ECO_2Project Outline

Ecological implications of Cloud-based IT infrastructures are creating a critical gap in the current state of the art in research and business. The ECO_2Clouds project investigates strategies that can both ensure effective application deployment on the Cloud infrastructure and reduce energy consumption and CO_2 emissions. The need for novel deployment strategies becomes more evident when an application spans multiple Clouds. Cloud providers operate under different regulatory frameworks and cost structures in relation to environmental policies and energy value-chains. In addition, optimizing the way key assets such as machines, applications and databases are deployed is constrained by a set of requirements such as quality, privacy and cross-platform, service-level agreements.

ECO_2Clouds will provide a challenging and innovative approach to Cloud computing service delivery by:

- developing extensions and mechanisms for Cloud application programming interfaces to collect eco-metrics at the IT infrastructure and Virtual Machine levels, and quantify the environmental impact of execution at infrastructure and application level;
- investigating the key environment, and the needed quality and cost parameters, so as to underpin a comprehensive approach to multi-cloud application deployment;
- developing evaluation mechanisms and optimization algorithms to assess different parameter configurations and their influence in energy-efficient Cloud sourcing and application deployment strategies;

The carbon-aware mechanisms will be integrated into the FIRE facility BonFIRE so as to test, validate and optimize the eco-metrics, models and algorithms developed and improve the FIRE offering.

ECO_2Clouds will develop and test *an application deployment strategy* which will primarily consider the environmental implications of deploying applications on multi or federated clouds. Among the multiple factors that should be considered in a successful application deployment strategy, ECO_2Clouds will conduct experimentally-driven research to investigate cutting-edge practices for sustainable federated cloud sourcing. This will be done by investigating key model parameters (ecological, quality and cost related dimensions) and proposing an optimization model for Cloud infrastructures.

ECO_2Clouds will address the following challenges for federated clouds:

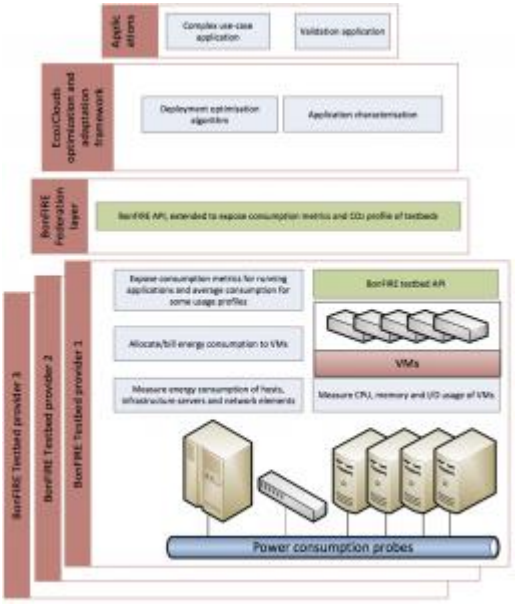
- To collect and expose carbon footprint concerns at the infrastructure level
- To incorporate carbon footprint concerns into a federated cloud deployment strategy
- To develop optimization mechanisms that can enable optimal utilization of federated cloud infrastructure.
- To develop adaptation mechanisms that can perform changes to a running application based on its energy consumption.

ECO$_2$Clouds will complement existing the multi-cloud facility provided by the FP7 project BonFIRE (Building Service Testbeds on Future Internet Research and Experimentation) which will be extended to provide real-time information about the energy usage of different processors. This will be complemented by innovative deployment optimization and runtime adaptation techniques and algorithms thus facilitating optimal energy consumption across different facilities ("cloud-hopping") in a cloud federation.

Experimental case studies will assess and compare the degree of energy efficiency and CO_2 footprint reduction achieved by ECO$_2$Clouds to those achieved without the support of the optimization and adaptation capabilities incorporated into the multi-cloud deployment strategies.

During the experimental validation we will target use of the FIRE facilities in general and the BonFIRE infrastructure in particular, which we will extend with energy measuring facilities and will use for application deployment and measurement of the resultant CO_2 consumption.

The conclusions about the validity of our scientific contributions will be the primary results to be exploited, both academically and through consultancy. The verified technical innovations and extensions to the BonFIRE infrastructure will also be exploitable as a key project legacy. The interactions between BonFIRE and ECO2Clouds are depicted here below.



ECO$_2$Clouds addresses several targets:

- Environment and society: Cloud computing is increasingly being seen as an effective solution to computational problems that involve intensive data processing and storage. As a result, enterprises and even governments are keen to make a transition toward Cloud sourcing in order to achieve efficiency and save costs. However, the proliferation of Cloud facilities raise environmental concerns due to the heavy energy consumption and CO_2 emissions of Cloud facilities. In this respect, the CO_2-aware Cloud sourcing strategy will benefit the environment and overall society.
- Cloud users and the Cloud research community specializing in this area: energy consumption in Cloud environments and CO2-aware applications on the Cloud is a key research objective in the Internet of Services (IoS). The benefits will be in terms of feedback and recommendations regarding the federated Cloud infrastructure tested in the project, the performance of the respective deployment optimization and adaptation mechanisms, and the development of deployment strategies including CO_2 awareness. ECO$_2$Clouds will enrich BonFIRE to provide a much needed, eco-aware infrastructure, tailored to the needs of the Cloud research community.
- Commercial enterprises and the wider research community working in the areas of Cloud sourcing and computationally heavy modeling: They will benefit from innovative ideas concerning design of Cloud sourcing strategies and general guidelines regarding the distribution of computationally intensive models onto federated Cloud infrastructure.