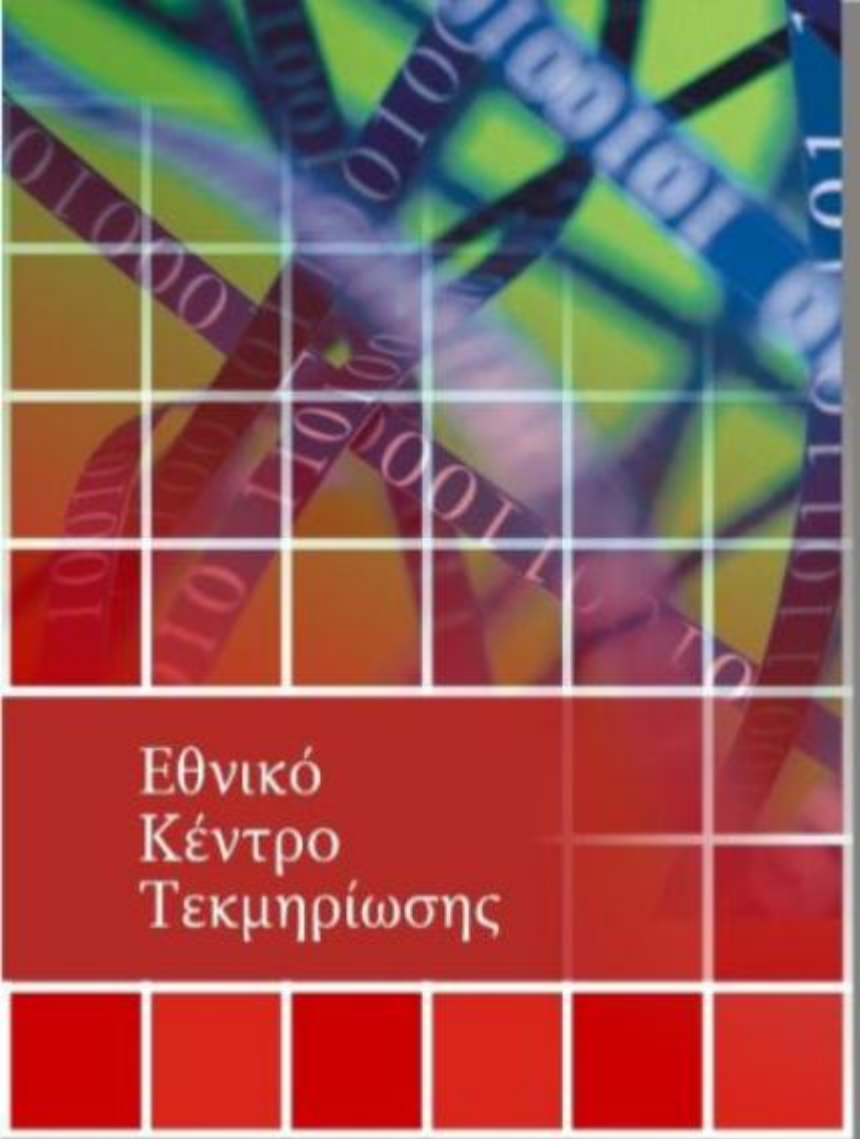

e-vigr: ekt's - Virtual Infrastructure GReen meteR

2010 ΕΛ/ΛΑΚ conference, Athens
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www.ekt.gr

at a glance

- The **Ekt's - Virtual Infrastructure Green meteR** is a set of scripts for estimating, in real time, and with appropriate assumptions, the power savings a virtualization/cloud computing infrastructure achieved in comparison to an non-virtualized equivalent system.

- **E-vigr** can calculate power consumption savings over **XEN** and **VMWARE** based virtual infrastructures, independently of specific h/w vendors

- It applies **real time power metering** of the physical servers, comprising the virtual/cloud infrastructure, virtualized infrastructure platform information, a **projected power consumption of virtualized servers**, based on collected performance metrics
- Can work over

- Available as open source **http://code.google.com/p/e-vigr/** (beta)

Virtualisation, cloud computing and green IT

- **Cloud Computing**
  1. Meaning lots of different things to different people – iaas, saas, grid etc.
  1. Core in most of these is virtualization
  1. Scalability and savings of scale can be important
- **Cloud & Green IT**
  - IT consumes **lots of energy** (Koomey >2% power consumed in the US)
  - Green IT : cloud infrastructures and virtualization one of the solutions to make “things better”
  - Large scale infrastructures can be more efficient - but also can consume lot of energy
  - Lots of different metrics - forums, previously overlooked, not clear always definition of parameters, need for a inderdisciplinary approach

EKT/NHRF: who we are

- EKT is the *national infrastructure for scientific documentation, online information and support services on research, science and technology* .
- Provides digital content (scientific, cultural, research and technology) services to the greek academic community,
  - **www.openaccess.gr**
  - The Greek PhD theses dissertation archive **phdtheses.ekt.gr**
  - **Helios-eie.ekt.gr**, the NHRF institutional repository
  - **Pandektis.ekt.g**r, the NHRF digital cultural collection
  - 5 peer reviewed open access journals for the humanities and science (**www.byzsym.org**, …)
  - **Parthenonfrieze.gr**, the digital Parthenon frieze online
  - The ABEKT library automation tool (**abekt.ekt.gr**)
  - **www.enterprise-hellas.gr**, connecting research and innovating enterprises

- Expertise in IT systems and s/w for providing and organizing **large volumes of structured and unstructured digital content** for science, technology and research
- Supporting **open source**, **open access**, **open standards** and **environmental responsibility**
- Operates (**since 1991**) one of the most important **Datacenters** in the greek academic community providing:
  - content services (EKT's IT systems)
  - computation: hosts one HellasGrid node
  - network connectivity and services: hosts GR-IX, GEANT GRNET node, etc.
  - > 120 m2 raised floor space, 100s of KWs consumed

Previous work on green it/ virtualization

Since 2007 we have introduced virtualization infrastructure for providing our services to our end users:

- **ELLAK 2008 conference (Athens)**: presented the feasibility of providing production grade services using open source virtualisation infrastructures, calculated energy savings of our consolidation project
- **Open Source Systems 2009 (Skovde, Sweden)**: Demonstrated that virtualisation infrastructures are most agile, cost effective and scalable when open source software is used on top of them.

- Next step (**ELLAK 2010 conference**): calculate in real time the power saving our virtualization infrastructure offers

power savings, green it and metrics:

- Green IT: not mature metrics/KPIs, not ready made s/w, should employ a interdisciplinary problem

http://code.google.com/p/**e-vigr**/

Ekt's - Virtual Infrastructure Green meteR

- **Ekt's - Virtual Infrastructure Green meteR (e-vigr)** is a set of scripts for estimating, in real time, and with appropriate assumptions, the power savings a virtualization/cloud computing infrastructure achieved in comparison to an non-virtualized equivalent system.
  - We have made our s/w and we give it as open source s/w
  - operates on Linux (CentOS – RHEL) written on TCL (rapid prototyping)
  - requires certain infrastructure enhancements but not specific vendors equipment
  - Simple, manageable and independent of specific monitoring systems in order to reduce complexity
  - Operates on XEN and on VMWARE platforms
  - Result : live monitoring of the power savings, environmental and economic footprint

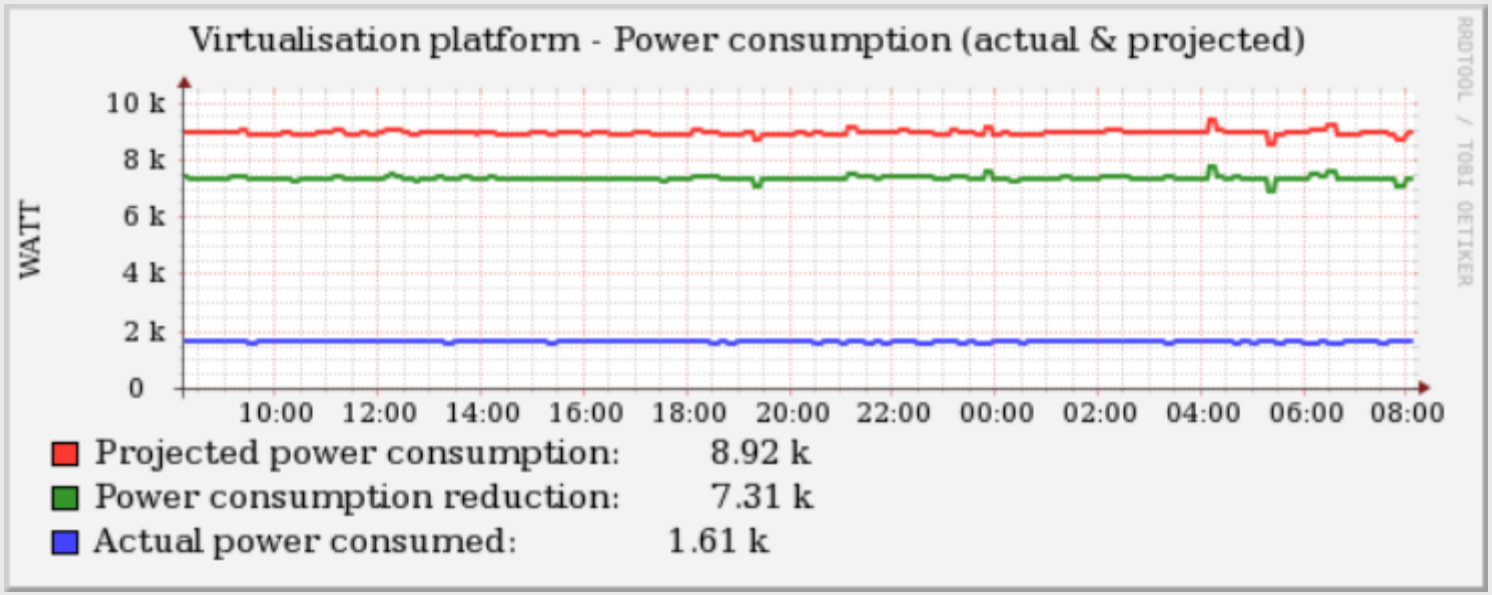
http://code.google.com/p/**e-vigr**/

Prerequisites

Steps (simplified)**:**

1. Measure the actual consumption of the virtualisation infrastructure servers
   - SNMP based, requires to enable an appropriate server-based ILOM, or alternatively metered PDU socket
2. Dynamically read the virtual servers that run over the virtualisation infrastructure
   - Depends on the virtualisation management, bare metal s/w MIB
   - Requires some SNMP specific enhancements on XEN infrastructures
3. Then model the projected power consumption of the virtual servers using valid assumptions

Basic output



*Graph created using cacti

http://code.google.com/p/**e-vigr**/

Projected power consumption

Modeling the power consumption of virtual servers:

- How can we model something that its virtual?
- Safe side: estimate the worst case scenario, i.e. the least power consumption savings

Valid assumptions:

1. Find the main factors that contribute to power consumption: server architecture, memory, cpus, etc
2. Lots of work has being done on this field

Assumptions

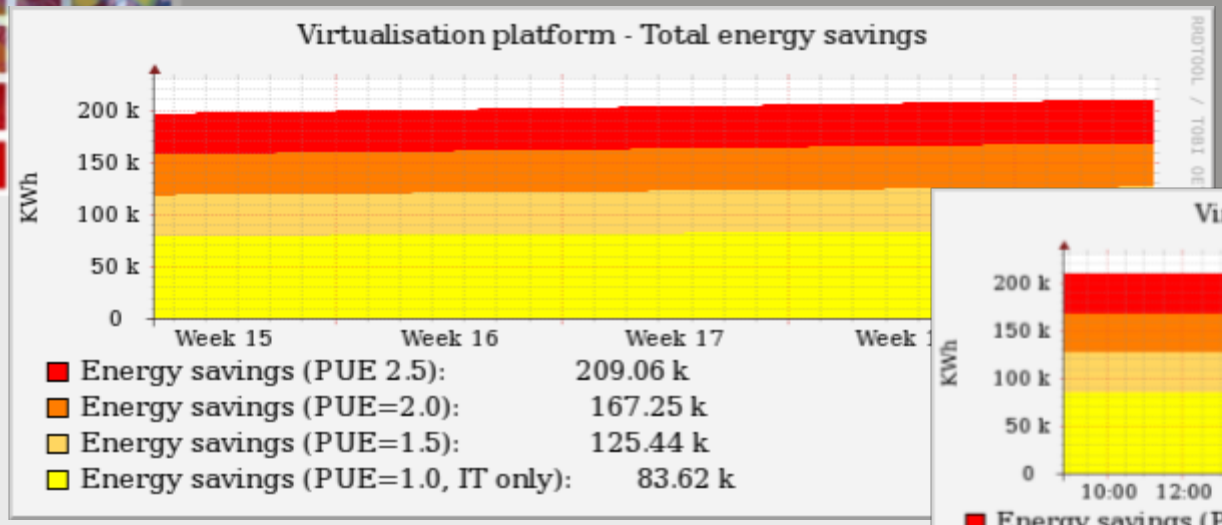
- Vendor example
  - Sun X4150 power calculator
    - available at http://www.sun.com/calc/servers/x64/x4150/index.html
  - What matters: CPU types, number of CPUs, memory, extension cards
- Vendors & Bibliography: what actually matters is the processor load for a given server
- US department of Energy:
  - P = (Pmax – Pidle) * n/100 + Pidle, n = CPU utilization

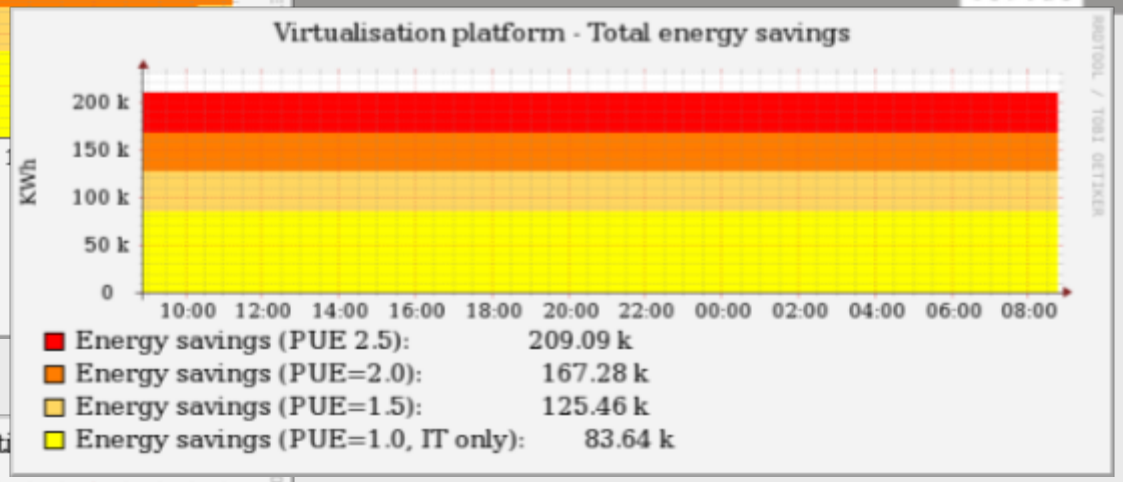
Implementing assumptions

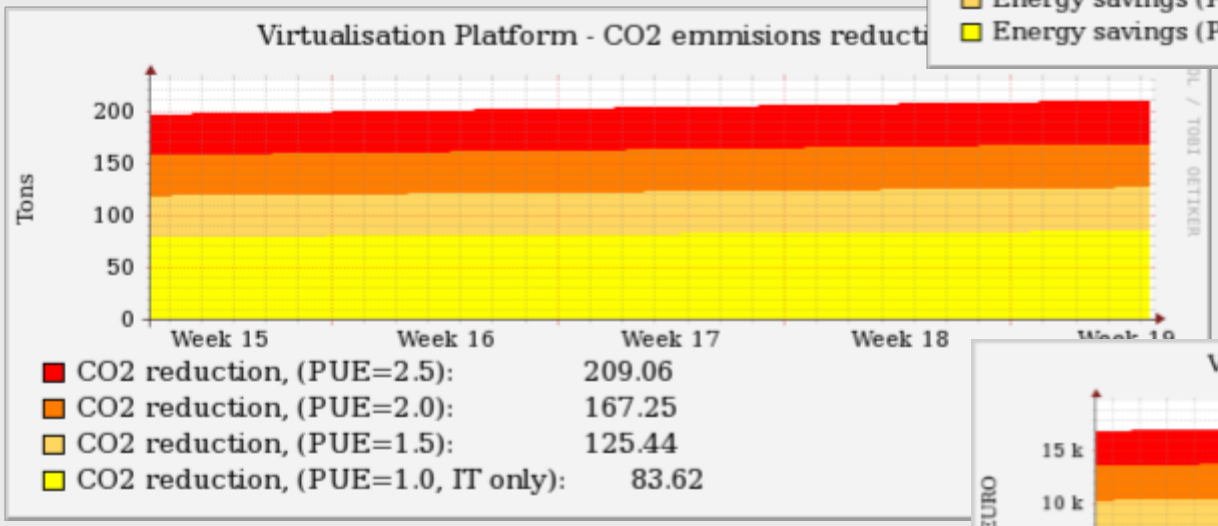
- Select a base server as the basic reference model & be on the safe side
- measure virtual server processor load and based on this equivalent server calculate the projected power
- The script “crawls’ all of the virtual servers and based on their load calculates the projected power savings.
  - It can recover from non responding servers, malformed SNMP answers, etc
- Now we are having the actual power consumed and the projected power consumed.
- It refers on the server h/w does takes into account no networking, or storage

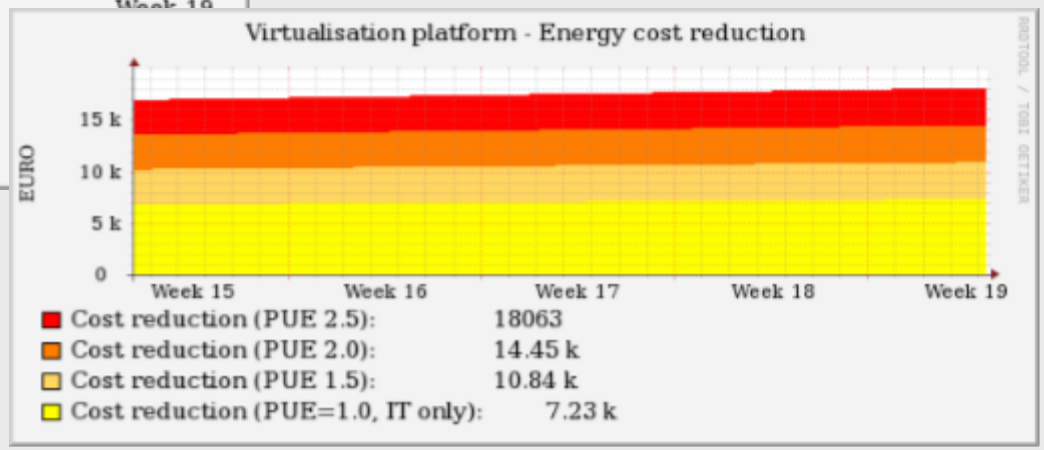
Derivative figures

- Based on the instantaneous power consumption benefits e-vigr estimates:
  - The saved Energy over a period of time
  - Cost savings (Kwh to Euro, source http://www.energy.eu/)
  - CO2 emmitions reduction
    - different for each country/installation (source greenpeace.gr)
- for different **PUEs (**http://www.thegreengrid.org/)
  - So far we have calculated only the server-side savings
  - Real datacenters need cooling, have UPS/PDUs power losses
- **PUE**: indicates how much more energy we need in order to cool the equipment and count for the losses in UPS power ,lines etc.
  - PUE = Total Facility Power / IT Equipment power
  - It depends on datacenter technology, season external environmental factors, load of the datacenter etc.
  - Calculates for PUE from 1.0 to 2.5









http://code.google.com/p/**e-vigr**/

EKT's power savings

- What was achieved by EKT since 2008 (2nd version of our virtualization platform initiated):
  - 167.000 Kwh consumed less.
  - 167 tons of reduced CO2 emmisions
  - 15.000e less
  - 16KW average power savings
- but also, e-vigr is:
  - Readily available as OSS and simple (room for lots of improvements)
  - initiated as an internal need but also can cover similar needs in other organisations
  - Raise awareness to infrastructure managers, policy makers, etc.
  - Tool for further implementing and evaluating Green IT technologies
  - Real graphs available in real time at http://code.google.com/p/e-