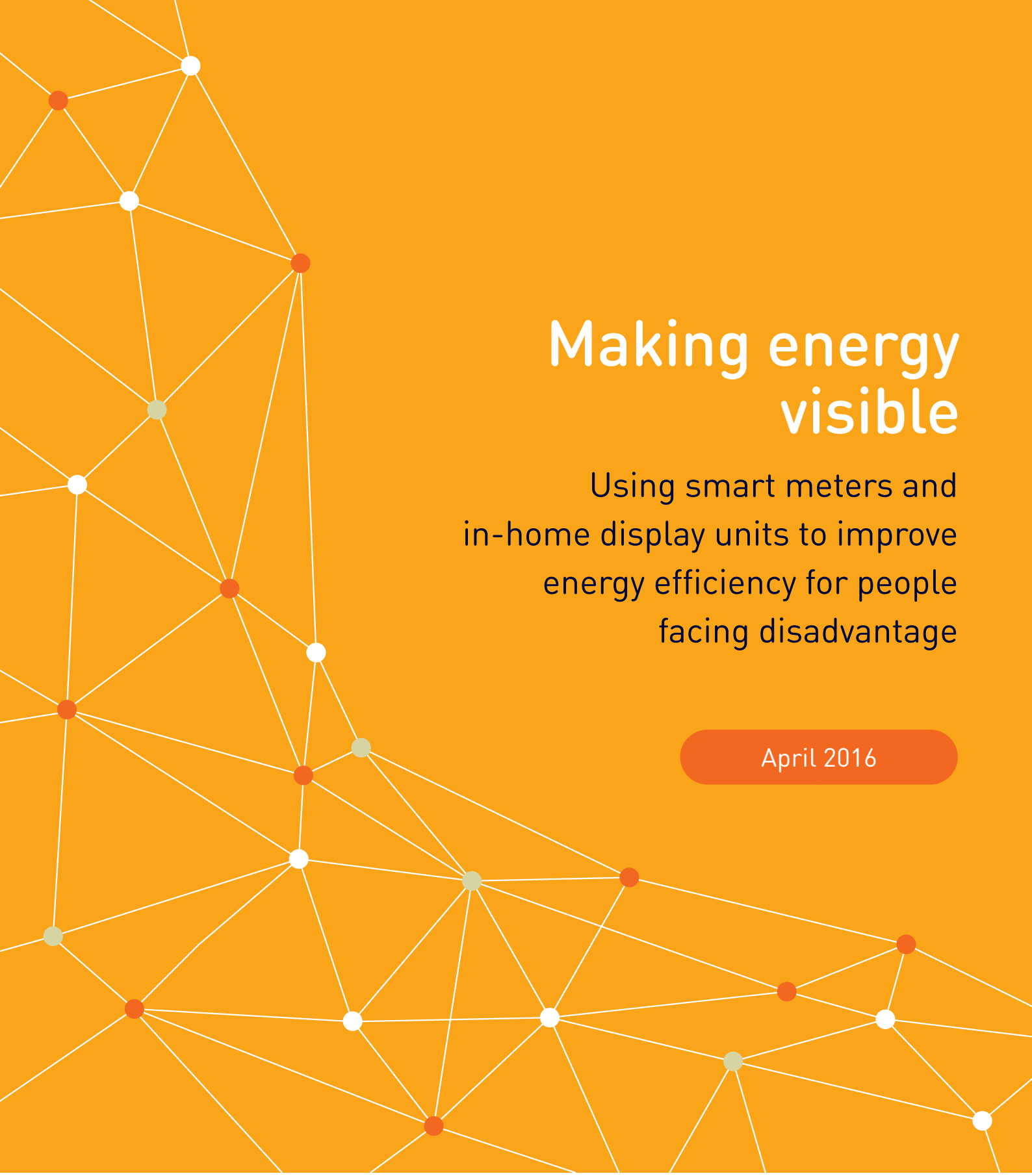

Making energy visible

Using smart meters and in-home display units to improve energy efficiency for people facing disadvantage

April 2016

VCOSS
Victorian Council of Social Service

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About VCOSS

The Victorian Council of Social Service (VCOSS) is the peak body of the community sector in Victoria. VCOSS works to ensure all Victorians have access to and a fair share of the community's resources and services, through advocating for the development of a sustainable, fair and equitable society. VCOSS' membership reflects the diversity of the community sector, with members ranging from large charities, peak organisations, small community services, advocacy groups, and individuals involved in social policy debates. VCOSS respects the land we live in, recognises its original custodians, and is committed to reconciling all injustices with Aboriginal and Torres Strait Islander people.

This report was produced by Dean Lombard, VCOSS policy advisor.

VCOSS acknowledges the traditional owners of country and pays its respects to Elders past and present.

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Contents

Executive summary

When energy costs leave households without sufficient funds for other necessities, it can push them into financial hardship. Having low incomes can also increase households' energy use and costs, as people cannot afford the energy saving modifications and appliances that would reduce their electricity use. Victorian households having difficulty meeting their energy costs use more than twice as much energy as their neighbours.[1] By understanding how electrical appliances use energy, and how household practices affect energy use, people can keep their energy costs down and improve their wellbeing.

Nearly every Victorian home has a *smart meter* installed. By the end of 2015, the Victorian Auditor-General estimates Victorians will have paid $2.2 billion in payments for the smart meter rollout, but many of the benefits of this program have not been realised.[2] By using the technology to enable people, especially people on low incomes, to better manage their energy use and compare energy prices and offers, the potential benefits of smart meters can be better realised.

In-home displays (IHDs) are devices that can be installed in people's homes and link to data from their smart meters, to tell them how much energy they are using in real time. By helping people understand their energy use, IHDs can assist them to use energy more effectively and lower their costs. This is particularly important for households facing poverty and disadvantage, to help prevent them experiencing energy-related financial hardship (energy hardship).

Making energy visible examines and compares the practical features of different IHDs and assesses their suitability to help low-income households manage their energy use. It also identifies policy, regulation, and industry practices that compromise the benefits of IHDs. It is hoped this report will assist people and organisations advising households of the potential benefits of IHDs, such as home energy auditors or financial counsellors, and inform and improve energy policy and energy market operations. With better advice and regulation, people facing disadvantage can be supported to access energy for essential home use, without accumulating debt, facing the threat of disconnection, or needlessly going without heating or other essential electricity uses.

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1 Essential Services Commission, *Supporting Customers, Avoiding Labels: Energy Hardship Inquiry Draft Report*, ESC, Melbourne, 2015, p. 32.

2 Victorian Auditor-General's Office, *Realising the Benefits of Smart Meters*, September 2015.

Four IHDs were assessed for this report: the *Watts Clever*, the *eKo*, the *Pipit 500*, and the *Ingeni*. These devices have several common and some unique features. Each device has relative strengths and weaknesses; and each suits some purposes better than others.

Our overall assessments, based on the features assessed in this report are:

- The **Pipit 500** as a default choice, as it is a solid performer across all areas.
- The **eKo** for households where the priority is to have attention-grabbing real-time feedback and bill prediction, and for those who either have access to an online customer portal[3] for reviewing historical use, or no major need to see their energy use history.
- The **Ingeni** for households that wish to understand their energy use history and have a reliable Windows computer, and no major need for real-time feedback.
- The **Watts Clever** for households that lack the internet access required for setup of other types of devices, or those that lack a ZigBee wireless connection.

There are also several policy, regulatory, and industry practice issues identified in this report that would, if addressed, improve access to and the usefulness of IHDs for Victorian energy consumers, especially those who are facing disadvantage. These include:

- Supporting households facing disadvantage to improve their knowledge of, access to and use of IHDs, including removing unnecessary cost barriers.
- Reducing barriers to connecting IHDs to smart meters.
- Improving access to electronic data on energy offers to help people determine their value based on their real electricity use.
- Addressing outstanding privacy concerns around smart meters.
- Improving the ability of IHDs to work with different types of smart meters.

3 Some distribution businesses and some energy retailers provide online portals where customers can log in to see their historic energy use and other information.

Recommendations

This report identifies some shortcomings in the policy and regulatory framework, energy business practices, and IHD characteristics. Changes could be made to improve the customer experience of IHDs and maximise their potential to help all Victorian households better understand and manage their energy use, and especially assist low-income and vulnerable Victorians reduce their risk of debt or disconnection. VCOSS makes the following recommendations to the Victorian government, energy distribution businesses, energy retail businesses and IHD manufacturers:

> Increase awareness of in-home displays to improve energy literacy

- Provide people with more information on in-home displays, including how to purchase, install, connect and use them, in energy literacy promotional materials produced by the Victorian government and energy companies.

> Reduce the cost of in-home displays for households facing disadvantage

- Encourage or require energy companies to provide, install and assist households to use in-home displays for free if they are in an energy hardship program.
- Invest in a Victorian government energy efficiency program for households experiencing disadvantage, which includes an additional subsidy to offset the purchase cost of in-home display units.

> Provide better data to compare energy offers

- Make it easier for people to access their personal energy use history to compare available energy offers.
- Improve the Victorian government's energy offer database so in-home displays and energy services companies can directly access the data to inform the best choice available among energy offers.

> Make it easy for households to connect an in-home display unit

- Ensure all smart meters have a functioning wireless connection system.
- Require energy distributors to have a simple, automatic way to connect an in-home display unit to a smart meter, with an alternative available by telephone for those needing assistance.
- Require energy price information to be sent by retailers through smart meters to in-home displays.

> Regulate the cost of pre-connecting in-home display units

- Reduce or eliminate the cost of pre-connecting in-home displays, to make it easier for community projects to provide them to households experiencing disadvantage.

> Protect the privacy of smart meter data

- Prevent smart meters being able to provide households with data from a previous occupant of a home, while retaining the ability to provide historical data for the current occupant of the home from the period before the in-home display was connected.

> Enable in-home displays to read data from non-standard smart meters

- Require non-standard smart meters to communicate consistently with in-home displays to provide the most useful information to enable households to monitor their energy use.

> Improve the function of in-home display units

- In-home display unit manufacturers can:
  - Enable concession rates to be incorporated into the devices, so their value can be factored into cost displays and bill prediction functions.
  - Enhance the devices to properly read certain types of non-standard smart meters, such as *two-element meters*, including for *controlled* loads.
  - Allow *demand tariffs* to be calculated by the devices.

This report also makes recommendations for individual improvements that could be made to each type of in-home display unit, which are included in the detailed assessment in Appendix I.

Disadvantage, in-home displays and the energy policy environment

Energy and people facing disadvantage

Everyone, especially people who face disadvantage, needs to access essential services such as electricity, water and gas. For many years VCOSS has advocated strongly that the energy policy framework and the operation of the energy market should not adversely affect Victorians facing disadvantage. We also promote a whole-of-government approach to reducing energy-related financial hardship for Victorians.

This report focuses on the way in-home display units can be used to assist people facing disadvantage. Disadvantage may take many forms, and the term is used in this report to cover a range of possibilities. People may have low incomes or available assets, or face other forms of disadvantage, such as having low-level literacy, limited English skills, lack of technology and internet access, or the skills to use them. People may also face physical, mental or social vulnerabilities, such as disability, being of advanced age, having a mental health condition, or being socially isolated. All of these factors can affect people's ability to understand, consume and afford their energy use, engage with the energy market and manage their energy use effectively and efficiently.

A reliable energy supply is a basic household need. Lighting, refrigeration, communications equipment, cooking facilities, hot water systems, heating and cooling all rely on a continuous energy supply. For some houses without mains water, electricity is also needed to pump stored water for household use. A loss of energy supply, or severe rationing of use, can cause adverse health and wellbeing effects, due to food spoilage, inability to cook, inability to maintain personal hygiene or comfortable room temperatures, and social isolation due to lacking means of communication, including television and internet.

The cost of energy can also push households into financial hardship when it is too high to leave sufficient money for other household necessities. This also adversely affects people's wellbeing, and is most likely to happen among low-income households, which spend twice as much on electricity and gas as a proportion of their total income than middle-income households.[4] One in five low-income households cannot pay one or more bills on time in any given year, and one in seven have their energy disconnected.[5]

Having limited resources can also increase households' energy use and costs, as people cannot afford the energy saving modifications and appliances that would reduce their electricity use. Victorian households in payment difficulty use more than twice as much energy as their neighbours.[6] Much of this may be due to poor quality housing. Almost a third of low-income Victorians are renters,[7] and the majority of private rental properties have inadequate insulation and insufficient draught-proofing,[8] which leads to high heating costs. Tenants have very little ability to improve their homes' capacity to retain heat, as they may have insecure tenure and it is difficult to modify their homes. Low-income

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4 Australian Bureau of Statistics, *4670.0 – Household Energy Consumption Survey, Australia: Summary of Results, 2012*, 2013.

5 Australian Bureau of Statistics *4670.0 – Household Energy Consumption Survey, Australia: Summary of Results, 2012*, 2013.

6 Essential Services Commission, *Supporting Customers, Avoiding Labels: Energy Hardship Inquiry Draft Report*, ESC, Melbourne, 2015, p. 32.

7 Australian Bureau of Statistics, *Survey of Income and Housing 2011–12* custom dataset, 2014.

8 Energy Consult P/L, *Housing condition/energy performance of rental properties in Victoria*, Department of Sustainability and the Environment, 2009.

owner-occupiers are not so constrained; but many are unable to afford making the changes they need.[9] Low-income households are also more likely to purchase cheaper or second-hand appliances, such as heaters and fridges, which are less likely to be energy efficient.

Core functions of in-home displays

Until recently, Victorian households could only receive information about their electricity use four times a year when their bill arrived, showing the amount used over the previous three months. If a customer had been using more energy than usual, they would likely be unaware of this until many weeks later, by which time the costs had already been incurred. If they had difficulty paying the bill, they could suddenly face debt or disconnection. Guesswork was required to determine why their use had been high.

Now, almost all Victorian dwellings have smart meters installed, which record energy use in half-hourly time periods. Smart meters can also send energy use data to IHDs, which convey the information to household members directly, in real time. Many studies have shown that, by helping household members understand their energy use, IHDs help people use energy more effectively and lower their costs.[10]

An IHD receives information about electricity use from the household's smart meter and conveys it in a user-friendly form, via different combinations of screens, indicator lights, loudspeakers, or other interface elements. While the IHDs assessed for this report work in different ways and present different types of information, the basic working principles of each are the same.

While each type of device assessed has its own strengths and unique features, they all have the same core functions, being able to display:

- Real-time electricity use
- Total use for the current day
- Historical use for the previous day, week, month, or years.

In all cases, the household's electricity use can be displayed in terms of the quantity or cost. However, cost can only be shown if tariff information has been entered into the device. Devices either require tariffs to be entered during set-up, or have default tariffs that can be changed by the user.

This report assesses the utility of IHDs commonly available in Victoria, with particular regard to their capacity to help households facing disadvantage to better understand their energy use and make informed choices in the energy market, including households that have no or limited access to the internet.

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9 Australian Bureau of Statistics, *4670.0 – Household Energy Consumption Survey, Australia: Summary of Results, 2012*, 2013.

10 For example: The American Council for an Energy Efficient Economy (ACEEE), *Advanced Feedback Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities*, June 2010; VaasaETT Empower, *The Potential of Smart Meter Enabled Programs to Increase Energy and Systems Efficiency: A Mass Pilot Comparison*, 2011; Centerpoint, *500 Unit In-Home Display Pilot – Mid Program Review*, March 2011; SilverSpring Networks/Oklahoma Gas and Electricity, *Positive Energy Together Results*, 2011; as well as over 50 studies cited by Accenture *Department of Primary Industries: IHD inclusion into ESI scheme*, November 2011.

In-home displays, smart meters and the Energy Saver Initiative

When it was first proposed to rollout smart meters to Victorian energy consumers, their ability to give real-time feedback about energy use through IHDs was provided as a core rationale. The potential value of IHDs to help households save energy and make better use of time-variant tariffs is well-documented.[11] The ability to communicate with IHDs is a core functionality outlined in smart meter specifications.

However, the Victorian government at that time decided not to include IHDs in the smart meter rollout, unlike what had been done as part of the smart meter roll-out program in the United Kingdom.[12] This created uncertainty about how households could reap the stated benefits of smart meters. For this reason, Victorian consumer advocates have called for IHDs to be provided free to households facing poverty and disadvantage, who are vulnerable to payment difficulties.

The *Victorian Energy Efficiency Target (VEET)* scheme was established in 2009 to help Victoria meet its greenhouse gas emissions reduction target, by encouraging home and business energy efficiency upgrades. It aims to make energy efficiency improvements more affordable and encourage growth and innovation in energy efficiency industries, by allowing accredited businesses to offer discounts and special offers on selected energy saving products and appliances known as accredited products. The discounts are funded by a requirement for Victorian energy retailers to buy a certain number of *Victorian Energy Efficiency Certificates (VEECs)*, each of which represents one tonne of carbon dioxide equivalent (CO_2-e) abated by specified energy saving activities known as 'Prescribed Activities'. The cost of VEECs fluctuates with market supply and demand.

The *Energy Saver Incentive (ESI)* is the name used to promote the VEET scheme. The Victorian government's *Switch On* energy information website provides consumers with information about the ESI, including information about the different types of accredited, discounted products and services available, and contact details for their supply and installation.

In 2012, IHDs were added as accredited discounted products under the ESI, recognising their energy-saving potential and responding to community concern that their cost was a barrier to low-income Victorians reducing their energy consumption.

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11 For example: The American Council for an Energy Efficient Economy (ACEEE), *Advanced Feedback Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities*, June 2010; VaasaETT Empower, *The Potential of Smart Meter Enabled Programs to Increase Energy and Systems Efficiency: A Mass Pilot Comparison*, 2011; Centerpoint, *500 Unit In-Home Display Pilot – Mid Program Review*, March 2011; SilverSpring Networks / Oklahoma Gas and Electricity, *Positive Energy Together Results*, 2011; as well as over 50 studies cited by Accenture *Department of Primary Industries: IHD inclusion into ESI scheme*, November 2011.

12 http://www.smartenergygb.org/

Increasing the usefulness of in-home displays for energy efficiency

Raising awareness of in-home displays to improve energy literacy

Recommendation

- **Provide people with more information on in-home displays, including how to purchase, install, connect and use them, in energy literacy promotional materials produced by the Victorian government and energy companies.**

If people understand how electrical appliances use energy, and how they can get better value from their energy use, they can cut their power costs and improve their wellbeing. This is particularly important for people facing disadvantage, who are most at risk of energy hardship. Households enrolled in energy hardship programs that take part in energy literacy programs outlining these issues are often able to drastically cut their energy costs as a result, even when major investments such as insulation or appliance upgrades are not possible.[13]

IHDs currently available in Victoria and assessed for this report could help Victorians experiencing disadvantage to reduce their energy costs. The rollout of smart meters across Victoria has cost the average Victorian household $760 since 2009.[14] IHDs could be used to help partly or wholly offset this cost to households over time.

IHDs can improve energy literacy in two ways. Firstly, they can inform households of the amount and costs of the electricity they are using in real time, potentially even reflecting any changes in their use of different appliances. Households can then directly and immediately see the cost consequences of changes in their use of appliances or other actions. Secondly, by providing a detailed history of a household's energy use, IHDs provide the most accurate prediction of future use, and so can help people best select the best and cheapest energy offer for them.

Cutting the cost for households facing disadvantage

Recommendations

- **Encourage or require energy companies to provide, install and assist households to use in-home displays for free if they are in an energy hardship program.**
- **Invest in a Victorian government energy efficiency program for households experiencing disadvantage, which includes an additional subsidy to offset the purchase cost of in-home display units**

Given the financial constraints households facing disadvantage often have, and the potential limitations on them making home modifications, IHDs represent one of the cheapest ways through which they can cut their energy costs. Further reducing the cost of IHDs for people facing disadvantage would improve their ability to install them. VCOSS and consumer advocacy groups have long called for the provision of IHDs at no cost to Victorian households vulnerable to bill payment difficulty or energy hardship. This could be achieved through two different mechanisms: by providing free IHDs to people in energy companies' hardship programs, and by establishing a Victorian government energy efficiency program for households facing disadvantage, including an additional subsidy to offset the purchase cost of IHDs.

IHDs were added to the ESI scheme in 2012. This was partly in response to the call to make IHDs affordable for low-income households. However, IHD affordability remains constrained by some aspects of the ESI scheme.

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13 Kildonan Uniting Care, *Research results from Kildonan's energy efficiency program, 2009–2010*, 2010.

14 Victorian Auditor-General's Office, *Realising the Benefits of Smart Meters*, September 2015, p. xi.

The effective subsidy offered through the ESI has ranged from $26 to $80 per unit,[15] which is from a little over one fifth to two thirds the current cost of the cheapest IHD ($120), and one seventh to one half the cost of the most expensive one ($170). This discount may not be enough to enable low-income households to afford an IHD; especially if the fluctuating discount level has led to IHD providers and installers hedging more conservatively against fluctuations in VEEC prices, thus lowering the customer benefit discount they offer.

A related issue is that VEEC rebates do not reduce the upfront purchase price of an IHD, because they cannot be issued until the device is installed and activated, meaning consumers are only reimbursed after installation. Low-income households, with their limited cash flow, would be better helped by direct discounts on the purchase price rather than by post-purchase rebates.

While the inclusion of IHDs in VEET is welcome, it is not sufficient to overcome the cost barriers for many households facing disadvantage. By supplementing VEET with other subsidies, more people facing disadvantage will be able to afford to install an IHD.

Providing better data to compare energy offers

Recommendations

- **Make it easier for people to access their personal energy use history to compare available energy offers.**
- **Improve the Victorian government's energy offer database so in-home display units and energy services companies can directly access the data to inform the best choice available among energy offers.**

Victoria's competitive retail energy market offers households a choice of energy providers, and all these providers offer differently structured and priced plans. This means any given household could pay a range of prices for the exact same energy use, depending on which energy offer they have chosen. For Victorian households with typical energy consumption, there is up to an $800 annual cost difference between the most expensive and the cheapest energy offer.[16]

A number of commercial and independent online comparison tools and switching websites enable people to search for a better energy offer, including the Victorian government's *My Power Planner*. This enables people to provide general or detailed information about their use and see the actual cost outcomes from different energy offers. Users can generate an approximate load profile by answering questions about household characteristics (such as composition, behaviour, appliances, and fuel mix), or upload their actual energy use data. Unfortunately, access to personal energy use data is not simple, with some retailers and distributors appearing to be unhelpful at providing data to customers in the format required, and many customers lacking the technical know-how to download the data files and upload them to *My Power Planner*.

One of the IHDs assessed for this report (the Ingeni) can compare energy offers based on the actual historical use of a household. However, its energy offers are entered manually into the app's online database by the manufacturer's staff, based on publicly available tariff information. This means it may not be always completely up-to-date and carries a risk of human error. Having energy offer details publicly accessible in electronic format is a potential solution. As well as improving the accuracy of the Ingeni's energy offer comparison feature, it would also enable more innovation in developing other tools that achieve this.

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15 VEECs went from around $40 each in early 2012 to $13 in mid-2013. Currently they are around $35.

16 May Mauseth Johnston, *Victorian Energy Prices July 2015: an update report on the Victorian Tariff-Tracking Project*, St Vincent de Paul Society, Melbourne, 2015.

Making it easy to connect an in-home display unit

Recommendations

- **Ensure all smart meters have a functioning wireless connection system.**
- **Require energy distributors to have a simple automatic way to connect an in-home display unit to a smart meter, with an alternative available by telephone for those needing assistance.**
- **Require energy price information to be sent by retailers through smart meters to in-home displays.**

All Victorian smart meters are required to provide a *home area network (HAN)*, which IHDs use to connect wirelessly and receive energy use data from the meter. A wireless system called *ZigBee* is used. Three of the four IHDs assessed for this report use the ZigBee wireless system, while one (the Watts Clever) uses its own. One of Victoria's five energy *distribution businesses*, Ausnet Services, has installed smart meters that do not have a functioning HAN, as at mid-2015. Because of this, IHDs using the ZigBee wireless system will not connect with meters in Ausnet Services' distribution zone, and therefore can't be used. Approximately 270,000 smart meters are affected by this problem.[17]

While VCOSS understands the Victorian government, the regulator and Ausnet Services are attempting to rectify this problem, it remains unacceptable that so many people do not have properly functioning smart meters, and consequently can't connect to most available IHDs.

To securely connect a ZigBee-based IHD to a smart meter via the HAN requires a connection, verification, and activation process referred to as *binding*. A secure and authenticated connection is needed to:

- ensure the IHD is communicating with the correct meter
- prevent unauthorised people from reading data from the meter
- verify that the device is installed and in use, so that its energy efficiency impact can be credited for the purposes of VEET.

The process requires unique identification information from both the meter and the IHD. This information is sent to the distribution business, which verifies that the meter belongs to the account holder, and instructs the meter to search for and connect to the identified device.

Different distribution businesses have different connection processes, some more onerous than others. Some enable connection automatically through an online customer website portal. Others require a request from the customer, which then takes several days to be processed. This delay prevents registration of the device for VEET purposes at the time of installation, and also means energy auditors can't use mobile IHDs when conducting a home visit in these areas.

Requiring all energy distribution companies to have a simple automatic method of connecting an IHD to a smart meter, would provide everyone a simple connection option. VCOSS recommends this also be backed up by a telephone process option for people who do not have access to the internet, or find online procedures difficult.

The purpose of IHDs is to provide consumers with meaningful energy use information generated from smart meter data. Often, presenting this information in terms of energy cost will be more meaningful to people than energy quantity (kilowatts). However, to do this, IHDs need the user's energy tariffs to be sent to them by the smart meter, or be entered by the consumer.

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17 Victorian Auditor-General's Office, *Realising the Benefits of Smart Meters*, September 2015, p. 17.

All Victorian smart meters are able to send tariff information to IHDs connected to the HAN. IHDs do not have to be able to read this information to obtain VEET accreditation, however, two of the devices assessed for this report (the eKo and the Pipit 500) are able to do this. This is of great user benefit, as tariffs are complex and little understood, and identifying tariff rates and entering them into an IHD is not a simple task for the average consumer, especially as the tariffs would need to be re-entered when they periodically change. Unfortunately, few if any energy retailers seem to be sending tariff information to smart meters so it can be sent to IHDs in this way.

If retailers were required to send tariff information to IHDs via smart meters, users could have greater confidence that their IHD unit was accurately showing the cost of their energy use.

Regulating the cost of pre-connecting in-home display units

Recommendation

- **Reduce or eliminate the cost of pre-connecting in-home display units, to make it easier for community projects that provide them to households experiencing disadvantage.**

To simplify the sale and installation of IHDs, many manufacturers and installers pre-connect the devices before delivery, meaning they just then need to be powered up once installed in the user's home. This is important for installers who work with community service organisations rolling out IHDs to vulnerable households.[18]

Some distribution businesses charge fees of up to $13 per unit to pre-connect an IHD. At low VEEC prices, this neutralises half the value of the minimum VEET rebate, and in some cases has made the collaborative rollout plans between vendors and community organisations unviable in certain distribution zones.

A 2011 Moreland Energy Foundation and Alternative Technology Association submission to the Victorian government[19] specifically identified this problem. It recommended action to the effect of capping the price of IHD connection by regulation, and providing an option for these costs to be incorporated into the general operating costs of the company, potentially enabling the service to be free to consumers.

Reducing or eliminating the cost of pre-connecting IHDs to smart meters would support collaborative projects between vendors and community organisations that provide vulnerable households with IHDs to help reduce their energy use.

Protecting the privacy of smart meter data

Recommendation

- **Prevent smart meters being able to provide households with data from a previous occupant of a home, while retaining the ability to provide historical data for the current occupant of the home from the period before the in-home display was connected.**

During the course of this assessment, it was found that IHDs were able to retrieve the historical energy use data of the previous occupants of the dwelling. This means that people moving house may unknowingly be giving the next occupant their detailed energy use history.

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18 For example, *SmartUser*, an IHD vendor and VEET 'accredited person', has provided free IHDs to Kildonan Uniting Care clients experiencing energy bill payment difficulties.

19 Moreland Energy Foundation and Alternative Technology Association, *Inclusion of IHDs in the Victorian Energy Efficiency Target (Joint submission to DSDBI)*, December 2011.

Current occupants might also unwittingly conduct an energy offer comparison using former occupants' very different usage data, leading them to choose an inappropriate and more expensive energy plan. While it is difficult to imagine any further harm being caused by this information being available to new dwelling occupants, this situation is contrary to the principles of privacy, compromising customers' ownership of their own data, and running counter to government messaging about smart meter privacy being protected.

This issue was also identified by Accenture in its issues paper[20] on the inclusion of IHDs in VEET. It appears to arise due to a combination of factors:

- the functional requirement of meters to retain at least 210 days of data, with some retaining more than this
- the desirable function of some IHDs being able to retrieve historic meter data so users can analyse their energy use patterns immediately
- there being no clear information provided to distribution businesses when dwelling occupancy changes
- energy market rules forbidding deletion of meter data
- there being no way to prevent IHDs from retrieving data beyond arbitrary dates.

Accenture recommended averting this problem by preventing IHDs from reading meter data from before the device was connected.[21] However, this limits their usefulness as a tool to help people understand their energy use, as they cannot see their previous energy use history. VCOSS recommends instead that IHDs be prevented from retrieving data prior to the latest change of occupancy, while retaining the ability for people to access their own energy history.

Enabling in-home displays to read data from non-standard smart meters

Recommendation

- **Require non-standard smart meters to communicate consistently with IHDs a standard configuration of certain non-standard smart meters to provide the most useful information to enable households to monitor their energy use.**

Many Victorian households[22] have *controlled loads*, which are electric hot water systems or in-floor heating systems on a dedicated circuit, controlled by a timer to operate primarily overnight using cheaper off-peak tariffs. These are especially prevalent outside major metropolitan areas that are without access to mains gas. Before the change to smart meters, these households generally had two or three meters. Now some have two or three smart meters, and some have *two-element meters* (that are essentially two meters in one), and some have standard smart meters with *time-of-use tariffs*. This complicates the relationship between the meter and an IHD in the following ways:

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20 Accenture, *Department of Primary Industries: IHD inclusion into ESI scheme*, November 2011.

21 Accenture, *Department of Primary Industries: IHD inclusion into ESI scheme*, November 2011.

22 Probably about 500,000: a conservative estimate based on 200,000 concession households receiving the Controlled Load Concession, concession households constituting around 30 per cent of the total customer base (Department of Human Services Concessions summary data for the financial years 2010–2014) http://www.dhs.vic.gov.au/__data/assets/excel_doc/0017/900314/DHS-concessions-summary-data-2013-14_Oct2014.xlsx) and concession households having a similar share of controlled load installations as non-concession households (Roy Morgan Research, Victorian Utility Consumption Survey 2007: Final Report, Department of Human Services, Melbourne, 2008).

- Where multiple meters are installed, the IHD reads the main power meter, showing general use, but not the controlled load use. This is appropriate because the most useful real-time energy use information for households is their discretionary usage, not an automated controlled load. However, people would receive incorrect estimate of the cost of their bills, as the controlled load would not be included.
- Where a single standard meter is installed, the IHD will show the controlled load use as part of total household use.
- Where a two-element meter is installed, IHDs may show inaccurate or confusing information, because none of the available IHDs assessed for this report worked correctly with two-element meters.

Different models of meters send two-element data to the HAN differently, and different IHDs respond differently when receiving the data, meaning that people with two-element smart meters may receive incorrect information if they connect an IHD. VCOSS estimates there are approximately 500,000 Victorians with controlled loads,[23] or about 20 per cent of customers, although it is not clear how many have standard meters, two-element meters, or multiple meter installations.

In the short-term, smart meters should be configured in a standard way that ensures IHDs receive data from the variable household usage (not from the controlled load). This would be sufficient to assist households to change their energy use habits and lower their energy costs. Standardising the behaviour of all smart meters so only the primary element values are sent to the IHD, is in line with previous technical recommendations.[24] This would standardise the way historical data is stored so that all IHDs can retrieve it.

Ideally, including the costs of controlled loads in bill predictions would benefit households vulnerable to hardship. Currently, dwellings with two meters would need to purchase an IHD for each, and it is unclear whether this would be cost effective. Dwellings with two-element meters require an IHD that can receive more than one data stream. VCOSS understands to achieve this would not only require new IHD software to be designed, but require further technical changes to the specifications required for smart meters, which should be considered in the longer term.

23 Ibid.

24 Accenture Department of Primary Industries: *IHD inclusion into ESI scheme*, November 2011, p. 66.

Improving the functions of in-home display units

Recommendation

- **In-home display unit device manufacturers can:**
  - **Enable concession rates to be incorporated into the devices so their value can be factored into cost displays and bill prediction functions**
  - **Enhance the devices to properly read certain types of non-standard smart meters, such as two-element meters, including for controlled loads**
  - **Allow demand tariffs to be calculated by the devices.**

The assessment conducted for this report found that all of the IHDs share some common shortcomings. None of them support *demand tariffs*, a new type of electricity tariff that is expected to become more widespread in the near future. None of them allow energy concessions to be entered during their configuration, so cost displays and any bill prediction will be inaccurate for concession households, an issue of particular significance for households facing disadvantage, who are more likely to be receiving energy concession rates.[25] And none support two-element meters or allow controlled load tariffs to be included in cost calculations along with standard use tariffs. We recommend the manufacturers of IHD units consider enhancing their products to include these features.

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25 It is possible for the user to reduce tariff rates by the concession amount when entering them into the device, but this is an additional complexity and, because of the way Victorian concessions are calculated, impossible to achieve complete accuracy.

Overview and comparison of four in-home display units

The different IHDs assessed for this report have many common features and some unique features. Each device has relative strengths and weaknesses; and each suits some needs more than others. This overview and comparison briefly outlines each device, and compares their different features and useability. A more detailed explanation and assessment of each device is also included in Appendix I of this report.

Methodology used to assess in-home display units

To assess and compare IHDs for this report, four different types of devices were installed in two dwellings for between 12 and 24 months over a two-year period. The usability and utility of the devices in a household situation was then assessed, with comparisons made of the way each device handled similar tasks, and assessment made of the relative merits of the unique features of each.

Importantly, this is an individual assessment and is focused on usability: no attempt was made to undertake a technical comparison of the devices or assess their accuracy. Additionally, this is a point-in-time analysis and does not take into account changes made to the products since the assessment period of March 2013 to April 2015.

Four IHDs were assessed:

- The *Watts Clever WIRELESS Energy Monitor – Smart Meter EW4500*, by Watts Clever (Australia)
- The *eKo IHD* by Intercel
- The *Pipit 500* by Secure Australasia
- The *Ingeni* by Planet Innovation.

This study tested the IHDs in two different distribution zones: the Citipower and Jemena zones. Whilst the findings are applicable to all potential users of IHDs, this analysis is particularly concerned with their usefulness for households facing disadvantage.

SUMMARY OVERVIEW

Watts Clever

Overall assessment: the Watts Clever is a solid performer across all basic features. Households wishing to keep an eye on energy use in real time, or to better understand their usage patterns (and the cost implications), will find the Watts Clever useful.

- **Best features:** easy to read, portable, cheap, works without ZigBee wireless
- **Biggest shortcomings:** complex interface, no indicator lights or alarms, no bill prediction feature.

Image courtesy: http://mysmartmeter.com.au

Image courtesy: http://mysmartmeter.com.au

eKo

Overall assessment: The eKo's bright display and prominent LED indicators make it an effective communicator even for people who are not actively engaging with it, while its reliable bill prediction is very useful to those on a tight budget. This makes it a good choice for households facing disadvantage that wish to better understand and manage their electricity use.

- **Best features:** good real-time feedback and bill prediction features
- **Biggest shortcomings:** poor historical data display, difficult to configure tariffs.

Pipit 500

Overall assessment: The Pipit 500 provides good real-time feedback, and also shows historical energy use information in some detail. This is useful for those who want to better understand and actively manage their electricity use in real time, as well as delve further into their energy use patterns.

- **Best features:** simple interface, good mix of real-time feedback and historical data
- **Biggest shortcomings:** no bill prediction feature, some information is conveyed in a way that may be difficult for some users to understand.

Image courtesy Secure Australasia P/L

Image courtesy: http://myingeni.com.au/

Ingeni

Overall assessment: The Ingeni presents rich historical use data, with much less focus on real-time feedback. It is likely best for people who want to understand their consumption patterns over time and the dynamic nature of their energy use. Its energy offer comparison tool also provides a simple way for users to find an energy offer that best fits their particular use patterns.

- **Best features:** good historical data, period comparison, and energy offer comparison
- **Biggest shortcomings:** poor real-time feedback, Windows-only software, no bill prediction feature.

FEATURE COMPARISON

Table 1 shows the main features of each IHD assessed for this report, and how they are supported in each device. A detailed explanation of the features and comparison of each device can be found in Appendix I.

Table 1: Assessment and comparison summary of the four IHDs

Feature	Watts Clever	eKo	Pipit 500	Ingeni
Uses ZigBee wireless to connect		✓	✓	✓
Has indicator lights		✓	✓	
Can operate without mains power	✓		✓	✓*
Tariff includes daily charge		✓		✓
Imports tariffs from meter		✓	✓	
Makes bill prediction		✓		
Accounts for solar panels		✓	✓	
Works reliably with two-element meters	✓	✓		
Downloads history from meter			✓	✓
Attracts VEET rebate	✓	✓	✓	
Ability to display tariff types				
Flat	✓	✓	✓	✓
Controlled load				
Block		✓		✓
Flexible	✓†	✓	✓	✓
Critical Peak		✓		
Demand				
Usefulness for				
Providing real-time feedback	★★★	★★★★★	★★★★	★★
Making use comparisons	★★	★	★★★★	★★★★★
Analysing history	★★	★	★★★★	★★★★★
Comparing offers	★★	★★	★★★	★★★★★
Using without the internet	★★★★★	★★★★★	★★★★★	★★★
Setting up without the internet	★★★★★	★★★★★**	★★★★★**	★
Ease of set-up	★★★★	★★★★★	★★★	★★★★

* The Ingeni is powered by the computer it is used with.

† The Watts Clever only supports flexible tariffs with up to three different time periods, so cannot support the most common flexible tariffs currently offered in Victoria.

** The eKo and Pipit 500 can only be set up without an internet connection in certain distribution zones.

Choosing the right in-home display unit for households

There are several organisations across Victoria working to help low-income households improve their energy efficiency and lower their energy costs. These organisations advise their clients on appliance choice and energy use, with improving people's energy literacy being an important aspect of both. Helping people choose the right IHD for their needs could be an important way to support people to better understand their energy use, and to help inform behaviour change or appliance choice.

Matching in-home display units to people's requirements

Each IHD assessed has different strengths and shortcomings, with each more suited to some situations than others. Ideally, a single device would be able to respond best in all situations equally clearly and conveniently. However, this assessment found that where people value one or two functions over others, different devices will suit different households. Matching the right device to each household is essential if people are to use IHDs to improve their energy efficiency and lower their energy costs. The following suggested rankings and summaries are based on VCOSS' assessment, with the method for this outlined earlier in this report, and our considered comparison of these four IHD devices.

One of the benefits of IHDs is that they offer households without an internet connection an alternative to distributor or retailer online portals for accessing their energy use data. Internet tools such as *My Power Planner* are also not readily available to households without a reliable internet connection. Availability of off-line alternatives is particularly important for low-income households, almost a third of which still do not have a home internet connection.[26] Older Victorians are less likely to use the internet; and those who do are more likely to use it for email and entertainment, than for online shopping and financial transactions.[27]

For people with computers and the internet, device availability and ease of use are important factors in determining which will be the most appropriate. Whether people will receive assistance in setting up the device is also a factor, including whether people can temporarily access an internet connection to connect the smart meter; or for the Ingeni, whether they have a Windows computer. A related issue is knowing which distribution zone the person lives in, as this will affect which devices can be connected without the internet, or if they will be capable of a wireless connection to the smart meter.

This assessment and report have also identified that no product fully supports two-element meters or allows controlled load tariffs to be included in cost calculations along with standard use tariffs. If a person has this arrangement, more detailed investigation is required as to whether they can use an IHD unit to provide useful information.

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26 Australian Bureau of Statistics *8416.0 – Household Use of Information Technology, Australia*, 2012–13 shows that 31 per cent of households with an equivalised annual income of $40,000 or less have no internet access; and that 41 per cent of households in the lowest income quintile and 23 per cent in the second-lowest have no internet access.

27 Consumer Utilities Advocacy Centre, *Tariff switching among older energy consumers*, CUAC, Melbourne, 2014.

General recommendations

Most households will benefit from using an IHD for a number of reasons. VCOSS' general recommendations for choosing the most appropriate device are:

- The **Pipit 500** as a default choice, as it is a solid performer across all areas.
- The **eKo** for households where the priority is to have attention-grabbing real-time feedback and bill prediction, and for those who either have access to an online customer portal[28] for reviewing historical use, or no major need to see their usage history.
- The **Ingeni** for households that wish to understand their energy use history, and who have a reliable Windows computer, and no major need for real-time feedback.
- The **Watts Clever** for households that lack the internet access required for setup of other types of devices, or those that lack a ZigBee wireless connection.

Choosing to reduce energy use or stay within a budget

Key feature to look for: clear real-time feedback

VCOSS' suggested ranking
1. eKo
2. Pipit 500
3. Watts Clever
4. Ingeni

Households wanting to control their energy use in order to lower their bills are best served by a device with strong real-time feedback.[29] The eKo and Pipit 500 best suit these households, with the 'traffic light' indicators complementing the prominent display of real-time and cumulative daily use.

In this assessment and comparison, the eKo's brightly-coloured LED daily use gauge is the reason for its high ranking, while the Watts Clever's lack of 'traffic light' indicators makes it less useful. The Ingeni is the least useful in relation to this function, as it only gives real-time feedback when the user is interacting with the application on their computer.

28 Some distribution businesses and some energy retailers provide online portals where customers can log in to see their historic energy use and other information.

29 The American Council for an Energy Efficient Economy (ACEEE), *Advanced Feedback Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities*, June 2010.

For low-income households trying to better budget for forthcoming bills, a bill estimation function is of great value. The eKo is the only one with this feature, making it the device of choice for these households.

Households trying to get a good understanding of their use costs are again best served by the eKo as it is the only device with good real-time feedback that allows the full tariff (including the daily charge) to be entered for use in calculations. The Ingeni also uses the full tariff and thus gives accurate costs, but its poor real-time feedback reduces its useability.

However, whether a household can access the internet, at least temporarily to set up a device, and the distribution zone in which they live, may change this ranking.

People living in the Ausnet Service distribution zone, which includes the outer eastern suburbs of Melbourne, and eastern Victoria, cannot currently support a ZigBee wireless connection to their smart meter, and can only use the Watts Clever, which does not rely on this function.

For people living in the Jemena and United Energy zones, which include most of Melbourne's northern and southern suburbs, the ZigBee IHDs require an internet connection to set up. Unless pre-connected at additional cost by an installer, who can activate them using a temporary mobile internet connection, people who cannot access the internet may similarly be restricted to using the Watts Clever.

Choosing to see energy use history and select the best energy offer

Key features to look for: rich historical use data and ability to apply different tariffs

VCOSS' suggested ranking

1. Ingeni
2. Pipit 500
3. Watts Clever
4. eKo

Households wanting to understand their energy use patterns and see the effect of behaviour change over time need rich historical data that is easy to see and compare. Households looking for a better energy offer also need to undertake a complex calculation involving multi-part tariffs and personal energy use data, especially if they want to consider time-of-use tariffs. For some low-income households, finding a better offer could be the difference between being able to afford their bills and getting into debt.

In this assessment, the Ingeni is considered to be the leader in relation to this function, with its comprehensive historical data features and average use comparison screen. In particular, the Ingeni's ability to show historical use by season is of great value for users wanting to understand why their bills vary. The Ingeni's energy offer comparison feature is also superior to its competitors.

The Ingeni can access a database of available energy offers, and by applying these to the user's actual energy use, users can access a quick, easy and accurate cost comparison. It is also far simpler to use than comparable features offered by the other assessed IHDs.

The Pipit 500 is considered the next best option, given its historical data display and useful period comparison feature; followed by the Watts Clever, which displays less historical use data than the others, with a less intuitive interface. The eKo is ranked last in this assessment of this function, because its historical use tables are less intuitive for the user than the simple column and bar graphs used by the other devices.

The eKo, Pipit 500 and Watts Clever all enable users to manually input tariffs. This means households could enter tariff information for an offer they are considering and see what the cost would have been for their historical use, to compare with that of their existing provider. However this is a moderately complex task, which may be a barrier for some households. The Pipit 500 and Watts Clever also do not allow the daily rate to be entered, so users must perform additional manual calculations (if they are able) to obtain a useful result. So, while these three devices could be used to compare different offers, the complexity involved compromises their useability.

Again, these recommendations change depending on a household's access to computers and internet connection, and will also be affected by the distribution zone in which a person lives.

While the Ingeni is assessed as the best option, it requires a Windows computer and an internet connection to maximise its benefits. For people without a Windows computer, it will not function. In this case, VCOSS would recommend people use the Pipit 500.

Because the Ingeni requires software to be downloaded, and an internet connection to update available energy offers, its usefulness is compromised without ready access to the internet, at least during installation and when comparing energy offers. If this is not available, the Pipit 500 is a better option.

As previously outlined, people living in the Ausnet Service distribution zone, which includes the outer eastern suburbs of Melbourne and eastern Victoria, cannot support a ZigBee wireless connection to their smart meter, and can only use the Watts Clever, which does not rely on this function.

For people living in the Jemena and United Energy zones, which include most of Melbourne's northern and southern suburbs, IHDs require an internet connection to be set up. Unless pre-connected at additional cost by an installer, who can activate them using a temporary mobile internet connection, people who cannot access the internet may similarly be restricted to using the Watts Clever.

Conclusion

The usefulness of IHDs in helping households facing disadvantage to better understand their energy use and change their behaviour to improve their energy efficiency and lower their bills has been well proven. This comparison of four IHD devices available to Victorian households also shows that small differences in functionality and user interface change the value proposition of specific devices for different types of household needs.

It has also enabled VCOSS to identify some broader issues in the energy market framework and related policy frameworks that affect the ability of households to get maximum value from IHDs and the smart meters they have made significant payment for.

Importantly, many of the findings and subsequent recommendations of this report are based on a combination of the assessment as outlined, observations by community service organisation staff members who have worked extensively with vulnerable households, and the conclusions of international research into the effect of IHDs on household energy consumption. While this provides some confidence in the veracity of these findings and recommendations, a further comparative study on the efficacy of these particular devices,with a sample of vulnerable and low-income Victorian households, would be of great value.

DETAILED FEATURES AND ASSESSMENT OF FOUR IN-HOME DISPLAY UNITS

Watts Clever

Image courtesy
http://mysmartmeter.com.au

Overall assessment

The Watts Clever is a solid performer across all basic features. Households wishing to monitor their energy use in real time or better understand their energy use patterns and their cost implications will find the Watts Clever useful.

- **Best features:** easy to read, portable, cheap, works without ZigBee wireless
- **Biggest shortcomings:** complex interface, no indicator lights or alarms, no bill prediction feature.

The Watts Clever's biggest advantages are currently being the cheapest standalone IHD on the market, and allowing installation and use without a ZigBee wireless connection. The latter makes it the only viable option for people living in the Ausnet distribution area.

Being battery-powered, the Watts Clever can be placed in any convenient location. Its portability means people can easily discover the power use of various appliances, as they can move it around the house when using appliances, to see how their electricity use changes in real-time with different use of appliances.

The Watts Clever provides good real-time feedback and sufficient historical data to help people better understand their energy use.

Description

The Watts Clever is a 117 x 127 mm panel that stands upright or hangs on a wall. The high-contrast LCD display shows a range of real-time and historical information and is further configurable via a row of buttons beneath it. It is battery-powered. Instead of using a ZigBee wireless HAN, it communicates with the meter via its own battery-powered wireless transmitter that reads energy via a sensor, which must be mounted on the meter.

The Watts Clever was the first IHD approved for VEET, and currently sells for up to $120. It can be installed without assistance, and because it uses its own wireless transmitter, it cannot be 'seen' by an energy distribution company. Consequently, the VEET rebate can only be claimed for the Watts Clever if it is installed by an authorised installer.

Installation

When first switched on, the Watts Clever enters a setup mode requiring the user to enter time, date, currency, tariff information, and some information from the smart meter that ensures the device correctly interprets information sent by the sensor. The most complex part is connecting the sensor to the smart meter. The Watts Clever comes with an adaptor for each smart meter type in Victoria, to ensure the sensor is mounted correctly. The manual clearly explains how to identify the smart meter type and attach the appropriate adaptor and sensor to it. It is marginally more complex to set up than a ZigBee device, but the process is well explained in the manual.

Image courtesy Watts Clever (Australia) Limited

Features

Home screen

The main display of the Watts Clever numerically shows real-time energy use and cumulative use for the current hour.

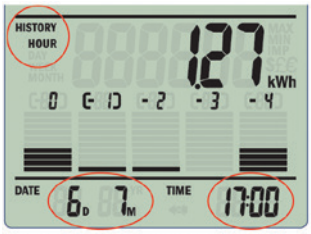
There is also an energy use gauge in the form of a single column graph, showing whether real-time use is lower or higher than usual, and a five-column graph showing hourly use for the last five hours. The display can show data for the current day, week, or month instead of hour; and can show electricity use in kilowatts or cost.

Lights and alarms

The Watts Clever does not have any indicator lights or audible alarms. However, the energy use gauge will flash if energy use exceeds the previous maximum, and this is readily visible on the bright high-contrast screen.

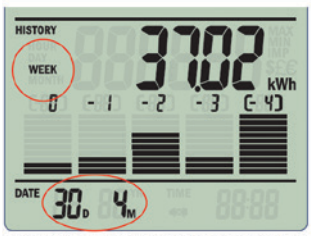
Other information

The five-column graph can be scrolled sideways to show historic use over previous hours, days, weeks, or months depending on the setting. Data can be displayed for the previous 24 hours, 50 days, seven weeks, or four months.

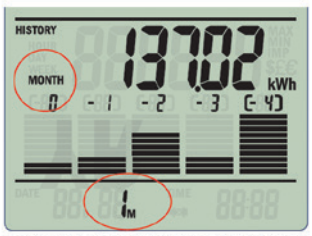


For hour history, it shows the selected HOUR of the DATE

For day history, it shows the selected DATE



For week history, it shows the selected WEEK starting date



For month history, it shows the selected month

Image courtesy Watts Clever (Australia) Limited

The date and time display shows the date (and time for hourly graphs) of the selected column. In day mode the display can present hourly use for a selected day, the tariff applicable for that hour, and the maximum and minimum hourly use for the selected day.

Real-time feedback

The Watts Clever's large, bright high-contrast display is easy to read from a distance, enhancing its ability to give real-time feedback. However the absence of coloured indicator lights and alarms mean it is not particularly good at attracting the attention of a disengaged user, compared with the eKo and Pipit 500, with their bright 'traffic light' LEDs.

Historical data

The Watts Clever does not retrieve historical data from the meter, but stores the data as it receives it, meaning is cannot show information previous to its installation.

The Watts Clever is the only one of the four assessed devices that displays historical data by default on the home screen. By highlighting the variability over time of energy use, it fulfils a valuable educational function. But for a user to further investigate their historic power use, they need to know how to navigate it using the multipurpose buttons beneath the display. While this is well explained in the manual, it is complex; and it is difficult to remember the sequences of button presses required. While its five-column chart display is good for an 'always-on' historical use graph, it is does not give a good picture of hourly or daily use when a user wishes to delve deeper.

Configuration

Entering energy prices into the Watts Clever is simple and accurate, with rates able to be entered in 0.01¢ increments. However, the daily charge component of billing cannot be entered. With daily charges making up between 30 and 50 per cent of the bill for low- and medium-consumption households, this compromises the cost information conveyed by the device. The user is able to view the cost of their use at any point in time, but will find it more difficult to estimate the cost of the next bill. Because bill prediction is a very useful feature for low-income households trying to manage energy costs, this exclusion may make the device less useful for these households.

The Watts Clever only supports certain price structures: flat rate and flexible (time-of-use) tariffs. Its time-of-use tariff setting only allows for three time periods per day, but the most common Victorian flexible tariffs have four time periods, which cannot be incorporated into these settings. It also does not support block tariffs, which are common in Victoria.

Recommendations for improving the Watts Clever

- Make historical use columns narrower so more can be displayed on one screen
- Add a 'traffic light' display and optional alarm to improve instantaneous feedback
- Allow a daily charge to be included in tariff-setting, adjust time-of-use tariff-setting to allow for four distinct time periods per day, and add support for block tariffs.

eKo

Image courtesy:
http://mysmartmeter.com.au

Overall assessment

The eKo has a bright display and prominent LED indicators showing real-time and cumulative daily electricity use. This makes it an effective communicator for people who are not actively engaging with it, while its reliable bill prediction is of great value to those on a tight budget. These features make it a good choice for vulnerable households to better understand and manage their electricity use.

- **Best features:** good real-time feedback and bill prediction features
- **Biggest shortcomings:** poor historical data display, difficult to configure tariffs.

The eKo's greatest strength is its real-time feedback. The LED display, with bright green characters on a black background, is easily visible in a person's peripheral vision, thereby potentially attracting the attention of household members who are otherwise not engaging with the device. The eKo also has bright LED 'traffic light' signals, showing real-time use, and the circular gauge showing cumulative daily use. By communicating without requiring much effort from the user, the eKo can educate household members and help them to be more vigilant about energy use with minimal interaction.

For users who do want to interact more actively with the device, navigating through the secondary screens is very simple.

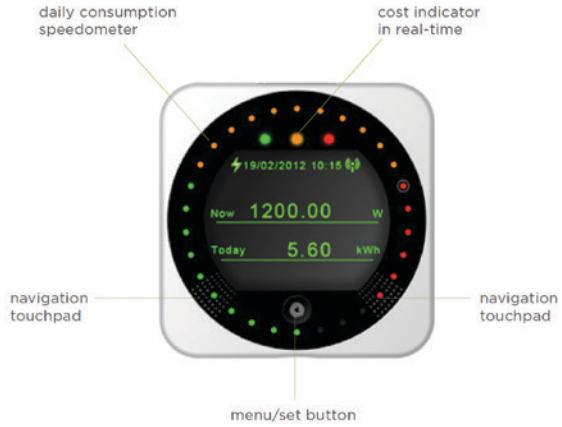


Image courtesy Intercel

Description

The eKo is an 86 mm square panel that stands upright or hangs on a wall. The round display can show different types of real-time and historical information. At the base of the display are a button and two touch-sensitive areas used to operate and configure the device. It is mains powered, and communicates with the meter using the ZigBee wireless system.

The eKo was the first ZigBee wireless IHD approved for VEET. It currently sells for $150–$170.

Installation

The eKo is simple to set up and the procedure is clearly explained in the Quick Start Guide that comes with the device. When connected to power, the information needed to wirelessly connect to the meter is displayed on the screen and a button at the bottom of the display is used to initiate the process.

After a successful connection is established, the eKo prompts the user to enter the time zone, billing period, tariff type and rates, including the daily supply charge, and feed-in tariff if the dwelling has solar panels.[30]

30 Features applying to solar panels also apply to other forms of home generation – such as home wind turbines – if they are connected.

Features

Home screen

The main display of the eKo shows the real-time electricity use, and cumulative use for the current day. This can be shown as either cost or kilowatts, and cycles by default between the two.

Lights and alarms

At the top of the display are three 'traffic light' coloured LEDs that indicate low (green), medium (yellow), or high (red) real-time use, calibrated according to the daily budget entered by the user. Around the display is a series of 30 LEDs (10 green, then 10 yellow, then 10 red) that show cumulative use for the day, illuminating sequentially and remaining on. The green section represents the first half of the daily budget spent; the yellow section represents the second half, and the red section represents over-budget use.

The eKo also has an audible alarm that can be set to sound when real-time use is high or cumulative use is over budget.

Other information

The main display can show a number of other screens in addition to the home screen:

- Estimated standby power consumption
- Predicted cost of next bill
- Tariff information as the cost per kWh, including for variable tariffs, where the eKo shows the current tariff rate and, if a time-of-use tariff is active, the next rate and the time that commences
- For customers with solar or wind power attached, real-time and cumulative surplus power exported to the grid
- Historical use (hourly, daily, weekly, and monthly)
- Carbon emissions from energy use
- Text messages sent by the energy retailer to the device.

Bill estimation

The bill estimate function is of great value to households on a tight budget, such as those facing poverty and disadvantage, and as it includes the daily charge, is more accurate than most of the other assessed devices' cost information. This function is further supported by the eKo's ability to handle most of the tariff types currently available and those expected to further be introduced in Victoria (with the notable exception of *demand tariffs*). However, since Victorian retailers are not generally sending tariff information to IHDs, users are required to enter tariff data manually; and this may be too complex a task for some, especially those with low literacy.

Image courtesy Intercel

Historical data

The eKo is less useful for analysing historic use. Its historical data is limited because it does not read any history from the meter, but records it from when first connected. As a consequence, its capacity to help the user understand household use patterns takes some time to develop. More importantly, eKo only displays historical data in a numerical or table form, making comparisons between periods less obvious. A choice between graphical and numerical or tabular data might meet a wider range of household needs, especially as graphical presentation increases the visibility of the effects of changed behaviour, better appliances, or home modifications.

Configuration

The eKo supports more tariff types than any of the other devices. However, the limited range of varying increments in which prices can be entered reduces the accuracy of cost displays and bill prediction; although apart from the feed-in tariff, the difference may not be particularly significant. Setting tariffs is complicated, requiring a range of keys and buttons. The user manual explains the process fairly well, but this is not included with the device, and must be downloaded from the manufacturer's website. Instead, only a brief Quick Start Guide is provided, which doesn't explain tariff-setting at all. This may be inaccessible for some households, particularly low-income households, who are less likely to have internet access or a computer.

Recommendations for improving the eKo

- Add a graphical display of historical data
- Allow tariffs to be entered in more accurate increments, especially for feed-in tariffs
- Include the user manual with the device.

Pipit 500

Image courtesy Secure Australasia P/L

Overall assessment

The Pipit 500 provides good real-time feedback, and also shows historical energy use information in some detail. This serves well those who wish to better understand and actively manage their electricity use in real time, as well as delve further into their energy use patterns.

- **Best features:** simple interface, good mix of real-time feedback and historical data
- **Biggest shortcomings:** no bill prediction feature, no major shortcomings, but some information is conveyed in a way that may be difficult for some users to understand.

The Pipit 500's greatest strength is its simple interface. It is easy to navigate between the different displays and its touch-based navigation is intuitive for the user. It has the most comprehensive features of all the devices, with real-time feedback, historical data, message handling, solar panels, use targets, and period comparison all available.

The Pipit 500 can run on batteries, so it can be unplugged and moved around the house without its operation being interrupted. This makes it easier for users to discover the power use of various appliances: they can take the Pipit 500 with them to different rooms, turn the appliance on or off, and see how their energy use changes in real-time.

Description

The Pipit 500 is a 115 x 80 mm rectangular device that stands upright or hangs on a wall. Its LCD touchscreen is backlit when in use, but dims after a short delay when left alone. It can also be configured to be constantly lit. There is also a three colour 'traffic light' LED indicator above the display. It communicates with the meter using the ZigBee wireless system.

The Pipit 500 has been one of the more popular IHDs in Victoria. It currently sells for $130–$150.

Installation

Connecting the Pipit 500 to the household smart meter is relatively simple, but written instructions for this are not included with the device. Instead, the user is directed to a website, where they need to register for a free account before receiving instructions online. This can take up to 48 hours to be finalised. However, when the device is first powered up, its screen displays the information needed to wirelessly connect to the meter, making it possible for an informed user to do so without the website information.

Once connected, the Pipit 500 displays the home screen, with energy use shown in terms of cost, based on a default tariff already set up on the device. The Quick Start Guide packaged with the device advises the user to change the tariff type and rate to their actual tariff. A budget can also be set by defining a daily use target for cost, energy use or greenhouse gas emissions. People with solar panels can also enter a feed-in tariff rate.

Features

Home screen

The main display of the Pipit 500 is a touchscreen divided into two sections. The left side shows real-time use in the form of a circular gauge, or surplus generation if solar panels are connected. The right shows cumulative daily use, with an indicator showing the daily use target.

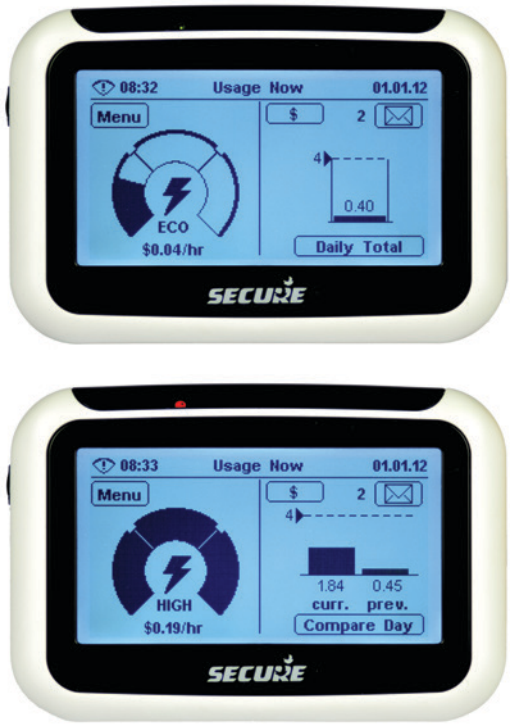


Image courtesy Secure Australasia P/L

By default, electricity use is shown by cost, but the display can also be switched to show kilowatts or greenhouse gas emissions. The right side of the screen can also be changed to show two-column graphs, comparing daily use with the previous day, or weekly use with the previous week. Alternatively, it can display the current tariff rate and, if a *time-of-use tariff* is active, the next rate and the time that it commences.

The home screen also shows the time, date, strength of the ZigBee wireless connection, and whether any text messages have been received from the energy retailer.

Lights and alarms

At the top of the display there are three 'traffic light' coloured LEDs that indicate low (green), medium (yellow), or high (red) real-time use, calibrated according to the daily target entered by the user (or the default target if none has been entered). The Pipit 500 also has audible and visual alarms that can be set to alert the user when real-time use is high, cumulative use is over budget, or when a text message from the energy retailer is received.

Other information

The Pipit 500's display can also show:

- Historical energy use, presented in column graphs or tables of hourly, daily, weekly, and monthly use
- Energy use comparison for the current day, week, month, or year with the previous one
- Text messages sent by the energy retailer to the device.

Electricity use can be shown as cost, kilowatts, or greenhouse gas emissions. Hourly, daily, and weekly data goes back around six to eight weeks; while monthly data goes back 12 months. The Pipit 500 retrieves up to 12 months' worth of historical data from the meter when it is connected.

Real-time feedback

The Pipit 500 gives good real-time feedback. The 'traffic light' LEDs showing real-time use easily attract the attention of household members not otherwise paying attention to the device. However, the screen by default dims when it is not in use, and it is difficult to read when unlit. This makes the cumulative daily use information practically visible only when someone is interacting with the device. The display can be set to be always lit if the user navigates to the settings screen; but some users may interpret the default auto-dim setting as an energy-saving mode, and thus be reluctant to change it, especially if they are trying to save money on electricity. The manual gives no clear indication as to how much more energy the device consumes when the screen is constantly lit.

Historical data

The Pipit 500 provides a clear presentation of historical data, and by offering a choice between column graphs and tables it serves different users equally well. Navigating through the historical data is straightforward. On the hourly and daily graphs, the user can scroll backward and forward between periods, making it easy to get an overall sense of use patterns. However, each graph is scaled according to the information it shows, with the highest column defining the vertical scale: so adjacent hourly or daily charts may look the same but represent different amounts of use. This compromises its ability to clearly communicate medium- and long-term use trends.

The period comparison feature has the potential to be of great value to households trying to understand their energy use and the effect of changes in use.

Image courtesy Secure Australasia P/L

Configuration

Tariff setting is simple and accurate, with volumetric rates able to be entered in 0.01¢ increments, however the daily charge cannot entered. With daily charges making up between 30 and 50 per cent of the bill for low- and medium-consumption households, this compromises the cost information conveyed by the device. The user is able to view the cost of their use at any point in time, but will find it more difficult to estimate the cost of the next bill. Because bill prediction is a very useful feature for low-income households trying to manage energy costs, this exclusion may make the device less useful for these households.

The Pipit 500 only supports flat rate and flexible (time-of-use) tariffs; and the time-of-use tariff setting allows for four time periods per day. This is sufficient for most Victorian households, but some retailers use *block tariffs*, and these cannot be entered.

The user can enter a daily budget target, and the home screen display bases its instantaneous and cumulative use indicators on that target, with the default target being $2 per day. However, the daily target can only be set in $1 increments, which are relatively large jumps, and do not include the fixed price. This limits its value as a budgeting tool and compromises the real-time feedback.

Recommendations to improve the Pipit 500

- Increase granularity of target-setting by allowing daily targets to be set in much lower increments
- Include instructions for connecting the device with the meter in the Quick Start Guide so users can bind the device without setting up an online user account
- Allow a daily charge to be included in tariff-setting, and add support for block tariffs.

Ingeni

Image courtesy: http://myingeni.com.au/

Overall assessment

The Ingeni presents rich historical use data to its users, with much less focus on real-time feedback. For this reason it is likely best for people who want to understand their consumption patterns over time, and the dynamic nature of their energy use. Its energy offer comparison tool also provides a simple way for users to find an energy offer that best fits their particular use patterns.

- **Best features:** good historical data, period comparison, and energy offer comparison
- **Biggest shortcomings:** poor real-time feedback, Windows-only software, no bill prediction feature.

This assessment found the Ingeni to be the best device for analysing historical use. It retrieves a large amount of historical data from the meter and makes it available at a range of resolutions, from half-hourly to annually. In particular, viewing monthly and seasonal data is highly instructive for households trying to understand how their energy use changes over time. This is especially useful for households who struggle to pay unexpectedly high bills: when they understand that they use more in one season than another, they are better equipped to either pay closer attention to their use at that time, or save extra money toward the now expected high bill.

As an accessory for a computer rather than a dedicated appliance, the Ingeni is in some ways a more innovative device than the others assessed for this report. It embraces a near future where rather than requiring a dedicated device, personal energy use data for real-time feedback or more detailed analysis will be channelled to a host of different devices whose capabilities, defined by updateable software, can be tailored and evolved according to need and technological change.

Description

The Ingeni is a ZigBee wireless aerial, in the form of a small USB device that plugs into a computer running Microsoft Windows. The device feeds data to a software application (app) installed on the computer. The app displays both real-time use and historical data from the meter on the computer's screen. The computer, in effect, is the IHD.

The Ingeni currently retails for around $90, and is not registered for VEET.

Installation

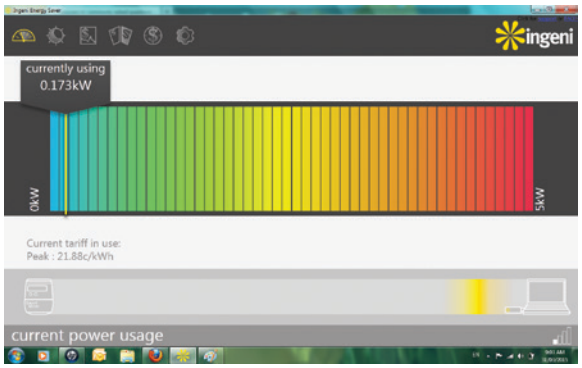
The Ingeni packaging instructs the user to download the free software from the web and install it: the installation process guides the user through the whole process, including identifying the relevant distribution business by asking the user to enter their postcode, telling the user how to connect the device to the meter, and getting the correct tariff data by asking the user to choose their retailer and energy plan name from a drop down list.

During this process the Ingeni is attached to the computer. Afterward, it can be removed and reinserted as required: it only receives data from the meter when plugged in, but the Ingeni app stores historical and configuration data regardless of whether the device is present, and all of its features apart from displaying real-time use can be used.

Features

Home screen

The home screen of the Ingeni Energy Saver app is a horizontal energy use gauge that shows real-time use, with text indicating the cost or kilowatt use. It also shows the current use rate, and whether or not the app is receiving data from the meter, with a graphical display beneath the use gauge. The home screen updates in real time, but if no user input is detected for a while, the screen stops updating until user input is detected again. The Ingeni continues to receive the data even if the display is not updating.



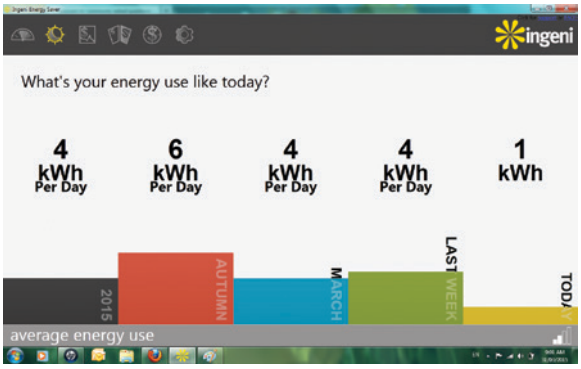
Lights and alarms

The Ingeni has nothing equivalent to indicator lights or alarms.

Other information

Other screens show different information:

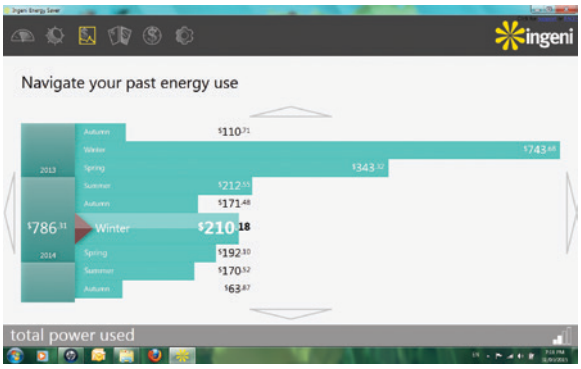
- An average use graphic display, comparing today's accumulated use with the average daily use for the previous week, and the current month, season, and year
- Historical use bar graphs that can show half-hourly, daily, weekly, monthly, seasonal or yearly use
- Price comparison of the cost of the user's current energy plan with all other available offers, calculated over a month, six months, or a year.



History is downloaded from the meter, with no stated limit on how far back this data can go. (The Ingeni assessed retrieved 20 months of half-hourly data – which may represent the Ingeni's limit, the meter's limit, or how long ago the meter was installed.) Energy offers used for the offer comparison feature are accessed from a database maintained by Ingeni's manufacturer, based on publicly available data.

Use comparisons

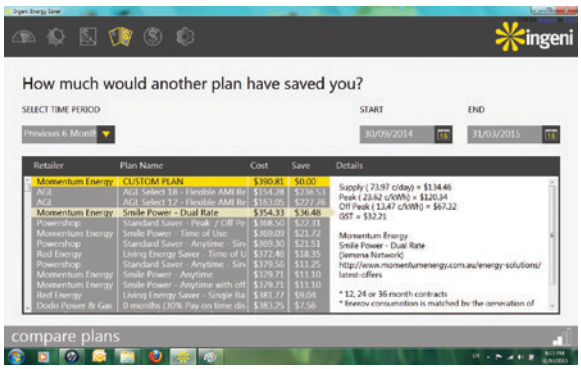
The Ingeni presents historical data in a manner that makes it easy to compare use across equivalent periods. It shows bar graphs of use, sized consistently, labelled with the relevant period, as well as the cost or kilowatt use they represent. These clearly convey patterns of use, especially over longer periods such as weeks, months, and seasons.



The average use comparison display is also useful and clearly conveyed. It is essentially a subset of the full historical display that shows today's use so far compared to average daily use in the previous week, and current month, season, and year. Including the seasonal daily average helps users understand that seasonality is an important variable in energy use.

Energy offer comparison

The Ingeni's energy offer cost comparison tool is a useful and distinctive feature, of great value to people looking for a better electricity deal. Because the Ingeni app already stores the user's current plan, actual use patterns and history, it is simpler to use and more accurate than alternatives.



Because energy offers are entered manually into the app's online database by the manufacturer's staff, based on publicly available tariff information, it may not be always completely up-to-date and carries a risk of human error. Because the Ingeni app allows the user to modify any plan, an astute user can identify and rectify such an error.

Another minor issue with the energy cost comparison function is that controlled load tariffs are included, even for a non-controlled load customer. Displaying controlled load tariffs only when the customer has a controlled load is an appropriate solution. But since people with controlled loads are generally discouraged from using IHDs, and people without controlled loads cannot access those tariffs, a better approach may be to simply exclude controlled load tariffs from the offer comparison database.

Configuration

Setting up the Ingeni is simple and comprehensive. On installing the software, the user is taken through a step-by-step approach that finishes with the Ingeni being connected to the meter and the correct tariff being set up to ensure that cost calculations are correct.

There is one flaw in the process. In order to show the relevant tariffs, the distribution zone must be recorded. Because most people don't know who their electricity distributor is, the user is required to enter their postcode during set-up, and this is used by the Ingeni app to identify the distribution zone. Unfortunately, many postcodes span two distribution zones, so the distribution zone may be recorded wrongly. [31] This can lead to incorrect tariff rates being used in calculations, and shown in the energy offer comparison screen. The problem could be addressed by changes to the software that collect additional information from customers in postcodes that are not entirely within a single zone: either have users indicate which service difficulties and faults phone number is shown on their bill, or have them nominate their distributor after directing them to the Victorian government's online distributor identification tool.[32]

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31 This was encountered during the investigation, because one of the dwellings used was in a postcode that spanned two distribution zones and the Ingeni app chose the incorrect distribution business.

32 During preparation of this report this problem was brought to the attention of the Ingeni's manufacturer so it can be addressed in a future software update.

Software

The Ingeni Energy Saver software is only available for Windows computers running Windows Vista or subsequent versions. Households with Mac OS or Linux computers can run it only if they also have Windows installed. This could exclude up to a quarter of households[33] from being able to use the Ingeni. More significantly, though, the software runs quite slowly on older hardware.[34] This can make navigating through the historical use data very frustrating. Because low-income households are more likely to have older computers, this could compromise its usefulness for many of these households.

While the presentation of the historical use information is clear, comprehensive, and easy to understand and navigate, some users may wish to export the data for further analysis in a spreadsheet. While there doesn't appear to be an export function, the data can in fact be exported to a spreadsheet using an undocumented feature. A data import feature is also undocumented. These features are not essential, and would probably only be used by a small minority of users. However they would add value to what is already a useful and innovative product, and make good use of the opportunities of having dynamic energy use data on a general purpose computer, rather than a dedicated device.

Recommendations to improve the Ingeni

- Revise the distributor identification section of the set-up process to accurately account for households in postcodes served by more than one distributor
- On the custom tariff entry screen make it clear that users should enter GST-exclusive rates
- Provide a documented and reliable data export and import feature (or at least simple backup and restore)
- Improve app performance for older computers
- Provide a version of the app for Mac OS and Linux computers.

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33 Global market share of Windows Vista, 7, and 8 is 74 per cent according to http://www.netmarketshare.com

34 Our assessment used an older Windows laptop to assess the Ingeni (a 2008 HP Compaq 6730b with an Intel Core Duo 2.1 GHz processor and 2 GB RAM running Windows 7) because it is typical of the types of computers many low-income households might have had handed down by friends or relatives or bought for a few hundred dollars from Green PC or secondhand shops. The software ran very slowly on this machine.

Appendix II

GLOSSARY AND ABBREVIATIONS

AER: *Australian Energy Regulator* – regulator of the *NEM*. The AER regulates Victorian energy network businesses (but not energy retailers, which are regulated by the ESC).

AMI: *Advanced Metering Infrastructure* – the Victorian smart meter system including the meters, communications, and information management systems.

AP: *Accredited Person* – a person or entity authorised to create *VEECs* in the VEET scheme.

ATA: *Alternative Technology Association* – a not-for-profit organisation that connects and assists people to make sustainable choices in their homes and communities, and advocates on related energy issues.

CO_2: *carbon dioxide* – a gas produced as a waste product of respiration of aerobic organisms, during the processes of decay of organic materials and the fermentation of sugars, and by combustion of wood, carbohydrates and fossil fuels such as coal, peat, petroleum and natural gas. CO_2 is vital to life on earth, but excessive amounts in air and water lead to global warming and ocean acidification.

controlled load: an electrical appliance – typically a hot water system or in-floor heater – that is connected to a dedicated circuit with a separate meter (or the second element of a *two-element meter*), operated automatically via a timer, and typically charged at a reduced off-peak rate.

distribution business: owners and managers of the substations, poles and wires, and meters that deliver electricity to homes and businesses. Also referred to as a *distributor*.

DEDJTR: *Department of Economic Development, Jobs, Transport and Resources* – Victorian government department responsible for energy policy since 1 January 2015.

DHHS: *Department of Health and Human Services* – Victorian government department responsible for concessions policy since 1 January 2015.

DHS: *Department of Human Services* – Victorian government department responsible for concessions policy prior to 1 January 2015.

distribution zone: the geographic area covered by a particular *distribution business*. All electricity customers in a distribution zone have the same *distributor*.

DNSP: *distribution network service provider* – same as a *distribution business*.

DSDBI: *Department of State Development, Business and Innovation* – Victorian government department responsible for energy policy from 9 April 2013 to 31 December 2014.

energy literacy: understanding of how appliances use energy and how household practices affect the energy use of appliances. Energy literacy training teaches people how to modify their behaviour and use of appliances to lower energy costs without compromising comfort and utility.

ESC: *Essential Services Commission* – regulator of Victorian energy retailers (as well as water and sewerage, rail freight, and ports).

ESI: *Energy Saver Incentive* – the name used for *VEET* in marketing and promotion to consumers.

FiT: *feed-in tariff* – price paid by energy retailers to customers who feed surplus energy from home generation (such as solar panels) into the electricity grid.

GST: *goods and services tax* – the 10 per cent tax levied on most goods and services in Australia, collected by businesses as a premium on prices.

HAN: *home area network* – a small wireless network broadcast by a smart meter (using the *ZigBee* wireless protocol) enabling devices in a dwelling to communicate with each other (for example, so an *IHD* can display information sent by a meter).

IHD: *in-home display* – a device that communicates with a smart meter to display energy use information and other data from the meter.

kgCO_2: *kilograms of carbon dioxide* – unit of measurement for greenhouse gases emitted by a process. If the gas emitted by a process is not actually CO_2 it is still expressed as the equivalent amount of *kg*CO_2 that has the same impact.

kW: *kilowatts* – unit of measurement for power, used to measure the amount of electricity in use by an appliance at any point in time.

kWh: *kilowatt–hours* – unit of measurement for power used over time, used to measure the amount of electricity used in a given time period.

LCD: *liquid crystal display* – a type of display screen used to display information by changing the colour of discrete regions of the screen to form characters.

LED: *light-emitting diode* – an electrical component that displays a coloured light when activated. Used for indicator lights or display screens.

MAC address: a unique identifier given to a device on a digital network.

MEFL: *Moreland Energy Foundation* – a not-for-profit organisation that works with communities and governments to implement sustainable energy projects, undertakes research, and advocates on related energy issues.

NEM: *National Electricity Market* – the interconnected electricity networks covering eastern and southern Australia including Queensland, New South Wales (including the Australian Capital Territory), South Australia, Victoria, and Tasmania.

NER: *National Electricity Rules* – the suite of regulations governing electricity businesses operating within the *NEM*.

NMI: *National Meter Identifier* – unique number assigned to each electricity meter for identification purposes.

RAM: *random access memory* – type of memory in a computer used for temporary storage of information being used in current processes.

SEP: *Smart Energy Protocol* – a *ZigBee* protocol designed for energy management devices.

smart meter: an electricity meter that records time of use as well as amount used, can be remotely read and switched on and off, and can broadcast a *HAN*.

single-element meter: an electricity meter that measures and controls all the electricity flowing through it together.

tariff: the price charged for electricity, comprising two different types of charges: fixed (charged per day or other time period), and volumetric (charged per unit of electricity used). There are several different types of tariffs, all of which generally have a fixed rate but differ in their volumetric rates and, for some, with additional fixed rates:

- *flat tariff* – all use is charged at the same volumetric rate.
- *block tariff* – use up to a certain amount is charged at one volumetric rate, and use beyond that amount is charged at a different rate (or several different rates for different amounts of additional use). Higher amounts of use may be charged at a higher rate (inclining block tariff), or lower rate (declining block tariff).
- *controlled-load tariff* – one or two special appliances (such as an in-floor heater or hot water system) are controlled by a timer to primarily operate overnight with use charged at a lower 'off-peak' volumetric rate, and all other use is charged according to a standard flat tariff (or another type of tariff).

- *flexible or time-of-use (ToU) tariff* – different volumetric rates charged for electricity used at different times: typically a higher rate during high (peak) use times (weekday afternoons and evenings), a lower rate for low (off-peak) use times (overnight), and a moderate rate at other times (mornings and weekends). Some ToU tariffs only have two rates (peak and off-peak).
- *critical peak price (CPP) tariff* – use is charged at a very high volumetric rate for a few hours on a small number of very high use days, and at a low flat rate at all other times.
- *demand tariff* – a fixed cost is charged at different rates each month (or other time period) according to the highest instantaneous use ('demand') recorded during the month, with higher rates for higher demand and lower rates for lower demand. Volumetric rates for electricity consumed are charged according to a standard flat or other type of tariff.

two-element meter: an electricity meter that measures and controls all the electricity flowing through it as two separate streams – one for general use, and one for a dedicated appliance such as hot water or heating.

USB: *universal serial bus* – a specification defining cables, connectors and communications protocols used for connection, communication, and power supply between computers and electronic devices.

VCOSS: *Victorian Council of Social Service* – the peak body of the social and community sector in Victoria. VCOSS supports and resources the community sector, represents the interests of vulnerable and disadvantaged Victorians in policy debates, and advocates for the development of a sustainable, fair and equitable society.

VEEC: *Victorian Energy Efficiency Certificate* – electronic certificate representing one tonne of carbon dioxide equivalent abated by specified energy saving activities in the *VEET* scheme.

VEET: *Victorian Energy Efficiency Target* – Victorian government scheme enabling accredited businesses to offer discounts and special offers on selected energy saving products and appliances, in order to make energy efficiency improvements more affordable, contribute to the reduction of greenhouse gases, and encourage investment, employment and innovation in industries that supply energy efficiency goods and services.

ZigBee: a specification for a suite of communication protocols used to create small wireless networks. ZigBee is designed for applications where long battery life and secure networking is required.

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