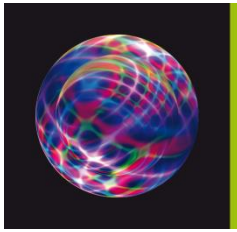
Alexandru Nichersu

Projects and use cases related to utility networks in EIFER



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Topics and compentences

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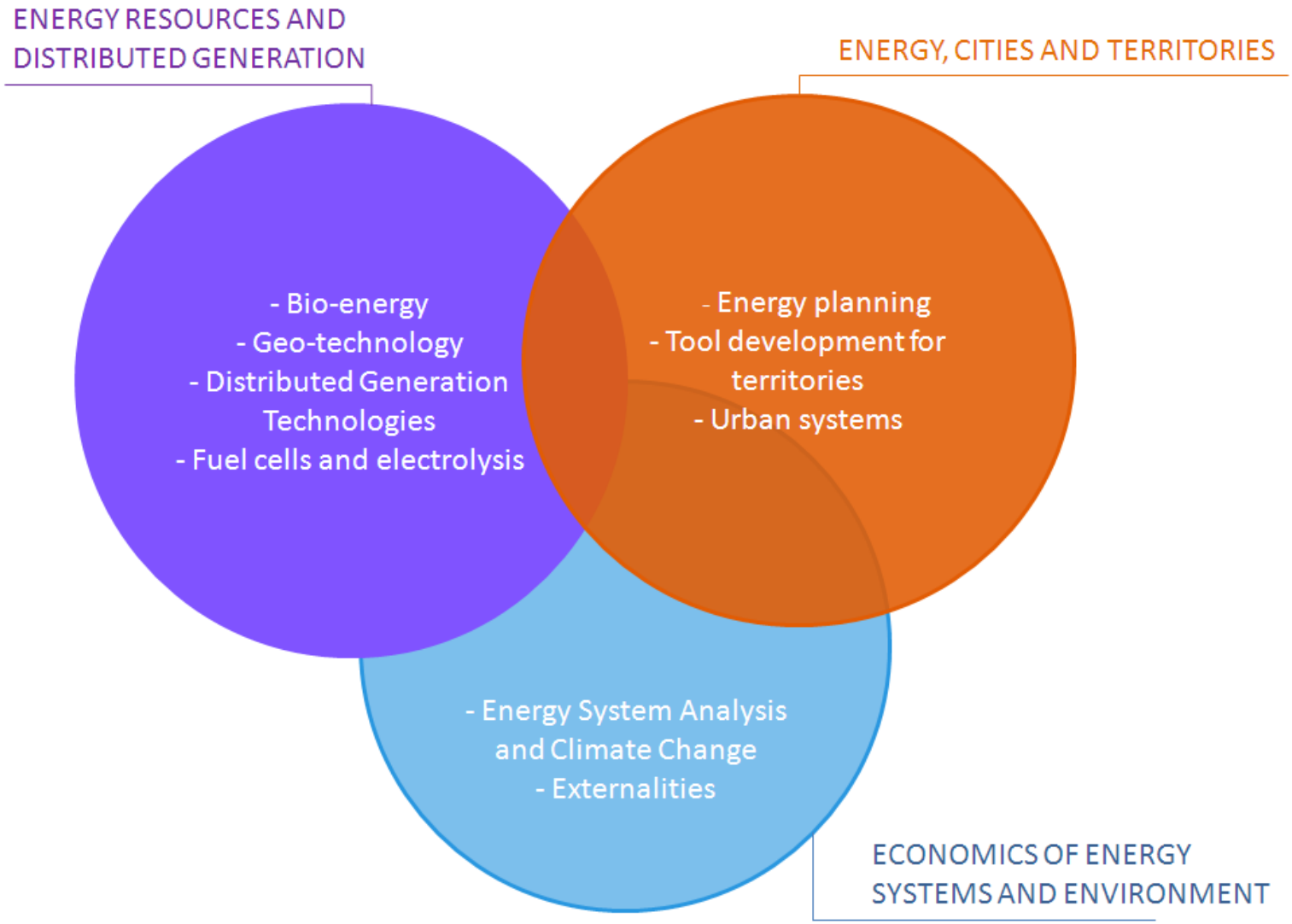

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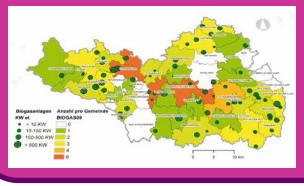
Energy Planning and Geosimulation

EIFER

- Research group “Energy Planning and Geosimulation”
  - **28 permanent staff members**
  - **4 - 6 Master students (FR/DE)**
- Key research areas
  - **GIS based energy planning for regions and cities**
  - **3D building stock simulation**
  - **Agent based modelling of energy systems and infrastructure**
  - **Land use planning and mobility concepts**
  - **Energy Regulation & Market Models**

Energy Planning



Urban Form

Electrical Systems

Electromobility

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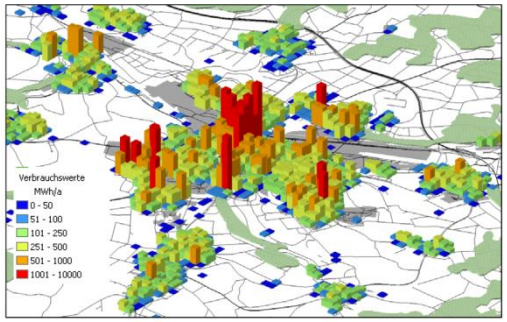
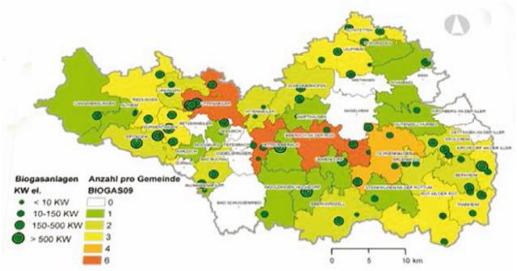
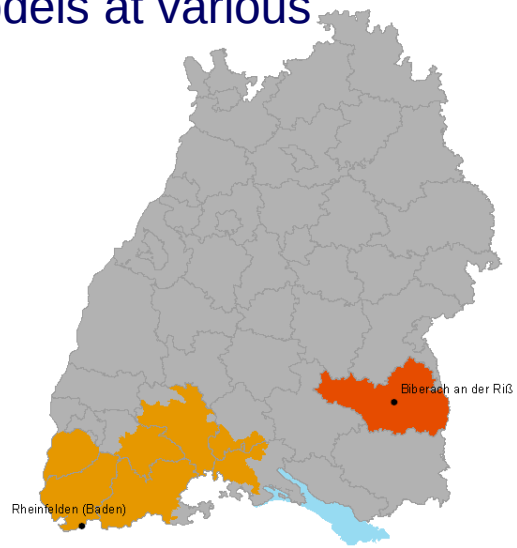
GIS based Energy Planning and Geosimulation

- Data management and analysis
  - Management and analysis of spatial data sets for regions and cities
- Spatial potential analysis for renewable energy sources
  - Technical and economic potentials of biomass and geothermal energy
- Demand side models for cities and regions
  - Development of localised energy demand models at various scales for different sectors







Projects

〈 CURTIS - EDF City Platform 〉

Application to simulate Cities

...But not only!

History - what happen since 2012

EDF's offer: support the ambitions of the cities

Diagnosis

A complete understanding of the specific issues within each City

› **Define the issues**

Simulation & Prospective

EDF City Platform lets you play with possible futures through direct access to the application

Foreseeing and quantifying the impact of your policies

Expertise

Advice from EDF experts to support decision-making

› **Making your vision clearer for the right choice**

Anticipate the side effects of specific decisions

Prioritize actions

Optimize investments

Visualize & Communicate

Berlin Tegel project Objectives

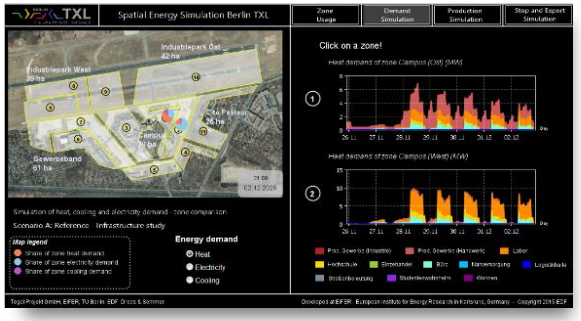
EIFER

- **Develop a spatial hybrid energy system model (Memodi)**
  - targeting districts in the early stage urban planning;
  - based on existing technical model components - sustainable development (Energylogic);
  - developed within the framework of a research cooperation gathering inputs from a range of technology experts and urban planner.

- **Provide a prototype**
  - based on the **Memodi** model;
  - based on the energy concept of the ***Berlin Tegel – The Urban Tech Republic***;
  - using the **Urban Lab** approach applied to 3 workshops;
  - for the **visualisation of different simulation use cases** which illustrate the interrelation between different technologies, land uses and planning decisions;
  - for **communication for Tegel Projekt GmbH** to promote its development strategy.

Modelling specifications

- **Multi-vectors**
  - Modelling of heating, electricity and cooling systems and coupled technologies (e.g. CHP).
- **Integrated multi-energy systems**
  - Hourly energy demand;
  - Production, distribution network and storage technologies.
- **Spatial aspects**
  - Construction phases of the district & demand assessment;
  - Design of distribution networks & connection to the grid;
  - Interface & visualization.
- **Temporal aspects**
  - Hourly resolution;
  - Temporal aggregation for scenario assessment.
- **Multiple sectors**
  - Based on the development planning.



Interface of the simulation prototype

Contacts for City Simulation Platform project

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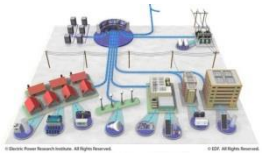
EDF demonstration projects

EIFER

Project management

PREMIO

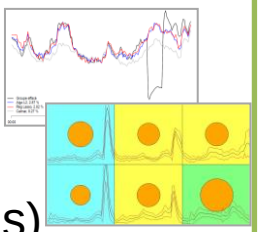
- Project management and technical lead
- Partnership and **technology transfer with EPRI** (USA)



Demonstrators assessment

Energie Efficace / Nice Grid / Millener / Wattyz

- Use Case & KPI definition, overall coordination of the evaluation
- **Technical**, sociological & environmental **analysis** (**segmentation of load curves**, estimation of baseline load profile, estimation of the impacts of demand response programs and distributed storage systems)

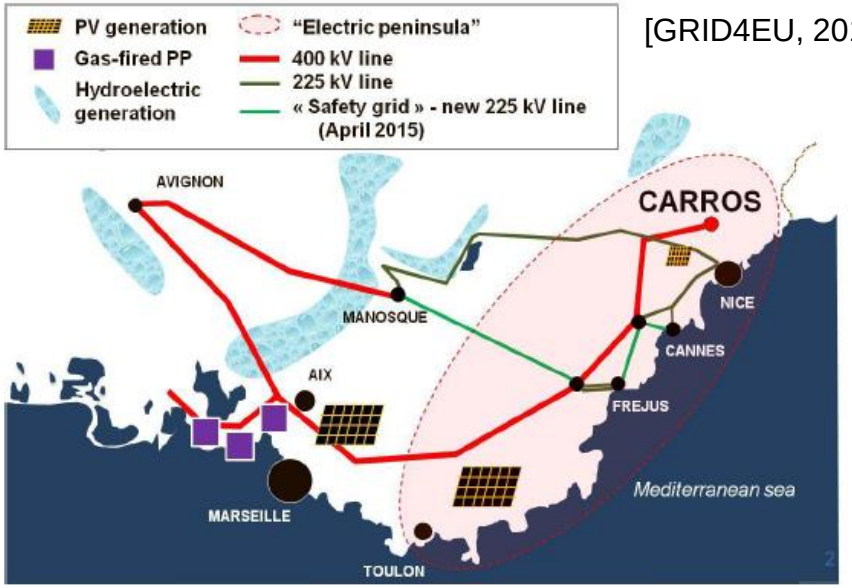


SMART

- Knowledge capitalization for the EDF group: writing of a guideline (**SmartBook)** containing methodologies to best assess SG demonstrators
- Organization of workshops

NICE GRID demonstration project

- The French Smart Grid demonstration project NICE GRID was launched in 2012 in the South-East of France. It was part of the European GRID4EU program



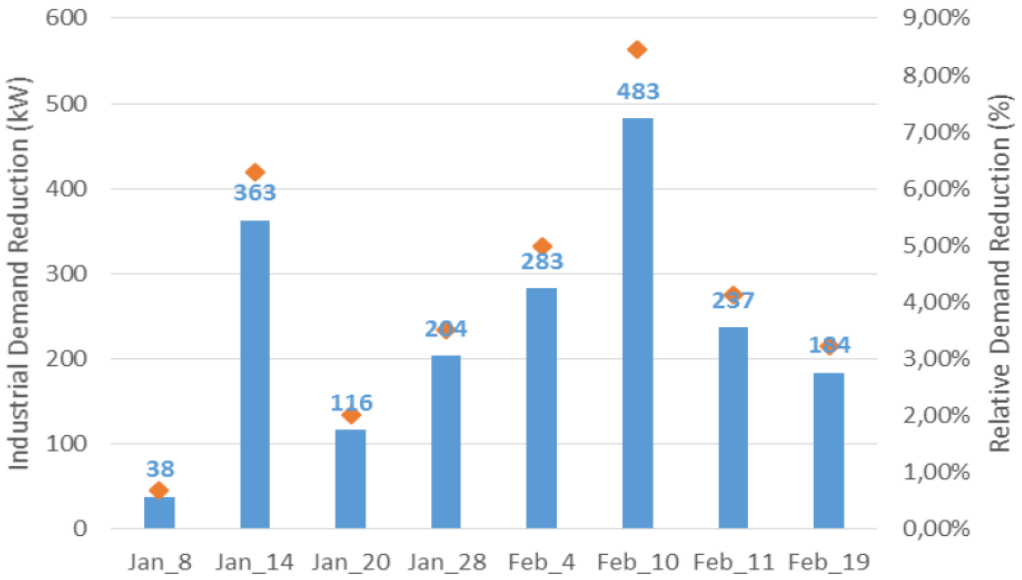
[GRID4EU, 2016]

- This region is powered by a single bulk transmission line (400 kV) which supports power demands with a peak between 6pm and 8pm that has been steadily growing over the years

- One of the objectives of NICE GRID was to reduce the peak demand. Therefore heat pumps and air handling units in a dozen tertiary and industrial premises were remotely controlled using a device. All sites were equipped with a smart meter to record energy consumption [GRID4EU, 2016]

Demand reduction values for industrial load shedding sessions

- The following graph shows the load reduction values for the 8 industrial load shedding sessions scheduled in winter 2014-2015 in the frame of the NICE GRID demonstration project



[GRID4EU, 2016]

- The average value of the 8 sessions is 240 kW. The values vary enormously from one session to another – between 38 and 483 kW – which is equivalent to a reduction in relative power of 1-9% [GRID4EU, 2016]

Contact for Smart Grids demonstrators

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[GRID4EU, 2016] DEMO6 – Dd6.9-2, Final assessment of the demonstrator's operation using the KPIs, http://grid4eu.blob.core.windows.net/media-prod/28747/grid4eu_demo6_deliverable_dd692_final.pdf

Flexibility of a biogas power plant

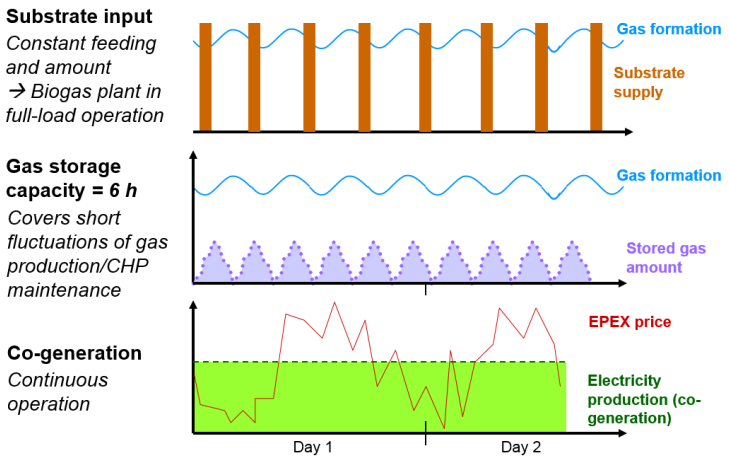
Anaerobic Digestion is one of the renewable energy that can be operated in a flexible way:

- Biological flexibility: flexible biogas production through changes in the substrate used (= gas production) in the plant
- Technical flexibility: flexible electricity production through changes in the power production by using biogas storage and partial load/On-Off-operation of the CHP

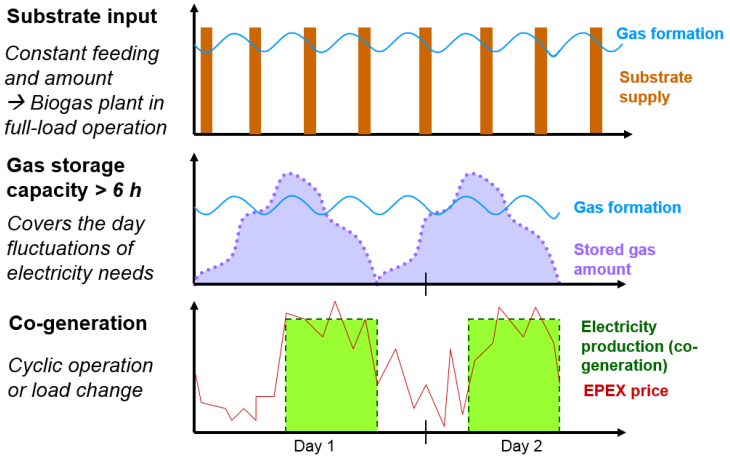
Since 2016 a feed in tariff is in place in France to valorise the electricity sold to the market.

The aim of the model was to simulate flexibility of electricity production to evaluate the benefit of adapting power production to spot market prices and French feed-in tariff.

Non-flexible operation plant (reference)



Flexible operation plant



Flexibility of a biogas power plant

Modelling of a flexible scenario:

The model is to demonstrate the flexibility possibilities of a biogas-CHP plant : it consist of a biogas fermenter, a gas storage, a flare and a CHP.

- Inputs: biogas production, CHP and gas storage capacity, operation rules, spot price of electricity
- Flexible operation rules: electricity production depending on the spot market price variations → power production during high price, storage of gas and no power supply at low price
- Storage rules: storage filing depending on the storage state of charge → gas burned in flare and CHP shutdown if storage full
- Outputs: annual incomes (market price and tariff remuneration); CHP, storage and flare operation

Remarks: CAPEX and OPEX (maintenance, investments, feedstock costs or fees etc.) not integrated

Contact for Biogas demonstrator project

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POMME

EIFER

- POMME:
  - Aims to build a software solution which allows to integrate different simulation tools with the FMI standard.
  - Collaboration among several organisations (SIANI, EIFER, MIRE(EDF-R&D) and OSIRIS(EDF-R&D))
  - Economical optimisation of the Production-Demand balance
  - Simulation of the control of the Production-Demand using an agent-based approach and the validation of the network stability

- Main tasks involved (Francisco Marzabal):
  - Deployment of models (Anylogic/Java) for the simulation and convertion to FMU standard for future use in the platform (DACCOSIM)
  - Anylogic Graphical Interface for visualisation of results through FMU.
  - Simulation control through Anlogic Graphical Interface. (Sim-Time Visualisation, time control, modification of input parameters during simulation time)

Contact for POMME project

Contact

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Project funded by local initiatives
P10WTR53 and P10WTR69

Multimodal Location Based Services

Semantic 3D city and energy data as Virtual and Augmented Reality

EIFER

EIFER
Dr. Jochen Wendel
Alexander Simons
Dr. Andreas Koch

CTIM Las Palmas
José Miguel Santana
Dr. Agustín Trujillo
José Pablo Suárez

lated to utility networks in EIFER

EDF

KIT Karlsruhe Institute of Technology

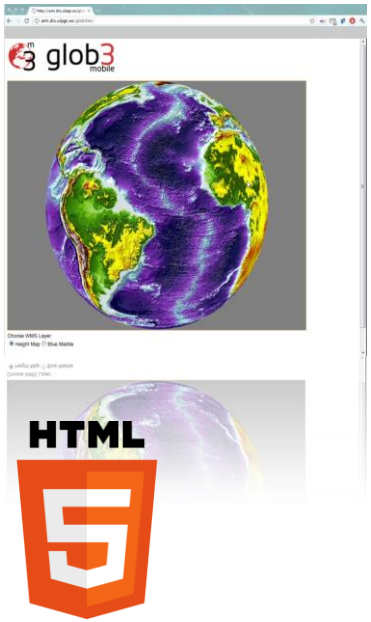
Glob3D mobile API

Glob3D mobile

- Developed by CTIM and IGO Software
- Geodata-app for multiple platforms based on OpenGL and WebGL

https://github.com/glob3mobile

http://glob3mobile.com/

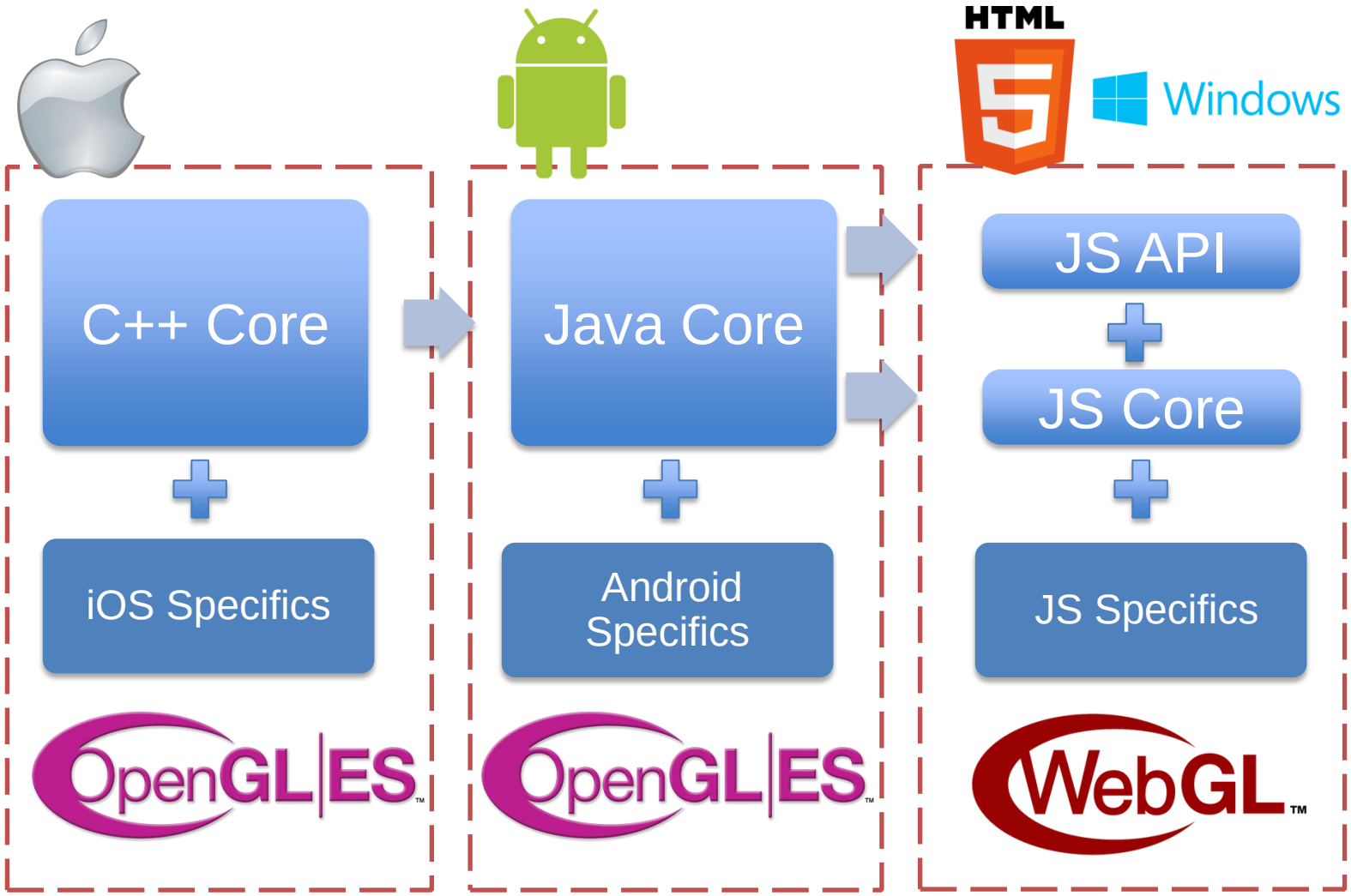


(ULPGC, CTIM 2014)

Glob3D mobile API

EIFER

Application core



(ULPGC, CTIM 2014)

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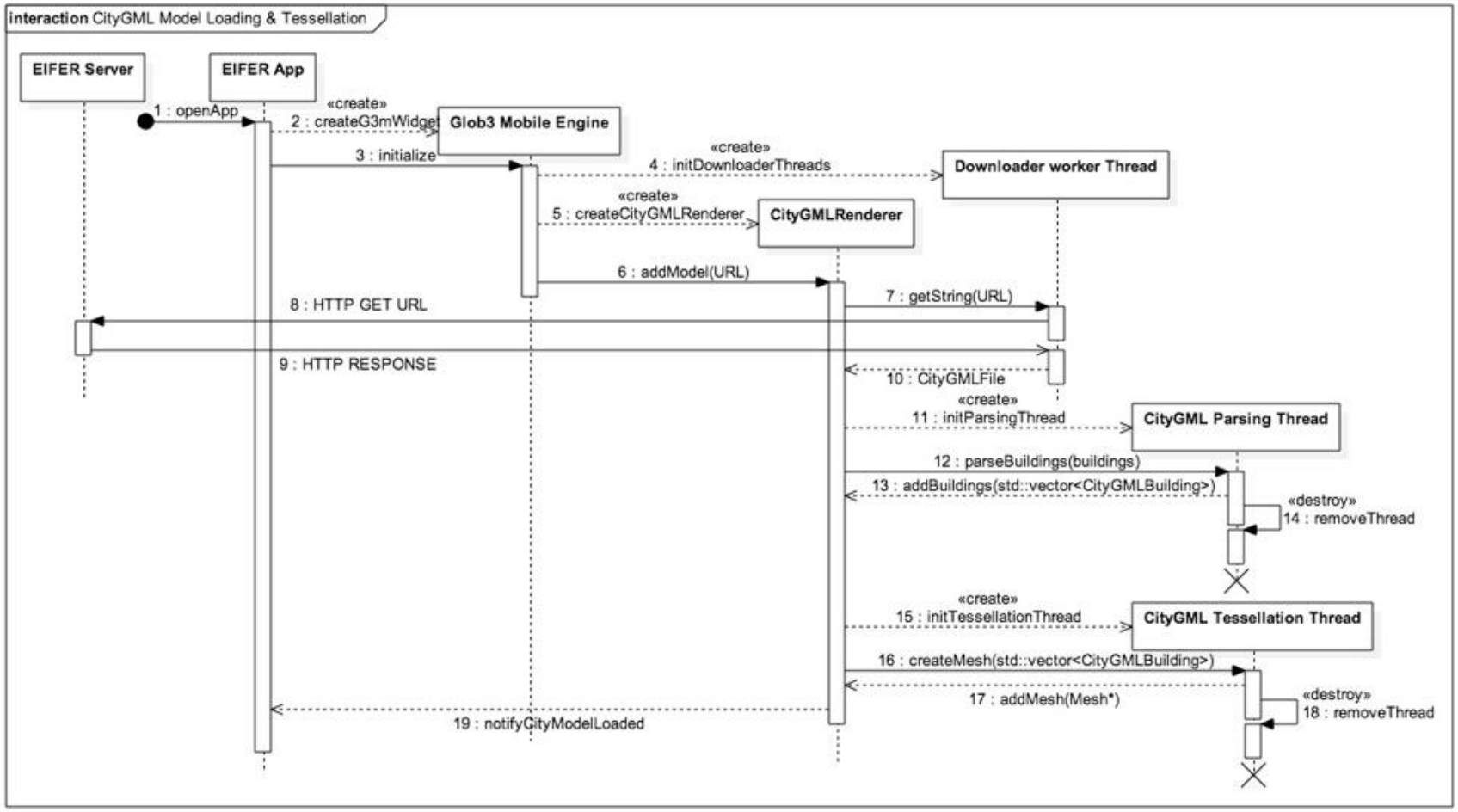
Multithreaded loading of a CityGML model



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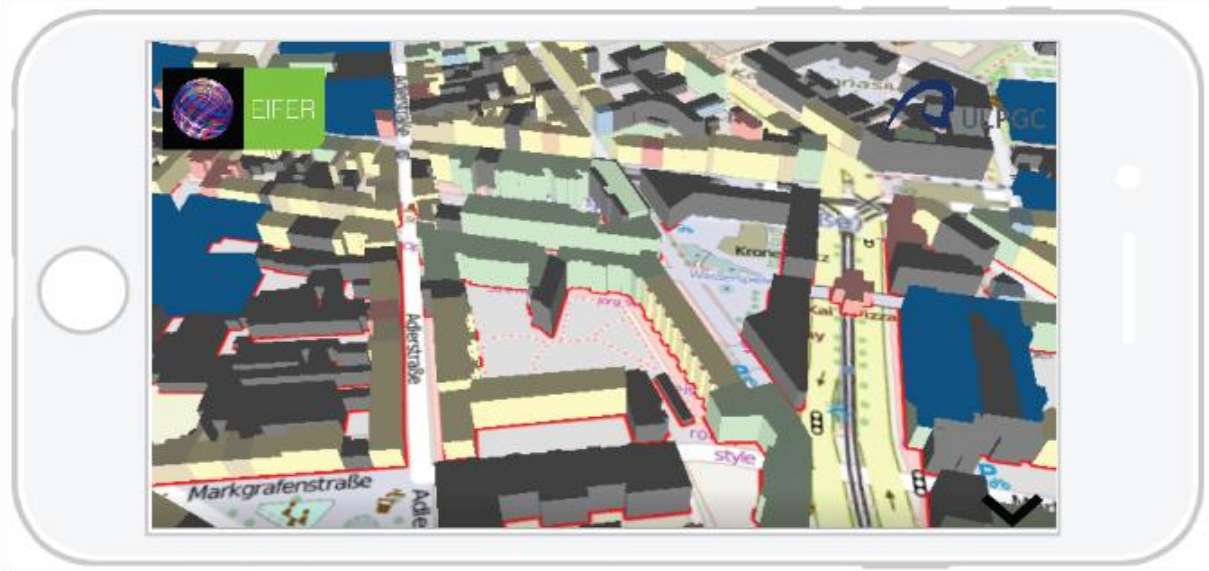
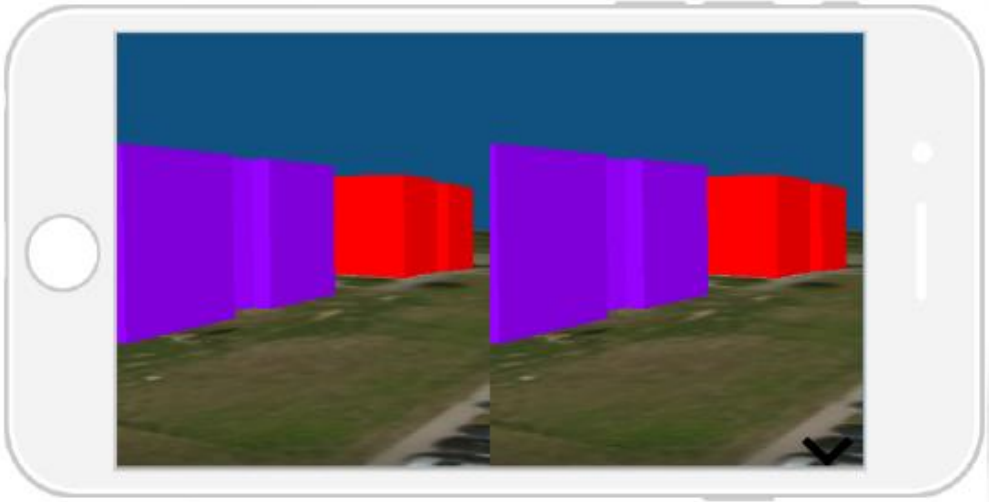
Glob3D mobile API

- **Map mode**
- Virtual Reality (single and stereo)
- Augmented Reality



Glob3D mobile API

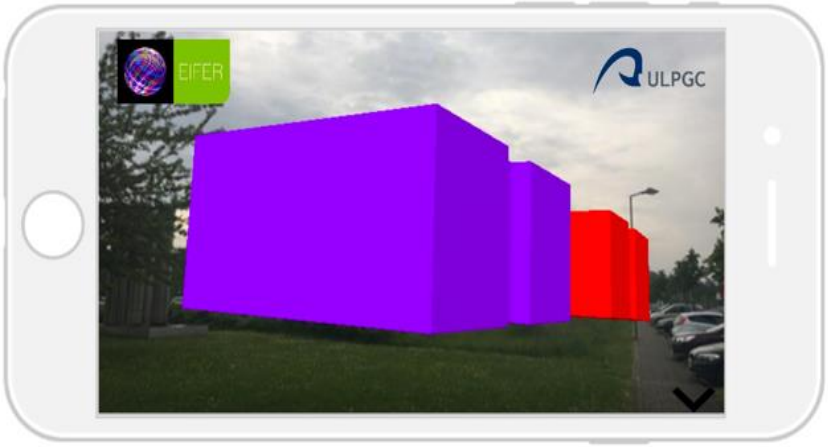
- Map mode
- **Virtual Reality** (single und **stereo**)
- Augmented Reality



CityGML LoD1 in stereo rendering
Technologiepark

Glob3D mobile API

- Map mode
- Virtual Reality (single and stereo)
- **Augmented Reality**



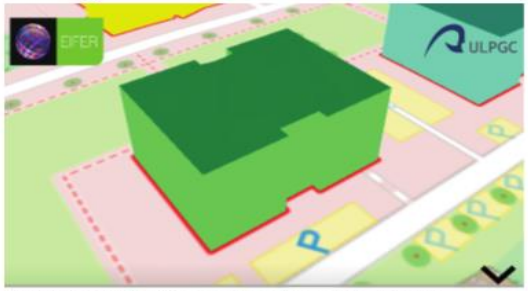
CityGML LoD1
Technologiepark

CityGML LoD2 with textures

Glob3D mobile API

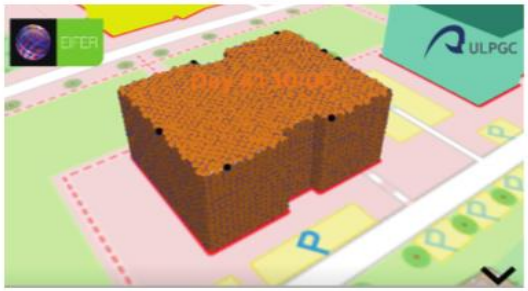
- Visualization of solar radiation and shadowing as animations directly from the SolarB energy model from PostGIS and CityGML

LoD2 building model

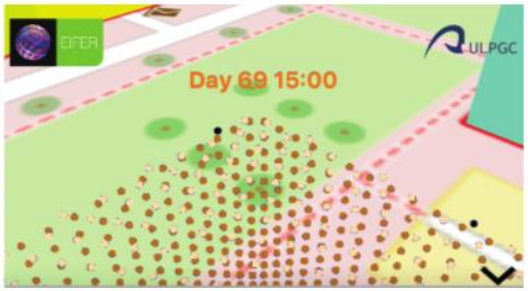


Modal selection dialog presented after long-pressing

Overview of the solar radiation point cloud for the selected building



Detail of the solar radiation data for a specific moment in the time series



Solar radiation and shadowing in AR

User survey, use case, software and standards

User survey, use case, software and standards

Interviews conducted in EIFER: 10

Use cases encountered:

- District heating
- Electrical networks (island networks, smart grids)
- Cooling
- Geothermy
- Industrial waste water
- Interoperability (other industrial standards)
- Network navigation
- Visualisation

User survey, use case, software and standards

EIFER

Name	General profiles	Technical profiles	Roles in product scope	Frequency in use of the product	Priority
Developer	25 – 35 years old, IT specialist in energy research	Programmer and software designer	Developing, coding models, explained by experts and interface developer	Direct user	1
Decision maker	36 – 60 years old, sedentary, meetings guy	Less familiar with softwares, and will prefer the use of common software / methods	Need to see the various results analysis such as risk assessment	Indirect user	1
Energy system modeler	25 – 35 years old, IT specialist in energy research	Programmer and energy researcher	Developing, coding models, analyze models, explained by experts or self developed and interface developer	Direct user	1
Developer/Modeler	25 – 35 years old, specialist in energy research	Energy engineer	Detailing, coding models, analyze models, explained by experts or self developed and interface developer	Direct user	1
Modeler	25 – 35 years old, energy engineer	Energy engineer	Write model specs, translate clients wishes	Indirect/direct user	1
System design, Operation and maintenance, Modeler/Developer	25 – 35 years old, energy engineer	Energy engineer	Write model specs, implementing according to spec, store and exchange data models, static and interactive visualisation, animation for extension of networks,	Indirect/direct user	1
Modeler	25 – 35 years old, energy engineer	Energy engineer	Discuss model specs, phesabililty study, make proposals	Indirect/direct user	1
Modeler	25 – 35 years old, energy engineer	Energy engineer	Discuss model specs, experimental tests, simulation, follow and analyze the results	Indirect/direct user	1
model user, specification writer	35-45 years old, project manager	PhD in wood combustion / technology expert	Test models, use models, describe them to clients, instruct them on using them, also specify them, translate clients demands for improvements to developers	Direct user / Indirect user	1
technical assessment, specification writer for data requests	25-35 years old, project manager	MSc in Ren Energies and En Eff	User of standard, building up technicall assement using information in the standard, feeding information to the standardized file	Direct user / Indirect user	1
Modeler, Developer	25-35 years old, project manager, electrical engineer	PhD in industrial engineering	Develop conceptual models and then develop models	Direct user / Indirect user	1
Managing competences	25-35 years old, cluster responsible	PhD in industrial engineering	Assuring reusability and transferability of models. Own standards that collect models in library format.	Direct user / Indirect user	1
Project coordinator	25-35 years old, project (manager)coordinator	Environmental engineering	Coordination of specification writing, user specification, user stories, and verification and validation according to client demands.	Direct user / Indirect user	1

User types

Name	General profiles	Technical profiles	Roles in product scope	Frequency in use of the product	Priority
Decision maker	36 – 60 years old, sedentary, meetings guy	Less familiar with softwares, and will prefer the use of common software / methods	Need to see the various results analysis such as risk assessment	Indirect user	3
Developer	25 – 35 years old, specialist in energy research	Programmer and software designer, Energy engineer	Developing, coding models, analyze models, explained by experts or self developed and interface developer	Direct user	2
Managing competences	25-35 years old, cluster responsible	PhD in industrial engineering	Assuring reusability and transferability of models. Own standards that collect models in library format.	Direct user / Indirect user	1
Modeler	25 – 35 years old, energy engineer	Energy or electrical engineer, Ing, PhD	Develops conceptual models, also specify them, translate clients demands for improvements to developers - write model specs, translate clients wishes, Discuss model specs, phesabilility study, make proposals, uses exising industrial standards to build up technicall assement using information in the standard, specifies interfaces	Direct user	1
Model tester / System designer	25 – 35 years old, energy engineer	Energy or electrical engineer, Ing, PhD	Uses models, describes them to clients, instructs them on using them, follows and analyzes the results, tests models	Direct user / Indirect user	2
Project coordinator	25-35 years old, project (manager)coordinator	Environmental engineering	Coordination of specification writing, user specification, user stories, and verification and validation according to client demands.	Direct user / Indirect user	1
System operator and maintenance	25 – 35 years old, energy engineer	Energy engineer	Static and interactive visualisation, animation for extension of networks, storage of maintenance information	Direct user / Indirect user	2

User stories

EIFER

Story ID	Rule	Behaviour	Expected Outputs	Business value	Priority	Granularity	Identified needs
US_CM01	As a cluster manager, I want to	assure homogeinity in the clusters tools	homogenoues model library	So that I'm able to enhance the interoperability	1	models	Connection to existing standards
US_D01	As a Developer, I want to	Program	The different models described by experts	So that I am able to convert mathemathical models in a runable simulation	1	Production units, network, substations	Spatial information (location, topology) for network components, model description
US_ML2	As a model tester / sytem designer, I want to	Test scenarios to validate results	Degree of confidence in results	Confidence in bussiness model	1	Digestor, flare, CHP, gas storage	KPIs for electricity production, economic part (prices for selling electricity, gas, invest price of diff components), Technical parameters of components
US_M02	As a model user, I want to	See results of models with associated confidence	Results of simulation (consumption, electricity production, storage capacity, all data related to flexible production facility related to rentability)	Rentability scenarios	3	Digestor, flare, CHP, gas storage	KPIs
US_MSD01	As a modeler / system designer, I want to	Develop a central storage	Central storage	So that I'm able to compare and assess different systems	1	Household, appliance of household (production facility), substation	KPIs (see list from GRID4EU)
US_MSD02	As a modeler / system designer, I want to	Calculate KPIs	KPIs	So that I'm able to compare and assess different systems	1	Household, appliance of household (production facility), substation	KPIs (see list from GRID4EU)
US_M01	As a modeler, I want to	Store a description of the physical process	Specifications written in UML	Sell models	2	Production unit (digestor, flare, CHP, gas storage)	KPIs for electricity production, economic part (prices for selling electricity, gas, invest price of diff components), Technical parameters of components
US_M03	As a modeler, I want to	Storing	Model	single and unified storage	1	Household, appliance of household (production facility), substation	storage
US_M04	As a modeler, I want to	Exchanging	Standardized file exchanged	allows easy exchange	1	Household, appliance of household (production facility), substation	standardized information exchange
US_M05	As a modeler, I want for	Input for vis, sim		visualisation	2	Household, appliance of household (production facility), substation	visualisation
US_M06	As a modeler, I want to	Write specifications	Models	So that I am able to model an energy system according to client requirements	1	space (pipes, buildings, production facility), time (months, days, hours, 15 min, 1 min)	DIN, weather, spatial information
US_M07	As a modeler, I want to	See results based on KPIs	Graphs / Reports	So that I am able to compare and evaluate diff system set-ups and perform sensitivity analysis	1	space (pipes, buildings, production facility), time (months, days, hours, 15 min, 1 min)	KPIs (envoironmental & energy eff, balance sheet)
US_M08	As a modeler, I want to	use standardized onthologies for energy system models	Multi energy models	So that I'm able to model local energy systems	1	building, distribution transformer	standardized onthologies for energy system models
US_PC01	As a project coordinator, I want to	allow my client to use the model for energy planning on a district scale	Model	So that I'm able to reuse the model for different clients	1	Substation, pipes, production facility	KPIs
US_SOM01	As a system operator, I want to	System management	KPIs	improve network efficiency	1	Substation, pipes, production facility	KPIs
US_SOM02	As a system operator, I want to	Facility manag	Facility Managements sytem support	improve network efficiency	1	Substation, pipes, production facility	facility management support
US_SOM2	As a system operator, I want to	Test models	KPIs	scenario calculation and refinment		Substation, pipes, production facility	publish report on costs, sizing to offer network improvement
US_SOM3	As a system operator, I want to	Test models	KPIs	saves costs for primary reserve		demand site management	stabilize grid
US_M09	As an modeler, I want to	Develop	Simulation	So that I am able to analyze energy systems in the urban context (the model is a tool for analyzing)	1	Production units, network, substations, demand, storage, energy management units	DIN, weather, spatial information

Software by user type

EIFER

User	Software	Description
Decision Maker	CURTIS	City Simulation Platform
Developer	Anylogic	simulation platforms
	ArcGIS/QGIS	data processing
	JavaIDE	
	Matlab	processing
	Tafat	
Modeler	Anylogic	Simulate, validation, tested proposals, results visualisation
	ArcGIS/QGIS	process and calculations
	CURTIS	City Simulation Platform
	Dymola	Testing models and their integration
	FME	
	Java	Model development
	Matlab	Process, simulate, plot
	MSoffice	Describe models, Tool development (e.g. Bebop), Excel implement model, variation of input, capitalization work and used for scenario calculation and refinment, Produce graphs for results, reports with detailed scenarios, write data specifications
	Netlogo	Model development
	Python	
	R	
	R	Data analysis, calculation algorithms to ease calculation processes
	Visio	Describe models
Project coordinator	ArcGIS/QGIS	Processing
	CURTIS	City Simulation Platform
	Java	Model development
	MSoffice	
	Python	Model development
	Visio	Describe models
System operator	Anylogic	Testing models and scenarios
	CURTIS	City Simulation Platform
	Design und Baum	
	FreeVisio	Describe models
	MSoffice	Produce graphs for results, reports with detailed scenarios, write specifications,
	Dimola / Modelica	Closed libraries
	Termis	Commercial product to simulate distrib netw and substations
	Termis library	Production systems
	Wdesign	Modelling

Software list

User	Software	Description
Modeler, Developer, System operator	Anylogic	Simulate, validation, tested proposals, results visualisation
Modeler, Developer, System operator, Project coordinator	ArcGIS/QGIS	data processing
Decision Maker, Modeler, Project coordinator, System operator	CURTIS	City Simulation Platform
System operator	Design und Baum	
Modeler	Dimola / Modelica	Closed libraries
Modeler	Dymola	Testing models and their integration
Modeler	FME	
Modeler	FreeVisio	Describe models
Modeler	Java	Model development
Modeler	JavaIDE	
Modeler, Developer	Matlab	processing, simulate, plot
Modeler, Developer, System operator, Project coordinator	MSoffice	Describe models, Tool development (e.g. Bebop), Excel implement model, variation of input, capitalization work and used for scenario calculation and refinment, Produce graphs for results, reports with detailed scenarios, write data specifications, Produce graphs for results, reports with detailed scenarios, write specifications,
Modeler	Netlogo	Model development
Developer	Python	Model development
Developer	R	
Modeler, Developer	R	Data analysis, calculation algorithms to ease calculation processes
Developer	Tafat	
System operator	Termis	Commercial product to simulate distrib netw and substations
System operator	Termis library	Production systems
Modeler	Visio	Describe models
Modeler	Wdesign	Modelling

Standards

User	Standards used	Description
Modeler	BDTopo	Spatial information
Modeler	CIM	Electricity grids standard
Developer, Modeler	CityGML	Spatial information, input for Tafat ontologies
Developer, Modeler	CSV	Simulation inputs and outputs
Developer, Modeler	DIN	Industry standards
Developer, Modeler	DPE/3CL	Standardized methodologies for normative thermal constructions of residential buildings (France)
Developer, Modeler	FMI	Functional Mockup Interface, standardized interface that instructs on simulation data exchange for cosimulations, Model exchange and cosimulation
Developer, Modeler	GB	DIN counterpart for China
Developer, Modeler	INSEE	Statistics
Modeler	ISO…	Heat losses, pressure drops, environmental impact measurement, testing of components, Functional Mockup Interface, standardized interface that instructs on simulation data exchange for cosimulations
Modeler	ISO…	Functional Mockup Interface, standardized interface that instructs on simulation data exchange for cosimulations
Modeler	PDF	inputs, spatial information
Developer, Modeler	SHP	inputs, outputs spatial information
Developer	TMY2	weather information
Modeler	x	Proprietary data formats, restricted to industrial partners
Modeler	x	Product catalogues, conference, direct contact with operators and manufactureres
Modeler	x	Policy papers, in search for KPIs

What is the importance of the Utility Network ADE for EIFER members

Use cases	Importanc
District heating	1
Electrical networks (island networks, smart grids)	1
Interoperability (other industrial standards)	1
Visualisation	1
Cooling	2
Geothermy	2
Industrial waste water	2
Network navigation	3

Thank you…

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