



SESSION 2: VALIDATION AND IMPACT ASSESSMENT METHODOLOGIES

**ICT-ENABLED BEHAVIORAL CHANGE TOWARDS ENERGY EFFICIENT LIFESTYLES (INBETWEEN)
PROJECT TECHNICAL COORDINATOR - DR MARKO BATIC, INSTITUTE MIHAJLO PUPIN**

Session 2: Validation and Impact assessment methodologies

Agenda

- **InBetween objectives & solution overview**
- **Validation methodology**
 - Key Performance Indicators (KPIs)
 - Energy consumption, GHG and economic analysis
 - Lessons learnt
- **Impact assessment methodology**
 - End-users changing their behaviour
 - Adoption of the InBetween ICT platform



InBetween solution Objectives

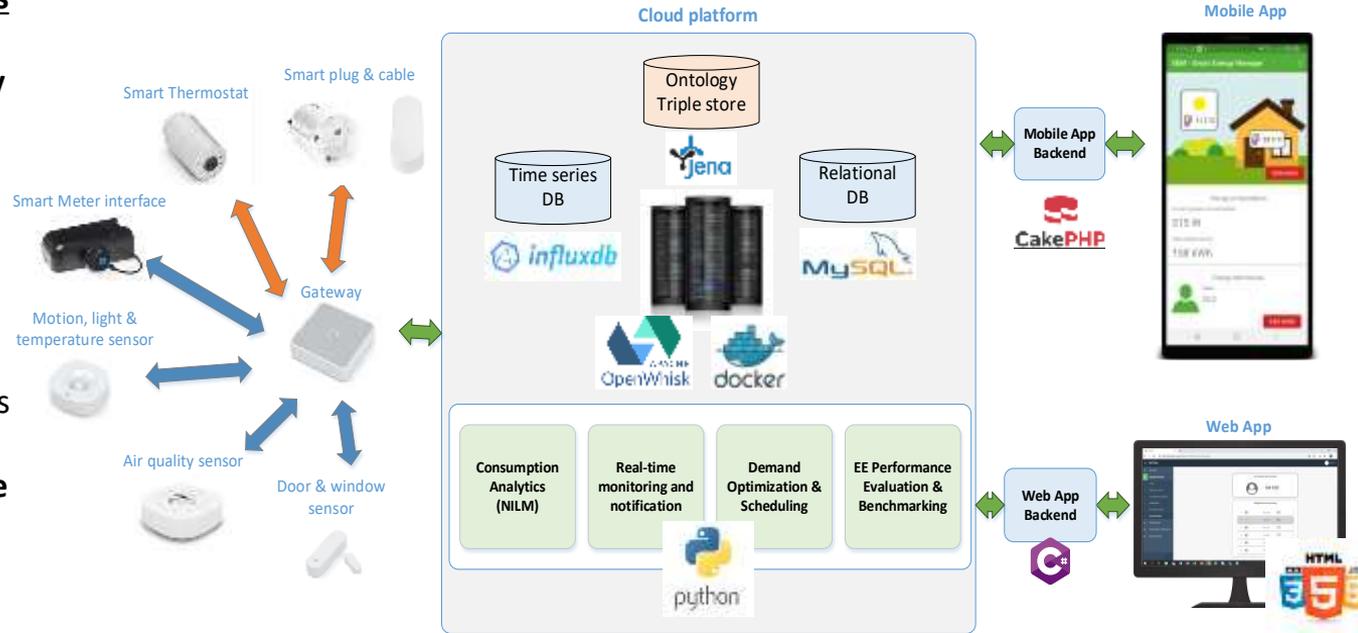
- Engage Users to
 - **IDENTIFY** energy wastes,
 - learn **HOW** to conserve energy,
 - **MOTIVATE** them to act and
 - help them to actually **CARRY OUT** EE practices.
- Deliver **affordable solution** that brings **added value** without significant **disruption** of everyday activities and comfort.



InBetween solution Overview

A cloud-based platform that features

- Innovative **Energy and Non-Energy Services**
- Holistic **Energy and Ambient Monitoring (IoT)**
- User-centric **Mobile and Web Apps**
- Integration with pre-existing **Home Automation** solutions



Validation methodology

Key Performance Indicators



Different KPI perspectives

- Platform users
- Demo site owners
- Platform maintenance teams, R&D etc.

Multiple KPI categories

- Energy performance and comfort (d/w/m)
- End-user engagement
 - App usage statistics (in-app activity)
 - User feedback
 - Collected data report
 - Notification statistics
- In-App reports – a mix of energy performance and notification statistics

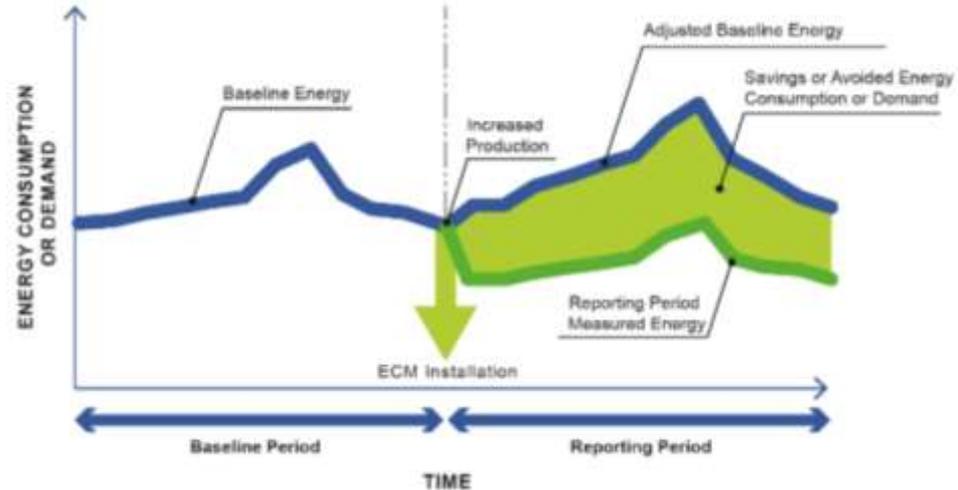
	00_00	Benchmark score
energy use	01_01t	Energy consumption - to
	01_01	Energy consumption by p
	01_02	Energy consumption by f
	01_03t	Energy consumption - h
	01_03	Energy consumption by p
	01_04	Energy consumption by p
	01_05	Energy consumption by p
	01_06	Energy consumption by p
	01_07t	Energy use by person - h
	01_07	Energy use by person - h
	01_08	Energy consumption by p
	01_09	Source energy consumpt
	01_10	CO2 emissions
	01_11	Energy savings
	01_12	CO2 emission savings
	01_13	Energy cost savings
01_14	Energy use % of ideal de	
01_15	Peak load indicator	
01_16	Load match index	
comfort	02_01	Temperature discomfort
	02_02	% uncomfortable hours
	02_03	Thermal discomfort indic
	02_04	% hours with bad air qua
	02_05	Stale air indicator
	02_06	Volatile organic compou
user en.	03_01	Recency index
	03_02	Message opening rate
	03_03	Compliance indicator



Validation methodology

Energy performance analysis

- Based on IPMVP (Option C)
- KPIs considered:
 - Total electricity consumption
 - Total space heating consumption
 - Domestic Hot Water
 - CO₂ emissions
 - Energy costs savings



Validation methodology

Energy performance analysis



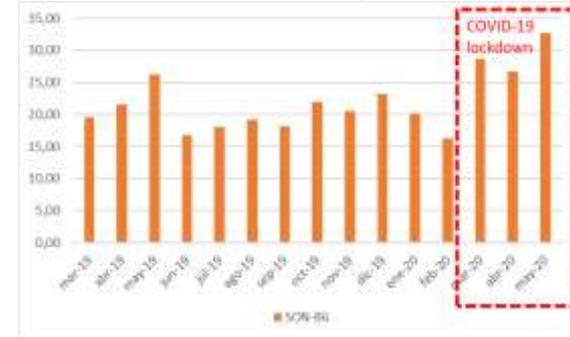
Data analysed in Vilogia:

- EMI data: linear regression based on HDD. Baseline complemented with invoice data.
- Heating consumption from radiator smart cables
- DHW from hot water tank smart cables
- Specific lockdown analysis

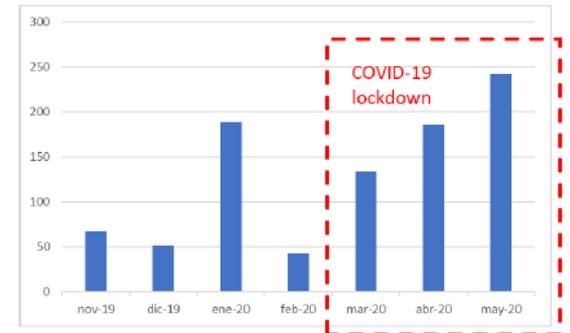
Data analysed in Sonnenplatz:

- Residential buildings
 - Electricity: comparison of monthly average consumption
 - Heating: analysis with linear regression using invoice data for baseline
- Non-residential buildings
 - Electricity: problem with solar PV generation. Normalization with invoice data.
 - Heating: analysis with linear regression using heat meters with invoice data
- Specific lockdown analysis for residential and non-residential

Electricity



DHW



Validation methodology

GHG and economic analysis

Analysis of GHG Emissions:

- **GHG emissions abatement associated to energy savings** of demo sites
- Calculations based on **CO₂ emission intensity for electricity generation**
- **Biomass** heating is not considered for emissions abatement.

Economic analysis

- Estimation of **economic savings associated to energy savings** observed
 - **Villogia**: total electricity savings, considering peak and off-peak hours.
 - **Sonnenplatz residential & non-residential**: total electricity savings (no time discrimination)



InBetween

Validation methodology

Lessons learnt

Results of the energy performance analysis

- Analysis results must be interpreted cautiously, there are many **factors influencing reliability of results**
 - Data availability
 - Combination of invoice and monitored data
 - Precision of HDD corrections
 - Change of habits during COVID-19 lockdown
 - Ability to associate the cause of energy savings
 - In some cases, savings comparable with margin of error of data normalization



Impact assesment methodology

End-users changing their behaviour

Impact #1

- Reduction in terms of total energy consumption, CO₂ reduction and operating costs

Impact #2

- Number of end-users changing their behavior

Impact #3

- Adoption of the InBetween platform



Impact assesment methodology

Comprehensive user activity logging



Engagement with the platform (KPI-A1)

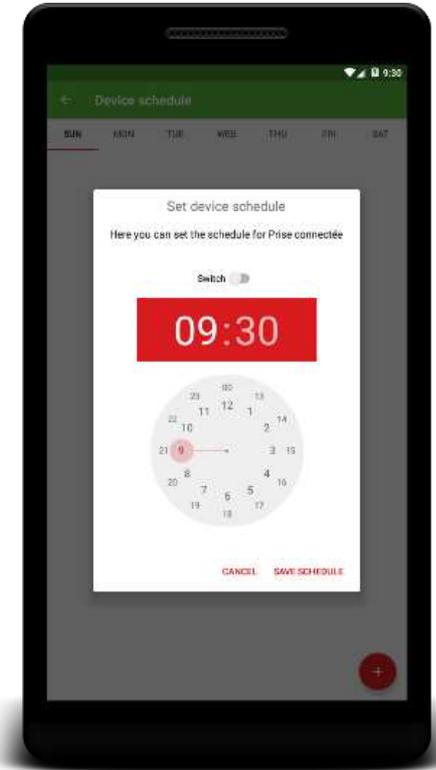
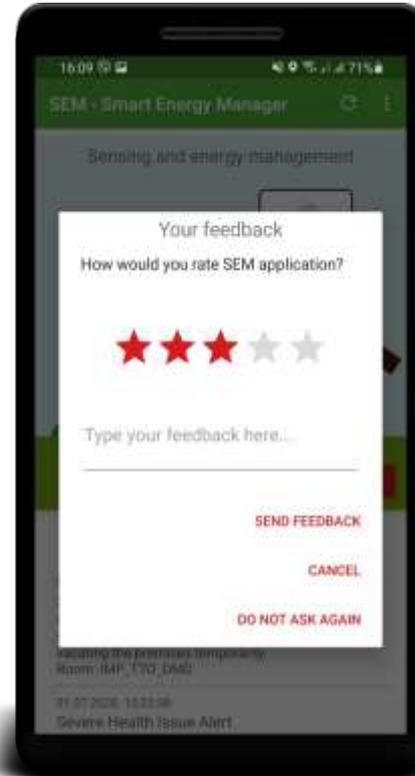
- Number of *sessions* and
- *intensity* of each session

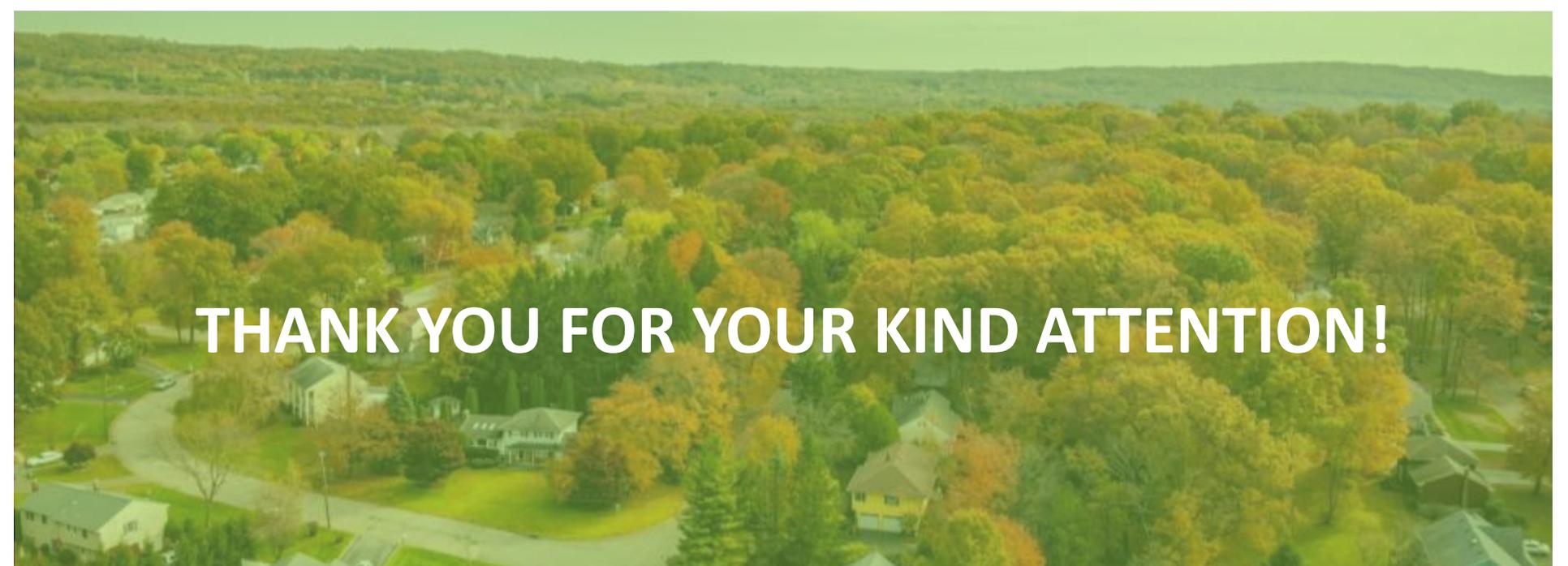
Compliance indicator (KPI-A2)

- Reaction to **notifications** (KPI-A21)
- The **use of actuators** (KPI-A22)

User satisfaction (KPI-A3)

- User feedback





THANK YOU FOR YOUR KIND ATTENTION!

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