# GridEcon: Business Models for the Grid

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# GridEcon: Project Facts

- ❑ **Title is Grid Economics and Business Models**
- ❑ **EC funded project**
  - ❑ **Objective** "Advanced Grid Technologies, Systems, and Services" within the EU Sixth Framework Program, Priority IST
  - ❑ **Funding period** is July 2006 to December 2008
  - ❑ **Project size** is 3.89M Euro (EC funding is 2.35M Euro)
- ❑ **9 consortium partners**
  - ❑ **Coordinator:** Intl. University of Bruchsal
  - ❑ **Partners:** Athens University of Economics and Business, Imperial College London, the451Group, LogicaCMG, ATC, Ernest&Young, RealTimeEngineering, Gigaspaces

# GridEcon: Project Scope

❑ **The goal is to advance the functionality of existing Grid technology, so that**

    ❑ an **economics-aware operation of Grid applications and services becomes possible** (new Grid business models can be implemented)

    ❑ **end-users can not only consume but also sell services (resources) on the Grid**, therefore, creating a new economy in which all end-users can actively participate (generate income)

# Motivation for a Project on Grid Economics and Business Models

- **There are many technical solutions for Grid computing**
  - Many open source middleware systems (Globus, glite (dgas), GRIA, Unicore, etc) have been developed
  - There are even a few commercial middleware implementations

- **But, only a few sustainable applications of Grid technology exist. They are**
  - In the area of **high-performance computing** and,
  - To a **limited extent, in the commercial environment**

- **What is the reason for this low take up? Are there no other sustainable business models?**

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# Motivation:
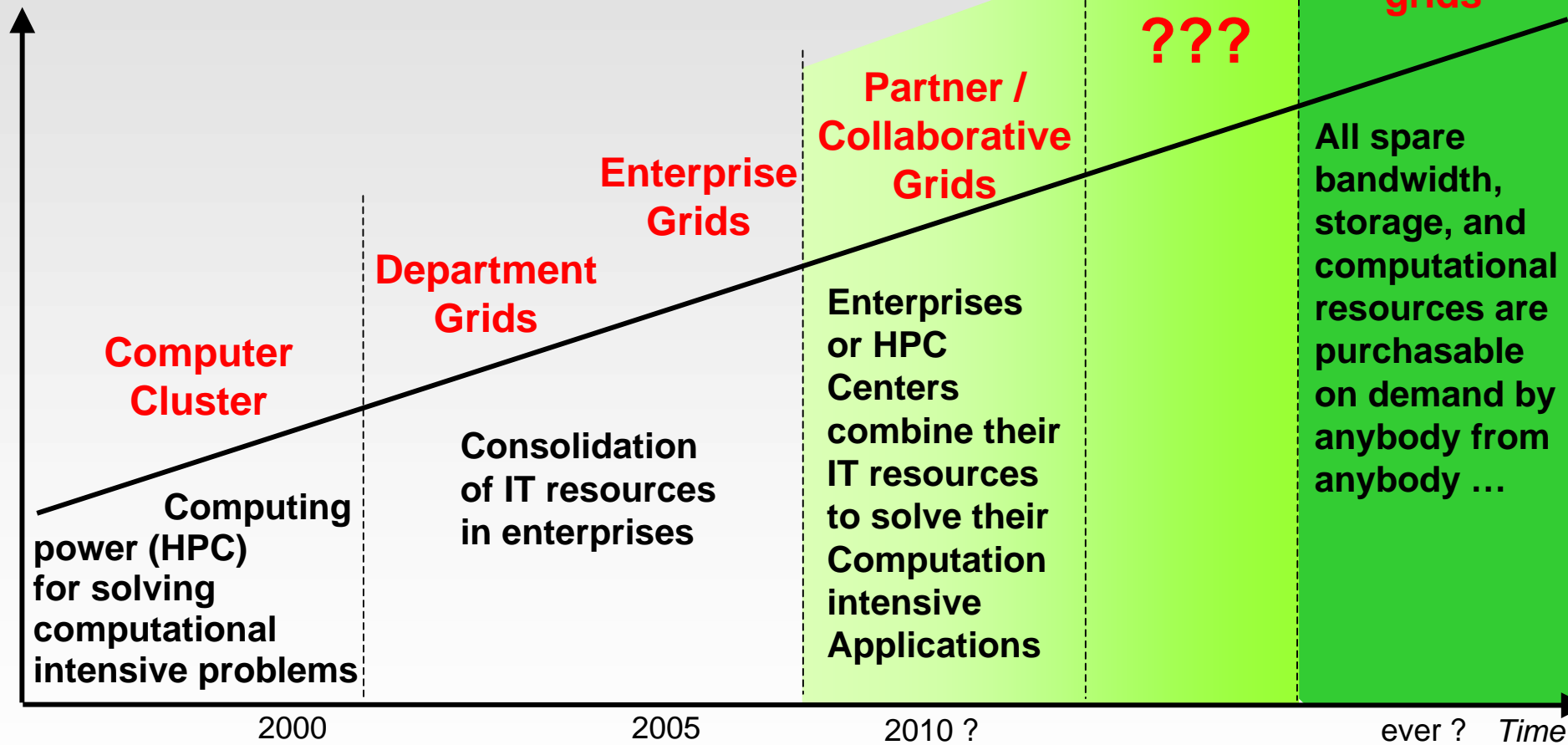# Sustainability of Grid Computing

❑ **Sustainability of Grid Computing is about**

  ❑ Finding **business model** which guarantees revenues to recover at least the cost for this new infrastructure

❑ **To achieve sustainability in the Grid environment**

  ❑ **Tools for users** (researcher, organizations, companies) are needed **so that users can benefit** from the Grid

    ❑ Benefit comes from **low cost of ownership, simplicity, on-demand, pay-as-you-go** besides cost reduction

    ❑ Benefit means that there is a return on a user's investment in Grid

    ❑ Tools are ontology definitions, data structure updates, **dynamic scheduler, risk broker, capacity planning, services markets**, etc

# Motivation: Closing the Gap to Open Grids



**Openness of Grid**

**Open grids**

**???**

**Partner / Collaborative Grids**

**Enterprise Grids**

**Department Grids**

**Computer Cluster**

Computing power (HPC) for solving computational intensive problems

Consolidation of IT resources in enterprises

Enterprises or HPC Centers combine their IT resources to solve their Computation intensive Applications

All spare bandwidth, storage, and computational resources are purchasable on demand by anybody from anybody …

2000          2005          2010 ?                    ever ?   *Time*

❑ **Classification of Grids by ownership, use, utility, kinds of resources (e.g. SW, HW) might help to define the ??? area**

# GridEcon: Research Plan

- **Consider different** (three) **Grid scenarios** in which preference conflicts exist
    - Scenario 1: **Interconnection of Grid systems**
    - Scenario 2: **Service-oriented architecture**
    - Scenario 3: **Software-as-a-service**
- **Identify** stakeholders and roles
- **Analyze** common issues in those scenario
- **Design** solutions based on economic models
- **Integrate** solutions (new services) into existing Grid middleware

# Incentives for Using the Grid: Addressed Features of the Grid

- ❑ **Cost reduction through IT Outsourcing (e.g. Enterprise Grids, Department Grids)**
  - ❑ Enterprises are using Grid technology to
    - ❑ **Interconnect** their IT resources
    - ❑ **Consolidate** their enterprise-wide IT resources

- ❑ **Capability to solve computationally intensive problems that cannot be solved without combining resources**
  - ❑ **Examples**: scientific computing, commercial calculations (Shortening time-to-market of products)
  - ❑ **Society benefits by getting**
    - ❑ New knowledge
    - ❑ Reputation
    - ❑ Technology leadership

# Incentives for Using the Grid: Not Addressed Features of the Grid

- ❑ **Availability of on-demand computational power**
  - ❑ Speeds up research output and time-to-market of products
- ❑ **Low cost of ownership (no upfront investment)**
  - ❑ Small and medium-size enterprises have not to purchase high-end servers and software anymore (e.g. injection molding simulation)
  - ❑ General public can establish home enterprises
  - ❑ Any researcher can have access to high-performance computers
- ❑ **Simplicity of using resources (hardware and software)**
  - ❑ Availability of a **pool of applications** in the e-science space
- ❑ **Pay-for-use / pay-as-you-go**
  - ❑ Grid computing could provide **small-medium-size enterprises, any researcher, or partner in a partnership** pay-for-use access to high-end servers and software
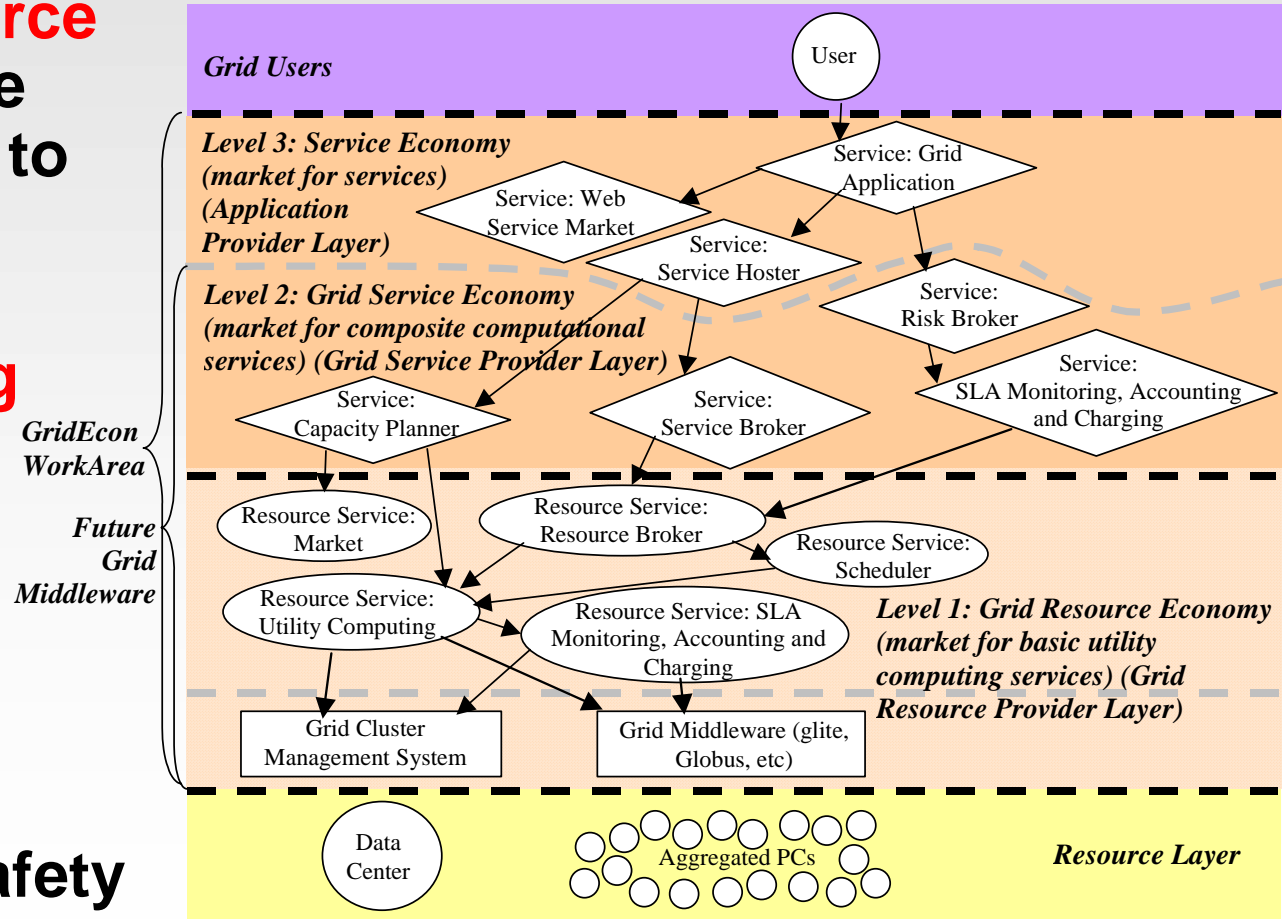
# Incentives for Using the Grid: Exam: HPC Center Interconnection

- **Despite the interconnection of HPC centers, not every researcher has access to the Grid**

    - A researcher in a poor state (poor country) cannot execute her application since she does not have access to a HPC environment

- **Conflicts in preferences between stakeholders cannot be resolved**

    - **Why** should state A (/ country A) allow a researcher of state B (/ country B) accessing its high-performance computer (which has been paid by tax payers of state A)?

    - **Will** the researcher of the local HPC center have higher priority over other researchers?

    - **How much** of the high-performance computing resources should be made available to the Grid?

- **Policies exist which try to address the issue of resource allocation but provide not economically efficient solution**

# GridEcon's Research Topics and Reference Architecture

- **Billing stack** for different kind of services has to be in place enabling **compensation of providers for resources** supplied

- **Fairness of resource allocation** (service markets) in order to reduce policy limitations

- **Capacity planning** and **decision support** through business intelligence tools

- **Risk analysis** of remote sites with respect to data safety



*Grid Users*

User

*Level 3: Service Economy (market for services) (Application Provider Layer)*

Service: Grid Application

Service: Web Service Market

Service: Service Hoster

Service: Risk Broker

*Level 2: Grid Service Economy (market for composite computational services) (Grid Service Provider Layer)*

Service: Capacity Planner

Service: Service Broker

Service: SLA Monitoring, Accounting and Charging

*GridEcon WorkArea*

*Future Grid Middleware*

Resource Service: Market

Resource Service: Resource Broker

Resource Service: Scheduler

Resource Service: Utility Computing

Resource Service: SLA Monitoring, Accounting and Charging

*Level 1: Grid Resource Economy (market for basic utility computing services) (Grid Resource Provider Layer)*

Grid Cluster Management System

Grid Middleware (glite, Globus, etc)

Data Center

Aggregated PCs

*Resource Layer*

# Conclusion

❑ **If GridEcon will be successful, there will be an environment to collaborate across individual organizational boundaries**

  ❑ **reducing participation risk** by paying an appropriate price, and

  ❑ **economically fair sharing** of costs and generated value

# Thank You!