programme was a success and managed to insulate 235,000 New Zealand homes [12].

Warm up New Zealand – Healthy Homes: This programme started in 2013 and is a follow up to the Warm up New Zealand – Heat Smart programme. It provides free insulation for households with a low-income, with the aim to provide a warmer, drier and healthier home to people who need it most.

Smart Homes can improve energy efficiency and with government subsidies there would be more incentives to buy Smart Home technology; however there is no such subsidy in New Zealand. If we look into the residential initiatives of EECA, we can see they are more focused on providing a warmer and healthier home than providing Smart Home Automation. This is understandable as the mean temperature for New Zealand living rooms and bedrooms in winter fails to meet the World Health Organisation (WHO) optimum indoor temperature which is 18°C to 24°C [13].

6. CONCLUSION

This report has provided answers to the question “Why aren’t we all living in Smart Homes?” by examining the issue under four headings: Technology, Consumers, Electricity retailers and Government policies. It has shown that this question cannot be answered with one simple reason, but instead is influenced by many reasons from each different section studied above. However, all hope is not lost. When Smart Home technology becomes cheaper, more flexible, easily manageable and secure, we will see this technology being widely acknowledged and promoted. This will lead to more consumers wanting these systems, and may lead to financial incentives (such as subsidies and/or lower electricity prices at certain times of the day) from electricity retailers, as they try to compete for consumers. Once this happens we will see more integration of Smart Homes, with household members living more comfortably and energy efficiently.

7. REFERENCES

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