OPTIMUS

OPTIMISING ENERGY USE IN CITIES THROUGH SMART DECISION SUPPORT SYSTEMS

Inference Rules: An Overview

Introduction

An inference rule is rule-based knowledge that can be expressed in a logical form (if-then), with a graphic expression or as a mathematical equation. Inference rules are an important part of the scenario modelling that allows the development of the action plans suggested by the OPTIMUS Decision Support System.

Inference rules are able to describe the system in terms of building characteristics and behaviour, technical equipment, etc. a priori, on the basis of expert knowledge and provide the optimisation criteria for a specific action. The inference rules form the theoretical basis of the specific suggested action plans that are implemented in the inference engine of the OPTIMUS DSS.

Based on predicted data and fed by real-time monitored data from the data capturing modules, the OPTIMUS DSS supports the implementation of action plans, structured upon a number of inference rules. A total of 7 Action Plans, supported by 9 Inference Rules, are available by the OPTIMUS DSS accommodating municipalities willing to plug - in their buildings to optimize energy use, but not compromise the comfort within the building.

Action Plan 1: Scheduling and Management of the Occupancy

It aims at the reduction of the building energy consumption by changing the location of building occupants. This way, a minimum number of thermal zones can be used and the consumption can be reduced by turning off the heating/cooling system in the unoccupied zones.

The indicators to be optimised are:

- Energy consumption.
- CO_2 emissions.
- Thermal comfort.

Action Plan 2: Scheduling the Set-Point Temperature

Based on the application of two inference rules, this AP is aimed to adjust the indoor temperature set-point by taking into consideration, respectively, thermal comfort as submitted by the building users, and the adaptive comfort concept. The target is to optimize energy use for heating and cooling, while maintaining comfort levels in accepted ranges.

The indicators to be optimized are:

- Energy consumption.
- CO_2 emissions.
- Thermal Comfort.

Action Plan 3: Scheduling the ON/OFF of the Heating System

Based on three inference rules, it aims at the reduction of energy use by the optimization of the boost time of the heating system taking into account the forecasting of the indoor air temperature and the occupancy levels of the building.

The indicators to be optimized are:
- Energy consumption.
- CO_2 emissions.
- Thermal comfort.

Action Plan 4: Management of the air side economizer

It involves scheduling of the amount of outdoor air to be used for cooling the indoor environment, in order to reduce or eliminate the need for mechanical cooling when favourable conditions occur, using air-side economizer technology.

The indicators to be optimized are:
- Energy consumption.
- CO_2 emissions.
- Thermal comfort.

Action Plan 5: Scheduling the Photovoltaic (PV) Maintenance

It aims at the detection of the need for maintenance of the PV system, alerting the user to check if corrective actions are necessary. This facilitates the identification of PV malfunctioning.

The indicators to be optimized are:
- Energy consumption.
- Renewable energy production.
- CO_2 emissions.

Action Plan 6: Scheduling the sale/consumption of the electricity produced through the PV system

Optimization of selling/self-consumption of electricity produced by a PV system considering different scenarios of energy market (green strategy, finance strategy and peak strategy).

The indicators to be optimized are:
- Energy consumption.
- CO_2 emissions.
- Renewable energy production.
- Income from the sale of surplus of energy produced through PV system

Action Plan 7: Scheduling the operation of heating and electricity systems towards energy cost optimization

It minimizes the energy cost of the building(s) by optimizing simultaneously the operating schedule of the heating (CHP & boilers) and electricity systems (grid, PV plant & batteries) for the upcoming week. Thus, the AP firstly specifies based on the season (winter/summer) the schedule of the heating/cooling systems and then suggests when the energy generated should be used, stored or sold in order to minimize energy cost or even make a surplus. The outcome of the energy demand and RES prediction models, as well as weather and energy prices forecasts, are exploited in order to optimize the energy flows from/to the grid and the batteries and minimize energy cost based on load shifting and peak shaving techniques.

The indicators to be optimized are:
- Energy cost.

The OPTIMUS project – OPTIMUS aims to design a Decision Support System (DSS) to help towns and cities reduce CO_2 emissions by optimising energy use in public buildings.

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