Energy & Environment activities on Smart Energy Systems

HPC for Energy & Environment - CRS4

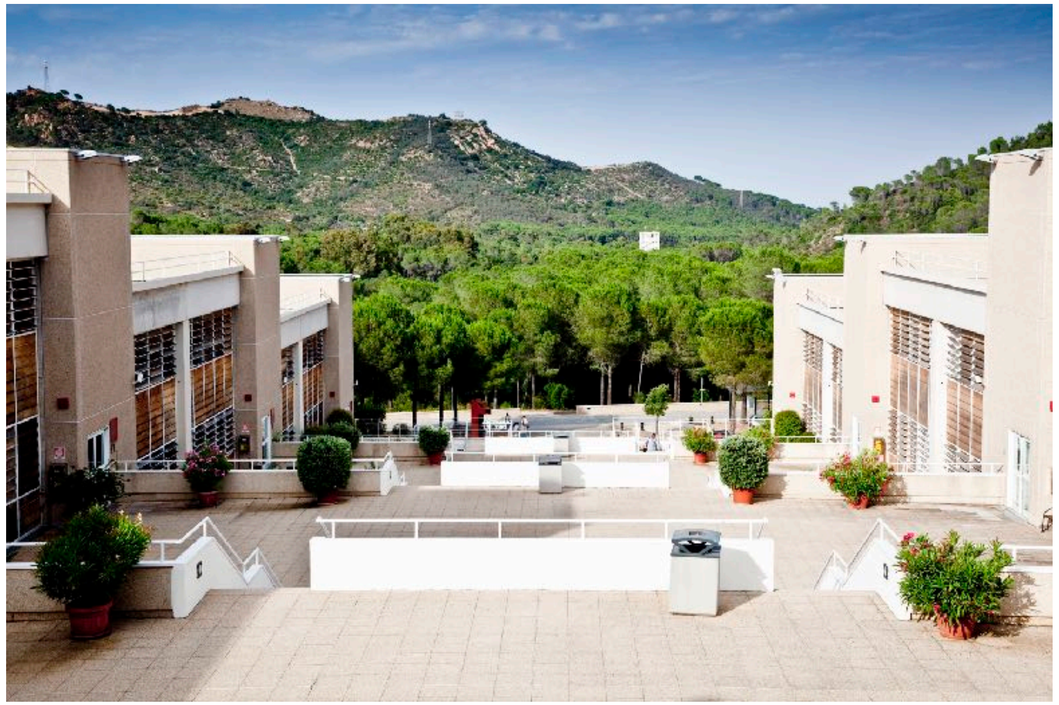
Polaris, 09010 Pula CA, Italy

http://www.crs4.it

About CRS4

- CRS4 is a interdisciplinary research center, founded by the Sardinia Autonomous Region on 1990, whose sole shareholder is the regional agency Sardegna Ricerche.
- The center promotes the study, development and application of innovative solutions to problems stemming from natural, social and industrial environments. Information Society and Technology and High Performance Computing are the supporting foundations.
- Since 2003, the center is located within Science and Technology Park (Polaris), a point of attraction for high-tech research in the Comune of Pula, about 40 km from Cagliari.
- CRS4, initially headed by the Nobel Prize in Physics Carlo Rubbia (1990 to 1999), has had the following Presidents: Nicola Cabibbo (2000 to 2003), Carlo Rubbia (2003 to 2006), Paolo Zanella (2006 to 2014), Luigi Filippini (2014 to 2017), Annalisa Bonfiglio (2017 to present).
- Today about 150 people are working at CRS4.
- The mission is to help Sardinia to build and support a layer of modern high tech industries considered essential to its economic and cultural development.
- CRS4's efforts in technological development and scientific research focus on state-of-the-art computational technologies and on their application to several areas: biosciences, information society, energy and environment.

- These sectors have a great socio-economic impact in terms of market share and citizen expectations and are characterized by a growing demand for high-tech products, services and procedures.
- The main purposes of CRS4 are interdisciplinary studies, development and application of innovative solutions for priority thematic fields. Therefore, CRS4 collaborates with industry, universities and scientific laboratories and also participates in relevant national and international projects.



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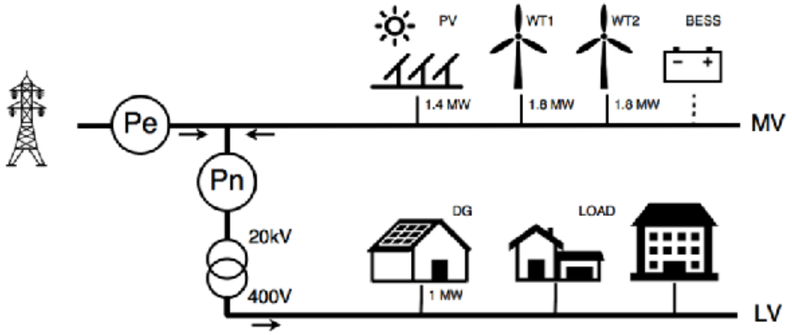
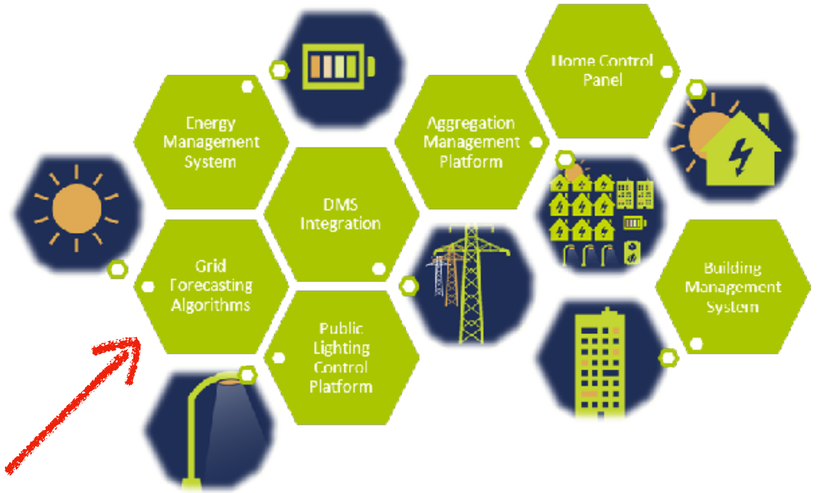
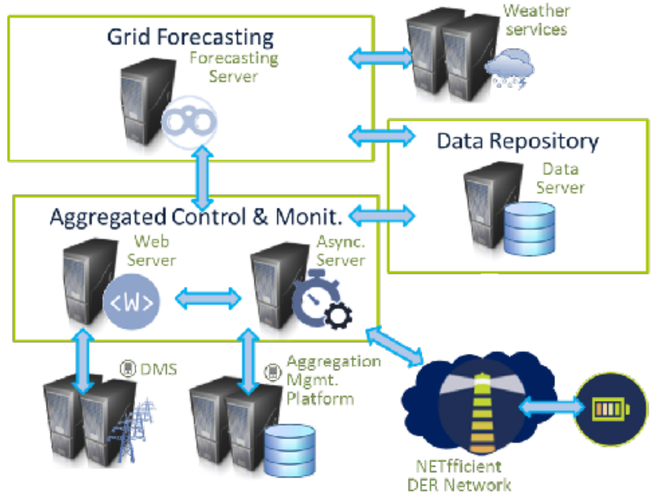
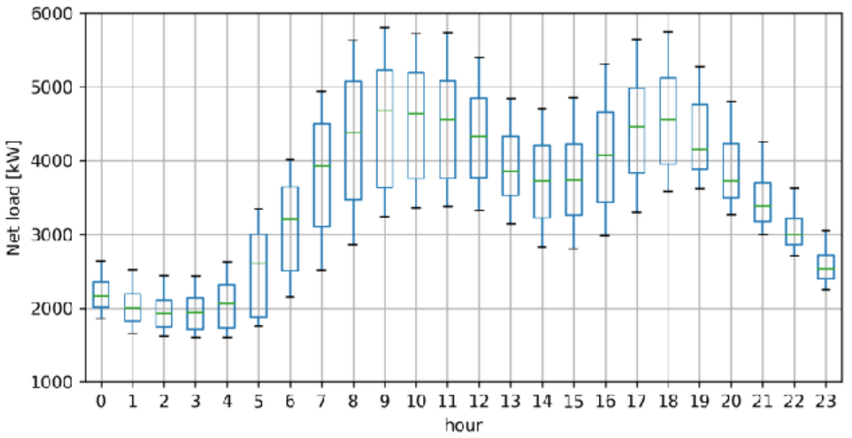
NETfficient project



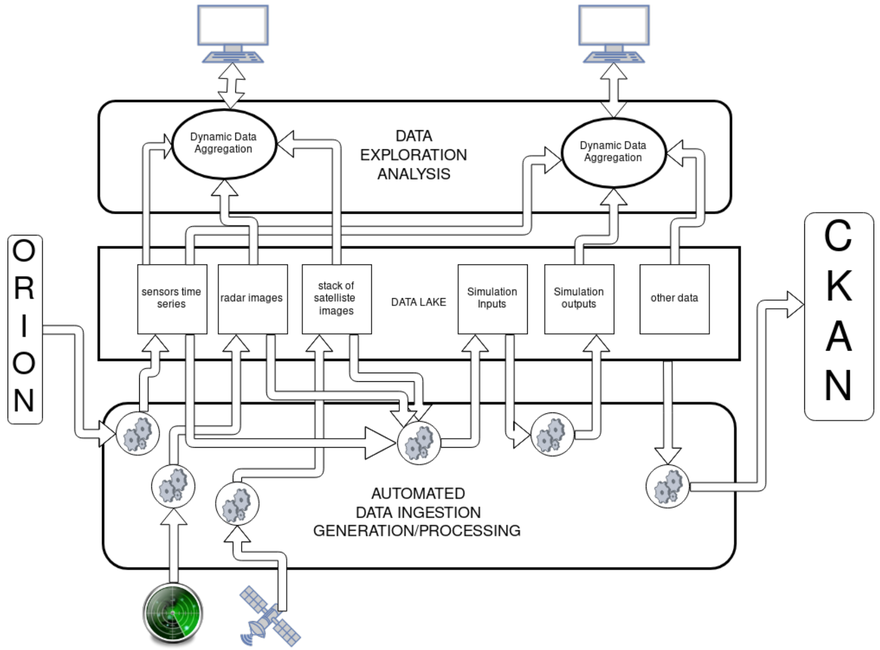




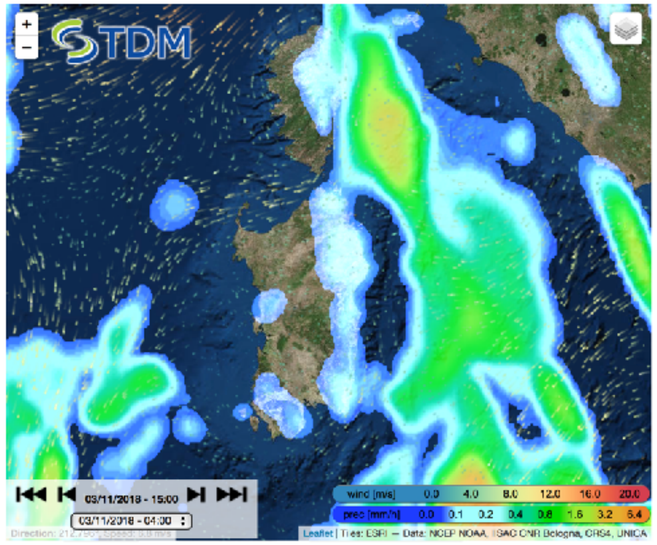
- The project has tested local energy storage technologies and developed information and communication tools, to exploit the synergies between energy storage, the smart grid and the citizens.
- Such tools include a energy management system and a management and decision support tool that enable the integration of renewable energy generation, forecasting and storage into a smart grid.
- Netfficient demonstrated the feasibility of local small scale storage technologies covering low voltage and medium voltage scenarios and a wide range of applications and functionalities. The test site is the island of Borkum (Germany)
- CRS4 has developed the Grid Forecasting Algorithms, based on high performance numerical simulation of the local weather conditions and on machine learning techniques that predict the energy flows for the whole smart grid and for the individual homes and buildings; providing load, wind power and PV power forecasting.
- This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 646463



Tessuto Digitale Metropolitano



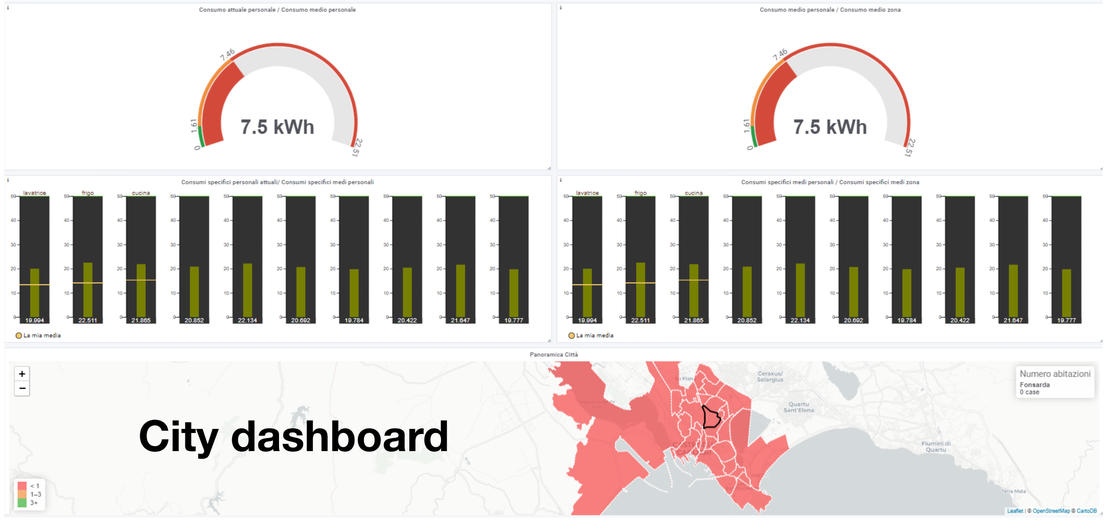
Big data architecture



High resolution weather simulation

Distributed energy monitoring

- The project "Tessuto Digitale Metropolitano - TDM" (2017-2021) aims to offer innovative and smart solutions to increase city attractiveness, resource management efficiency and the safety and quality of life of citizens, through the study and development of enabling technologies and innovative vertical solutions for the protection from environmental risks, energy efficiency awareness and cultural heritage management.
- Methods and applications will be tested and validated in the city of Cagliari (Sardinia, Italy), using advanced communication infrastructure and widespread distributed sensor network.
- TDM is a collaborative project between CRS4 and the University of Cagliari, funded by the regional agency Sardegna Ricerche (POR FESR 2014-2020, Azione 1.2.2).



City dashboard

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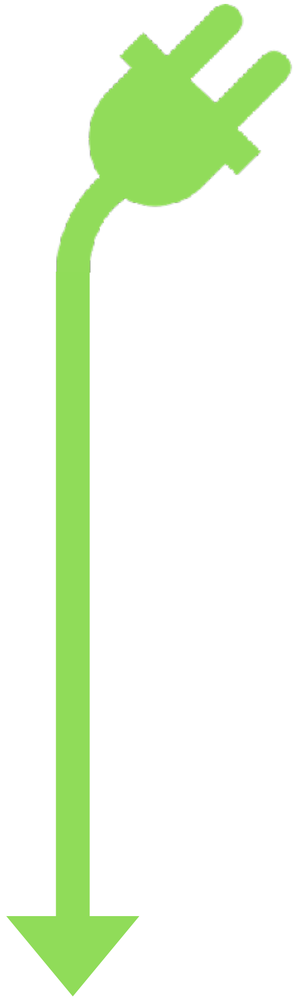
Recent publications



- Massidda, Luca, and Marino Marrocu. "Smart meter forecasting from one minute to one year horizons." *Energies* 11.12 (2018): 3520.
- Massidda, Luca, and Marino Marrocu. "Quantile Regression Post-Processing of Weather Forecast for Short-Term Solar Power Probabilistic Forecasting." *Energies* 11.7 (2018): 1763.
- Massidda, Luca, and Marino Marrocu. "Decoupling weather influence from user habits for an optimal electric load forecast system." *Energies* 10.12 (2017): 2171.
- Marrocu, Marino, and Luca Massidda. "A simple and effective approach for the prediction of turbine power production from wind speed forecast." *Energies* 10.12 (2017): 1967.
- Massidda, Luca, and Marino Marrocu. "Use of Multilinear Adaptive Regression Splines and numerical weather prediction to forecast the power output of a PV plant in Borkum, Germany." Solar Energy 146 (2017): 141-149.

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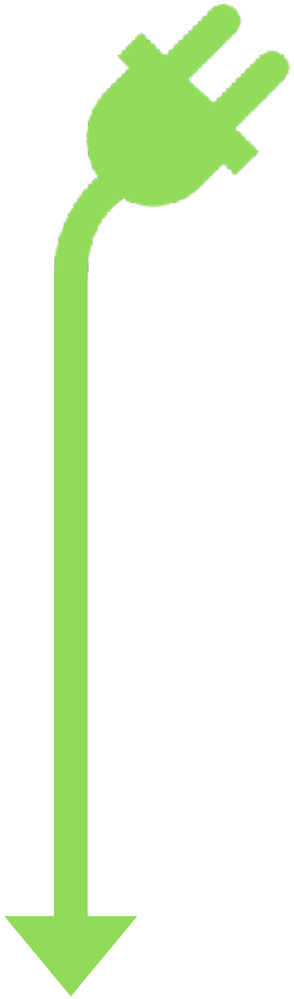
Research directions



- Non-Intrusive Load Monitoring: load disaggregation for energy efficiency applications, micro-grid optimization, Demand Response strategies
- Nowcasting for renewable energy generation: very short term forecast of power generation for the power grid management
- Climatic energy scenarios: very long term forecast of load and renewable energy generation for investment planning

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Thank you for your kind attention

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