TURKEY in HORIZON 2020

TURKEY IN HORIZON 2020
ALTUN/HORIZ/TR2012/0740.14-2/SER/005

This project is co-financed by the European Union and the Republic of Turkey
Bu proje Avrupa Birliği ve Türkiye Cumhuriyeti tarafından finanse edilmektedir

Theme Oriented Trainings:
Secure, Clean and Efficient Energy

CARTIF

EXAMPLES OF FUNDED H2020 PROJECTS

CENTRO TECNOLÓGICO CARTIF

CARTIF

Private, independent, applied research centre

Its mission is to improve the companies' competitiveness through the creation and transfer of knowledge to companies

Non-profit organization

Committed to generate innovation and technological development

[TECHNOLOGY CENTRE] CARTIF

Location

WE'RE SOCIAL

Parque Tecnológico de Boecillo, 205
47151, Boecillo, Valladolid (Spain)

www.cartif.es

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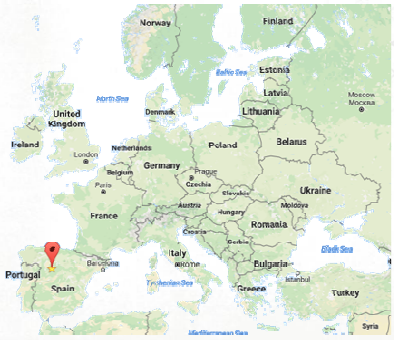
@CARTIFCT



[CENTRO TECNOLÓGICO] CARTIF

A success story…

1994
Birth and first steps in the University of Valladolid

1999
Headquarters in Technology Park
High growth

2005
Still growing

2011
New expansion
International focus

2014
20 years old!

More than 1.100 RTD projects, turnover of 145 M€, more than 400 new jobs created, employing 130 people (41 PhDs)

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The sectors

… committed to improve the companies' competitiveness, covering 5 sectors

- Health
- Agrofood
- Construction & Infrastructures
- Energy & Environment
- Industrial solutions

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The technological divisions

… committed to generate innovation and technological development within 5 business divisions

SYSTEMS
- ICT
- Automation
- Biomedicine

MECHANICAL ENGINEERING

- Mechanical Design
- Materials

ENERGY

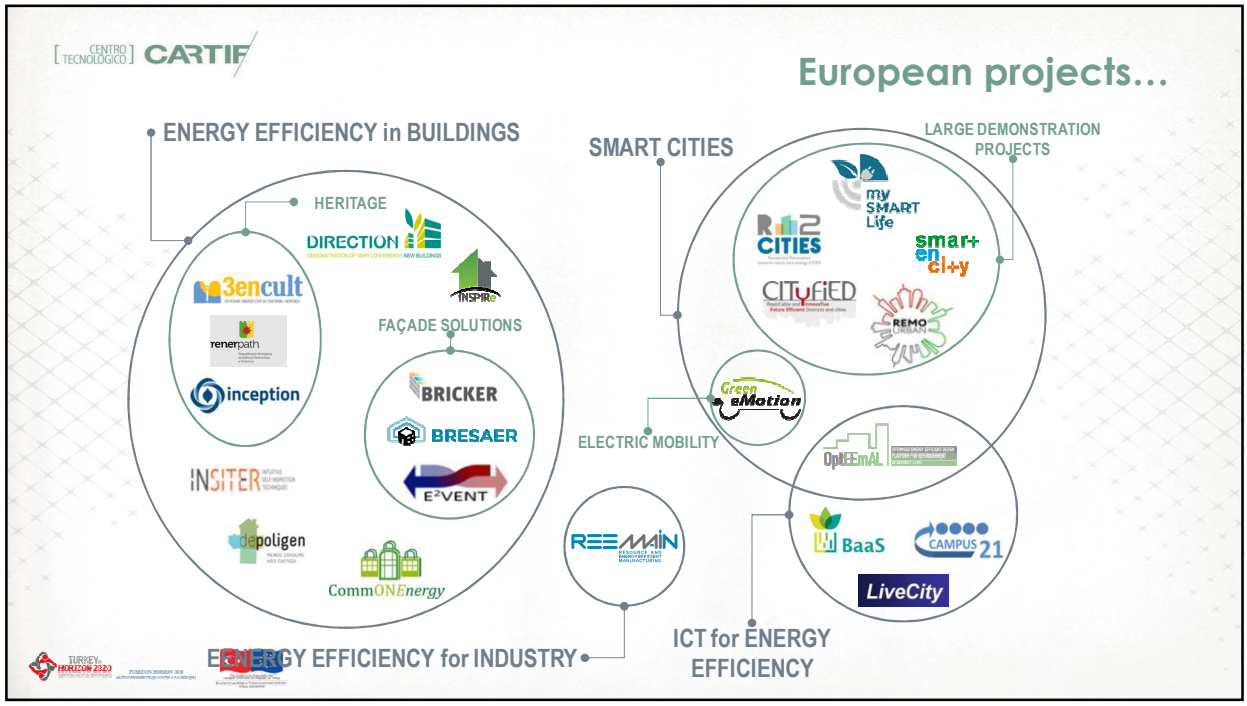
- Energy Efficiency
- Renewable Energy
- Sustainable Buildings and Districts
- Smart Cities

AGROFOOD AND SOUSTAINABLE PROCESSES

- Environment
- Chemical Processes
- Agrofood
- Laboratories

ROBOTICS AND VISION

- Mobile Robotics
- 3D vision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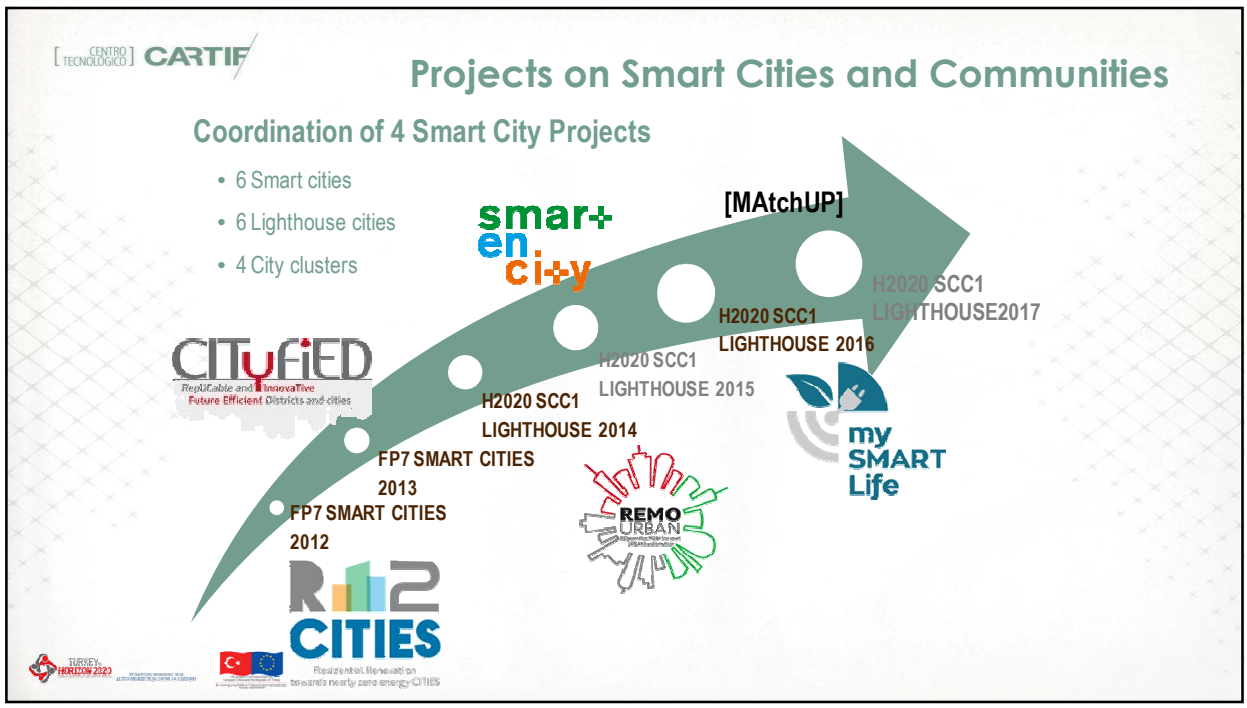
European projects...
ENERGY EFFICIENCY in BUILDINGS
HERITAGE
DIRECTION
3encult
renerpath
inception
INSPIRE
FAÇADE SOLUTIONS
BRICKER
BRESAER
E²VENT
INSITER
depoligen
CommONEnergy
SMART CITIES
LARGE DEMONSTRATION PROJECTS
my SMART Life
R2 CITIES
smar+ en ci+y
CITyfiED
REMO URBAN
Green eMotion
ELECTRIC MOBILITY
OptEEmAL
BaaS
CAMPUS 21
LiveCity
REEMAIN
ENERGY EFFICIENCY for INDUSTRY
ICT for ENERGY EFFICIENCY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Projects on Smart Cities and Communities
Coordination of 4 Smart City Projects
• 6 Smart cities
• 6 Lighthouse cities
• 4 City clusters
smar+ en ci+y
[MAtchUP]
H2020 SCC1 LIGHTHOUSE2017
H2020 SCC1 LIGHTHOUSE 2016
H2020 SCC1 LIGHTHOUSE 2015
H2020 SCC1 LIGHTHOUSE 2014
FP7 SMART CITIES 2013
FP7 SMART CITIES 2012
CITyfiED
ReplicAble and InnovaTive Future Efficient Districts and cities
my SMART Life
REMO URBAN
R2 CITIES

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HORIZON 20220

OptEEmAL

OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

Example of EU funded project

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contact@opteemal-project.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 680676

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OptEEmAL

HORIZON 2020-WORK PROGRAMME 2014-2015
Industrial Leadership
5. Leadership in enabling and industrial technologies

CALL FOR ENERGY-EFFICIENT BUILDING

TOPIC: H2020-EeB-05-2015
Innovative design tools for refurbishment at building and district level

GA no.
680676

Contact
contact@opteemal.eu

Call budget overview

CALL: CALL FOR ENERGY-EFFICIENT BUILDINGS
Call identifier: H2020-EEB-2014-2015
Publication date: 11 December 2013 **OJ reference** OJ C 361 of 11 December 2013

Topic: EeB-05-2015: Innovative design tools for refurbishing of buildings at district level — Closed
Publication date: 11 December 2013

Types of action: IA Innovation action
DeadlineModel: single-stage
Opening date: 22 October 2014
Deadline: 04 February 2015 17:00:00
Time Zone : (Brussels time)

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HORIZON 2020-WORK PROGRAMME 2014-2015
Industrial leadership
5. Leadership in enabling and industrial technologies

CALL FOR ENERGY-EFFICIENT BUILDING

TOPIC: H2020-EeB-05-2015
Innovative design tools for refurbishment at building and district level

GA no.
680676

Contact
contact@opteemal.eu

Topic Description

Specific challenge:
The development of **sustainable solutions for refurbishment of buildings** and their proper **integration at district level** requires major innovations in the **design tools**, construction methods and management practices, including socio-economic aspects and innovative financing instruments.
Buildings should no longer be renovated individually, but as part of a global energy system, where their interactions with their environment can be predicted and simulated, as well as taking into account interactions with inhabitants and customers. **Design tools** should also support the evaluation of different retrofitting alternatives.
A challenge is to ensure the **interoperability between tools** from various domains and at different scales. But more importantly, knowledge collection and management in the fields of refurbishment issues should be developed and implemented in order to propose solutions adapted to **collaborative multi-disciplinary** refurbishing work.

Scope:
Research activities should be focused on **design at buildings and district level**, taking into account the adjacent **systems** such as district heating/cooling and decentralised thermal energy generation and other interactions with the neighbourhood, giving priority to local renewable resources. Projects should promote and set up an **integrated approach** in support of innovation, by providing actors with **holistic methods and tools**. Energy efficiency technologies should become elements of design **databases** that allow stakeholder to select the most suitable approach for performance improving, taking full advantage of geo-clustered data sets. The design phases linked to the retrofitting of existing buildings taking into account subsequent **operation and maintenance** will be considered as priority. In this respect, there is a need for further research on **operational information** that can be used in design models. Knowledge based design can also be used to provide input into management systems

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HORIZON 2020-WORK PROGRAMME 2014-2015
Industrial leadership
5. Leadership in enabling and industrial technologies

CALL FOR ENERGY-EFFICIENT BUILDING

TOPIC: H2020-EeB-05-2015
Innovative design tools for refurbishment at building and district level

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680676

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Projects should also cover **validation actions** on a technical level, which apply the tools on refurbishment projects; and on a societal level, i.e. validation with the occupants of the building. For the latter, involvement of organisations within an **Integrated Project Delivery** Approach, supporting a participatory design approach, could be an asset.
For this topic, proposals should include an outline of the **initial exploitation and business plans**, which will be developed further in the proposed project.
Wherever possible, proposers could actively seek synergies, including possibilities for funding, with relevant national / regional research and innovation programmes and/or cumulative funding with European Structural and Investment Funds in connection with smart specialisation strategies. For this purpose the tools provided by the Smart Specialization Platform, Eye@RIS3 may be useful[1]. The initial exploitation and business plans will address such synergies and/or additional funding. Exploitation plans, outline financial arrangements and any follow-up will be developed further during the project. The results of these activities as well as the envisaged further activities in this respect should be described in the final report of the project.
Activities expected to focus on **Technology Readiness Level 5-7**. A significant participation of SMEs with R&D capacities is encouraged.
The Commission considers that proposals requesting a **contribution from the EU between EUR 4 and 7 million** would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact:
- **More effective refurbishment** at building and district level.
- **Optimised design** of integrated energy-efficient buildings, considering the different physical dimensions in a coupled and holistic way (energy, comfort, air quality, acoustics etc.), enabling actors to take validated and quantified choices for the refurbishment at building and district level on the basis of quantified performance objectives with compliance with regulation and user-oriented comfort expectations and constraints .

Type of action: Innovation Actions.

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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

OptEEmAL

The main idea…

Web-based platform for district energy-efficient retrofitting design to:

- Support integrated design methodologies (IPD methods)
- Systemic delivery of optimised designs
- Reduce uncertainties and time of the design process
- Provide improved solutions compared to Business-as-usual

Through a **3-steps process:**

- Input data by stakeholders and diagnosis
- Formulation of retrofitting alternatives (scenarios), evaluation (based on indicators) and optimisation
- Best scenario selection and data exportation to stakeholders

Call requests	OptEEmAL addresses
The development of sustainable solutions for refurbishment of buildings and their proper integration at district level requires major innovations in the design tools, construction methods and management practices, including socio-economic aspects and innovative financing instruments.	The OptEEmAL Platform will automatically provide optimised and advanced design solutions for refurbishment of buildings and districts through a 4-step process integrating knowledge collected in existing successful interventions. The definition of scenarios and their optimisation will be based on an advanced Energy Conservation Measures catalogue, containing information about their design, construction, operation and maintenance. This platform will be connected to existing and validated catalogues and data sets. These feasible solutions will be based in key indicators calculated through innovative integration of tools and methods, ensuring their interoperability, to provide consistent and reliable data. These data will be shared and calculated evaluating energy, environment (LCA), economic, comfort (incl. air quality, acoustics, etc.), social and urban performance.
Buildings should be renovated as part of a global energy system, where their interactions and their environment can be predicted and simulated, as well as taking into account interactions with inhabitants and customers. Design tools should also support the evaluation of different retrofitting alternatives.	Under OptEEmAL, the district is evaluated as a whole, considering interactions between buildings, their typologies, uses, and district energy networks. Clustering techniques will be used to simulate their performance through the integration of simulation tools and methods able to evaluate each of the relevant pieces of information in order to provide optimised scenarios. These alternatives will be compared and optimised according to stakeholders' objectives and overcoming existing barriers. Particular importance will be given to complex districts of mixed use, especially to those including historic buildings, to give a consistent and reliable diagnosis basis able to formulate in the real market, the different retrofitting alternatives.
Ensure the interoperability between tools from various domains and at different scales.	Integrated tools and methods will work in an interoperable framework that will ensure a reliable data sharing process based on an ontology-based data model that will contain all relevant information in the identified fields. The inputs and outputs from and to the Platform will be based on standards (IFC, CityGML), allowing the utilisation of any tool compliant with them. The internal platform interoperability will also ensure proper data parsing among these pieces of information (geometrical inputs in IFC, energy data, comfort data, etc.) enabling a holistic evaluation through existing tools for energy simulation, cost calculation, Life Cycle Assessment, etc.
Knowledge collection and management in the fields of refurbishment issues should be developed and implemented in order to propose solutions adapted to collaborative multi-disciplinary refurbishing work.	Knowledge from existing initiatives will be collected and integrated in an advanced Energy Conservation Measures catalogue that will include validated and consistent energy and resources efficient measures applicable to different building conditions, typologies, etc. All the process will be based on a collaborative framework through an IPD based interaction with the user, where all relevant stakeholders will be involved from the beginning of the design phase.

OptEEmAL

Addressing the specific challenge of the topic (EeB-05-2015)

Call requests	OptEEmAL addresses
Research activities focused on design at buildings and district level, taking into account the adjacent systems and other interactions with the neighbourhood giving priority to local renewable resources.	Under OptEEmAL framework, the district will be holistically and systematically evaluated as a whole, ensuring proper evaluation of particularities and interactions about each building and energy networks. Local RES, measures to reduce the demand and the consumption (as the retrofitting of existing HVAC systems, improved control strategies, etc.) will be included in the Energy Conservation Measures catalogue, providing advanced scenarios for achieving the user targets, even beyond the design phase.
Projects should promote and set up an integrated approach in support of innovation by providing actors with holistic methods and tools.	OptEEmAL Platform is a holistic solution in which the presence of the involved actors is ensured throughout all the different design phases. All information needed, coming from them as inputs, and information provided as outputs will follow standards that will ease the stakeholders to utilise this information, while OptEEmAL will provide all functionalities needed during the process as advanced simulations by interacting with consistent and well validated simulation tools and methods, enabling the user to obtain an optimised design without requesting advanced expertise on simulation skills. The automation of this design process allows the evaluation of a wider range of scenarios with a drastically time reduction during the process.
Energy efficiency technologies should become elements of design data bases that allow stakeholders to select the most suitable approach for performance improvement, taking full advantage of geo-clustered data sets.	OptEEmAL Platform will provide access to existing data sets to cover both information gaps to perform a reliable and advanced diagnosis and to existing data sets about materials and equipment through the ECMs catalogue. Geo-clustering techniques will be used for the first purpose, allowing the data completion with existing data bases for information in the fields of clime and energy; and, when it would be possible, other relevant inventories.
The design phases linked to the retrofitting of existing buildings taking into account subsequent operation and maintenance will be considered as priority. Further research on operational information that can be used in design models is requested, where knowledge based design can be used to provide input to management systems.	OptEEmAL provides an advanced Energy Conservation Measures Catalogue that includes information for energy and resource efficient alternatives that can be implemented for each case. This catalogue will contain technical information for the evaluation of alternatives, but also data about operation, cost and maintenance that will give valuable information to the user for the further operation of the district. Special focus will be given to include advanced information about usually disregarded information in existing catalogues as the retrofitting of existing active systems (e.g. HVAC) and advanced control strategies that can drastically reduce the energy consumption. This information will be given at the end of the design, covering thus not only the traditional design, but also District Energy Management design.

OptEEmAL

Addressing the scope of the topic (EeB-05-2015)

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Projects should also cover validation actions on a technical level, which apply the tools on refurbishment projects; and on societal level, i.e. validation with the occupants of the buildings. Involvement of IPD approach, supporting participatory design approach, could be an asset.	A strong Validation and Demonstration strategy on technical and societal levels has been established within the project implementation. Three levels of TRL (5-7) will be covered, validating the platform components and their interfaces, demonstrating a platform prototype in a relevant environment, and the demonstration of the final platform in an operational environment respectively. In the TRL6 validation (demonstration in relevant environment), it will be covered demonstration activities with interventions already carried out, validating the design through a fine-tuning process of the platform with measured and demonstrated interventions. Subsequently, the final platform will be used by three technical offices to carry out design projects in three demo cases with different boundary conditions including historic buildings to evaluate the performance under these conditions (TRL 7). Through the implementation of the IPD approach, all stakeholders, including inhabitants, will be involved in the process, and a demonstration strategy plan with inhabitants has been set up to validate their participation in the process and their involvement in the use of the platform (especially providing input information and validating the design outputs).
Optimised design of integrated energy-efficient buildings, considering the different physical dimensions on a coupled and holistic way, enabling actors to take validated and quantified performance objectives with compliance with regulation and user-oriented comfort expectations and constraints.	As a result, OptEEmAL will achieve the expected impact through the development of this holistic platform to provide stakeholders with systemic functionalities able to make optimised design projects and consistently quantified through the calculation of project benefits, performance and impacts. The design of alternatives will ensure their compliance with stakeholders' objectives as well as the compliance with existing barriers and regulations through an exhaustive analysis of these aspects in an advanced evaluation of current conditions, targets and barriers.

OptEEmAL

Addressing the scope of the topic (EeB-05-2015)

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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

OptEEmAL

The objectives…

- Developing a holistic and effective services platform for District Energy Efficient Retrofitting Design: diagnosis and generation of scenarios on energy, cost, environment, social evaluation for data export.
- Reinforcing commitment of all involved stakeholders through an Integrated Project Delivery approach.
- Creating an integrated ontology-based District Data Model, containing key information on energy, comfort, environment, economic, social wellbeing and urban morphology.
- Cataloguing Energy Conservation Measures, providing outputs to the design and district operation and maintenance stages.
- Developing a bio-inspired optimisation module. Aim: automating decision making process to obtain optimal design for an energy efficient retrofitting plan at district level.
- Externally connecting the OptEEmAL Platform to relevant entities.

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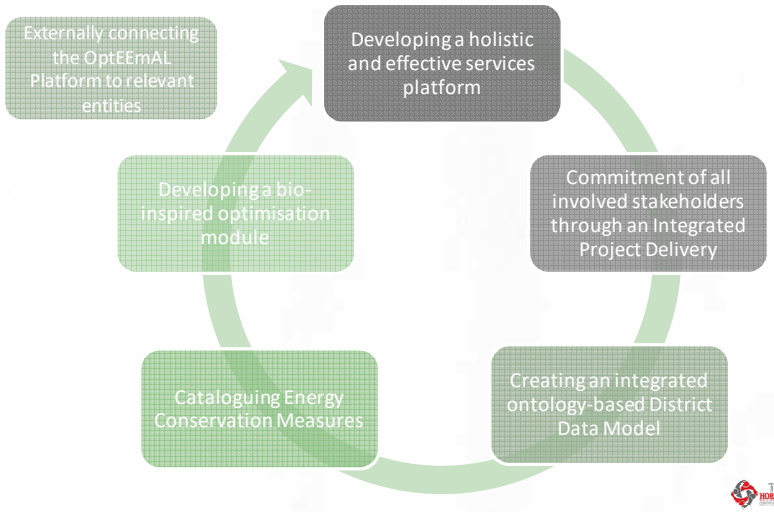
OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

OptEEmAL

The objectives…



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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

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The demonstration sites…

- Six case studies to validate a first OptEEmAL Platform prototype to ensure that all system specifications work as required.
- Validation in three demo cases:
  - San Bartolameo, Trento (IT)
  - Txomin Enea, San Sebastián (ES)
  - Polhem Area, Lund (SE)

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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

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The consortium…

13 partners

8 countries

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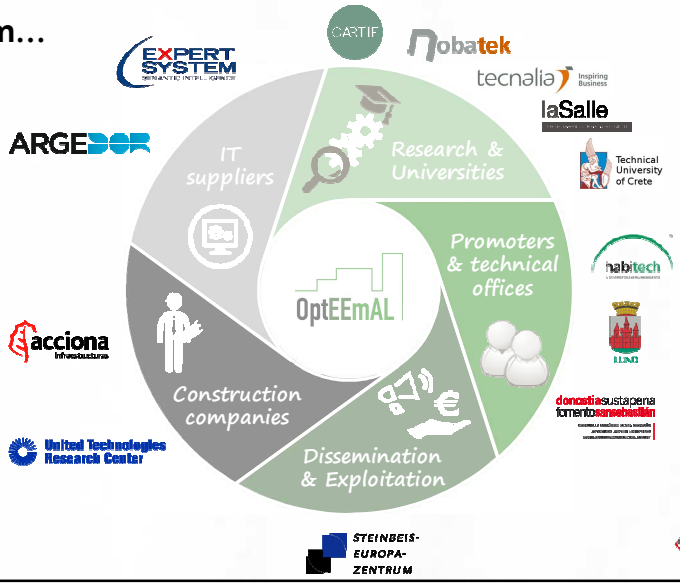
The consortium…



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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

OptEEmAL

The impact…

- Economic impact: reduction of costs during design phase by 19% (compared to BAU) and of the operational phase by 25% by promoting holistic solutions, leading to a higher Return on Investment.
- Increase of market competitiveness through utilisation of energy efficient solutions and improvement of contractual processes.
- Growth of the European construction sector through creation of new jobs and strengthening SMEs in the sector.
- Social impacts by involvement of inhabitants in decision making process: improvement of social wellbeing.
- Fostering dissemination of the new knowledge at professional level

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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

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The impact…

	Concept	OptEEmAL Impact
	Reduction of districts energy consumption	25%
	Reduction of global energy consumption	0.94M MWh/year
	Reduction of overall CO_2 emissions	0.68 $MtCO_2$/year
	Creation or improvement of direct jobs	24,885
	Creation or improvement of indirect jobs	34,839
	Improvement of inhabitants quality of life	6.7 million people
	Reduction of costs during the design phase	19%
	Economic energy saving	140M €/year
	Economic direct growth	166M €/year
	Indirect economic growth	600M €/year
	RoI reduction with holistic district designs	+50%

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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

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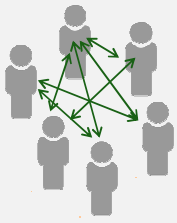
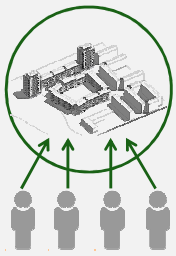
4 pillars…

IPD
(Integrated project delivery)



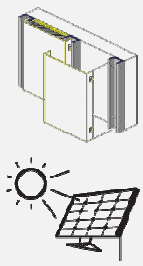
1. **Collaboration** among stakeholders
2. Change reduction
3. Cost reduction

BIM
(Building Information Modeling)



1. **Knowledge sharing** among stakeholdes
2. Site management

ECMs catalogue
(building and district)



1. Eenrgy efficient technologies
2. Pasive, active, control

Key Performance Indicators (KPIs)

- Energy
- Economics
- Environmental
- Comfort
- Urban
- Social

1. Assessment of the performance at district level

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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

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How it works…

1. Data input

Context data, project configuration data, district information (CityGML) and building information (IFC and others) are entered

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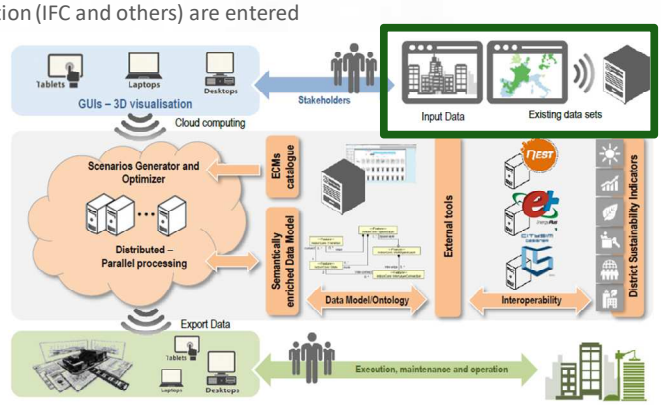

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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

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How it works…

2. District assessment based on KPIs

Assessment of the district performance with simulation tools.

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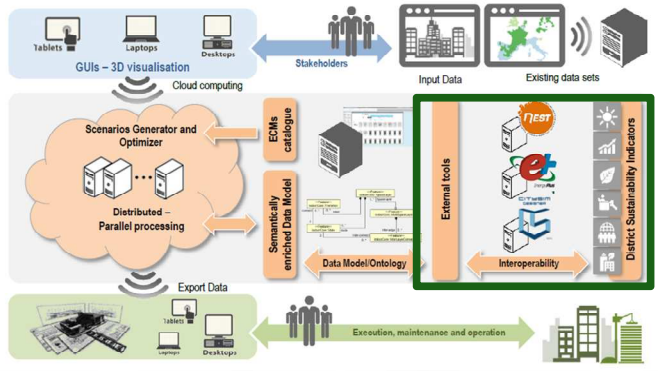

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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

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How it works…

3. Identification of Energy Conservation Measures (ECMs)

Identification of the ECMs that could be integrated according to the user configuration

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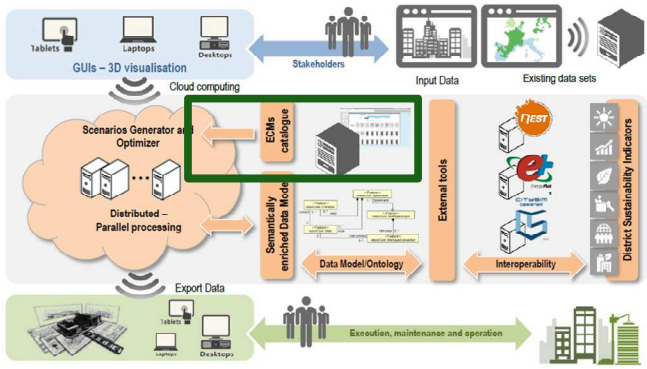

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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

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How it works…

4. Checking the strategies

User checks that strategies selected meet the criteria defined.

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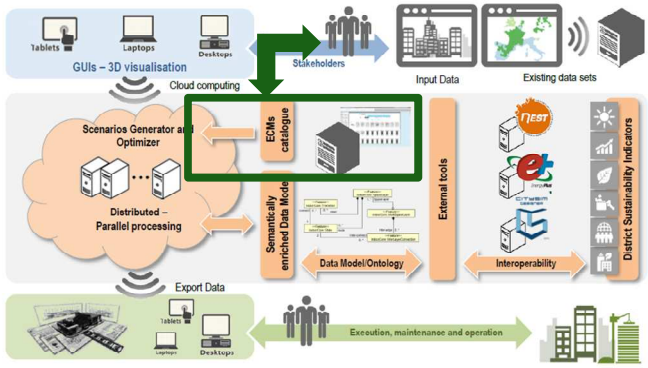

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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

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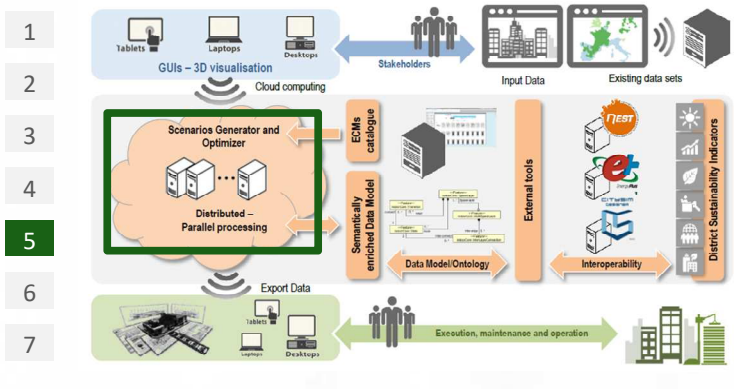
How it works…

5. Scenario generation and optimization

Scenarios are created from the ECMs selected and their performance is evaluated. The optimizer will find the most suitable combination of measures.



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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

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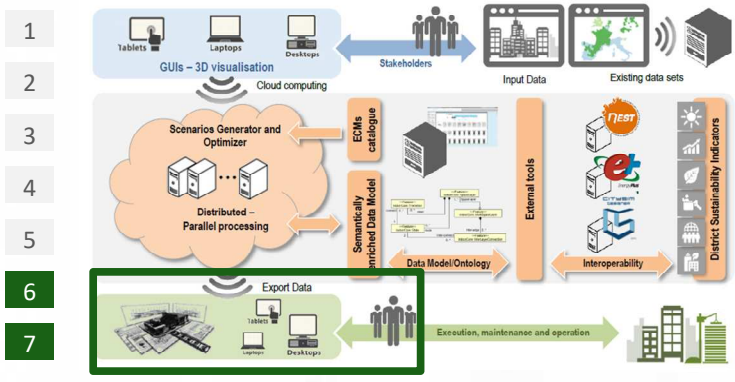
How it works…

6. BIM modified generation and 7. Data export

The IFC is updated with the ECMs selected and is exported together with the corresponding reports.



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OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

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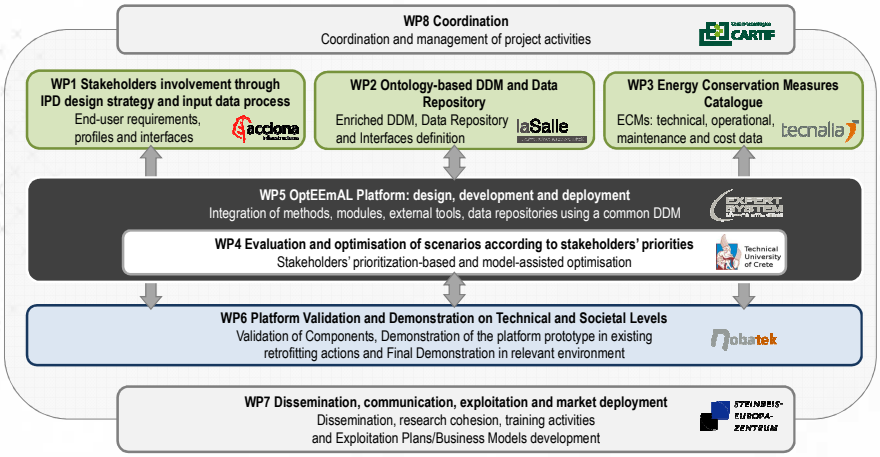
The work plan…



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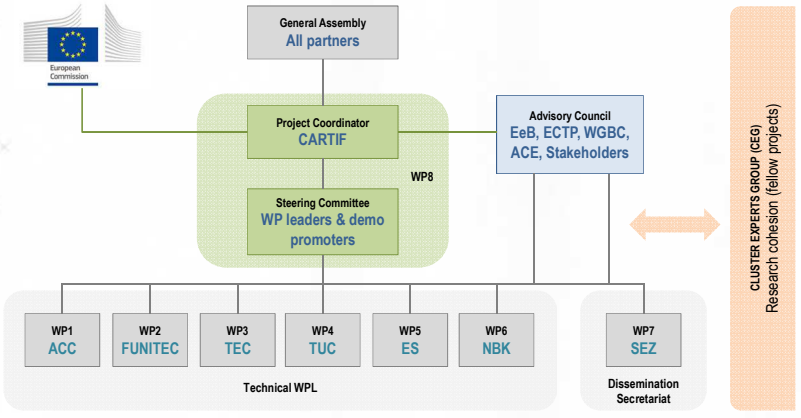
OPTEEMAL – OPTIMISED ENERGY EFFICIENT DESIGN PLATFORM FOR REFURBISHMENT AT DISTRICT LEVEL

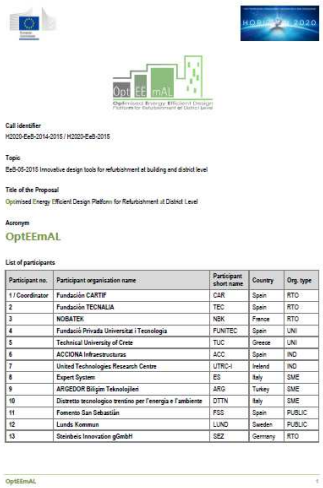
OptEEmAL

The management structure…



CENTRO TECNOLÓGICO CARTIF

OptEEmAL



Call identifier
H2020-EeB-2014-2015 / H2020-EeB-2015

Topic
EeB-05-2015 Innovative design tools for refurbishment at building and district level

Title of the Proposal
Optimized Energy Efficient Design Platform for Refurbishment at District Level

Acronym
OptEEmAL

List of participants

Participant no.	Participant organisation name	Participant short name	Country	Org. type
1 / Coordinator	Fundación CARTIF	CAR	Spain	RTO
2	Fundación TECNALIA	TEC	Spain	RTO
3	NOBATEK	NBK	France	RTO
4	Fundació Privada Universitat i Tecnologia	FUNITEC	Spain	UNI
5	Technical University of Crete	TUC	Greece	UNI
6	ACCIONA Infraestructuras	ACC	Spain	IND
7	United Technologies Research Centre	UTRC-I	Ireland	IND
8	Expert System	ES	Italy	SME
9	ARGEDOR Bilgim Teknolojileri	ARG	Turkey	SME
10	Distretto tecnologico trentino per l'energia e l'ambiente	DTTN	Italy	SME
11	Fomento San Sebastián	FSS	Spain	PUBLIC
12	Lunds Kommun	LUND	Sweden	PUBLIC
13	Steinbeis Innovation gGmbH	SEZ	Germany	RTO

OptEEmAL 1

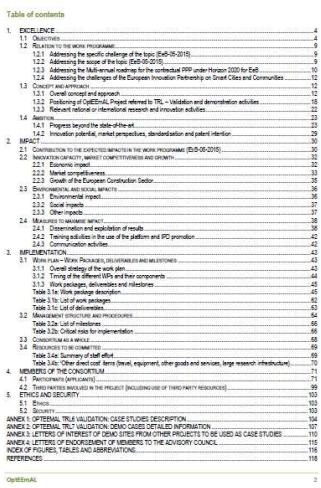


Table of contents

OptEEmAL 2

The full proposal

70 pages! + Annexes

TURKEY HORIZON 2020

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HORIZON 2020
NEXT WORK PROGRAMME

The new work programme is expected in October 2017

Do I have an idea? and

What is the right topic?

Save the Date: Energy Info Days 2017

TURKEY HORIZON 2020

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HORIZON 2020

FINDING THE RIGHT CALL AND TOPIC FOR YOUR IDEA

→To find the right funding opportunity for your idea, you need to find a relevant call and topic.

Calls

Calls are the specific areas which you can apply within. The calls are announced by the European Commission on the website; Participant Portal.

The **calls describe the general framework** such as research and innovation subject, deadlines, budget, etc. Within each call, there is a number of specific topics and an application needs to address one of these.

Topic

Every call consists of a number of specific topics. These describe the societal challenges which the European Commission expects projects to address. **Your project proposal needs to carefully correspond with the expectations and goals described in the topic text**.

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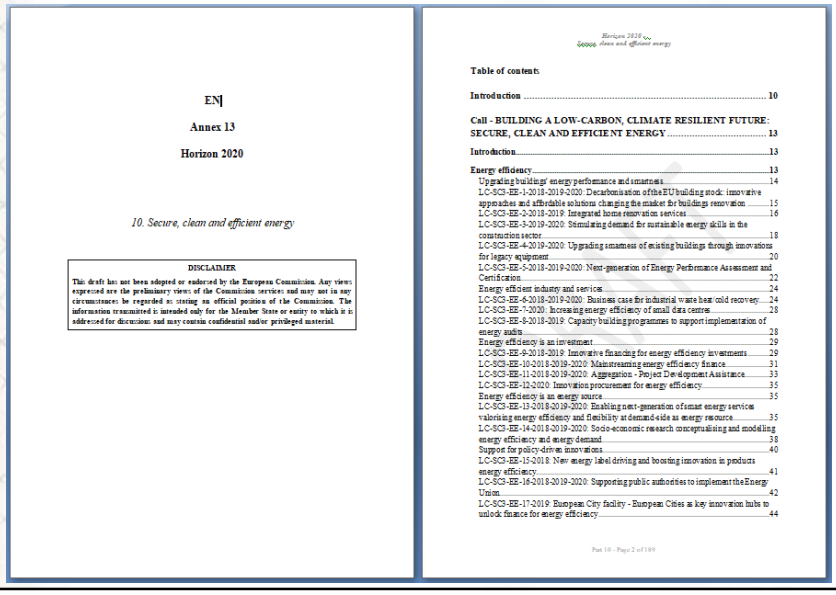
HORIZON 2020



EN

Annex 13

Horizon 2020

10. Secure, clean and efficient energy

DISCLAIMER

This draft has not been adopted or endorsed by the European Commission. Any views expressed are the preliminary views of the Commission services and may not in any circumstances be regarded as stating an official position of the Commission. The information transmitted is intended only for the Member State or entity to which it is addressed for discussion and may contain confidential and/or privileged material.

Horizon 2020 – Work Programme – Secure, clean and efficient energy

Table of contents

Part 10 - Page 2 of 189

What is your idea?

What is your topic?

TURKEY in HORIZON 2020

TURKEY IN HORIZON 1020
ALTUN/HORIZ/TR2012/0740.14-2/SER/005

This project is co-financed by the European Union and the Republic of Turkey
Bu proje Avrupa Birliği ve Türkiye Cumhuriyeti tarafından finanse edilmektedir

Theme Oriented Trainings:
Secure, Clean and Efficient Energy

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