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RL-Energyplus: additional content

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Overview

In this document we provide additional content for our submission to the NTT Group Sustainability Conference 2023.

Platform: main features

Landing page

The screenshot shows the RL-Energyplus dashboard. On the left is a dark sidebar with navigation options: DESIGN & EXPERIMENT (Define your research), COMPUTING (Configure computing resources), and SUPPORT (Guidance and support). The main content area features a welcome message for Sergio, a user profile, and a summary of key metrics: 4 Scenarios, 17 Experiments, 2 Clusters, and 7 Tasks, each with a last created or started timestamp.

Metric	Count	Last Action
Scenarios	4	Last created: 01/06/2023 20:08:12
Experiments	17	Last created: 02/06/2023 13:25:52
Clusters	2	Last created: 02/06/2023 16:35:07
Tasks	7	Last started: 03/06/2023 19:32:45

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Scenarios: definition

The screenshot shows the 'Scenarios List' page in the RL-Energyplus application. The left sidebar contains navigation options: DESIGN & EXPERIMENT (Dashboard, Scenarios, Models, Experiments), COMPUTING (Clusters, Tasks), and SUPPORT (Help Center). The main content area displays a table of scenarios:

Id	Name
2	Shopping Mall
23	Basic environment
24	Test scenario
25	Iglesia San Juan del Hospital
34	Auditorio de la Diputación de Alicante

The 'Auditorio de la Diputación de Alicante' scenario is selected. The right sidebar, 'Scenario Sidebar', offers actions: Create scenario, Configure scenario, Files, Remove scenario, and Scenario list.

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The screenshot shows the 'Scenario Configuration' page for the selected scenario. The left sidebar is identical to the previous view. The main content area shows the configuration details for 'Auditorio de la Diputación de Alicante':

Scenario: Auditorio de la Diputación de Alicante

Configuration:

```
{
  "environment_dlist": {
    "ADDA-v0": "RL_Energyplus_envs_vo.adda_v0:TestEnv"
  },
  "sensor_list": {
    "ENERGYPLUS_VARIABLE_EXTERNAL_TEMP": [
      "Site Outdoor Air Drybulb Temperature",
      "Environment"
    ]
  },
  "meter_list": [],
  "actuator_list": {
    "ENERGYPLUS_ACTUATOR_HVAC_COOLING_SETPOINT": [
      "Schedule Compact",
      "Schedule Value",
      "Cooling set point schedule"
    ],
    "ENERGYPLUS_ACTUATOR_HVAC_HEATING_SETPOINT": [
      "Schedule Compact"
    ]
  }
}
```

The right sidebar, 'Scenario Sidebar', offers actions: Create scenario, Configure scenario (highlighted), Files, Remove scenario, and Scenario list.

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Scenarios: file management

The screenshot shows the 'Scenarios' file management interface in RL-Energyplus. On the left is a dark sidebar with navigation options: DESIGN & EXPERIMENT (Dashboard, Scenarios, Models, Experiments), COMPUTING (Clusters, Tasks), and SUPPORT (Help Center). The main content area is titled 'Scenarios' and shows 'Scenario files configuration' for the scenario 'Auditorio de la Diputación de Alicante'. It includes an 'Upload file' button and a 'Files' section with three file icons: ADDA-v1.idf, ADDA-v2.idf, and Alicante_SP-hour.epw. A right-hand sidebar shows details for 'ADDA-v2.idf', including its size (1288053) and 'Download'/'Delete' buttons. The footer indicates 'RL-Energyplus © 2023 - v1.0.26'.

Experiments: definition

The screenshot shows the 'Experiments' definition interface in RL-Energyplus. The sidebar is similar to the previous screenshot, with 'Experiments' selected. The main content area is titled 'Experiments' and shows an 'Experiment list' table. Above the table are 'Refresh' and 'Show Only Favourites' buttons. The table lists five experiments with their IDs, names, scenario names, and favorite status. A right-hand sidebar titled 'Experiment Sidebar' contains 'ACTIONS' like 'Create experiment' and 'Experiment list'. The footer indicates 'RL-Energyplus © 2023 - v1.0.29'.

Id	Name	Scenario Name	
38	Training - 256x256 network	Iglesia San Juan del Hospital	★
39	Inference - 256x256 - 5 days	Iglesia San Juan del Hospital	★
40	Inference 256x256 - training period	Iglesia San Juan del Hospital	★
41	Basic experiment (train)	Auditorio de la Diputación de Alicante	★
42	Basic experiment (inference)	Auditorio de la Diputación de Alicante	★

RL-Energyplus

DESIGN & EXPERIMENT
Define your research

- Dashboard
- Scenarios
- Models
- Experiments

COMPUTING
Configure computing resources

- Clusters
- Tasks

SUPPORT
Guidance and support

- Help Center

Experiments > Configuration

Experiments

Experiment configuration

Experiment*

Basic experiment (train)

Scenario

Auditorio de la Diputación de Alicante

Configuration:

```
{
  "action": "train",
  "environment": "ADDA-v0",
  "is_retrain": true,
  "model_name_training": "RLEN-ADDA",
  "model_name_retraining": "RLEN-ADDA-10",
  "training_cancel_flag": false,
  "training_iter_num": 100,
  "checkpoint_iter_num": 5,
  "tutorial_plus_dataset": true,
  "verbose": false,
  "level": 2,
  "verbose_output": "file",
  "config_refresh_logger": 1000,
  "environment_cloud_update": false
}
```

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Experiment Sidebar

ACTIONS
Choose the action you want to take

- Create experiment
- Configure experiment
- Execution control panel
- Remove experiment
- Experiment list

Experiments: execution

RL-Energyplus

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COMPUTING
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- Tasks

SUPPORT
Guidance and support

- Help Center

Experiments > Execution Control Panel

Experiments

Execution Control Panel

Experiment Name

Basic experiment (train)

+ Launch Refresh Show Only Favourites

Id	URL	Status	Started	Last updated
904fccc-3afc-439e-ab02-505349443a0b	Execution URL	Finished	06/10/2023 21:04:44	07/10/2023 14:50:45
ade06ce4-5640-4759-9a0c-d6422177edf	Execution URL	Finished	06/10/2023 18:09:12	06/10/2023 21:05:13
39181c1a-61eb-4e66-bb71-9933d5896644	Execution URL	Finished	06/10/2023 16:45:59	06/10/2023 19:31:20
5da06733-01b6-4bd4-8370-a7f4d44b06c5	Execution URL	Finished	06/10/2023 08:58:05	06/10/2023 19:30:31
c039ac3-001b-444d-9719-0d340d07454f	Execution URL	Finished	06/10/2023 06:58:23	06/10/2023 19:30:12

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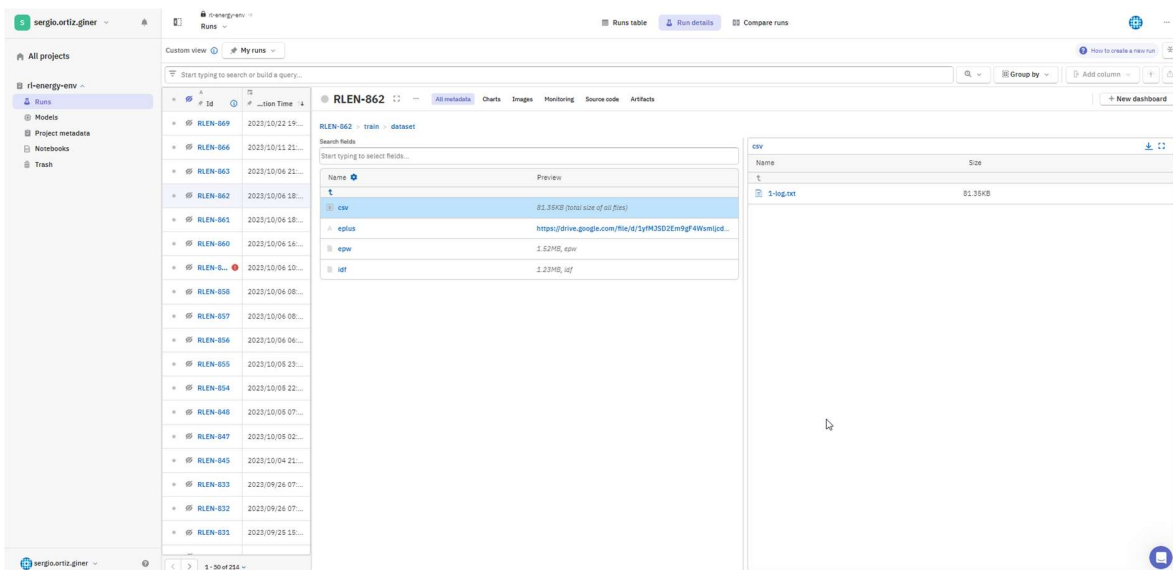
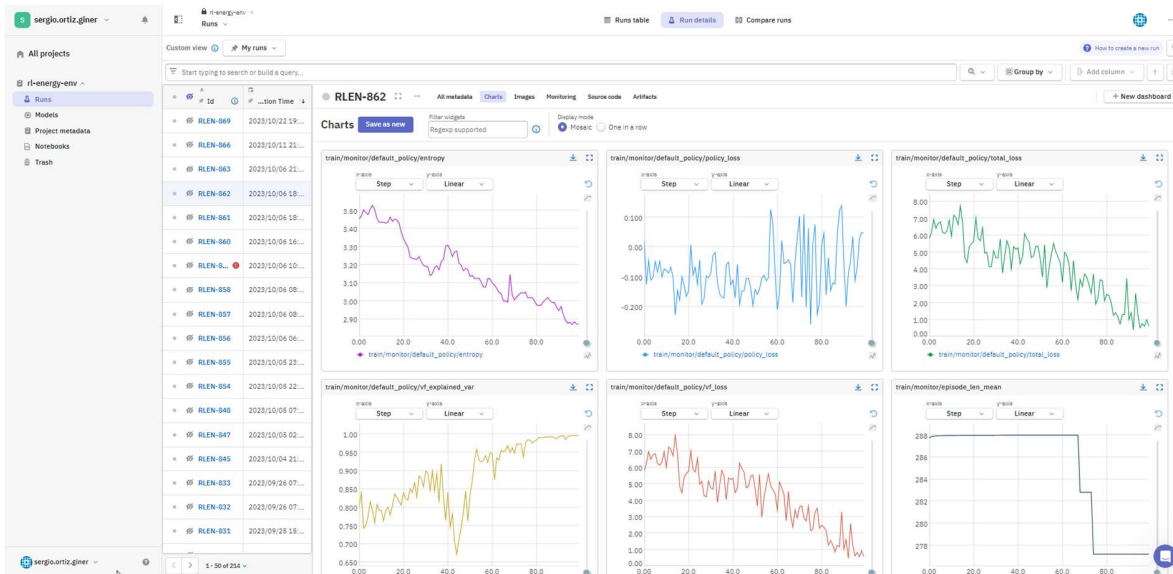
Experiment Sidebar

ACTIONS
Choose the action you want to take

- Create experiment
- Configure experiment
- Execution control panel
- Remove experiment
- Experiment list

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Experiments: integration with Experiment Tracking Tool (Neptune.AI)



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Models

RL-Energyplus

Models > Versions

Models

Model versions

Model Name: Preliminary testing

Scenario Name: Auditorio de la Diputación de Alicante

[Metadata repository](#) [Refresh](#)

Id	Creation time
RLEN-ADDA-1	30/09/2023 20:45:29
RLEN-ADDA-2	02/10/2023 20:07:27
RLEN-ADDA-3	04/10/2023 16:52:42
RLEN-ADDA-4	04/10/2023 20:12:12

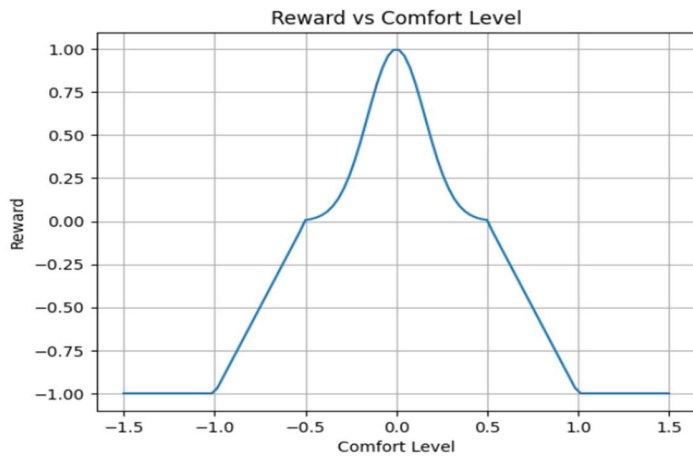
RL-Energyplus © 2023 - v1.0.26

Training environment: ADDA

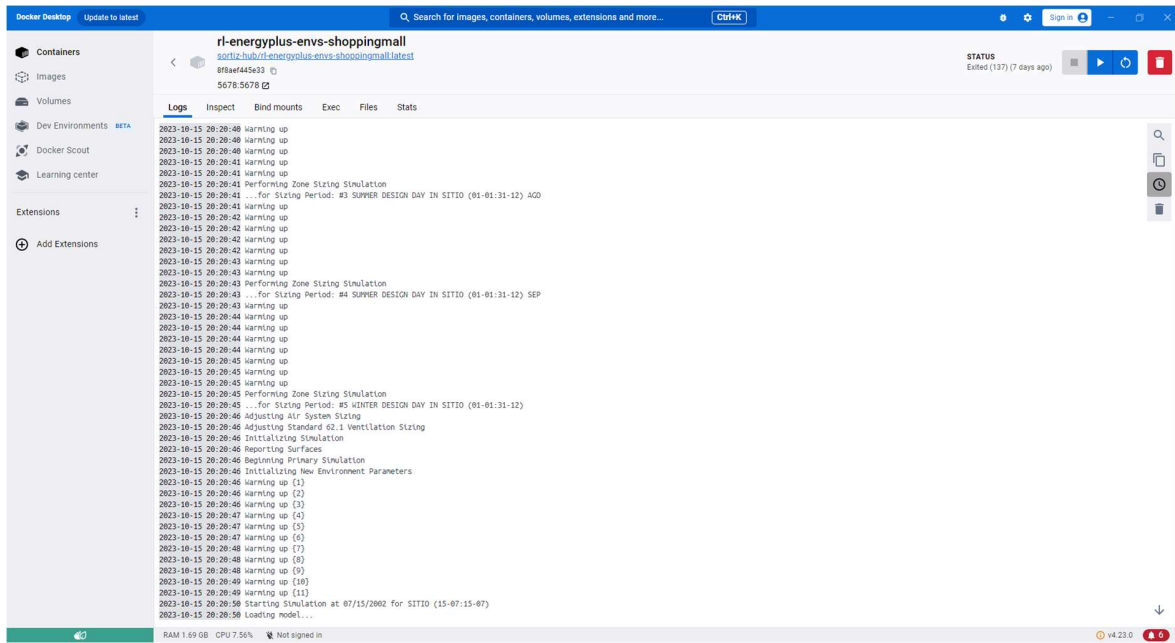
```
adda_v0.py 3.M X
rlenergyplus_envs_us > adda_v0.py > TestEnv
1 import math
2 import datetime
3 import numpy as np
4 from pathlib import Path
5 import gymnasium as gym
6 import threading
7 from enum import Enum
8 import random
9
10 from rlenergyplus.spl.us.base_env import EnergyPlusBaseEnvironment
11 from rlenergyplus.exception import WaitException, EpisodeFinishedException
12 from rlenergyplus import utils
13
14 class TestEnv(EnergyPlusBaseEnvironment):
15     """
16     ----- Environment features
17     Observation space:
18     - Daily minute ([-1,1] - [daily_minute_min,daily_minute_max])
19     - External temperature ([-1,1] - [external_temp_min,external_temp_max])
20     - Zone information
21     + Mean Air Temperature ([-1,1] - [zone_temp_min,zone_room_temp_max])
22     + Air Relative Humidity ([-1,1] - [zone_relative_humidity_min,zone_relative_humidity_max])
23     + People Count ([-1,1] - [zone_people_count_min,zone_people_count_max])
24     + Comfort Level (PMV) ([-1,1] - [zone_pmv_min,zone_pmv_max])
25     Action space:
26     - Cooling Setpoint [discretization of continuous state - (cooling_setpoint_min,temp,cooling_setpoint_max,temp,agent_action_temp_step)]
27     - Heating Setpoint [discretization of continuous state - (heating_setpoint_min,temp,heating_setpoint_max,temp,agent_action_temp_step)]
28     Rewards:
29     - Reward-comfort
30     > abs(PMV) <= 0.5:
31     reward=e^(-20*PMV^2)
32     > abs(PMV) in [0.5,1]:
33     reward=1-2*PMV - if PMV<0
34     reward=1+2*PMV - if PMV>0
35     > abs(PMV)>1:
36     reward=-1
37     - Max negative reward threshold to stop execution -> reward_max_negative_threshold
38     """
39     def __init__(self,**kwargs):
40         self.config=kwargs
41         if (self.config is not None) and len(self.config)>0:
42             super().__init__(**self.config)
43             random.seed()
44             self.target_temp=-1
```

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Reward function used for reinforcement learning



Local execution of environments: Docker



Cloud-based execution of environments: AWS Fargate cluster

RL-Energyplus

DESIGN & EXPERIMENT
Define your research

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- Models
- Experiments

COMPUTING
Configure computing resources

- Clusters
- Tasks

SUPPORT
Guidance and support

- Help Center

Clusters > List

Computing clusters

Computing cluster list

id	Name
15	RL-EnergyplusTesting

Cluster Sidebar

ACTIONS
Choose the action you want to take

- Create cluster
- Remove cluster
- Cluster list

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RL-Energyplus

DESIGN & EXPERIMENT
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Configure computing resources

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Tasks > List

Computing tasks

Computing task list

Refresh

id	Name	CPU	Memory	Status	Extended status	Cluster
113	ShoppingMall Task	1024	3072	stopped		

Task Sidebar

ACTIONS
Choose the action you want to take

- Create task
- Start task
- Remove task
- Task console
- Task list

RL-Energyplus

DESIGN & EXPERIMENT
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COMPUTING
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- Tasks**

SUPPORT
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Tasks > Start

Computing tasks

Start computing task

Name
ShoppingMall_Task

Image
ghcr.io/sortiz-hub/rl-energyplus-envs-shoppingmall:latest

Cluster*
RL-EnergyplusTesting

Start

Task Sidebar

ACTIONS
Choose the action you want to take

- Create task
- Start task**
- Remove task
- Task console
- Task list

RL-Energyplus

DESIGN & EXPERIMENT
Define your research

- Dashboard
- Scenarios
- Models
- Experiments

COMPUTING
Configure computing resources

- Clusters
- Tasks**

SUPPORT
Guidance and support

- Help Center

Tasks > Console

Computing tasks

Task Console

Name
ShoppingMall_Task

Lines
200 Refresh

Logs

```

22/10/2023 17:23:57|Starting RL-Energyplus...
22/10/2023 17:23:57|Checking debug configuration
22/10/2023 17:23:57|Debug configuration not found!
22/10/2023 17:23:57|Early debugging configuration not found...
22/10/2023 17:23:57|is_debug:False
22/10/2023 17:23:57|is_early_breakpoint:False
22/10/2023 17:23:57|Checking repository type...
22/10/2023 17:23:57|repository:api
22/10/2023 17:23:57|Checking token endpoint...
22/10/2023 17:23:57|Token endpoint configuration not found!
22/10/2023 17:23:57|token_endpoint: https://api.rl-energyplus.com
22/10/2023 17:23:57|Checking platform endpoint...
22/10/2023 17:23:57|Platform endpoint configuration not found!
    
```

Task Sidebar

ACTIONS
Choose the action you want to take

- Create task
- Stop task
- Task console**
- Task list

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Scenario: Auditorium Diputación Alicante (ADDA)

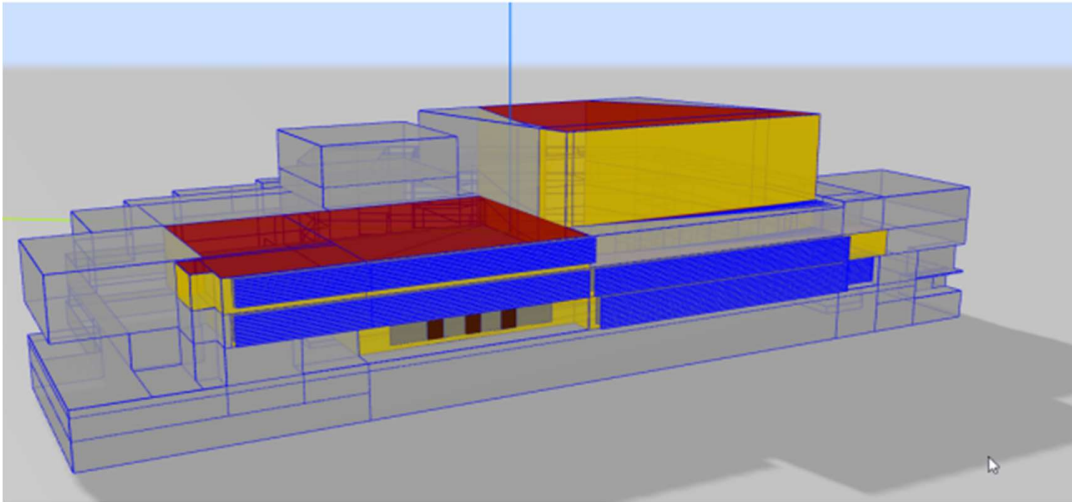
Purpose

Temperature & humidity control

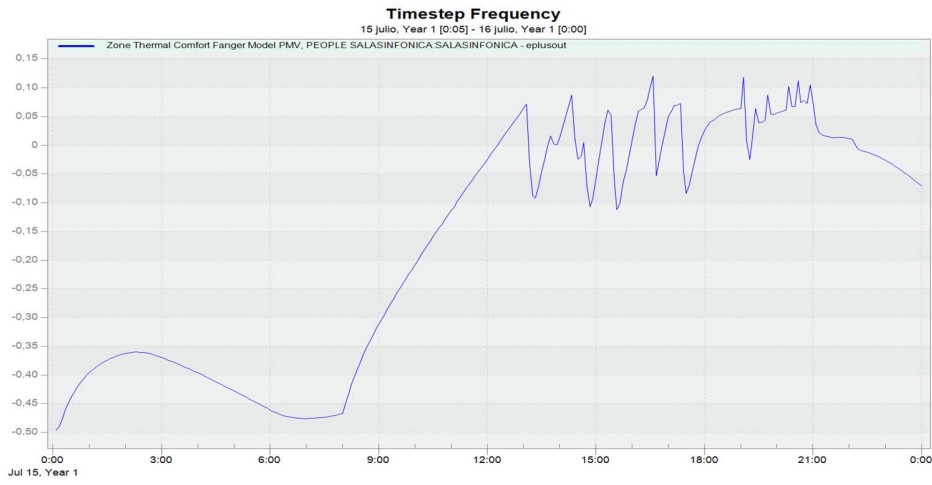
Photographs



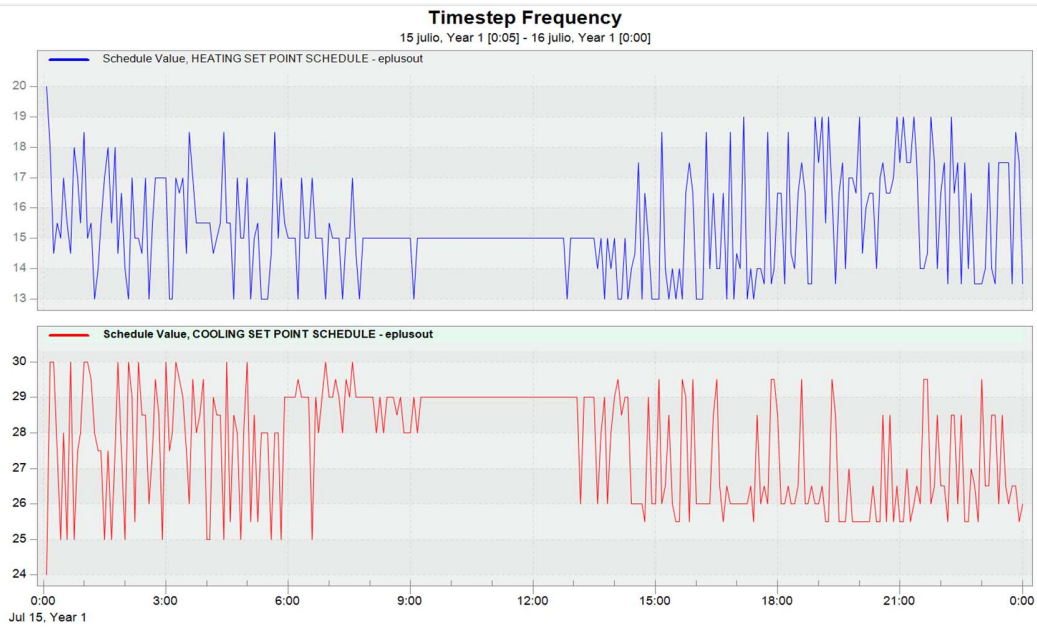
Digital twin



Simulation data: PMV comfort indicator



Simulation data: actuator data (heating and cooling setpoints)



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Scenario: San Juan del Hospital Church (Valencia)

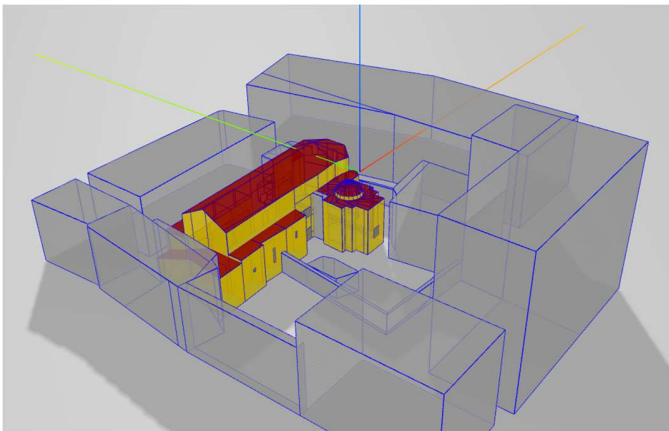
Purpose

CO2, temperature and humidity control

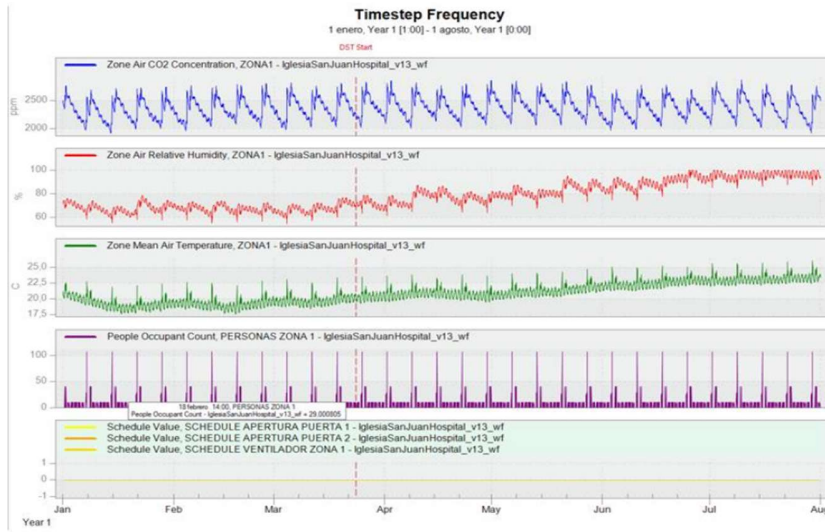
Photographs



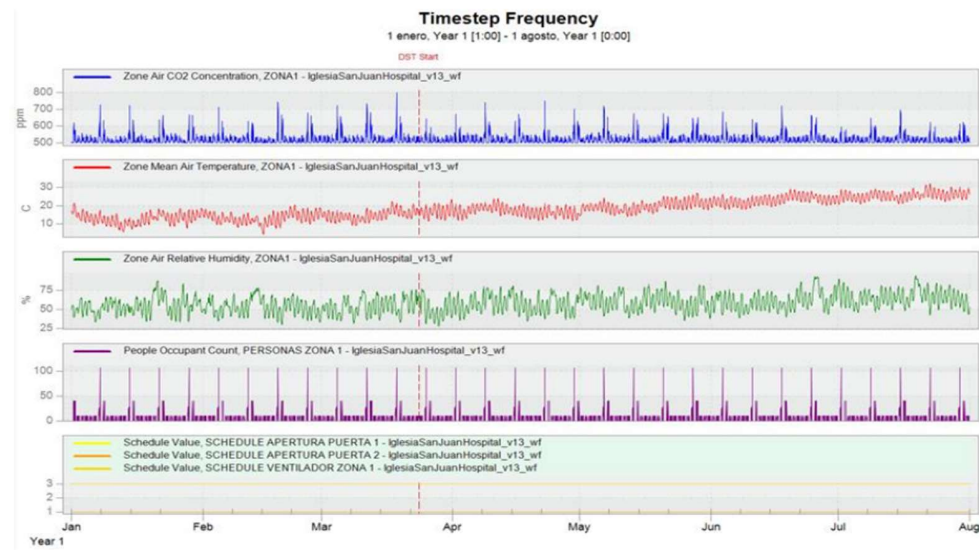
Digital twin



Simulation data: baseline - all doors closed + fan deactivated



Simulation data: baseline - all doors open + fan activated



Simulation data: AI agent predicting best policy for doors and fan (optimizing temperature)

