Energy Saving with Redshift Climate

The amount of energy that can be saved with Redshift Wireless's Redshift Climate product is a complex issue. There are a significant number of variables that must be considered.

This document goes through some of the savings that can be made with the system, and at the end gives examples of some of the savings that are possible. Unfortunately the greatest savings are hard to quantify because they are based on user actions to which we have no information.

One of the key areas for energy saving is to place limits on thermostat settings. The NSW Government have estimated that adjusting the thermostat by just 1˚C can save up to 15% off your cooling bill. When you realize that many people set the thermostat 3-4˚C away from optimum, you get an idea of the size of the savings possible.

Another way is to ensure that your devices has clean filters. The US Government notes that 5-15% of energy can be wasted with dirty air filters.

Variables

- Size of Unit
  - Commonly 2.5 kW electrical, but up to 5 kW
- Hours of Operation per day
- Climactic Zone
- Thermostat
- Insulation and Building Construction
- Price of Electricity

Some Possible Savings

The following numbers are based on A/C and heating units consuming an average of 1 kWh when in use. This is based on 1/3rd of an assumed average sizing of 2.5-3 kW. It is also based on an electricity price of $0.25 / kWh. This will vary with location, size of room, age of unit, climate etc.

These numbers should be used in conjunction with existing electricity bills to verify their reasonableness.

Conservative Numbers

One degree of difference – Cooling	$ 65/year
One degree of difference – Heating	$ 65/year
Ensuring efficiency with clean Filters	$ 35/year
Units left on accidently overnight	$ 36/year
Powering down during lunch and recess	$ 65/year
Staff Room – Unit turned off when not needed	$223/year
Staff Room – Unit turned off an hour earlier	$ 42/year
Lost remotes	$ 35 each

Energy Saving Areas

- Administrative Limits
- Automation
    - Automatic Power Down at End of Day
    - Periodic Power Down
    - Room Automation
    - Automatic Power Up
- Interlocks
- Weather Rules
- Lost Controls
- On Billing

Administrative Limits

An Administrative Limit is a control placed on the device that restricts the range of settings for that device that can actually be used. A great example of this is thinking about the number of times when you walk into an office from outside and it is too cold in summer, or too warm in winter.

Lounge Room	(Lounge)		Now
Heat	18-30	LMH-	Cool
Cool	16-27	LMH-	16
Fan		LMHA	Low
Auto	18-25	---A	

These are dependent on the mode. Where people have local control, they tend to cool to 20˚C and warm to 23˚C[1]. Administrative Limits turns that on their head.

It allows the administrator to set separate temperatures for heating and cooling within an area, but giving local control. For instance, cooling might be limited between 23˚C and 26˚C, and warming between 16˚C and 20˚C. This allows local control, whilst placing limits on use.

One Degree of Difference

[1] http://www.savepower.nsw.gov.au/about/data-assumptions.aspx

Increasing the thermostat up by 1˚C in Summer, from 22˚C to 23˚C can save 15% on your cooling bill[2]. This can be $65 per unit just from cooling, and a similar amount for heating.

Local Control

By giving people access to control devices whilst mobile, it reduces the tendency to need to leave a device on because of the effort required to turn it back on.

The Web based interface gives improved timer settings, so that a device can be turned off after a time without complex remote control interfaces to use.

Automation

Automatic Power Down at End Of Day

In many facilities, people do not make the overt decision to turn off air conditioners and heaters at the end of the day. Often this job is left to security or cleaning staff.

Even when staff members themselves are engaged to turn the heating or cooling off, they often do this at the completion of the day, meaning that the building remains at this temperature for a long period.

We have a number of strategies to improve energy performance at the End Of Day.

Our first is to ensure that all units are turned off at the end of normal use. This can be overridden as required, but becomes the default. If classes finish at 3PM, all units will turn off at 3PM, unless a decision is made not to do this in individual cases, either locally, or remotely

The second thing that can be done is to move the device into fan mode rather than heating or cooling a time before the end of the day. Once again, if classes complete at 3PM, we can move the device to fan mode 30 minutes before this.

During this time the temperature will only rise slightly, but significant energy will be saved.

[2] http://www.savepower.nsw.gov.au/business/power-saving-tips/increase-the-temperature-setpoint-when-cooling.aspx

Automatic Power Down at intervals

In most offices there are rooms that are staffed periodically. We have the technology to power down rooms by default, requiring user interaction to turn the device back on.

The psychology here is that people will often not be motivated enough to turn a device off, but if it is off, they will then need to be motivated to turn it back on, saving energy.

Automation for Rooms

Certain rooms are often only used for a couple of hours a day. An example of this might be a staff room in a school. The room is generally only used before school, at morning tea, and lunch. Outside these times, the room is often not used.

We are able to schedule these rooms so that the temperature is suitable for when they need to be used, and little energy is used at other times. This can be by moving to fan only mode, or significantly adjusted thermostat settings.

Automated Startup

Once again in a school, many teachers will turn the device in their room on as soon as they get to the school in the morning. This might be 30 minutes before the classroom is to be used. We can change this to automate the startup to 10 minutes before normal usage, saving significant amounts of energy.

Automation for Special Events

In a school situation, assemblies are a way of life. During an assembly, a classroom teacher will often have the heating or cooling in their room operating for the period of the assembly, regardless of the occupancy of rooms.

Administrative staff can automate turning off heating and cooling during assemblies, with the devices automatically turning on so the climate is OK for return to class. Of course, if a teacher needs to bypass the assembly to work in their room, they can have override if this is desired.

Air Filters

Numerous studies suggest that savings of 5-15% can be made by ensuring that air filters are cleaned appropriately. Our system allows this to be managed in an intelligent manner. By monitoring the air flow through your device, we can predict an appropriate time for cleaning.

Whilst these numbers are the same order of magnitude as the One Degree of Difference, we are not as confident of that level of saving in our calculations. We are confident that a $35 is reasonable given the evidence.

Interlocks

Our research has found that too often people are using Air Conditioners inappropriately. This is particularly the case in the intermediate seasons of autumn and spring.

What we can do is to add an interlock to the control, based on prevailing conditions. This might be based on external weather or internal temperatures.

The decision can be made that select units will not operate until certain limits are met. For instance, you could limit cooling so it cannot be engaged until the indoor and outside temperatures are greater than 25˚C

Weather Rules

A weather rule would allow actions to happen only on certain climatic conditions. For instance, it would be possible to program heating to come on in a classroom at 8:30AM, but only if the external temperature was below 10˚C and the inside temperature was below 15˚C.

Lost Controls

The cost of a lost or destroyed remote control is commonly about $50. Even the cost of batteries is non-trivial. With our system, remote controls in their traditional form are no longer used.

PC's, Laptops, Tablets and Mobile Phones can be used to control heating and cooling.

Billing for Heating and Cooling

Many organizations rent particular buildings out for various purposes. At the moment there is little in the way of managing the recovery of costs for heating and cooling.

With this system, we are able to give dedicated logins to groups using the facilities, with control only possible during their rental period.

Because all interactions with the system are logged, we are then able to prepare reports that can be used for billing. The organization may be charged $0.50 per hour for heating and cooling per device, to pay not only for the electricity but for the capital cost of the air conditioner. It is up to them how much they use. This can be a simple source of revenue for the organization.

Case Studies

The following case studies make certain assumptions. They are based on an average energy consumption for Air Conditioners and Heaters of 1000W, and an average electricity price of $0.25 / kWh. It also assumes that this is constant throughout the year. It also assumes that units are on all year, even when they really are not needed.

Depending on the climatic zone, these may not be accurate. Some zones will require less heating and cooling. Some installations will have larger average consumption, particularly when the units are rated over 6 kW of heating/cooling.

The examples below are there to put numbers on a very complex subject. These are only some of the savings possible.

Assembly

A school has a one hour assembly each week for an hour. The school has six classes in each year, and seven years (Kindergaten, Years 1-6). Assuming that all the Air Conditioners are on, and are consuming about 1kW on average, automatically turning these units off for that one hour a week for the year will save about $441 each year.

$441 = 42 weeks * 42 units * 1 kWh * $0.25/kWh

Staff Room

The staff room is used from 8:15AM to 9:00AM, 11:00AM to 11:15AM, 12:30PM to 1:30PM, and occasionally from 3:00PM to 4:00PM.

We can automatically turn the device on only during the times it would be occupied, and manually when needed after school. The guaranteed saving each day for this one room would be 4:15. Over 42 weeks, this is worth about $223.10

$223.10 = 42 weeks * 5 days * 4.25 hours * 1 kWh * $0.25

If the Air Conditioner is only needed until 4PM one day a week, but it is normally left on that extra hour, the savings are

$42.00 = 42 weeks * 4 days * 1 hour * 1 kWh * 0.25

Lunch Time

The room is not needed during Lunch Time and Recess. These are one hour and 15 minutes respectively. This saves $65.62

$65.62 = 42 * 5 * 1.25 hours * 1 kWh * $0.25

Left On Overnight

Units occasionally get left on. This will normally just be overnight, but occasionally it will be left over a weekend. We assume it is left on eight times a year for an equivalent of 12 hours, and once a year over a weekend for 48 hours. This averages out at the equivalent of 18 hours. The total becomes $36/year

$24 = 8 Times a year * 12 hours * 1 kWh * $0.25
$12 = Once a year * 48 hours * 1 kWh * $0.25

Left On becomes $36/year

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