MIT PORTUGAL PROGRAM

"Education, Science and Innovation : building international partnerships to promote science based economic development"

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Daniel Roos
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Carlos Silva

MIT Portugal

DEVELOPING INNOVATIVE TECHNOLOGICAL ENTREPRENEURSHIP AT UNIVERSITIES

21–22 FEBRUARY 2012

OBJECTIVES – A Portuguese Perspective

- Transform scientific and engineering education in Portugal, through a **new research and knowledge network – Bring the Portuguese Universities together *(Institution building)***
- Invest in **educating human resources and attracting the best worldwide,** that will help make the vision a reality, **a new generation of leaders *(People)***
- Cultivate the on-going development **of advanced methods and models to enhance the value of systems thinking (Ideas)**
- Demonstrate the advantage of systems thinking in **real-world applications** related to promote **entrepreneurship** and **science based economic development *(Economic Development)***

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OBJECTIVES – An MIT Perspective

- Why Portugal?
  - Interesting and Important Problems
  - Quality of Faculty Colleagues
  - Support of Key Government Officials/Focus on Science, Technology, R&D, Education
  - Global Impact of Success

MIT-Portugal Program

Engineering systems focus: gives emphasis to complex systems that not only have critical technological components, but also have significant economical and socio-technical level interactions, going beyond traditionally defined engineering disciplines.

The following specific fields were identified as the initial focus areas, on top of which an integrative anchor program was developed:

- Engineering Design and Advanced Manufacturing
- Transportation Systems
- Sustainable Energy Systems
- Bio-Engineering Systems

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MIT-Portugal Program Components

Education

New engineering systems world-class education programs in:

- Bio-Engineering Systems
- Sustainable Energy Systems
- Engineering Design & Advanced Manufacturing
- Transportation Systems

Global MBA Program

Research

Portuguese universities are collaborating with MIT faculty in program-affiliated research initiatives, in an effort to stimulate R & D within the industrial sector.

Outreach

- An MIT Portugal Affiliates Program was implemented to engage key partners in industry, foundation and private association sectors to reinforce Portugal's scientific and technological capacity in partnership with MIT.
- Establish an innovation – entrepreneurship ecosystem in Portugal
- Impact Portuguese Universities

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EDUCATION

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PhD and Masters programs

- **PhD,** combine technology and systems thinking, innovation and entrepreneurship:
  - 3-4 years
  - 1 year of classes in either modular-intensive or traditional term-length format: varies by program
  - International program: all materials, lectures and activities in English
  - Teaching by Portuguese and MIT faculty (in person and distance learning)
  - Most students do 12-18 months research at MIT and have MIT co-advisor
- **Executive master programs,** a successful mechanism to involve industry:
  - 1 year programs mostly for professionals
  - Comparable to first year of PhD lectures plus additional activities

The MPP MAP

Program Launched in October 2006 Following Five Month Assessment, with Portuguese National Consortia

- 7 Universities
- 19 Research Centers
- 1 Government Laboratory

UM -

FEUP -

UC -

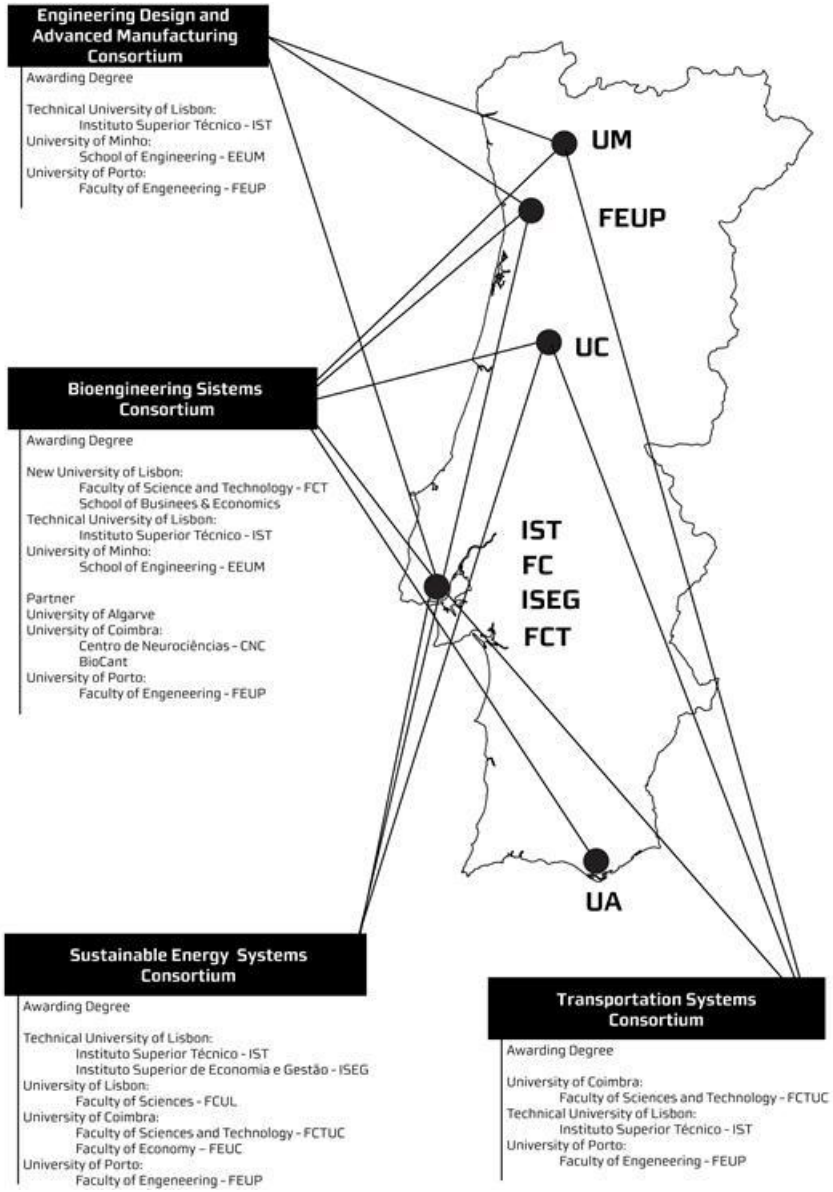
IST -

FC -

ISEG -

FCT -

UA -



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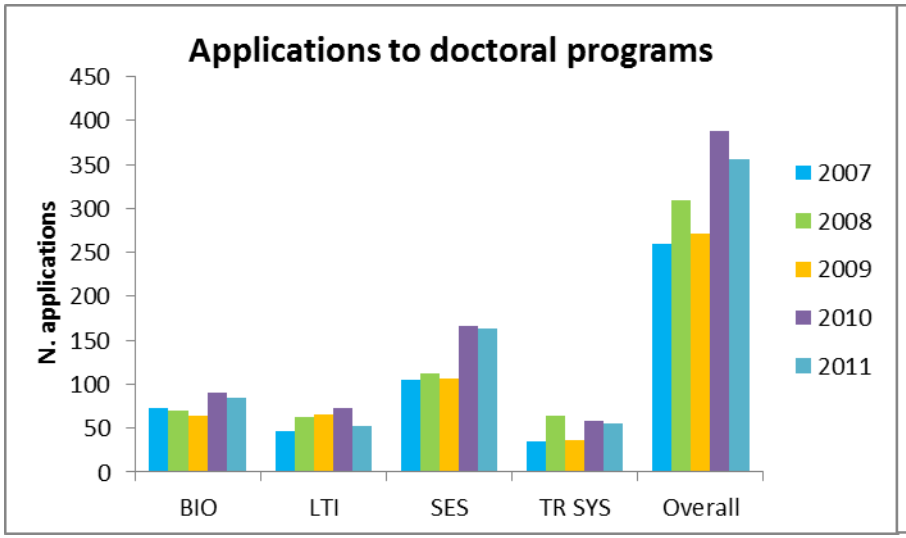
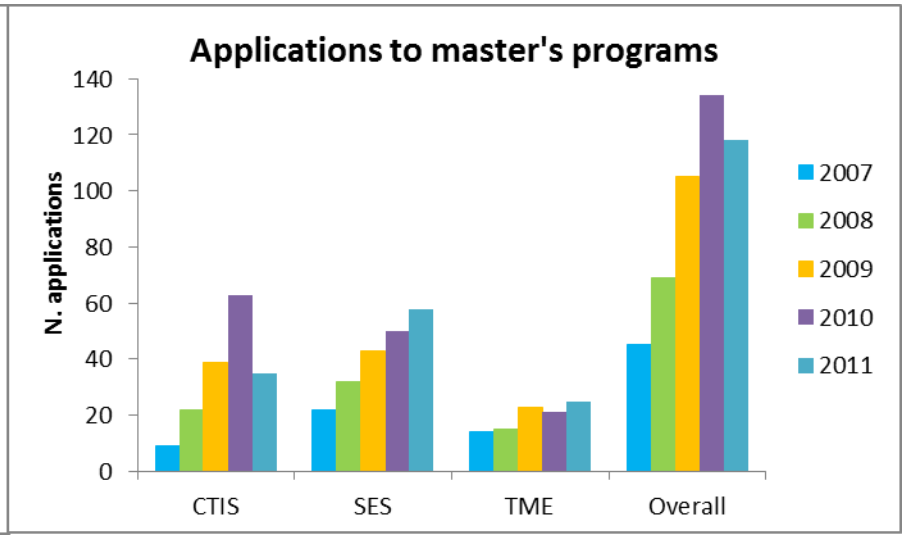
Recruitment





- The number of applications has been progressively increasing over the years. During its 5 editions the educational programs have received a total of 2054 applications.
- This year (2011/12) the total number of applications was 474:
  - doctoral programs: 356
  - Master's programs: 118

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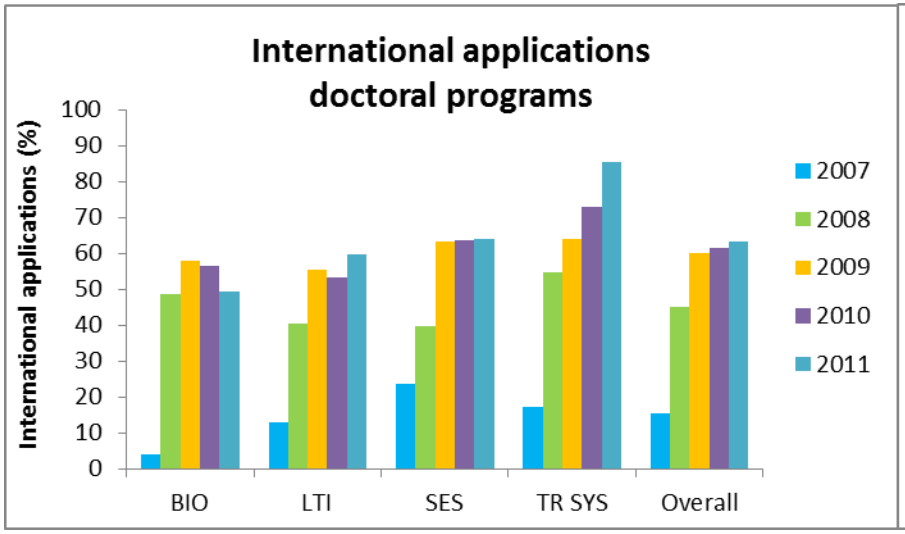
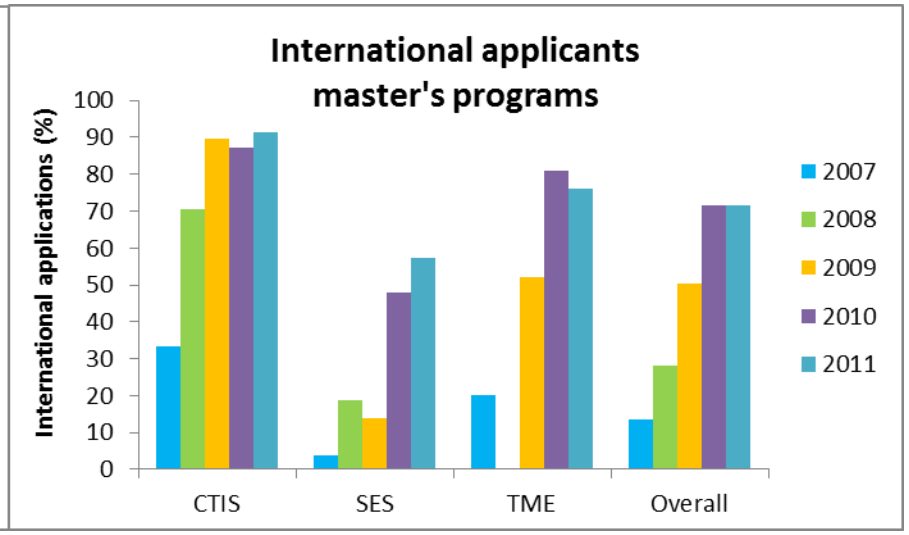
International applications





- The number and quality of international applicants has dramatically increased since 2007.
- Doctoral programs: last 3 editions (2009-2011) > 60% of applications are international.
- Master's programs: last 2 editions (2010,2011) > 70% of applications are international.

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Key Impacts

- Educational PhD programs were unique blending technology with system thinking, innovation and entrepreneurship. Example of leadership course
- EDAM interns at multinational corporations outside Portugal
- MPP experiences impact teaching at universities.
- MIT visits changed the way students willingness to take risks.
- There are currently 350 PhD students involved , of which 25% are international; 30% of the PhD students admitted for this year (2011/12) are international.
- There are currently 64 Master's students, of which 32% are international. 120 are already graduated.
- Students are graduates of leading academic institutions such as MIT, University of California Berkeley, Imperial College London and University of Michigan.

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RESEARCH

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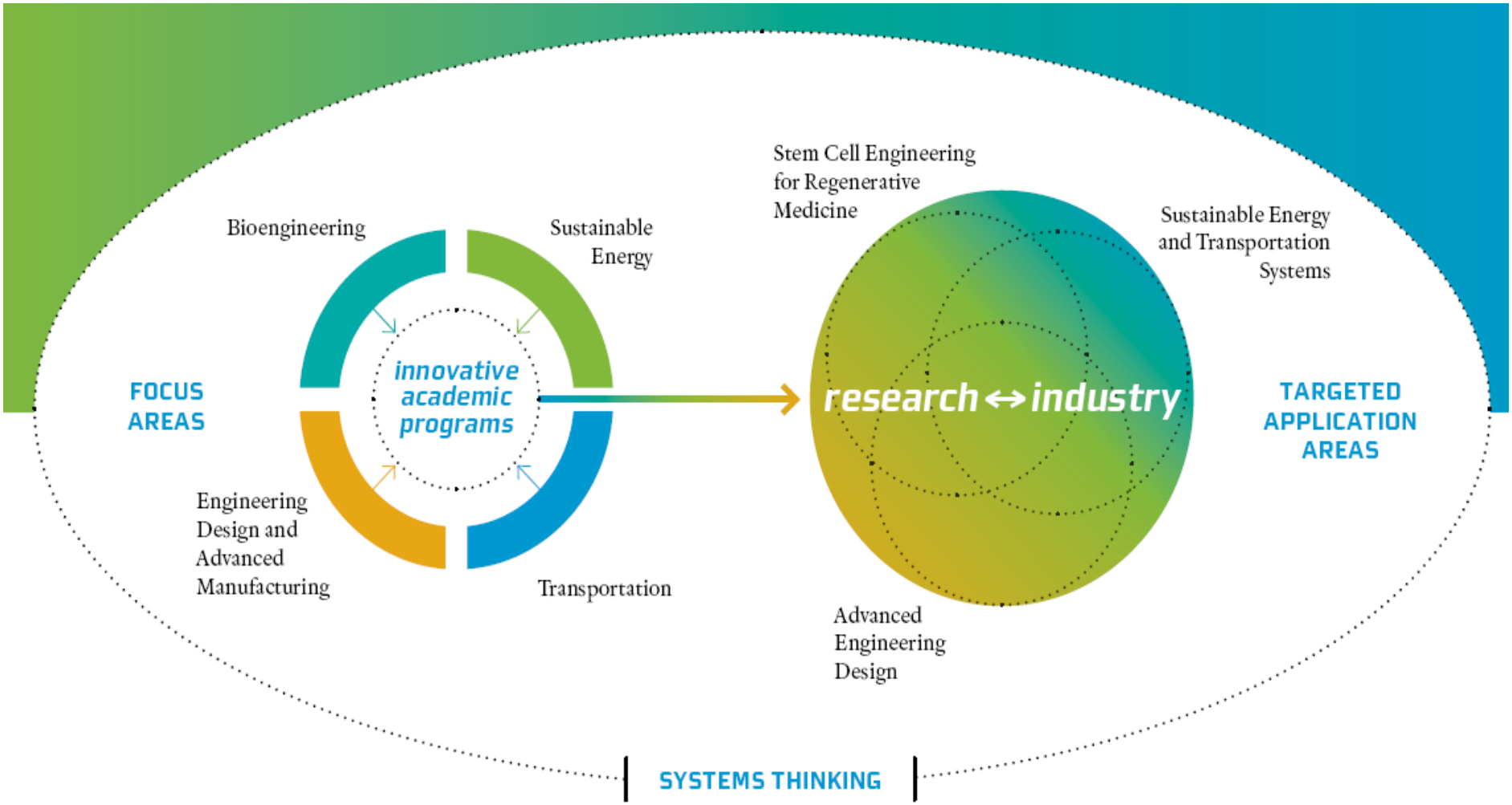
Our knowledge-creation model



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An example:
Systems for Smart Interiors

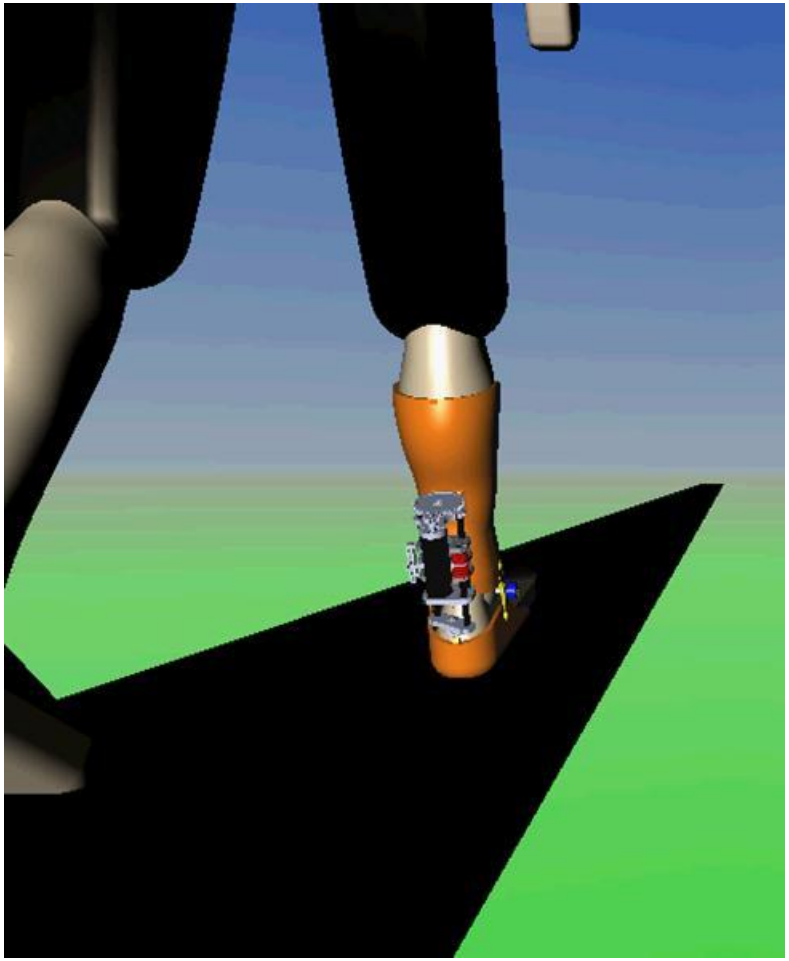
The objective of this research is the development of integrated systems for smart interiors in automobiles, an entirely new generation of high-performance mechanical systems and interfaces between humans and electronic and mechanical devices inside cars.

Different tasks have been addressed to accomplish its objectives:

- studying textile and composite materials with sensing capabilities;
- embedding optical fiber sensors into flexible carriers;
- inserting interfaces between humans and electronic mechanical devices; and
- developing of a new SMART car seat.

IBER-OLEFF FiberSensing TMG Sunviauto Indústria de Componentes de Automóveis, S. A.

Enhancing mobility with hybrid orthoses



The DACHOR Project in figures can be summarized in:

- 11 articles in international peer-reviewed journals,
- 54 articles in international and national peer-reviewed conferences,
- 4MPP+2 PhD students,
- 8 MSc students,
- 3 physical prototypes,
- 6 media events,
- 2 awards and
- several computational models.

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Extending life through faster stem-cell development

This project combines a cross-disciplinary approach of Stem Cell Bioengineering and Experimental Haematology to establish a reproducible, robust and efficient *ex vivo* expansion system for mesenchymal stem cells (MSC) from human bone marrow, adipose tissue and umbilical cord matrix.

The research consortium worked on the isolation and *ex vivo* expansion of MSC under GMP conditions for Cellular Therapies. These MSC were then used in the treatment or prevention of graft-versus-host disease (GVHD) and also to facilitate allogeneic hematopoietic stem cell engraftment and decrease regimen-related toxicity.
Eight patients have already benefited from this pioneer treatment. The clinical cases include:

- Acute GVHD
- Extensive chronic GVHD
- Hurler's syndrome
- Familial hemophagocytic lymphohistiocytosis
- Aplastic anemia

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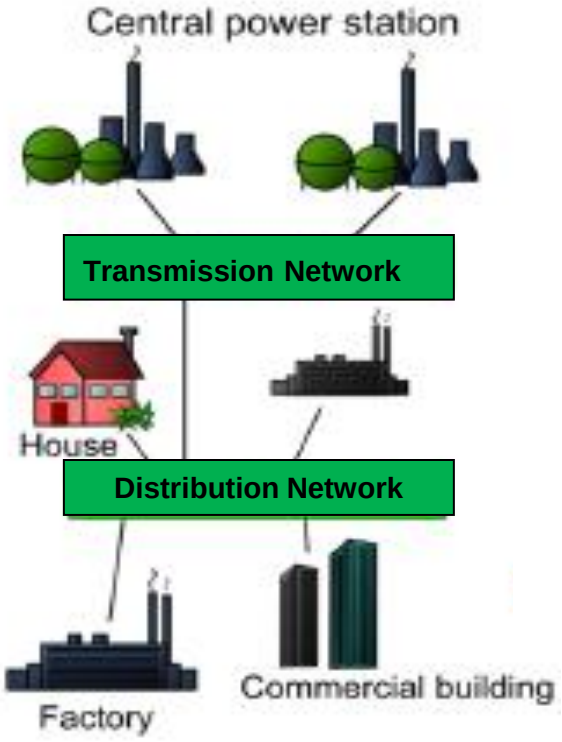
INSTITVTO PORTVGVÊS DE ONCOLOGIA

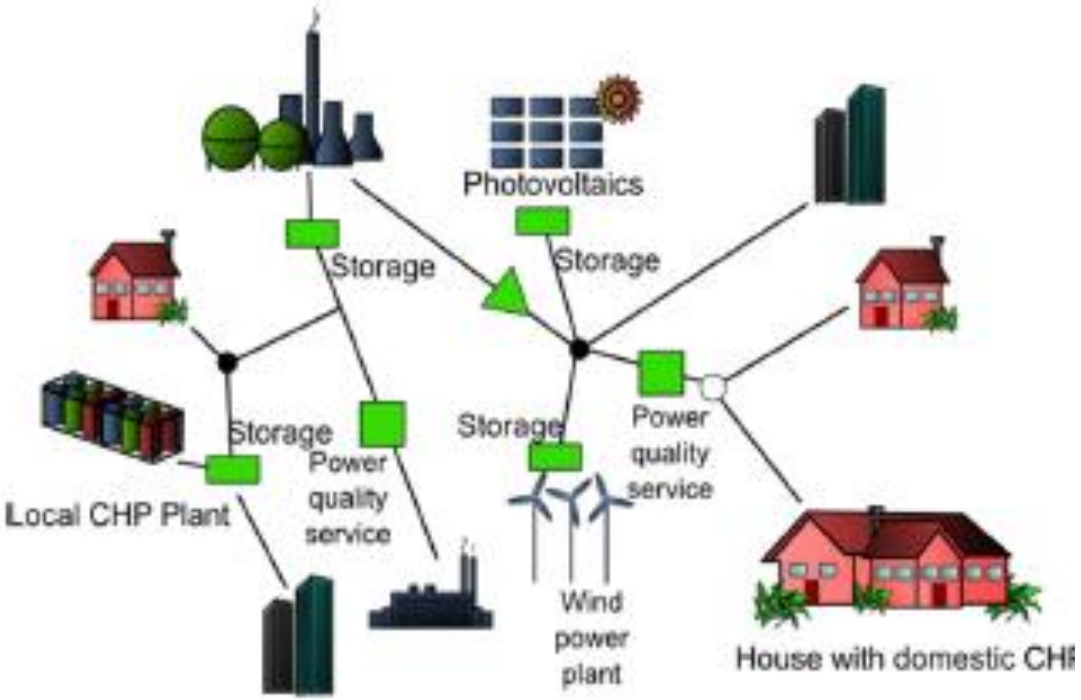
crioestaminal
células estaminais

THE ENERGY INTERNET

THE NEXT REVOLUTION



CENTRALIZED PRODUCTION



DECENTRALIZED PRODUCTION

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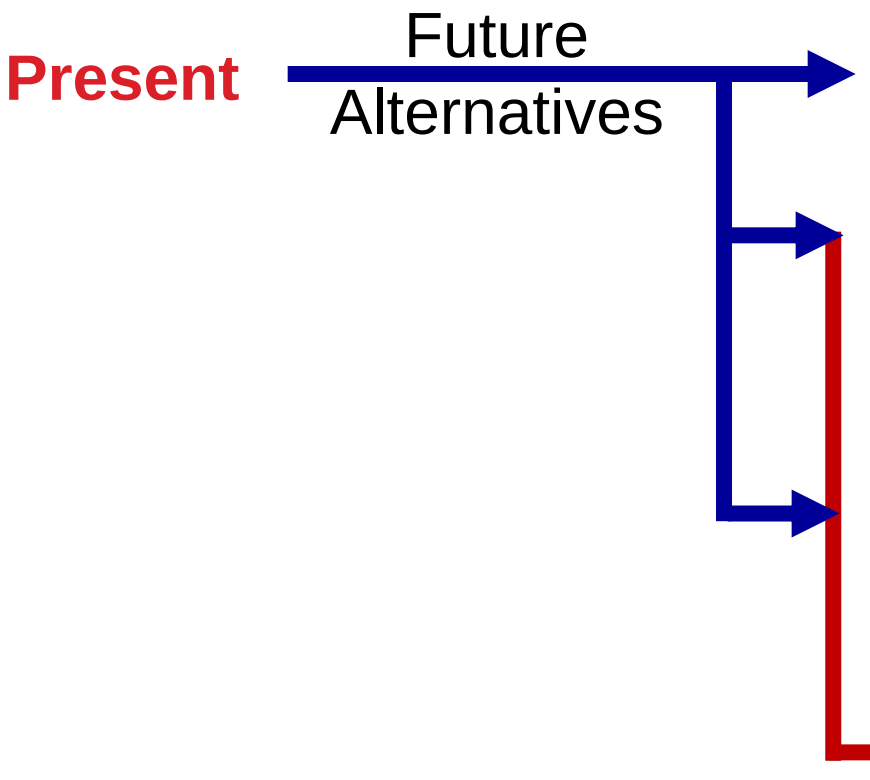
Opportunities for Innovation



Do "nothing" status quo

Reduce demand

– Improve efficiency
– Demand Side Management
– Pricing mechanisms

New Energy Sources

–wind, solar, biomass, geothermal…
–nuclear, tar sands,…

A systems approach – the ENERGY SOFTWARE

– Intelligent networks, smart grids
– Mobility, electric hybrids,…
– Storage, batteries, H_2,…
– intelligent and integrated buildings

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“Green Islands Project”

The project goal:

- Reduce fossil fuel dependence and create value and jobs building comparative advantages for Portugal through Engineering Design and Systems Thinking.
- Full scale demonstration in São Miguel, Azores

SGC Energia | Grupo SGC

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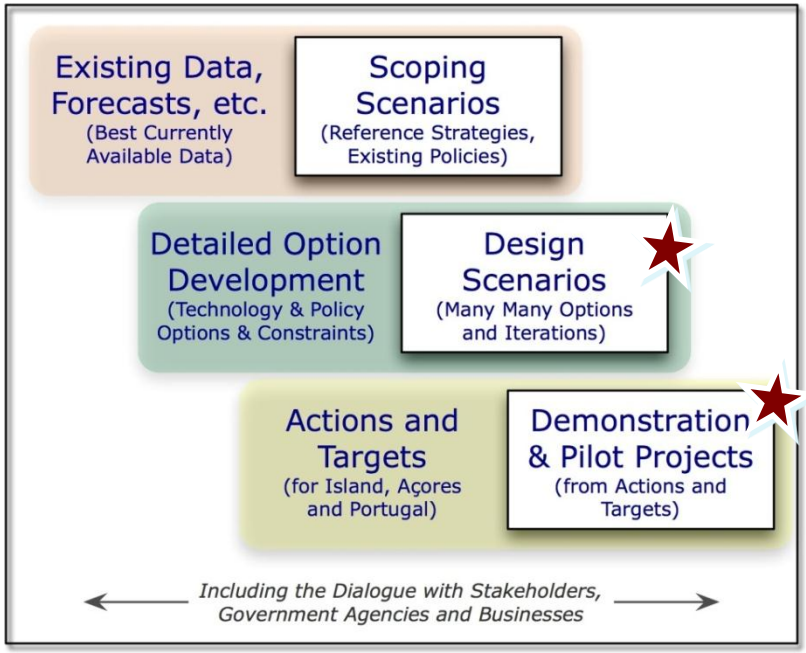
Azores Green Islands Project

- Three Phase Research Strategy
  - Novel Research Topics Focused on the Integration of New Supply and Demand Technologies, including Storage, Transportation, Efficiency
- Direct Collaboration with the Regional Government and Energy Firms



- **EDA**
- **EDP**
- **Galp**
- **SGC Energia**
- **Martifer**
- **EFACEC**
- **SGC energia**

others…

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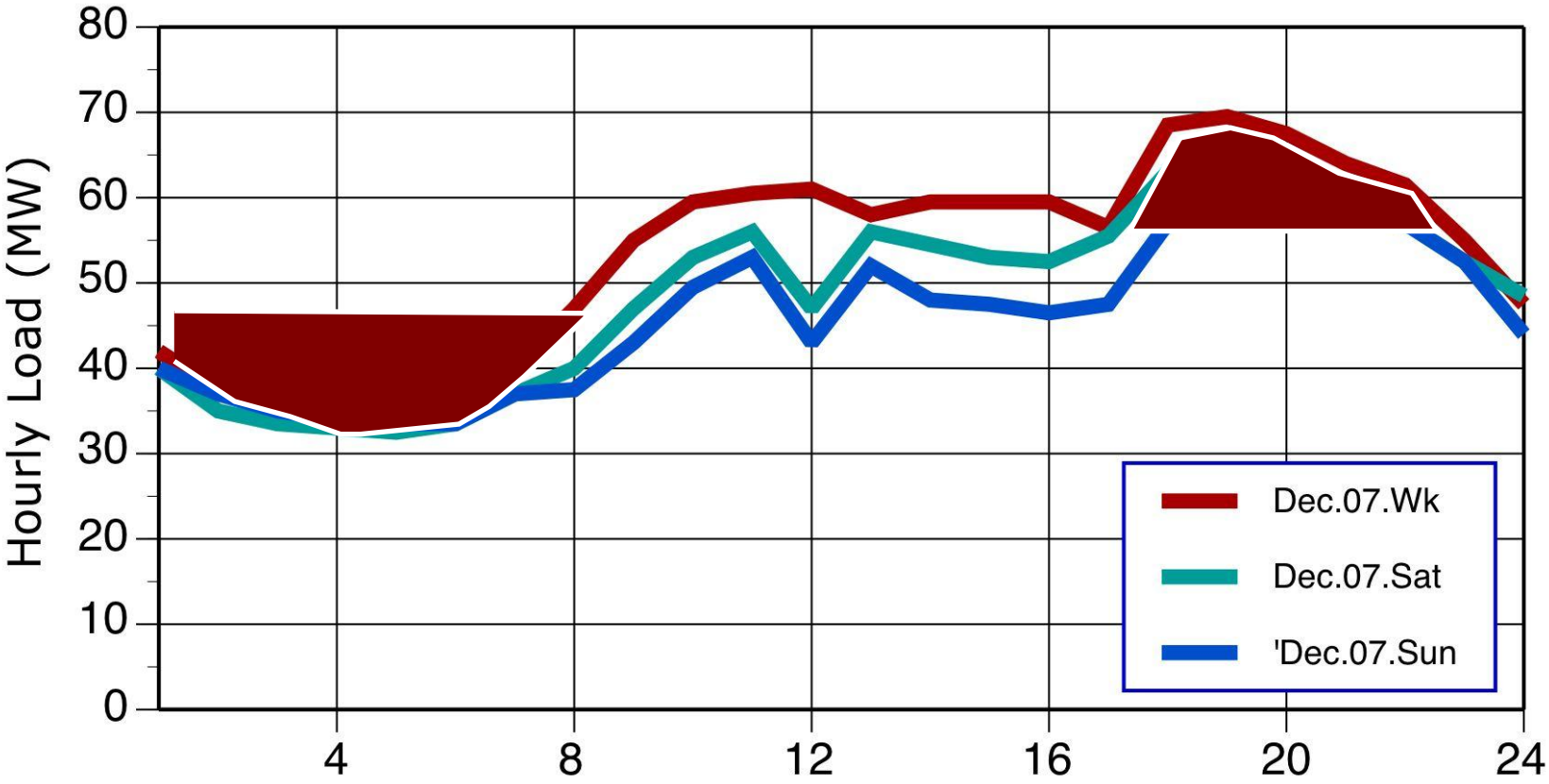
The main challenges

- 2007 Electricity Demand



Electricity Demand - São Miguel
(EDA, December 2007)

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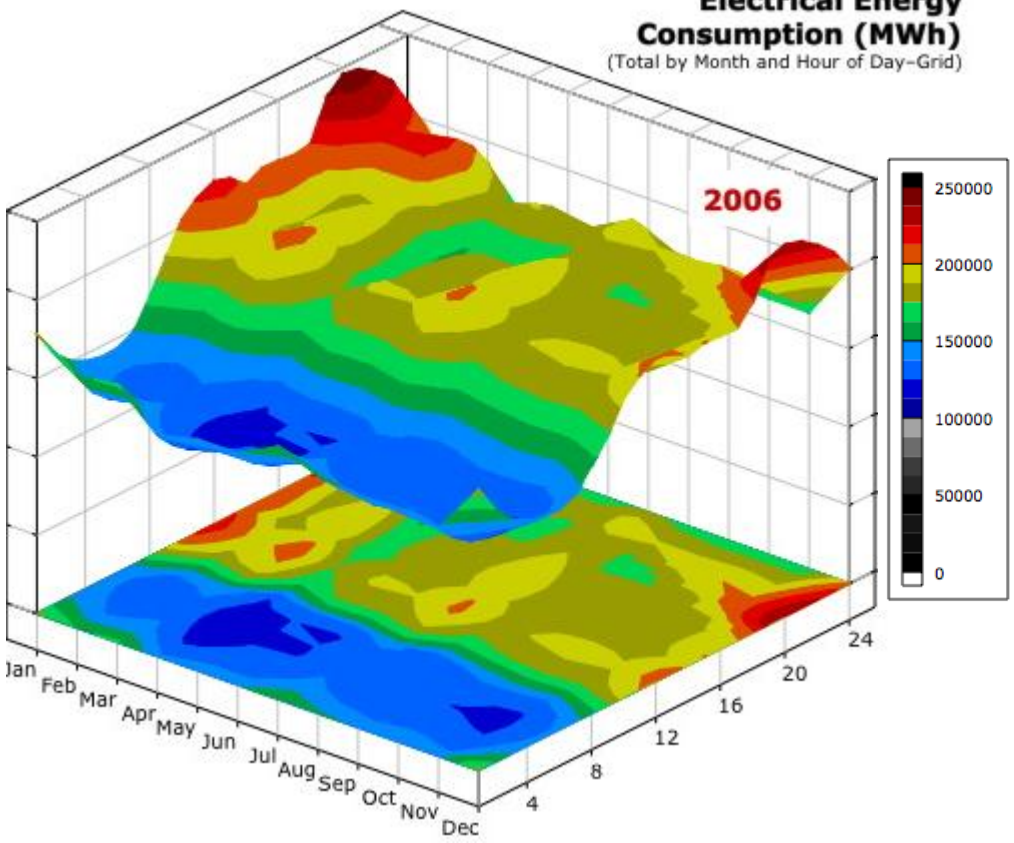
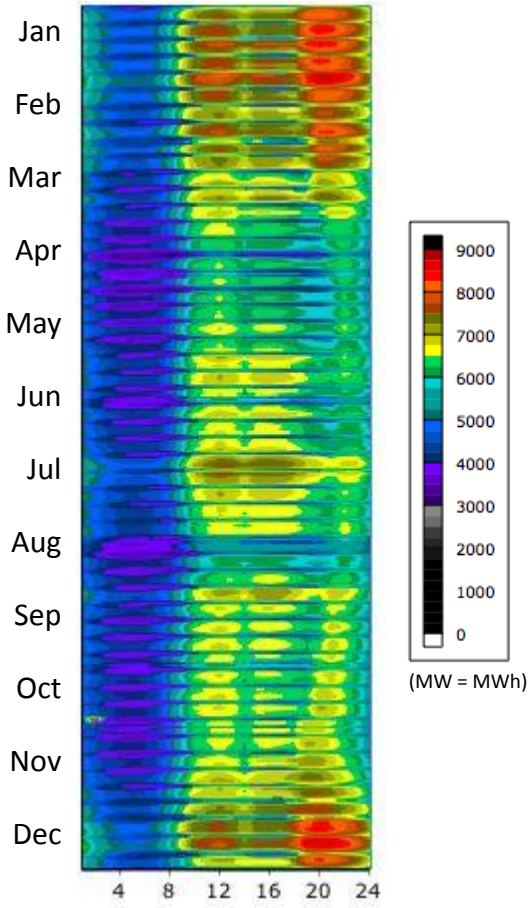
The difficulty…
Higher resolution for a better design



Electricity Demand 2006 (REN Data)



Hourly Electric Demand

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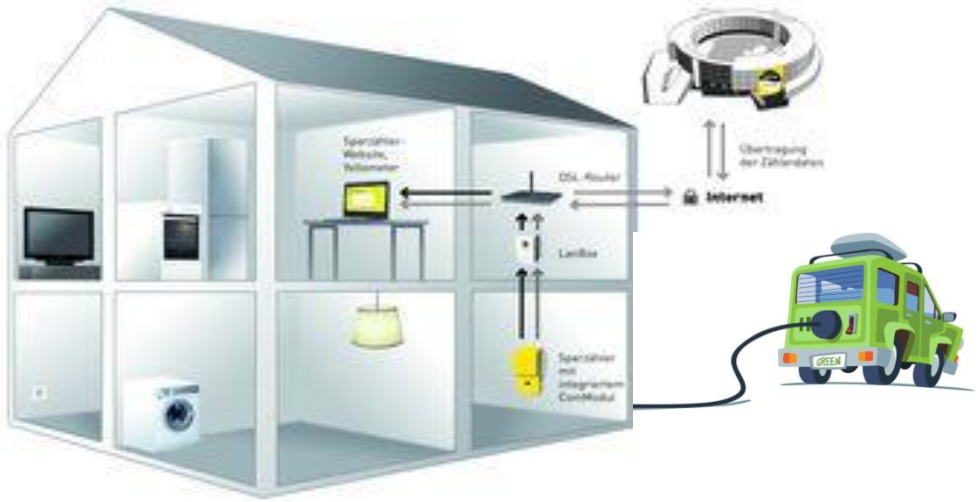
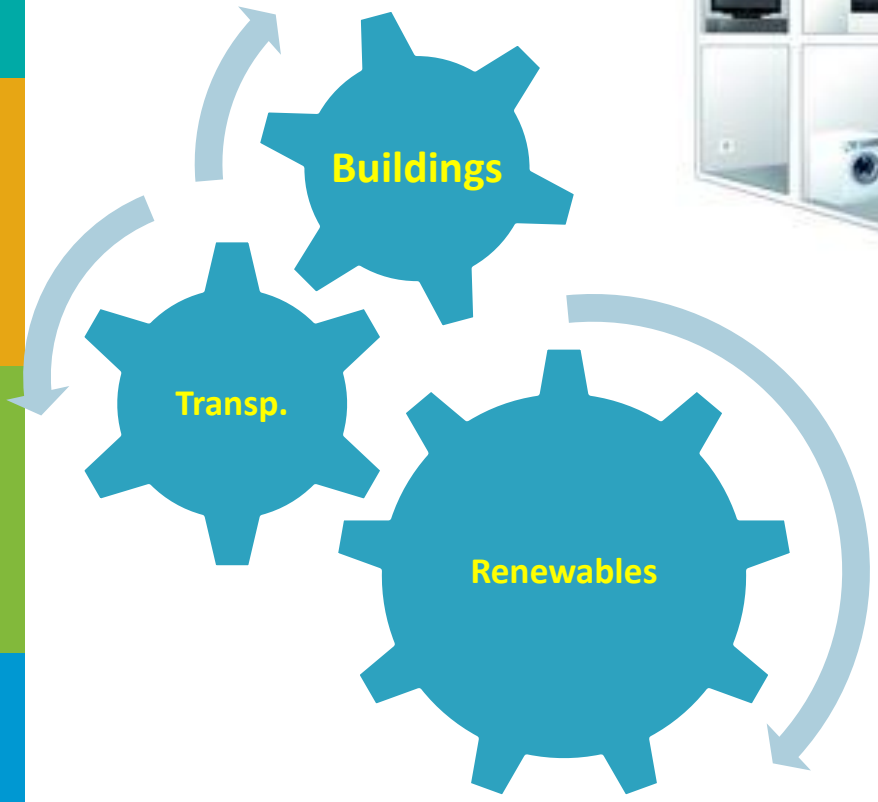
The challenge





The “secret” is that they need to cooperate, they are not working alone

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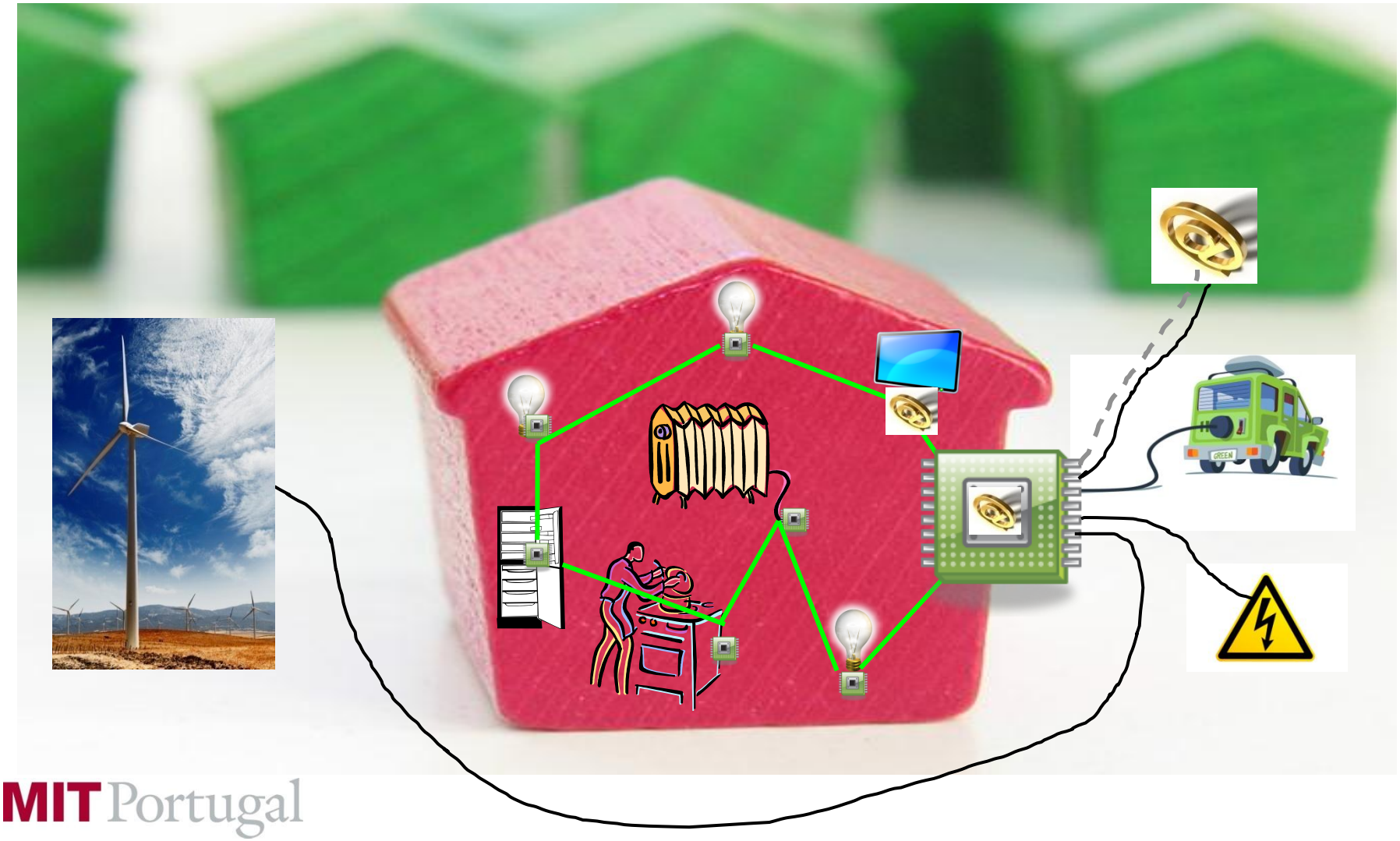
The future – Intelligent Energy Networks, the energy software revolution



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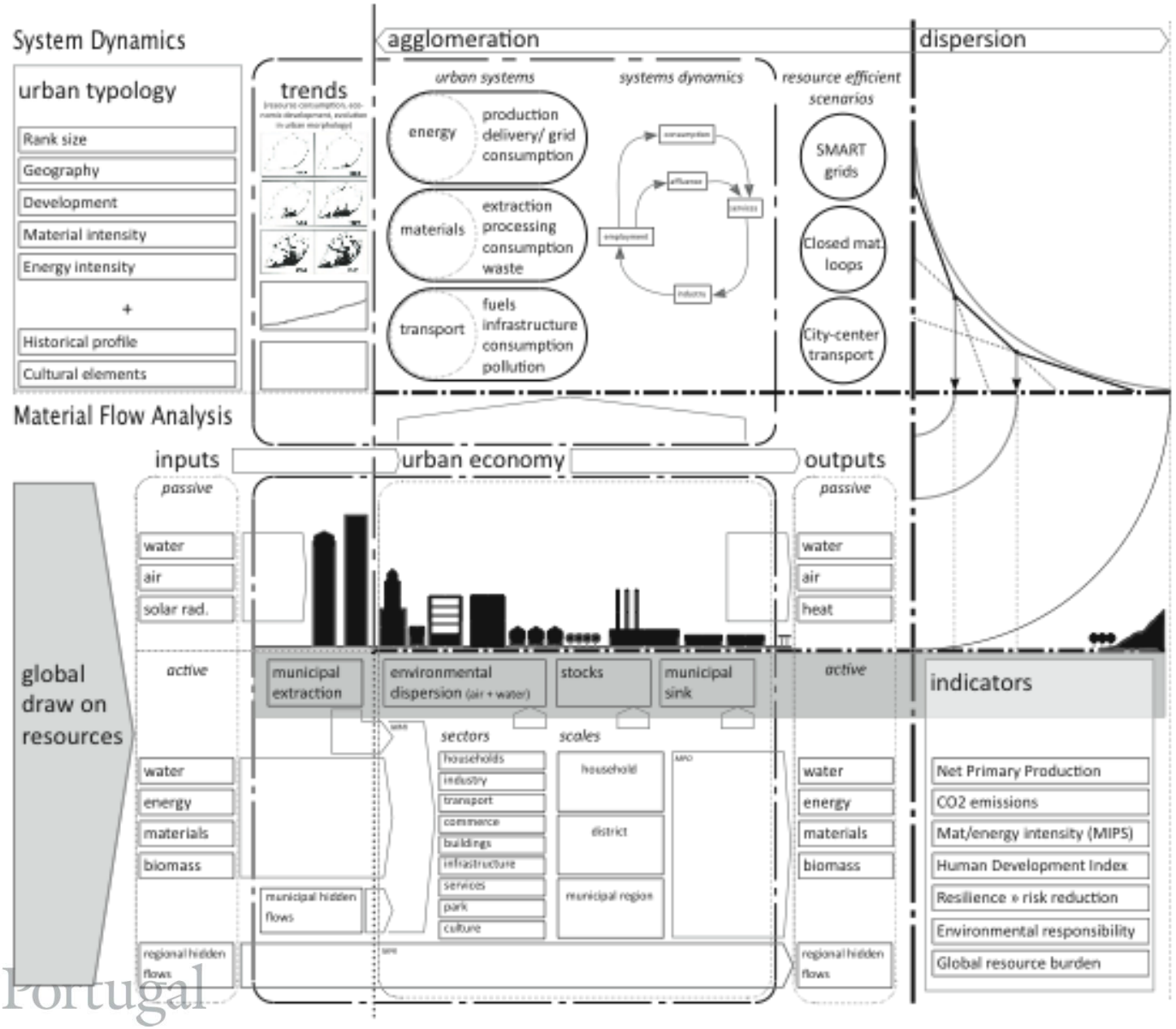
Urban Metabolism



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Renewables Integration

André Pina

Hourly dynamics of supply and demand in energy systems planning tools

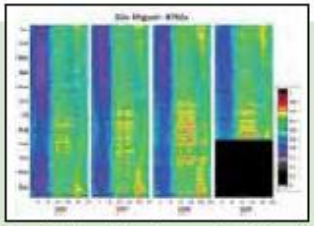


Fig. 1. Electricity demand variation in São Miguel

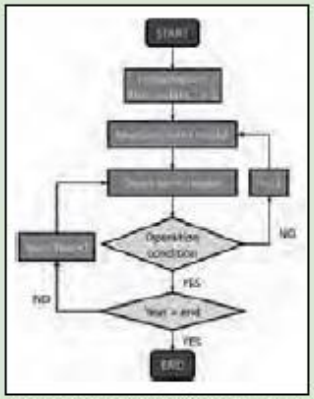


Fig. 2. Integrated modeling framework

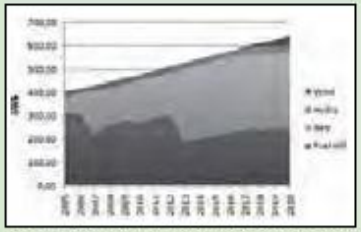


Fig. 3. Fig 3: Electricity production scenario using TIMES

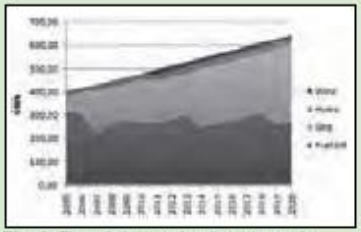
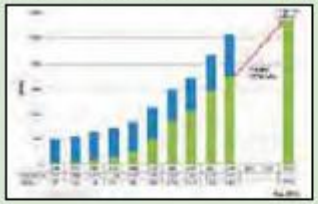


Fig. 4. Electricity production scenario using the developed framework

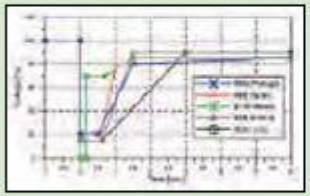
Grid management for large renewable penetration

António Santos

Portuguese installed Wind Power



Fault Ride Through capability:



Simulation results:

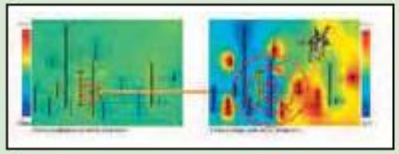


Fig.1 Short circuit simulation with the loss of large wind power generation

Fig.2 Voltages drops after short circuit simulation

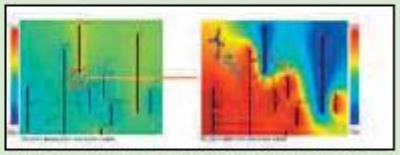


Fig.3 Short circuit simulation without the loss of wind power generation

Fig.4 Voltages drops after short circuit simulation

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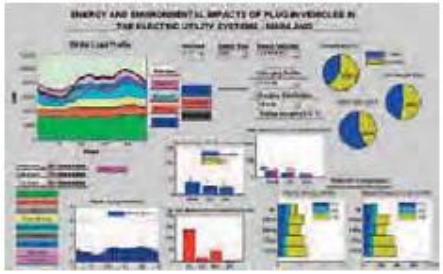
Electric Vehicles

Economic and environmental impact of EV in Electric Systems

Cristina Camus

Impact of V2G in grid operatio

Filipe Soares



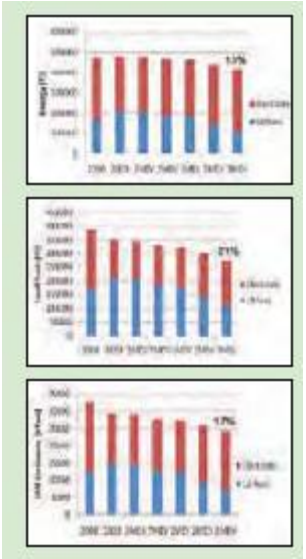


Fig. 1. Technical management and market operation framework for EV integration into electric power systems.

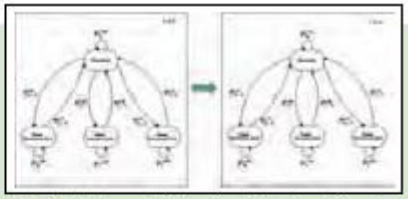


Fig. 2. Markov chain to simulate the drivers' behaviour

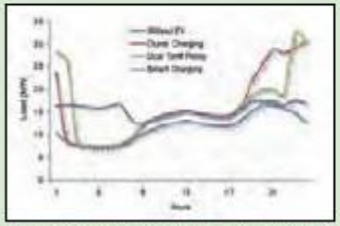


Fig. 3. Load diagram for a scenario with 50% of EV

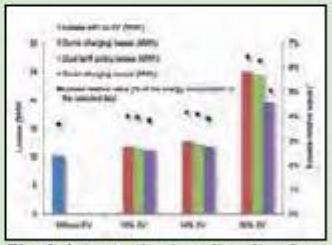


Fig. 4. Losses absolute (bars), referred to the left vertical axis, and their value relative to the overall energy consumption (crosses), referred to the right vertical axis.

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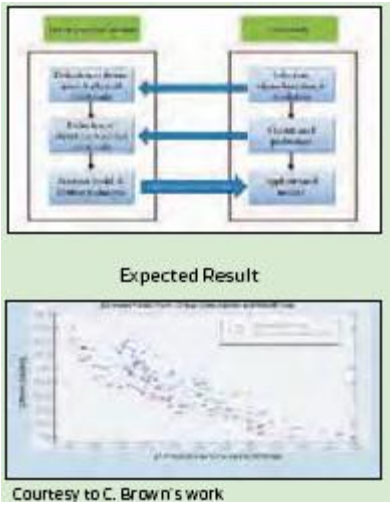
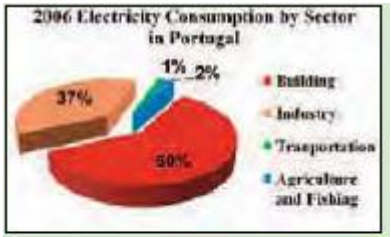
Buildings Retrofit

Ehsan Asadi

Multi-objective optimization of retrofit strategies





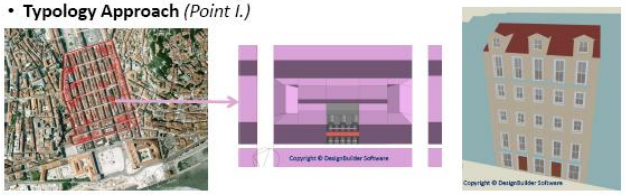
Dom Dinis Secondary School, Photography: Fernando Guerra e Sérgio Guerra

Energy Efficient Retrofit in Lisbon

Nuno Clímaco

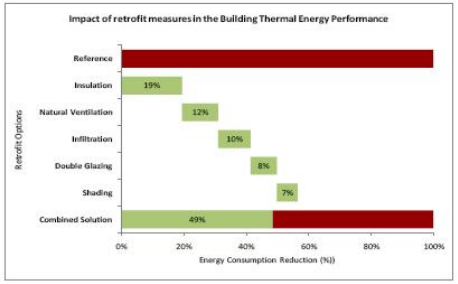
2 of the 6 typology monitored buildings

- **Typology Approach** *(Point I.)*



- **Results** *(Point II. and IV.)*

Not just energy savings (49%) but also the improvement of coupled comfort, air quality and health dynamics.



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Buildings Design

Gonçalo Cardoso

Decentralized Energy Production for sustainable built environmet

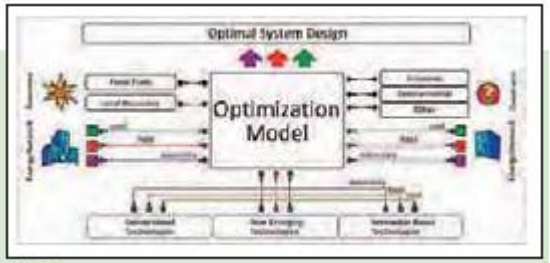

Fig 1.

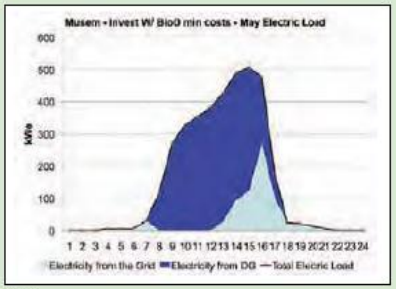

Fig 2.

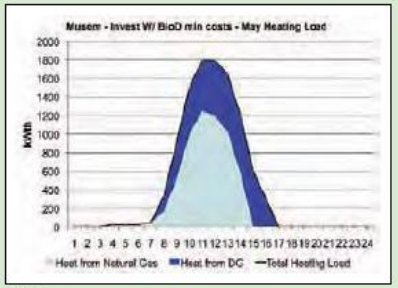

Fig 3.

Design of Carbon Neutral Buildings

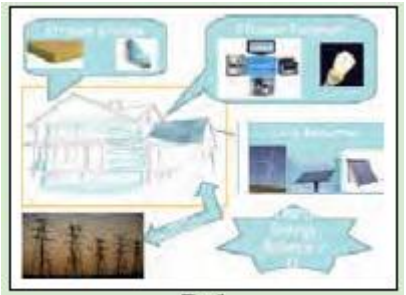

Fig. 1

Fig. 7

Maria Kapsalaki

Fig. 2 e 3

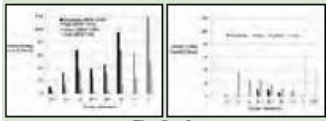

Fig. 3 e 4

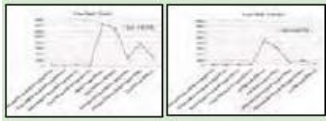

Fig. 5 e 6

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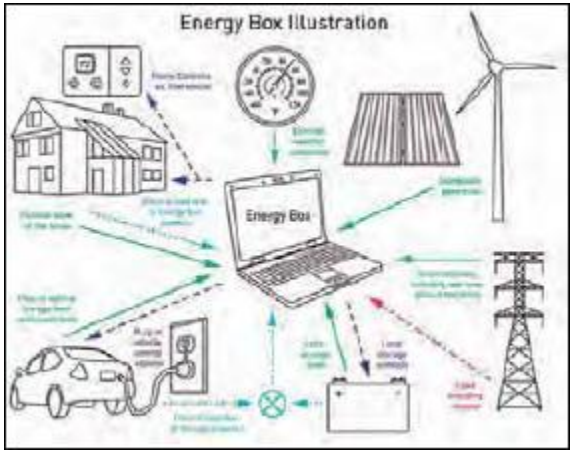
Energy as a Service - DSM

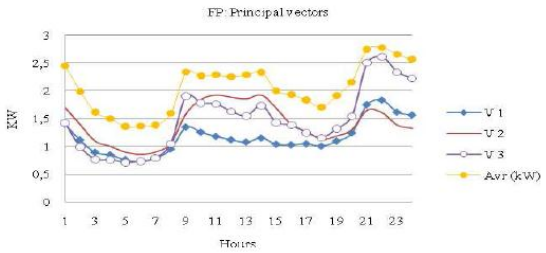
Daniel Livengood

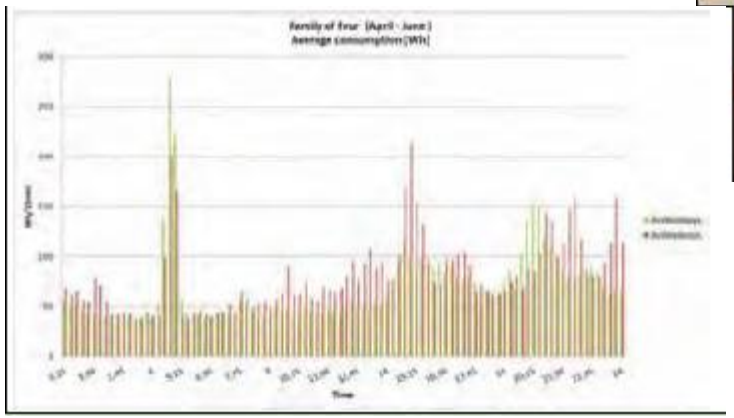
Locally automated control of residential energy use

Demand response in residential sector

Joana Abreu







MIT Portugal

Portugal spilovers - EIT

MIT Portugal

KIC Innoenergy partners

Emphasis on Entrepreneurship

Sustainable Energy

MIT Portugal

INNOVATION

MIT Portugal

Two Educational Thrusts

- (2008) 

  - Adaption of MIT I-Teams into Bioengineering program across multiple schools and schedules

- (2010) ISCTE-IUL MIT PORTUGAL
INNOVATION AND ENTREPRENEURSHIP INITIATIVE
  - 5 year “intervention” into Portuguese ecosystem
  - Triple Helix
    - Min. of Science/FCT
    - ISCTE-IUL, MIT
    - Caixa Capital/Catalysts

Impact of Innovation Education

BIO Engineering	26 Portuguese Principal Investigators and 54 students 18 Portuguese technologies scrutinized by students using the methodology adapted from MIT. 66% projects (12) acted on the student recommendations to develop startups and industrial partnerships, refocus research, or develop new IP. The net effect of all innovation education activities in bioengineering in their first three years: • 4 startup projects • 6 new partnerships involving a research lab and industry. • 2 startups initiated by BioTeams alumni at a rate of one per student cohort. • ***Students used their innovation training to identify the technologies articulate the innovations and initiate the company already while continuing their PhD studies.*** We trained 14 Portuguese faculty on the pedagogy behind i-Teams at MIT. • These faculty joined the distributed team leading bio-teams. • At least one course inspired in the i-Teams pedagogy was created in IST in the area of clean technologies.
EDAM	Adapted i-Teams pedagogy to strengthen the collaboration with and leverage the network UTEN 60+ students analyzed IP from the UTEN network to identify viable opportunities.

100+ students, 4 startups, 3 new patents, 6 new academia-industry partnerships, 2 commercialization projects ongoing, 14 faculty trained on innovation methodology

DNAMiMics
Time-saving knowledge

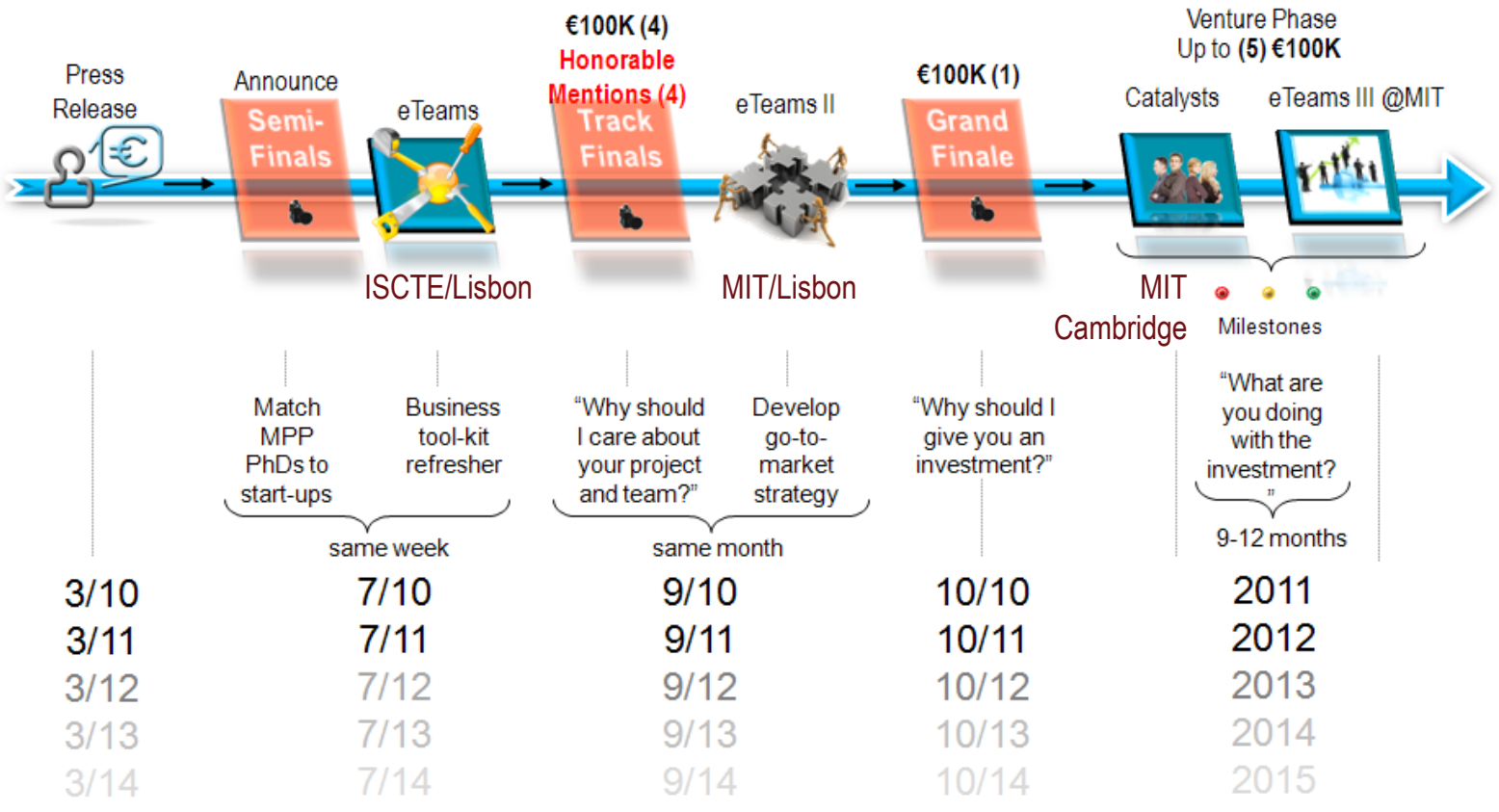
SILICOLIFE
Computational Biology Solutions for the Life Sciences

ion jelly

CELL2B

Venture Competition Architecture

Connect Innovators and Investors™



MIT Portugal

ISCTE IUL Instituto Universitário de Lisboa

AUDAX

CAIXA empreender+ AWARD Caixa Geral de Depósitos

Cambridge innovation Center

MIT Entrepreneurship CENTER

DESHPANDE CENTER FOR TECHNOLOGICAL INNOVATION

FCT

Venture Competition Awardees

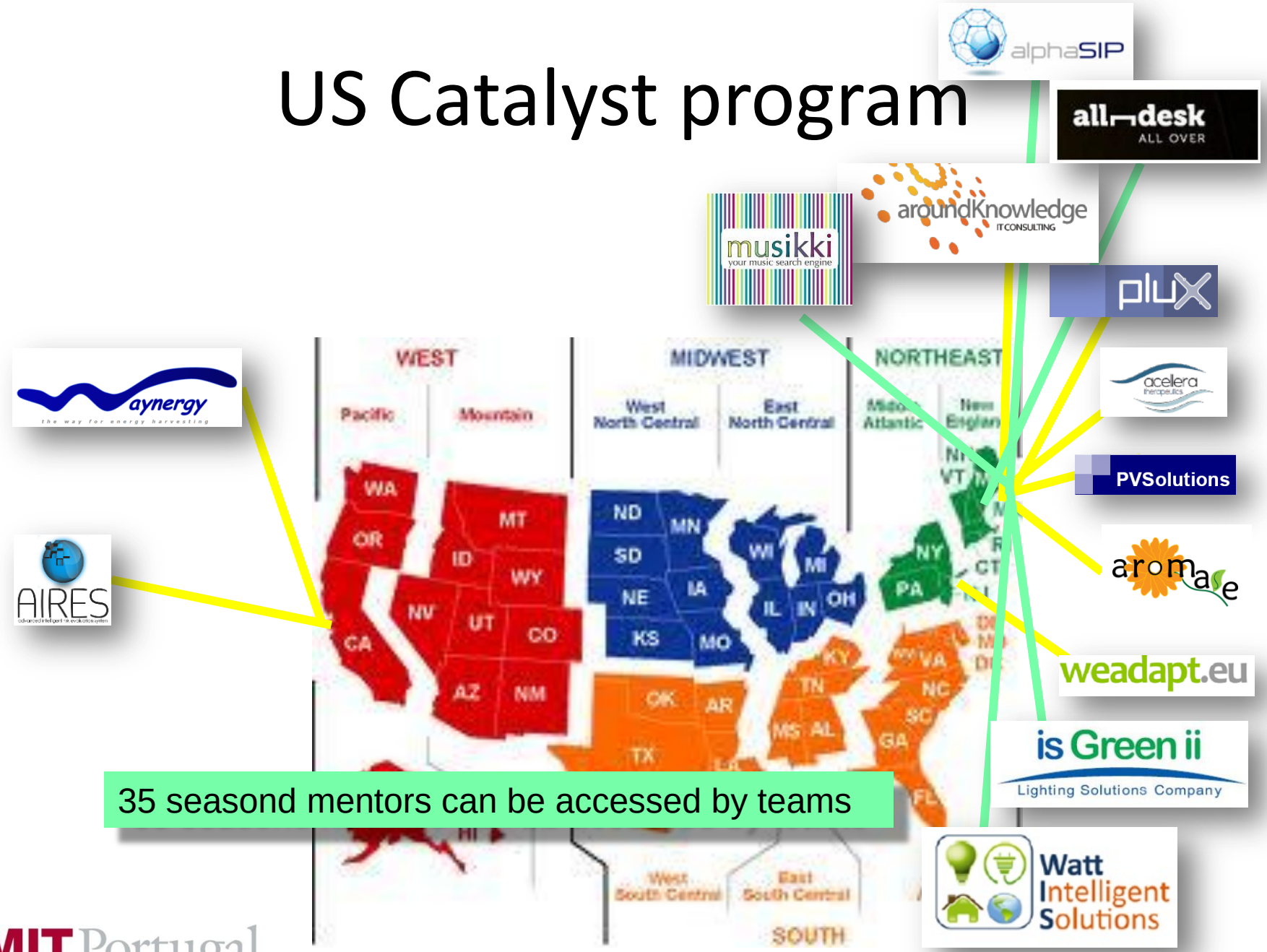
2010 Participants			Type
Accelera	cell therapy for liver transplant	LS	SO
Cell2B	cell therapy to diminish organ rejection	LS	SO
Plux	Stroke rehab P/T biofeedback	LS	SO
Regenear	facial cartilage regenerator	LS	SO
TreatU	breast cancer delivery module	LS	SO
Critical Move	Driverless, trackless cyber cars for inter and intra campus "last mile"	ET	SU

2011 VC Participants			Type	Institution
AlphaSIP	Cardiovascular and hematology medical diagnostics CNT chip	LS	SU	
Blue Works	Autonomous device and decision support system for Ophthalmology	LS	SO	U Coimbra
MediaOmics	Cell culture provider (biologics)	LS	SO	FCT
MetaBlue	Household Otoscope	LS	SO	FEUP
Cyclotech	Technetium supplier, a key material for Nuclear Med analysis	LS	SO	
AlgaeLiquor	Microalgae based oil and protein producer	E&T	SU	
Strato POWER	Dirigible wind turbine	E&T	SU	
Watt Intelligent Solutions	Smart meter	E&T	SO	MPP
Actual Sun	Independent solar baseline monitor	E&T	SU	
isgreen	Intelligent LED lighting to replace fluorescent lighting	E&T	SU	
selfTech (GolMow)	Robotic golf course lawn mower	P&S	SO	IST
Wi-Go	Kinect-driven shopping cart	P&S	SO	Univ Beira
hole19golf	Golfing social networking PDA app	P&S	SU	
Law4All	Freemium "Westlaw" for non-lawyers	P&S	SU	
Musikki	Kayak for music info	P&S	SU	
All-Desk	On-line realtor for unused offices	IT&W	SU	
Eunoia	Cellphone based music sharing	IT&W	SU	
eupa	GPS enabled vital sign tracker for the aged	IT&W	SU	
NetMust	Digital Music Rights platform in Portugal	IT&W	SU	
One Care (Intellicare)	Wireless, home-based devices to gauge health (weight, glucosometer, …)	IT&W	SO	

Tech Transfer

12

US Catalyst program



35 seasond mentors can be accessed by teams

MIT Portugal

2010 Venture Competition Impact

MIT Portugal-affiliated early stage ventures (as of 8/2011)	MPP Total	BioTeams	IEI
Companies	22	3	19
Business Plan awards	190,000 €	30,000 €	160,000 €
Venture investments and loans	4,400,000 €	750,000 €	3,650,000 €
Subtotal	4,590,000 €	780,000 €	3,810,000 €
Proposed venture investments	5,600,000 €		
2015 Revenue Potential*	3,000,000,000 €		

*Based on venture business plans

MIT Portugal

“Connecting Innovators and Investors”

- ~230 VCs, angels, strategic investors managing US$3,000,000,000
- 169 founders of startups in various venues:
  - Founders’ Reception, DogPatch Labs, TechStars, MassChallenge, and Venture Café
- 11 startup founders who led interactive sessions:
  - “Demystifying Early Stage Financing,” “Launching in the US,” “Sales for Technical Founders,” “Growing the Right Team,” and “Peer Panel”
- 6 thought leaders who led interactive sessions:
  - Prof. Fiona Murray (MIT Sloan), Entrepreneurship Coaching
  - Bill Aulet (MIT Sloan), Entrepreneurial Marketing
  - Joseph Hadzima (MIT Sloan), Dos and Don’ts, Observations of Hundreds of Companies over 30 Years
  - MIT TLO
  - Joost Bonsen (MIT MediaLab), MIT Innovation Tour

MIT Portugal

Impact of Innovation Ecosystem Capacity Building

Portuguese participants of MPP innovation

- Participation through bio-teams
  - 56 industry professionals became mentors and experts to the bio-teams experience
  - An estimated 200 professionals from the local ecosystems in Minho, Porto, Lisbon, and Coimbra participated as audience in the different events.
- Participation through the IEI venture competition
  - Involved twenty (20) international judges to select awardees;
  - 800+ innovators and investors in audience participation over three events
  - 20 Portuguese professionals and 20 US-based professionals mentored teams throughout the competition
- Media attention reinforcing the “Branding” and authored multiple press releases: “Connecting Innovators and Investors”

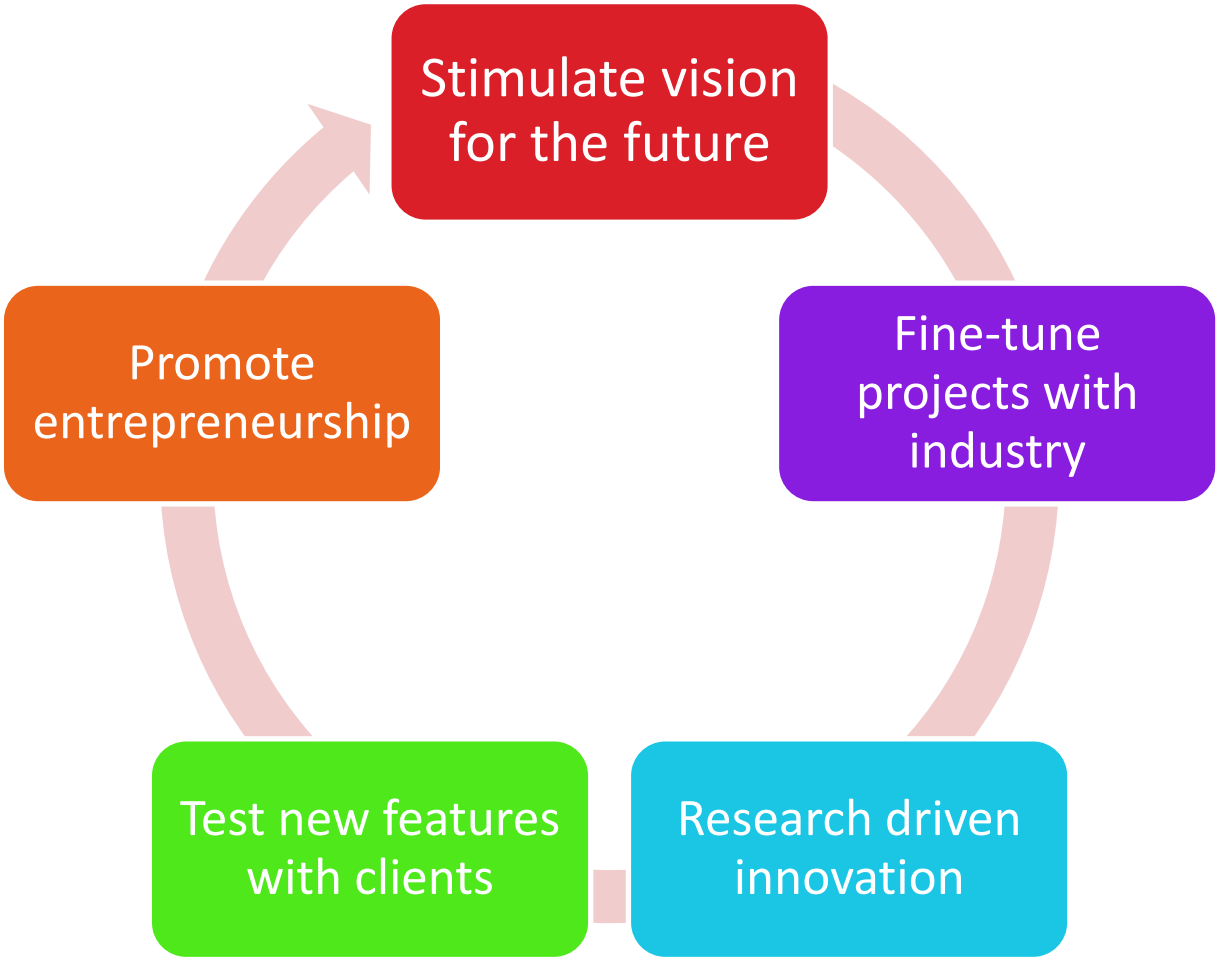
Over 1000 innovators, industry experts, mentors, judges, … became part of MPP’s extended family through their direct participation of these innovation activities. Many more learned about MPP’s commitment to innovation through the media

MIT Portugal

Transforming research in an energy startup

MIT Portugal

MPP innovation process



MIT Portugal

Stimulating vision for the future

Combined heat and power production and management

Smart Appliances

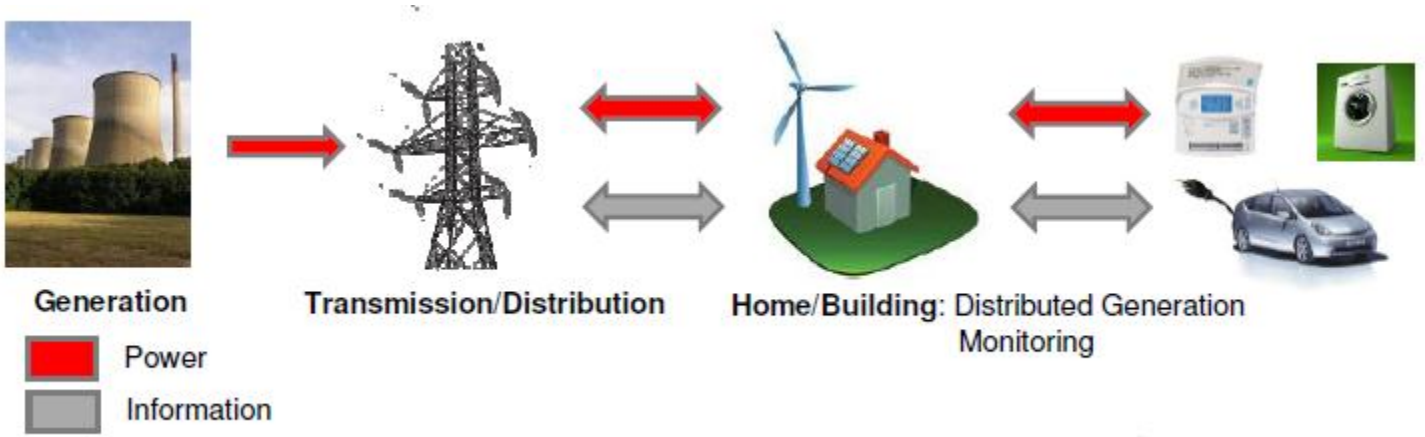
End user engagement

Storage

Nearly netzero buildings

MIT Portugal

Systems thinking

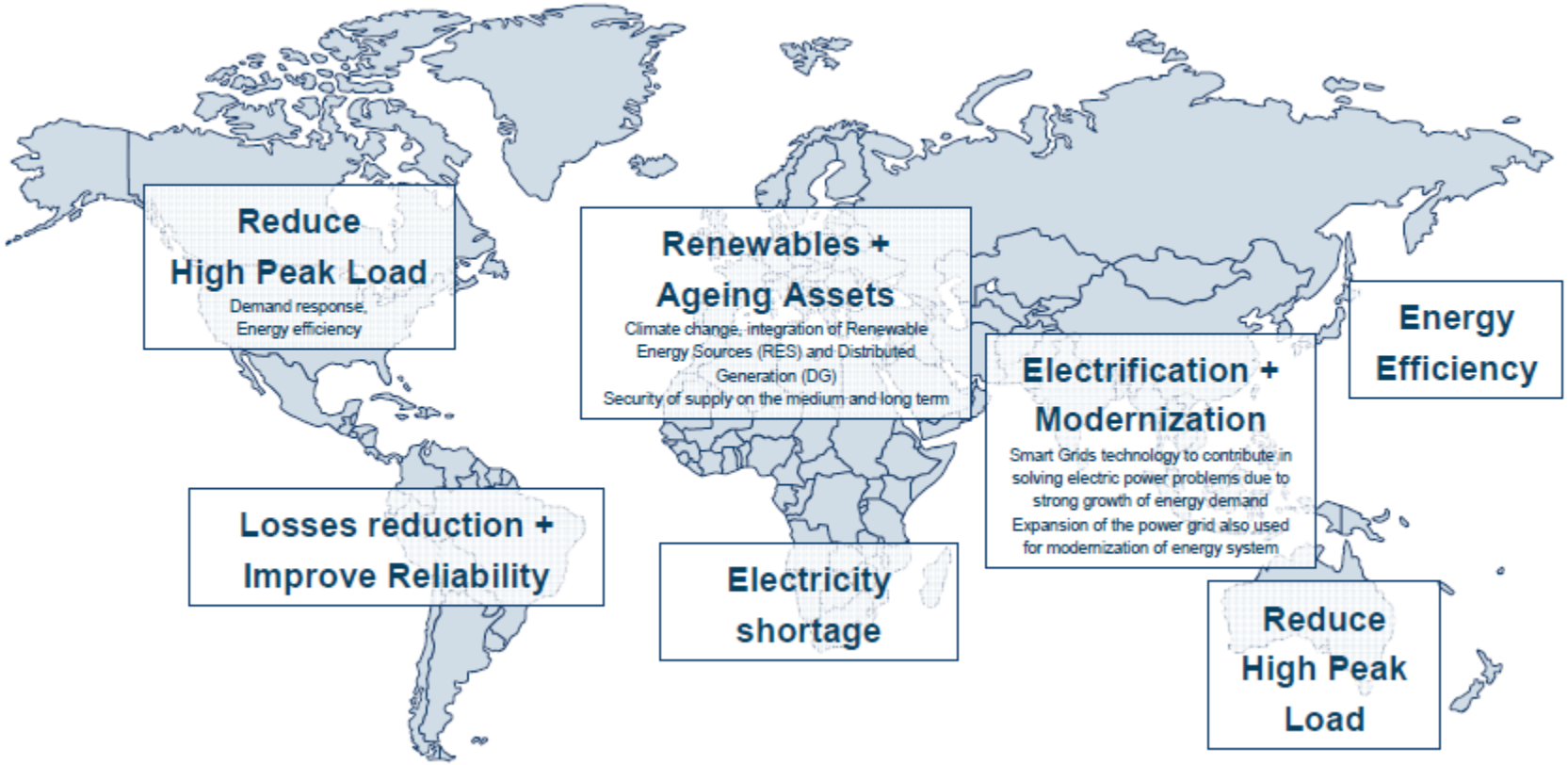


Information is equal to…

- Benefits to utilities
  - Self-monitoring
  - Automated restoration
  - Monitor equipment remotely
- Benefits to consumers
  - Access to information
  - increase customer choices
  - Promote energy efficiency

MIT Portugal

Solutions have a context



MIT Portugal

KEMA

Fine tune projects with industry

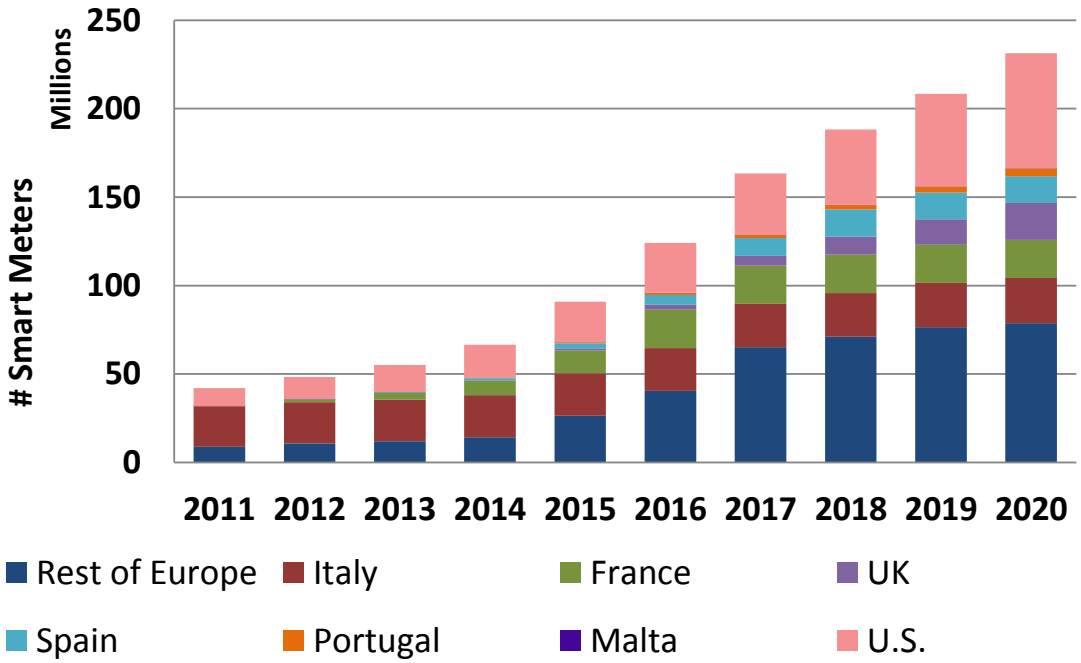
- Benefits to consumers
  - Direct feedback electricity & gas
  - Energy efficiency measures
  - Social comparison

- Benefits to utilities
  - Demand response for thermal storage
  - Microgeneration management

The opportunity

EU Directive 2009/72/EC establishes that **until 2020, 80% of the energy customers shall have smart meters installed.**

225 Million meters alone in the EU and the U.S. are expected to be installed **by 2020**



China: 1Billion

Russia: 50 Million

Brazil: 62 Million

India: 1 Billion

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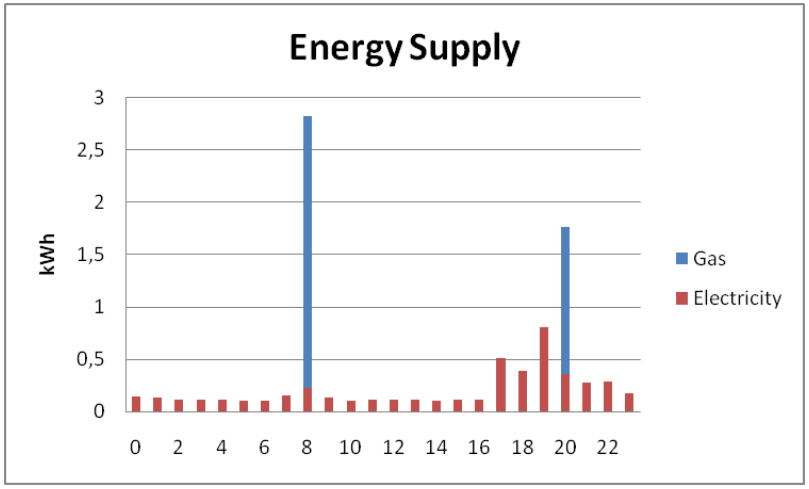
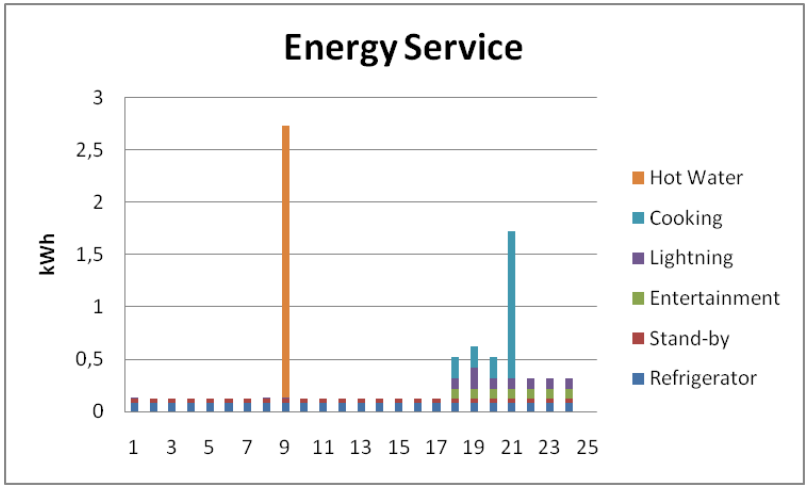
The idea





- **Direct feedback to customers**
  - specific energy efficiency measures
  - estimate potential savings
  - compare it with other households
- **Information to utilities**
  - client segmentation
  - reinforce customer relationship
  - induce changes in consumer behavior

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Research driven innovation

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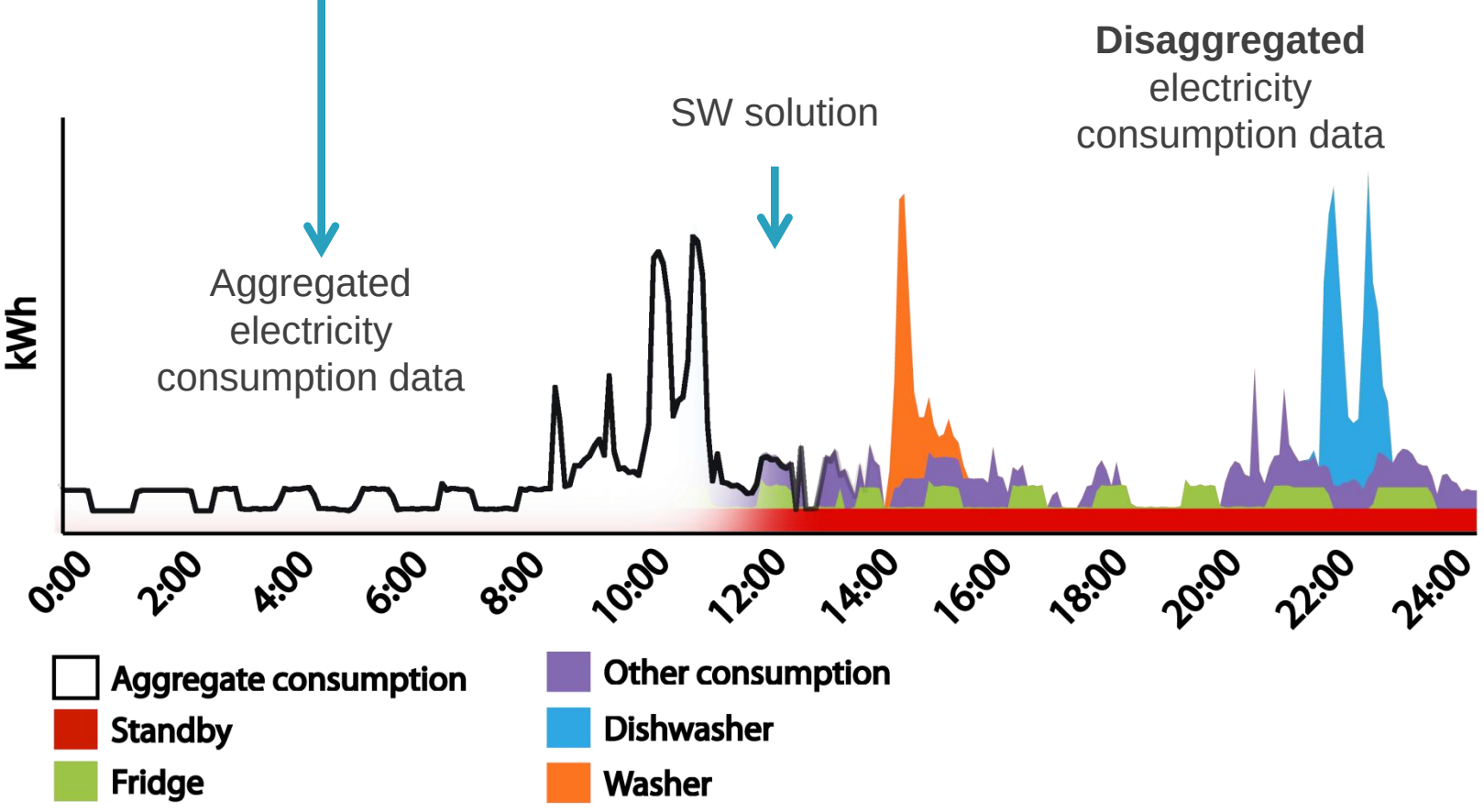
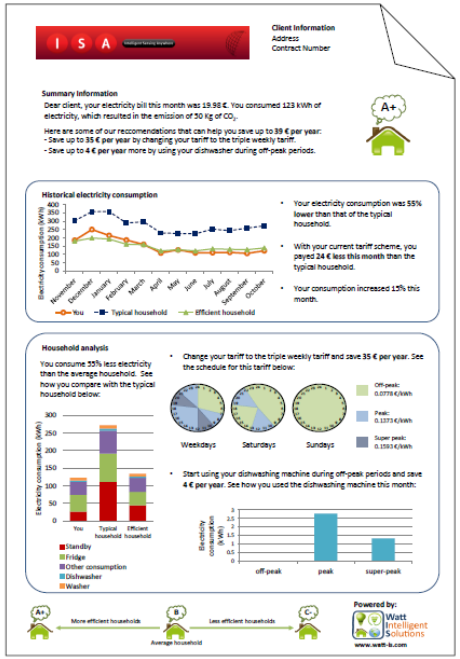
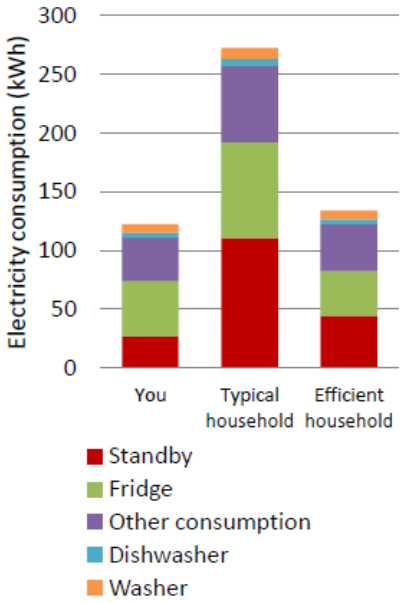


Test the service with clients

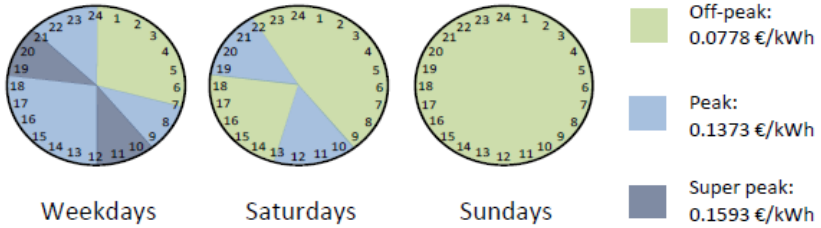


Household analysis

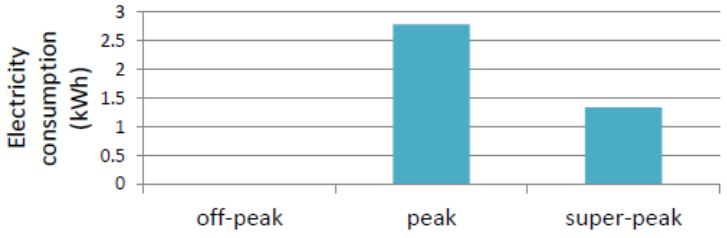
You consume 55% less electricity than the average household. See how you compare with the typical household below:



- Change your tariff to the triple weekly tariff and save **35 € per year**. See the schedule for this tariff below:



- Start using your dishwashing machine during off-peak periods and save **4 € per year**. See how you used the dishwashing machine this month:



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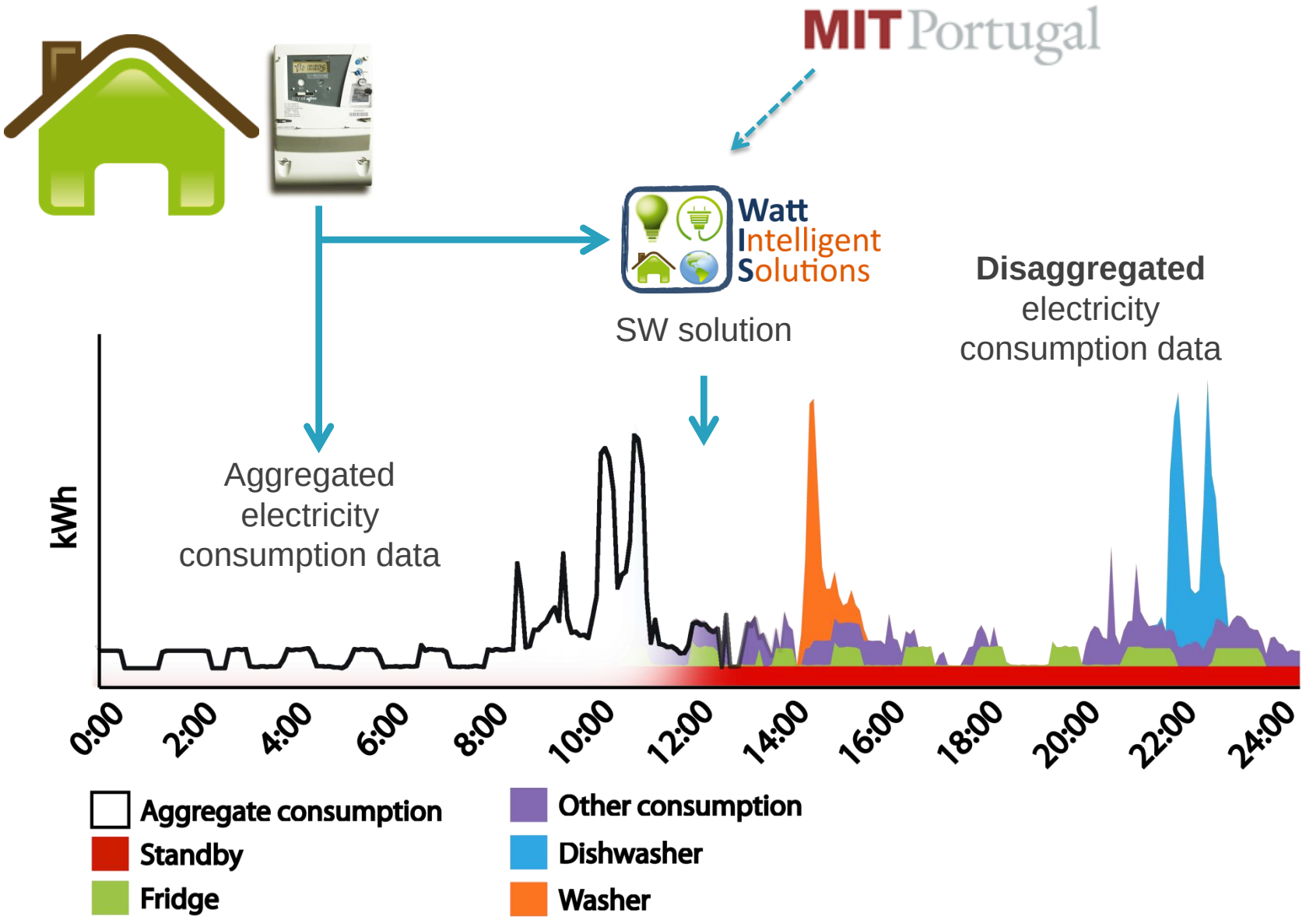
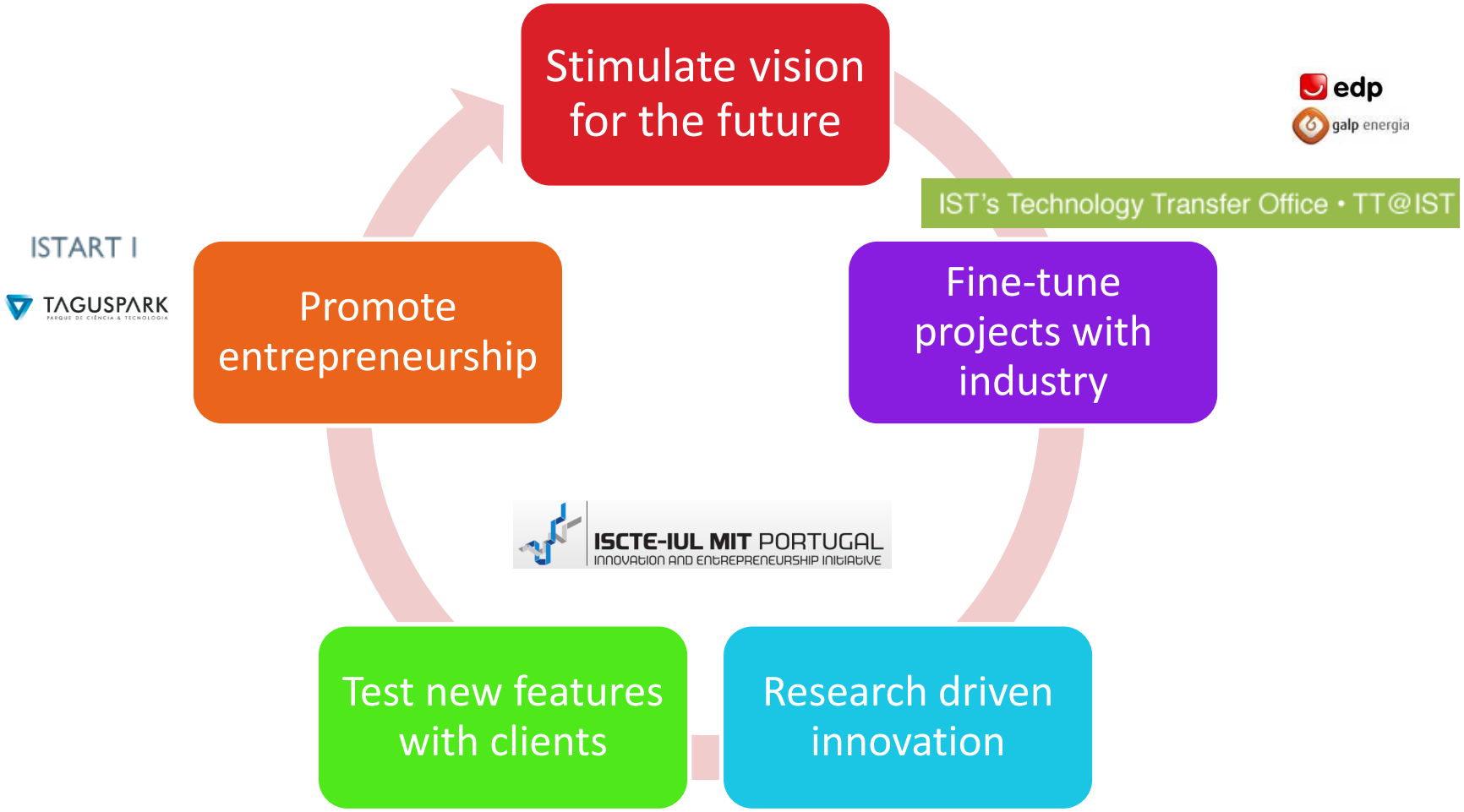
Promote Entrepreneurship



MPP innovation process



REFLECTIONS AND LESSONS LEARNED

MIT Portugal

REFLECTIONS

- MPP has achieved its Overall Objectives for both Portugal and MIT
- MPP has been beneficial for Students and Faculty
- Buy in of university administrators important. Engineering Deans at Endicott house
- Challenges:
  - Culture Matters
  - It Takes Time
  - Human Resource Needs in Portugal
  - Changes in Research Process
  - Industrial Participation
- The Future:
  - Original Plan For a Ten Year, Two-Phase Program
  - Portugal Committed To MPP 2 – Work Plan will Build upon MPP 1, Emphasis on Entrepreneurship.

REFLECTIONS

- Educational PhD programs were unique blending technology with system thinking, innovation and entrepreneurship. Example of leadership course
- EDAM interns at multinational outside Portugal
- Objective was to create innovation ecosystem in Portugal
  - Seminars in Portugal with MIT experts.
  - Portuguese technology transfer officers intern at MIT
- Buy in of university administrators important. Engineering Deans at Endicott house
- MIT Europe conference held in Lisbon
- Impact of Visit of Susan Hockfield

UNIVERSITIES – PEOPLE- IDEAS - ENTREPRENEURSHIP

the challenge is out there…

… *Let´s cooperate to take the opportunity*.

MIT Portugal