



ASCETiC Project

D7.3.3 Dissemination,
Collaboration and
Standardization Report (Year 3)

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PP	Restricted to other programme participants (including the Commission)	
RE	Restricted to a group specified by the consortium (including the Commission)	
CO	Confidential, only for members of the consortium (including the Commission)	

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Preface – Positioning this deliverable in the ASCETiC project

This deliverable is the third, and final, report on dissemination, collaboration and standardization activities corresponding to the final period of the project. The relationship between all deliverables of this iteration can be seen in the figure below:

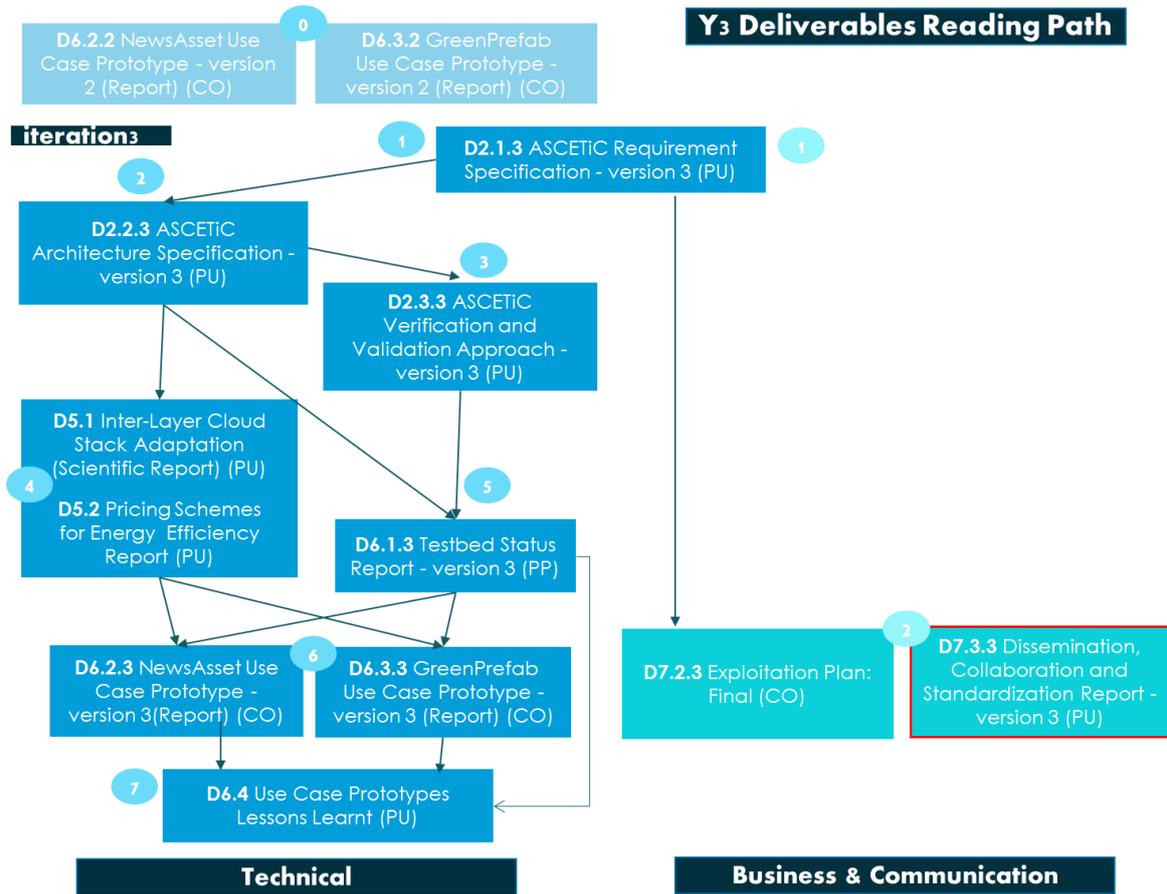


Figure 1: Y3 deliverables' reading path

As part of the overall communication strategy followed in the project, all activities regarding dissemination, collaboration and standardization performed during this third year of the project are listed in this document in order to support the overall business strategy of the project.

Executive Summary

The objective of this document is to summarize all the dissemination, communication, collaboration and standardization activities performed during the third, and final, year of the project.

There were many ongoing activities started in Y1 and Y2 of the project that have been continued during this year. However new activities, more related to communication, have been started during this final period. All these actions have been measured in order to track their evolution and impact, while any corrective action has been applied to avoid any deviation.

This last period corresponds to the third step of the strategy depicted during the first year of the project: step one corresponds to the creation of awareness phase, in order to reach the widest audience possible, attracting and engaging all relevant stakeholders; phase two is the launching of the communication phase, giving more importance to the scientific dissemination but starting a more commercially oriented dissemination line; finally, the last step of the dissemination strategy of the project is the consolidation of the communication phase, performing more activities to attract potential customer and/or end users.

In order to communicate project results, more high ranked scientific conferences have been targeted, as well as other more industry oriented. As a novelty introduced this year, several webinars to present the **ASCETiC Toolbox** to different stakeholders have been organized. The intention for organizing this kind of meetings is to attract the interest to the Toolbox in order to support the exploitation strategy of the consortium. The work performed on social media has continued as usual.

The collaboration work started in previous years has been continued during this year, including the leadership of the Inter-Cloud Challenges, Expectations and Issues, and some collaboration actions with projects of the Smart Cities DC Cluster.

Finally, the project has continued using well know standards to make results more attractive and to ensure interoperability, while ASCETiC has also contributed to the standardisation activities of the survey launched by Cloud Watch in order to identify the gaps on the most used standards.

1. Introduction

1.1 Purpose

The objective of this deliverable is to report on the dissemination, communication, collaboration and standardisation activities performed during the third, and last, year of the project. The document follows up the activities started during the previous years and reports on the new ones developed during this period.

1.2 Structure

This document is structured into four main sections, one per activity, corresponding to two tasks of the work package: *Task 7.3 Dissemination* and *Task 7.4 Community Awareness: Collaboration and Standardization*.

In Section 2, all activities related to dissemination and communication are documented, together with the update on the produced material. There is a dedicated subsection to the webinars, as they are a novel activity introduced in Y3.

Section 3 contains all the collaboration activities performed with list of potential candidates for collaboration, elaborated during the previous years, and the activities performed within the Inter-Cloud cluster that ASCETiC is leading.

In Section 4 all standardisation activities are documented, plus an update of a potential roadmap once the project has ended.

Finally, in Section 5 the impact of all the activities performed until the end of the project is measured. As the aim of the dissemination strategy is to support the business development, some plans for the future are also depicted here.

In Annex I, all publications from Y1 and Y2 are also included.

1.3 Glossary of Acronyms

Acronym	Definition
ASCETiC	Adapting Service lifeCycle Towards Efficient Clouds
IaaS	Infrastructure as a Service
PaaS	Platform as a Service
RES	Renewable Energy Sources
SaaS	Software as a Service
VM	Virtual Machine
VMM	Virtual Machine Manager

Table 1. Acronyms

2. Dissemination and Communication

As in Y2, the activities performed during this year have been developed to support the business development of the ASCETiC Toolbox. For this reason, the dissemination strategy has been split in two, for the scientific dissemination of the project research results to reach the scientific audience, and for the dissemination of the ASCETiC Toolbox to a more commercially oriented audience.

2.1. Tools and materials

In order to support the strategy of the project, the dissemination tools and materials are periodically updated in order to include the latest publishable results of the project.

2.1.1. Project website

As it happened in previous years, the project website is considered the front end for the audience interested in scientific and research achievements and results.

The content is continuously updated, as soon as there is new material or references to be published.

As it can be seen in the Figure below, the strategy for engaging stakeholders is working as visitors that arrive for the first time to the site make two or more visits.

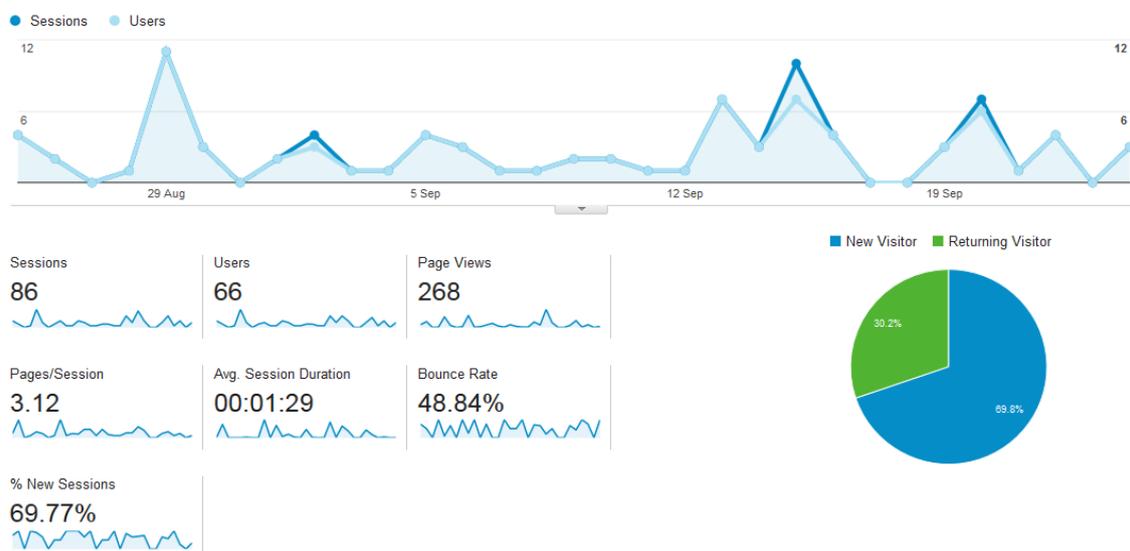


Figure 2: Number of visitors to the project website

The Figure also shows that the average time per session is more than twice than the time reported in Y2 (43'), and also the number of visited pages (3.12 in Y3 opposite to 1.19 in Y2).

ASCETiC has also participated in several events, cloud and energy efficiency related, where several people have had the opportunity to hear about the project. This situation is translated into an increased number of visitors coming

from organic searches and through the links available in the project social media channels, commercial website and dissemination material, as it can be seen in the Figure below.

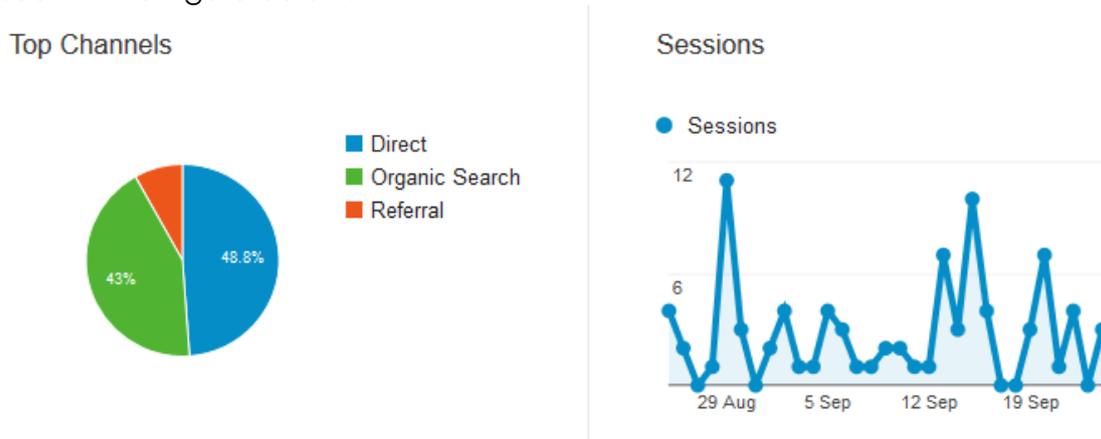


Figure 3: Principal channels for accessing the website and peaks of sessions

As it can be seen in all Figures, the period analysed comprises from August 29th to September 19th. During this period the project website has received 86 visits, most of them coming from Spain (19), followed by United Kingdom (15), United States (13) and France (11).

The project website has received visits from 18 different countries, mainly from Europe (12), Asia (3) and America (2).

The following Figure shows the behaviour of the visitors when landing on the ASCETiC website, the average time visiting each page, the number of views per page and the number of unique page views.

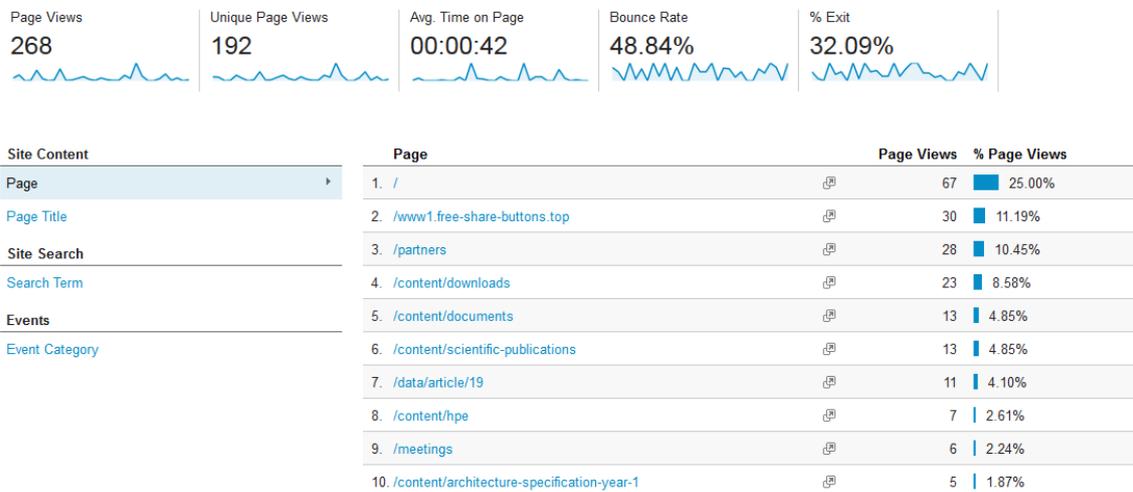


Figure 4: Most visited pages and average visit time per page

The Figure above also shows that the average time spent per page is low. However, the most visited pages are the ones with content available for downloading, this demonstrates that visitors are already looking for content of their interest and, as reflected in Figure 2, are recurrent visitors.

2.1.2. Toolbox website

The ASCETiC Toolbox website is the second site of the project. This website is more commercially oriented, with specific content about the Toolbox and not to the scientific achievements.

This website is periodically updated with new content about the Toolbox: installation and configuration manuals; video demos; technical and business documents; and any other information of interest for any potential customer.

By the time this document was written, the Toolbox website is under maintenance in order to update its appearance to result more attractive to potential stakeholders.

2.1.3. Social Networks

The project still continues its activity on social media channels, Twitter and LinkedIn, to share its latest achievements and news.

2.1.3.1. LinkedIn

The project has 16 active debates about project news, or cloud and/or energy efficiency related topics. The main novelty is that it is planned to open the group to all the LinkedIn community after the end of the project, so it can continue alive when there are no more project related news to publish.

2.1.3.2. Twitter

Twitter, as it is expected, it is the most active social channel. During this period, the project has reached 170 visitors, more than the double than in Y1 and a 30% more than in Y2. Also the number of tweets has increased, surpassing the 500 barrier with project related content. The project account has been also included in several Cloud related discussions lists as a reference to be followed.

2.2. Publications

ASCETiC consortium has continued with the work performed during Y1 and Y2, actively writing scientific publications to show its latest achievements. The list of publications can be seen in the following table:

Type	Title	Status	Location	Authors	Date	Link to the publication
Paper	Guiding Cloud Application Developers in Designing Balanced trade-off among Energy impacting requirements	Presented	IWSM Mensura/ MegSUS 2015, Cracow (Poland)	Christophe Ponsard, Raphael Michel, Jean-Christophe Deprez, Sanae Saadoui (CETIC)	October 2015	http://www.iwsm-mensura.org/2015/megus
Short paper	A SLA Manager for energy-efficient Cloud software	Rejected	HPE Tech Con 2016 International Conference	Lorenzo Blasi, Luca Porrini (HPE)	October 2015	N/A (the paper is nonetheless available on HPE intranet with an HPE Restricted level of Confidentiality)
Short paper	SLA-based Cloud Provider Selection	Published internally	HPE Internal short paper (Knowledge Brief)	Lorenzo Blasi, Christian Temporale (HPE)	October 2015	N/A (the paper has HPE restricted level of Confidentiality and is available and published only on HPE intranet)
Short paper	Energy-Aware Programming Model for	Accepted	PDP 2016	Francesc Lordan, Jorge Ejarque, Raül	February 2016	http://www.pdp2016.org/programme.html

	Distributed Infrastructures			Sirvent, Rosa M. Badia		
Short paper	Towards Design-time Simulation Support for Energy-Aware Cloud Application Development	Published	CLOSER 2016 (TEEC special session)	Christophe Ponsard, Jean-Christophe Deprez, Renaud De Landtsheer, Gustavo Ospina (CETIC)	April 2016	http://www.scitepress.org/DigitalLibrary/PublicationsDetail.aspx?ID=QT7FPwRZ12M
Conference paper	Revisiting Business Models within Cloud market	Published	12 th REHVA World Congress (CLIMA 2016), Aalborg (Denmark)	Alexandros Kostopoulos, Eleni Agiatzidou (AUEB), Lara López, Ana Juan (ATOS)	May 2016	http://vbn.aau.dk/files/233775398/paper_463.pdf
Conference paper	Accuracy of Energy Model Calibration with IPMI	Published	IEEE International Conference on Cloud Computing (CLOUD'2016), San Francisco (USA)	Richard Kavanagh, Django Armstrong, Karim Djemame (ULE)	June 2016	http://eprints.whiterose.ac.uk/102046
Journal paper	Toward Sustainable Data Centers :	Published	Computing Journal	Jordi Guitart (BSC)	June 2016	http://dx.doi.org/10.1007/s00607-016-0501-1

	a Comprehensive Energy Management Strategy					
Conference paper	The ASCETiC testbed – An Energy Efficient Cloud Computing Environment	To appear	11 th EAI International Conference on Testbeds and Research Infrastructures for the Development of Networks and Communities (TRIDENTCOM)	Marc Körner, Alexander Stanik, Odej Kao, Marcel Wallschläger, Sören Becker (TUB)	June 2016	N/A
Revised conference paper	Guiding Cloud Developers to Build Energy Aware Applications	Published	ICSOFT 2015, Colmar (France)	Christophe Ponsard, Jean-Christophe Deprez, Raphael Michel (CETIC)	July 2016	http://www.springer.com/gp/book/9783319301419
Conference	Energy-aware Pricing within	Accepted	13 th International	Alexandros Kostopoulos,	September 2016	http://nes.aueb.gr/publications/gecon16_kostopoulos.pdf

paper	Cloud Environments		International Conference on Economics of Grids, Clouds, Systems and Services (GECON 2016, Athens (Greece))	Eleni Agiatzidou, Antonis Dimakis (AUER)		
Conference paper	Energy Efficiency Support through Intra-Layer Cloud Stack Adaptation	Accepted	13 th International Conference on Economics of Grids, Clouds, Systems and Services (GECON 2016, Athens (Greece))	Karim Djemame (ULE)	September 2016	N/A
Conference paper	Energy Prediction for Cloud	Accepted	13 th International	Karim Djemame, Ibrahim Alzamil	September 2016	N/A

	Workload Patterns		Conference on Economics of Grids, Clouds, Systems and Services (GECON 2016, Athens (Greece))	(ULE)		
Joint paper	Trends in Cloud Economics Scenarios, Requirements and Technologies	Accepted	13 th International Conference on Economics of Grids, Clouds, Systems and Services (GECON 2016, Athens (Greece))	Alexandros Kostopoulos, Eleni Agiatzidou (AUEB)	September 2016	http://2016.gecon-conference.org/program
Conference paper	Energy Consumption-based Pricing Model for	Accepted	32 nd UK Performance Engineering	M. Aldossary, K. Djemame (ULE)	September 2016	N/A

	Cloud Computing		g Workshop (UKPEW'2016)			
Journal article	Optimization Tools for Building Energy Model Calibration	Presented	Sustainability in Energy and Buildings SEB-16	Rigoberto Arambula Lara, Emanuele Naboni, Giovanni Pernigotto, Francesca Cappelletti, Yi Zhang, Furio Barzon, Andrea Gasparella, Piercarlo Romagnoni (GPF)	September 2016	Energy Procedia, ISSN 1876-6102 / official link not yet available
Conference paper	Resource Boxing: Converting Realistic Cloud Task Utilization Patterns for Theoretical Scheduling	Accepted	9 th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2016)	B. Primas, P. Garraghan, K. Djemame, N. Shaklevich (ULE)	December 2016	N/A
Conference paper	A Unified Model for Holistic Power	Accepted	9 th IEEE/ACM International	P. Garraghan, Y. Al-Anii, J. Summers, H.	December 2016	N/A

	Usage in Cloud Datacenter Servers		International Conference on Utility and Cloud Computing (UCC 2016)	Thompson, N. Kapur, K. Djemame (ULE)		
Conference paper	Economic Implications of Energy-Aware Pricing in Clouds	Rejected	8 th IEEE International Conference on Cloud Computing Technology and Science (CloudCom), Business Process Monitoring and Performance Analysis in the Cloud (CloudBpm)	A. Dimakis, A. Kostopoulos, E. Agiatzidou (AUEB)	December 2016	N/A

Table 2. List of publications

2.3. Workshops and Events

In order to show project results, partners have participated in different related events. The list of attendees and the role of ASCETiC is shown in the table below.

Event name	Website	Date	Location	Attendees	Contribution
Cloud Forward 2015	http://cf2015.holacloud.eu/	06-08/10/2015	Pisa, Italy	Ana Juan (ATOS)	Presentation of Inter-Cloud cluster, research topics identifies and other actions performed.
11º Congreso Internacional de Cómputo en Optimización y Software (CICos 2015)	http://campusv.uaem.mx/cicos/	22-23/09/2015	Mexico	Daniele Lezzi, Rosa M. Badia (BSC)	COMPSs Programming Model tutorials
Supercomputing Conference (SC'15)	http://sc15.supercomputing.org/	15-20/11/2015	Austin, Texas	Rosa M. Badia (BSC)	BSC booth explaining ASCETiC results
COMPSs Tutorial	http://www.bsc.es/marenostrum-support-services/hpc-education-and-training/patc-trainin/2015-23-27-nov-patc-parallel	04/02/2016	Barcelona, Spain	Jorge Ejarque, Rosa M. Badia, Raül Sirvent (BSC)	Full day tutorial on the COMPSs Programming Model
PDP'2016	http://www.pdp2016.org/	17-19/02/2016	Heraklion, Greece	Raül Sirvent (BSC)	Paper presentation
Ciclo de Conferencias	http://webpub.esi.uclm.es/actualidad/noticias/ciclo-de-conferencias-sobre-cloud-	16/03/2016	Albacete, Spain	Javier Conejero	Presentation showing COMPSs Programming

sobre Cloud Computing (ESI-UCLM)	computing http://webpub.esi.uclm.es/img/upload/plugin/cartel_conferencias2016.pdf			(BSC)	Model and ASCETiC results
TEEC'2016	http://www.smartgreens.org/SpecialSessions.aspx#TEEC/	24/04/2016	Rome, Italy	Karim Djemame (ULE)	Workshop Chair
CLIMA 2016	http://vbn.aau.dk/en/activities/clima-2016--12th-rehva-world-congress%2843019fd3-70a7-4c5c-9176-825add5913f%29.html	22-25/05/2016	Aalborg, Denmark	Lara López (ATOS)	Presentation of business models for energy efficient clouds (paper presentation)
International Supercomputing Conference (ISC'16)	http://www.isc-hpc.com/id-2016.html	19-23/06/2016	Frankfurt, Germany	Rosa M. Badia (BSC)	BSC booth explaining ASCETiC results
University of Reading Malaysia Research Seminar 2016	http://goo.gl/zBP4Hu	17/08/2016	Johor Bahru, Malaysia	Furio Barzon (GPF)	Presenting GreenPrefab results and tools in ASCETiC
Sustainability in Energy and Buildings SEB-16	http://seb-16.sustainedenergy.org/	11-13/09/2016	Turin, Italy	Rigoberto Arambula (GPF)	Journal article presentation
GECON 2016	http://2016.gecon-conference.org/	20-22/09/2016	Athens, Greece	Alexandros Kostopoulos (AUEB)	Paper presentation
Cloud Forward 2016	http://cf2016.holacloud.eu/	18-20/10/2016	Madrid, Spain	Ana Juan (ATOS)	Cluster Meeting

Table 3. List of events

Furthermore, ASCETiC has organized its first workshop on energy efficient clouds co-located with the SMARTGREENS conference. Related projects, listed in the collaboration section, were invited to participate in order to keep fruitful discussions on energy efficiency covering the whole cycle (from hardware to software). covering the whole cycle (from hardware to software).

2.4. Webinars

During this last year of the project, in order to follow with the communication strategy outlined in Y1, several webinars have been organized to show any potential stakeholder the benefits of adopting ASCETiC, how to use it and what it is useful for.

These webinars are really important to show others how they can download, install and operate ASCETiC components. Otherwise, many of them will not take the time to do it on their own and ASCETiC will lose potential interested parties.

The banner features the ASCETiC logo at the top center, which consists of a stylized green and blue cloud-like shape above the text 'ASCETiC'. Below the logo is a central icon of a toolbox with a wrench and a screwdriver. The background is a landscape with a blue sky and green grass. On the left, a white rounded rectangle contains the text 'SAVE THE DATE!' followed by a list of webinar topics and dates: 'ASCETiC in a nutshell - 10/10', 'IaaS layer - 11/10', 'PaaS layer - 17/10', 'SaaS design tools - 20/10', and 'SaaS programming model - 21/10'. On the right, another white rounded rectangle contains the website 'www.ascetic-project.eu', two QR codes, and 'www.ascetic.eu'. A horizontal strip of logos for partners like Atos, University of Leeds, BSC, hp, and others is located below the central text. At the bottom left, there is a European Union flag and a text box stating: 'This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under Grant Agreement no 610874'. At the bottom right, a white rounded rectangle contains social media icons for Twitter (@asceticproject) and GitHub (ascetictoolbox).

Figure 5: ASCETiC Webinars

Figure above is the banner used to advertise the webinars, this banner, together with a document that summarises the main ASCETiC goals and achievements, and an invitation letter are the material produced to disseminate the webinars.

As it can be seen, there are 5 different ones, starting from a project overview to introduce the ASCETiC Toolbox, to the rest that explain what the Toolbox consists layer per layer.

These webinars will start with a small set of slides to highlight the main features of each layer, ending with a demo to show the potential of the Toolbox.

The material produced for these webinars will be also included in the Toolbox website as complementary material.

3. Collaboration

In deliverables 7.3.1 [1] and 7.3.2 [2] we reported the collaboration efforts of the ASCETiC project made during the 1st and 2nd years of the project. Given the contact that has occurred with other projects, this section reports on the advances made during Year 3 of the project. The list of active projects identified as candidates for collaboration, as reported in 7.3.2, are discussed and updates on collaboration efforts are reported on.

3.1. EC Cluster

ASCETiC is currently leading the Inter-Cloud Cluster of the European Commission [3], focused on Inter-Cloud challenges, expectations and issues. This cluster is a mean for collaboration within projects with the same scope and a way to share approaches and experiences as well as to discuss challenges for future research topics.

There are several projects members of this cluster, below it is the list:

- MODAClouds
- PaaSage
- SeaClouds
- mOSAIC
- CloudSocket
- AppHub
- SWITCH
- BEACON
- SSICLOPS
- ENTICE
- CYCLONE
- CLOUDLIGHTNING

Means for collaboration within this cluster have been established in two ways:

Technical collaboration

- Publication of joint scientific papers
- Best practises
- Future research roadmaps

Dissemination and Exploitation

- Organisation of joint workshops
- Project Innovation Management
- Publication of joint whitepapers

As a result of the activities performed until this moment within the Cluster, its position paper [4] has been published in December 2015, led by ASCETiC.

ASCETiC is also participating in the Brokerage & Pitch Event supported by the EC on November 3rd, together with other projects members of the Cluster.

3.2. Smart Cities DC Cluster

The Smart Cities Cluster has been contacted during this last year of the project, as there are some similarities on the work performed to improve energy efficiency in a data centre.

ASCETiC has evaluated the different novel metrics introduced by this cluster. However, they are out the project scope as they are focused on energy efficiency at data centre level or for improving the RES penetration.

The ASCETiC consortium has continued the collaboration with some of the projects that are participating in this cluster, focusing on common topics.

3.3. Parallel Projects

The following parallel projects that were identified last year as potential collaborators and are still running are listed below, followed by a summary of each project:

- ENTRA
- GENiC
- RenewIT
- EUROSERVER
- ParaDIME
- MONT-BLANC
- BEACON
- DICE
- SLALOM
- CloudScale
- MODAClouds
- BigFoot
- CELAR
- SeaClouds

Performed Actions

In order to foster collaboration, the ASCETiC project last year gave a named individual the lead in maintaining contact with other projects, thus ensuring that responsibility for coordinating collaboration is maintained.

The following actions have been performed in Y3 as part of the collaborative efforts between ASCETiC and other projects:

ENTRA

Form of Contact: Email discussions

Contact with Prof. John Gallagher (PI). Early discussions took place on a common approach for ENTRA and ASCETiC to promote “energy-aware” software development among advanced program analysis and modelling of energy consumption. These predictions are facilitated at a very early stage, during design phase, giving the opportunity to develop greener IT products based on them. Another area of potential collaboration is program analysis and energy modelling techniques.

The field of energy-aware software development is overall a joint interest for ENTRA and ASCETiC as both projects have advanced during their execution. The shared context is the description of different activities and scenarios for energy-aware software development. For example, ASCETiC has completed in Y3 the design and implementation of the *Requirements and Engineering* tool as well as the *Experiments Manager*. Finally, the final energy-aware prototype tools developed by both projects for analysis and optimization (e.g. code optimizer) can be integrated into tool-chains for energy-aware software development processes and life-cycle. These prototype tools, which are components providing the functionality supporting the activities of energy-aware software development. The ENTRA project was completed in March 2016.

GENiC

Form of Contact: P2P

While ASCETiC is more focused on software, GENiC is focused on infrastructure and hardware. However, both projects have in common the approach for monitoring the system. For this reason, GENiC project was invited to participate in the workshop organized by ASCETiC to share their approach. The GENiC coordinator attended to this event to keep some fruitful discussions with the ASCETiC team, sharing views and concerns about energy savings in data centres.

Future Plans

Both projects end due to September 2016, so there are no plans to continue the collaboration between them.

RenewIT

Form of contact: Periodical meetings

Meetings have been held with external partners as well as the BSC team that participate in this project. The aim of the periodical meetings is to define a common Virtualises Infrastructure Management component and a set of common energy and performance metrics for our current and mid-term work within ASCETiC.

The VMM that is being developed in ASCETiC is being used on top of the Micro Data Center that is provided by the Institut de Recerca en Energia de Catalunya (IREC), which is partner and coordinator of such project.

In addition, the VMM is being integrated with the Energy Modeller developed by the BSC team that participates in RenewIT.

Future Plans:

To enrich VMM policies with new parameters and constraints: availability of heterogeneous energy sources (renewable and non-renewable) performance and efficiency with respect to different application metrics (execution time, throughput, response time...) and differentiation of management policies according to different types of workloads (High-Performance Computing, Data-Intensive and Web).

EuroServer

Form of contact: Periodical meetings

Meetings have been held with the BSC team members that participate in EuroServer to establish infrastructure energy models for their mid-term addition within our components in ASCETiC.

The VMM has been integrated with the power models and low-consumption (ARM-based) hardware that is being developed within EuroServer project.

ParaDIME

Form of contact: F2F meetings

Several discussions with Oscar Palomar and Santhosh Kumar have taken place to identify common topics for a joint paper. Summary of the topics:

- Exchange experiences in power modelling between ParaDIME and ASCETiC.
- Compare ParaDIME approach with Scala and AKKA in the programming model part to the COMPSs Programming Model.
- Understand how the Pricing Modeller could complement the work done in ParaDIME.
- Compare both cloud software stacks used in ParaDIME and ASCETiC.

Future Plans:

Although the ParaDIME project has already finished, we target to produce a joint paper but the conference has not been selected yet.

MONT-BLANC 2

Form of contact: F2F meetings

We met Filippo Mantovani (project coordinator) to further investigate possible ways of collaboration. The main idea that is going to be chased is to deploy the ASCETiC Toolbox in a Mont-Blanc testbed by entering the Mont-Blanc End-Users Group. We have studied that the deployment is possible, since Mont-Blanc tested successfully to deploy OpenStack in their testbed. Also, Mont-Blanc focuses on measuring energy, not optimizations, so the optimizations implemented in ASCETiC could compliment their work.

Future Plans:

The target will be to publish tests in a conference as part of basic research. The deadline of the conference should be around end of November, mid-December.

CloudScale

Form of Contact: Face-to-face meeting and email discussions

Discussions with Sebastian Lehrig (investigator) at CloudWatch events have been on a common approach for CloudScale and ASCETiC to promote “efficiency” at software development stages as well as “software patterns” both projects will be suggesting.

Further discussions have taken place on the concepts for architectural templates (ATs), defined in CloudScale as a language to formalize architectural styles on component models. This formalization allows enriching styles by quality annotations and completions for model-driven quality analyses. This is of relevance to ASCETiC as these annotation can be “energy-efficiency” to support the SaaS SDK layer.

The collaboration with this project has mainly been on SaaS applications, and a follow-up of the idea of enriching ATs by scalability (CloudScale) and energy

efficiency (ASCETiC) annotations and completions to allow software architects and developers to analyse their applications' scalability and energy efficiency. Another common interest for both projects is how to make cloud system scalable by design so that they can exploit the elasticity of the cloud, as well as maintaining and also improving scalability during system evolution. This was of particular relevance for GreenPrefab, ASCETiC use case, whose scenarios require the execution of 1.000's of embarrassing simulation jobs.

MODAClouds

Form of Contact: P2P meeting

Periodical meetings with the MODAClouds and ASCETiC technical staff have been kept in order to determine how results from both projects can be enriched. MODAClouds project has already ended.

BigFoot

Form of Contact: Email exchange

Several research issues were identified between both projects, including data analytics and energy consumption. In particular, both projects are using measurements spanning multiple periods and different workload in order to characterize the performance implications of different solutions.

Future Plans

The overall collaboration between both projects was incremental in Y3, since BigFoot project ended the previous year.

SeaClouds

Form of Contact: Face-to-face meeting and email discussions

Following discussions with Francesco D'Andria (Project Manager), ASCETiC gave a presentation on cloud standardization with emphasis on multi-cloud interoperability at the Seamless adaptive multi-cloud management on service-based applications Workshop organized by the SeaClouds project, September 2014.

Other discussions on specific Cloud standards adoption focused on TOSCA as an alternative to OVF for ASCETiC.

BEACON

Form of Contact: Face-to-face meeting and email discussions

A joint dissemination event at Cloud Data Center Forum took place at Belgian level on 20th October 2016. During this event, CETIC presented its joint vision on how PaaSage, ASCETiC and BEACON can help data centres in better exploiting underlying technologies.

Future Plans

Incidentally, BEACON staff member who are in a different CETIC department than those who work on ASCETiC, has been invited to the ASCETiC Webinar, in particular the one focused on IaaS and PaaS. Based on the knowledge acquired, it will help to determine if BEACON could exploit some of the ASCETiC results to include energy consumption measurement in a context of software defined network and network function virtualization.

SLALOM

Form of Contact: Face-to-face meeting and email discussions

ASCETiC and SLALOM initially defined the possible steps for their collaboration path, mainly related to energy efficient metrics. ASCETiC reviewed multiple versions of the SLALOM SLA specification and reference model. SLALOM was initially more concerned on the definition of abstract metrics and SLA comparability; in the end, they focused on the detailed and comparable description of few metrics important to current providers and adopters, such as availability and performance; energy metrics remained low on their priority list.

Future Plans

SLALOM project has already ended, so there are no plans for collaborating in a near future.

As several of these candidates for collaboration were ended before, or at the same time as ASCETiC, other collaboration actions have been started during Y3. The summary of these actions is depicted below:

Lenovo collaboration cluster

Form of contact: Joint collaboration

A joint collaboration project has been started with Lenovo. The knowledge from ASCETiC will be applied in two work packages. Our contribution to the collaboration is focused on enhancement of the VM management for HPC applications, as well as to the modelling of their energy consumption.

Periodical meetings (teleconferencing and face-to-face) are arranged between BSC and Lenovo teams, as well as between BSC groups.

OPTET

Form of contact: F2F meetings

OPTET is a research project focused on privacy and security domain and has a different approach compared to the ASCETiC project. The OPTET project identified and addressed the drivers of trust, focused on the Internet and Cloud. In particular, OPTET trustworthiness enablers covering the full software life-cycle support the advent of trustworthy platforms where trustworthiness can be explicitly exposed, analysed and reasoned.

In ASCETiC, mainly in Y3, we focused on inter-layer communication and self-adaptation. Particularly, in ASCETiC architecture, it is assumed that each component within the corresponding cloud layer exposes accurate information. However, we may have different stakeholders in each cloud layer with conflicting interests among them. Hence, the investigation of issues related to trustworthiness in each cloud layer, with respect to what information is exposed, seems to be an interesting and innovative aspect for further research.

Future Plans

The overall plan, since both projects came to the end, is to extend our research by considering privacy aspects in cloud layered architectures, such as ASCETiC, where trustworthiness will be explicitly exposed in each cloud layer.

4. Standardisation

ASCETiC has contributed to the CloudWatch survey with the aim of identifying the most commonly used standards in European projects and the gaps that the show. As the project is making use of many of this identified standards, it was well-positioned to identify the lacks on energy considerations on some of them. This information was delivered back to CloudWatch, who will publish the results in its Standards Hub [5].

4.1. Revision of technical standards used in Y3

In Year 3, ASCETiC has continued making use of the following:

Advanced Message Queuing Protocol (AMQP) 1.0

In August 2011, the AMQP working group announced its reorganization into an OASIS member section. OASIS AMQP was approved for release as an ISO and IEC International Standard in April 2014. AMQP 1.0 was balloted through the Joint Technical Committee on Information Technology (JTC1) of the International Standards Organization (ISO) and the International Electrotechnical Commission (IEC). The approved OASIS AMQP submission has been given the designation, ISO/IEC 19464.

ActiveMQ [6] supports the AMQP 1.0 protocol which is an OASIS standard [7]. Several components at PaaS and IaaS layers of the ASCETiC architecture communicate through a message queue that implements the AMQP 1.0 standard.

Open Virtualization Format (OVF)

The Open Virtualization Format (OVF) is an open standard for defining, packaging and distributing virtual appliances that can run virtualized on a Cloud. ASCETiC has contributed to its wide spread adoption and has shown that it has confidence in the ability to build an OVF that can be deployed on a set of target virtualization platforms (hypervisors). To this end, ASCETiC has defined additional constraints and requirements on the OVF package to enable automated deployment (with emphasis on energy efficiency, performance, and cost) as well as portability. Interoperability, i.e., the ability to be deployed on target virtualization platforms, has also been enhanced.

ASCETiC has ascertained the feasibility of using OVF and showcased the energy awareness of the architecture in the life-cycle of a Cloud application. The architecture supports interoperability through the use of OVF. Implementation of Initial performance evaluation results of the architecture show that Cloud provider interoperability is feasible and incurs minimal performance and energy overhead during application deployment in comparison to the time taken to instantiate Virtual Machines. Moreover, the extension of the Service Level Manager (SLA) delivered support for application and energy terms and OVF resources to be included in the PaaS/IaaS negotiation. Finally, VM characterisation has included the analysis of OVF descriptions of Virtual Machines (VMs) for better management and thus providing insights into potential future workloads patterns.

In Year 3, from the practical experience with OVF, the following phases have been covered in experimentation for its evaluation: 1) Service submission; 2) Negotiation; 3) Contextualization; 4) Deployment; 5) Initialization and 6) Undeployment. This choice has been made to provide perspective on the performance and energy consumption of the ASCETiC architecture and its OVF implementation. Construction and Operation have been omitted from this scope as these phases are highly dependent on the application. This is also true of Initialization but this phase enables comparisons to be drawn on the energy consumption of the ASCETiC architecture against that of operating a Cloud application, where by in normal use cases of a Cloud, Operation energy consumption far out-ways that used in Initialization [8].

OVF implementation, feasibility and performance has been showcased via the deployment of a NewsAsset, GPF and SocialSensor applications, where by the introduction of OVF and the ASCETiC architecture has minimal impact on lifecycle phase times and host energy consumption. The results show that the implementing Cloud provider interoperability is feasible and incurs minimal overhead during application deployment in comparison to the time taken to instantiate Virtual Machines.

It will be important to investigate in the future support for the Topology and Orchestration Specification for Cloud Applications (TOSCA) future proofing further Cloud provider interoperability.

4.2. Sustainability standards

The ISO 50001 standard

ISO 50001 is based on the ISO management system model familiar to more than a million organizations worldwide who implement standards such as ISO 9001 (quality management), ISO 14001 (environmental management), ISO 22000 (food safety), ISO/IEC 27001 (information security).

ISO 50001:2011 specifies requirements for establishing, implementing, maintaining and improving an energy management system, whose purpose is to enable an organization to follow a systematic approach in achieving continual improvement of energy performance, including energy efficiency, energy use and consumption [9]. For more details on this standard see [10].

Following the work in Year 3 on the SaaS tools, specifically the *Requirements Engineering and Design* and the *Experiment Manager* design, implementation and evaluation in the context of NewsAsset use case, the ASCETiC framework provides both a method and a tool to support compliance with the ISO50001 considering the consumption that can be related the execution of software inside a Cloud deployment, in other words: 1) the specification of the energy reduction goals and how to measure them; 2) the definition of *metrics* that are easily collected thanks to a rich set of ready-to-be-deployed probes; 3) collected data can be consolidated back to the goal level using SaaS visualization tools, and 4) energy policies can be statically specified as part of design models but can also be dynamically be deployed inside the self-adaptation component present in different Cloud layers.

ISO 50001 is based on the *Plan-Do-Check-Act* continual improvement framework and incorporates energy management into everyday organizational practices. In relation to ASCETiC, the Cloud has to some extent the ability to run a Plan-Do-Check-Act cycle on its own at short term. So the Cloud manager can focus on the longer term improvement of the policies:

Plan: conduct the energy review and establish the baseline, energy performance indicators (EnPIs), objectives, targets and action plans necessary to deliver results in accordance with opportunities to improve energy performance and the organization's energy policy. In ASCETiC this is supported by all SaaS, PaaS and IaaS layers. Re-planning also takes place at all three layers during service operation thanks to self-adaptation.

Do: implement the energy management action plans. In ASCETiC this is supported by the PaaS and IaaS layers, specifically the Application Manager and the Virtual Machine Manager.

Check: monitor and measure processes and the key characteristics of its operations that determine energy performance against the energy policy and objectives and report the results. In ASCETiC this is supported by the PaaS and IaaS layers, specifically the Application Monitor and the Infrastructure Monitor.

Act: take actions to continually improve energy performance. In ASCETiC this is supported by all SaaS, PaaS and IaaS layers during service operation thanks to self-adaptation.

5. Evaluation Criteria and Measurement Impact

Description	Measurement	Threshold	Y1 + Y2 Figures	Y3 Figures
Project flyers and factsheet	Produce one updated version per period	3 during project execution 1 per year	2 flyers 2 posters 1 brochure	
Scientific and white papers	Write and submit	10 during project execution	16	
Collaboration with other projects	Collaborate with different projects with complementary objectives or related activities	3 per execution year	2	
Press releases	Press releases produced by the project	4 during project execution (project initiation and each year progress)	0	
Events and workshops	Attended events	6 during project execution	26	
	Organized workshops	1 – EAB meeting mid second year	1	1
Collaboration with related initiatives	Collaboration with standardization bodies and groups	2	0	
Website and social networks updates	Qualitative measurement: more important that number of visitors is the number of collaborations (tweets, posts, etc.)	Minimum 15 updates and social network communications per year		

Table 4. Impact measures

The project has been very active regarding dissemination activities during this last year of the project.

Several publications have been done this year, including more high ranked conferences and journals and events more industry oriented. Participating and publishing results have shown in the past to be the best strategy to follow, not only to attract people to the project, but to engage them showing the features and promising possibilities of the ASCETiC Toolbox.

By the time this document is written, a press release, to be translated into different languages, is being prepared to show the evolution of the ASCETiC Toolbox and the final available results. This press release will be also translated into a blog entry to be shared with different Open Source communities that can be interested on publishing it on their sites.

6. Conclusions

Dissemination, collaboration and standardization have demonstrated to be key pillars for the project in order not only to reach the widest audience as possible, but to attract and engage them, in order to share different points of view and take other considerations into account to enrich the project results.

Year 3 strategy was focused on spreading the word about the ASCETiC Toolbox, the main project result, both to scientific and industry community. Thus, main dissemination and communication activities have been outlined and developed to support the business strategy of the project, aiming to ensure its sustainability after the reporting period.

In addition to this, the project has submitted a request to join OW2 community, as it has been identified as a good opportunity to maintain the Toolbox.

References

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- [10] D7.3.2 Dissemination, Collaboration and Standardization Report v2, <http://www.ascetic-project.eu/content/dissemination-collaboration-and-standardization-year-2>

Annex 1 – Y1 and Y2 publications

Type	Title	Status	Location	URL	Authors	Date
Book chapter	ASCETiC: Adapting Service lifeCycle Towards Efficient Clouds	Published	European Project Space (EPS), Barcelona (Spain)	http://closer.scitevents.org/epsprogram.aspx?y=2014	Ana Juan, David Garcia (ATOS), Eleni Agiatzidou (AUEB), Francesc Lordan, Jorge Ejarque, Raül Sirvent, Rosa M. Badia, Jordi Guitart, David Ortiz, Mario Macías (BSC), Jean-Christophe Deprez, Christophe Ponsard (CETIC), Christian Temporale, Pasquale Panuccio, Davide Sommacampagna, Lorenzo Blasi (HP), Karim Djemame, Django Armstrong (ULE), Michael Kammer (TUB)	April 2014
Paper	Proactive Adaptation in Service Composition Using a Fuzzy Logic Based Optimization Mechanism	Presented	4th International Conference on Cloud Computing and Services Science (CLOSER'2014), Barcelona, Spain	http://closer.scitevents.org/Home.aspx?y=2014	De Gyves Avila and K. Djemame.	April 2014
Paper	Energy	Presented	Workshop on	http://2014.ict4s.org/	Karim Djemame, Django	August

	Efficiency Embedded Service Lifecycle: Towards and Energy Efficient Cloud Computing Architecture		Energy Efficient Systems at ICT4S, Stockholm, Sweden		Armstrong, Richard Kavanagh (ULE), Jean-Christophe Deprez (CETIC), Ana Juan, David Garcia (ATOS), Raul Sirvent (BSC), Eleni Agiatzidou (AUEB), Michael Kammer (TUB) and Lorenzo Blasi (HP)	2014
Position Paper	ASCETiC Position Paper	Presented	Software Services and Cloud Computing Concertation Meeting	http://www.cloudwatchhub.eu/software-services-cloud-computing-concertation-meeting-10-11-sept-2014		September 2014
Paper	Energy-Aware Profiling for Cloud Computing Environments	Presented	30 th UK Performance Engineering Workshop, Newcastle, UK	http://homepages.cs.ncl.ac.uk/nigel.thomas/UKPEW14.htm	I. Alzamil, K. Djemame, D. Armstrong, and R. Kavanagh	September 2014
Paper	Energy related Goals and Questions for Cloud Services	Accepted	Measurement and Metrics for Green and Sustainable Software (MeGSuS'14)	http://www.iwsm-mensura.org/2014/workshop/megsus14	Jean-Christophe Deprez and Christophe Ponsard (CETIC)	October 2014

White paper		To be presented during the next EAB meeting	ASCETiC Whitepaper			October 2014
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Table 5. List of publications Y1

Type	Title	Status	Location	URL	Authors	Date
Article	Energy-Aware Profiling for Cloud Computing Environments	Submitted ¹	Electronic Notes in Theoretical Computer Science	http://www.journals.elsevier.com/electronic-notes-in-theoretical-computer-science/	I. Alzamil, K. Djemame, R. Kavanagh (ULE)	November 2014
Paper	Design and Implementation of a Cloud-Federation Agent for Software Defined Networking	Published ²	IEEE International Conference on Cloud Engineering (IC2E)	http://conferences.computer.org/IC2E/2015/	Constantin Gaul, Marc Körner, Odej Kao (TUB)	March 2015
Paper	Benchmarking Evolutionary Algorithm Approach In Building Energy Efficiency	Published ³	International Conference on Sustainability in Energy and	http://www.seb-15.sustainedenergy.org/	E. Naboni, Y. Zhang, A. Malcangi, F. Barzon (GPF)	April 2015

¹ This article has been provisionally accepted, but the review process is still ongoing.

² Publication can be downloaded here:

<http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7092938&newsearch=true&queryText=Design%20and%20Implementation%20of%20a%20Cloud-Federation%20Agent%20for%20Software%20Defined%20Networking>

³ Publication soon available at: <http://www.sciencedirect.com/>

	Analysis		Buildings 2015, Lisbon			
Paper	Energy Modelling and Monitoring within an Energy-Aware Architecture	Submitted/Rejected	EuroPar 2015, Vienna	http://www.europar2015.org/	R. Kavanagh, D. Armstrong, K. Djemame (ULE), D. Sommacampagna, L. Blasi (HP)	May 2015
Paper	Towards An Interoperable Energy Efficient Cloud Computing Architecture – Practice & Experience	Accepted	ICC'2015, London	http://icc2015.ieee-icc.org/	D. Armstrong, R. Kavanagh, K. Djemame (ULE)	June 2015
Paper	A UML KPI Profile for Energy Aware Design and Monitoring of Cloud Services	Accepted	ICSOFT, Colmar	http://www.icsoft.org	Christophe Ponsard, Jean-Christophe Deprez, Jacques Flamand (CETIC)	July 2015
Pap	Driving the	Accepted	SATtoSE,	http://sattose.org/2015	Christophe	July

er	Evolution of Cloud Software towards Energy Awareness		Mons		Ponsard, Jean-Christophe Deprez, Dimitri Durieux (CETIC)	2015
Paper	Defining the Energy Saving Potential of Architectural Design	Published	7 th International Conference on Sustainability in Energy and Buildings, Lisbon	Energy Procedia, Vol. 83, 2015, p. 140-146. Journal article ISSN 1876-6102 http://www.sciencedirect.com/science/article/pii/S1876610215028696	Emanuele Naboni, Antonio Malcangi, Yi Zhang, Furio Barzon (GPF)	July 2015
Paper	Designing beyond BR10 and Passivhaus Standard prescriptions with the use of Genetic Energy Optimisation	Published	7 th Passivhus Norden-Sustainable Cities and Buildings, Copenhagen	ISBN 9788778774231 http://passivhus.dk/wp-content/uploads/7PHN_proceedings/071.pdf	Emanuele Naboni, Antonio Malcangi, Yi Zhang, Furio Barzon (GPF)	August 2015
Paper	Towards and	Accepted	GECON 2015,	http://www.gecon-conference.org/gecon2015/	R. Kavanagh, D. Armstrong,	September

	Energy-Aware Cloud Architecture for Smart Grids		Romania		K. Djemame (ULE), D. Sommacampagna, L. Blasi (HP)	2015
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Table 6. List of publications Y2