Project acronym: SAVES 2

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D4.2 First version of energy dashboard for all participating universities

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SAVES 2

Executive summary

This report is to be read in reference with the online 'Energy Dashboard' found at https://switchoff.nus.org.uk where the individual university Student Switch Off Competitions can be viewed.

SAVES 2 involves 14 universities across seven countries within the European Union. The project aims to engage students in energy-saving behaviour by running fun energy saving competitions and activities for students living in dormitories of those 14 universities.

To support these aims, DMU, in conjunction with EcoVisum (a spin-off company created by DMU), has developed a dashboard that represents student dormitories as 'competitors' in online energy saving competitions.

The dashboard consists of a public-facing 'front-end' which displays competitions set up in an administrative 'back-end', managed by universities. The back-end handles their data which provides targets for energy-saving.

The development of dashboard follows a 'continuous development' model, where suggestions, issues and future features are managed in an open process with input from both front-end and back-end users, some via a special 'Technical Advisory Group' drawn from participating universities and acting as a liaison point with student users.

The main challenges so far have been handling the diverse sources of energy data and the diverse range of actors involved in the management of energy in large organisations such as Universities. To mitigate these challenges it is vital to engage universities early enough to locate the appropriate technical support staff so that they can begin running competitions from regularly-updated data.

This report details the development and progress of the energy dashboard. It provides:
1. A background to the development of the dashboard from the SAVES 1 project
2. An overview of the technical features of the dashboard
3. A review of the challenges of development and adoption by participating universities
4. A clear roadmap for the future development of the energy dashboard utilising user requirements and the technical advisory group
5. An illustration of how the progress is managed of universities adopting the on-line competitions

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Glossary

Actual consumption	The live data showing the actual consumption of a competitor. When compared with target consumption, competitor savings or increases are calculated.
Baseline period	Competitions need data from a previous period for realistic energy savings calculations. This usually covers the same dates, but from the preceding year, although (to allow for data issues) any baseline period can be set. See section 2.0 of the report for more detail.
Competitor	A participant in any competition – this is typically a student dormitory, although if metering is fine-grained enough, this can be a block, floor or even a flat, within a larger dormitory.
Historic data	Usually a year's worth of data running up to the point where regular data is available and uploaded to the dashboard. Without this, savings calculations cannot be calculated.
International competition	Combines local competitions from universities that choose to participate in any available international competition.
League Table	Competitions are presented as 'league tables', where competitors are shown in order from most savings to least, with the top three highlighted (see Figure 2).
Local competition	A competition run by a university only for the students of that university.
Target consumption	Calculated from the baseline, this provides a reasonable target against which savings calculations are made from actual consumption. Data can be monthly, daily, hourly or more frequent, but the current default target is a calculated daily average.

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1.0 Background

The Student Switch Off (SSO) campaign was set up by the National Union of Students of the United Kingdom (NUS-UK) in 2006 to encourage students living in university dormitories to pledge to save energy and encourage their flat-mates to do the same. Over the academic year, the SSO campaign incorporates a variety of offline and online events and competitions to keep awareness as high as possible and distributes prizes at both the individual level and the dormitory level, to keep pro-active students motivated. These include fortnightly photo competitions themed around different energy-saving actions where students post photos on a SSO Facebook fan pages for their university to win prizes; dormitory visits; communication skills training (to give proactive students more expertise to encourage their friends to save energy) and online climate change quizzes. At the end of the academic year, the dormitory that saved the most energy at each participating university, is rewarded for their efforts (e.g. a party, a BBQ etc).

An energy dashboard was developed by De Montfort University under the SAVES project (IEE/13/719/SI2.675836) as part of an expansion of the UK Student Switch Off (SSO) campaign into universities in four further countries across Europe (Cyprus, Greece, Lithuania, and Sweden). Prior to SAVES (2014-2017), in 2012/13 Student Switch Off was delivered at 54 UK universities, reached 130,000 students, engaged 25,000 through Facebook fan pages, pledge schemes and events, and delivered average energy-savings of 6% per participating dormitory. SAVES 2 expands this EU reach further into Romania, Bulgaria, and Ireland for 2017-2020.

The dashboard expanded the SSO competition engagement from a quarterly progress report on how much energy dormitories were saving, to a more real-time experience. Rather than receiving notifications a few times per year, students could access the dashboard via the web at any point and get up to date information about the progress of their dormitory in the competition. The dashboard produced a leader board or league table of the best performing dormitories. Some universities also displayed the dashboard on public screens, to further promote their competitions. Underpinning this work was the question of whether the timely feedback generated by the dashboard would encourage students to remain motivated throughout the competition period and increase the potential for energy savings.

The addition of the dashboard helped transform the process of gathering and processing energy consumption data to calculate the league table positions. The automated process of data transfer from university systems (be it half-hourly, daily or monthly) to the dashboard and calculating results replaced the need for manual spreadsheet calculations. The dashboard enabled universities to update their figures on demand, manage their own data and control the progress of their own competitions.

To cater for universities wishing to continue using the energy dashboard beyond the end of the SAVES project, De Montfort University created a 'spin-off' company called EcoVisum. In the SAVES 2 project the energy dashboard, now managed by the same technical team under EcoVisum, will be opened up to the participating universities and upgraded further to meet their needs and the needs of the project.

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2. An overview of the technical features of the dashboard
3. A review of the challenges of development and adoption by participating universities
4. A clear roadmap for the future development of the energy dashboard utilising user requirements and the technical advisory group (TaG)
5. A progress status on universities adopting the online competitions

It is to be read in conjunction with the on-line Energy Dashboard tool found at https://switchoff.nus.org.uk where the individual university Student Switch Off Competitions can be viewed.

2.0 Overview of the Dashboard

Briefly, the dashboard operates as follows:
1. University staff (generally energy or sustainability managers or equivalent) arrange the mode of data transfer and format with EcoVisum

2. With assistance from EcoVisum, university staff either set up automated transfer of data directly from their systems (a once-only process), or upload their data by file upload within the dashboard

3. Meters (or "data points" processed by the dashboard from their data) are allocated to specific student dormitories in a one-time operation via the dashboard. Where meters serve other functions (e.g. a laundry room as well as dormitories), or cover multiple student residences, the dashboard allows meter allocation to be split accordingly

4. The university can then set up competitions by adding dormitories, blocks or floors ('competitors') to them and making the competition public

The competitions display savings per dormitory (see Figure 2). The 'target saving' is a realistic figure calculated against a 'baseline' taken from data for (usually) the equivalent period in the previous year. If dormitories exceed this, the 'savings bar' for their dormitory (or floor, depending on how meters have been allocated) will turn green and increase in width; an increase turns the savings bar red. The dashboard then orders these results in the competition so the highest savings are at the top.

It is then possible to use these figures to measure the pre- and post-intervention energy-savings. The dashboard does this by revealing how well each competitor dormitory has performed, by comparing the calculated 'target consumption' against actual consumption.

The energy dashboard has three main tiers of functionality. For the general user (without authentication) there are a series of league tables available for each organisation (university). University administrators can sign into the system to edit and manage their users, list of dormitories, their raw data and their competitions. Finally, super-users (EcoVisum and NUS UK) can manage the list of organisations and create and manage international competitions.

2.1 Public features

The dashboard can be accessed by anyone with a modern web browser (http://browsehappy.com) (see Figure 1). When visiting the home page (https://switchoff.nus.org.uk) users are presented with a welcome message and a list of all participating organisations. The dashboard includes links back to this home page both in the Student Switch Off logo and in the clearly marked 'home' link. It also includes links to Student Switch Off social media pages, to the Student Switch Off website and to the international competition page.

**Figure 1: Landing page of the dashboard**
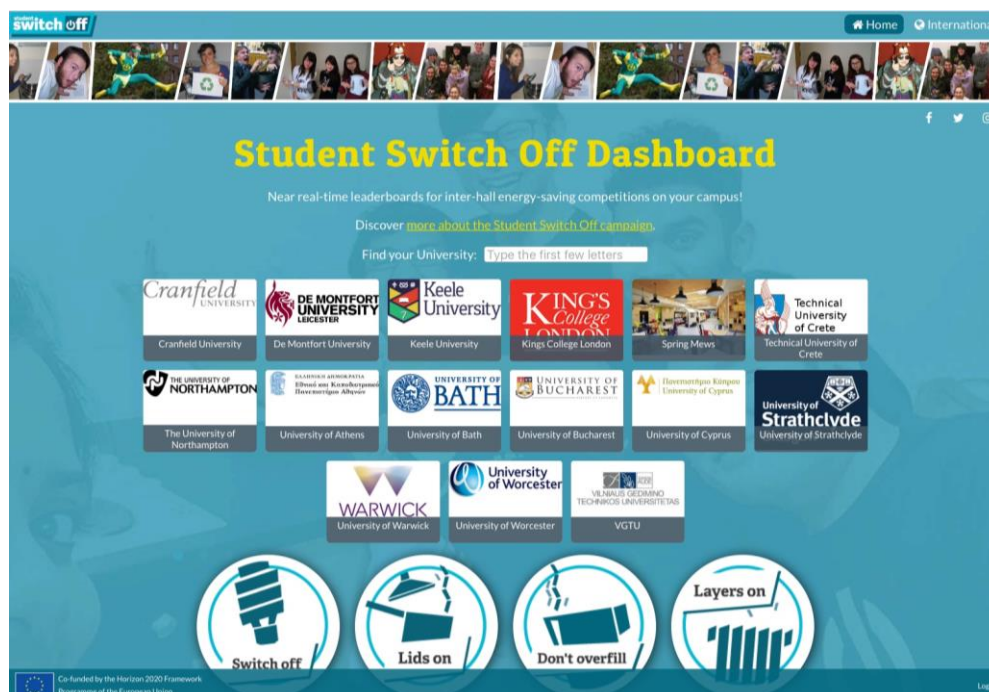
Clicking through to an individual organisation takes the user to the university home page (Figure 2). Here users can view the available competitions at that university. This is the link which universities will be distributing to students and has the form "https://switchoff.nus.org.uk/university-name".

On the right there is a 'sidebar' with the university name and logo and a list of all available competitions. Competitions are marked with a globe if they are part of a global competition and are marked with a trophy if they are designated the 'main' competition i.e. the one that appears on the university's page at the URLs above.

The current competition is presented on the left. The competition is presented as a series of dormitories ('competitors') each with an image (a default image is shown if no image is provided) and a label (typically the dormitory name). If the competition is properly configured and running and if there are valid data available then the current savings value is presented on a 'savings bar' for each competitor. The width of the bar is proportional to the savings up to a maximum of 20% at which point the bar becomes 'maxed out'. The savings bar is coloured green to the right for savings and red to the left for increased consumption.

Figure 2: A University home page
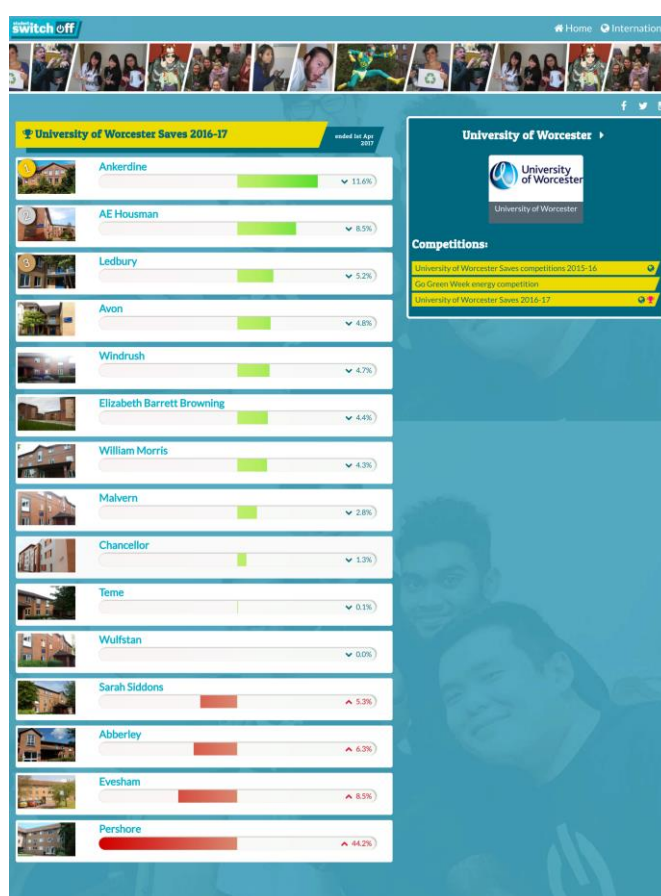
Clicking through again on one of the competitors will reveal more detail about how the calculation was conducted for that competitor (Figure 3). The competitor details are presented above a table which contains a row for each day of the competition. Each row contains the date, the target consumption (based on the previous year's consumption), the actual consumption and the daily savings figure. At the end of the table the total target and total actual consumption are given and the total savings figure is shown. This savings figure matches that presented on the league table. In this way, we provide a simple audit of the savings calculation.

The dashboard software continuously updates energy savings for each participating building as new data become available.

Figure 3: A detailed overview of the energy data

The final page available to public users is the international competition page (Figure 4). This shows the 'global' international competition between dormitories across universities. International competitions are managed by super-users and individual universities can register one of their competitions participate in an international competition. Once registered, each dormitory in the local competition will be added into the international competition. Clicking through to a competitor reveals a similar competitors page to that in the standard 'local' competitions.

Figure 4: International Competition
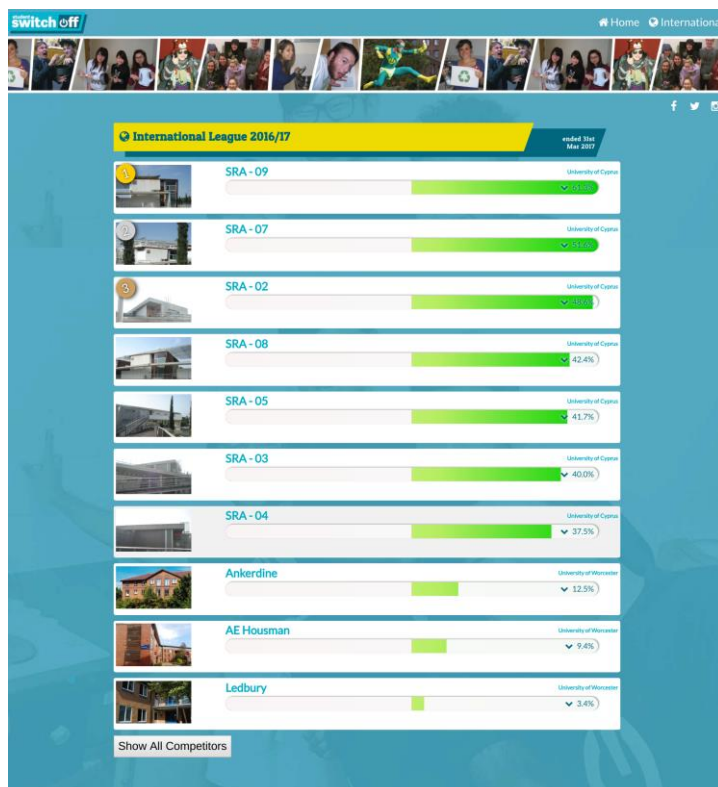
2.2 Administrative features

Administrative users have access to configure a single university. To access the administrative features, users need to enter authentication credentials (username and password) into a login page. Correct credentials will identify the user and grant access to administrative functions specific to that user.

Once logged into the dashboard, the administrative user has access to a new menu at the top of the panel on the right-hand side of their university page (Figure 5). The panel also includes a few additional editable features.

Figure 5: Admin login page

When logged in, pencil icons appear next to the university name, short description and logo. Clicking on the pencils enables editing these fields and a file upload dialogue for changing the logo image. Menu items for 'users', 'halls', 'data' and 'competitions' also appear.

- **Users**: In many cases there are multiple people in one university who are involved in the Student Switch Off campaign. For example, the person responsible for data management and metering is often not the same person who is responsible for communication and engagement with students.
- **Halls**: This is where the dormitories are created and managed. Users can add as many halls as they need, giving each hall a display name and an image. Halls can also be deleted and edited here. Once data are uploaded (see below) the datasets (i.e. electricity meters) can be flexibly allocated to halls here. It is for example possible to add two meters together, split one meter between multiple halls and remove a sub-meter from a main meter using this interface.
- **Data**: The data interface allows users to manually upload data files and to inspect the available data. Users can upload files and see how the server responds (e.g. uploaded successfully or error any messages associated with formatting problems) almost immediately depending on the file size. Recently uploaded files are shown with their status message (awaiting conversion, awaiting import, imported successfully etc.). To the right side there is a list of all the available datasets (taken from uploaded files). Clicking on a dataset will show an expandable monthly summary of the data. Individual data points are editable to cover the case where the raw data are incorrect.
- **Competitions**: This interface allows for management of a list of competitions per organisation. Each competition has a display name, a competition period and a set of default attributes for each competitor. The default attributes include the baseline period (from which a target will be generated) and a choice of which targeting 'model' to use.

Models are the defined methods for calculating target consumption from consumption data in the baseline period. The simplest model, known as 'daily', calculates a target by calculating the average daily consumption across the entire baseline period. This target is applied to every day of the competition. Two alternative variations of this simple model are also available.

1. **The 'weekday' model** will produce seven different target values, one for each day of the week. These are calculated from the baseline period and applied to the competition according to the day of the week. So, the target for every Sunday in the competition is calculated as the total consumption of all Sundays in the baseline period divided by the number of Sundays in the baseline period.

2. **The 'monthly' model** produces up to twelve different target values, one for each month of the year. Since competitions often do not include twelve months this can be applied with a baseline which covers less than twelve months. As one might expect, the target used for every day in e.g. January during the competition is calculated as the average consumption across all January days in the baseline period. Care should be taken to ensure every month required in the competition period is available in the baseline period.

2.3 Super-user features

Super admins can make dashboard changes for *any* university/organisation on the system and create or delete them. Super admins can show/hide organisations so that their landing page becomes public, but recent updates according to user requests mean that organisations can now do this themselves.

Super admins also have access to three extra menu items:

- **Users**: add/edit/remove super-users
- **Universities**: create/edit/remove organisations, plus a summary table with their current status
- **International**: add/edit/delete international competitions

3.0 Challenges

Tracking the status of all universities and any related issues was a significant challenge in the previous SAVES project as we were learning by doing. Although still a challenge EcoVisum have developed a clearly structured process. New universities are given a checklist with key questions about their data management systems. Before a video call is arranged with universities to go through the data import process, EcoVisum make sure these basic questions have been answered, although in some cases the ongoing unpredictability of data quality, changes in personnel and other pressures on university staff mean that this often has to be addressed on a case-by-case basis. The process is closely managed by EcoVisum (see section 4.0) and shared between project partners as necessary.

Apart from the above, the remaining challenges fall into two clear groups:

3.1 Administrative

- **Time pressures on university staff:** Setting up new universities typically happens in the run up to the new academic year. This is a time when things are already busy and means that the key people are often preoccupied with their own internal issues and spending time setting up or preparing data for the dashboard is not prioritised. However, regular communication has ensured that availability is monitored so that demands on their attention are timed to periods when they are known to be available. Email, Skype and phone calls are the preferred methods of contact.

- **Other pressures on key contacts** (e.g. typically the estates staff or energy managers) such as energy audits, building changes, new metering, etc. mean that they are often unavailable for significant periods of time.

- **The holiday period** leading up to competition launches has meant that a majority of key contacts have been on leave during the crucial initial setup period, and although efforts were made to pre-empt this by encouraging early setup, this proved ineffective (partly because technical changes e.g. to metering over the summer meant that setup for some halls or entire universities had to wait – in other cases the key staff had not been identified), so the main window of available time has been the September before students return.

- **Manual uploads** can be neglected during the summer period, often necessitating a reminder and resulting catch-up of the necessary missing data before a new competition can be set up. This can often highlight some of the data issues listed below.

3.2 Technical

- **Energy metering/data suppliers**: there are a growing but limited number, so expertise gained with one university's supplier can sometimes be transferred, although this is not guaranteed and each university manages the data it receives in its own way. Some suppliers have been cooperative, one or two are reluctant to help or require significant payment to set up their data systems in a way that allows the dashboard to access the data. One of the latter is in negotiation at the time of writing.

- **Broken meter/supplier connections** within university infrastructure have led to gaps in data that affect the calculations so that dormitory savings or increases appear out of reasonable range. It can be no simple matter to track down the cause of out-of-range readings as they often come to light on the dashboard first - in one case rats had eaten through university data cables! These out-of-range savings and losses, when examined, can reveal flaws in the data supplied. In some cases this has highlighted specific issues a university then needs to address; in others, it has been an issue with the dashboard itself (e.g. even a slight alteration in data can cause an unforeseen halt)—the latter is easier to correct as it is managed in-house, but there is far less control over issues at participating universities.

- **Missing historic data** due to any of the above invariably leads to out-of-range savings calculations. In some cases, a participating dormitory may have only recently started to receive regular and reliable data, or may have changed metering or function. If data are completely missing there is a need to supply a reasonable estimate against witch savings can be calculated, in cases where a hall has changed function or had new infrastructure installed, it may be that the university needs to adjust the meter 'data entities' attached to that hall in order to reflect the changes in use/equipment.

3.3 New feature management

Much of the first phase of the SAVES 2 project has involved facilitating and enabling the transfer of data into the dashboard from the new universities. This process is expected to continue throughout the project to some extent to handle changes to systems, data quality problems and liaison with third parties whose systems are not natively capable of operating in the way we need them to. Once set up, continuous activity means that EcoVisum gains capacity to look at adapting the dashboard software to more closely align with newly arising and extant user requirements.

User-requirements arise from the focus groups with students across the participating universities that from part of the monitoring and evaluation of the project. EcoVisum will work to a simple agile methodology during this phase. Agile methods are hotly debated but agile in various forms pervades the software industry and can be considered an industry standard of sorts. The key benefit of an agile approach is that it provides clear visibility of the complexities of the development process. This enables non-experts to drive the development process whilst also protecting the technical partners from taking on unrealistic challenges.

The process will be mediated and steered by the Technical Advisory Group (TaG) which is chaired by De Montfort University. The TAG will review the user-requirements from the focus groups to review the feasibility and appropriateness of the requests. The TaG will then take decisions regarding which new features to implement and the direction in which the dashboard is developed.

Key steps are as follows:
1. TAG members review the **potential features** identified by the focus groups.
2. The TAG will discuss the merits of each feature and agree to admit features into an **ideas pool**
3. EcoVisum will divide **ideas** into one or more **user stories** and maintain them as a **requirements list**
4. The TAG will maintain a list of up to three **user stories** for EcoVisum to spend some time developing
5. EcoVisum will accept regular deadlines to plan and implement the user stories, feeding back progress to the TAG

In this way, the TAG will keep close tabs on the development process and there should be few surprises. Some of the ideas need a bit of explanation, in particular **user stories** are simple articulations of a requirement. They must be tied to a particular user type, describe some action the user needs to take and give a motivation for the user to take the action. A standard template is very simple:

"As a [**some kind of user**], I need to [**perform some action**] so that I can [**fulfil some goal**]"

Critically, EcoVisum have the responsibility of converting accepted feature requests into actionable user stories. Only then will the TAG be able to prioritise these features. Technical decisions over how the selected user stories are implemented will be the responsibility of EcoVisum. Regular meetings of the TAG are necessary to feedback progress and flag any poorly defined user stories (which can often be divided into smaller user stories).

New features will be managed via a software 'version control' system 'GIT' (which also enables the dashboard software to be 'rolled back' to a previous working version should any issues prove problematic).

There are a few things the dashboard does not yet handle (e.g. degree day adjustments) so these are listed and managed via an industry-standard software 'version control' system ('GIT' which also enables the dashboard software to be 'rolled back' to a previous working version should any issues prove problematic). Some of these would involve a significant programming overhead on the 'back end' where the data is processed, others are more concerned with easing usability.

Dashboard issues and feature development are tracked and managed by EcoVisum on github (a collaborative online version control service). Priority is agreed in collaboration with university admin users, feedback from their students, the Technology Advisory Group (TaG) and NUS UK. Some feature priorities are mutable and can change according to feedback and demand. Here are just a few examples:

Super admins:
- improve universities overview table. This tracks what stage a university has reached, how many competitors they have, the date of the latest data upload, whether they have a current competition, etc.

Uni admins
- enable users to manage datasets in more detail
- add graphical representations of savings calculations

Students
- enable students to vote on their favourite energy-saving tips

According to the level of technical work involved (not always obvious as much of this work is not visible), timescales vary and may be unpredictable, especially if the feature impacts upon or changes existing functionality. However, once priorities are agreed and a schedule planned, the timescale will be clearer, especially with input in collaboration with the TaG.

Since dashboard technical changes follow a 'continual development' model, incremental changes (including issue fixes) are added periodically without a schedule and sometimes without announcement as they can be invisible to the user, but changes to user functionality and significant feature additions are always announced in a 'release' during which the new version is made available with a brief guide if necessary, although EcoVisum aims to make admin interface usability obvious, hopefully avoiding the need for a 'manual'.

4.0 Managing Progress

This concluding section details the process of universities setting up and creating their dashboards and competitions. EcoVisum manage this process through their data import checklist approach, and then via a spreadsheet that tracks the essential steps required for a university to progress towards a live competition. Figure 6 is an example of the template used by EcoVisum.

Figure 6: An example of the progress template

SAVES2 universities	Checklist sent	Checklist returned	Dashboard account	Telco arranged	Telco completed	Strategy chosen	Doc'mtion provided	halls added	Adapter(s) created	Adapter(s) tested	data imported	import validated	historic data	import automated	2016-17 comp okay	public	2017-18 comp'tition	Notes
University of Cambridge																		
Kings College London																		
London School of Economics																		
University of York																		
University of Athens																		
Technical University of Crete																		
University of Cyprus																		
Dublin City University																		
National University of Ireland, Galway																		
National University of Ireland, Maynooth																		
University College Cork																		
Vilnius Gediminas Technical University																		
University of Bucharest																		
University of Sofia																		

SAVES2

The list below provides the link to each SAVES 2 university's public page (if published):

University	URL
University of Cambridge	https://switchoff.nus.org.uk/cambridge
Kings College London	https://switchoff.nus.org.uk/kcl
London School of Economics	https://switchoff.nus.org.uk/lse
University of York	https://switchoff.nus.org.uk/york
University of Athens	https://switchoff.nus.org.uk/athens
Technical University of Crete	https://switchoff.nus.org.uk/crete
University of Cyprus	https://switchoff.nus.org.uk/cyprus
Dublin City University	https://switchoff.nus.org.uk/dcu
National University of Ireland, Galway	https://switchoff.nus.org.uk/nuig
National University of Ireland, Maynooth	https://switchoff.nus.org.uk/nuim
University College Cork	https://switchoff.nus.org.uk/ucc
Vilnius Gediminas Technical University	https://switchoff.nus.org.uk/vgtu
University of Bucharest	https://switchoff.nus.org.uk/unibuc
University of Sofia	https://switchoff.nus.org.uk/uni-sofia

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