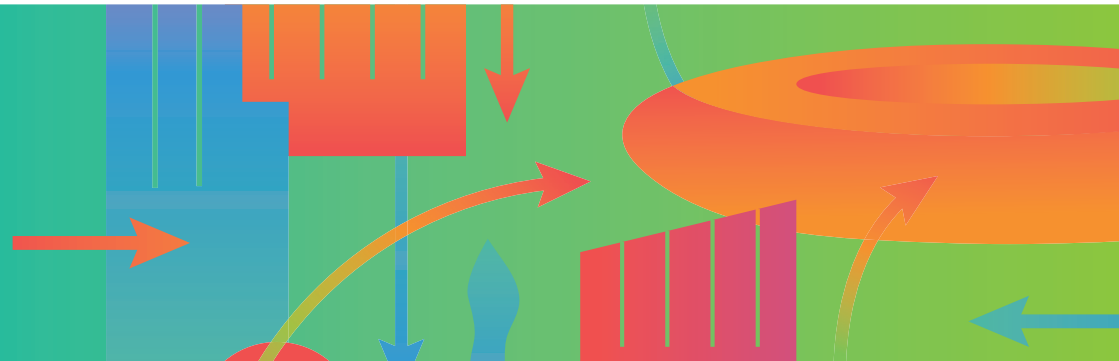
2018

EeB PPP Promising Technologies

Monitoring and diagnostic methodologies

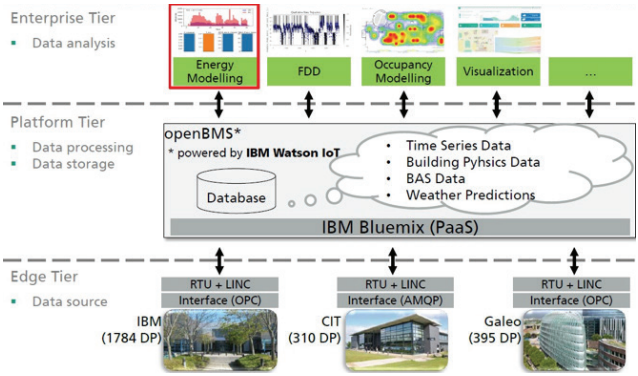
ENERGY EFFICIENT BUILDINGS

AN ECTP COMMITTEE FOR INNOVATIVE BUILT ENVIRONMENT



Energy consumption prediction models

Methods and models for reliable prediction of thermal and electrical energy demand



The picture shows how the technology (Energy Modelling, marked in red) is integrated in the Topas architecture

Advanced building performance monitoring and auditing systems often include optimal control or fault detection and diagnosis. Many of these data-based analysis tools require a concise and reliable prediction of the thermal and electrical energy demand. The presented technology provides methods and models for this task. The need is to have flexible and interoperable tools to support the reduction of energy consumption, by identifying sources of inefficiency causing the gap between predicted and actual performances.

In the TOPAs tool different types of models were developed: white box models based on the programming language Modelica and black box models that utilize machine learning algorithms like Random Forest Regression among others. Furthermore, a toolchain has been implemented for the integration of these models into the building operation. This has been realized by utilizing third party technologies like Functional Mockup Interface (FMI) and Python-packages like PyFMI and sklearn.

An important feature is the implementation of algorithms allowing continuous model updating, so as to decrease the uncertainty due to seasonal effects. The main targets for exploitation are large commercial and industrial buildings (> 4000 m2).

- Based on both white box models (based on Modelica) and Black box models based on Machine Learning (e.g. Random Forest Regression)
- It implements an algorithm allowing continuous model updating (increase in the accuracy for seasonal effects)
- Toolchain for integration of these models into the building operation
- Interoperability

- Technical completion: between 1 and 2 years
- Can be used in new constructions
- Can be used in renovation/ retro-fitting
- Compatible with existing solutions

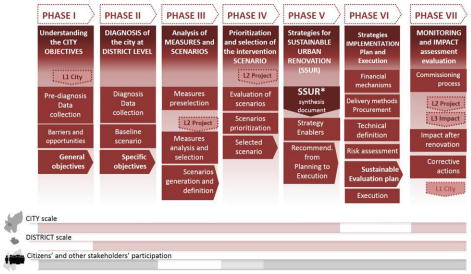
Project: **TOPAs,** Tools for Continuous Building Performance Auditing, www.topas-eeb.eu

Contact: Nicolas REHAULT, Fraunhofer Institute for Solar Energy Systems, nicolas.rehault@ise.fraunhofer.de

TOPAs

Methodology for sustainable urban renovation at district level

7 phases methodology to enable the replicability and mass market deployment of energy-efficient retrofit of districts



The CITyFiED methodology enables replicability and mass market deployment of energy-efficient retrofit of districts, considering as a reference the CITyFiED demonstrations (building renovation, district heating networks, renewable energy sources integration and monitoring), decision-making processes and business models. It is composed of 7 phases and a decision-making process to understand the city objectives and needs in order to deliver customized strategies for sustainable urban renovation at district level with energy efficiency as main pillar and local authorities as clients. Targets are small and medium size cities, with buildings built before the '90s.

3 levels of KPIs are defined: 1) at city level for initial assessment; 2) at project level to assess results; 3) at impact level for the city and citizens. An effective dialogue is ensured among the stakeholders who are grouped in 3 categories according to their role:

- Experts representing local authorities usually being promoters of sustainable renovations, representing citizen's interest. This group involves professionals from public bodies, politicians, urban managers, engineers, architects, etc., who are proposed to be organized in role-based committees: a Steering committee for decision-making; Technical and Monitoring committees for strategies definition, implementation and evaluation; an optional group with decision makers from higher levels (Assessment committee).
- Consultant experts and stakeholders from the building, energy and financial sector. They provide services to the Municipality during the renovation phases. The methodology foresees the introduction of a multidisciplinary External Consultancy Group (ECG) of professionals with various backgrounds to closely cooperate with local authorities: energy experts, environmental consultants, architects, contracting parties and financial institutions, etc.. They either participate in the strategies implementation, providing equipment or services to the Municipality at agreed time and cost, or are related to business models and financing schemes.
- Citizens and other stakeholders (building owners, tenants and other institutions e.g. NGOs, universities) are involved, being considered the renovation end users. Their integration in the decision-making process through different techniques guarantees their engagement and long-term acceptance.

- **Methodology specifically developed to support Municipalities as clients, from the early stages of the project up to the end.**
- **Flexible procedure proposing a set of customized strategies (catalog) for sustainable urban renovation at district level**
- **Based on decision-making processes and business models, but not only**
- **3 levels of KPIs defined: 1) at city level for initial assessment; 2) at the project level to asses' results; 3) at the impact level.**

- Technical completion: less than 1 year
- Can't be used in new constructions
- Can be used in renovation/ retro-fitting
- Compatible with existing solutions

Project: CITyFiED, www.cityfied.eu

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CITyFiED
RepliCable and InnovaTive
Future Efficient Districts and cities

Smart meters

Smart meters and automatic meter reading for efficient operation and consumption of heat, cooling, water and electricity

Smart data from smart meters and automatic meter reading systems can provide insights that allow more optimal management of energy and water systems and create transparency and awareness for the consumer.

Our comparison of the traditional measurements and the smart measurements (i.e. more measuring points, higher resolution) shows that benefits can indeed be achieved by strategical exploitation of this information. Data can give valuable insights for day-to-day optimisation of supply as well as improvement of the system.

The intelligent energy and water system is characterised through the focus on high efficiency in order to reduce energy and water waste. This involves utilising the available sources as efficiently and sustainably as possible while creating the ideal circumstances for integrating renewables:

- By monitoring and analysing return temperatures in the energy network, it is possible to reduce energy waste and boost the efficiency of the energy system.
- By monitoring the water flows, it is possible to determine unexpected high consumption, identify leaks, and bursts. The smart data enables us to reduce waste water and helps us react faster to avoid unnecessary damage to buildings and personal property.
- Transparency and awareness of energy and water consumption has an impact on the behaviour of the consumer and contributes to a lower consumption.

- **Automatic Meter Reading (AMR): The technology creates transparency of the consumption of energy and water as the consumption data are remotely read every hour and enables the technical personnel to identify unexpected high consumption.**
- **Automatic Meter Reading (AMR): The technology creates awareness of the consumption of energy and water by the end user, which leads to lower consumption – expected to be 15-30 % lower.**
- **Smart meters: Intelligent meters with integrated smart software, which reports to the Automatic Meter Reading (AMR) system if there is a leak or burst in the piping and reduce loss of water and energy.**
- **Smart meters: Intelligent heat meters measuring Delta T to surveillance the return temperature to analyse if the energy is exploited efficiently to anticipate lower energy consumption and reduce loss.**

- Technical completion: less than 1 year
- Can be used in new constructions
- Can be used in renovation/ retro-fitting
- Compatible with existing solutions

Project: READY, www.smartcity-ready.eu

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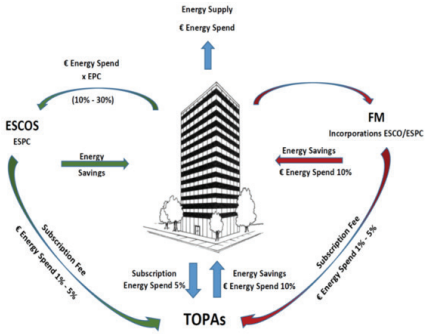
READY

TOPAs CORE
Platform to drive IoT-based energy management and performance data analysis



TOPAs Core takes an IoT driven approach to building energy management and facilitates the extraction, processing and analysis of energy performance data to support sustained energy savings and to minimise the gap between predicted and actual energy usage across a large portfolio of buildings. The TOPAs Core is designed to facilitate integration and interoperability across blocks of buildings through a 'plug and play' approach obtained by leveraging standardised automation protocols and open interfaces with easy configuration and setup. TOPAs Core can enhance the smartness readiness indicator of buildings enabling the use of advanced energy management services (e.g. energy prediction models, fault detection and diagnosis, model predictive control) through the TOPAs open platform.

Key features are:

- robust IoT-Platform for data management;
- openness: plug-in for many different systems and ontology for integration;
- advanced data analysis, visualization and energy management services;
- plug&Play and Easy-to-use.

The platform aims to efficiently support Energy Managers, ESCOs and Facility Managers of both new and existing buildings during their daily work with reduced costs and high flexibility.

Some of the barriers that TOPAs addresses are:

- Return on investment not worth risks - TOPAs provides energy savings with low investment
- Project development cycles - TOPAs continuous auditing informs business case for investment
- Difficulty in Measurement and verification - TOPAs is a comprehensive monitoring, management and M&V tool

- **Robust IoT-Platform for data managment**
- **Openness: plug-in for many different systems and ontology for integration**
- **Advanced data analysis, visualization and energy management services**
- **Plug&Play and Easy-to-use**

- Technical completion: between 1 and 2 years
- Can be used in new constructions
- Can be used in renovation/ retro-fitting
- Compatible with existing solutions

Project: TOPAs, Tools for Continuous Building Performance Auditing, www.topas-eeb.eu

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TOPAs

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This technology brochure highlights the highly promising innovations from selected co-funded European projects under the 7th Framework Program (FP7) and the 8th Framework Program (H2020).

The Energy-Efficient Buildings (EeB) Public Private Partnership (PPP) is a joint initiative of the European Commission (EC) and the Energy Efficient Buildings Committee of the European Construction Technology Platform (ECTP).

This initiative aims at promoting research on new methods and technologies to reduce the energy footprint and CO2 emissions related to new and retrofitted buildings across Europe.

ECTP
INNOVATIVE BUILT ENVIRONMENT

European Commission