Changing behaviour with smart technology

Reducing hotel resource consumption through smart technologies and experience design

Griffith University collaborated with WISE Sustainability as part of an Australian Research Council-funded project (DP200100972). The research deployed smart technology in combination with persuasive communication and experience design to create greener hotels. The aim of this brochure is to encourage accommodation providers to embrace technology to help them drive behaviour change, and to operate more sustainably.

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1. The Business Case

Hotels use high amounts of energy and water, which can incur significant financial and environmental costs. The source of such consumption levels can be attributed to resource-intensive equipment like chillers and pumps and the guests' direct usage. Guests can account for more than 50% of energy and water in hotels and a far higher share in self-contained accommodation.

The challenge for owners and engineers has been:

▶ How to make significant savings using solutions that offer a fast return on capital expenditure;

▶ Where to focus first to achieve the best results;

▶ What solutions do not disrupt service delivery but improve guest experience.

SMART Technology refers to interconnected intelligent systems of sub-meters, controls, air quality and thermal sensors. These can assist in driving savings; they are flexible and scalable to retrofit buildings, and provide immediate feedback to enable prompt decision-making to save. This brochure is targeted at general managers, accommodation owners, operations managers, sustainability managers and maintenance staff. We will share insights from working with diverse accommodation providers on how technology can help reduce resource consumption and why it is essential to also consider how people use this technology. We tackle three areas, understanding resource use, getting started with smart tech, and working with people.

Using concrete examples, we aim to:

▶ Emphasise the cost savings and improved operational efficiencies.

▶ Remove the fear or doubt of using smart technology and give practical advice to avoid common mistakes.

▶ Connect the people that matter, namely staff and guests to eco-feedback to motivate action.

Did you know?

💡 Guest energy and water consumption rates can be up to 4 times higher per person than in a residential home (Ricaurte, 2021).

💡 Energy expenses can account for 3-6% of a hotel's operating costs, but only 20-30% of hotels actively manage their energy use (Bohdanowicz & Martinac, 2007).

💡 Swimming pools can lose several millimeters of water daily due to evaporation, especially in hot climates. There could also be leaks; smart metering will help identify these quickly.

2. Understanding Water and Energy Use in Hotels

Measuring resource use is the first step towards reducing it. Most properties review their resource use when it comes to paying the bills, or on a quarterly, or annual basis. This method offers only a single moment in time to understand resource use. Hotels may use the annual totals to benchmark consumption with other properties. This has traditionally been thought helpful in identifying inefficiencies, but variations in size, amenities, electrical and mechanical systems, and local climates complicate comparisons.

The use of SMART technology can support a much-refined approach to managing footprints and operational costs. This is because SMART technologies offer a highly granular analysis. They capture the nexus of energy, water, with other important variables to offer you important insights for maximising conservation(Warren et al., 2018).

Would you like to know how your hotel compares to others?

Consider looking up average consumption rates in your region using the Cornell Hotel Sustainability Benchmarking Index.

There are several toolkits specifically designed for hotels, for example through the World Sustainable Hospitality Alliance, the One Planet network, or the New Zealand Energy Efficiency and Conservation Authority. Some countries offer free programs to support businesses, for example, EcoBiz in Queensland, Australia.

The value of detailed and real-time analysis is that it reveals how people are using water and energy. For example, hot water usage alone can account for up to 25% of a hotel's energy use. Water consumption per guest-night in a hotel can range from 300 to 600 litres per day, or even more.

WATER - SMART technology can easily be installed to retrofit your hotel and give you better control, including through:

💧 Individually metered rooms and water-consuming facilities.

💧 Outside irrigation that responds to soil moisture content and weather forecasting.

💧 Automated use of hotel swimming pool cover at night.

💧 Monitoring of water-wise practices in the kitchen.

Many hotel buildings have a high electricity baseline, and the variable use of guests is less pronounced than for water (MacAskill et al., 2023). Hotel operators should therefore foremost review their hotel infrastructure and operational settings to unlock potential resource savings. Ensuring that unoccupied guest rooms have HVAC turned off when guests are out or when the room is unoccupied can save up to 40% in energy (Nguyen & Aiello, 2013).

ELECTRICITY - SMART technology can help achieve savings by:

⚡ Adjusting heating and cooling settings in common areas in off-peak times to a more economical set point.

⚡ Integrating smart sensors with building management systems.

⚡ Smart lighting systems can reduce lighting electricity use.

Before you install metering technology it is useful to ask yourself some key questions, for example where most resources are consumed in your business. Simple 'diagnostics' will help to choose the most useful SMART system, and also get the most out of the data outputs, for example which rooms require more heating or cooling, what equipment needs replacing and what advice to give to guests (Coghlan et al., 2023).

Are you looking to reduce your resource consumption at your business?

💡 Do you know what the biggest user of energy is in your business?

💡 What share of your costs is for energy and water? How much is used by staff?

💡 What is your equipment maintenance cycle? Do you inspect HVAC systems regularly?

💡 Are your systems operating efficiently (ie. solar arrays, inverters, battery systems...)

💡 Do you already have some smart meters installed, and are you using the data outputs for your decision-making?

#1   What our research participants say

"I had a smart meter attached to my electricity circuit at home [...] it certainly modified my behaviour. When I switch the kettle on and I was able to see the dial go into the red, I started putting less water into the kettle and putting my heating down, it might not have had a massive impact on you know, even I was just keen to make a difference."

—— Accommodation operator in England.

Multiple SMART technologies, particularly sensors and sub-meters, can give you an intelligent system to be your 'eyes' in places. Ideally, tech systems are connected through cloud services and communicated through different channels and outputs. They also need to be accompanied by human interaction to enhance effectiveness and make guests and staff comfortable collaborators.

Temperature sensors

Monitor real time internal temparature & humidity.

Air quality sensors

Monitor real time air quanlity.

Door/occupancy sensors

Monitor real time air quanlity.

Sub-meters
• Continuous reporting
• Electricity consumption
• Hot & cold water consumption

Utility meters
• Monthly reporting (utility bills)
• Low resolution - Monitor whole building electricity & water consumption

Weather station

Monitor real time external temperature & humidity in the local area.

High-resolution outputs

SMART HUB 1

SMART HUB 2

SMART HUB 3

Cloud-based or Local

Central processing hub

Opportunities

• Tailored data outputs
• Eco-feedback to staff & guests
• Improve resolution on high consuming areas

Data interpretation & use towards greater savings

3.1 Equipment: Smart Sensors and Sub-metres

Smart sensors collect information from their physical environment and use built-in computing resources to process data. Some newer hotel buildings include a range of sensing functions already built into HVAC or lighting systems. In larger buildings these may report back to a central 'brain' or a building management system (BMS). Reduced costs and ease of use of smart sensors, including cloud storage, has made retrofitting buildings simpler and far less expensive than local BMS-based systems. Sub-metres can be used to measure electricity, water, and gas consumption. These meters monitor the buildings' overall consumption for utility billing purposes.

Sub-metering a hotel and its different areas (e.g. guest rooms, kitchens, spa) offers significant benefits, including through:

⚡ Granular data helps identify inefficiencies, leading to targeted resource-saving measures and optimises maintenance schedules.

⚡ Sub-metering fosters accountability among staff and encourages more responsible energy use.

⚡ Better control over utilities can enhance the overall guest experience through more consistent and reliable services.

⚡ Make the most out of any renewable electricity potentials and technologies.

Are you looking to reduce your resource consumption at your business?

💡 Which guest rooms are typically the least thermally comfortable? Identification of poorly performing guest rooms may help to optimise how you occupy them.

💡 Is your equipment functioning optimally? Monitoring equipment over time may assist with identifying underperforming equipment such as solar panels, inverters or battery systems.

💡 Do you know how much electricity or water a typical guest night uses? Sub-metering can help to forecast consumption and better understand costs.

💡 How do external drivers affect your resource consumption, for example the weather?

3.2 Sensors and sub-metering in practice: 10 Tips to get started

To get the most from your monitoring plan there are a number of steps that you should consider:

1 Understand your Baseline: Begin by identifying your current energy and water usage. Review past utility bills to establish a baseline.

2 Leverage incentives: There are increasingly government funded programs to assist with costs associated with hiring a professional energy auditor, and for installing metering equipment.

3 Seek advice from a professional: If unsure where to start, consider consulting with an energy management expert. They can help you design a system that meets your specific needs.

4 Are you monitoring the whole site or just learning from a small sample? Perhaps start with high-impact areas: such as HVAC systems, hot water systems, lighting, kitchens and guest rooms.

5 What do you want to learn? Be clear what you like to monitor (e.g. electricity or hot water) and why? You could consider automated systems, such as sensors for unoccupied rooms.

6 How large an area needs to be monitored? This affects the type of system used – make sure you pick a solution that can grow so your initial investment is efficiently spent.

7 Is there existing metering? Check whether current equipment has a pulse output port; if yes then you can connect to a pulse reader. If you are not sure how to determine if it has a pulse output write down the serial number, model and make, then contact the manufacturer directly.

8 You will need to collect the data with a gateway and this must use the same transmitting protocol as the sensors. Each global region can have different frequencies; ask your specialist company to help.

9 Most equipment can be installed by your preferred plumber or electrician which keeps costs low. When installing the equipment be sure to ask the manufacturer or expert supplier to configure the devices to the reporting levels you want (e.g. Wh or kWh for energy).

10 Make energy management a team effort: Educate employees about the importance of energy and water efficiency and involve them in monitoring and managing energy use.

💡 The graph below shows data from a case study hotel in Australia's tropics which has identical rooms, however, these are situated differently on the site.
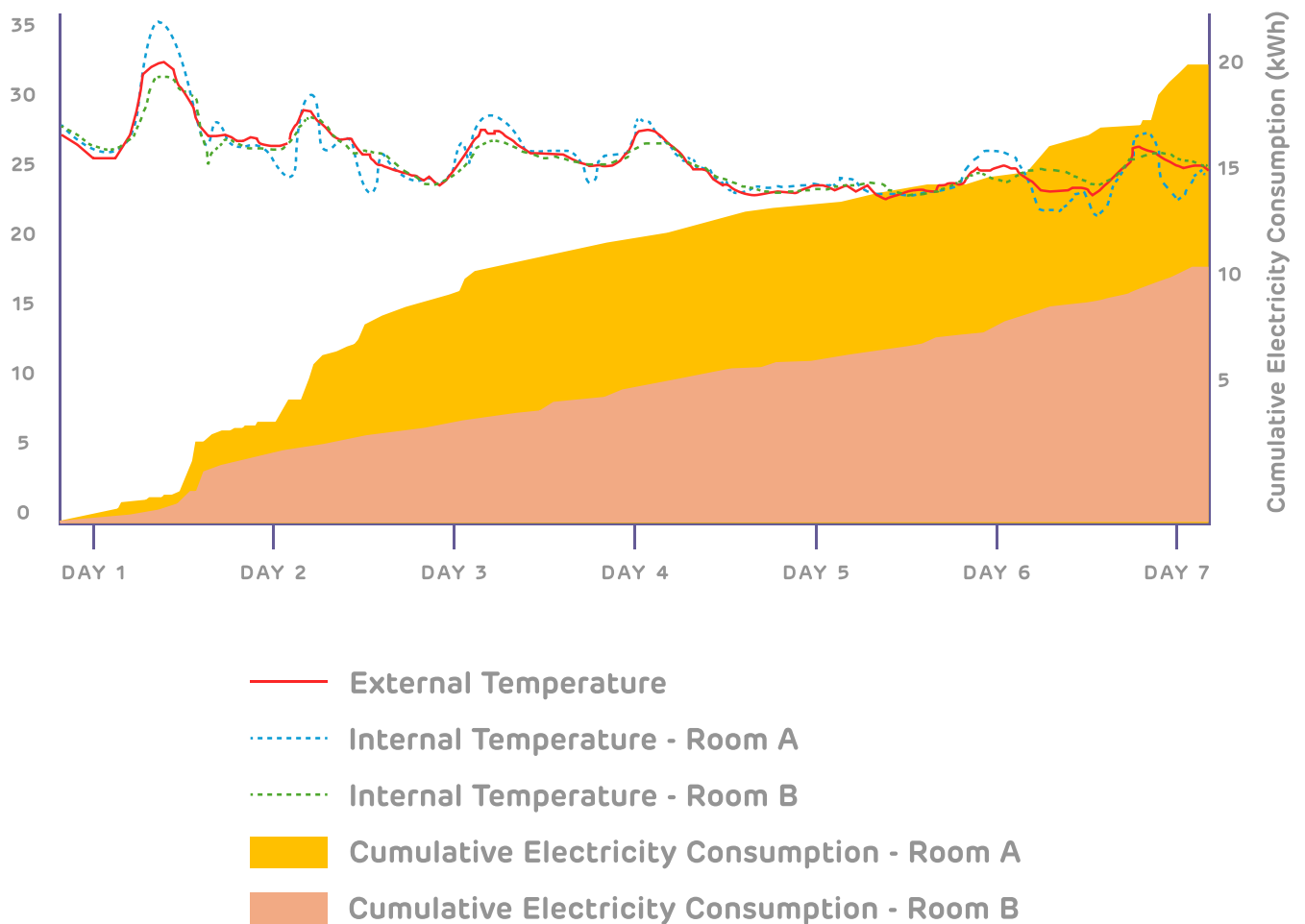
💡 Temperature sensors reveal that ambient temperatures in one of the rooms (A) is consistently warmer than in other rooms (e.g. B).

💡 The result is that the warmer Room A's electricity consumption is almost double that of Room B. This is because guests appear to overcompensate with higher use of the air conditioning.

Temperature (°C)

Cumulative Electricity Consumption (kWh)

Legend:
— External Temperature
····· Internal Temperature - Room A
····· Internal Temperature - Room B
■ Cumulative Electricity Consumption - Room A
■ Cumulative Electricity Consumption - Room B

4. Creating a sustainable guest experience

Scientists have studied pro-environmental behaviour in tourist accommodation and have explored a wide range of approaches. Here's a few examples of what works.

A hotel in Austria is shifting norms that hotel rooms do not always need a fridge. Smart metres help measure the consumption of devices to inform guests accurately.

Real-time feedback on water and energy use provided to guests can help change beliefs and educate them about usage.

A shower timer can subtly influence guests to have shorter showers. Shower timers can be enhanced with imagery or text.

Did you know?

Shower timers can reduce guest shower time. It was found that a timer, combined with persuasive messages, reduced water runtime by 26% (Pereira-Doel et al., 2024).

Guests, when exposed to sustainability advice from staff, saved 27% electricity, 22% gas, 22% water and 10% firewood versus a control group (Warren et al., 2018).

Different types of interventions can reduce food waste at buffets, including smaller plates (20% less in specific setting), table signage inviting guests to return to the buffet (21% reduction), and a stamp collection game to engage kids (34% reduction). Automated real-time measurement of plate waste can help test different interventions (see Dolnicar et al., 2023).

#4 and #5   What our research participants say

"I do keep hearing that since COVID, a lot of people are looking for more sustainable tourism experiences. I'm really needing to understand what that looks like [and] understand how we can extend that and therefore promote it as part of what we do as one of our values because obviously there's a cost saving benefit for us."

—— Holiday home owner, rural Australia

"We have learnt a LOT! Sustainability is ongoing, it's challenging, you need to be adaptive, patient, open-minded, use initiative, imagination and have excellent communication skills."

—— Manager, serviced apartments, Darwin, Australia

There are many ways to engage your guests, even before arrival and afterwards. You can combine the insights gained from the SMART technology with creative ways of service delivery. Some visitors like to learn something and appreciate new information, others look for positive or 'novel' experiences.

BEFORE

➡ Use local weather information to let your guests know beforehand what to expect and pack the right things.

➡ Add information to booking on low carbon transport options, timetables or pick up services.

DURING

➡ Smart metering can provide direct eco-feedback to visitors. For some, just knowing that they conserved resources is a reward, for others incentives could make a difference.

➡ Connect real-time weather with activity suggestions and make sure to provide low carbon options such as bicycles.

➡ Communicate any seasonal restrictions (e.g. water shortage during drought).

➡ To ensure guests are comfortable, provide extra blankets or hot water bottles when it is cold.

AFTER

➡ Undertake a guest survey to find out what they liked and what sustainability ideas they might have.

➡ Provide information about tangible impacts that your company achieved, for example new record in resource savings.

Have you thought about the following questions:

💡 Do you communicate energy conservation strategies with guests (e.g. at check-in, through signage in rooms)?

💡 Do you actively seek out best practices whose impacts can be measured through smart meter data?

💡 Do you use your data for your sustainability reporting or green marketing?

5. Motivating staff

Staffing is one of the eternal challenges for hospitality businesses aiming to deliver competitive service standards. Constant staff turnover depletes consistency of service delivery and delivers low productivity as you have to keep recruiting and training new staff. Strong sustainability programmes can boost staff morale by 55% and reduce average turnover by 25-50% (Whelan & Fink, 2016). Technology has a role to play in attracting staff, motivating them and encouraging personal development progress. Much of the same tech that goes into monitoring environmental factors can also be used to guide staff in sustainability.

5.1 Sharing Values

Hotel managers should consider emphasising their commitment to social and environmental sustainability goals if they want to attract staff who will be loyal. This requires a Responsible Tourism Policy to be created and displayed. If you want to recruit new talent then it is important to celebrate the values that they share and aspire, too. Social equality and protecting the environment are very important values for new staff; 83% of staff believe that their employer was not doing enough to be more sustainable and 65% say they would more likely move and work for a company with robust environmental policies (Gaskell, 2022). Technology has a role here in displaying the goals and updating progress automatically on your company's website, in staff rooms and in public displays at your property.

The excitement of seeing what the SMART Tech can deliver can motivate your team to progress further in delivering a more sustainable service.

#6 **What our research participants say**

"We have 70 odd staff that live in on site, make use of, you know, the resources whilst they're here. We're aiming to have the sustainability and environmental awareness and we want that the kind of the ethos of our environment, our green credentials, if you like to run through as the message and it becomes embedded in the staff, and each of the staff could spout to any guests who asked what we're about and why."

—— Manager of time-share accommodation, United Kingdom

💡 Gamification is the implementation of elements from games in a non-game environment to increase engagement and influence user behaviour.
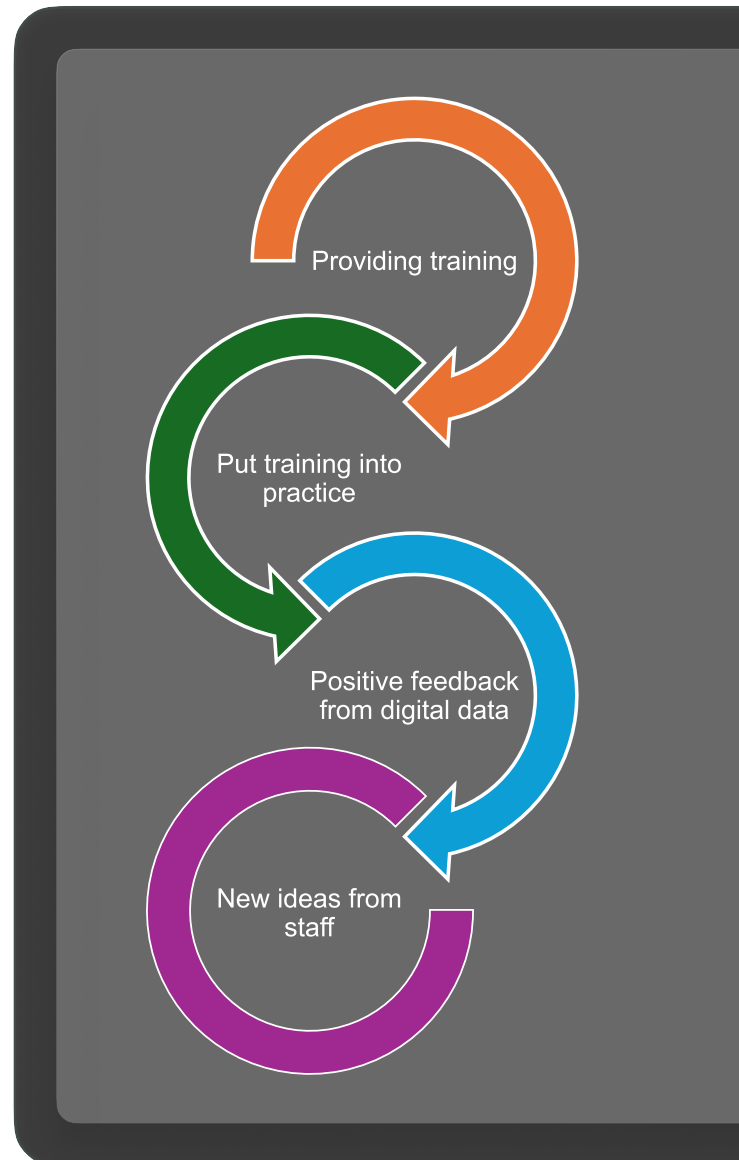
💡 Integrating gamification principles in your business to give staff and guests a purpose can greatly increase motivation to participate in sustainable tourism.

5.2 Staff journey

Existing and new staff may find it hard to comprehend how much resource and pollution is created by different appliances/equipment, the importance of conserving, and what it will achieve in scale. This means it is difficult to implement pro-environmental action in your business. Conversely if you train your employees you increase your human resource green literacy which motivates staff to support pro-environmental actions (Nisar et al. 2021.).

Once the training is over staff should be encouraged to apply their knowledge straight away with live feedback on progress they are making. You can track where you employees are in their training programme, how well they are doing and reward them for success.

The live data you collect form your SMART system can be presented to staff and show progress. With sub-metering you can even drill down and show individuals the results of their actions. This might also spark new ideas for improvement. When staff see the results of their efforts it reaffirms their values and encourages them to continue (Warren, 2023).

Providing training

Put training into practice

Positive feedback from digital data

New ideas from staff

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