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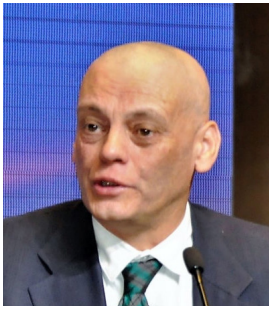
Message from the EfS Coordinator

Manuel Carlos Gameiro da Silva

Full Professor, M Sc, Ph.D, Aggregation

Full Professor at Department of Mechanical Engineering, Faculty of Sciences and Technology of the University of Coimbra. Scholar of the MIT-Portugal Program. Invited Professor of the Master Course GBBV Green Buildings, Batiments Verts at ENTPE – University of Lyon, France. Coordinator of the Sustainable Energy Thematic Line of I-LAETA and Vice-President of Rehva. Chair of the Education Committee of Rehva.



A Iniciativa Energia para a Sustentabilidade (EfS) da Universidade de Coimbra tem sido, para todos os que nela têm estado envolvidos, ao longo dos 12 anos que já decorreram desde o seu lançamento, um desafiante espaço de partilha e criação de ideias e conhecimento.

Nasceu e cresceu, de baixo para cima, como uma iniciativa marcadamente multi e interdisciplinar, envolvendo docentes e investigadores com formações de base muito diversas e provenientes de várias unidades orgânicas e diferentes unidades de investigação ligadas à Universidade de Coimbra que, em comum, têm um interesse nas questões da sustentabilidade energética e ambiental.

A Iniciativa cobre as áreas de atuação em que normalmente se desenvolve a atividade das instituições universitárias, nomeadamente a investigação, o ensino, a formação pós-graduada, a difusão do conhecimento, a inovação e a transferência de tecnologia.

Agora, mais do que nunca, devido às situações que se colocam à humanidade num preocupante cenário dominado pela emergência climática e pela procura urgente de soluções, esta iniciativa é particularmente relevante. Neste momento em que a Europa lança o programa Green Deal, ela será certamente uma das formas adequadas de a Universidade de Coimbra e os seus parceiros responderem aos desafios que lhes vão ser colocados.

Este Yearbook, lançado pelo Comité de Investigação Científica e Ligação às Empresas (CICLE), para além de dar a conhecer os projetos e as pessoas envolvidas nas atividades da iniciativa EfS, pretende também lançar as sementes para os novos desafios que certamente se colocarão no futuro próximo a todos aqueles que estão motivados para dar uma contribuição significativa para que o nosso planeta continue a ser o lar das gerações vindouras.

The Energy for Sustainability (EfS) initiative at the University of Coimbra has been, for all those who have been involved in it over the 12 years that have passed since its launch, a challenging space for sharing and creating ideas and knowledge.

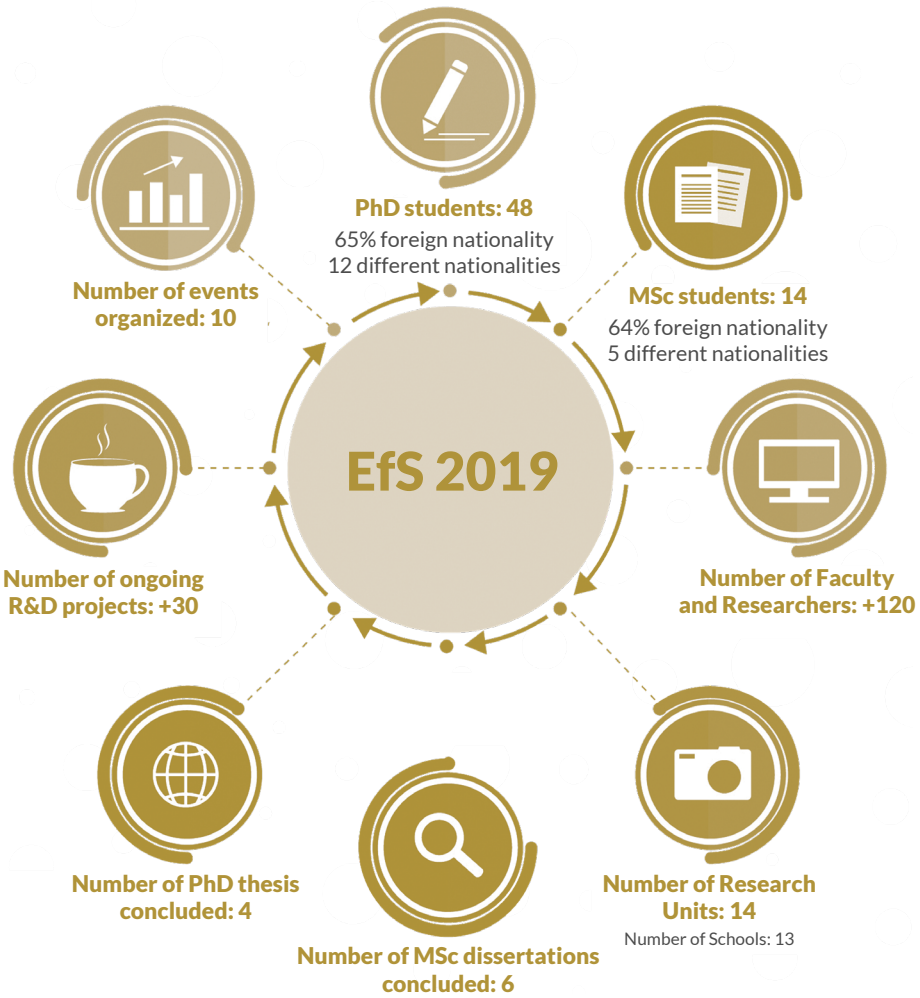
It was born and it grew, bottom-up, as a markedly multi and interdisciplinary initiative involving faculty professors and researchers with very diverse backgrounds and coming from various Organic Units and different Research Units linked to the UC that share an interest in issues of energy and environmental sustainability.

The initiative covers working areas in which the activity of university institutions is usually developed, namely research, teaching, postgraduate training, the dissemination of knowledge, innovation and technology transfer.

Now, more than ever, due to the situations humanity is facing in a worrying scenario dominated by the climate emergency and by the urgent finding of solutions, this initiative is particularly relevant. At a time when Europe is launching the Green Deal program, it will certainly be one of the appropriate ways for the University of Coimbra and its partners to respond to the challenges that will be placed on them.

This Yearbook, launched by the Committee for Scientific Research and Outreach (CICLE), in addition to disseminating the projects and people involved in the activities of the EfS initiative, also intends to lay the seeds for the new challenges that will certainly arise in the near future to all those who are motivated to make a significant contribution so that our planet continues to be our home for the future generations.

EfS 2019 in numbers



Experiences

The program exposes its student cohort to the reality that to tackle our energy and sustainability challenges we need to collaborate across fields of expertise and geographies. This is visible in the course units that make up the taught part of the Masters and Ph.D. program, as well as in the knowledge gaps and research designs seen on student's dissertations.

Guillermo Ivan Pereira, EfS Alumni

My experience in the EfS initiative has gone beyond just academics. It has been fascinating to meet classmates and fellow researchers who come from a variety of backgrounds, and the multi-cultural environment of the programme is truly something to be appreciated. Moreover, the vast experience of the lecturers in energy, sustainable development, and particularly the more economics-oriented courses, have answered and clarified several issues I have faced in my field. I believe the skills I have been gaining throughout the course will help me attain a more pragmatic, innovative, and holistic view of these issues, and consequently, become a more well-rounded sustainability professional.

Jade M. Carneiro, EfS MSc student

The EfS Master's program being multidisciplinary, was of extreme importance for my understanding of the sustainable area in all aspects, economic, environmental and social, within the framework of my branch of research in advanced biofuels.

My satisfaction with the program made me feel motivated to continue in the Ph.D. program in Sustainable Energy Systems in 2017, where my research is currently focused on the production and regulation of the advanced biofuels use in the maritime sector.

Vinicius Andrade dos Santos, EfS PhD candidate

Foi o carácter transdisciplinar da iniciativa EfS que me fez escolher a UC para aprofundar os meus conhecimentos pois penso que esta iniciativa (tanto durante o mestrado como no programa doutoral) consegue reunir pessoas, entidades e áreas do saber muito distintas mas complementares de forma a responder aos desafios multidisciplinares que a atualidade nos apresenta.

Vanessa Tavares, EfS PhD candidate

PhD concluded in 2019

Gabriela Oliveira

Market dynamics of eletric vehicles in Portugal: Coupling preference modeling and diffusion analysis

Supervisor: Luís Cândido Dias

ABSTRACT

Electric Vehicles (EVs) have been considered as potential solutions to reduce the environmental problems from road transport. However, in order to boost EVs market penetration in Portugal a more comprehensive approach of the market is required. Therefore, this work consisted in the joint analysis of consumer preferences and diffusion of EVs in order to identify the structure of consumer preferences and to verify its impact on market dynamics of EVs. A multiple and interlinked methodology that included two preference elicitation methods and System Dynamics was used. Three results can be highlighted regarding future pathways towards a significant market share of EVs. First, Fuel/electricity consumption was found to be the most relevant attribute for Portuguese consumers. Second, Plug-in Electric Vehicles were the most preferred vehicles with the price was found to be their major barrier. And third, the definition of purchase subsidies based on the evolution of preferences showed to be more time and cost-effective to foster future adoption of EVs.

CURRENT PROFESSIONAL ACTIVITY

Responsible for the process of consumer satisfaction analysis in a company from the ceramic sector in Portugal.

Guillermo Pereira

Assessment of Policy, Technology, and Business Model Adaptation for Smart and Sustainable Electricity Distribution

Supervisor: Patrícia Pereira da Silva

ABSTRACT

This thesis focused on the changing role of electricity distribution system operators (DSOs) and contributed to a more detailed understanding of policy, technology, and business model adaptation towards smart and sustainable electricity distribution. This was delivered through three policy-oriented empirical assessments. Firstly, a foresight analysis implemented through a Policy Delphi expert elicitation technique was developed, evaluating future alternatives to inform business model innovation, technological adaptation, and market design options. Secondly, a case study approach was conducted highlighting the DSO's challenges and opportunities at present. Lastly, a capabilities assessment was carried, exploring the ability of DSOs to implement business model innovations and adaptation in a rapidly changing electricity sector. The findings indicate a future in which DSOs continue with their core electricity distribution responsibilities, while expanding their business model to facilitate flexibility services, by integrating distributed energy resources in their operations. These future possibilities are contrasted with empirical evidence of a present situation in which DSOs are challenged by corporate inertia and regulatory barriers to pursue innovative business models and deploy smart grid technology, particularly in which the value of full-scale rollouts of smart meters remains uncertain for DSOs. These results obtained enhance the relevance of network infrastructure to support the ongoing energy transition and validate the ability of DSOs to expand their business model and adjust their value capture and creation processes.

CURRENT ACTIVITY

Postdoctoral Research Associate in Sustainable Energy Innovation at the Manchester Institute of Innovation Research, The University of Manchester.

João Carrilho

Contributions to the Study of the Indoor Environment through Online Monitoring of its Physical Parameters

Supervisor: Manuel Gameiro da Silva

ABSTRACT

Several aspects of the implementation of continuous monitoring of the indoor environment are explored in this thesis, and a selection of approaches is contributed towards mitigating some of the difficulties encountered in the development of such monitoring systems. One immediate advantage of continuously monitoring the indoor environment is simply making visible objective measures to the building occupants, and thus contributing towards informing and educating to make them part of inclusive energy saving solutions. Other advantages are, for instance, the possibility to correlate current conditions to past events, which in turn opens the path to the prediction of extreme conditions, adaptive model identification and energy optimised control of the building systems, while ensuring a healthy and comfortable indoor environment. This continuous monitoring can be implemented with low-cost sensors that are readily available on the market today and have sufficient quality to provide indicative measures of most physical parameters of interest.

Vivek Singh

Assessing energy-efficiency market transformation: the case study of a developing Asian country

Supervisors: Carla Oliveira Henriques, António Gomes Martins

ABSTRACT

A novel Input-Output (IO) modelling framework has been designed by introducing a bottom-up approach into an IO model which is combined with technical data for the holistic assessment of nine energy efficient technologies. Two modelling formulations were also suggested which combine the use of the Economic IO Lifecycle (EIO-LCA) assessment with multiobjective interval portfolio theory to support public decision-makers on the design of programs to foster the investment on energy efficient technologies. In addition, a proposal for obtaining the efficient portfolio solutions was also suggested, which allows considering three types of investment strategies, i.e., a conservative strategy (leading to a lower number of subsidized devices), an aggressive strategy (leading to a higher number of subsidized devices) and a combined strategy. Finally, the anticipated economic, energy, environmental and social impacts obtained in each solution previously computed are projected.

MSc in 2019

Adriana Figur Ribeiro

Assessment of the impact of offshore wind power generation in the United Kingdom

Supervisor: Pedro Moura

ABSTRACT

The United Kingdom aims to increase the share of renewable energy, with offshore wind generation playing an important role in such an objective. Thus, the work aimed to identify the constraints and measures for increasing the participation of offshore wind energy in the United Kingdom grid, as well as the associated benefits. Historical wind series were considered for four operating offshore parks, and the generation potential and correlation with consumption were determined. The technologies of power plants, batteries and pumped hydro storage were characterized, being identified as the main measures to increase the participation of offshore wind power, the energy storage and demand-side management. The analysis considered scenarios with increasing offshore insertion from an economic and reducing CO_2 emissions perspectives. It was concluded that there is a high potential for reducing emissions, and that costs will fall sharply in the future, allowing the potential to be tapped.

CURRENT ACTIVITY

Adriana concluded her Master's degree in September 2019. She is currently looking for a new challenge.

Bruna Coelho da Conceição Pôjo

Amazon's hydroelectric power plants - Adapting the energy sector for energy security

Supervisor: Pedro Moura

ABSTRACT

The Amazon basin alone is considered to be the largest hydrographic basin on the planet, covering almost 90% of northern Brazil, but studies have shown that even with the increase of the installation of hydroelectric plants in the Amazon, will not be sufficient to meet the future energy demand expected for Brazil. In this context, the main objective of this dissertation is to evaluate the diversification potential of the Brazilian energy sector that influences the energy security of the country, identifying potential scenarios of complementarity and similarity (to hydro) between alternative energy sources (solar, wind, water) in each region (North, Northeast, Southeast / Midwest, South). Pearson's correlation coefficient calculation was used for the assessment. Overall, the results pointed to the potential for wind energy in all regions and the solar potential in the Northeast and South regions as scenarios that should be further explored in energy sector diversification.

Marcos Daniel Nujo Tenente

Eco-efficiency assessment of the electricity sector: evidence from 28 European Union countries

Supervisors: Patrícia Pereira da Silva, Carla Oliveira Henriques

ABSTRACT

The purpose of this study is to carry out the eco-efficiency assessment of the electricity sector in 28 European Union countries, taking into account its economic and environmental performance over time, considering the years of 2010 and 2014, combining Data Envelopment Analysis through the Directional Distance Function approach with Input-Output analysis to perform the eco-efficiency evaluation of the direct and indirect consumption and direct production supply chains of the electricity sector. According to our findings, the countries who invested in renewable energy deployment efficiently, progressively replacing fossil fuel generation of electricity, have a higher potential in terms of eco-efficiency. It was also found that in direct and indirect consumption supply chain the evolution of the sectors directly and indirectly linked to the electricity sector were the main drivers of the efficiency scores obtained.

CURRENT ACTIVITY

Research grant at INESC Coimbra - Instituto de Engenharia de Sistemas e Computadores de Coimbra, developing an EIO-LCA model for calculating energy and GHG payback time for each technology under evaluation, in the context of the project “T4ENERTEC - Tools for supporting the selection of energy efficient technologies”.

Katya de Sousa Dias Coelho

Evaluation of a Modular Green Roof System: Thermal, Hydrological and Acoustic Behaviour

Supervisor: Nuno Simões

ABSTRACT

The rapid urban expansion and numerous infrastructure developments have led to several problems in cities such as: floods, urban heat island effect (UHI), noise pollution, reduction of water and air quality, among others. Green roofs are currently targeted as a solution that can benefit the environment and help minimize these problems. Due to its advantages, the acceptance of these solutions has grown, enhancing the appearance of new solutions. In which modular solutions are to be highlighted. Considering the importance in characterizing this type of solution, this work aimed at performing an experimental campaign to evaluate the following behaviours:

Thermal: characterization of the ambient and superficial temperatures that may have a positive impact on the mitigation of UHI;

Hydrological: evaluating the retention capacity of stormwater that may contribute to the delay of runoff avoiding floods;

Acoustic: quantifying the sound absorption that may contribute to improve the acoustic quality of the environment.

CURRENT ACTIVITY

Researcher at Itecons with a scholarship in the area of Research and Technological Development.

Natália Maria da Silva Romeiro

Improvement of Thermal Performance of Housing Buildings in Brazil: Comparative Analysis of Brazilian and Portuguese Regulatory Requirements

Supervisor: J. A. Raimundo Mendes da Silva

ABSTRACT

The study analyzed the limitations of the Brazilian norms through a comparison with the Portuguese regulation and highlighted possible proposals that contribute to a more demanding methodology. As a case study, a house with the constructive standards defined in *Programa Minha Casa, Minha Vida* (PMCMV) was selected for three Brazilian cities with different bioclimatic zones. Results were analysed through the following methodologies: i) the simplified method of the Brazilian norm NBR 15575; ii) the prescriptive method of RTQ-R; and iii) the computer software Design Builder. Through the analysis of the results and the comparison with the methodology of the Portuguese Regulation (REH), the main limitations in the norms were identified, as well as the constructive elements with greater influence on the heat gains and losses of the building. Thus, it was possible to conclude that the prescriptive methodology of the Brazilian norms restricts the analysis of the elements of walls and roof, ignoring the contribution of the glazed areas. Furthermore, it presents different limits and methodologies for the same evaluation parameters among the norms, which can lead to different interpretations. Since the norms already have a relatively adequate structure, the incorporation of the proposals in the regulation emerges as a viable contribution to a more demanding methodology, by valuing determining constructive elements of the building.

Yvonne Alexandra Vogt Gwerder

Life Beyond the Grid: A Life Cycle Sustainability Assessment of Energy Provision by Households

Supervisors: Fausto Freire, Luís Cândido Dias

ABSTRACT

This thesis presents a combined Life-Cycle Sustainability Assessment (LCSA) and Multi-Criteria Decision Analysis (MCDA) study on two off-grid houses in a rural village in Portugal to assess the sustainability of meeting electricity and heating needs in off-grid homes. The sustainability of meeting energy needs in the off-grid homes, compared to using the grid, was found to be dependent on the indicators under consideration, the technologies used in the homes, and household energy needs. We compared the current situation to four energy provisioning scenarios using Multi-Attribute Value Theory to rank alternatives based on their sustainability performance. The considered scenarios evaluated the impacts of extending and connecting the grid to the homes to allow for either: electricity consumption from the grid, or both consumption and injection of excess electricity generated to the grid. The results showed that meeting household electricity and heating needs in a sustainable way requires an analysis of the local context and available resources. Thus, a consideration of trade-offs is central to understanding the value of alternative possibilities for energy provisioning. This paper demonstrates that combining LCSA and MCDA procedures is useful for assessing sustainability impacts by incorporating decision maker's preferences.

CURRENT ACTIVITY

Working for HPL, a Sustainable Finance Advisory Firm whose mission is to accelerate capital flows to accelerate the global sustainability agenda. Yvonne provides technical advisory to clients developing thematic bond frameworks (i.e. green, social, or sustainability bonds) and support in business development activities for the firm.

Selection of ongoing R&D projetcs

PROJECTS FUNDED BY COMPANIES OR PUBLIC INSTITUTIONS

Study on the implementation of social tariffs in the Portuguese energy sector

In Portugal, social tariffs have been in force since 2010 for electricity and since 2011 for natural gas, with the aim of reducing the burden of domestic consumers' energy expenditures and consequently contributing to universal access to energy services at affordable prices. In 2016, after the implementation of an automatic procedure granting access to vulnerable households to social tariffs without needing to request it, the number of beneficiaries more than quadrupled.

In 2018, social tariffs represented a transfer of about 85 million euros to more than 800 000 Portuguese domestic consumers, financed by ordinary electricity producers, the natural gas transportation company and natural gas suppliers, in distinct shares.

Social tariffs contribute to the mitigation of domestic consumers' affordability issues, being a relevant financial measure to guarantee universal access to energy services. For energy efficiency promotion and energy poverty reduction, it is necessary to adopt complementary measures.

PRINCIPAL INVESTIGATOR: Rita Martins (CeBER)

PARTNER INSTITUTIONS: CeBER, Observatório Agência para a Energia (ADENE)

S&V SUNROOF – Large dimension panoramic and removable intelligent roofing for buildings

Aware of the architectural trend towards the incorporation of large glazing solutions and the challenges that this system poses for architecture, engineering and fabrication, this consortium aims to develop a panoramic and removable glass system for the roof's building (either normal glass or photovoltaic glass). The removable ability of the system forces the existence of mobile leafs, whose movements will be controlled mechanically. A control and automation system will be developed using a vast array of sensors. The operation of the S&V system, i.e., opening and closing, can be remotely controlled by the user, or as a direct response to data supplied by the sensors. Additionally, within the scope of this project, a predictive algorithm that is able to anticipate control actions on the glass system will be developed, increasing the levels of environmental comfort. The solution to be developed must also guarantee high mechanical, acoustic, higrothermic and safety performance.

More information: http://www.itecons.uc.pt/projectos/sunroof

PROPONENT ENTITY: Silva & Ventura, Lda

PARTNER INSTITUTIONS: Itecons (principal investigator: Nuno Simões); WSBP Electronics, Lda.

V2G Demo - Vehicle2Grid Demonstration in Buildings

The main objective of the V2G Demo project is to demonstrate the main benefits of using Electric Vehicles (EVs) as a clean energy storage option to ensure power supply capacity to buildings or communities. In the context of the project, Magnum Cap has developed improved Vehicle-to-Grid (V2G) chargers with the aim of achieving reduced losses, size, weight and costs. Such chargers have been tested and validated by ISR-UC evaluating their efficiency and power quality parameters. After the validation, the chargers have been used in the Department of Electrical and Computer Engineering at the University of Coimbra to demonstrate the implementation of a Building-to-Vehicle (B2V) and Vehicle-to-Building (V2B) system, adjusting the charging period of EVs based on renewable generation availability (using B2V), and injecting into the building part of the energy stored in EVs to compensate periods of low generation or reduce the demand from the grid in periods of high tariffs (using V2B).

PRINCIPAL INVESTIGATOR: Aníbal Traça de Almeida (ISR-UC)

PARTNER INSTITUTIONS: ISR-UC, Magnum Cap

Development of the Azores Regional Action Plan for Energy Efficiency

The Action Plan for Energy Efficiency for the Autonomous Region of Azores encompasses the strategy aggregating a set of energy efficiency programs and actions to be implemented in the most relevant areas of the regional economy. Actions are being developed for the industrial, residential, commerce and services, transportation, agriculture and fisheries and public administration sectors, including the identification of the legislative instruments and funding programs to necessary to increase the impact of the actions implementation. Moreover, this project aims to develop energy efficiency manuals to inform and sensitise the bodies responsible for energy management in buildings for the best practices.

PRINCIPAL INVESTIGATORS: Carlos Henggeler and Luis Neves (INESC Coimbra)
PARTNER INSTITUTIONS: INESC Coimbra

PROJECTS FUNDED BY NATIONAL OR INTERNATIONAL R&D FUNDS

INNOVIP - Innovative Multi-Functional Vacuum-Insulation-Panels (VIPs) for Use in the Building Sector

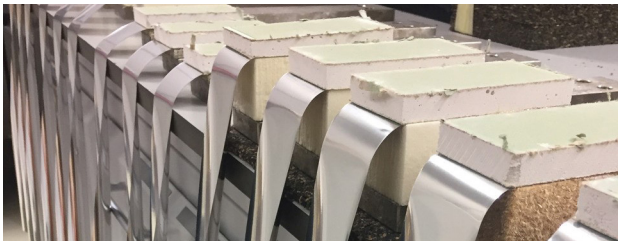
OVIP is a EU funded project that focuses on the development of a highly efficient and multifunctional insulation product for buildings. The goal of the project is to further develop Vacuum Insulated Panels (VIP) for the building sector. The VIP panels will be made versatile, easier to manufacture and to mount, and will demonstrate improved properties over time.

Itecons is part of a consortium of 13 international partners from both industry and academia that share the vision to offer an innovative VIP solution. The INNOVIP product will be available at a lower market price by reducing the density of the core material or by incorporating new core materials along with cost efficient high gas barrier films.

This solution will lead to a breakthrough in energy efficiency, both for new buildings and renovations. This product can be deployed for various applications (walls, roofs, floors, internal and external).

More information: http://innovip-h2020.eu/

PARTNER INSTITUTIONS: Itecons (principal investigator: Nuno Simões); FIW Muenchen, va-Q-tec, HANITA coatings, Nordisk Perlite, TECNAN, SOPREMA, MOTOSTAL, LNE, FHG, OBU, LUREDERRA, BAYFOR

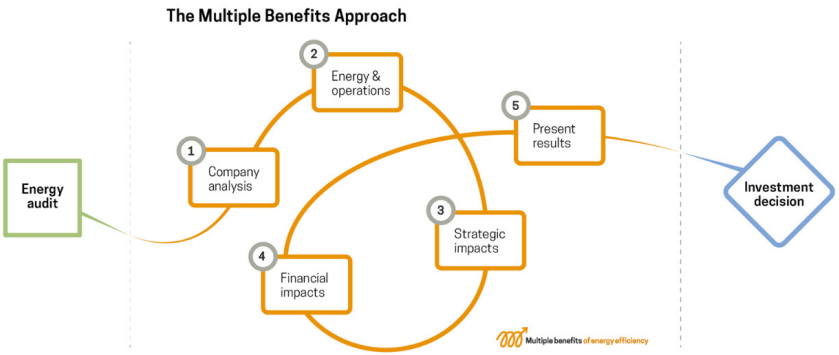


M-Benefits - Valuing and Communicating Multiple Benefits of Energy-Efficiency Measures

Project-level investment decisions take account of many factors, rarely tackling one issue in isolation. Company decisions are based on its strategic priorities and values, an assessment of the risks involved, and anticipated benefits (e.g., increased productivity, regulatory compliance,
reduced maintenance, greater reliability, improved workforce satisfaction and retention). In contrast, energy efficiency experts traditionally present the rationale for investment only focused on energy 'payback', which is not a strategic goal for companies. As a result, these proposals are often missed or ignored because they are not prioritized by investment committees. The M-Benefits project will develop a training platform and tools, as well as work directly with organizations to analyze and propose energy-saving projects while evaluating the operational and strategic impacts. In parallel, M-Benefits partners will compile an evidence base of case studies, project examples and results to bolster the business case for projects.

PRINCIPAL INVESTIGATOR: Aníbal Traça de Almeida (ISR-UC)

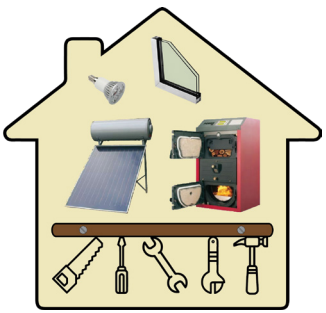
PARTNER INSTITUTIONS: ISR-UC, Fraunhofer, Université de Neuchâtel, Universiteit Utrecht, University of Oxford, Borg & Co AB, BPIE, Grazer Energieagentur, FIRE, KAPE, NTUA, Hochschule Luzern



T4ENERTEC - Tools for supporting the selection of energy efficient technologies

This project aims at developing a methodological framework to support public entities in investment planning for energy efficiency programs based on portfolio theory explicitly considering the energy and carbon embodied in each energy efficient technology.
A two-part methodological approach for supporting public investors with the selection of several energy efficient technologies to be funded is developed. An Economic Input-Output Life-Cycle Assessment modelling framework is used for the appraisal of the energy payback-time/greenhouse gas payback- time of each technology. Then, the promotor of this project will participate in the development of a multiobjective optimization model based on portfolio theory to support public bodies with the selection of the energy efficient technology portfolios to be financed in an uncertain environment. A new approach for obtaining the optimal portfolios of energy efficient technologies will be proposed, which allows exploring distinct types of investment strategies, according to the investor's preferences. The project benefits from the participation of INESC Coimbra, with relevant experience in consulting in the Plan for the Promotion of Energy Efficiency with the major players in the energy sector in Portugal, and CIE-ADAI, which has significant expertise in LCA addressing building retrofit strategies considering uncertainty.

PRINCIPAL INVESTIGATORS: Álvaro Gomes and António Gomes Martins (INESC Coimbra)
PARTNER INSTITUTIONS: INESC Coimbra and CIE – ADAI.




Percentage of households with Ener
35
30
25
20
15
10
5
0
%
North
Centre
Lisbon MA
Alentejo
Algarve
Data source: IDEF 2015/2016


ordem
dos engenheiros

Events organized in 2019

— Public Lecture | Edmilson Moutinho dos Santos: “Scenarios for Energy Transition in Brazil: Are Brazilians heading against a world-wide renewable energy chain?” | “Energy Transition Options for the Power Generation Sector in Brazil: Conflicting Interests and Difficult Choices to Make”, 15.11.2019

— EfS Fall Doctoral Workshop 2019, 07.11.2019

— European Researchers’ Night 2019, 27.09.2019

— PHOTO EXHIBITION “Energy for Sustainability”, 09-10.2019

— 4th Energy for Sustainability International Conference – Designing a sustainable future, 24-26.07.2019

— EfS Research Day, 29.05.2019

— IV EfS Photo Contest Awards 2019

— Public Lecture on “SUSTAINABILITY & CLEANTECH”, 20.05.2019

— EfS Spring Doctoral Workshop 2019, 15.05.2019

— XII Encontro Iniciativa EfS, Estudantes e Empresas, 13.03.2019