Pan-European Data Centre Alliance (PEDCA)

Final Report

An EU Commission Funded Project under the seventh framework : project number 320013		
Dissemination Level		
PU	Public	PU
PP	Restricted to other programme participants (including the Commission Services)	

Contents

The Project is dedicated to the memory of Dirk-Achim Tellbach "DA" 1961-2014.

Executive Summary

The vast majority of the 500 million citizens of the European Union are most probably unaware of the fact that their everyday economic and social wellbeing depends on reliable, secure and efficient data centres and the services they provide.

Data centres are facilities that provide the connectivity hubs, power distribution, operational environment and physical security for all the equipment needed to support our digital age. Data Centres are infrastructures for digital services and in the same way as railway lines and stations are infrastructure for trains, they make no valuable contribution on their own, the value is only generated when they are utilised effectively in digital services delivery.

The data centre sector has and is experiencing rapid growth globally. This growth ranges from 5-25% CAGR (Compound Annual Growth Rate) depending on the region. Energy consumption, service availability, cost and security are the main topics driving investment, innovation and competition within the sector.

The PEDCA research estimates the data centre industry market is worth around €18.85 Billion per annum, the EU Data Centres consume approximately 11.8GW (or 103,368 GWh p.a.) which is around 3% of the total electricity generated across the EU. DC industry market of €18.85 Billion p.a.

Despite reductions over the last decade in the CO_2 emissions required to generate electricity, using the 2010 figure of 347g/kWh (including embedded carbon) from the CDC Climate Research Report (Part 4 2014) gives an overall figure of 38.6 million tonnes of CO_2 emitted in order to operate the EU's data centre industry.

If an illustration of the value of the PEDCA objectives were needed, then one should look at what the effects of raising awareness, education and training would be if it resulted in all the EU's data centres implementing best practices successfully; this scenario would result in energy savings in the region of 15,500GWh in one year, which is almost as much as the total annual amount of energy consumed by 1,000,000 EU household dwellings[i]

This would also save the EU approximately €1.1 billion in electricity costs alone per year[ii] and would also drop GHG emissions by 5.4 Mega Tonnes of CO_2. However many aspects of training, skills, education, awareness and governance are the barriers to this goal which PEDCA aims to begin to address.

Similar to the factories of the industrial revolution, data centres can be thought of as the factories of the digital revolution, although the key difference is that the output of the factory is controlled by all citizens at work and play, rather than the factory manager. However, energy consumption and carbon emissions are not immune to scrutiny in any section of society, and data centres are no exception. However data centres enable ICT which probably saves more energy than it consumes and there's no option to for economies that aspire to grow "not to do data". Therefore the aspects of service reliability, availability, information security and competiveness are just as important as

energy consumption and environmental impact issues because the very existence of data centres are equally integrated to these essential functions.

This project is strategic in nature and attempts to provide a platform to underpin the data centre's future critical role it plays in society and to ensure the EU maintains its leading position. It is becoming urgent for the established data centre businesses, organisations of all types and academic institutions to contribute to R&D, share and develop skills, define and adopt standards and best practice strategies. All of these activities will lead to increased trust of new technology such as cloud computing and encourage collaboration and interoperability. EU states with a less established data centre industry and footprint, but with a need for it to grow can benefit greatly from the knowledge transfer, insight, experience and raised profile.

Through a process of researching the baseline with consultation with stakeholders, this project identifies the key actions and sets out a strategic plan to address these needs.

However using a conservative forecast of 5% growth and assuming a modest success factor of 1% from year two and an approach calculated on low baselines, the impacts of the Joint Action Plan over 6 years hold a significant potential for delivering contributions of up to €1.24billion GDP, delivering Carbon savings of 5000 kilo tonnes and over 9000 jobs created or preserved, for an investment of less than €2.0m.

Aims and Objectives of PEDCA

The vision and concept of PEDCA was to build upon the existing collaboration within the data centre industry via the Data Centre Alliance (DCA). The proposal was to establish and make the DCA facility available to all European states focussing on encompassing both higher education, academic researchers, stakeholders and the wider data centre industry. Although the overall objectives of PEDCA we identified as priorities when the proposal was written in 2011, by the time of the project kick off in July 2013 the data centre sector has evolved and changed significantly in many areas and regions, resulting in both adding even greater urgency to many aspects but reducing it in some areas in which significant developments have taken place since 2011.

However the main aims of the project remained as:

- To form a Pan-European Data Centre Academy (PEDCA) that addresses the Digital Agenda objectives for the fast growing DC industry, to drive much needed innovation and creativity in the areas of new technology, skills enhancements and improved practices.
- To improve and enhance the position of Europe's data centre industry and drive the opportunity for EU businesses to establish and maintain competitive advantages over fast developing new markets overseas.
- To leverage the expertise and skills from Europe's three main data centre "hotspots" and transfer knowledge and experience to other EU states and international territories with a less established data centre footprint to encourage economic growth, access to digital services and new digital business opportunities.
- To identify key requirements for the development of improved data centres able to support the needs of new generation e-infrastructures, cloud computing and High Performance Computing (HPC).
- To focus R&D on promoting ideas, methods, new technologies, skills and education that address the growing problem of data centre energy consumption and resultant CO^2 emissions, this is essential for successful achievement of the goals communicated in Europe 2020.
- To setup an independent research facility that is networked and scalable to enable trusted visibility and clarity of the problem of DC energy consumption with analysis of the priorities to achieve the goals of EU digital agenda; technology Research and Development, industry Research and development, Training and Education, and Skills Development.
- To disseminate PEDCA's major results to a wide audience to maximise the exploitation of the work in order to encourage private investment by interfacing PEDCA closely with the business community across Europe.

The Project's deliverables provide the background to the project and the essential elements to take the results forward and exploit the work to realise its full impact potential. These include:

- Scope (D2.1)
- Regional Analysis (D1.1)
- Training & Research SWOT (D2.2)
- PEDCA Requirements (D2.3)
- Terms of Reference for Expansion (D3.2)
- The Joint Action Plan (D4.1)
- The Business Plan (D5.1)
- Dissemination Report and Roadmap (D6.1)
- Economic Impact Analysis (D7.1)

People of the PEDCA project

Almost a 1,000 people lent their expertise and gave up their time to contribute to the PEDCA project. The consortium below appreciates and thanks them for taking part.

Dirk-Achim Tellbach AKA "DA" ***DA was instrumental in organising the Frankfurt cluster of PEDCA. DA had been connected to data centres since 1999 and forged a successful career spanning Siemens, Abovenet and wusys. His vision and experience of the sector shaped the PEDCA project and its Joint Actions. Sadly and tragically, after a short illness DA passed away in 2014. DA maintained a keen interest in the project's progress right up to his final hours and the project consortium dedicate the project to him.***

Professor Hassan Abdalla, University of East London Professor Hassan Abdalla BSc MSc PhD CEng FIMechE PFHEA FRSA is currently the Dean of the School of Architecture, Computing and Engineering at UEL and a visiting professor at Cranfield University, UK. Hassan commenced his career in industry before joining academia. He has been in a senior management positions for over 15 years. Hassan has been leading major research projects nationally and internationally in partnership with world class universities and organizations across the globe. His research group has a track record of securing funds from EPSRC, DTI, industry and the Commission of the European Union. His school led several technology transfer projects in the East Midlands in collaboration with the regional development agency (EMDA) and SMEs. He was one of the European leading researchers for the IMS multinational collaborative projects jointly with Japan, USA and Europe. He is the author and co-author of over 100 papers published in international journals and conferences world-wide. He served on the research council EPSRC assessment panel, DTI/STI advisory Board, and a member of the peer review college. He is a member of other research boards and committees overseas**.** Hassan co-ordinated the PEDCA project, leading the project management team and supporting the participants in both in conjunction with the Commission and in the field during events.

Dr. Rabih Bashroush, University of East London Dr. Bashroush is a Senior Lecturer at the School of Architecture, Computing and Engineering (ACE) at University of East London where he also leads the Software Architecture Research Group (SOAR). He is currently a visiting Professor at Danfoss Electronics, Denmark. Before that, Dr. Bashroush was a Senior Engineer at the Institute of Electronics, Communications, and Information Technology (ECIT), the Queens University Belfast (QUB), UK for 5 years. He has over 15 years' experience in software development and held visiting scientist/researcher positions at a number of academic and industrial research groups including the Software Engineering Institute SEI, Carnegie Mellon University, Pittsburgh, USA; the Software Architecture Department, Philips Research Labs, Eindhoven, Netherlands; and the Department of Information and Software Engineering, George Mason University, Virginia, USA. Rabih provided a key role in leading the base-lining research and specifically contributing to the needs analysis phase and later developing JAP and sustainability models.

Maikel Bouricius, Green IT Amsterdam Region Maikel is a project manager for Green IT Amsterdam, a private/public consortium with datacenter members, ICT organisations, energy related firms and the universities in the Amsterdam Region. Together with our members we initiate projects or conduct research (R&D) within the scope of Greening of the IT industry and Greening by IT. Previously Maikel worked for a green IT hardware provider & consultancy, specialized in hardware, lifecycle management and consultancy services. Miakel contributed across the all the work packages and played a key role in engaging participants in Amsterdam to the project.

Simon Campbell-Whyte, Data Centre Alliance Simon has been involved in the colocation, hosting and telecommunications industry for 20 years. During this time Simon reviewed over 100 data centres working on behalf of many major corporations on critical projects. Having co-founded the industry association, the Data Centre Alliance in 2010, Simon now heads up the DCAs secretariat team, and is involved in a wide range of the DCAs activities on a daily basis. Simon represents the DCA on various committees including ISO/IEC and CENELEC Co-ordination Group for Green Data Centres. In addition to co-ordinating the overall direction of the PEDCA project Simon also provided a technical lead and represented PEDCA at many conferences, exhibitions, workshops and seminars

Douglas Chorpita, Goethe-Universitat Frankfurt Douglas works in the Department of Educational Technology at the Goethe University in Frankfurt am Main, Germany. He holds university degrees in Computer Science, Applied Mathematics, Linguistics, Education and German Literature. With 10+ years of teaching/ training/ lecturing/ presenting experience, he mixes a strong technical and natural science background (15+ years as senior software engineer, university level work in Physics and Chemistry) with extensive international skills (work in eight countries on four continents, travel in more than 60 countries, proficiency in five languages). Douglas' communication and multi-cultural skills contributed much to PEDCA especially in narrative and production lead editor roles.

Vasiliki Georgiadou, Green IT Amsterdam Region After completing her studies in electrical and computer science engineering, Vasiliki explored various interests spanning from artificial intelligence and robotics to mainframe security, working as a software engineer at IBM Nederland B.V. At 2010 she started as a researcher at Almende B.V. leading the development and integration of an energy aware plug-in for data centre management systems within the activities of a now completed EU FP7 project, FIT4Green. Currently, her work and research interests at Green IT Amsterdam focus on promoting and realizing energy sustainability initiatives within the IT industry, and especially related to the data centre sector exploring opportunities for better integration to their local ecosystem. To that end, she is also involved as both project manager and researcher within activities related to two EU FP7 projects, GEYSER and PEDCA. Her role within PEDCA was connected with research pertaining to economic impact assessment and analysis of a potentially successful implementation of the project's Joint Action Plan (JAP) and its recommendations.

Dr Dirk Harryvan, Cerios Green BV Dirk is a Sr. data centre consultant with Cerios Green. He has developed an independent metric and methodology for characterizing and improving the efficiency of data centre, the OpenDCME. The OpenDCME is made available through a creative commons license at: http://www.opendcme.org . The metric is part of the MJA-3 for ICT sector and by the NEN (The Dutch standards body) as the starting point of a standard metric for data center efficiency. This methodology has been used by Dirk in over 60 data centres across Germany and the Netherlands to quantitatively assess the energy efficiency of the facility infrastructure, the IT infrastructure its management and overlying processes. Dirk also maintains contact with the European Commission around the Code of Conduct (CoC) for data centres. Dirk's technical, practical and operational knowledge of data centres provided an in valuable contribution to all the PEDCA activities.

Peter Higgs, University of East London Peter is a degree qualified Engineer with over 30 years of Engineering and Management experience in SME's and FTSE100 companies in the Aerospace & Defence, Space and IT sectors. During the course of his extensive and varied career he has accumulated significant engineering experience of a wide range of systems, equipment's and disciplines, and has also held a number of senior technical and management positions at Director level. Peter founded his own consultancy company in 2009 to provide marketing and engineering consultancy and services in the Aerospace & Defence, Space, IT and local government sectors and he currently represents a number of UK and overseas companies in the UK. His activities also include the production of structured processes and documentation against specified ILS, Quality, and Information Security Management Standards, with specific expertise in the provision of consultancy and services to assist companies achieve certification to ISO 9001, ISO 27001, and ISO14001. He is also an approved contractor for major UK Certification Authorities, and is qualified as Lead Auditor for ISO 27001.The portfolio of clients includes Data Centres which provided PEDCA with not only a world class project manager, but also valuable knowledge of data centre standards, auditing and certification experience.

Steve Hone, Data Centre Alliance Steve Hone is the co-founder of Data Centre Alliance and sits on the management team as Operations Director. Having been in the IT Industry since the heady days of the .Com boom and has worked on many critical IT projects over the years. In 2007 he co-founded Colofinder.co.uk, an independent data centre search and selection consultancy providing specialist advice and guidance on the colocation market globally. Prior to getting into IT and Data Centres Steve's background was in Electrical and Mechanical Engineering having served an initial 6 year apprenticeship within the MOD before eventually moving into the world of commercial management. As Operations Director of a fast growing industry association Steve was able to develop many of the operational components for the JAP as well as contributing a great deal to the strategic and sustainability aspects.

Johannes Schaefer, Frankfurt Economic Development Corporation Johannes was educated at Uenster University, Germany and Juniata College, Huntingdon (PA), USA. He has held posts at U.S. Department of State (Foreign Service National, U.S. Embassy Bonn), Frankfurt Chamber of Commerce and Industry, numerical magic gmbh, Group Deutsche Börse (Eurex), Interxion Telekom GmbH, alpha bravo consulting (owner), Frankfurt Economic Development Corporation. Johannes specialises in communications/press, public relations and lobbying. Johannes was able to provide PEDCA with a great deal of contacts and contributions from the business and commerce community in Frankfurt.

Dr. Alexandru Iosup, Delft University of Technology Alexandru Iosup received his Ph.D. in Computer Science in 2009 from TU Delft, the Netherlands. He is currently an Assistant Professor with the Parallel and Distributed Systems Group at TU Delft. Between 2005 and 2013 he was a visiting researcher with U. Dortmund, Germany; U. Wisconsin-Madison, WI, USA; U. Innsbruck, Austria; U. California-Berkeley, CA, USA; and Technion, Israel. He received as personal grants a TU Delft Talent Award in 2008 and a Dutch NWO/STW Veni grant in 2011. He has authored over 75 refereed publications receiving several awards and distinctions, including best paper awards at IEEE CCGrid 2010, Euro-Par 2009, and IEEE P2P 2006He is the Netherlands Teacher of the Year 2015, and the TU Delft Lecturer of the Year 2013-2014. His research interests are in the area of distributed computing, where he focuses on the design, analysis, deployment, and measurement of large-scale systems; and in higher education. Alex was able to contribute a great deal to the strategic direction of the project, especially useful was Alex's in depth knowledge of cloud computing and his expertise in contributing to the training development activities.

Professor Dennis Kehoe, AIMES Grid Services Professor Dennis Kehoe, is the Chief Executive Officer of AIMES Grid Services Ltd based in Liverpool, where he was previously the Saxby Professor and Royal Academy of Engineering Research Professor at the University of Liverpool. He has specific interest in the creation of new high growth, high technology businesses emanating from cloud computing and is a non-executive director of a number of technology start-up and spin-out businesses created from the AIMES Centre at the University and was formerly a director of the North Liverpool Academy Trust and Chairman of the Board of Aerogistics Holdings Ltd. He is currently Chairman of Opticare Ltd and Chairman of Containerport Ltd and has led a number of major research and development projects funded by the UK Government and the EU. Dennis's role within the DCA includes assisting the DCA engage with funding bodies and research councils. He assists and advises DCA on research activities and helping to ensure funded projects are successfully delivered.

Albrecht Kraas, wusys GmbH Albrecht Kraas holds C-level positions for more than 20 years. These included, inter alia, founding and operation of ISPs (CNI (Arcor), AboveNet et al), international data-oriented carriers (AboveNet, Metromedia Fiber Networks - MFN, euNetworks) and datacenter business (World Switch / Global Switch, euNetworks). Albrecht Kraas also operated the Internet exchange point DE-CIX for many years and then was a long lasting member of its advisory board. Albrecht brings his wide-ranging expertise in the overall ICT context to many international advisory activities. Albrecht's industry knowledge and experience in setting up collaborative organisations was invaluable as leader of the "business plan" aspects of PEDCA.

Achim Shreven, wusys GmbH Achim worked at wusys GmbH, a major provider of data centre services in Frankfurt. Achim's main focus on the project was to establish the sustainability & business model for the Joint Action Plan. He studied Business Administration and has worked as a business manager and in accountancy. For the PEDCA project he coordinated the activities of Work Package 5 (Establishing a Business Plan). His main tasks in the Work Package were researching the value proposition and funding channels of the Joint Action Plan, coordinating the contributions of the consortium and to realize the deliverables. As being relatively new to the Data Center Sector he enjoyed the work and shares the vision for a dynamic and harmonic European collaboration platform.

Chris Orange, London & Partners 24 years' experience of promoting London and the UK for foreign direct investment, providing business location advice and support to potential and existing overseas investors, for Central Government (UK Trade & Investment), regional (Think London, London & Partners) and sub-regional (Gateway to London, the regeneration agency for east London). MA Phonetics (UCL, 1982) BA Hons Linguistics (UCL, 1981). Chris's expertise in trade and industry development provided a valuable steer to all PEDCA outputs.

Dr Jon Summers, University of Leeds Jon Summers is a senior lecturer in the School of Mechanical Engineering at Leeds and sits on the Accreditation Board of the Data Centre Alliance. During the last 20 years, he has worked on a number of government and industry funding projects which have required different levels of computational modelling. Since 1998, having built and managed compute clusters to support many research projects, Jon now chairs the High Performance Computing User Group at Leeds University and is no stranger to high performance computing having developed software that uses parallel computation. Applications of his modelling skills have led to publications in the areas of process engineering, tribology, through to bioengineering and as diverse as dinosaur extinction. In the last three to four years Jon's research has focussed on a range of air flow and thermal management and energy efficiency projects within the Data Centre, HVAC and industrial sectors. Jon's experience in leading the development of academic and scientific research within the data centre industry was invaluable to PEDCA. Jon's leadership on developing the JAP based on his real world experiences provides a strong foundation for the projects exploitation in other regions.

Esther van Bergen, Green IT Amsterdam Region Ms Esther van Bergen has a background in communication and design, and worked as a project manager and process consultant before she became a senior consultant at Capgemini, where she focused on IT strategy in relation to governance and process improvement, and IT strategy in relation to sustainability services. Esther van Bergen combines her knowledge and expertise on communication, sustainability and system integration in her work as project manager at Green IT Amsterdam, where she builds bridges across disciplines, boardrooms and operational units, amongst others in the PEDCA project. Esther provided essential key inputs to all of PEDCA's activities but especially in construction of the dissemination road map and impact analysis.

Frank Verhagen, Cerios Green BV Frank Verhagen MSc. is co-owner and managing director of Cerios Green B.V., based in The Netherlands. He is also CEO of the Twente Wireless and Communications Institute. Frank has over 20 years of experience, in public companies like Devote N.V., Delta Lloyd N.V. and HSO Business Systems B.V. With Cerios Green B.V. he has managed the funding, design and build of data centres, including a high profile energy efficient data centre that uses free cooling from passing bodies of river water. This has led to his appearance in several publications. Today, Frank is a board room consultant specialising in data centre restructuring and greening ICT in several private and public organizations. Frank's other role is to represent the Netherlands DCA member interests at DCA Board of Governors meetings. Franks leadership of the PEDCA regional analysis work provided the project with clear direction from an early stage, which set the direction and reference points throughout the project.

Otto Visser, TUDelft Otto is an researcher at the Delft University of Technology in the Netherlands. After working in wireless sensor networks for 7 years, Otto's focus has now changed to research in cloud computing, scalability and social demographics. Otto contributed to both the early research and the construction of the JAP actions. Otto also co-ordinated and convened the successful Alumni training sessions at TU Delft and contributed much to the course content.

Jaak Vlasveld, Green IT Amsterdam Region Jaak Vlasveld is an innovation expert, experienced in integrating new technologies in current and novel scenarios through setting up and running multi-stakeholder collaboration programmes. Jaak has a background in telematics and in philosophy. He consulted on various topics, including the ICT infrastructure for science in the Netherlands, on adoption of mobile e-Health services and on the role of

stakeholder involvement in services innovation. Currently, Jaak Vlasveld is director of Green IT Amsterdam Region, a research oriented consortium of stakeholders focusing on ICT and sustainability. Green IT Amsterdam develops and researches on non-profit basis Green IT solutions and possible policies. Green IT is a non-profit legal entity acting as an association for the IT-sector, the Energy sector, user organisations and knowledge institutes, with as objectives 1) the greening of IT, 2) greening by IT, and 3) creating new business opportunities for the "Green IT Economy", in order to contribute to carbon reduction goals. With over 40 public and private consortium participants, Green IT Amsterdam is a strong local network with ties to the ICT community, energy sector, and public authorities, with R&D&I activities throughout Europe. Jaak provided a key ambassadorial role in all regional visits, especially those outside of tri nation base of PEDCA. Jaak also provided key leadership in widening the participation and engaging with stakeholders.

Ineke Vlot, SMK Ineke works in the Dutch Ecolabelling Foundation SMK since 1996. As manager of the non-food department she is involved in criteria development and management of the accredited certification system Milieukeur, the Dutch national environmental label. The SMK activities cover Certification of many products a services which include, data centre climate control, as well as green electricity. Ineke is secretary of SMK's Board of Expert of Milieukeur non-food and is also active in criteria development and certification of the EU Ecolabel of the European Commission, following SMK being appointed as the Dutch EU Ecolabel Competent Body. In the PEDCA project she focused on Standards, Best Practices & Certifications and, being familiar with stakeholder involvement processes, facilitated the Amsterdam Focus Panel discussions. From 1989 to 1996 Ineke worked as a project manager at the Centre for Energy Conservation and Environmental Technology, a non-profit consultancy bureau. She studied Biology and Environmental Sciences University at Leiden University.

Michael Walker, Aimes Grid Services Michael specialises in strategic, tactical, project or change management. Whether working in innovative technologies, face to face with clients and partners or developing internal teams, the seeking and implementing of collaborative "win-win" solutions has always been a successful methodology for Michael. As Project Director at Aimes Grid Services a cloud and data centre service provider, he is responsible for the successful completion of internal projects such as the creation of AIMES new modular 1000 m2 "State of the Art" data centre as well as devising, bidding and delivering innovative technology based projects in energy efficiency, development platforms for business process improvement and, currently, the Internet of Things. Michael provided the analytical know how and leadership to the economic impact assessment work of PEDCA. In addition Michael was able to contribute much to the strategic direction of the JAP, especially in the areas where his experience of managing a successful professional association could be applied.

Main Project Results

Establishing the Joint Actions.

The project began with consulting with stakeholders on the scope and establishing an initial participant network of interested stakeholders, which was to grow and expand throughout the project.

The Project then detailed research teams to establish a baseline regional analysis, existing training and research and technology road-mapping.

Following this initial base-lining SWOT analyses and GAP Analyses were developed through surveys, workshops, interviews and regional visits which led to establishing a set of requirements to be addressed by PEDCA.

The requirements were then tested and developed further via consultation activities, for example at the “focus panel” event in London where professional “brainstorming” techniques were utilised to validate the requirements and develop ideas for solutions. This process was repeated in Warsaw and Amsterdam, whilst concurrently publically aired across a wide range of events across the EU conference circuit.

The project also developed some piloting of activities in order to gain real-world experiences of some of the more complex activities, these included training sessions in Frankfurt, London and Amsterdam, as well as conducting a “dry run” of the certification model for a data centre.

Six Joint actions were identified, which underwent further scrutiny from stakeholders and during the last two Focus Panels in Amsterdam and Frankfurt.

Underpinning the Joint Action Plan for Exploitation

A Sustainability study for JAP and specification for its implementation, including business continuity, constitutional set up and business plan was established for all six joint actions. The financial plan produced was built upon a model that can be reconfigured used and reused again as changing needs and conditions dictate.

PEDCA achieved high visibility from the outset with a presence at many industry and stakeholder events over the 18 months. This enabled the project team to establish and experiment with different approaches to dissemination. The final phase of the project includes a detailed roadmap for dissemination based on these results and experiences.

The final element of measuring impact was based upon establishing real world scenarios aligned to the six joint actions and exploiting the earlier baseline research conducted in the regional analysis, surveys and technology road mapping.

Project methodology

Identifying the requirements

The Joint Action Plan is derived from the PEDCA's four pillars of requirements. The four pillars were developed and refined via stakeholder feedback from the basic areas envisioned at the project's beginning.

All requirements identified and were carefully categorised according to their priority, difficultly, cost and time to delivery. This process allowed the team to maintain a clear focus and ensure integrity of the requirements.

Strategy	Business Innovation	Skills, Training and Education	Awareness
• Setting the Research Agenda • Coordination • Representation • Basic R&D / Idea Generation • Proof-of-Concept • Independent Review • Trusted Information	• Early Stage Technology Development (ESTD) • Development of Standards & Policies • Commercialization Support • IPR Framework	• Gap and Regional Analysis • Skills Identification and Mapping (e.g. SFIA) • Application of Standards & Policies (to training) • Programme Development (defining learning outcomes, etc.) • Programme Accreditation	• Awareness Programmes (e.g. policy makers and stakeholders, awareness events) • Voice for the industry • Quality Assurance and Processes • Cultural Change

Developing the Strategy

The main focus of this pillar identified problems related to R&D and the general low levels of cohesion of the industry. Many participants felt that there was little consultation to and from research funding bodies and that funding was not targeted effectively. There are many reasons for this lack of influence in **setting the research agenda**; the main ones being the relatively new emerging data centre "industry" which is not easy to define, fragmented groups and associations that representing various interests and aspects of the data centre "industry" and low levels of co-ordination between these groups. **Representation** of the sector is improving through associations such as the DCA but more needs to be done to focus on the needs of each of the elements which are essential to design, construction and operation of a successful data centre. **Coordination** is also a problem for data centre research; the PEDCA project research highlighted a large number of projects that had been funded, however the results of the majority had not reached sections of the data centre "industry" nor the conference circuit. Scientific and academic research facilities have historically not been widely involved in the data centre sector. However due to the University of Leeds' collaboration and assistance in forming the DCA in 2010/11 and its involvement with the PEDCA project, this is now begun to change. Today the university's School of Mechanical Engineering

is receiving project funding from twelve data centre industry organisations actively engaged in developing various **independent review** and **proof of concept** projects. Notably this has been achieved via word of mouth, reputation and recommendation. Nearly every private or public sector organisation are owners of data centre assets of some shape or form, and cannot be expected to be experts in the complex field of data centre design and management. Although commercial advice is readily available, the PEDCA project research identified many areas where non-commercial **trusted information** would assist owners of data centres to navigate the market more successfully or implement best practices such as the EU code of conduct for data centre energy efficiency.

Developing actions to promote Business Innovation

The data centre sector has evolved considerably within the last decade. Most notable amongst the changes have been wide ranging revisions of the environmental conditions recommended by the manufacturers of the ICT equipment which data centres are designed to contain and manage. In addition, increases in power demand per square metre, and increased focus on energy consumption, security and reliability have all contributed to a strong demand for innovative technologies and methods to deliver competitive advantage. The fast growing data centre sector has attracted much attention from private investors and equity groups, however, due to the complex technical nature of many of these innovations combined with a general lack of understanding of the data centre sector, many business opportunities have not been commercialised or received enough investment to succeed. Participants felt that commercialisation of these innovations could be improved through working with investors and innovators to support them through the **proof of concept** and **Early Stage Technical Development (ESTD)** stages, specifically helping with market acceptance and business development processes. Universities and Regional Development Agencies offer many services for **commercialisation support** such as business incubation facilities, advice for **IPR frameworks**, and export or expansion to new markets, however evidence suggests many of these services have been under exploited by the data centre sector.

The development of **standards and policies** can help a complex, emerging technology ecosystem such as a data centre and promote the successful commercialisation of new products. Standards can make a difference to the success of innovative businesses by creating a common framework for innovation. Standards set the framework by defining common vocabularies, establishing the essential characteristics of a product or service, and by identifying the best practice within the ecosystems that will ensure successful outcomes. Once, in place, the pace of innovation will be accelerated and the likelihood of success enhanced. However standards within the data centre sector are still emerging, generally immature, and in some topics, not reaching a wide enough audience of experts or contributors.

Improving Skills, Training and Education

The landscape of the data centre sector is changing, it is expanding from the densely populated city centres and financial districts and into new areas within countries, and it is expanding from established countries into new regions, which has an impact on the workforce requirements. The PEDCA regional analysis research identified wide difference in training in EU regions, for example participants at the Warsaw focus panel voiced different priorities and attitudes to data centre energy efficiency than the more established data centre communities in London, Frankfurt and Amsterdam. The PEDCA project conducted extensive consultation with employers, training providers

and workers throughout the project. Many cited a skills gap, lack of recognition of skills and the need for improved professional development in many areas. It is clear this is moving fast and that a regular **regional and gap analyses** are needed in order to react to these changing circumstances. A key requirement identified during the research was the need for **skills identification and mapping** to clarify the requirements against the different sectors of the data centre industry such as service providers and the various supply chains involved in design, construction and operation. Training and Education are essential for the successful **application of standards and policies**. Our research showed that there are problems with this linkage, for example the EU Code of Conduct for Data Centre Energy Efficiency which has seen limited take up of related training. In addition, with a large number of standards and metrics on the horizon, take up of the appropriate training will become even more important issue if these standards are to have the desired effect. The commercial training sector has moved forward considerably since 2011 with high quality training and professional development matrices on offer. However take up of training in many sectors still remains low. This alongside the barriers of availability and cost of training at pre-employment levels remains a key issue to address in order to maintain a supply of employable human resources to satisfy demand. The PEDCA project research developed an entry level course which was successfully piloted in three EU regions which can be deployed by industry and academic institutions to address this need. Many workers in data centre organisations cited the need for **programme development and accreditation** to establish policies that could be deployed to address both the take up of training, suitability of skills and encourage new entrants to the industry.

Driving Awareness

Implementing the JAP successfully will require **driving awareness programmes** to gain involvement and assistance from all stakeholders and policy makers. An essential element of this is to build consensus through dialogue and common interest through a **voice for the industry.** The PEDCA research evidenced that this was missing due to a combination of emerging sector, political and geographic reasons. Working with the EU Commission and other agencies during the project highlighted the need for the industry to develop solutions and policies aligned with overall governmental goals. The PEDCA project identified that industry led self-regulation through its own **quality assurance and processes** is the best precursor to policy and is also required to develop the improvements the industry requires. Barriers to adoption and take up of new professionalisation initiatives will not be easy, and careful consideration of the **cultural change** and impact is needed.

The Six Joint Actions

The endorsement and validation of the joint actions have been based entirely on stakeholder knowledge and canvassed opinion. They are shown in the figure below set horizontally against the requirements identified and described earlier in this section. However, all six Joint actions are, to an extent, dependencies of each other and must also work concurrently together. A good deal of the plan has been piloted or at least "road tested" during the project, and therefore does not exist only in theory or "on paper". This was particularly important in developing the sustainability and financial plan of WP5 which needed to be robustly supported with real world costs and market experience. A notable exception is the Skills Matrices within Joint Action 4 (JA4) which is a task equivalent to the timescales and cost of the entire PEDCA project on its own, it is also unlikely to be either appropriately or successfully with private funds alone.

The joint actions are not numbered in any fixed order of delivery, and therefore appreciation of the whole strategy rather than the individual actions is needed in order to fully understand the overall value.

JA1 Technology Leadership Platform (TLP)

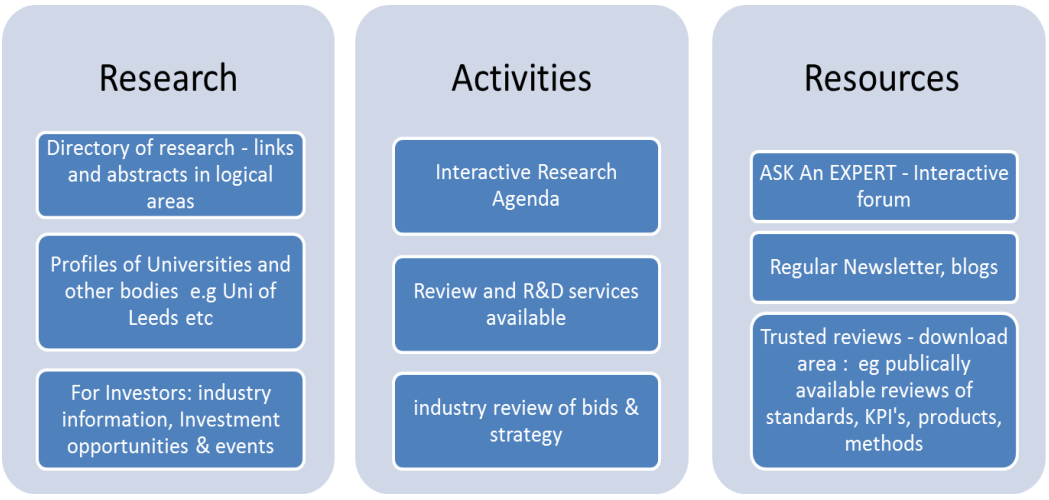
Mission of the Technology Leadership Platform:

In 2011, the DCA took an early lead in forging a working relationship with Academia and the research community. The DCA itself was formed largely as a result of a number of discussion sessions at The University of Leeds. This led to reaching out to other academic institutions and regional government in other high data centre footprint cities and ultimately the establishment of the PEDCA proposal to take the DCA forward and to identify its role, clarify its agenda and determine what and how the data centre can be improved. During the course of this period and during the project the University of Leeds in particular, has become very active in working on projects with the data centre industry. Specifically, The School of Mechanical Engineering at Leeds has successfully applied its expertise in thermal and heat transfer sciences. However, many other areas of the data centre design, construction and operation need similar research and the development of "centres of excellence". The DCA plans to act as the platform to bring all this together in one place providing a service to industry by acting as a hub or portal for needs identification, research initialisation and exploitation of innovation and dissemination of information that helps users improve data centres.

Clearly to maximise the impact and exploitation potential of publically funded research it needs to be shared prominently with the industry sectors participants. Moreover, research also cannot be targeted correctly without consultation with the experts in the field, nor can the agenda be set without detailed knowledge of what topics have been already funded or addressed. These are the main issues that JA1 aims to address. Together with these themes, the action will also encourage use and development of research facilities and academic support, commercialisation support and a connection point for investors and lastly, a portal to develop trusted information and end user support for fast evolving technology. The action will disseminate and provide access to data centre research, development and innovation activities by the DC sector for the industry, which would enable engagement of stakeholders in accessing research results and activities, products and services and in turn, empower them to provide feedback and influence on the research agendas for the DC sector.

Description:

The TLP will be an online reflection of both the research facilities and activities in the field. It is envisaged to provide a single point of access for three main sections of information:



The platform will extend the existing DCA website and made available to the existing network of users; it will include:

- A directory of data centre research projects
- Profiles of universities and other bodies and research services
- An investor area offering information and resources about the industry
- An area to interactively develop engagement on research initiatives, call notifications, responses, support and critique for proposals.
- Download areas for trusted information and reviews

- A forum area for non-experts and owners of data centre assets
- Information on standards, best practices, KPI's and guidelines
- Blog and newsletter area

The Joint Action will develop community led collaboration across scientific investigation, academic research and the DC sector to promote investment in the R&D needed to make better data centres.

The TLP will hold regular workshops to support idea generation and foster R&D activities as identified in pillar 2 of the requirements. These could take the form of interactive workshops, sandpit activities or regular roundtable events with publishable outcomes.

The events can also look at the existing or ongoing research output to establish possible routes to exploitation. There would also be an opportunity to link commercialisation and the launching of new ideas to the marketplace as was identified in pillar 2 of the requirements.

The TLP would provide access to designated experts within the membership of PEDCA to solicit review services, which is in line with aspects of the requirements within pillar 1

Once the TLP becomes established, the case studies, activities or community standing should appear in printed magazine. The PEDCA would also aspire to developing a sponsored peer-reviewed open access journal for the dissemination of the novel, non-commercial research and development outputs.

Benefits of JA1

It will:

- Focus research agendas to address the sector's needs,
- Reduce the risk of research duplication and scope cross-over
- Boost DC sector confidence in public funded R&D
- Improve the impact, exploitation and use of research outputs,
- Improve the awareness and take up of "best practice", new methods and standards through trusted information and advice, helping them to improve their data centres
- Improve connectivity to the academic research and scientific investigation communities (including those outside of the DC sector).
- Encourage investment & commercialisation of innovations
- Link technology organisations that do want to work with universities and research institutions.

JA2 Representation

The Mission of Representation

The PEDCA research has confirmed that the data centre sector is represented by fragmented groups and/or associations that partially represent the sector's needs. A key dependency of all Joint Actions is to build an industry association membership and network to represent the data centre effectively. The DCA was formed to address this need in 2011, and has been successful in leading the market and delivering many key initiatives and services. The research carried out in the PEDCA project shows that the DCA is now best placed to fulfil this role, however resource limitations, cultural and geo-political barriers need to be overcome. The Joint Action (JA2) sets out the plan to develop the industry association further. This entails meeting local, national, regional and international needs whilst ensuring neutrality, independence and democracy. Models for constitutional set up, membership, collaboration and affiliation with stakeholder groups have be developed and or field tested. A funding and sustainability plan has been developed through PEDCA and validated with the help of the project's advisory board. The Joint Action aims to coordinate the sector, increase participation and involve stakeholder groups and other associations to build a stronger more effective collective and collaboration platform for the DC sector through the EU wide realisation of the Joint Actions.

Description:

A successful industry association takes time to establish itself and it must follow rules of engagement via a democratic constitution with its members that promote trust, independence and a concise collective message. Critical to the success of representing the industry or market sector, in this case the data centre "industry", is the ability to listen to views, engage in dialogue, consult widely and establish common aims and objectives. Advisory boards, technical committees, expert, focus and steering groups must be established in order to establish the correct agenda and ensure it is consistently reviewed and updated. Rules need to be established to promote harmonious and respectful collaboration and well as a democratic and open constitution.

The JA on representation for the PEDCA will:

- Build a non-commercial, non-profit distribution, association ensuring neutrality and independence
- Create models for affiliation and collaboration to integrate and align with related associations and stakeholder groups,
- Build on the current DCA model throughout the EU regional clusters to gain subscription revenue to fund the JAP
- Make adjustments to the DCA model in order that it can be aligned with international best practice for not-for-profit organisations of this type
- Engage end user following and general participation
- Build liaison and work programmes with stakeholder groups (e.g. cloud, ICT, Smart cities, cyber-security, etc.)

In order to encourage more member involvement in both DCA decision making and steering groups and to ensure the inclusion of each of the JAP's topics, each year the DCA steering group/topic leader will be asked to consider if there is a contribution to be made to:

- Standards/Guidelines - For example, is there a best practice missing or a gap that needs addressing or a standard that needs improving or updating?
- Research & Development- For example, is there unanswered research question, can R&D funding improve anything and can research councils be better informed?
- Training and skills - For example, does existing training and education meet the needs, is there a skill shortage in any particular area or new skill in short supply?
- Awareness activities- For example, does any aspect of the topic need wider dissemination to any particular stakeholder group or audience?

This will be aligned to an annual event dedicated to DCA members (JA3), to review each group's output and the group's activities and goals. This will be at a date to be decided during the summer of 2015.

The Benefits of JA2

- The development of a trusted non-profit organisation – aligned with international best practice
- The affiliation and collaboration with national representative groups and associations
- Increased end user following
- Increased general participation
- Widened participation in JAP
- Coordination of voice for the sector
- Improved outputs from governmental relationships
- Financial sustainability of JAP
- Improved dialogue with stakeholder groups

Better trading relations and opportunities for trade (both inside and outside EU)

JA3 Awareness

Misson

The PEDCA project research highlighted that the data centre sector is misunderstood by many groups. The Data Centre "industry" is not well defined between those who are active within it and those who own data centre assets. Its complex technical nature is also misrepresented or misinterpreted which means it is relatively easy for policy makers and other stakeholders to become confused about the role data centres and their staff play in society and how they can be encouraged or measured. In addition, graduates of schools, colleges and universities are not widely informed of the career opportunities or the skills they should possess to gain employment within this fast growing sector. This joint action will raise awareness of the importance of the DC sector to local and EU economies so that the sector will improve its standing against other high energy demand sectors – with the aim of improving its reputation in the eyes of the government, stakeholders and the public. It will also Introduce employment prospects and reduce the current sector challenges resulting from inappropriately skilled employees. Finally it will improve the awareness of topics relating to the sector such as energy efficiency, service availability and security.

Description

The Joint Action involves expanding and developing activities that increase the data centre sector awareness of users, stakeholders and governmental institutions. This includes a better understanding the DC sector's strengths or weaknesses within the EU and if applicable the sector of member state(s). In particular this JA on awareness will

- Develop interfaces, workshops and dissemination material to highlight issues and assist with appropriate policy development
- Promote the career opportunities within the DC sector
- Promote the value of DC training and skills and overcome certain cultural barriers toward training staff.
- Highlight the value of adopting best practices and adoption of standards
- Promote the critical nature of the various types of data centres
- Describe the required interfaces with tiers of government and why collaboration and understanding is so important to the sector. For example what makes smart cities or smart grids ***smart***, how to tackle climate change in smart way, whilst maintaining the appropriate reliability and security of data
- Build upon the work by the DCA/PEDCA with national press and focussed "boot camps" (related to awareness of job opportunities). With the help of the PEDCA members, it will facilitate the appropriate education of stakeholder groups e.g. energy managers, public sector users and owners of data centre assets in all organisations.
- Utilise and promote trusted information and research gained through the Joint Actions as a whole.

Benefits

This JA has had some development throughout the first 18 months of PEDCA via its dissemination activities (described in D3.2 and D6.2), but further development of this PEDCA JA should lead to the following benefits:

- Improved policy measures

- Improved understanding of the data centre's role in economic and social groups
- Upskilling of the workforce
- Helping to address cultural barriers to training
- Aligning of the sectors needs with alumni
- Improved uptake of standards and best practices.
- Constructive dialogue between the sector and policy makes,
- More structured employment opportunities and encourage the next generation to engage more readily with the industry,
- A more valued DC sector (via both JA02 and JA03), and
- Improve the sectors use and management of energy to contribute to EU GHG targets – in terms of the word Green, developing the "greening of ICT" and the "greening by ICT" concepts.

JA4 Skills Matrices

Mission

The lifecycle of a data centre requires skills derived from a wide range of scientific, engineering, technical and management disciplines. Developing a "job description" for the data centre sector, similar to, for example Skills for the Information Age (SFIA) is the overall mission for this Joint Action. The PEDCA research showed that, In order to achieve wide acceptance and ensure its useful exploitation, these skills matrices need to be freely accessible within the public domain. However, tackling this task for all types of data centres would require a significant amount of time and resources, due to the myriad of services, components and products and the resulting sheer number of different roles involved in the design, construction, operation and decommissioning of data centres. However, in the absence of skills frameworks that can be referenced, it is not possible develop a complete picture of professional development roadmaps, identify linkages to education or define "best practices of staff development and human resources policies. This joint action sets out a plan to develop skills matrices based on priorities and ease of delivery. It is also worth mentioning that this is a key research requirement identified by the PEDCA project, a dependency of JA5 and an urgent candidate topic for a future EU funding call.

Description

The development of the necessary skills matrices would require a concept design of the matrix framework to establish a stakeholder (PEDCA member) mandate and integration (using the SFIA method) to a framework through the validation by representative group(s) of stakeholders and beneficiaries. The framework would identify all skills, levels, categories, knowledge, experience, qualifications and industry roles for initial development of a functional matrix version based on the SFIA method. In order to create a sense of ownership amongst beneficiaries a programme of regular Reviews, awareness PR, gathering of endorsements and the provision of a user support contact point. The aim would be to tackle specific clearly industry sectors clearly defined by scope. This would allow the integration of any existing work and also ensure risks are minimised and manageable. The project recommends the commercial sector as the first matrix based on a number of criteria relating to priority, size of the task and potential impact.

Benefits

Stakeholder feedback suggests that having open and vendor neutral criterial for hiring of the workforce would be beneficial. So if this could be funded directly via appropriate fund holders then this JA would deliver:

a) A framework for developing open and non-commercial skills matrices,

b) Matrices of skills for the various job roles within the sector,

c) A strategy for maintaining such skills matrices in a fast moving technology and cost environment, and

d) "Job descriptions" for the DC sector.

Enabling the sector to improve the matching of the skills of the workforce with the needs of the industry will also impact other areas where an industry-wide joint approach is beneficial. Impacted areas are research and development, centres of excellence, but additionally an improved ignment with education and training development (education and training matrix).

JA5 Training Curriculum

Mission

Our research showed that many people working within the data centre sector have developed expertise in their field but are not recognised specifically recognised for their data centre specific skill set. Training organisations have moved to address this gap, particularly within design and technical roles, these need both encouragement and bolstering to promote better uptake, interoperability and recognition. However contribution to the development of training curricula is required by industry employees and employers via a professional association to ensure training practices are encouraged or in some cases made mandatory requirements for entry. This joint action sets out the contribution to which aims to improve the performance of Data Centres with respect to service availability, security, energy efficiency and operational professionalism through training and education. This involves developing the Pan-European DCA to become a professional institution that can facilitate the training joint action.

Description

Training programmes that are currently available, include

- CNET
- DCProfessional,
- Distance MSc via the EISTER project
- EPI
- 5Hart

The joint action involves the DCA ultilising its membership network gained through JA2 to develop the skills matrices in JA4. However, in defining the skills required, the JA can identify the best methods to acquire them through working with training organisations and educational institutes. The professional association arm of the Pan – European DCA membership will provide the dual role of defining standards of training (learning outcomes etc.) and safeguarding the public interest in enforcing these standards where appropriate. The Professional Association will also provide a role for employees of data centres in ensuring their particular skill set is both recognised and transferrable.

By aligning this joint action with the activities of the JAP training can be updated where nesscary to reflect fast moving technological development and standards.

Stakeholder input on the identified training requirement covered a diverse range; from the need for an MSC curriculum through CPD for the M&E/IT Engineer to top-up training for technicians.

Benefits

The proposition of JA5 is dependent on the output of JA4, however combined the JA will deliver

- An Increased pool of skilled and trained professionals
- The raising of the standard of training and professional development will improve the European data centre industry profile and reputation for increased competitiveness

- More trained people actively contributing to standards, best practices and operational professionalism.
- A reduction in recruitment costs and improved staff retention
- Better visibility of the professional development career path for new entrants and employees
- An Improvement of the European knowledge economy and technical know-how
- Improved confidence of end users of data centres (contributed by JA6)

JA6 Standards, Best Practices & Certifications

Mission

The PEDCA Project found low engagement and awareness of standards development activities. A small core group is active but the wide ranging subject matter needs more organisations to commit resources to standards development activities. The PEDCA project also found problems with recognised best practices such as the EU code of Conduct, where issues including for example; awareness, management and engagement were cited as causing concern. However, the main problems stemmed from the lack of governance in the field of data centre credentials relating to client derived purchasing and selection criteria, which at best is due to ignorance of how these credentials are attained or at worst misrepresentation of a particular standard or metric to gain a competitive advantage.

The Objective of this Joint Action is threefold, connecting experts to standards development activities, assisting with the uptake of best practices, such as the EU Code of Conduct, creation of a Data Centre Certification Scheme, providing a harmonised set of standards and best practices, to independently verify and improve the performance of Data Centres. This will delineate:

- resilience class
- site physical security
- energy efficiency
- operational professionalism

The Certifications scheme was developed to respond to fragmented, sometimes conflicting data centre benchmarks where little or no governance is applied. In addition currently available schemes do not cover the “whole” data centre, or address the deceptive use of benchmark metrics. Data centre investors, customers and clients often evidenced confusion when faced with this situation.

Description

The JA’s threefold activities are:

1. Integrate and connect stakeholders to standards and best practice development of the JAP.
2. Develop actions to improve take up of the EU Code of Conduct by providing case studies, tools, resources and advice and guidance via JA1. The JA will develop actions to assist with administration and support tasks to help improve take up rates.
3. Develop a Certification Scheme utilising the DCA pilot model already initiated by the DCA. launched in June 2014, the scheme has undertaken a proof of concept external audit of a data centre and has a well-defined roadmap that mapped against best practices for certification schemes (ISO27021:2005) This JA is to develop the service to meet the needs of a Pan-European scheme set up with the appropriate quality assurance governance and management processes.

The “golden rules” around the development of the scheme demanded it to be Independent, transparent, non-commercial, affordable for wide adoption and to reflect “real” standards both existing and (where practical) those under development. It should also be easily understood by non-experts, customers of data centres and trusted. This demanded the careful examination of

existing certification schemes such as those delivered by SMK and best practice for schemes of this nature, ISO17012:2005.

Benefits

- improved value proposition to end users of data centres creating more customer trust and lowering end user risk
- lower risk for builders and investors
- improvement in Europe's data centre industry profile and reputation
- improvement in the EU sector's competitiveness
- reduced barriers to Cloud adoption
- encourages take up of policies and standards
- financial incentives could be applied to certified data centres (e.g. insurance discounts)
- easier to demonstrate compliance to other related Standards
- helps contribute towards a 'sustainable cloud'
- easier to demonstrate compliance to energy and environmental standards

Impact and Exploitation of Results

During the 18 months of the project the consortium has managed to establish a network of professionals both within NL, DE and UK and also in many other EU states who engaged in the subject matter of the project for the very first time. However the focus of the research wasn't just to develop an ambitious JAP on paper and then leave it for someone else to tackle the implementation; therefore in many areas, the project utilised real-world testing and developed existing scenarios and experiences to underpin the research activities of the JAP.

The project exceeded all success criteria KPIs as described in the Description of Works (DOW), including number of collaborating EU countries, private sector organisations, universities and Regional Development Agencies who participated on the project.

The motivations to exploit the JAP are considerable, even when taking the extremely cautious approach to economic impact assessment, the numbers represent a large opportunity: The PEDCA research estimates the data centre industry market is worth around €18.85 Billion per annum, the EU Data Centres consume approximately 11.8GW (or 103,368 GWh p.a.) which is around 3% of the total electricity generated across the EU. Despite reductions over the last decade in the CO_2 emissions required to generate electricity, using the 2010 figure of 347g/kWh (including embedded carbon) from the CDC Climate Research Report (Part 4 2014) gives an overall figure of 38.6 Million tonnes of CO_2 emitted in order to operate the EU's data centre industry.

However using a conservative forecast of 5% growth and assuming a modest level success factor of 1% and an approach calculated on low baselines impacts of the Joint Action Plan over 6 years hold a significant potential for delivering growth contributions of up to €1.24billion GDP, delivering Carbon savings of 5 million tonnes and over 9000 jobs created or preserved, for an investment of less than €2.0m. In summary impact baselines of PEDCA are as follows:

- No impact counted in year 1 (2015), despite progress being underway
- A 1% overall cumulative effect of impact year on year
- Cumulative Impact calculated over 1-6 years
- Illustrations provided for a flat line of growth and an assumed 5% growth (CAGR)

This section looks at how the existing activities have been developed and the new directions taken, together with the planned exploitation and expected impact of the research results

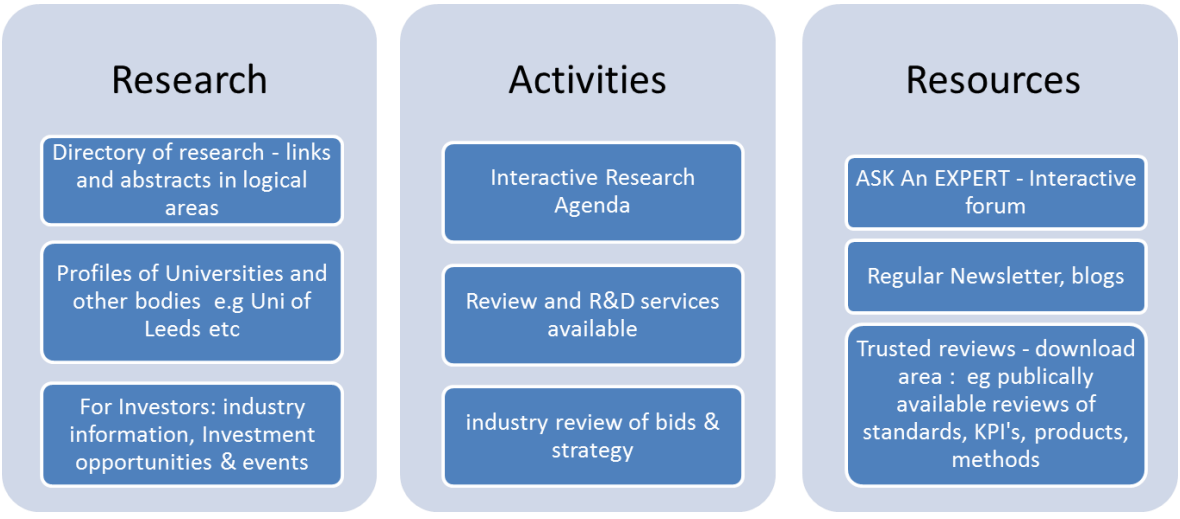
Exploiting PEDCA and taking it forwards

Technology Leadership Platform (JA1)

Many dependencies of this joint action are already established through the work of PEDCA, these include:

- A fully operational “members platform” portal, with trained staff able to develop pages, content, blogs, forums and related social media integration.
- An initial network of Universities and academic research institutions that are willing to participate.
- A council of technical steering groups with industry and stakeholder participants are set up within the DCA. These are undergoing the process of being re-organised to supply regular (annual) contributions to the research and development agenda, standards and best practices and other JA’s such as skills, training and awareness.
- Contributory interfaces and membership of Standards Committees and Best Practice groups both at International and European level are established.
- Lists of existing and past data centre related publically funded R&D are established. Links with some of the coordinators are established.
- Investor and private funding organisations have shown interest in the DCA’s activities, for example, Lombard plc joined as members of DCA during 2013.
- Relations with some funding bodies such as Innovate UK have been initialised through PEDCA
- A network of, and access to further audiences of “end users” are established via media partnerships, “end users” are organisations without active commercial interests in the data centre sector who own or manage data centre assets, i.e. all other private and public sector organisations.

The exploitation of JA1 will begin with finalising the design of the TLP and construction of the pages, then integrating the services outlined below.



The next phase will be engaging in raising awareness of the TLP. Being technical in nature but also requiring strategic thinking the TLP will develop awareness marketing to attract participation to Data Centre technical experts and consultants, Research Councils and funding bodies, the scientific community outside of data centre sector and private funding and investor groups.

The final ongoing phase will require regular updating and communication. It is envisaged to use the annual DCA symposium to regularly update the community of the TLP's activities.

Impact of JA1

It is envisaged that the Impact of JA1 will contribute 40% of the total impact of the PEDCA project mainly through promoting the adoption and commercialisation of high performance energy technology, standards and methodologies, as well as coordinating research and development activities.

Representation (JA2)

A good start has been made in exploiting PEDCA to expand and enhance the DCA initiative launched in 2011. Membership and the participant network has increased exponentially, however the work of PEDCA must now be fully exploited in order to fully realise the investment in time and resources by both the EU and the project beneficiaries. Establishing members that are willing to contribute funding for the JAP via membership requires a robust value proposition. Much of this is in place already, which together with the natural enhancements that the JAP brings, will make this more compelling. However, together with the risks of fast expansion that any organisation faces, cultural, geographical, language and political barriers remain to be overcome in order to truly represent Europe's data centre sector as a whole or realising the wider ambition of representing the sector globally. As a direct result of the PEDCA project initialisation of member groups in Netherlands, Germany, Poland, Romania, Finland, Sweden, The Middle East and USA has begun.

The DCA is able to provide members with a robust value proposition based on two aspects; firstly Public Relations and awareness of the member's organisations and individuals; and secondly, activities that improve the data centre sectors's business climate as a whole. It is expected that each stage of implementation of the JAP will improve this value proposition further and enable further member acquisition to fund the next phase thus organically growing and sustaining the organisation.

The main initial exploitation of JA2 includes:

- Initialising member acquisition campaigns to follow up all contacts and inviting them to become members of DCA and growing the community.
- Working with other groups to explore National chapters and affiliations in other countries, e.g. ECO in Germany and DAA in The Netherlands.
- Implementing national language versions of the DCA website, starting with the Netherlands
- Enhancing the constitution of the DCA as defined by the PEDCA results (D5.1)
- Developing the member "voice" as defined by the PEDCA results (D4.1) e.g. group infrastructure and data bases.
- Integrating "end users" into the community as defined by the PEDCA results (D4.1)

Impact of JA2

The project did not identify any direct or measurable economic impact to GDP, Energy or GHG that could be derived from this joint action on its own. However the resulting growth of the Pan European DCA is a key dependency of the overall JAP, and the action contributes to industry cohesion which can be measured by the number of stakeholders joining and benefiting from the industry body.

Awareness (JA3)

This joint action is closely related to JA2 in that it involves influencing various audiences in order to reach beneficial outcomes. This may include but is not limited to the activities of the industry itself, educational aspects, career opportunities, energy efficiency strategies, improvement initiatives. This is required in order to support and sustain the Pan-European implementation of the Joint Action Plan. During the research many organisations expressed the importance of these activities by the DCA, which will be exploited further in the following areas:

Mainstream Media

The DCA initialised publications in the "New Statesman" in UK and "Fenceworks" Netherlands, these are useful for raising the profile of the industry and its issues. The UK publication for example, proved a key instrument in influencing government policy by highlighting for example where misaligned financial incentives could damage the industry's growth. Further activities raising awareness in the mainstream media or other related sectors will be undertaken under JA2.

Data Centre Alliance Journal

The DCA operates a Journal hosted within the industry publication "Data Centre Solutions" which has over 100,000 subscribers across Europe. In addition to providing regular DCA updates, the DCA solicits articles of a thought leadership and educational content from its membership for inclusion in the publication. This has proved extremely popular and is gaining in prominence, the DCA has recently (December 2014) agreed to provide a similar activity within "Inside Networks Middle East" as part of the plan to reach further international participants.

Online social media

The DCA utilises Linkedin and Twitter on a daily basis. The PEDCA project enabled the hiring of a Membership Services trainee who has the daily task of managing this on behalf of DCA members ensuring their social media activities are both mirrored, enhanced and complimented by the DCA online resources. In addition to these channels, the DCA operates a social networking service via functionality built into its member's portal data-central.org, which provides the facility to embed Twitter and other popular social media feeds. As a result of feedback during the PEDCA project, the DCA is currently investigating an "App" for smartphones and tablets to provide better community integration, which is currently at prototype.

Working with policy makers

The DCA has a good early track record in establishing working relations with politicians, governmental departments and policy making groups. Having established a productive dialogue with

UK ministers and MP's this has resulted in developing work with departments representing Energy, Business, Innovation & Skills and Trade and Investment. At the European level the DCA has played a positive role in conjunction with DG Connect and the other EU research initiatives. It is hoped that many of the results of PEDCA will play a beneficial role in shaping policy and assisting with its implementation.

Working with Academia schools and colleges

The PEDCA project has played a significant role in raising the profile of industry's skills and human resources needs. The three "Bootcamp" training sessions have provided the materials, experience and know-how to deliver an recognised "entry ticket" for the industry, close co-ordination to JA4 and JA5 provides the opportunity to solve problems experienced in addressing the skills gap and the future generation of data centre workers. PEDCA has established an informed network of EU educational institutions to enable these activities to take place.

Developing dialogue with "end users"

"End users" are defined as organisations who are not engaged in business interests dedicated to designing, constructing or operating data centres. Put another way, they are organisations that provide another private or public sector product or service. The vast majority of these organisations will own or operate some amount of data centre assets, but can be regarded as non-experts in this field. Therefore it is a key activity of this joint action to educate and influence this audience in order to raise awareness and encourage the uptake of technologies and methodologies that can deliver improvements in reliability, security and energy efficiency of data centres. These could include for example, best practices, standards, product and or service sectors of the industry.

Working with other stakeholder groups

The data centre is an integrated system which involves a myriad of stakeholders. Although the PEDCA project adopted a well-defined scope for the research it highlighted the need to ensure silos are broken and a collaboration and cross pollination of ideas are established.

The DCA has signed various strategic partner agreements with stakeholder industry associations with the aim of sharing work plans, establishing joint activities and knowledge sharing. Target groups include those with cloud, buildings, storage, energy, engineering, telecommunications, end user and scientific interests.

Events and Conferences

The PEDCA project's timeline coincided with an upturn in the number of commercial events and conferences that feature or are dedicated to the data centre sector. The experience of the researchers attending these commercial events indicated an over-supply, with a correction likely to be seen which may result in the combining of subject matter, the discontinuation or scaling down of some events and or specialisation of certain aspects over the short term. Against this backdrop, the research showed that dedicated non-commercial dissemination events best suit the needs of the

JAP. For 2015 an annual DCA symposium is the preferred method to disseminate the activities and work of the JAP/DCA.

Impact of JA3

The project research showed that industry participants saw actions that improved knowledge and awareness of stakeholders an essential role of the PAN European DCA. The role of successfully communicating routes to data centre improvement to new markets, policy makers and "end user" audiences was strongly supported and linked to economic impact. Therefore a 40% of the overall impact contribution is assigned to this joint action.

Skills matrices (JA4)

The PEDCA research has identified this action as a key initiative, but also as the only action where a no accessible work exists that can be built upon. Training organisations have successfully mapped technical role based training to professional development frameworks in conjunction with BTECH which being recognised in more than 80 countries worldwide, is a notable step forward for the sector. However the PEDCA project identified a need for a full evaluation of skills matrices that can be open to all, including training companies, industry participants, employers and stakeholders to both contribute to and use. Due to the sheer volume of skills and roles involved. The task in hand is considerable and only manageable if broken down in to self-contained sections. The project considers the data centre service provider sector as the priority, because it is less complex, has a high profile and the most urgent need. Implementation of this joint action will commence during 2015 as resources/funding allow.

Impact of JA4

Clearly this action is a dependency for the exploitation of JA5 therefore, the consortium did not assign any economic impact for JA4. However this is a research requirement finding of the PEDCA project.

Training Policies (JA5)

The DCA will work to raise awareness of the value of training and encourage its take up. However this alone is not enough to overcome the cultural barriers, low uptake and availability of training in some sectors of the industry identified by the PECDCA project. The DCA itself does not wish to become commercially active in the delivery of training and aspires to remain neutral during the selection of training organisations. However, the role of this joint action is to establish a body to set standards of quality, professional development and assist with complimentary activities to strengthen both commercial training institutes, academia, schools and colleges. Although in the medium and long term it will be necessary to realise the output of JA4, the PEDCA project produced a training course for entry level staff that can be immediately exploited and established as the industry recognised requirement for entry level employees of the industry. This plan can be implemented during 2015 by working with the training providers, universities and employers utilising the cost structure developed in WP5. In the short term other training courses can be developed to assist with the urgent uptake of energy efficiency best practices. Other JA's particularly JA6 are also a useful tools for specifying requirements for training policies and ensuring appropriate skills are present within the data centre.

Starting with the entry level course developed within PEDCA, the action aims to develop a standardised curricula that integrates not only the various developing technologies, methodologies and standards across the data centre industry, but also the workers and experts in the field. This will naturally develop more input and ownership from the industry and subsequent take up of training. The overall effect will be for the Pan European DCA to fulfil the role of a "professional association" to fit alongside its "Industry association" role.

Impact of JA5

Upskilling the workforce of data centres is a key contributor to all economic impact scenarios, however due to the missing dependencies needed to move this action to maturity, we have only assigned a small contribution to the overall impact of PEDCA of 10%.

Standards, Best practices and Certifications (JA6)

The overall plan for JA6 is to improve engagement in the standards by raising the profile of best practices by recognising them when and where they have been successfully implemented. During the PEDCA project the DCA launched both its Certification scheme and became an Endorsing industry association for the EU Code of Conduct for Data Centre Energy Efficiency. The action has been piloted successfully in the field and is market ready.

Exploitation of JA6 has already commenced with the recruitment of four DCA Approved Auditors, most recently Keysource during December 2014. The completion of the first DCA Certified data centre has been completed as part of the PEDCA project which will soon be announced.

Further exploitation of this JA includes delivering the action plan for the EU Code of Conduct which includes developing services, promotion activities and resources designed to improve and widen the uptake and implementation of energy efficiency in data centres.

Impact of JA6:

Developing industry accepted policies and governance of best practices & standards is the "glue" that holds together the JAP as a whole, as well as serving as an important mechanism to deliver the actions output as added market value for the participants. However, delivery across the EU will take time and resources and it is no simple task to fulfil. Therefore the overall impact contribution reflect this at 10% of the overall impact of PEDCA.

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[i] Estimated by assuming a data centre employing best practices improves its PUE by 3 points (e.g.2.0 to 1.7) and makes a 10% saving on ICT load from actions such as e.g consolidation, tackling under-utilisation and turning on power saving features etc. in a year. This would result in an estimated 15,500GWh saving which is equivalent to 871,129 dwellings using the EU average of 17,793 kWh/dw 2008 figures. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65964/1524-eu-energy-efficiency-household-trends-art.pdf

[ii] Reference for industrial electricity costs is https://www.gov.uk/government/statistical-data-sets/international-industrial-energy-prices