



Knowledge-Based System to Support Plug Load Management



Jonny Carlos da Silva
Mech. Eng. Department, UFSC, Brazil

Scott Poll
NASA Ames Research Center, USA

Introduction

Lighting and HVAC loads have been the top contributors to building energy consumption.

With the decreasing trend in lighting and HVAC energy consumption, plug and process loads are taking up an increasingly larger slice of the building energy use pie.

We describe the development of a knowledge-based system to analyze data collected from a plug load monitoring system. The KB system generates summary usage reports and alerts building personnel of malfunctioning equipment and unexpected plug load consumption. In terms of plug load energy consumption, it has been found that motivated users are **key to saving energy**.

The system is planned to be applied to Sustainability Base, a recently constructed LEED Platinum office building at NASA Ames Research Center, to identify malfunctioning loads and reduce building energy consumption. In the current phase, a testbed was designed.

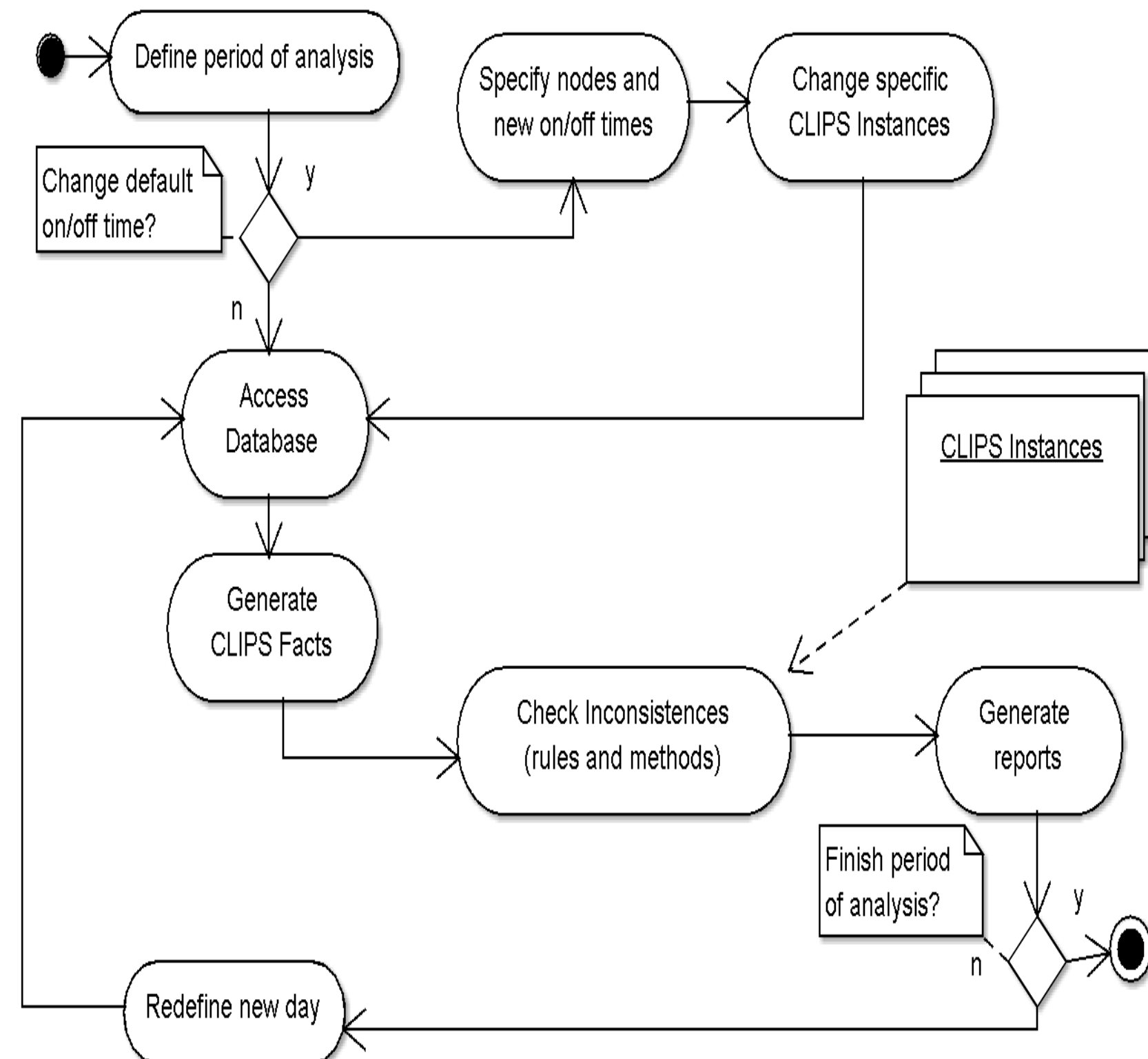
Sustainability Base



List of equipment Monitored in the testbed

Equipment	No.	Equipment	No.
Desktop	6	Calculator	1
Laptop	3	Storage drive	1
Printer	7	Battery charger	1
Phone	2	Vend. machines	2
Speaker	3	Space heater	1
Scanner	3	External drive	1
Monitor	7	Coffee maker	1
Hub	2	Refrigerator	1
Copier	1	Bridge	1
Shredder	3	Microwave	1
Lamp	2	TOTAL	50

KB system diagram



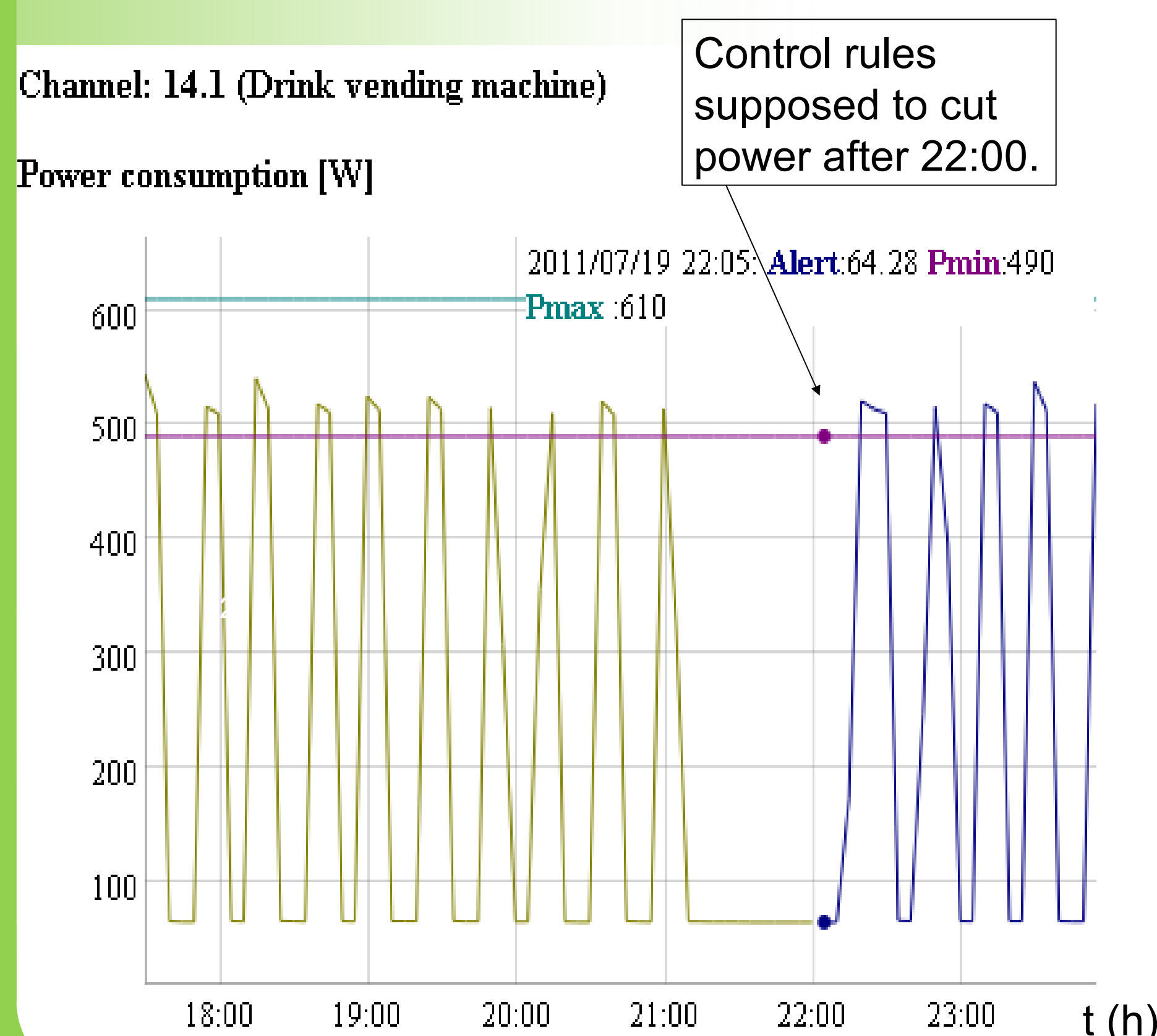
KB system developed in CLIPS using a combination of rules, semantic network and object-oriented modeling. Functions:

1. Alert loss of communication
2. Alert failure of schedule-based on/off rules
3. Alert abnormal power consumption
4. Alert possible channel change
5. Present power mode transitions
6. Present percentage of time in different power modes
7. Present overall energy consumption per day

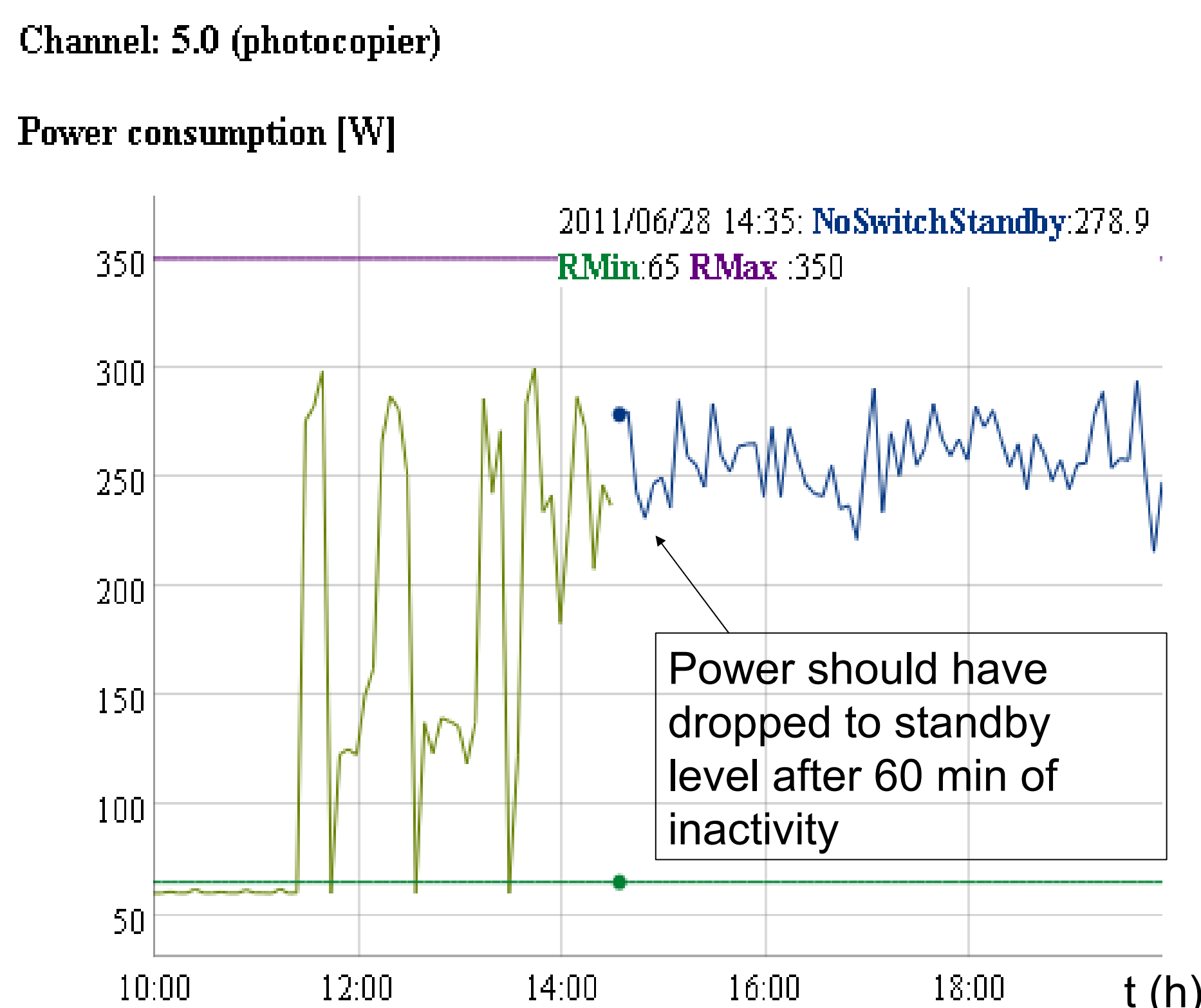
Example text report

Report corresponding to date:20110728
 6.3 @12:30 mode change on to idle power= 4.61
 11.3 @12:30 mode change standby to on power= 1.3
 ...
 @12:45 9.3 consumed power out of all ranges (phantom, standby, idle and active). Possible change in the channel has occurred. Check the user. Power= 88.15
 ...
 5.0 @13:30 consuming in abnormal range:Power:265.05
 ...
 4.0 @22:00 loss of communication
 ...
Attention: it is possible channels were changed because @ 12:45 channel 9.3 consumed power 88.15 out of its normal ranges. Check other channels in the same node.

Channel fails to switch off



Channel fails to transition



Conclusion

The developed KB system processes data acquired from a plug load monitoring system, **triggers alerts and generates reports**. The alerts call attention to **malfunctioning equipment, failure of schedule-based rules, or changes in use pattern**. The reports summarize plug load power consumption statistics. Providing such feedback to occupants is expected to **identify malfunctioning equipment and reduce the energy consumption of Sustainability Base**.