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Achieving near Zero and Positive Energy Settlements in Europe using Advanced Energy Technology

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http://www.zeroplus.org/

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H2020-MSCA-RISE-2014: 645677

http://www.smartgems.tuc.gr/index.php?id=smart_gems

SMARTGEMS energy network

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The ZERO-PLUS concept

TARGET

Provide the market with an innovative, yet readily implementable system for NZE residential neighborhoods that will significantly reduce their costs.

↓

ZERO-PLUS building

- ✓ Regulated energy of **70 kWh/m2 per year**
- ✓ RES energy production of **50kWh/m2** energy per year
- ✓ **16% reduction of initial costs**

STRATEGIES

Increasing the efficiency of the components directly providing the energy conservation and energy generation in the NZE settlement.

Reducing the costs through efficient production and installation processes.

Reducing operational costs through better management of the loads and resources on a district scale rather than on the scale of a single building.

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zero+

Who we are

Case study owners

CYPRUS, Peyia

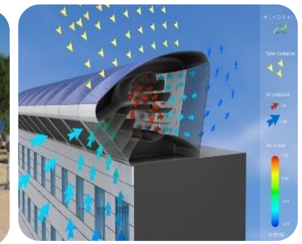
FRANCE, Voreppe

ITALY, Granarolo dell' Emilia

UK, Derwenthorpe

Technology providers

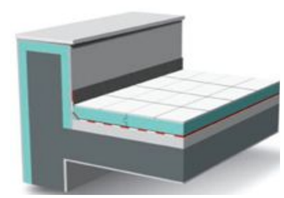
FAE HCPV



WindRail

SolarBlock biPV

REACT+



FIBRAN XPS

freescoo HVAC

Research partners

- Monitoring and Evaluation of the Settlements' Performance
- Design and Optimisation of Modular Envelope Components
- Energy Production and Management of Individual Buildings
- Integrated Design and Optimization of the NZE Technologies to be implemented at the Settlements Level – Creation of Simulation and Monitoring Protocols
- Market Analysis and Model for Business Growth
- Construction Management, Cost Management and Implementation of the Innovative Technologies
- Integrated Design and Optimisation of the Zero Energy Settlements

אוניברסיטת בן-גוריון בנגב Ben-Gurion University of the Negev · OXFORD BROOKES UNIVERSITY · National and Kapodistrian University of Athens · ECO. DEEPER THINKING · Technical University of Crete · The Cyprus Institute · TUM · ABB · ANERDGY · ar(a · CONTEDIL · fibran · GEORGE VASSILIOU Ltd · JRHT Joseph Rowntree Housing Trust · Opac38

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Technical and financial optimisation of the ZERO-PLUS settlements

<u>Aims:</u>

Evaluation of the energy interaction between the selected technologies and the total integrated energy performance of the settlement by using advanced simulation techniques.

Minimization of the life cycle cost of the energy and environmental systems and techniques.

Optimization of the global energy and environmental performance of each of the settlements.

Methodology steps:

1. **Optimization and sensitivity analysis**, so as to identify the optimized, innovative systems and techniques, minimize their life cycle costs and optimize the global energy and environmental performance of each one of the four settlements.
2. Selection of the **optimum technical sizing / units** of each technology.
3. Integration of the optimized, innovative systems and techniques **in the final design** of the buildings and the settlements.

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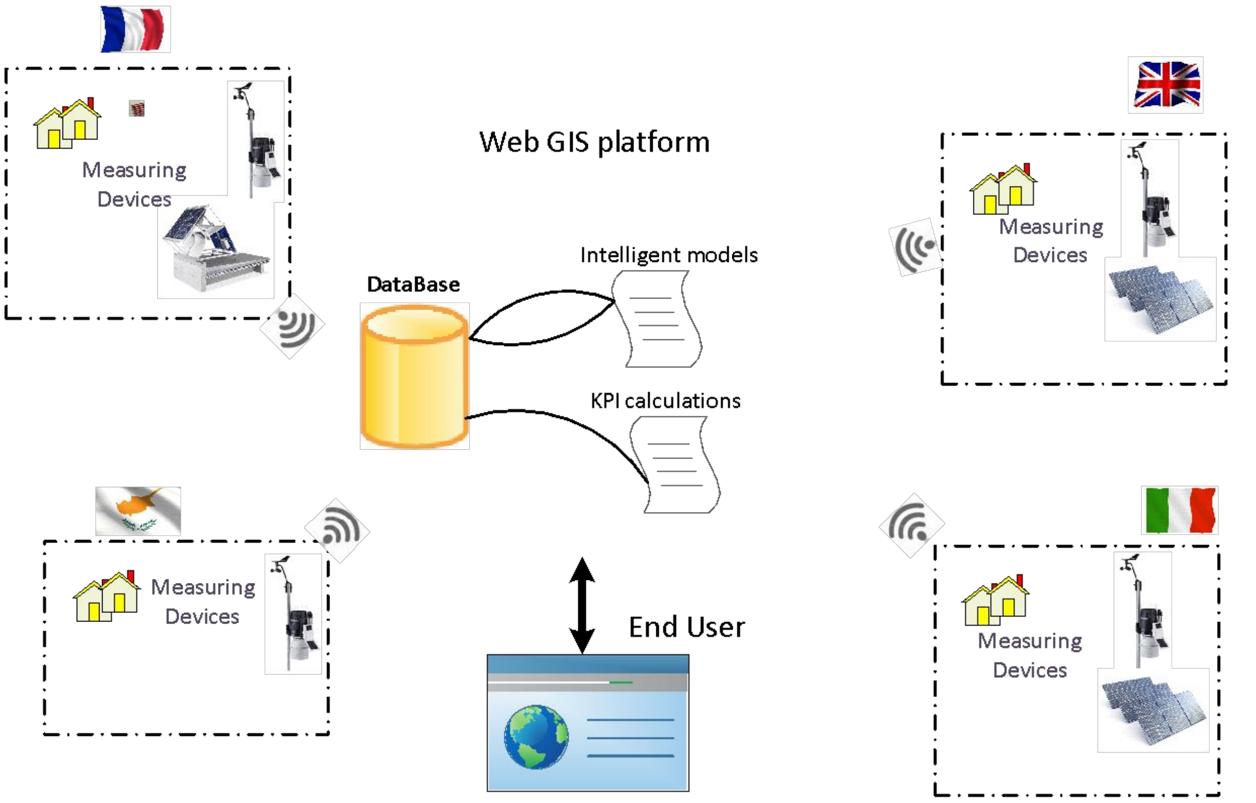
Monitoring and Evaluation of the Settlements' Performance

Fundamental component is the Web-GIS Platform

- ❑ Intelligent models for evaluation of IEQ
- ❑ Intelligent models for analysis of energy demand, production and predictive maintenance
- ❑ Fault detection of sensors
- ❑ Generation of 15-day report for Problem Identification



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Beyond ZERO-PLUS

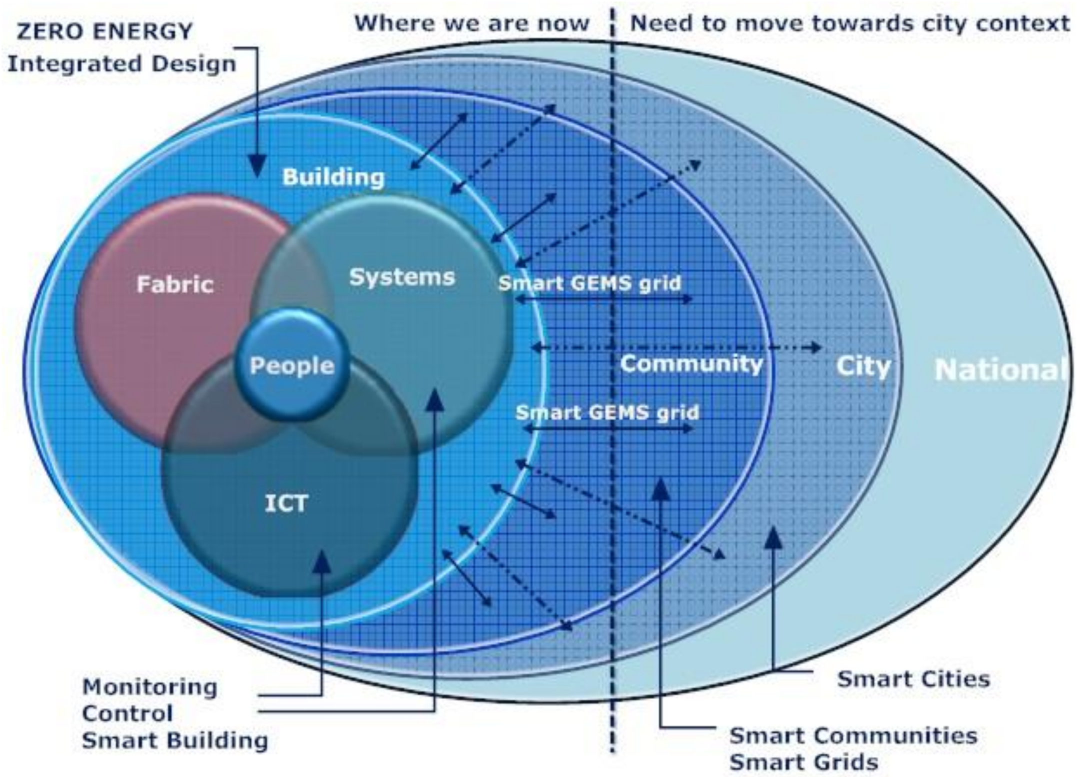
1. Include **non-regulated energy** in the scope as well (occupant centered energy use)
2. It shouldn't be only about how much you reduce energy consumption but also about **when** you reduce it (demand response at settlement level)
3. Consider the **embodied carbon** of technologies
4. Integrate the analysis of microclimate mitigation and the performance of grid and community energy production systems for energy savings **in a single tool**
5. Involve the **utilities and public authorities** to see how procedures to install and deploy innovative technologies can be simplified
6. Take into consideration **building owner requirements**
7. Expect an **overlap** between commissioning and monitoring

Smart GEMS: Project Overview

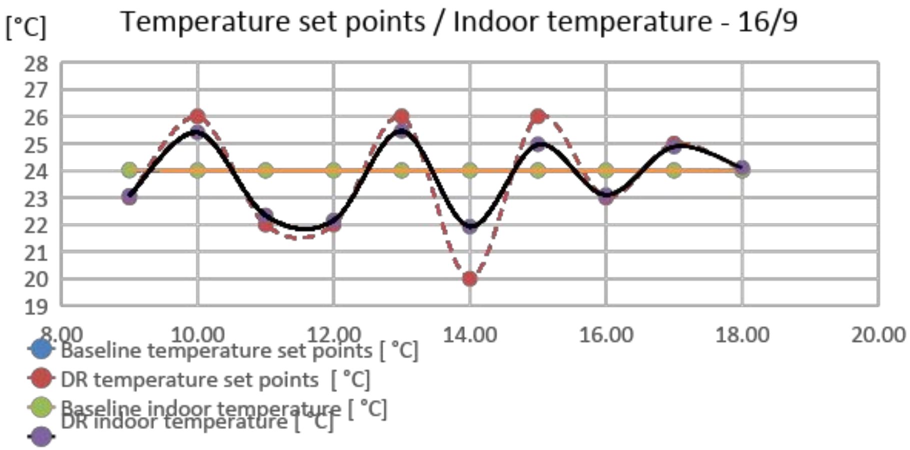
Phase 1: Smart and zero energy buildings performance
Users / consumers' aspects

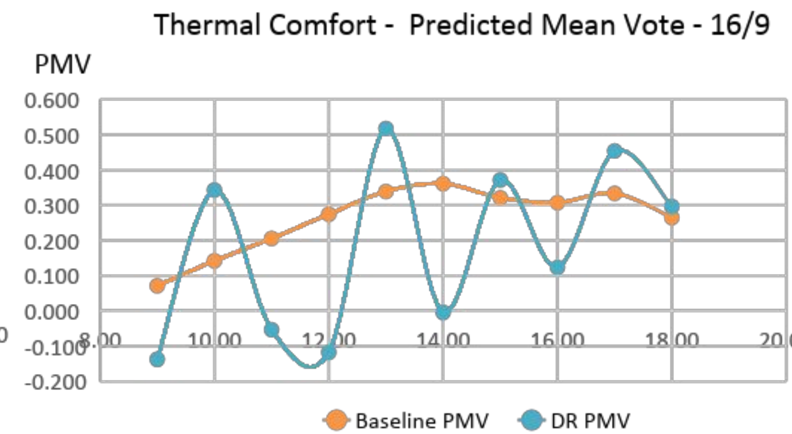
Phase 2: Smart grid components to expand the cycle of the smart grid penetration to community or city level

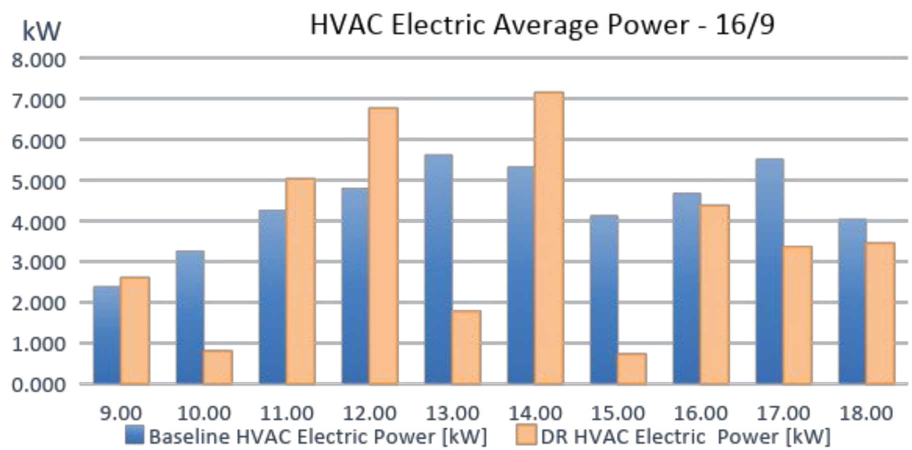
Phase 3: Integration of components targeting to the development of smart applications and optimisation of smart grid performance

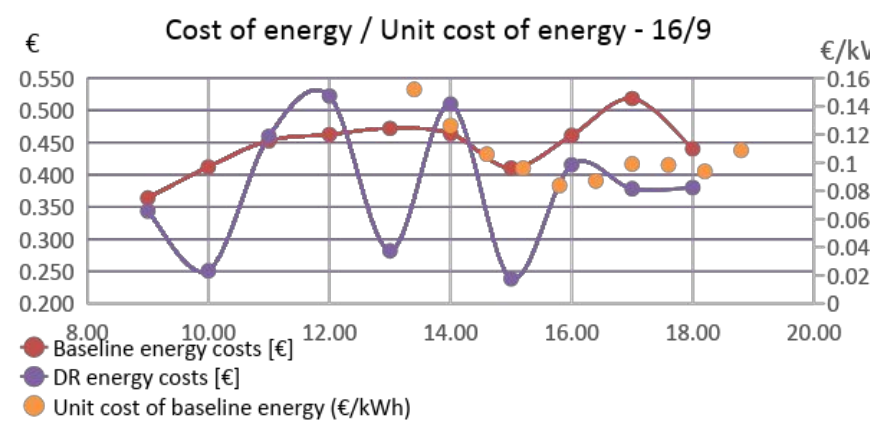


Genetic HVAC Optimisation Algorithm for Industrial Near Zero Energy Building Demand Response (in progress)









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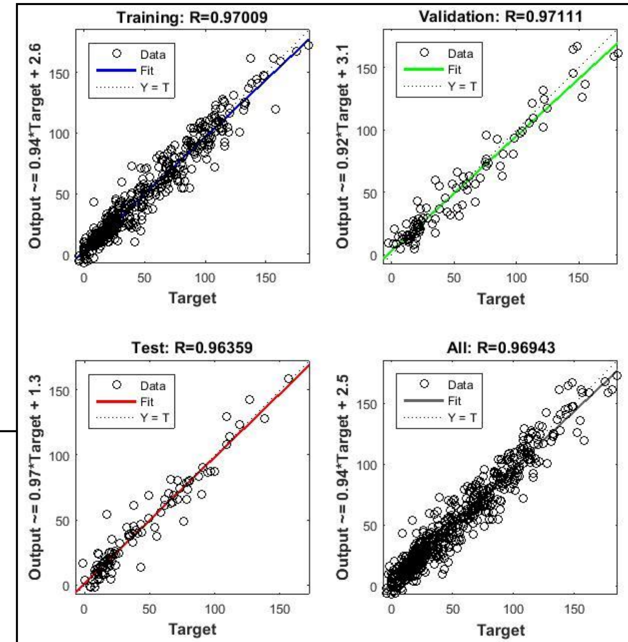
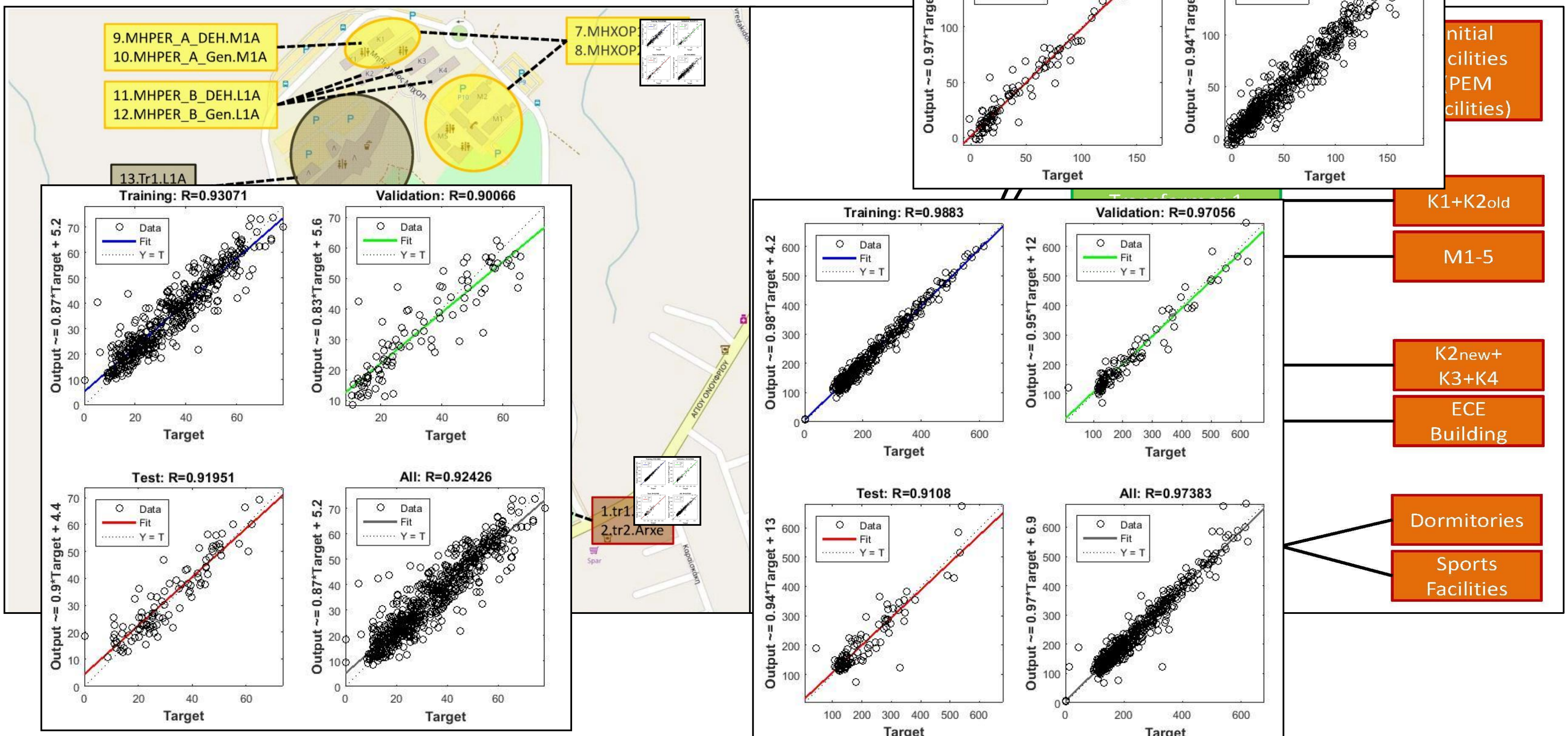
Smart meters / TUC microgrid topology / ANN electric power predictions





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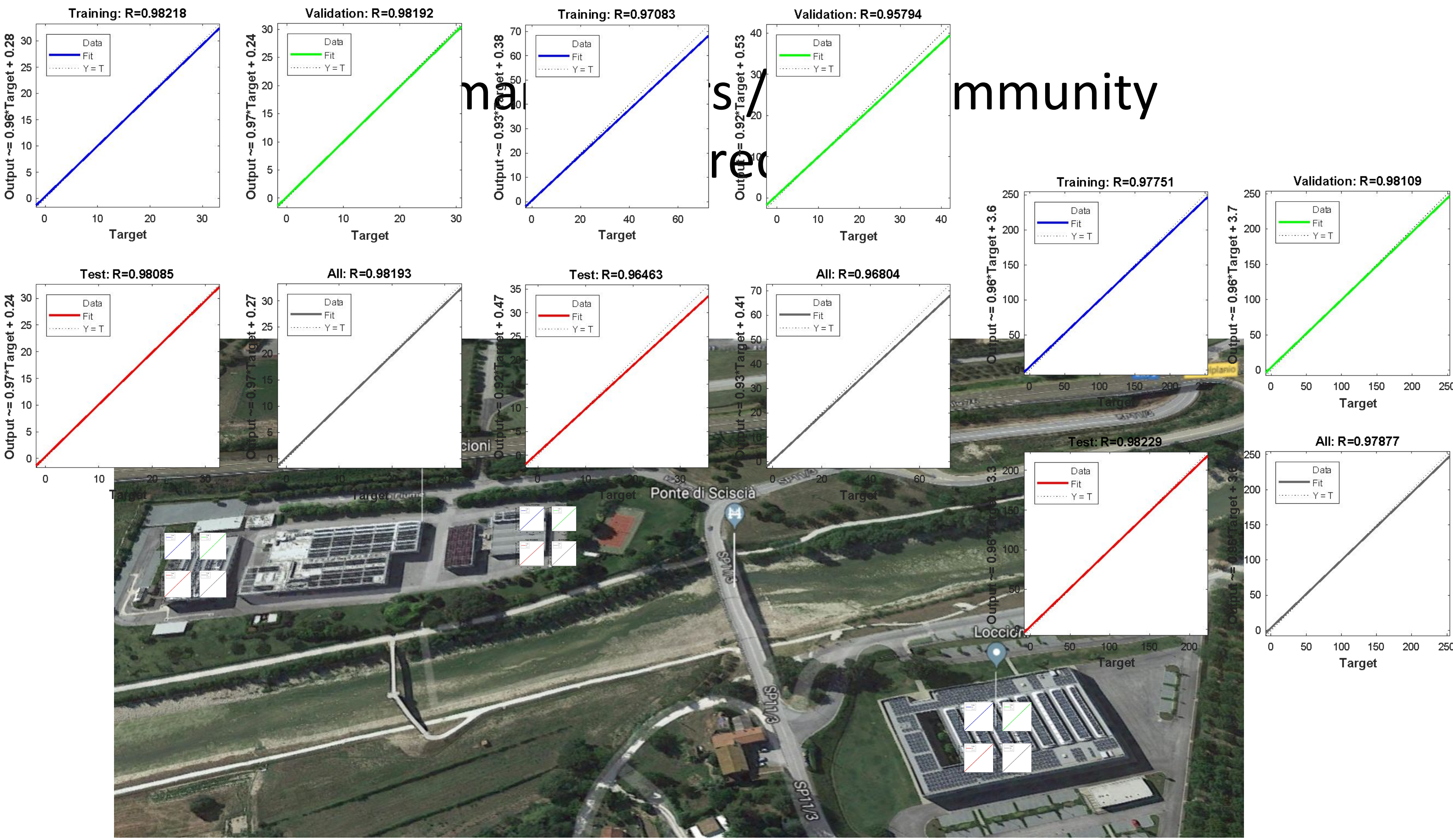

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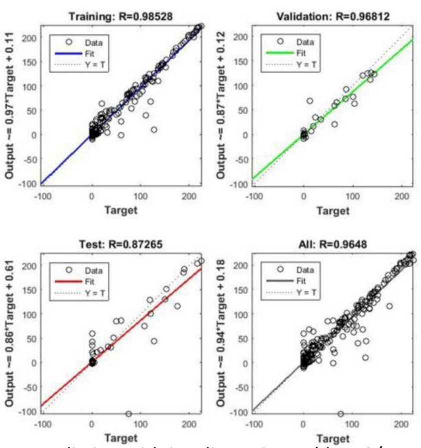
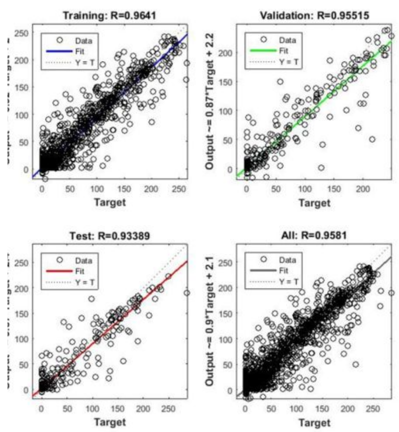
Development of Leaf Community excess power production forecasting ANN algorithms for optimum thermal energy storage

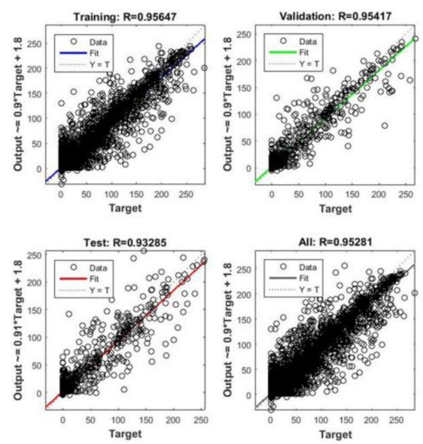
	Inputs	Target	Output
1st prediction	day of week time of day irradiance	excess production (P_{OUT})	excess production (P_{OUT})
2nd prediction	day of week time of day irradiance temperature	excess production (P_{OUT})	excess production (P_{OUT})
3rd prediction	day of week time of day micro-grid production	excess production (P_{OUT})	excess production (P_{OUT})



Prediction with irradiance input (data 3/5 - 26/7), 30 hidden neurons, 5 delays, Lavenberg-Marquardt algorithm



Prediction with irradiance and temperature input (data 23/1 - 29/2), 30 hidden neurons, 5 delays, Lavenberg-Marquardt algorithm



Prediction with production input (1 year data), 30 hidden neurons, 5 delays, Lavenberg-Marquardt algorithm

Based on the prediction when excess power in Leaf Community overcomes 60kW GWHP3 is activated to store energy. With a further excess of 50kW, GWHP2 is activated.

A. Mavrigiannaki, N. Kampelis, D. Kolokotsa, Daniele Marchegiani, Laura Standardi, Daniela Isidori, Cristina Christalli, "Development and testing of a micro-grid excess power production forecasting algorithms," in Energy Procedia, 2017, vol. 134.