SEVENTH FRAMEWORK PROGRAMME

THEME [ICT-2011.6.2]
[ICT systems for energy efficiency]

Grant agreement for: Collaborative project*

Annex I - "Description of Work"

Project acronym: ISES

Project full title: " Intelligent Services for Energy-Efficient Design and Life Cycle Simulation "

Grant agreement no: 288819

Version date:

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Part A

Workplan Tables

A1:
Project summary

Project Number [1]	288819	Project Acronym [2]	ISES

One form per project

General information

Project title [3]	Intelligent Services for Energy-Efficient Design and Life Cycle Simulation		
Starting date [4]	01/12/2011		
Duration in months [5]	36		
Call (part) identifier [6]	FP7-ICT-2011-7		
Activity code(s) most relevant to your topic [7]	ICT-2011.6.2: ICT systems for energy efficiency		
Free keywords [8]			

Abstract [9]

The objective of ISES is to develop ICT building blocks to integrate, complement and empower existing tools for design and operation management (FM) to a Virtual Energy Lab. This will allow evaluating, simulating and optimizing the energy efficiency of products for built facilities and facility components in variations of real life scenarios before their realization, acknowledging the stochastic life-cycle nature.

The focus of the prototype application domain is on buildings, factories and warehouses because in buildings about 40% of the global energy is used and 30% of CO_2 emissions and solid waste is created. There is a huge market for more energy-efficient design of new buildings and for refurbishing of the huge building stock through energy-efficient component products.

The goal of the project is to increase, by an order of magnitude, the quality of energy-efficiency in design through the development of an In-Silico Energy Simulator Laboratory, based on an interoperable ontology-supported platform. The focus of RTD is on multi-model design and testing, stochastic lifecycle analysis/simulation in combination with new supporting ontology and interoperability tools and services, and respective re-engineering of existing tools, making them more intelligent and smartly interoperable. Further goals are the combination of energy profile models with product development STEP models and building and facility BIM models.

The Virtual Energy Lab will be configured as an ontology-controlled SOA system with distributed services, distributed modelling and analysis/simulation tools and distributed data sources. This will allow concentrating the RTD work on ICT gaps, whereas existing, market-proof services, tools and data sources can be incorporated nearly development-free.

A2:
List of Beneficiaries

Project Number [1]	288819	Project Acronym [2]	ISES

List of Beneficiaries

No	Name	Short name	Country	Project entry month[10]	Project exit month
1	TECHNISCHE UNIVERSITAET DRESDEN	TUD	Germany	1	36
2	GRANLUND OY	OG	Finland	1	36
3	UNIVERZA V LJUBLJANI	UL	Slovenia	1	36
4	SOFISTIK HELLAS AE	SOF	Greece	1	36
5	NYSKOPUNARMIDSTOD ISLANDS	NMI	Iceland	1	36
6	NATIONAL OBSERVATORY OF ATHENS	NOA	Greece	1	36
7	LEONHARDT ANDRA UND PARTNER BERATEN DE INGENIEURE VBI GMBH	LAP	Germany	1	36
8	TRIMO INZENIRING IN PROIZVODNJA MONTAZNIH OBJEKTOV, D.D.	TRI	Slovenia	1	36

A3:
Budget Breakdown

Project Number [1]	288819	Project Acronym [2]	ISES

One Form per Project

Participant number in this project [11]	Participant short name	Fund. % [12]	Ind. costs [13]	Estimated eligible costs (whole duration of the project)					Requested EU contribution
				RTD / Innovation (A)	Demonstration (B)	Management (C)	Other (D)	Total A+B+C+D	
1	TUD	75.0	T	705,600.00	33,280.00	95,520.00	0.00	834,400.00	641,360.00
2	OG	50.0	A	977,400.00	93,960.00	20,660.00	0.00	1,092,020.00	556,340.00
3	UL	75.0	T	462,496.00	24,000.00	12,000.00	0.00	498,496.00	370,872.00
4	SOF	75.0	A	682,600.00	66,000.00	16,000.00	0.00	764,600.00	560,950.00
5	NMI	75.0	A	374,880.00	36,720.00	15,180.00	0.00	426,780.00	314,700.00
6	NOA	75.0	A	178,720.00	37,120.00	7,140.00	0.00	222,980.00	159,740.00
7	LAP	75.0	A	252,915.00	69,420.00	11,178.00	0.00	333,513.00	235,574.00
8	TRI	50.0	F	155,280.00	70,560.00	7,540.00	0.00	233,380.00	120,460.00
Total				3,789,891.00	431,060.00	185,218.00	0.00	4,406,169.00	2,959,996.00

Note that the budget mentioned in this table is the total budget requested by the Beneficiary and associated Third Parties.

*** The following funding schemes are distinguished**

Collaborative Project (if a distinction is made in the call please state which type of Collaborative project is referred to: (i) Small of medium-scale focused research project, (ii) Large-scale integrating project, (iii) Project targeted to special groups such as SMEs and other smaller actors), Network of Excellence, Coordination Action, Support Action.

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project, and it cannot be changed. The project number **should appear on each page of the grant agreement preparation documents** to prevent errors during its handling.

2. Project acronym

Use the project acronym as indicated in the submitted proposal. It cannot be changed, unless agreed during the negotiations. The same acronym **should appear on each page of the grant agreement preparation documents** to prevent errors during its handling.

3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry info force of the Grant Agreement (NB : entry into force = signature by the Commission). Please note that if a fixed starting date is used, you will be required to provide a detailed justification on a separate note.

5. Duration

Insert the duration of the project in full months.

6. Call (part) identifier

The Call (part) identifier is the reference number given in the call or part of the call you were addressing, as indicated in the publication of the call in the Official Journal of the European Union. You have to use the identifier given by the Commission in the letter inviting to prepare the grant agreement.

7. Activity code

Select the activity code from the drop-down menu.

8. Free keywords

Use the free keywords from your original proposal; changes and additions are possible.

9. Abstract

10. The month at which the participant joined the consortium, month 1 marking the start date of the project, and all other start dates being relative to this start date.

11. The number allocated by the Consortium to the participant for this project.

12. Include the funding % for RTD/Innovation – either 50% or 75%

13. Indirect cost model
A: Actual Costs
S: Actual Costs Simplified Method
T: Transitional Flat rate
F :Flat Rate

Workplan Tables

Project number

288819

Project title

ISES—Intelligent Services for Energy-Efficient Design and Life Cycle Simulation

Call (part) identifier

FP7-ICT-2011-7

Funding scheme

Collaborative project

WT1
List of work packages

Project Number [1]	288819	Project Acronym [2]	ISES

LIST OF WORK PACKAGES (WP)

WP Number [53]	WP Title	Type of activity [54]	Lead beneficiary number [55]	Person-months [56]	Start month [57]	End month [58]
WP 1	Requirements for ICT-Enabled Energy Efficient Design and Life-Cycle Simulation	RTD	7	32.00	1	6
WP 2	Architecture, Components and Stochastic Approach	RTD	1	34.00	4	12
WP 3	Model and System Ontology of the Overall Framework	RTD	3	40.00	6	18
WP 4	Energy Profile and Consumption Patterns for Built Facilities and Their Components	RTD	5	60.00	6	24
WP 5	Multi-Model Combiner and Simulation Configurator	RTD	1	60.00	10	30
WP 6	Multi-Model Manager and Simulation Evaluator	RTD	2	56.00	10	30
WP 7	Intelligent Cloud-Enabled Multi-Model Energy Simulations	RTD	3	56.00	13	33
WP 8	Dissemination and Exploitation of the Project Results	RTD	4	36.00	1	36
WP 9	Pilot Virtual Lab and Public Demonstrators	DEM	8	53.00	7	36
WP 10	Project Management	MGT	1	18.00	1	36
			Total	445.00		

Project Number [1]	288819	Project Acronym [2]	ISES

List of Deliverables - to be submitted for review to EC

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D1.1	Gap analysis	1	8	12.00	O	PU	6
D1.2	Use case scenarios and requirements specification	1	7	20.00	O	RE	6
D2.1	Overall stochastic approach for the Virtual Energy Lab Platform	2	1	10.00	O	PU	12
D2.2	Architecture and components of the Virtual Lab Platform	2	1	24.00	O	CO	12
D3.1	Ontology Specification	3	3	24.00	O	PU	15
D3.2	Ontology prototype	3	3	16.00	P	PU	18
D4.1	Technical specification of the overall framework and the principal energy profile and consumption pa	4	5	14.00	O	PU	12
D4.2	Prototype of the intelligent search, access and interoperability services to the energy-related ICT	4	5	14.00	P	PU	15
D4.3	Prototype of the intelligent services for BIM-based product catalogue profiling and BIM integration	4	4	12.00	P	PU	18
D4.4	Characteristic energy	4	5	20.00	O	PU	24

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
	profile and consumption patterns for the ISES Virtual Energy Lab						
D5.1	Prototype of the multi-model integration services	5	1	12.00	P	PU	15
D5.2	Prototype of the multi-model combiner	5	4	32.00	P	PU	24
D5.3	Prototype of the simulation configurator	5	1	16.00	P	PU	30
D6.1	Prototype of the host product multi-model filters	6	1	16.00	P	PU	18
D6.2	Prototype of the simulation synthesis and the version management service	6	2	14.00	P	RE	21
D6.3	Prototype of the simulation evaluation service and the multi-model navigator	6	2	26.00	P	PU	30
D7.1	Cloud-enabled test-bed	7	3	3.00	O	CO	15
D7.2	Cloud-enabled software integration	7	3	33.00	O	PU	30
D7.3	Prototype of the developed intelligent workflow definition, execution and monitoring services	7	3	16.00	P	PU	33
D7.4	Use of the Prototyped Virtual Energy	7	3	4.00	O	PU	33

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
	Lab on a Cloud Environment						
D8.1	Project Web Site and Collaboration Infrastructure	8	3	8.00	O	PU	3
D8.2.1	Project Newsletter #1	8	1	1.50	O	PU	6
D8.2.2	Project Newsletter #2	8	4	1.00	O	PU	12
D8.2.3	Project Newsletter #3	8	2	1.00	O	PU	18
D8.2.4	Project Newsletter #4	8	5	1.00	O	PU	24
D8.2.5	Project Newsletter #5	8	4	1.50	O	PU	30
D8.3.1	Intermediate public workshop	8	4	6.00	O	PU	24
D8.3.2	Final public workshop	8	8	6.00	O	PU	36
D8.4.1	Initial Exploitation Plan	8	4	2.00	O	CO	12
D8.4.2	Intermediate Exploitation Plan	8	4	2.00	O	CO	18
D8.4.3	Final Exploitation Plan	8	4	2.00	O	CO	30
D8.5	Internal Risk Management Database and IPR-related Monitoring	8	4	1.00	O	CO	12
D8.6.1	Contributions to eeBDM Harmonisation (initial report)	8	1	0.50	O	PU	12
D8.6.2	Contributions to eeBDM Harmonisation (intermediate report)	8	1	0.50	O	PU	18
D8.6.3	Contributions to eeBDM Harmonisation (final report)	8	1	1.00	O	PU	36

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D8.7	Third eeBDM Workshop – Summary and Proceedings	8	1	1.00	O	PU	12
D9.1.1	First public demonstrator of the Virtual Energy Lab and developed ee-performance indicators	9	4	20.00	D	PU	24
D9.1.2	Final public demonstrator of the Virtual Energy Lab	9	8	22.00	D	PU	36
D9.2	End user report on the Virtual Energy Lab pilot	9	5	11.00	O	PU	36
D10.1.1	Periodic Report #1	10	1	4.00	R	CO	12
D10.1.2	Periodic Report #2	10	1	5.00	R	CO	24
D10.1.3	Periodic Report #3	10	1	5.00	R	CO	36
D10.3	Project Manual	10	1	1.00	O	CO	4
D10.4	Final Project Report	10	1	3.00	R	PU	36
			Total	445.00			

WT3:
Work package description

Project Number [1]	288819	Project Acronym [2]	ISES

One form per Work Package

Work package number [53]	WP1	Type of activity [54]	RTD
Work package title	Requirements for ICT-Enabled Energy Efficient Design and Life-Cycle Simulation		
Start month	1		
End month	6		
Lead beneficiary number [55]	7		

Objectives

The complexity of the energy efficient design and the stochastic life cycle consideration of built facilities and their energy-relevant components (facades and internal walls, HVAL and lighting equipment etc.) lies in the very broad scope of the factors that need to be considered. These include user influences, material and component influences, automation systems and the facility as such (space and space boundaries, exterior envelope and so on). Similar considerations are relevant when new products are planned and developed or existing products are upgraded by component and subsystem providers, and when subsystems have to be configured for a given cultural and climatic location. Due to that complexity, considerable gaps still exist in the information use and the information flows between the involved design / analysis / simulation and the FM systems and tools.
Therefore, before the design and implementation work on the ISES platform in WPs 2-7, WP1 will:
– Perform analyses of user roles, existing information resources and anticipated usage scenarios and needs
– Develop typical use casesthat shall be used as baseline for all subsequent RTD work
– Provide objective specification of the requirements regardinga) ICT-related energy and CO2 emissions modelling,
and b) the interoperability needs for efficient application of advanced simulation methods.

Description of work and role of partners

The work in WP1 is structured in 3 tasks.

T1.1 Gap analysis [Participants: All project partners, Lead: TRI]
A survey of existing databases and other ICT resources for climate and user profiles as well as relevant product catalogues will be performed with special focus on essential parameters needed for energy and CO2 performance assessment. Gaps will be identified and their impact on the virtual lab platform operability will be investigated. Data models and functionalities of state-of-the-art tools to be used in ISES will be analysed in parallel. These include: basic design CAD systems and CAFM systems as well as various analysis and simulation tools in the scope of the project (heat, moisture, air flow etc.) .
[INDICATIVE] Gaps already identified within the HESMOS project with regard to climate data basis, CAD and CAFM systems and analysis and simulation tools will be taken into account to shorten the gap analysis process. Hence, in ISES, the attention will be on user profiles, product catalogues and stochastic which are not in the focus of HESMOS.

T1.2 Use case scenarios [Participants: All project partners, Lead: LAP]
Scenarios will be defined in detail for the three major simulation cycles identified in the project objectives (two design cycles and one internal simulation feedback cycle). This includes detailed characterisation of user roles, processes and supporting tools, interoperability methods, data models and data interfaces. Acknowledged methodologies like ARIS or the IDM (Information Delivery Manual) approach of the BuildingSMART initiative (ISO 29481-1) will be used as basis for the definition of relevant process maps and exchange requirements.
[INDICATIVE] The life-cycle scenarios identified in the HESMOS project will be used as baseline, especially with regard to the two design cycles mentioned above. However, as shown in Part B, section 1.1 the objectives and focus of attention of ISES are quite different from HESMOS. Therefore, only some general considerations will be adopted and respectively adapted.

T1.3 Requirements specification [Participants: All project partners, Lead: LAP]

The results of T1.1 and T1.2 will be synthesized and requirements structured in the following groups will be derived:
(1) Modelling and interoperability requirements, (2) Functional requirements, (3) Stochastic life-cycle simulation requirements and (4) GUI requirements. Each partner will contribute and draw requirements from their expert point of view, in accordance with their specific profile and expertise, as described in the Part B, Section 2.2.
[INDICATIVE] Whilst the objectives of ISES and hence the requirements to the Virtual Energy Platform are different from HESMOS, the general methodology and classification of requirements developed in HESMOS will be used as baseline, enabling a straightforward approach.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	TUD	3.00
2	OG	3.00
3	UL	3.00
4	SOF	3.00
5	NMI	3.00
6	NOA	5.00
7	LAP	6.00
8	TRI	6.00
	Total	32.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D1.1	Gap analysis	8	12.00	O	PU	6
D1.2	Use case scenarios and requirements specification	7	20.00	O	RE	6
		Total	32.00			

Description of deliverables

D1.1) Gap analysis: Existing ICT gaps regarding the energy efficient analysis and life cycle simulation of various types of host products will be analysed and the relevant findings will be documented. [month 6]

D1.2) Use case scenarios and requirements specification: Use case scenarios and requirements specification: Use cases will be formalised (e.g. via BPMN).and structured business scenarios will be set up. On that basis, requirements will be collected, synthesised, classified and arranged in accordance with the identified user roles. An extended summary will be made public. [month 6]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS1	Requirements	7	6	Requirements and user scenarios are defined and ICT resources for life-cycle energy performance are surveyed

Project Number [1]	288819	Project Acronym [2]	ISES

One form per Work Package

Work package number [53]	WP2	Type of activity [54]	RTD
Work package title	Architecture, Components and Stochastic Approach		
Start month	4		
End month	12		
Lead beneficiary number [55]	1		

Objectives

This WP will:
– Set upthe overall cloud-based ISES platform architecture, including data preparation via local CAD and FM systems as well as distributed and local databases for climate data, user profiles and product catalogues
– Specify the component services and their interrelations to prepare for the needed harmonised APIs that will be developed in WPs 3-7
– Define the prerequisites for multiple parallel simulation runs on the cloud, thereby setting the basis for the RTD work in WP7, specifically dedicated to the cloud environment
– Develop the overall stochastic approach for the Virtual Energy Lab platform in alignment with the objectives of the project and the technical platform architecture.
The platform itself will be developed using the SOA approach and the general conceptual layer structure described in the Part B, Section 1.1. It will take into account both remote web services, especially the services for life cycle energy, CO2 and cost simulations executed on a cloud, and the local CAD, FM and product catalogue systems that will be used in ISES. Specific attention will be paid to the central role of an FM system for the overall Virtual Energy Lab platform, and to the ICT building blocks that will be newly developed from scratch. The latter include not only completely new services, such as the Multi-Model Combiner (WP5) or the Multi-Model Filtering, Evaluation and Navigation Services (WP6), but also components enabling the interoperability of existing tools on the Virtual Energy Lab platform, such as plug-ins and adapters.

Description of work and role of partners

The work in WP2 is structured in 3 tasks.

T2.1 Draft architecture and ICT components specification [TUD (lead), OG, UL, SOF]
Draft architecture and ICT components specification. Early draft specification of the overall platform architecture will be performed to facilitate as much as possible parallel developments in the other RTD work packages. The components of the platform will be identified and their principal interactions and information flows will be defined and formalised in UML activity and component models. Modelling will be performed in close cooperation with WP3 which will develop the system ontology of the whole framework.
[INDICATIVE] From the HESMOS project, the principal SOA approach enabling the coherent use of distributed local applications, web applications and web services will be used as basis and some of the general services of the general management services of the HESMOS Virtual Energy Lab will be reused with respective adaptation. However, the use of Cloud Computing on the ISES platform (s. WP 5-7) will also require substantial changes in the architecture, development of other supporting middleware services and adjustment to the basic cloud computing paradigm.

T2.2 Development and specification of the overall stochastic approach [TUD (lead), OG, SOF]
The stochastic processes involved in the envisaged energy, emissions and cost simulations will be analysed from systemic point of view in order to develop a pragmatic, manageable treatment of the stochasticity of the product life-cycle. Prioritisation of the stochastic parameters to be considered will be worked out and the treatment of stochastic issues in the separate components of the Virtual Energy Lab will be principally defined. Consequences regarding the ICT components will be deduced and the baseline for the detailed stochastic approach in WPs 4, 5 and 6 will be set up.

T2.3 Final specification of the platform architecture and principal service orchestration [TUD (lead), OG, UL, SOF]
The findings from T2.1 and T2.2 and the feedback from WP3 and WP4 will be synthesized in a final specification of the platform architecture. Based on the gap analysis from WP1 and acknowledged data exchange, interoperability and communication standards such as STEP physical files and IfcXML (for data) or WSDL (for the web services), the service APIs will be defined and aligned with the ontology developed in WP3. Furthermore, using the developed scenarios, orchestration of the services will be carried out, formalised in BPEL.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	TUD	12.00
2	OG	8.00
3	UL	6.00
4	SOF	8.00
	Total	34.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D2.1	Overall stochastic approach for the Virtual Energy Lab Platform	1	10.00	O	PU	12
D2.2	Architecture and components of the Virtual Lab Platform	1	24.00	O	CO	12
		Total	34.00			

Description of deliverables

D2.1) Overall stochastic approach for the Virtual Energy Lab Platform: The developed stochastic approach will be described in concise form, highlighting its innate features. Special attention will be put on the use of energy profiles and energy consumption patterns as well as the multi-model combiner and simulation configuration concepts, enabling the automated simultaneous configuration, management and evaluation of hundreds of simulation models. [month 12]

D2.2) Architecture and components of the Virtual Lab Platform: Architecture and components of the Virtual Lab Platform: A technical description of the overall ISES architecture will be provided, including the major components and their inter-relationships and principal APIs (basic, functionality, underlying meta models etc.). An established formalisation approach such as UML component diagrams will be uses as basis for the following tool / service developments. An extended summary will be made public. [month 12]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS2	Architecture	1	12	Defined architecture of the Virtual Energy Lab Platform with all model and service components

WT3:
Work package description

Project Number [1]	288819	Project Acronym [2]	ISES

One form per Work Package

Work package number [53]	WP3	Type of activity [54]	RTD
Work package title	Model and System Ontology of the Overall Framework		
Start month	6		
End month	18		
Lead beneficiary number [55]	3		

Objectives

The information resources for the Virtual Energy Lab are numerous; it is therefore difficult to harmonize them using a coherent single model schema. For multi-model interoperability and reasoning upper level concepts will be developed, enabling resource data inter-linking via common ontologies and overarching rules. For the modelling of built facilities, the major targeted host product of ISES, the standard IFC model (ISO PAS 16739) will be used as basis. The objectives are:
– Integration of the multi-model resources (climate data, user profiles, product catalogue data etc.) on higher conceptual level – enabled by ISES developed model ontology
– Development of an ontology-based BIM (OntoBIM) that will enable high-level reasoning on all models related to the Virtual Energy Lab and address problems related to product data availability, insufficient expressiveness of the underlying meta model (subset of STEP/EXPRESS) and the difficult derivation of generalized geometry data suitable for energy /cost simulation from IFC models
– Uniform definition of all system components, thereby providing for high-level queries, informed decisions about workflows and scenarios, and hence for adequate business process support – enabled by ISES system ontology of the overall framework.
– Forwarding the developed ISES ontologies to BuildingSMART as suggestion for standardisation.

Description of work and role of partners

The work in WP3 is structured in 3 tasks.

T3.1 Component and background models [UL (lead), OG, NMI, TUD]
Background (resource) models that need to be considered will be examined and high-level concepts of the model ontology enabling their coherent treatment will be developed, together with rules and methods for ad-hoc inspection and inclusion of native attributes of the data objects in the resource databases. The background models to be analysed include climatic database schemas, user profile schemas, product catalogue schemas (STEP, PLIB) and building information models (BIM). For the latter, the IFC model is preselected. The other background models will be defined on the basis of the findings from WP1. Specific attention will be paid to the integration of product catalogue information with BIM on high semantic level, suitable for the needs of the Virtual Energy Lab.
[INDICATIVE] Prior developments from the HESMOS project in the area of climate and material databases as well as BIM will be integrated into ISES.

T3.2 Ontology-based Building Information Model (OntoBIM) [OG (lead), UL, NMI, TUD]
The goal of this task is to develop a lean model that does not contain all BIM data but can reference it via dedicated services as needed. A high-level ontology-based representation of the facility data will be developed using the IFC model as starting point. The specific focus of the research and development will be on energy and cost issues Developments from related EU projects like e-COGNOS, SWOP, InPro, InteliGrid and STAND-INN as well as IfcOWL and available results from the HESMOS project will be examined and adopted as much as possible.

T3.3 System ontology of the overall framework [UL (lead), TUD]
Minimized manual work, support of design and operation processes and informed decision making are only possible if a knowledge-based platform that “knows” its components (i.e. its data models, organisational model, service model, activity model, user model etc.) and that can act on the basis of overarching systemic rules is

established. In this task, the system ontology of the overall framework will be developed and implemented to answer these needs. Findings from the EU project InteliGrid and the German project BauVOGrid will be used as basis to avoid development from scratch. Technically, the ontology will be implemented using OWL and RDFS, to align the work with the Semantic Web concepts, thereby enabling intelligent service interoperability and knowledge-intensive user support.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	TUD	8.00
2	OG	10.00
3	UL	16.00
5	NMI	6.00
	Total	40.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D3.1	Ontology Specification	3	24.00	O	PU	15
D3.2	Ontology prototype	3	16.00	P	PU	18
		Total	40.00			

Description of deliverables

D3.1) Ontology Specification: The developed concepts of the ontology will be described in textual form as well as formally, and illustrated graphically. The textual description will focus on the main elements of the ontology and the adopted reasoning, whereas low-level details will be presented only as formal (appended) specifications. [month 15]

D3.2) Ontology prototype: This deliverable comprises the operational prototype of the developed ontologies (model ontology, system ontology, OntoBIM), including all basic and specific ontology management services. [month 18]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS2	Architecture	1	12	Defined architecture of the Virtual Energy Lab Platform with all model and service components
MS3	Basic concepts, methods and services	1	18	Developed model and system ontologies, concepts for all services, the basic support

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
				modules and the services of WP4

WT3:
Work package description

Project Number [1]	288819	Project Acronym [2]	ISES

One form per Work Package

Work package number [53]	WP4	Type of activity [54]	RTD
Work package title	Energy Profile and Consumption Patterns for Built Facilities and Their Components		
Start month	6		
End month	24		
Lead beneficiary number [55]	5		

Objectives

The ISES Virtual Energy Lab platform will depend on a variety of heterogonous data sources for the life-cycle simulation of energy performance and in-door environment for health and comfort of products and facilities under real dynamic environmental, usage and technical conditions. Properly structured, these data sourcesshall provide the input to specific analysis and decision making contexts in the configuration of the simulation models.
Hence, the objectives of WP4 are:
– To develop the necessary service framework for the search and retrieval of data held as distributed, semi- or non-harmonised IT resources so that to enable their integration into the ISES Virtual Energy Lab platform, and
– To structure and organise resource templates that can be arranged and used for analyses in different combination and contexts for given facility and component configurations, including characteristic meteorological parameters and concrete climatic events in localised climate zones, specific activity areas characterizing building zones or sections of buildings (e.g. factory hall, exhibition hall, supermarket, office space), and varying usage patterns.
Given the heterogonous nature of the underlying data sets, their different origin and incompatible semantics and their differingpurposes makes it difficult to find typical patterns and to filter out the relevant parameters for subsequent energy-efficient design and life-cycle simulations.Therefore, a large amount of preparatory work has to be done first. This includes:
– Specification of characteristic stochastic profiles arranged in catalogues for capturing climate data, activity and usage patterns, product life-cycle energy profiles and energy related product information
– Development of services and tools enabling search, retrieval filtering, mapping and profiling of the target data
– Survey of the information resources using the above tools, and
– Semi-automated definition of stochastic patterns, thereby enabling combination of a wide range of possible scenarios.
Current state-of-the-art tools do not yet utilise such precise data. Analysis and simulations are still limited to the use of pre-defined reference data sets or indicators, such as the PMV, providing good mean values and profiles but lacking the coverage of a broader spectrum of probabilities. However, in order to make the developed solutions as open and flexible as possibleWP4 will draw on previous work in energyand data modelling such as the CHAMPS, Gluck and Delphin energy simulation models, modelling concepts from gbXML and energy analyses software such as RIUSKA, EnergyPlus and eQuest,andfrom other EU research projects like Hesmos, InPRO, FIEMSER and EnPROVE.

Description of work and role of partners

The work in WP4 is structured in 4 tasks.

T4.1 Framework and stochastic templates for product life-cycle [NMI (lead), NOA, LAP, TRI]
This task will set up on the high level the overall service framework for search, retrieval, filtering, mapping and profiling of data held as distributed, semi- or non-harmonised IT resources. Templates capturing relevant parameters for different climate, activity and usage scenarios will be developed to facilitate (semi-) automated information retrieval a) from the ISES Virtual Energy Lab platform, and b) by proxies to distributed IT resources. The focus will be on capturing data describing both deterministic and stochastic processes and conditions simulating variations in the product environment.

T4.2 Intelligent search, access and interoperability services to the energy-related ICT resources [NMI (lead), NOA, SOF]
In this task, the framework services will be developed based on the templates provided by T4.1 as well as appropriate data mining and clustering algorithms. The services will be conceptualised to work with minimal end user interaction, so that – once appropriately configured – search and retrieval can be largely “robotized”. Task 4.4 will directly use the developed services but they will be also available for later and broader needs – for detailed studies or even in other domains. To achieve that, the implementation will be as generic as possible. The concrete service APIs will follow the general specifications from WP2.

T4.3 Intelligent services for model-based product catalogue profiling and BIM integration [SOF (lead), NMI, LAP, TRI]
In this task, the services for integration and configuration of new products in BIM will be developed. This includes:
(1) extension of BIM with regard to product catalogue data (focused on the energy and cost issues addressed in ISES),
(2) implementation of interfaces between product representation standards from ISO 10303 STEP (mainly AP 203 and AP 214) and ISO 13584 (PLIB), which are mainly supported by mechanical CAD systems, and the BIM standard IFC (ISO PAS 16739), mainly supported by building design CAD systems, and (3) intelligent knowledge-based catalogue search, using appropriate deduction and subsumption methods.
[INDICATIVE] The developed eeBIM Framework in the HESMOS project will be used as baseline.

T4.4 Development and specification of characteristic energy profile and consumption patterns [NMI, NOA, LAP, TRI]
The templates developed in T4.1 and the services from T4.2 and T4.3 (partially in beta state) will be used to extract, filter and categorise actual data that will be applied as building blocks by the Multi-Model Combiner (WP5). To achieve that, intelligent request templates will be configured and used for the retrieval of data from the identified data sources. Adapting the captured data to the developed templates will be performed partially manually, but for typical data sets (e.g. reference climate data from IEA or the US D.O.E.) dedicated proxies and mapping tools will be developed and applied. Data will be prepared for a wide range of conditions to cover a broad set of parameters (e.g. for climatic parameters data will be collected for a maximal European range, i.e. from Greece to Finland and Iceland).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
4	SOF	9.00
5	NMI	18.00
6	NOA	15.00
7	LAP	6.00
8	TRI	12.00
	Total	60.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D4.1	Technical specification of the overall framework and the principal energy profile and consumption pa	5	14.00	O	PU	12

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D4.2	Prototype of the intelligent search, access and interoperability services to the energy-related ICT	5	14.00	P	PU	15
D4.3	Prototype of the intelligent services for BIM-based product catalogue profiling and BIM integration	4	12.00	P	PU	18
D4.4	Characteristic energy profile and consumption patterns for the ISES Virtual Energy Lab	5	20.00	O	PU	24
		Total	60.00			

Description of deliverables

D4.1) Technical specification of the overall framework and the principal energy profile and consumption pa: An informal description of the framework and the developed templates and patterns will be provided that will be used as baseline for the following service prototypes. [month 12]

D4.2) Prototype of the intelligent search, access and interoperability services to the energy-related ICT: An operational software prototype of the services will be realised, accompanied by a concise description of the provided major features /not including source codes/. [month 15]

D4.3) Prototype of the intelligent services for BIM-based product catalogue profiling and BIM integration: An operational software prototype of the services will be realised, accompanied by a concise description of the provided major features /not including source codes/. [month 18]

D4.4) Characteristic energy profile and consumption patterns for the ISES Virtual Energy Lab: This deliverable, rounding up WP4 results, will document the developed energy profiles and consumption patterns to complement the developed software services and tools and to facilitate broader dissemination of the ISES findings. [month 24]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS2	Architecture	1	12	Defined architecture of the Virtual Energy Lab Platform with all model and service components
MS3	Basic concepts, methods and services	1	18	Developed model and system ontologies, concepts for all services, the basic support modules and the services of WP4
MS4	Service prototypes	4	24	Developed service prototypes from WPs 4

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
				and 5 with all features and performed first public workshop

Project Number [1]	288819	Project Acronym [2]	ISES

One form per Work Package

Work package number [53]	WP5	Type of activity [54]	RTD
Work package title	Multi-Model Combiner and Simulation Configurator		
Start month	10		
End month	30		
Lead beneficiary number [55]	1		

Objectives

Detailed stochastic simulations run on a cloud environment can provide a clearer picture of life-cycle energy performance and consumption and deliver more exact prognosis regarding costs, energy, emissions and secondary effects. Another goal of such simulations is to point out weak places or critical situations where underperformances or ill operation of the developed products may occur, leading to malfunctions, excessive energy consumption and costs and hence even loss of image of the producer as well. However, since they require a complex, huge mass of data, in current practice only simplified aggregation methods are used, the most common being the test reference year (TRY) method. This is not sufficient to satisfy the above goals.
Therefore WP5 will:
– Develop methods that can combine stochastic events to various critical scenarios, provide suitable model simplifications (to keep simulation runs manageable) and configure the simulation cycle workflow,
– Develop services and tools that enable the definition of multiple simulation models in a coherent and well-balanced variant matrix, appropriate for the computing power provided by the specific cloud environment used, and
– Prepare the ISES platform for the use of the actual value-added analysis / simulation services and tools on the top level of the platform architecture (air flow and wind simulation, energy simulation, moisture simulation, cost calculation and so on – see Part B, Section 1.1).

Description of work and role of partners

The work in WP5 is structured in 5 tasks.

T5.1 Host product multi-model integration [TUD (lead), SOF, NMI, LAP]
Preparing simulation data requires first putting all parameters that need to be investigated in the context of the host model. For that purpose, using basic interoperability services from WP4 the data collected from all other resources will be inter-linked with the host model. In the case of BIM that means e.g. to relate climate, environmental, user profile and product / components data with individual walls, floors, rooms and spaces, as well as the building envelope (facades, roofs) and the building as a whole in accordance with EN 15251:2007. A generalised link model will be developed and methods will be designed as generic as possible to enable different integration scenarios for different types of facilities. Product catalogue data will be mainly integrated with BIM by achieving schema level integration of IFC and ISO 13584 "Parts Library" (PLIB). This will enable importing product characteristics directly from mechanical CAD systems such as CATIA or SolidWorks.
[INDICATIVE] As in T4.3, the developed eeBIM Framework in the HESMOS project will be used here as baseline.

T5.2 Sensitivity analysis of relevant parameters [TUD (lead), NOA, NMI]
Analyses of the sensitivity of the overall host system with regard to the identified typical stochastic parameters required for detailed simulations will be performed in order to determine their adequate levels of discretisation. For parameters showing higher sensitivity such analyses shall be carried out for different typologies of the host product and for different climatic zones (Greece, Middle Europe, Iceland). Special focus will be put on variations in the design parameters of new products to provide for greater flexibility and more dynamic choice of configuration options.

T5.3 Stochastic profile-based multi-model combiner [SOF (lead), TUD, NOA, LAP]

Using the series of collected data and the energy profile and consumption patterns developed in WP4, a service enabling the combination of these patterns, taking into account various possible arrangements of the patterns over time and inter-linking the stochastic variables of the involved modelling domains (climatic data, user profiles, product characteristics and costs) will be developed. Emphasis will be put also on user preferences and their inter-relationship to stochasticity, such as the amount of uncertainty and risk that can be taken, limits for investment and operational costs, energy performance, CO2 emissions etc.

T5.4 Model simplification and simulation matrix configuration [TUD (lead), NMI, NOA, LAP]
Even with the strongly increased computational power through the use of a cloud environment, simulations can be very time-consuming and can easily become impractical in real-life situations. To avoid that, simulation models require goal-oriented simplification so that accuracy loss is minimal and computational speed is maximised. To cope with that problem, in this task model simplification methods will be developed, especially with regard to geometry and its relationship to the other required data. In addition, possible simulation models will be configured into a variant matrix and prioritised in accordance with general and specific user preferences. These preferences, matched with the principal service orchestration templates from WP2 will provide the input for the workflow definition, execution and monitoring services that will be developed in WP7 as part of the supporting cloud utilities of the Virtual Energy Lab.

Description of work and role of partners (cont.)

T5.5 Specialised GUI for the multi-model combiner and simulation configurator services [SOF (lead, TUD, NMI, LAP]
The developed multi-model combiner and the simulation matrix configurator will not be executed fully automatically. They require substantial user interaction to adjust project and tool/service parameters to the specific user needs and context. Taking into account that the end user evaluating the results of the set of simulation runs (with typical role of decision maker) may often not be the same person preparing the data and running the simulations themselves (usually an experienced energy consultant, process engineer or architect) a separate GUI will be developed to round up the software tools of WP5 and make them applicable as an individual module. Special care will be taken to provide the end-user with capabilities for informed queries using a novel engineering query language enabling quick simulation configurations on the basis of the developed stochastic patterns and the model ontology from WP3.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	TUD	24.00
4	SOF	14.00
5	NMI	6.00
6	NOA	10.00
7	LAP	6.00
	Total	60.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D5.1	Prototype of the multi-model integration services	1	12.00	P	PU	15
D5.2	Prototype of the multi-model combiner	4	32.00	P	PU	24

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D5.3	Prototype of the simulation configurator	1	16.00	P	PU	30
		Total	60.00			

Description of deliverables

D5.1) Prototype of the multi-model integration services: An operational software prototype of the services will be realised, accompanied by a concise description of the provided major features /not including source codes/. [month 15]

D5.2) Prototype of the multi-model combiner: An operational software prototype of the multi-model combiner will be realised, accompanied by a concise description of the developed major features /not including source codes/. [month 24]

D5.3) Prototype of the simulation configurator: An operational software prototype of the simulation configurator will be realised, accompanied by a concise description of the developed major features /not including source codes/ [month 30]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS3	Basic concepts, methods and services	1	18	Developed model and system ontologies, concepts for all services, the basic support modules and the services of WP4
MS4	Service prototypes	4	24	Developed service prototypes from WPs 4 and 5 with all features and performed first public workshop
MS5	Full prototype of the Virtual Energy Lab (beta)	2	30	Implemented full integrated prototype of the Virtual Energy Lab on the cloud, pilots are prepared for full demo runs

Project Number [1]	288819	Project Acronym [2]	ISES

One form per Work Package

Work package number [53]	WP6	Type of activity [54]	RTD
Work package title	Multi-Model Manager and Simulation Evaluator		
Start month	10		
End month	30		
Lead beneficiary number [55]	2		

Objectives

Whilst with the services and tools from WP4 and WP5 a basis for detailed analyses and life-cycle simulations of energy performance will be provided – to help designers to improve the design of new products and architects to improve the behaviour of built facilities – it is equally important to be able to understand correctly, evaluate properly and present in compact form the results of such comprehensive analyses to decision makers. To achieve these goals, WP6 will develop a set of services and tools for:
– Filtering the output of simulation runs,
– Synthesising the results obtained from multiple parallel simulations,
– Managing the various simulation models used, as well as
– Intelligent evaluation and navigation, thereby providing for fast and convenient examination of the results by non-simulation experts (product designers, architects, managers, process engineers and FM operators)
The overall objective is to enable the different roles engaged in the design and life-cycle operation processes to take informed decisions on the basis of the advanced functionality enabled via the ISES Virtual Energy Lab.

Description of work and role of partners

The work in WP6 is structured in 4 tasks.

T6.1 Host product multi-model filters [TUD (lead), OG, LAP, TRI]
To enable focused presentation of results and prepare the data for efficient simulation evaluation and model navigation, a set of multi-model filters linking various types of data to the host product (building or other facility) will be developed. Coverage of a broad range of cases and models will be provided via a generic approach, using a high-level filter definition language based on STEP/EXPRESS and operating on STEP, IFC and XML model data with the help of the model ontology of the platform (WP3). Functionality on class level (view definition) will be complemented by a set of geometry-oriented algorithms such as zoning, space separation and enclosure etc.

T6.2 Simulation synthesis and version management service [OG (lead), TUD, TRI]
Due to parameter variation and the combination of different patterns to different life-cycle simulation models, a large variant matrix comprising these simulation models has to be processed simultaneously on the cloud environment. To cope with that issue, a service will be developed that will consolidate and synthesise the simulation results before passing them over for detailed engineering evaluations. Moreover, to provide the basis for the execution of feedback simulation cycles and to enable storing suitable models and profiles for future use in similar situations, a supporting version management service will be realised, linking together the used multi-model data so that they can be easily reconstructed whenever necessary.

T6.3 Simulation evaluation service [OG (lead), TUD, LAP, TRI]
Simulations will be evaluated and their results will be prioritised according to multiple criteria. Special attention will be paid to criteria relating energy performance and consumption to investment and operational costs in order to provide a sound basis for balancing environmental and economic aspects. An important development topic will be the evaluation of life-cycle behaviour of designed new products and components taking in consideration different use cases and scenarios.

T6.4 Multi-model navigator [OG (lead), TUD, LAP, TRI]

To enable goal-oriented focusing on different aspects and easy examination of simulation results for decision makers, including ordering and prioritisation in accordance with different user criteria, a multi-model navigator capable to switch between various modelling representations will be designed and implemented. It will provide novel cockpit functionality to allow decision-makers to easily examine and judge the impact of design decisions on the basis of appropriate aggregated values. Additional advanced utilities enabling focused drill in the simulation results will include a geometry-based product viewer as well as various diagramming and tabular views. This is new functionality that will be developed largely from scratch.
[INDICATIVE] The ISES multi-model navigator will be built upon the nD Navigator from the HESMOS project. The latter will be extended from a tool developed primarily for public end-users and owners of PPP facilities to a valuable aid for energy experts - to enable examination of complex inter-relationships between stochastic variables and related simulation results. Hence, via ISES a second level of navigation into the multi-dimensional space of energy-relevant information will be established.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	TUD	20.00
2	OG	24.00
7	LAP	6.00
8	TRI	6.00
	Total	56.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D6.1	Prototype of the host product multi-model filters	1	16.00	P	PU	18
D6.2	Prototype of the simulation synthesis and the version management service	2	14.00	P	RE	21
D6.3	Prototype of the simulation evaluation service and the multi-model navigator	2	26.00	P	PU	30
		Total	56.00			

Description of deliverables

D6.1) Prototype of the host product multi-model filters: An operational software prototype of the developed multi-model filters will be realised, accompanied by a concise description of the offered filter types with illustrative examples /not including source codes/ [month 18]

D6.2) Prototype of the simulation synthesis and the version management service: Prototype of the simulation synthesis and the version management service: An operational software prototype of the services will be realised, accompanied by a concise description of the developed major features /not including source codes/. An extended summary will be made public. [month 21]

D6.3) Prototype of the simulation evaluation service and the multi-model navigator: An operational software prototype of the multi-model navigator will be realised, accompanied by a concise description of the developed major features /not including source codes/ [month 30]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS3	Basic concepts, methods and services	1	18	Developed model and system ontologies, concepts for all services, the basic support modules and the services of WP4
MS4	Service prototypes	4	24	Developed service prototypes from WPs 4 and 5 with all features and performed first public workshop
MS5	Full prototype of the Virtual Energy Lab (beta)	2	30	Implemented full integrated prototype of the Virtual Energy Lab on the cloud, pilots are prepared for full demo runs

Project Number [1]	288819	Project Acronym [2]	ISES

One form per Work Package

Work package number [53]	WP7	Type of activity [54]	RTD
Work package title	Intelligent Cloud-Enabled Multi-Model Energy Simulations		
Start month	13		
End month	33		
Lead beneficiary number [55]	3		

Objectives

Based on the constraints of the requirements analysis, the use case specifications and state of the art analysis, as well as several initiatives including FoI, IoT and e-Innovation, the technical ISES cloud architecture will be defined and a cloud-based infrastructure using private and public computing resources will be established. As indicated in WP2, the ISES architecture will be based on open standards and technologies. It will follow formal international standards such as ISO and IEEE, industrial de-facto standards and best practices, and EU expert groups' recommendations. Specifically, the objectives of WP7 are set up as follows:
– To develop the overall cloud architecture based on the requirements and use-cases from WP1,
– To refine the platform architecture drafted in WP2 with regard to specific experience and constraints of cloud-based software integration,
– To develop a suite of ISES APIs for the integration of the identifiednew and existing software services and tools,
– To provide the adaptation of selected analyses/simulation tools for efficient use of cloud computing facilities,
– To develop intelligent workflow services based on the system ontology developed in WP3, and
– To design and implement required supporting cloud services (execution, monitoring, etc.).

Description of work and role of partners

The work in WP7 comprises 4 tasks.

T7.1 Technical cloud architecture and cloud-enabled test-bed [UL]
The ISES cloud infrastructure will be established on the basis of the requirements and use cases from WP1 and the work done in WP2 (draft architecture) and WP3 (system ontology). A test-bed will be set up in order to (1) enable early use of off-the-shelve and adapted for ISES simulation services on the cloud, and (2) provide actual input for the management and evaluation services that will be developed in WP6.

T7.2 Cloud-enabled service APIs [UL (lead), OG, SOF, TUD]
This task will design and implement the required cloud-enabled ISES APIs for integration and adaptation of the selected analyses/simulation software. Several aspects will guide API development: (1) completeness of the API functions with regard to the project's objectives, (2) contract rules, and (3) security rules. Care will be taken to ensure all necessary prerequisites to guarantee that the required analysis/simulation services can be a part of the ISES cloud.

T7.3 Adaptation of energy performance and cost simulation tools for use on a cloud environment [OG (lead), SOF, UL]
Selected analyses/simulation software will be adapted and re-engineered for more efficient use of the ISES cloud. This includes parallelisation of software processes including partial redesign and re-implementation of existing modules. The goal is to show the benefits of such adaptations, quantify the needed efforts and provide best practice examples. Dynamic air flow simulation, being one of the most difficult and costly energy simulations in current practice, is tentatively selected as first choice candidate.

T7.4 Intelligent workflow definition, execution and monitoring services [UL (lead), TUD]
Within this task an intelligent workflow definition will be developed based on ontologies and models defined by WP3. This will enable an intelligent execution of computing jobs, real-time monitoring of cloud infrastructure.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	TUD	8.00
2	OG	12.00
3	UL	24.00
4	SOF	12.00
	Total	56.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D7.1	Cloud-enabled test-bed	3	3.00	O	CO	15
D7.2	Cloud-enabled software integration	3	33.00	O	PU	30
D7.3	Prototype of the developed intelligent workflow definition, execution and monitoring services	3	16.00	P	PU	33
D7.4	Use of the Prototyped Virtual Energy Lab on a Cloud Environment	3	4.00	O	PU	33
		Total	56.00			

Description of deliverables

D7.1) Cloud-enabled test-bed: D7.1) Cloud-enabled test-bed: The test bed providing the necessary prerequisites for the development of cloud-enabled services and tools of the ISES platform will be set up and made available to all partners. An extended summary will be made public. [month 15]

D7.2) Cloud-enabled software integration: The fully operational prototype of the cloud environment for the ISES platform integrating all developed services and simulation tools will be deployed and prepared for the pilot demostrators. [month 30]

D7.3) Prototype of the developed intelligent workflow definition, execution and monitoring services: An operational software prototype of the cloud related workflow services will be realised, accompanied by a concise description of their major features /not including source codes/. [month 33]

D7.4) Use of the Prototyped Virtual Energy Lab on a Cloud Environment: This deliverable will document the experience gained and the lessons learned (benefits, strengths, opportunities, weaknesses, threats and current gaps) from the deployment and use of the ISES Virtual Energy Lab platform on a cloud. It will thereby also serve as recommendation for similar ICT developments in the energy, AEC and other related domains. [month 33]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS3	Basic concepts, methods and services	1	18	Developed model and system ontologies,

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
				concepts for all services, the basic support modules and the services of WP4
MS5	Full prototype of the Virtual Energy Lab (beta)	2	30	Implemented full integrated prototype of the Virtual Energy Lab on the cloud, pilots are prepared for full demo runs
MS6	Final system prototype, pilot demonstrator and final report	1	36	Performed public demonstrators and evaluation of the results, issued final project reports

WT3:
Work package description

Project Number [1]	288819	Project Acronym [2]	ISES

One form per Work Package

Work package number [53]	WP8	Type of activity [54]	RTD
Work package title	Dissemination and Exploitation of the Project Results		
Start month	1		
End month	36		
Lead beneficiary number [55]	4		

Objectives

The goal of the exploitation activities is to package results into products and services, identifying elements suitable to be commercialised and assessing related risks and opportunities according to the developed IPR management approach.
The goal of the dissemination activities is to ensure that the generated knowledge from ISES is propagated to large audiences, in particular in the construction and the related equipment and element production sectors, the ICT sector and the energy sector, including academic and research institutions EU wide and beyond. Therefore, along with traditional dissemination activities a dedicated target user group and an international scientific advisory committee will be established to enable faster creation of network effects.

Description of work and role of partners

The work in WP8 is structured in 5 tasks.

T8.1 Project Web and Collaboration Infrastructure [Participants: UL (lead), TUD, SOF, NOA]
Within this task, the corporate image of the project will be designed, the project web site (including Flash Video clips) and a mailing list for interested parties will be set up and maintained, and an e-Forum on energy efficient construction, design and development of new energy-related equipment and components as well as facilities operation and management will be established to capture and propagate valuable findings and specifications. In addition, the internal project collaboration infrastructure, including DMS and BSCW services will be set up and a SharePoint portal, using know-how from previous projects, such as HESMOS, will be established.

T8.2 Dissemination Planning and Management [Participants: All partners, Lead: SOF]
This task is dedicated to the planning and performing of various dissemination activities such as publications and presentations at conferences, fairs etc. It includes also the issuing of half-yearly newsletters that will provide concise, up-to-date insight of developed concepts, achieved results and RTD plans. The newsletters will be distributed electronically and as flyers at conferences and other events. Additionally, two major public workshops for academia and industry will be held at m24 and m36 respectively.

T8.3 Target End-User Groups [SOF (lead), TRI, LAP, NMI, OG]
A target end-user group (TEUG) will be set up to bring together interested companies from the construction, component production, ICT and energy sectors, providing them with active insight to the project results and enabling synergies and cross-fertilization of ideas as well as creation of network effects. Close cooperation with the eeBDM will be established and contributions to the eeBDM collaboration space initiative of the EC will be made by ISES. All persons in the ISES Consortium and in the TEUG will be invited to become active members of the eeBDM initiative.

T8.4 Exploitation Planning and Management [Participants: All partners, Lead: SOF]
This task is dedicated to the planning and the management of the project’s exploitation activities. The goal is to develop a clear vision, for each individual partner as well as together as a consortium, as to how to bring the developed platform services to the market. Four consecutive versions of the exploitation plan will be generated – an initial plan at the outset (m6), two intermediate plans at months 18 and 30, and a final plan at project end.

T8.5 IPR and Risk Management [SOF (lead), TUD]

IPR management requires study of various legal issues and is therefore defined as distinct RTD activity. It will provide the final IPR agreement, replacing the consortium agreement and covering the IPR aspects of the exploitation of the project results. It will also watch and update as necessary the initial list of IPR-related deliverables and will be responsible for resolving associated issues if such issues arise during the project duration. Closely associated with that is the Risk Management of the project. A suitable risk management methodology for risk identification, assessment, classification, prioritization and monitoring will be developed and a software system for continuous risk management will be set up by TUD. To achieve that, know-how from the earlier FP6 project InteliGrid and the FP7 project HESMOS as well as known risk management approaches e.g. from the Australian RM standard (AS/NZS 4360:1999) or the Swinburne OH&S Management System will be used. The work will be performed by SOF with know-how and technical support from TUD.

T8.6 Contribution to eeBuilding Data Models Harmonisation [TUD (lead), SOF, OG, NMI]
ISES will develop ontologies in the areas of (1) System Management and Information Logistics (Overarching System Ontology), and (2) Building Information Modelling (OntoBIM), thereby enabling the interlinking of BIM and other relevant ee data, as well as product catalogues (see WP3). The public, non IPR affected ontologies will be available for the scientific community in the eeBDM collaboration space. They will be uploaded in the site Document Library in any of the commonly accepted semantic formalisations together with their documentation or description. ISES has valuable contributions to make at the eeBuilding Data Model knowledge base in the following sections of the Wiki: (1) Energy Models, (2) Related Projects, and (3) Energy Use and Consumption Patterns (new Wiki section to be suggested by ISES). ISES will follow the Wiki editorial rules so that the published pages will reflect already reached consensus amongst the related projects:

T8.7 Organisation of the 3rd eeBDM workshop at the ECPPM 2012 [TUD (lead), NMI]
The 3rd eeBDM workshop will be organized by the ISES partners TUD and NMI, using the organisational, technical and RTD related experience and leesons learned from the previous two workshops. NMI is host of the ECPPM 2012, and TUD-CIB is inaugurator of the ECPPM series of conferences and leads the EAPPM that takes care of the ECPPM conferences. The ECPPM 2012 will take place in Iceland in July 2012.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	TUD	5.00
2	OG	3.00
3	UL	4.00
4	SOF	13.00
5	NMI	3.00
6	NOA	3.00
7	LAP	2.00
8	TRI	3.00
	Total	36.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D8.1	Project Web Site and Collaboration Infrastructure	3	8.00	O	PU	3
D8.2.1	Project Newsletter #1	1	1.50	O	PU	6

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D8.2.2	Project Newsletter #2	4	1.00	O	PU	12
D8.2.3	Project Newsletter #3	2	1.00	O	PU	18
D8.2.4	Project Newsletter #4	5	1.00	O	PU	24
D8.2.5	Project Newsletter #5	4	1.50	O	PU	30
D8.3.1	Intermediate public workshop	4	6.00	O	PU	24
D8.3.2	Final public workshop	8	6.00	O	PU	36
D8.4.1	Initial Exploitation Plan	4	2.00	O	CO	12
D8.4.2	Intermediate Exploitation Plan	4	2.00	O	CO	18
D8.4.3	Final Exploitation Plan	4	2.00	O	CO	30
D8.5	Internal Risk Management Database and IPR-related Monitoring	4	1.00	O	CO	12
D8.6.1	Contributions to eeBDM Harmonisation (initial report)	1	0.50	O	PU	12
D8.6.2	Contributions to eeBDM Harmonisation (intermediate report)	1	0.50	O	PU	18
D8.6.3	Contributions to eeBDM Harmonisation (final report)	1	1.00	O	PU	36
D8.7	Third eeBDM Workshop – Summary and Proceedings	1	1.00	O	PU	12
		Total	36.00			

Description of deliverables

D8.1) Project Web Site and Collaboration Infrastructure: Project Web Site and Collaboration Infrastructure: The Project Web Site will provide a structured description of the project, video presentation and links to relevant publications, downloads and other foreground and background material. It will be a ‘live’ deliverable that will be continuously enhanced and extended during the project. In addition, as non-public part of D8.1 the project collaboration structure will be set up including arrangements for file and document sharing, email exploders, discussion groups, the project calendars and internal web pages for developers. [month 3]

D8.2.1) Project Newsletter #1: The project newsletters (D8.2.x) will be issued regularly and distributed electronically in pdf format using a 2 or 4 page A4 layout. Each newsletter will contain a general section containing overall project issues and news feeds as well as a focused section on 1 or 2 specific topics. In this way, individuality and greater attraction of the separate newsletters will be achieved. [month 6]

D8.2.2) Project Newsletter #2: See Deliverable D8.2.1 [month 12]

D8.2.3) Project Newsletter #3: See Deliverable D8.2.1 [month 18]

D8.2.4) Project Newsletter #4: See Deliverable D8.2.1 [month 24]

D8.2.5) Project Newsletter #5: See Deliverable D8.2.1. This deliverable will include results of the performed public demonstrators. [month 30]

D8.3.1) Intermediate public workshop: The deliverables D8.3.x refer to the planned public project workshops. This includes performing the respective workshop but also its managerial and technical preparation and the involvement and coordination of the ECTP and associated end user groups. For each workshop, a project leaflet

/ press release will be issued. The result of the workshop, the interest shown and raised critical questions will be documented and forwarded to the EC and the ECTP. [month 24]

D8.3.2) Final public workshop: See Deliverable D8.3.1 [month 36]

D8.4.1) Initial Exploitation Plan: Initial Exploitation Plan: Deliverables D8.4.x refer to the development of the project's exploitation plan, including the relevant IPR and management issues, the related dissemination plans and the contribution of each partner to each IPR-relevant ISES product as well as their shares and associated exploitation plans. The exploitation plan will also provide a developed proposal for a mandate to be issued by the EC to the European Standardisation Organisation in the area of coverage of ISES. D8.4.x will be essentially a 'rolling' specification that will develop in parallel with the RTD work. The separate issues at months 12, 18 and 30 mark the review versions of the plan. [month 12]

D8.4.2) Intermediate Exploitation Plan: See Deliverable D8.4.1 [month 18]

D8.4.3) Final Exploitation Plan: This deliverable shall provide the final version of the exploitation plan. [month 30]

D8.5) Internal Risk Management Database and IPR-related Monitoring: Internal Risk Management Database and IPR-related Monitoring: This deliverable will comprise a software implementation of the risk management database developed in accordance with the methodology defined in task T8.5, as well as populated database objects regarding monitored risks and IPR issues, together with their status, development over time and actions planned and taken. [month 12]

D8.6.1) Contributions to eeBDM Harmonisation (initial report): Contributions to eeBDM Harmonisation (initial report): Deliverables D8.6.x refer to the contributions that will be made by ISES to eeBDM harmonisation in the areas identified in task T8.6. D8.6.x will be essentially a 'rolling' document with fixed issues planned at months 12, 18 and 36. [month 12]

D8.6.2) Contributions to eeBDM Harmonisation (intermediate report): Contributions to eeBDM Harmonisation (intermediate report): See Deliverable D8.6.1. [month 18]

D8.6.3) Contributions to eeBDM Harmonisation (final report): Contributions to eeBDM Harmonisation (final report): This Deliverable shall provide the final contributions of ISES to eeBDM harmonisation that will be also forwarded to the respective standardisation bodies, as indicated in Part B of the DoW. See also Deliverable D8.6.1. [month 36]

D8.7) Third eeBDM Workshop – Summary and Proceedings: Third eeBDM Workshop – Summary and Proceedings: Results of the preformed workshop (published paper summaries and electronically available proceedings). [month 12]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS1	Requirements	7	6	Requirements and user scenarios are defined and ICT resources for life-cycle energy performance are surveyed
MS2	Architecture	1	12	Defined architecture of the Virtual Energy Lab Platform with all model and service components
MS3	Basic concepts, methods and services	1	18	Developed model and system ontologies, concepts for all services, the basic support

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
				modules and the services of WP4
MS4	Service prototypes	4	24	Developed service prototypes from WPs 4 and 5 with all features and performed first public workshop
MS5	Full prototype of the Virtual Energy Lab (beta)	2	30	Implemented full integrated prototype of the Virtual Energy Lab on the cloud, pilots are prepared for full demo runs
MS6	Final system prototype, pilot demonstrator and final report	1	36	Performed public demonstrators and evaluation of the results, issued final project reports

WT3:
Work package description

Project Number [1]	288819	Project Acronym [2]	ISES

One form per Work Package

Work package number [53]	WP9	Type of activity [54]	DEM
Work package title	Pilot Virtual Lab and Public Demonstrators		
Start month	7		
End month	36		
Lead beneficiary number [55]	8		

Objectives

The goal of WP9 is to provide high quality testing, validation and evaluation of the developed Virtual Energy Lab in practical environments in support of short-term marketable results and dissemination of the project findings to a broad audience of industry practitioners. The objectives are:
– to show the practical achievements of ISES,
– to demonstrate the benefits of the developed overall approach, and
– to provide a grounded comparison of state-of-the-art solutions and the results of ISES, comparing the energy demand of one and the same facility designed by current state-of-the-art and new ISES methods, thereby enabling quantification of the exploitation potential and benefits.

The full ISES prototype will be deployed and demonstrated in real-practice scenarios illustrating the three targeted feedback cycles, i.e.:
– the design of new products and components, taking into account a range of typological contextual issues, such as cold/moderate/warm climatic zones, different facility uses (industrial, exhibitional, sales, office) and material/dimensioning variations,
– the design or re-design of existing facilities for the use of more efficient energy related components of the services systems, facades and separation walls, and
– the simulation feedback cycle allowing to obtain more accurate results and/or refine use cases for future application.

Description of work and role of partners

The work in WP9 is structured in 4 tasks.

T9.1 Public demonstrator facility and demonstrator requirements specification [Participants: All partners, Lead: TRI]
Early preparatory work in selecting appropriate demonstrator facility and respective demonstrator requirements specification will be carried out, starting immediately after completing WP1, in order to avoid practical or administrative risks of achieving good pilot cases as much as possible. The RTD work in WPs 4-7 will also benefit via the provided opportunity for early real-life testing.

T9.2 Energy-related performance indicators [NOA (lead), TRI, LAP, NMI]
Synthetic energy-related key performance indicators will be defined at an early stage to enable objective validation of the results achieved by ISES. They will be obtained by selecting and deriving aggregated energy/emissions values and relating these to investment and operational costs as well as various soft constraints resulting from initial user requirements such as comfort, response elasticity and adaptability. These indicators will help to relate rule-of-thumb criteria based on past experience and accumulated know-how to the more precise results obtained from the ISES Virtual Energy Lab and to prioritise the latter for faster decision making. The work will be done independently from WP5 to avoid unwanted bias, but possible later cross-linking will be also taken into account.
[INDICATIVE] Indicators developed for decision-makers in PPP projects in HESMOS will be checked and used as orientation aid and development baseline. The ISES indicators shall enhance the indicators from HESMOS on the more detailed level of energy expert use.

T9.3 Configuration, deployment and public demonstration of the Pilot Virtual Lab [Participants: All partners, Lead: TRI]
The full developed prototype of the Virtual Energy Lab will be configured and deployed for the targeted public demonstrators. Two such demonstrators are planned: (1) Early demonstrator at month 24, when the basic functionality of the platform will be already in place, but advanced, user-friendly and cloud functionality will still be under development, and (2) Final demonstrator at month 36, which will provide, test and show all platform features. The intention of the first demonstrator is to facilitate early interest in the ISES results and enable public feedback for the final development phase. Therefore it will be performed at the site of the coordinator, TUD. In contrast, the final demonstrator will be set up on a real project of the end users (TRI, LAP). Care will be taken that the applied ISES test suite for the Virtual Energy Lab can be easily compared and evaluated against current industry practice to make the benefits from ISES tangible and clearly visible to the public.

T9.4 Comparison of state-of-the-art and ISES-based design and further needs [NOA (lead), TRI, LAP, OG, SOF, NMI]
The final task of WP9 will provide a report on the ISES findings from end-user viewpoint, comparing state-of-the-art practice and the findings of the FP7 project HESMOS with the new ISES method. IT will draw conclusions about the benefits, eventual shortcomings and further needs and it will produce a public document that will present the major project results in concise industry-friendly form.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	TUD	4.00
2	OG	6.00
3	UL	3.00
4	SOF	6.00
5	NMI	4.00
6	NOA	8.00
7	LAP	8.00
8	TRI	14.00
	Total	53.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D9.1.1	First public demonstrator of the Virtual Energy Lab and developed ee-performance indicators	4	20.00	D	PU	24
D9.1.2	Final public demonstrator of the Virtual Energy Lab	8	22.00	D	PU	36
D9.2	End user report on the Virtual Energy Lab pilot	5	11.00	O	PU	36
		Total	53.00			

Description of deliverables

D9.1.1) First public demonstrator of the Virtual Energy Lab and developed ee-performance indicators: First public demonstrator of the Virtual Energy Lab: This deliverable refers to the deployment of the ISES Virtual Energy Lab platform in its first beta version and its respective first practical demonstration. A short description of the pilot and the findings thereof will be provided for reviewing and dissemination purposes /planned also as major topic of Project Newsletter #5/. The deliverable will furthermore describe the developed energy-related performance indicators in T9.2 and show how ISES can increase ee-performance through their use. [month 24]

D9.1.2) Final public demonstrator of the Virtual Energy Lab: This deliverable will provide the practical industry demonstration of the deployed ISES platform with all its features, run at selected site of the end user TRIMO. [month 36]

D9.2) End user report on the Virtual Energy Lab pilot: Using the results of public and test runs of the ISES platform the end-user view with regard to the platform benefits, eventual shortcomings and further development needs will be presented in concise and industry-friendly form to address broad practice-oriented audiences. [month 36]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS4	Service prototypes	4	24	Developed service prototypes from WPs 4 and 5 with all features and performed first public workshop
MS6	Final system prototype, pilot demonstrator and final report	1	36	Performed public demonstrators and evaluation of the results, issued final project reports

WT3:
Work package description

Project Number [1]	288819	Project Acronym [2]	ISES

One form per Work Package

Work package number [53]	WP10	Type of activity [54]	MGT
Work package title	Project Management		
Start month	1		
End month	36		
Lead beneficiary number [55]	1		

Objectives

The goal of this work package is to ensure that the project achieves its mission in time and within budget, and that partner efforts harmonically and synergistically lead to the achievement of the common project objectives.

Description of work and role of partners

The work regarding WP10 is structured in three distinct tasks.

T10.1 EC liaison and overall project management [Participants: All partners, Lead: TUD – see text below]
The task is dedicated to the overall coordination of the RTD work, ensuring timely deliverables submission, management and financial progress monitoring, control and reporting, organization of internal project meetings and technical workshops, accounting support for the project, payment distribution and, last but not least, liaison with the EC. It includes also the operational management of the Target End-User Group and the Scientific Advisory Committee.
The task's duration is equal to the full duration of the project. It will be performed by the coordinator (TUD) with support of all project partners and especially the S/T manager and the WP leaders who will coordinate locally the RTD work in their respective work packages. However, the technical part of this support work is a necessary component of the cooperative RTD work of the partners and will be respectively identified as such in the Consortium Agreement.

T10.2 Project Manual [TUD]
This task will develop the technical Project Manual, identifying also the QM procedures.

T10.3 Final Report [TUD]
Concluding the project, this task will be specifically dedicated to the editing and submission of the Final Project Report. It is planned to produce the Final Report as a book published by a known publisher. However, a large part of the actual content of the report will be provided by the RTD work packages on the basis of their achieved results and documented in their technical WP deliverables.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	TUD	11.00
2	OG	1.00
3	UL	1.00
4	SOF	1.00
5	NMI	1.00
6	NOA	1.00
7	LAP	1.00

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
8	TRI	1.00
	Total	18.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D10.1.1	Periodic Report #1	1	4.00	R	CO	12
D10.1.2	Periodic Report #2	1	5.00	R	CO	24
D10.1.3	Periodic Report #3	1	5.00	R	CO	36
D10.3	Project Manual	1	1.00	O	CO	4
D10.4	Final Project Report	1	3.00	R	PU	36
		Total	18.00			

Description of deliverables

D10.1.1) Periodic Report #1: The Deliverables D10.1.x comprise the periodic management reports submitted on regular basis as required by the EC. They shall reflect and summarise from management point of view the work done in the respective reporting period of the project. Part of these deliverables shall be public as specified by the EC rules. [month 12]

D10.1.2) Periodic Report #2: See Deliverable D10.1.1. [month 24]

D10.1.3) Periodic Report #3: See Deliverable D10.1.1. [month 36]

D10.3) Project Manual: D10.2) Project Manual: The Project Manual will serve the efficient management and coordination of the project. It shall contain all important data of the project for internal use by the consortium, the coordinator and the Management and Technical Board (MTB). These are: the essential contact data, principal roles and responsibilities of the partners, basic technical and quality management procedures, the barchart and resource planning chart with up-to-date progress indicators, the milestones planning and status, the list and schedule of deliverables and a short description of the project collaboration infrastructure implemented as part of task T8.1 (WP8). [month 4] [month 4]

D10.4) Final Project Report: The Final Project Report will encompass all important project findings, based on the results reported by the partners in the technical deliverables. [month 36]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS1	Requirements	7	6	Requirements and user scenarios are defined and ICT resources for life-cycle energy performance are surveyed

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS2	Architecture	1	12	Defined architecture of the Virtual Energy Lab Platform with all model and service components
MS3	Basic concepts, methods and services	1	18	Developed model and system ontologies, concepts for all services, the basic support modules and the services of WP4
MS4	Service prototypes	4	24	Developed service prototypes from WPs 4 and 5 with all features and performed first public workshop
MS5	Full prototype of the Virtual Energy Lab (beta)	2	30	Implemented full integrated prototype of the Virtual Energy Lab on the cloud, pilots are prepared for full demo runs
MS6	Final system prototype, pilot demonstrator and final report	1	36	Performed public demonstrators and evaluation of the results, issued final project reports

WT4:
List of Milestones

Project Number [1]	288819	Project Acronym [2]	ISES

List and Schedule of Milestones

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS1	Requirements	WP1, WP8, WP10	7	6	Requirements and user scenarios are defined and ICT resources for life-cycle energy performance are surveyed
MS2	Architecture	WP2, WP3, WP4, WP8, WP10	1	12	Defined architecture of the Virtual Energy Lab Platform with all model and service components
MS3	Basic concepts, methods and services	WP3, WP4, WP5, WP6, WP7, WP8, WP10	1	18	Developed model and system ontologies, concepts for all services, the basic support modules and the services of WP4
MS4	Service prototypes	WP4, WP5, WP6, WP8, WP9, WP10	4	24	Developed service prototypes from WPs 4 and 5 with all features and performed first public workshop
MS5	Full prototype of the Virtual Energy Lab (beta)	WP5, WP6, WP7, WP8, WP10	2	30	Implemented full integrated prototype of the Virtual Energy Lab on the cloud, pilots are prepared for full demo runs
MS6	Final system prototype, pilot demonstrator and final report	WP7, WP8, WP9, WP10	1	36	Performed public demonstrators and evaluation of the results, issued final project reports

WT5:
Tentative schedule of Project Reviews

Project Number [1]	288819	Project Acronym [2]	ISES

Tentative schedule of Project Reviews

Review number [65]	Tentative timing	Planned venue of review	Comments, if any
RV 1	12	Brussels	Review after MS 2, mainly focused on requirements, use cases and the overall architecture of the suggested platform.
RV 2	24	Dresden	Review after MS 4, focused on major conceptual issues and the developed up and running services and tools from WPs 3 to 7
RV 3	36	Ljubljana or Brussels	Final project review and public workshop, preferable at the venue of the main end-user or at the EC

WT6:
Project Effort by Beneficiary and Work Package

Project Number [1]	288819	Project Acronym [2]	ISES

Indicative efforts (man-months) per Beneficiary per Work Package

Beneficiary number and short-name	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	WP 9	WP 10	Total per Beneficiary
1 - TUD	3.00	12.00	8.00	0.00	24.00	20.00	8.00	5.00	4.00	11.00	95.00
2 - OG	3.00	8.00	10.00	0.00	0.00	24.00	12.00	3.00	6.00	1.00	67.00
3 - UL	3.00	6.00	16.00	0.00	0.00	0.00	24.00	4.00	3.00	1.00	57.00
4 - SOF	3.00	8.00	0.00	9.00	14.00	0.00	12.00	13.00	6.00	1.00	66.00
5 - NMI	3.00	0.00	6.00	18.00	6.00	0.00	0.00	3.00	4.00	1.00	41.00
6 - NOA	5.00	0.00	0.00	15.00	10.00	0.00	0.00	3.00	8.00	1.00	42.00
7 - LAP	6.00	0.00	0.00	6.00	6.00	6.00	0.00	2.00	8.00	1.00	35.00
8 - TRI	6.00	0.00	0.00	12.00	0.00	6.00	0.00	3.00	14.00	1.00	42.00
Total	32.00	34.00	40.00	60.00	60.00	56.00	56.00	36.00	53.00	18.00	445.00

WT7:
Project Effort by Activity type per Beneficiary

Project Number [1]	288819	Project Acronym [2]	ISES

Indicative efforts per Activity Type per Beneficiary

Activity type	Part. 1 TUD	Part. 2 OG	Part. 3 UL	Part. 4 SOF	Part. 5 NMI	Part. 6 NOA	Part. 7 LAP	Part. 8 TRI	Total
1. RTD/Innovation activities									
WP 1	3.00	3.00	3.00	3.00	3.00	5.00	6.00	6.00	32.00
WP 2	12.00	8.00	6.00	8.00	0.00	0.00	0.00	0.00	34.00
WP 3	8.00	10.00	16.00	0.00	6.00	0.00	0.00	0.00	40.00
WP 4	0.00	0.00	0.00	9.00	18.00	15.00	6.00	12.00	60.00
WP 5	24.00	0.00	0.00	14.00	6.00	10.00	6.00	0.00	60.00
WP 6	20.00	24.00	0.00	0.00	0.00	0.00	6.00	6.00	56.00
WP 7	8.00	12.00	24.00	12.00	0.00	0.00	0.00	0.00	56.00
WP 8	5.00	3.00	4.00	13.00	3.00	3.00	2.00	3.00	36.00
Total Research	80.00	60.00	53.00	59.00	36.00	33.00	26.00	27.00	374.00
2. Demonstration activities									
WP 9	4.00	6.00	3.00	6.00	4.00	8.00	8.00	14.00	53.00
Total Demo	4.00	6.00	3.00	6.00	4.00	8.00	8.00	14.00	53.00
3. Consortium Management activities									
WP 10	11.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	18.00
Total Management	11.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	18.00
4. Other activities									
Total other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	95.00	67.00	57.00	66.00	41.00	42.00	35.00	42.00	445.00

WT8:
Project Effort and costs

Project Number [1]	288819	Project Acronym [2]	ISES

Project efforts and costs

Beneficiary number	Beneficiary short name	Estimated eligible costs (whole duration of the project)						Requested EU contribution (€)
		Effort (PM)	Personnel costs (€)	Subcontracting (€)	Other Direct costs (€)	Indirect costs OR lump sum, flat-rate or scale-of-unit (€)	Total costs	
1	TUD	95.00	494,000.00	0.00	27,500.00	312,900.00	834,400.00	641,360.00
2	OG	67.00	582,900.00	5,000.00	21,000.00	483,120.00	1,092,020.00	556,340.00
3	UL	57.00	285,000.00	0.00	26,560.00	186,936.00	498,496.00	370,872.00
4	SOF	66.00	453,750.00	5,000.00	21,000.00	284,850.00	764,600.00	560,950.00
5	NMI	41.00	156,825.00	0.00	21,000.00	248,955.00	426,780.00	314,700.00
6	NOA	42.00	121,800.00	2,500.00	16,000.00	82,680.00	222,980.00	159,740.00
7	LAP	35.00	155,750.00	2,500.00	14,000.00	161,263.00	333,513.00	235,574.00
8	TRI	42.00	176,400.00	2,500.00	16,000.00	38,480.00	233,380.00	120,460.00
Total		445.00	2,426,425.00	17,500.00	163,060.00	1,799,184.00	4,406,169.00	2,959,996.00

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

2. Project acronym

Use the project acronym as given in the submitted proposal. It cannot be changed unless agreed so during the negotiations. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

53. Work Package number

Work package number: WP1, WP2, WP3, ..., WPn

54. Type of activity

For all FP7 projects each work package must relate to one (and only one) of the following possible types of activity (only if applicable for the chosen funding scheme – must correspond to the GPF Form Ax.v):

• **RTD/INNO =** Research and technological development including scientific coordination - applicable for Collaborative Projects and Networks of Excellence

• **DEM =** Demonstration - applicable for collaborative projects and Research for the Benefit of Specific Groups

• **MGT =** Management of the consortium - applicable for all funding schemes

• **OTHER =** Other specific activities, applicable for all funding schemes

• **COORD =** Coordination activities – applicable only for CAs

• **SUPP =** Support activities – applicable only for SAs

55. Lead beneficiary number

Number of the beneficiary leading the work in this work package.

56. Person-months per work package

The total number of person-months allocated to each work package.

57. Start month

Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.

58. End month

Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

59. Milestone number

Milestone number:MS1, MS2, …, MSn

60. Delivery date for Milestone

Month in which the milestone will be achieved. Month 1 marking the start date of the project, and all delivery dates being relative to this start date.

61. Deliverable number

Deliverable numbers in order of delivery dates: D1 – Dn

62. Nature

Please indicate the nature of the deliverable using one of the following codes

R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

63. Dissemination level

Please indicate the dissemination level using one of the following codes:

• **PU =** Public

• **PP =** Restricted to other programme participants (including the Commission Services)

• **RE =** Restricted to a group specified by the consortium (including the Commission Services)

• **CO =** Confidential, only for members of the consortium (including the Commission Services)

• **Restreint UE =** Classified with the classification level "Restreint UE" according to Commission Decision 2001/844 and amendments

• **Confidentiel UE =** Classified with the mention of the classification level "Confidentiel UE" according to Commission Decision 2001/844 and amendments

• **Secret UE =** Classified with the mention of the classification level "Secret UE" according to Commission Decision 2001/844 and amendments

64. Delivery date for Deliverable

Month in which the deliverables will be available. Month 1 marking the start date of the project, and all delivery dates being relative to this start date

65. Review number

Review number: RV1, RV2, ..., RVn

66. Tentative timing of reviews

Month after which the review will take place. Month 1 marking the start date of the project, and all delivery dates being relative to this start date.

67. Person-months per Deliverable

The total number of person-month allocated to each deliverable.

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Part B

B1. Concept and objectives, progress beyond state-of-the-art, S/T methodology and work plan

B 1.1 Concept and project objective(s)

ISES will develop ICT building blocks to integrate and complement existing tools for design and operation management into a **Virtual Energy Lab** capable of evaluating, simulating and optimizing the energy efficiency of products and facilities, in particular components for buildings and facilities, before their realization and taking into account their stochastic life-cycle nature. For the energy-efficient design and operation of products the semantic contexts of several different roles will be integrated. A holistic approach will be applied to enable efficient use of today's loosely connected numerical analysis tools, modellers and graphical presentation tools and new stochastic methods will be developed to deal with the random nature of energy profiles and consumption through the product life-cycle.

Stochastic considerations are required for several reasons:

Firstly, the efficient design of products and their optimal control in operation need several feedback cycles to reach an optimal design and operation control process. Moreover, the new product is often a component in a bigger host product, such as a new or existing building, carrying some functionality, influencing the behaviour of the host product and providing considerable feedback even if the component is not necessarily a control component. A single, optimal design of the component as a market product is not adequate due to the various contexts (hosts) in which the component product will have to be applied. Therefore variants of the component products have to be developed for the different possible contexts of the host product, which requires several **component design iterations**.

Secondly, each variant component has to be complemented with several operation procedures concerning the functional behaviour of the component and the interaction with the functional behaviour of the system of the host product. In addition, these operation procedures have to be tuned for the built-in design and during operation, too. Due to the largely random nature of energy consumption over the life cycle, standard worst case evaluations of life cycle cost not only for the component product but for the interaction with the host systems has to be carried out during design. This requires several **host design iterations**.

Thirdly, stochastic life cycle issues have to be considered. In practical terms, this means that the stochastic nature of the overall life-cycle has to be approximated by a stochastic discrete process of possible sequences of characteristic energy patterns and profiles. The design solutions sought are the worst cases resulting from the identification of the worst process pattern sequences. This can be achieved by an appropriate **simulation task**, namely the simulation of a large number of combinations of possible energy patterns sequences, with subsequent identification of the worst sequences for the design targets. Such simulation tasks may require hundreds of individual simulations run in parallel in a cloud environment, with target-oriented feedbacks between evaluated and further simulations that cannot be anymore configured by hand but have to be managed highly automatically, with only general control interaction by the user.

Existing ICT systems for design and operation management are strong in their core functionality, such as product modelling, cost calculation, structural, energy or airflow analyses or facility management. However, they are still weak in holistic energy-efficient design, the integration of multiple design aspects and multi-model analyses including stochastic considerations. Such features are important for energy-efficient investigations requiring concurrent consideration of energy, investment costs, maintenance costs, training costs (for maintenance personnel), various design requirements, quality of life requirements (architectural, structural, wind, earthquake, flood, fire), design appearance etc., as well as the stochasticity in the life cycle.

To tackle these gaps, ISES will specifically **focus on the following RTD issues**:

- Interoperability between energy analysis tools and product and building design tools
- Interoperability between product design tools (STEP) and building and facility design tools (BIM)
- Energy profiles and consumption patterns for building facilities and components that are not yet adequately represented for stochastic treatments and are not generic enough
- Configurators and evaluators for combination of energy profiles for stochastic life-cycle consideration
- Multi-model concurrent engineering design for which only light-weight prototypes are currently available with regard to managing, filtering, navigation and evaluation services

– Intelligent and adaptable access and management methods for heterogeneous distributed information resources and services
– Intelligent and flexible interoperability methods for model and system interoperability based on ontology methods.

The **objective of ISES** is to develop a missing framework of components for beneficially applying existing ICT tools (CAD modellers, FM systems, different simulations and analysis tools, cost calculation tools, Building Automation Data Management Systems (BAS), and product models – STEP/BIM), and:

(1) Provide them with an interoperability structure on ontology-extended BIM and SOA basis through **development of a new model and system ontology** based on description logic with semi-automatic simulation model configuration capabilities;

(2) Complement them with **a set of new supporting services and tools**, enabling efficient simulation and evaluation of the energy life-cycle behaviour of products;

(3) Provide a **new information logistic and intelligent access controller** for the ICT system management (services, tools and data) and for the interfacing to cloud facilities:

(4) **Extend existing data resources** by (a) stochastic based climatic data scenarios, (b) usage/user activity profiles, and (c) a database variant manager to manage the alternatives and variations of new product designs and their application in larger systems.

The **targeted application domain** is buildings and facilities. However, ISES is not only directed to construction and product development for construction. ISES developed products will be generic, so that they can be also used in other domains or can serve as templates and best-practice cases.

The product of ISES will be the stochastic and model-based Virtual Energy Lab platform for new component product development and integrated mechanical and building engineering. It will allow engineers to handle the analysis of the energy-efficient design of products and take efficient and informed decisions. This comprises the following **three tasks***:* (1) the consideration of the stochastic nature of the energy performance and consumption profiles of the new product life-cycle, (2) the balanced design of the new products (components), their functionality and behaviour for the various possible life-cycle demands, and (3) the balanced interaction of the product component with the host product.

Each of these three tasks requires several simulations with feedback cycles in order to reach an optimally balanced solution (see Fig. 1 below).

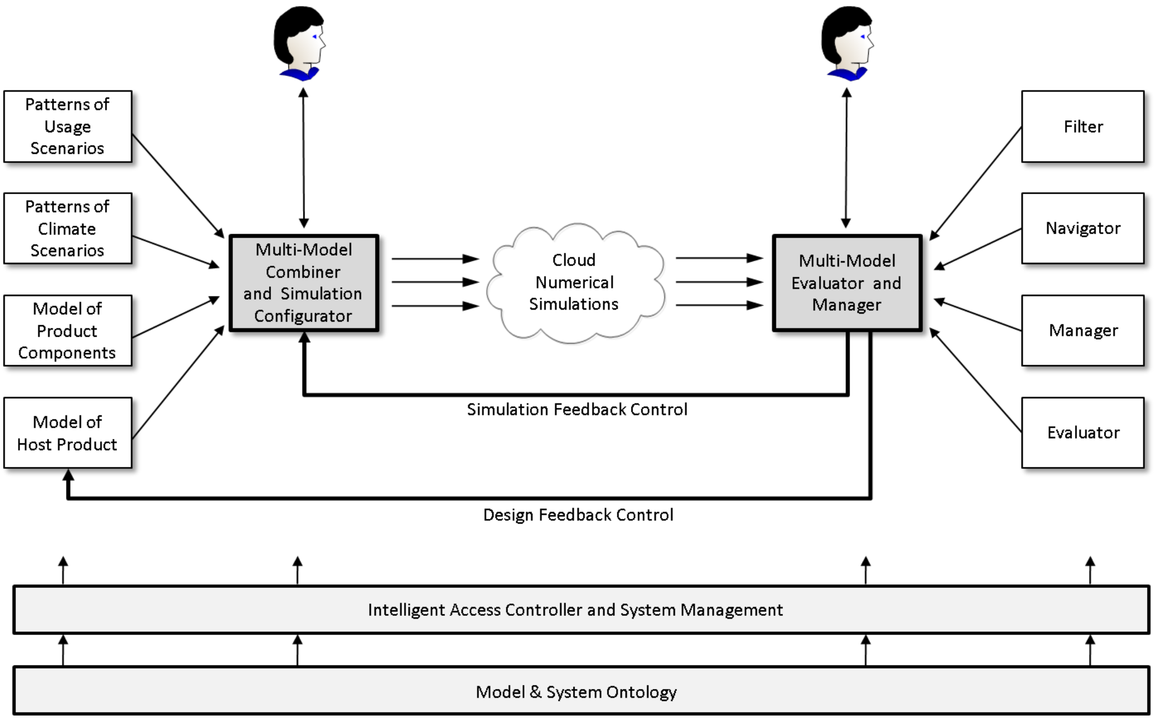

Fig. 1: Functional structure of the ISES Virtual Energy Lab platform

Task 1 requires a *simulation feedback cycle* in order to obtain the worst-case scenarios, which are the baseline of the subsequent two design tasks. The latter need *design feedback cycles* for (a) optimizing the new product to be offered as a general market product, where the client can select out of several variants (Task 2), and (b) in an independent later stage for the configuration of the new product in a specific host product, e.g. the design of a facility by an engineer or architect (Task 3). These design feedback cycles occur at different phases of design and production, whereby the first feedback cycle, i.e. the simulation feedback, is needed as sub-cycle in the design feedback cycles. This means that the number of resulting feedback cycles is multiplicative. The **breakthrough of the ISES approach** is to highly automate the configuration, management and evaluation of these hundreds of models for the various needed simulations by means of new innovative services and tools.

The Virtual Energy Lab will be structured in **four sequential tiers and two supporting tiers** (see Fig. 1).

The **first tier** (Fig. 1, left to right) is the domain modelling and input tier to the virtual energy lab. It includes tools and databases for (1) the modelling of the new product, including a model schema extender to STEP, (2) the modelling of the host product itself, (3) the modelling of energy profiles and (4) patterns of energy consumption, which are for built facilities the patterns of the climate and usage scenarios. These four domain models have to be combined into one model and have to be configured appropriately to the various approximated stochastic simulation input models. The process will be automated with the support of the tools of the second tier to provide the necessary efficiency.

This process has to be repeated continuously for each design cycle. Because these are nested cycles, several hundreds of simulations may be necessary to obtain an energy- and emission-efficient design solution. To provide resources needed for scalability of the process the **third tier** enables access to cloud computing resources. Also, the configuration of the various simulation models by an engineer would result in tens or more hours of labour, which is not acceptable. Therefore, in the **second tier** the *multi-model combiner* that combines the different domain models to one investigation model is complemented with a *simulation configurator*, which has the task to configure the simulation models automatically according to a few general input directives by the engineer. The objective is to concurrently configure as many as possible simulation models in order to reduce sequential simulation and hence overall simulation time as much as possible.

The **fourth tier** is dedicated to new services and tools concerning the evaluation of multi-models, including *prioritisation of the results* and four supporting services, namely *multi-model filter*, *navigator*, *evaluator* and *manager*, providing easy user access with proactive support for requesting and selecting simulations to be compared. This fourth tier is the decision support and output tier. To avoid time-consuming and tedious manual work, comparison and prioritisation of results and the suggestion of new simulation runs will be done by *decision support services* of the virtual energy lab. Adequate comparison services will be developed to navigate the multi-model result space and support efficient and informed decision-making.

These four design and simulation workflow support tiers are complemented with two platform support tiers (Fig.1, bottom). The first support tier is subsuming the services for the intelligent, automatic access to databases, catalogues, models and various services. The second support tier contains the generic lab system model represented in description logic based ontology. This ontology describes the overall system and its components but it describes also on a high semantic level the various model schemes, their combination possibilities, the automation algorithms and the evaluation and feedback control information.

The **architecture** of the Virtual Energy Lab will be built using the SOA paradigm. It will be logically structured in five layers (see Fig. 2 below), i.e. numerical, service, kernel functional, kernel data, and auxiliary data layer. The new ICT building blocks to be developed are marked by the thick boxes on Fig. 2. The Virtual Energy Lab will be based on available commercial modellers and information management systems for design and for operation management and their related standardized data structures for BIM, the product model standards IFC (ISO/PAS 16739) and STEP (ISO 10303).

The **kernel data layer** will include the high-level model (semantic description of product end host models) and system ontologies (semantic description of virtual energy lab). This will provide the baseline for automatic model configurations and modifications as well as automated virtual energy lab processes. The **kernel functional layer** will include an intelligent access controller that will orchestrate the intelligent application of the various resources and virtual energy lab processes needed. The numerical tools of the related **numerical tool layer** are all available on the market and can be used with minor modifications. As part of the intelligent access services prototype APIs will be developed to integrate these numerical tools on high semantic level based on an extension of the ISO standardized BIM with the ISES model ontology to an OntoBIM. The **service layer** will include new services for multi-model filtering and navigation, multi-model management and evaluation to provide for holistic multi-model energy-cost analyses and life-cycle evaluation. The kernel data layer will be complemented with an **auxiliary data layer**, in which various data catalogues will be located, such as material data or sensor system data. These catalogues will be extended by two catalogues containing patterns about climate scenarios and about user/usage scenarios structured according to the needs of the semi-stochastic approach of stochastic sequences of scenario patterns. Existing catalogues for climate scenarios offer characteristic time histories per hour for one year with several climatic parameters. This is sufficient for mean and overall min/max behaviour analysis. Missing is the change of climatic conditions during short periods of time, extreme wind loads, clustering and accumulation effects. Such accumulation effects are important for complex (mixed) energy systems as targeted by ISES.

Hence, very important is the **treatment of life-cycle stochasticity** in the ISES Virtual Lab platform.

The highly non-stationary stochastic process concerning usage and climate will be approximated by a stochastic process of partly stationary processes, which can be modelled as a discrete stochastic process where the discrete events are the stationary stochastic process modules. A further approximation can be done, because the stochastic nature in the modules is of minor importance and the design objective is either average values of the life-cycle or extreme values or extreme change values over a short time (e.g. hours) in order to obtain either the overall energy demand and CO_2 emissions or the worst cases of changes in heating and cooling to design the energy providing systems which is usually a mix of several systems and their elasticity. This approximation is the replacement of stationary stochastic modules by characteristic deterministic scenarios, i.e. deterministic patterns. Extreme values and extreme change values are the result of the respective worst-case sequences of the patterns. This means that the task of non-stationary stochastic processes can be reduced and approximated by many discrete deterministic sequence processes, in which each process is the random sequence of many deterministic characteristic pattern (analogous to Monte Carlo simulation). Such simulations can easily be several dozens or even hundreds and will therefore be run on the ISES cloud environment.

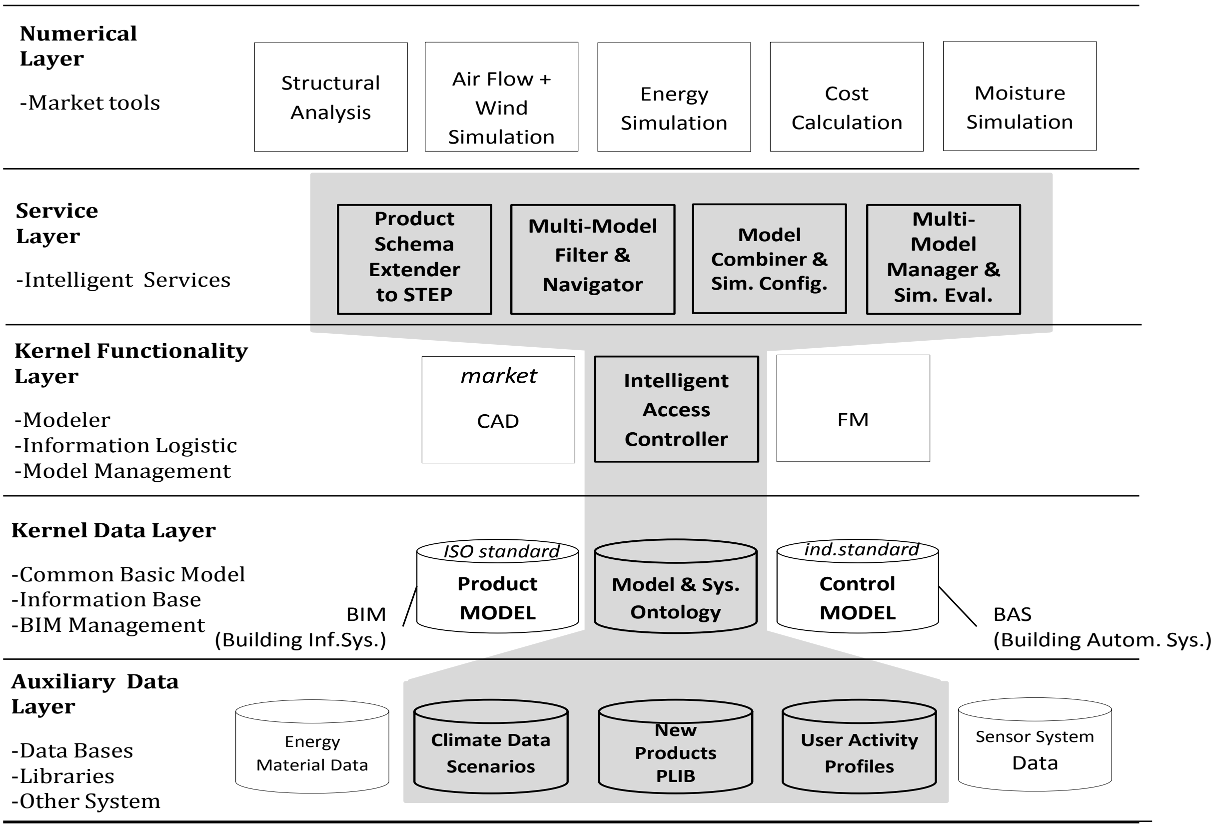

Fig. 2: Principal architecture of the Virtual Energy Lab

The ISES Virtual Energy Lab will be in first place a platform for engineers. Its **use** shall facilitate primarily energy-aware and energy-efficient development and collaboration work of the following three types of users:

(1) **Designers**, especially **Building Services Engineers**

(2) **Product / component developers** of HVAC equipment, energy supply equipment, building elements

(3) **Energy experts** providing detailed analyses and recommendations in complex design situations.

Building Services designers will benefit from the ISES Virtual Energy Lab in four ways. *Firstly*, through the model-based Virtual Lab platform architectural and structural design intent can be better considered and relevant data can be directly uploaded to building services design tools without data loss from approximations and mappings or from cumbersome information re-entry, which are often sources of errors, wrong decisions and time/costs loss. *Secondly*, having a good interoperability with various other relevant information resources and models as well as powerful computational facilities run on a cloud environment, various stochastic simulations reflecting different critical scenarios can be run with varying input parameters, thereby providing for easier checking of alternatives, carrying out design iterations, and hence, better consideration of life-cycle ee-performance. *Thirdly*, collaboration with product developers via the ISES platform will allow to better consider new product features, integrate the new products in the domain-specific eeBIM model via the developed link between BIM (IFC) and product catalogue data (STEP), and consider different variants and configurations taking into account life-cycle aspects of both the designed facility and the component products. *Fourthly*, energy experts can be integrated more easily.

Product developers will benefit from the ISES Virtual Energy Lab in four principal ways. *Firstly*, through the possibility to examine life-cycle related stochastic processes via cloud-enabled simulations a better picture of the energy related behaviour of designed new products can be obtained. *Secondly*, through the capability of stochastic clustering and examination of extreme values and extreme scenarios with regard to climate and user behaviour more flexible product variants for different use cases and different climatic conditions (from Greece to Finland and Iceland) can be developed. *Thirdly*, through the link of BIM and product catalogues better coordination with the designers and hence better choice of components and better ee-performance of the installed equipment and the used prefabricated building elements can be achieved. *Fourthly*, as above, better integration of energy experts in the development process will be made possible.

Energy experts will benefit from the ISES Virtual Energy Lab in three major ways. *Firstly*, through the developed new stochastic methods and tools for the treatment of life-cycle stochasticity, more comprehensive simulation models covering extreme situations can be studied to provide for more reliable results to both designers and product developers. *Secondly*, through the highly automated multi-model combiner and simulation configuration facilities, wide ranges of stochastic parameters and hence different simulation scenarios can be efficiently considered. *Thirdly*, through the adaptation of energy analysis and simulation tools to run on cloud and the developed features for highly automated multi-model evaluation and management, possibilities to use a full simulation scenario matrix instead of severely limited in time one-by-one simulations will be provided, thereby an in-depth energy behaviour analysis and enabling much better reliable decisions.

Last but not least, the outlined features and basic methods of using the ISES Virtual Energy Lab platform will enable new ways of looking at and examining life cycle energy aspects that are not yet considered today.

The novel interaction of architectural and building services design with the development and use of new products will be shown by ISES with **specific focus on prefabricated façade elements**. Such elements are offered in very diverse variants on the market. They play a very important role in the life cycle energy and cost balance of a facility, especially in the case of repetitive, highly industrialised buildings such as supermarkets, industrial halls, storehouses, etc. These kinds of buildings are a primary area of interest of the end-user TRIMO, who is among the market leaders in that domain. Due to their repetitiveness and the need for efficient adaptation in many different climatic and use situations, the importance of the stochastic consideration of energy performance for such buildings and the related façade components is particularly high.

B 1.2 Progress beyond the state of the art

B 1.2.1 ICT Systems and Engineering Tools

ICT systems for the energy and emission design of products are rare and not very comprehensively developed. Only some company-specific proprietary tools exist today. For the integrated design no ICT system is known, in particular not for the construction sector since many products (almost all technical equipment) for buildings and facilities are designed and produced outside the construction industry. Therefore there exist no ICT tools, services and data models for product design that represent adequately, efficiently and sufficiently buildings and facilities, and vice versa, such products cannot be adequately represented in construction industry ICT applications. That is why the important interaction design cycle of product and host product is not possible or only on a very approximate level, including a lot of assumptions. ISES is developing ICT building blocks and related engineering ICT services to provide a platform that goes beyond the state of the art and allows:

- Integrating design and energy analysis tools for a holistic energy-efficient multi-model design,
- Testing products virtually in their envisioned future building and facility environments.

Energy supply and energy control systems are not only technically very complex but also very cost-intensive. The main difficulty is the right balance of energy-efficiency and investment and maintenance costs. Higher investment costs for technical equipment, building cladding, more sophisticated arrangements of energy resources and ICT control systems do not necessarily lead to lower maintenance costs. More sophisticated equipment and control systems, i.e. more complex systems bear a higher risk in good performance and may lead to higher maintenance, service and labour costs and lesser energy efficiency. What is needed is a combined life-cycle energy simulation and cost calculation to find the right balance between investment costs, maintenance costs, non-sophisticated and robust technical equipment and low energy demand and CO_2 emission, respecting also the other design objectives. To meet that challenge ISES is developing a multi-model design and virtual testing lab.

Simulation tools as developed by ISES are needed for one major reason in the design phases – namely to study very early the complex energy system under dynamic life-cycle conditions in order to draw the right (i.e. energy and cost-efficient) design decisions, with preferably lowest system complexity and highest flexibility for component products as well as for whole facilities (for the latter, also considering the retrofitting potential). Today, without precise prediction tools, the risk of wrong decisions is high and hence leads to less innovative design solutions, less energy saving and less emission reduction.

There exist many state-of-the-art software tools for product and for building design, for cost analysis, for energy analysis, for facility management and for lifecycle analysis. Each of them has proven its efficiency and reliability in their particular domain, namely (1) CAD-STEP in product design, (2) CAD in building design, (3) Multizonal Building Energy Solvers (MBES) in energy consumption analysis and simulation, (4) Building Envelop System (BES) solvers in the analysis of heat and moisture transportation, storage and buffering analysis and simulation, (5) civil engineering analysis (structural, wind earthquake, flood, fire) using the Finite Elements Method (FEM), (6) facility management systems (FM) for the management of buildings concerning operation, maintenance and renting, and (7) cost calculation and estimation in the different design construction and operation phases. However, they are mainly stand-alone software tools, they are designed for experts, and they are mostly "closed-world" tools with limited, proprietary data interfaces concerning energy aspects. A basic problem is that a common model and model interoperability methods are missing. Hence, an integrative holistic approach is missing, making data gathering for any study a very tedious manual effort. Accordingly, today's design is only loosely coupled with energy analysis. Energy analysis is done – if at all coupled with design – on very simplified rough basis of classification of the building and its components in terms of "accepted/rejected" according to national codes and regulations requirements (EPBD). Even the layout and design of the HVAC system is based on simplified models lacking extended lifecycle scenarios. Energy analysis is mainly focused on the final design phase. Feasibility design is currently out of scope, i.e. not supported by the available tools. Detailed energy analyses with specialised tools are available but not coupled with design modellers or CFD (computational fluid dynamics) and CSD (computational structural dynamics) tools and hence need manually set up separate models, i.e. these are time and labour consuming manual processes, which are error-prone and do not integrate with design tools to allow real design simulation cycles and building energy system optimization, in particular under life-cycle studies. Testing of alternative products, services and user interactions under realistic conditions and life-cycle scenarios before realization are totally out of scope. This is technically possible but, because of the one-of-a-kind software products and the expensive computations involved (in terms of costs and time), it is not practically affordable. Simplified, specifically adjusted tools and models for simulation provide a realistic but expensive option, and the generality, objectivity and reliability of their results are very questionable with regard to industry practice.

The energy efficiency and emission behaviour of facilities and buildings are not evaluated according to one internal standardized method but according to individual national guidelines and codes. Initial building performance assessment is carried out at the design stage utilising various simulation tools. Further assessments are carried out in the form of commissioning tests, but there is little or no monitoring or feedback once the building is occupied (cf. US-DOE 2002). As a result, Directive 2002/91/EC by the European Parliament for energy performance of buildings that requires owners to quantify the energy usage of their buildings against benchmarks set by government agencies throughout the building life cycle was accepted in 2003. These guidelines will more or less lead to a kind of classification of good or bad energetic behaviour of a facility but are not of very high value for component product design or for sufficient determination of a modern energy system and energy-efficient design of a facility. More sophisticated methods based on detailed numerical energy calculation methods acceptable for component product, facility and building design still have the drawback of assuming a deterministic approach for the life-cycle through the application of a characteristic climate profile with 1-hour steps, as provided by the D.O.E, USA.

The demand is not for stand-alone tools like an enhanced CAD system covering all the above features, but for an open, scalable system integrating distributed tools/services. Therefore a system is to be developed by ISES as a hybrid open SOA system combining web services and remote calls that is based on a common ontology and complemented with orchestration descriptions for different use scenarios in order to guarantee for the end-user integrated and error-free engineering working procedures. In particular, methods for interfacing simulation models for products, whole facilities, buildings, building and envelope (cladding) parts will be developed. Especially for application in the early design stage of buildings and building components (from the supply industry), the ISES virtual energy lab will allow to combine a concise building model description and modelling and simulation capabilities for prediction of building energy performance and related costs, indoor air quality and energy demand.

Advanced energy systems comprise a mix of different energy sources, energy buffers and energy suppliers and hence result in very complex multi-controllable systems. What is missing today is appropriate software to model and manage the various sub-systems, which are delivered by different suppliers in order to investigate their interaction and behaviour in advance and analyse their ill-performance through simulations.

Table 1 below show an overview of the complementary of the different tools opposing strength (what is there on a qualified level) and weakness (what is missing or still unqualified).

Table 1: Overview on strengths and weakness of tools

Tools	Strength	Current Weaknesses
BIM-based CAD	1. Building modelling 2. Building element model 3. Geometric representation (3D) 4. Animation Potential (4D) 5. nD building element information 6. Interoperability (BIM/IFC)	1. Energy analysis 2. Time and space dependent representations 3. Emission analysis 4. Climatic zone modelling 5. STEP interoperability 6. Openness 7. Simplified models 8. System interoperability
BIM-based FM	1. Building model 2. Spatial modelling 3. Space representation 4. Interoperability (BIM)	1. Energy simulation 2. Emission analysis 3. Durability analysis 4. Openness 5. System Interoperability

Tools	Strength	Current Weaknesses
Energy Analysis MBES BES	1. Energy analysis 2. Energy consumption 3. Climatic zone modelling 4. Energy information	1. Building modelling, incl. spatial geometry 2. New elements 3. New services 4. Openness 5. Interoperability (all kind)
Climatic Data Bases	1. Climatic information 2. Climatic models	1. Building models 2. Energy models 3. Interoperability 4. Stochastic consideration
User Activity Profiles	1. User activity models	1. Building model 2. Energy model 3. Stochastic consideration
ICT control systems	1. Individual system model	1. Interoperability (BIM) 2. Building model
nD Navigator	1. Building model (3D) 2. Ergonomic GUI	1. Energy model 2. Climatic model 3. User activity model 4. Time history model 5. Multi-Models 6. Model hierarchies
Model Filter, View Generator	1. Filtering on Schema- and Class-Level 2. Generic model view definitions (based on TUD-GMSD) 3. Generation of valid sub-schemas and –models 4. Reusable Sub-Views	1. Topological model queries 2. Support of geometry constructs 3. Instance-Level filtering 4. Re-usable and re-combinable view definition components 5. Multi-model filtering 6. Engineering model query language

Activity and usage profiles are not standardized but assumed individually and applied as characteristic deterministic representatives of the life-cycle. The assumption of the characteristics is the heaviest drawback in these approaches. Climate change and user behaviour (society) change are not sufficiently recognised. Life-cycle is a stochastic process problem. Acknowledging this fact, ISES develops a semi-stochastic method, which can be applied to different stages of modelling granularities (as described in section 1.2.3 below for design phases), leading to a very differentiated energetic analysis respecting the design needs for component products as well as for facility design. For the application of this semi-stochastic approach ISES will develop several ICT building blocks like stochastic climate and user profiles, model combiner, simulation model configurator and semi-automatic simulation evaluation.

B 1.2.2 Data Models

A critical issue for running energy simulations is the data that is available about the component product and/or the facility to be built or renewed. Building Information Modelling (BIM) has become a key technology for collecting data about products within the AEC and FM industries. It consolidates and manages available product data from different sources to provide high quality and up-to-date information about the buildings. It thus acts as a single point of information that shall be used by energy simulation services to avoid time consuming and costly re-entering of differently structured component product and building data.

Running energy simulation on the basis of BIM has been a topic of several research projects (e.g. in the EU projects InPro and STAND-INN), but mainly to show advantages of BIM-based data integration. In these projects energy analysis is seen as a typical downstream application that re-uses available design data and not as a driver for more sophisticated energy analysis methods and optimization purposes. Several pilot studies such as the HITOS projects in Norway (Lê et al. 2006) have been initiated to show the benefits of current BIM implementations. Besides making a start on

IDM (http://idm.buildingsmart.no) and MVD specifications (http://www.blis-project.org/IAI-MVD/), including agreements for energy analysis, experiences have been used to work on the development of BIM guidelines, such as from the Senate properties in Finland (www.senaatti.fi), the General Services Administration in the USA (www.gsa.gov/bim) or the buildingSMART e.V. in Germany (Liebich & Hoffeller 2008). In February 2009 the GSA released series 05 of their BIM guide, which is dedicated to energy performance of buildings and thus provides a basis for this research.

Whereas the benefits of BIM-based energy analysis have been proved in general there are still a number of issues when used in normal projects or throughout the lifecycle of a building. Main problems are related to data quality and data maturity requiring appropriate concepts for data validation and stochastic approach. Accordingly, takeover of BIM data by building performance applications such as Autodesk Ecotect, Olof Granlund's Riuska or EnergyPlus still requires a lot of manual work for starting energy calculations. This in particular becomes critical if several design iterations shall be supported as needed for energy optimization purposes, in particular under stochastic considerations.

The strategy is to use and enhance existing CAD-BIM tools that are strong in geometric and building element modelling as the component product and building modeller to play together with the FM-BIM tool the role of kernel software complemented with an ontology-extended BIM management system as the kernel data management systems for the Virtual Energy Lab (VEL). Such tools are widely available and are state-of-the-art tools in building design. Nevertheless, they lack in energy related issues, except some simplified rough energy code checkers. These FM tools will be enhanced (in the ISES project in particular for Riuska) concerning energy related data models and information in order to play the data hub in the VEL environment. Partially, more sophisticated and specialised data management issues will be outsourced as web services like model filters (for generating model views) and nD navigator. They will be completed by intelligent enhanced tools and data bases accessible via Web Services and remote calls in a hybrid SOA. All tools have first of all to be enhanced with regard to energy information aspects, and second they have to be enhanced with regard to interoperability aspects, namely (1) data interoperability, (2) model interoperability, and (3) system interoperability.

The baseline of the integration of CAD, FM and energy analysis tools and furthermore the extension of these integrated tools to a simulation platform, which means seamless access to various information sources (see Table 2) must be a highly flexible and extendable data structure. The current IFC as the most developed data structure in AEC is the most appropriate candidate here. That is why the used CAD and FM must be BIM-based CAD and FM systems in order to show and utilise (a) the functionality and (b) the basic data structure interface. Such CAD and FM systems already exist, like the FM system of partner OG (belonging to the technical BIM leading ones). The same holds for the energy analysis tools, even though no standardized data model exists, i.e. each tool uses its own proprietary data model. The most widespread exchange data structure is IDD/IDL developed in the context of the public domain energy calculation tool EnergyPlus. Hence, energy tools have to be extended by an interface to the BIM world. However, such interfaces are complex because they have to include not only data transformation but also model transformation, model mapping and model filtering (model views). Partially this functionality will be separated, generalized and made available as web services in ISES.

What is more, the BIM, more precisely IFC-BIM, which is an ISO-PAS 16739[1] standard, has to be extended, because it was originally developed mainly for architectural design. It has meanwhile opened to other domains, like structural analysis, HVAC and FM, using a smooth architecture and a data structure platform concept with domain extension (current version 2x4). However, the STEP (ISO 10303) data models, usually applied for component product modelling, and the IFC (ISO-PAS 16739) data model, usually applied for the facility, are not sufficiently compatible. They have different objects and are structured differently, but they also use the same baseline, namely the same basic concepts, the same modelling language EXPRESS (ISO 10303, Parts 11 and 12) and the same exchange format SPF (STEP physical file format, ISO 10303, Part 21). Additionally, IFC uses all the resource

[1] IFC is a derivate of the ISO 10303 STEP product model. It is the separation for the construction industry in the BuildingSMART initiative of the IAI (International Alliance for Interoperability) and it still uses the basic features of ISO 10303, namely all APs below 100.

models of STEP (ISO 10303, parts 40s). Therefore the basic technology for extension of the BIM with a STEP interface model is provided by ISO 10303. This extension is rather complex because a fully compatible system has to be modelled in the architectural system of IFC. Excepting some simplifications concerning a simplified geometry and using the basic object of the STEP basic resource models (parts 40s), a reasonable interface will be developed by ISES.

As a consequence, ISES will extend the current BIM through the above mentioned interface to STEP, in particular to ISO 10303, Parts 203 and 214. In our approach we will first develop an interoperability model using the IFC property sets approach and bounding boxes for geometry, which is a standardized valid possibility of BIM, which can be object-specifically extended later on.

In modelling we have to switch back and forth between building element oriented models (as the current mechanical and construction CAD are structured), room element oriented models (as the current FM tools are structured) and climatic zone oriented models (as the energy models are structured), where one building element can belong to several zones (as a whole or as a subpart), or vice versa, one climatic zone may reference several building elements. This zone structuring and the transformation between zones, rooms and building elements incl. component products are basic enhancements of BIM, FM and CAD modellers in ISES, besides their enhancement for energy data and information.

The BIM, i.e. the existing BIM objects, will be enhanced for the energy information, which is mainly an extension on the level of attribute extension and basic resources and an interface to IDD/IDL.

Another important extension of the BIM is the separate but complementary ontology model. The ontology model serves for model interoperability of the system models. Although this is not a unique BIM task, BIM with its already existing grouping functionality provides the basis for this extension. A group can be used for defining the set of the elements of the system, whereas the ontology defines the meaning of the system.

Integrating the monitoring system of facilities can be essential for control component products. Fortunately, in the last years IP-based gateway and middleware solutions like OSGi, OPC or SOAP have been established that may provide unified data access for common technologies like BACnet, KNX, LON, or EnOcean. Nevertheless, accessing data from building monitoring and control systems requires profound knowledge about the installed building automation systems from available gateways down towards device and datapoint level inclusive their semantic meaning. The necessary information is still not integrated in the BIM, even though it is often available in network design databases or partly via self-reporting functions of gateway. ISES will take benefit of this information and develop a simplified data access interface based on the model ontology.

In Table 2 below, the BIM is analysed with regard to strengths (what is there) and gaps (what is missing). Simplified spoken, ISES will fill the identified gaps in the BIM by complementing BIM with energy information, STEP interoperability and model ontology. In particular, the developed OntoBIM will be capable of serving as a sufficient basis for integrating the different tools and databases, which will allow ISES to benefit from the strengths of the tools available on the market. Inter-linking web services will have to be developed, too, e.g. intelligent access services where model management functionality (as mentioned above) will be implemented. The related model interoperability needs modelling methods like subsumption and partitioning, which are not yet supported and will be solved by applying ontology reasoning based on description logic.

Table 2: Overview on strengths and weakness of BIM

Modelling Method	Strengths	Current Gaps
BIM	1. Building model 2. Grouping mechanism (systems) 3. Building elements including HVAC and building service equipment 4. New elements via property sets 5. Interoperability	1. Energy system model 2. Energy information 3. Emission information 4. Hierarchical models 5. STEP interoperability 6. Ontology representation 7. Control system model 8. Openness

B 1.2.3 Design and Operation Process

In the following we describe how the state-of-the-art (a) of the design and operation processes of a facility or building will change and (b) how the design process of a component product will change when working with the ISES virtual energy lab, which provides a multi-model energy integrated design environment and its virtual testing in virtual facility (host product) models.

Feasibility Design of facilities: The facility is modelled in a few zones, which show the principle energy and emission information and behaviour. Predefined templates of zones should be offered in intelligent libraries as semi-instantiated zone objects. In this phase basic energy scenarios are investigated and the classes of the energy subsystem (energy providing, heating, cooling, isolation, etc. systems) are determined. Today this is supported only by proprietary ICT tools.

This design state of facility models is of interest for the feasibility study of new component products. In particular this high-level model granularity is of advantage to study the variation of climate changes during life-cycle in order to find out whether or not a new or updated component product may be feasible. Today this is not possible at all.

Preliminary design of facilities: The facility is modelled in climatic zones where a zone reflects the group of rooms with about similar energy behaviour. The zone objects should already show a granularity of external, internal and semi-exposed walls, ceilings, roof, floors and sub-surfaces, windows areas, areas of permanent/ semi-permanent openings, parking area, energy buffer space etc.. Again predefined templates should be available in intelligent libraries. In this phase the components of the basic subsystems are determined, which means, the class of windows, wall structure, boiler, ventilation, etc. and their location are defined. Today this is only supported by proprietary stand-alone tools like DesignBuilder, which do not show interfaces to BIM, BAS or neither to STEP.

This model granularity of the facility is important for the conceptual variation study of a new component product, e.g. what is the variation of the functionality of the new product, in order to figure out the overall scope and bandwidth of the new component product. Today this is not possible, because component products are designed by CAD-STEP tools without interfaces to facility and building data modellers.

Final Design: Each room is a climatic zone, and rooms have to be subdivided in several climatic zones or several rooms have to unify to a climatic zone. The same holds for the different open spaces. This switching back and forth has to be done smoothly. For each zone a smoothly modification of energy related information must be possible (to run simulation alternatives). Also, the whole building and parts of the building have to be modelled and simulation results have to be presented on different time scales (time resolution) and granularity. In this phase the product types of each component and their exact location and interaction are determined. In order to optimize the layout of the energy behaviour of the facility, several semi-stochastic analyses are carried out. Today this interaction can only be carried out by hand, which means only very few interaction cycles are realized and a semi-stochastic analysis is not imaginable.

With the ISES virtual energy lab, the semi-stochastic simulation analysis and the several design iterations of the new product can be carried out in order to optimize the various product variants and design a good portfolio of the new product, which is a critical competition issue. This is a sophisticated engineering task, because the host product system is to be assembled from components coming from different suppliers (where standardization is not always given) resulting in a lot of variant systems from which the characteristic ones for the design rational have to be selected.

Operation phase of facilities: quite similar to final design. In this phase the system is tuned in its daily operation in order to improve delivery and efficiency. The operation phase can be used for three purposes. First, it can be used in the virtual energy lab for the simulation of different ways of operation behaviour in a proactive concurrent engineering manner during the design phase in order to find out the best variant product and the optimal operation process of the variant product. Second, it can be used during the real operation of the facility to tune the overall facility system incl. the behaviour of the component product (tuning of the product processes). Third, it can be used for retrofitting studies in order to find out what the best replacement component product is in order to enhance energy and emission efficiency.

Lifecycle Analysis of facilities: Life cycle considerations which have to be done today on deterministic basis of a one year characteristic climate profile can now be carried out on semi-stochastic level with ISES for any of the above four design phases for acknowledging the stochastic nature of climate and use. In addition, life-cycle studies can be carried out to improve the operation of the system for the future concerning control and workflow and also to detect weakness or study the exchange of products, processes and services for improvement.

B 1.2.4 The HESMOS IVEL

The FP7 project HESMOS[2] develops an industry-driven holistic approach for sustainable optimisation of energy performance through integrated design and simulation, while balancing investment, maintenance and reinvestment costs. IVEL is a tool dedicated for architects, building service engineers and facility managers for the ee-design and operation of buildings. The objective of the project is to close the gaps between existing building data so that life cycle analyses and simulations can be easily done in all relevant design, refurbishment and retrofitting phases where energy saving potentials exist. The attention is specifically on public private partnership (PPP) construction projects where great ICT-related challenges and potential benefits exist, due to the stronger life cycle considerations in the relevant business cases. The main product of HESMOS will be an *Integrated Virtual Energy Laboratory (IVEL)* enabling comprehensive studies of design and retrofitting alternatives concerning energy performance and total costs.

In general terms, the development of the HESMOS IVEL follows a standard UML based approach. User requirements elicitation is performed on the basis of the IDM methodology (ISO 29481) which promotes BIM-driven communication with the end users, and the synthesis of user requirements and ICT issues to solve is performed both top-down (using developed PPP use cases) and bottom-up (via a structured analysis of the features of available services and tools). The software architecture is established on the basis of these findings, adapting a general distributed service and model-based approach to the specific requirements of the domain. It comprises several types of services and applications, bound together by an *IVEL Core Module* that acts as middleware providing for the required data and functional interoperability. Modularisation of the platform components is consistent with the identified actor roles (architect, facilities manager, building operator, owner, public) and respective business cases (design, commissioning, operation and maintenance, refurbishment). Consequently, the following modules are defined:

- *Design module*, comprising a CAD system and related design and cost estimation tools (the primary use of this module is intended for the building designers – architects and building services engineers)
- *Facility management module*, comprising a FM system and related FM and cost calculation tools (main users are the facility managers)
- *Public access module*, providing a general-purpose interface to the IVEL via an nD-Navigator thereby enabling light-weight easy-to-do studies of the building performance with regard to energy, emissions and life cycle costs (main users are the building owners and the PPP contractors, but can be also any involved public bodies and tenants of the facility)
- *Operation monitoring module*, providing services for monitoring and control of the Building Automation Systems (BAS) and their linkage to the overall platform (main users are the building operators and the facility managers)
- *Energy analysis and simulation module*, providing the energy related computational services and tools (Here, unlike traditional approaches that presume as main users of such tools highly specialised energy consultants, a service-oriented approach shifting the preparation of simulation models partially to the other modules and the related actors on the basis of well-defined data models, data exchange specifications and respective workflow facilities).

Each of these modules will be basically exchangeable due to the targeted standardised data models, information exchange specifications and APIs. With the exception of the IVEL Core Module and the Energy analysis and simulation module (which are strictly service-oriented and accessed via WSDL-based interfaces) all other modules will provide their own GUIs, tailored to the specific needs and views of the respective actors. The IVEL Core controls the binding to all other services and provides all workflows and model mappings to various data formats. The interoperability with non WSDL-based applications is ensured by a special H-Connector providing a homogeneous interface via SOAP technology.

A central issue for the realisation of the IVEL platform is the achievement of long-term information interoperability. This is being done by enhancing the standard IFC model of the BuildingSMART initiative towards a true energy efficiency related eeBIM framework. Thus, the overall HESMOS approach is to build the IVEL as an open SOA platform based on eeBIM, BIM-CAD and BIM-FM, extended by development of missing functionalities and services for intelligent access to ICT control systems on the one side and advanced energy analysis and simulation tools on the other side, thereby providing for a coherent and easy-to-use environment for the end users built upon a common conceptual modelling basis.

In short, the HESMOS IVEL will be in first place a **platform for architects, facilities managers, operators and owners engaged in PPP projects to examine life-cycle energy and related cost issues** and take more informed and efficient decisions.

The following table shows the differences but also the complementarity of the addressed RTD issues in HESMOS and ISES.

[2] The EU project HESMOS (Grant No. 260088) has started in September 2010 with duration of three years.

Table 3: Comparison of HESMOS and ISES

#	Issue	HESMOS Platform	ISES Platform
1	Industry areas	Architecture and building construction with special emphasis on PPP projects	Construction and related mechanical manufacturing industries
2	Major use cases and related life-cycle phases	▪ Design ▪ Commissioning ▪ Operation and maintenance ▪ Refurbishment	▪ Component product development (building elements, HVAC equipment, energy supply equipment) ▪ Design ▪ Refurbishment
3	Types of facilities add-ressed	Moderately complex public buildings with pronouncedly unique character (schools, shopping malls, govern-mental buildings, stadiums etc.)	▪ Highly complex, unique facilities ▪ Highly unified, repetitive buildings where efficient use of prefabricated products is of great importance (supermarkets, storehouses etc.)
4	Types of users/actors	▪ Architects ▪ Facilities Managers ▪ Owners ▪ General public (energy experts use is secondary issue)	▪ Design engineers, primarily MEF engineers ▪ Product developers ▪ Energy experts
5	Model-based working	▪ Multi-model consideration ▪ Development of eeBIM framework ▪ Advanced modelling, visualisation and model transformation methods	▪ Multi-model consideration ▪ Use of eeBIM framework ▪ Development of innovative platform and multi-model BIM ontologies
6	Modelling framework	▪ BIM ▪ Climate database and user profiles (reference curves only) ▪ Material databases ▪ Building Automation Systems	▪ BIM ▪ Climate database and user profiles (incl. time-dependent stochastic behaviour) ▪ Material databases ▪ Product catalogues
7	Coverage of energy performance aspects	▪ Standard analysis cases ▪ Balancing of ee-performance and costs is a primary issues (consi-dered explicitly in arch. design)	▪ Standard and exceptional cases ▪ Balancing of ee-performance and costs is a secondary issue (considered mainly implicitly)
8	Use of stochastic para-meters	Strong approximation, mainly based on mean values and single reference curves	Comprehensive, based on stochastic clustering and consideration of worst case scenarios as well as broad ranges of stochastic variables
9	Simulation modelling	▪ Multi-model based ▪ Performed mainly interactively	▪ Multi-model based ▪ Performed in highly automated way
10	Simulation performance	Separately run analysis/simulation tools invoked via *web service tech-nology*	Simultaneously run multiple simulation models via a set of analysis/simulation tools used via *cloud technology*
11	Model evaluation	Mainly interactive, via specialised tools or a web accessible nD Navi-gator	Highly automated, with the help of a novel Multi-Model Evaluator and Manager (the third tier in the ISES architecture)
12	Addressed standards and harmonisation bodies	▪ BuildingSMART (IFC, IDM) ▪ eeBDM	▪ BuildingSMART (IFC, IDM) ▪ eeBDM ▪ ISO STEP (PartLib, STEP AP 214)
13	Major new software prototypes planned	▪ eeBIM-CAD ▪ eeBIM-FM ▪ Advanced energy simulation tools ▪ nD Navigator ▪ IVEL Core Services ▪ Ontology-based BAS-BIM mgmnt.	▪ Ontology-based platform logistics ▪ Advanced stochastic energy sim. tools ▪ Multi-model combiner & sim. configurator ▪ Multi-model navigator ▪ Multi-model evaluator and manager ▪ Product catalogue extender

Hence, whilst different in many aspects, HESMOS provides a good basis for straight-forward development of several components of the ISES platform as indicated at respective places in the WP descriptions in Part A. In certain sense, the ISES Virtual Energy Lab can be seen as extension of the HESMOS platform for engineers and experts, enabling the solution of complex energy-related tasks where higher risks, greater uncertainty or increased responsibility of decisions because of the high repetitiveness of the designed facilities and the used products is the case.

B 1.3 S/T Methodology and associated work plan

B 1.3.1 Overall strategy

The focus of ISES research and development work will be on:

– Bridging the functional and information gaps between existing services and tools in the target domain,
– Developing new knowledge and simulation management services, and
– Providing a coherent cloud-enabled ICT environment where advanced processes improving energy-related design and operation solutions can be successfully fulfilled.

The project work plan is broken down into 8 RTD (WP 1-8), 1 demonstration (WP 9) and 1 management (WP10) work packages reflecting the decided overall approach and the associated major activities.

RTD work will start in WP1 with analyses of the requirements to the ISES platform from end-user and information availability perspective and definition of relevant use cases and scenarios. This will be followed (with partial overlap) by development of the overall stochastic approach and the design of the software architecture of the platform in WP2. In parallel, with an offset of two months, detailed work will start on the functionality of the kernel data layer (model ontology, system ontology, ontology-based BIM and related services) – WP3, and the services for intelligent access to the required information resources (climate data bases, stored user profiles, energy material data, product catalogues) – WP4. At the same time, early specification of the pilot demonstrators and the related requirements will be done to enable a focused development approach. WP7, following directly the completion of WP2 and using the developed software design therein, will set up early a cloud test-bed for all other software developments and provide the technical service APIs for the cloud to facilitate the domain-specific service/tool developments in WPs 5 and 6. The succeeding work in the RTD WPs 3 – 7 will be performed in overlapping waterfall manner to enable efficient mobilisation of the resources. They will be continuously supported and provided with feedback on the one side by WP9, dedicated to the pilot demonstrators, and on the other side by WPs 8 and 10 related to the dissemination and exploitation of the project results and the project management as a whole.

The principal logical inter-dependencies of the major components of the work resulting from this overall strategy are presented on Fig. 3 below. The timing of the work packages and their components, explicating the adopted waterfall structuring of the work, is shown in Fig. 4 in the following section. The mobilisation of the resources for each WP and task is provided in section B 2.4.

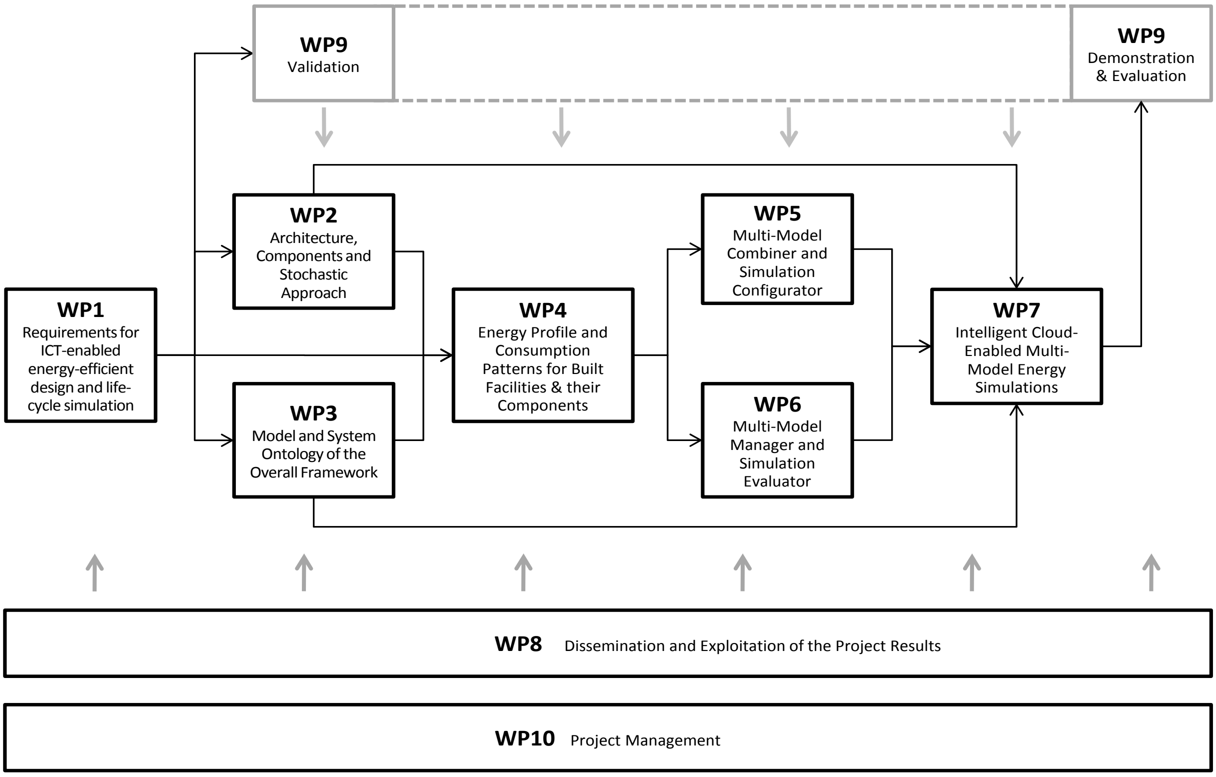

Fig. 3: Graphical presentation of the dependencies between the major project components

B 1.3.2 Timing of work packages and their components

The Gantt chart below presents the timing of the work packages and their components, following the decided overlapping waterfall structure.

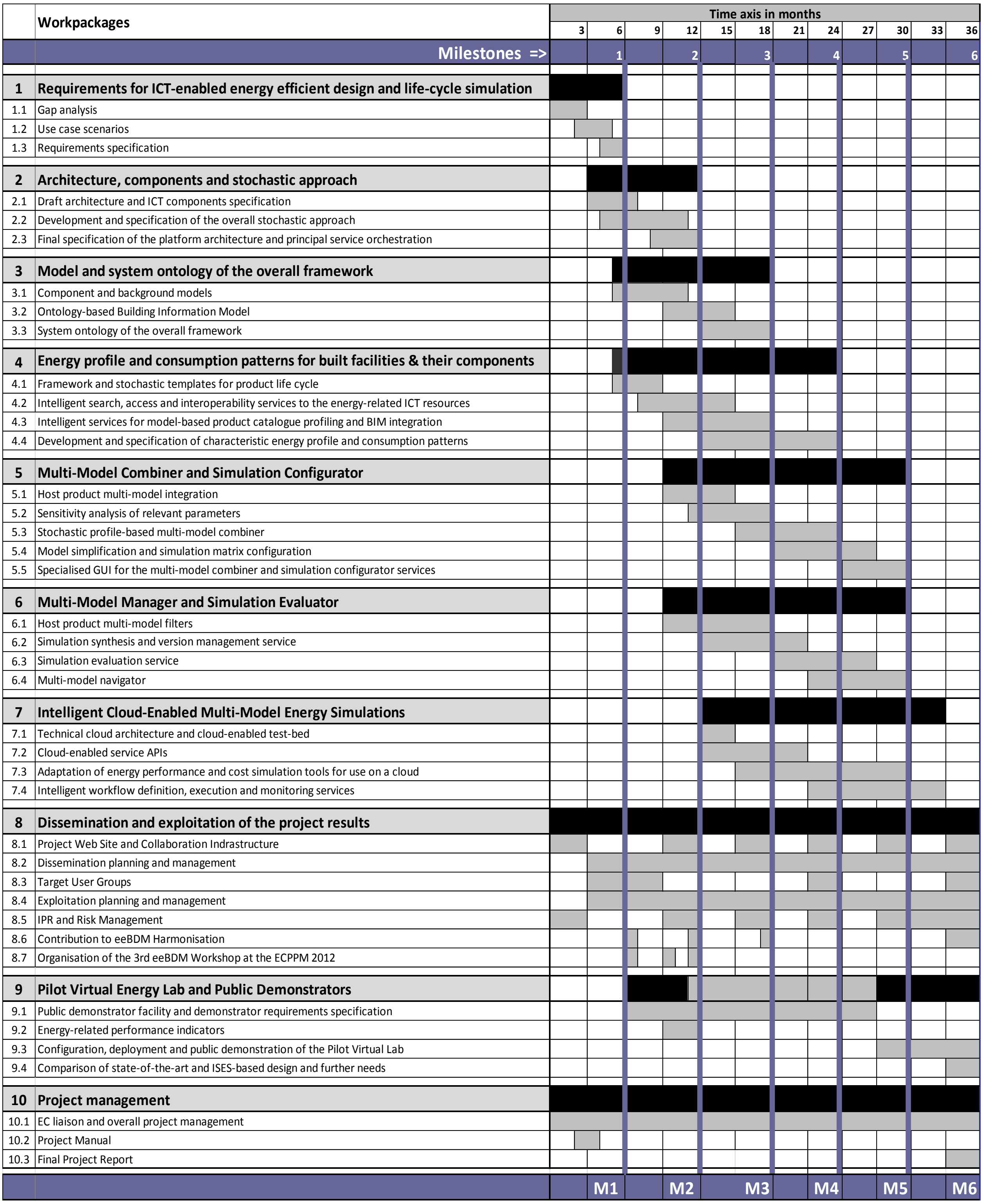

Fig. 4: Project Gantt chart

In accordance with that structure, the major project **milestones** are defined as follows:

- **MS 0**: **Kick-Off** [at month 0]
- **MS 1**: **Requirements** [month 6]
  Marks the completion of WP1 and the related decisions and updated risk plans
- **MS 2**: **Architecture** [month 12]
  Marks the completion of WP2, including the developed overall stochastic approach and the underlying software architecture of the software prototypes, the first conceptual component models in WP3 and energy-related performance indicators in WP9, thereby providing sufficient material for a first project review and updated RTD decisions
- **MS 3**: **Basic concepts, methods and services** [month 18]
  Marks the completion of WP3 with the overall model and system ontology, the implementation of the services in WP4 and main concepts of WP 5 and WP6
- **MS 4**: **Service prototypes** [month 24]
  Marks the completion of WP4 and various service prototypes in WPs 5 – 7 thereby allowing changes and adjustments in development approaches in timely fashion for the second project review
- **MS 5**: **Full beta prototype of the Virtual Energy Lab** [month 30]
  Marks the completion of WPs 5 and 6, the full beta prototype of the Virtual Energy Lab and the start of the evaluation of the pilot demonstrators with the ISES platform
- **MS 6**: **Final system prototype** [month 36]
  Marks the end of the project by the realised full platform, a public workshop and the issued final project report.

B 1.3.3 Risks and associated contingency plans

Due to the novelty of the proposed services infrastructure and BIM management, certain **risk factors** related to the RTD work, the demonstration activities and the project management can be anticipated and need to be taken into account.

To react to such possible problems, **continuous assessment and evaluation** of the respective market and technology segments will be performed by the project management **for the early recognition of risks and elaboration of adequate contingency plans**. For that purpose, a specific task is assigned in **WP 11**. Collaborative software support for timely risk identification and management will be set up as part of the internal IT collaboration infrastructure of the project.

As a whole, **risk management** will follow the principal phases:

- Identification,
- Continuous qualitative assessment of the risk with regard to goals, costs and schedules,
- Risk mitigation through pro-active management and alternative contingency plans,
- Post risk analysis where risks are re-assessed, and
- Fallback Plans, to identify actions that need to be taken if everything else fails.

As mentioned in the description of WP11, an approach adapting issues from the Australian RM standard (AS/NZS 4360:1999) and the Swinburne OH&S Management System will be applied.

Risk assessment will be performed using a risk database for all project activities in the WPs. For that purpose, the following categories are defined: (1) identified problem/risk, (2) actual/potential impact on the project, (3) risk effect / level of impact, (4) probability of occurrence, (5) risk exposure, and (6) proposed solution / contingency strategy.

Risk exposure will be measured by combining the effect and probability of occurrence of an identified risk, in case it materialises.

These terms are defined in the following matrix (table 4).

Table 4: Relationship between risk probability, effects and exposure levels

Risk exposure levels: ➘		PROBABILITY		
		High (H)	**Medium (M)**	**Low (L)**
EFFECT	**Uncontrollable (U)**	**High**	**High**	**Medium**
	Critical (C)	**High**	**Medium**	**Medium**
	Marginal (M)	**Medium**	**Medium**	**Low**
	Small / Negligible (N)	**Medium**	**Low**	**Low**

Initially identified technological, demonstration related and managerial risks will be taken into account using the described procedure as shown in table 5 below.

Table 5: Initially identified project risks

Problem/Risk	Impact	Probability	Effect	Exp. level	Solution/contingency strategy
Technological risks					
TR1. Delay or lack of quality in the development of user scenarios and the synthesis of user requirements	Insufficiently clarified technological goals and overall RTD delay	L	C	M	Decision about the requirement gathering process already at the project kick-off and strict monitoring at management level
TR2. Limited availability or accessibility regarding good quality model data	Delay in the preparation of test cases leading to impeded service development	M	M	M	Early survey of related state-of-the-art issues in T1.1; eventual relocation of resources at MS1 [month 6]
TR3. Insufficient quality of basic off-the-shelve model management tools	Unplanned development work to handle expected yet missing features	M	C	M	See TR2. If necessary, the missing features will be provided by the software developers (SOF, OG) or the academic partners (TUD, UL).
TR4. Development of advanced BIM methods turns out to be more difficult than expected	Limitations in the initially planned functionality	L	C	M	Early mitigation measures, incl. close monitoring of WPs 2 and 3 to detect such constraints at the outset and react with practice-oriented solutions
TR5. Partial or full failure in the development of the planned innovative stochastic methods in WP6 and WP7	Failure to reach the objectives of WP6 and/or WP7 and hence of the project as a whole	L	U	M	This issue is difficult to prepare for. Hence, it will be continuously monitored until good results are ensured but at least until MS3 [month 18].
TR6. The use of advanced stochastic methods leads to indefiniteness in the solver software	Possible erroneous results or failure of developed stochastic methods and tools to perform as planned	L	U	M	Check of input values and expected results and monitoring of peaks.
TR7. Generic interoperability concepts and methods prove not sufficiently practical	Missed practical goals and limited acceptance of the approach	M	C	M	Splitting interoperability methods in generic and specific components already at the software design phase; Involvement of the end-users to prioritise the planned development features
TR8. Ontology scalability is lower than expected	Limitations on the envisaged practical scope of application for the planned pilots	H	C	H	Early testing of ontology related tools and, if necessary, ontology re-design moving part of the defined concepts to less critical components with simpler data representation types
TR9. Parallelism of simulations through workflow based cloud computing leads to degraded performance or even to deadlocks	The simulations use competing resources and cannot finish; the desired benefit is not achieved	M	U	H	Early and strong testing of related tools and interoperability methods in WPs 7 and 8.

Problem/Risk	Impact	Probability	Effect	Exp. level	Solution/contingency strategy
TR10. Distributed resource data cause serious performance problems	Limited usefulness of ISES in practice	M	C	M	Taking special care during system design with regard to the granularity of information queries and data transfer
TR11. Different goals of partners with regard to the overall ISES architecture remaining undiscovered at the outset	Interoperability problems	L	C	M	The adopted SOA approach should normally provide a solution; as work-around, plug-in and proxy technology can be applied to bridge gaps
TR12. Dependency on third-party products	Severe delay in service development	L	C	M	ISES uses as little as possible third-party services which are all widely acknowledged; alternative choices are available
TR13. Problems with proprietary interfaces to existing systems and tools	Severe delay in service development	M	C	M	Such problems are very unlikely due to the adopted model-based approach; If nevertheless happening, rework of the project plan will be necessary
TR14. Problems with the scalability of the cloud solutions	Adverse effect in service development and exploitation regarding WPs 5, 6 and 7	L	C	M	Whilst quite unlikely to happen, such problem can only be tackled by adjusting the project plan in cooperation with the PO
TR15. New products on the market or updated or new standards regarding cloud computing, BIM and part libraries, partially overlapping planned RTD results	Wasted resources, loss of time and/or competitiveness	M	C	M	Increase market and standard watch via the participation of 3 partners in the IEA, 3 partners in BuildingSMART and 2 partners in related ISO work; Decide corrective actions at scheduled or extraordinary meetings of the MTB and inform the PO
Demonstration related risks					
DR1. The pilot projects cannot be adequately prepared for the ISES platform	Partial or complete failure of the demonstrator	L	U	M	The planned early start of WP9 should prevent this to happen; If problems are encountered, the selected projects shall be replaced by one of the other test sites
DR2. The developed methodology and work processes are not accepted by the end users	Pilot evaluation is unsatisfactory; ISES remains poorly accepted in practice	L	C	M	Continuous feedback with the end users should provide for timely corrective actions
DR3. Low usability of the user interfaces	As above	H	C	H	Contingency planning is as for DR2
DR4. Practical cloud and/or equipment problems	Partial or complete failure of the demonstrator(s)	L	U	M	Equipment is planned as adequately as possible; In case of problem, resources will be restructured or covered by the partners
Managerial risks					
MR1. Risks stemming from the multidisciplinary nature of the consortium	Failure to transfer knowledge b/n the partners	L	C	M	Restructure management to ensure better communication; Improve communication channels
MR2. Underestimated time for completion of deliverables	Tasks completed with delay; deliverable miss deadlines	L	C	M	Tight control by WP leaders regarding planning, validation; Strengthen QM
MR3. Underestimated efforts to complete some tasks	Resource/budget overrun or lower quality of the results	M	C	M	Do detailed monitoring of resources and budget, take corrective actions if necessary
MR4. Lack of experience or qualification of involved staff	Low quality, missed objectives	L	C	M	MTB decides about necessary changes by the respective partner; If quality is not improved, inform the PO
MR5. Diverging technological and exploitation objectives of the partners	Unnecessary, fruitless disputes	L	M	L	Define strict decision-making procedures; In parallel, provide appropriate discussion forums
MR6. Partners leaving the project	Missed tasks, objectives, quality problems	L	U	M	Redistribute tasks as much as possible; Find replacement partner with involvement of the PO

B2. IMPLEMENTATION

B 2.1 Management structure and procedures

The project management will ensure that all contractual, financial, legal and management issues, including risk and time management, are taken into account. In regard to the European Commission special care will be taken to meet all deadlines and to produce all reports in good quality. In regard to developers and researchers special care will be taken to minimise paperwork and let them concentrate on the innovative part of the work. In regard to the partner organisations (the Contractors) care will be taken to ensure that all financial issues are handled in timely fashion. The project will create two documents to specify how work is done and define the internal relations:

1. **The Consortium Agreement** (CA), which will define the management structure, the relations among the partners, the IPR issues and other legal aspects of collaboration.
2. **The Project Manual,** which will define the technical and procedural details of project colla-boration, i.e. the tools, file formats, file naming conventions, workflows of documents, quality assurance procedures and the project calendar, including internally defined deadlines for the reports and deliverables.

B 2.1.1 Management Structure

The overall management structure is presented in the figure below. The management roles and personnel are defined in the following subsections.

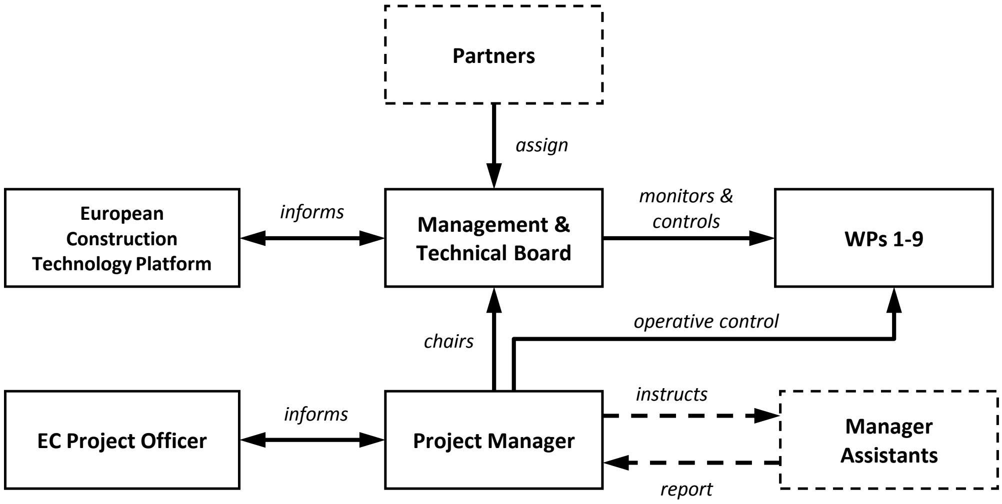

Fig. 5: Overview of the overall management structure

Management and Technical Board (MTB)

In accordance with the relatively low complexity of a STREP, the competence of the partners and the high know-how, experience and technical abilities of their senior representatives in the project, the *Management Board* – typically responsible for the overall management of resources and the fulfillment of schedules and goals, and the *Technical Board* – responsible for monitoring and controlling the RTD work in the project's work packages, will be joined into a single body – the **MTB**.

The MTB will be the top decision-making body of the project, comprised of one representative of each contractor. Its role will include:

- Proper management of resources in order to meet the project's objectives
- Ensuring the quality management of the project and the separate WPs
- Monitoring and controlling the progress of the RTD work
- Tracking of costs related to the budget

- Tracking of risks
- Tracking of the exploitation plan and IPR issues
- Ensuring compliance with legal obligations
- Resolution of conflicts

The Project Manager shall invite for and chair all meetings of the MTB. Such meetings shall be convened at least once every 6 months and upon written request of at least three contractors in the case of an emergency situation. Any decision requiring a vote at a MTB meeting must be identified as such on the invitation. Should a contractor suggest adding a discussion/decision to the proposed agenda, they shall do so in writing to all other contractors at least seven calendar days prior to the meeting date. MTB meetings may be organized as face-to-face meetings or as online telecom or video-conferences. The MTB is the final authority for project-related decisions. It is responsible for all legal, financial and operational matters associated with the execution of the project in accordance with the commission contract.

Project Manager

The Project Manager from the coordinator (**Prof. Scherer, TUD**) is responsible for the scientific and operative management of the project. He is head of the MTB and chairs the MTB meetings. His operative management functions involve the steering of the project, both technically, financially and administratively, according to the contract documents, consortium agreement, project manual and the decisions made by the MTB. This includes the management of dependencies between various tasks and work packages, co-ordination of technical progress, final approval of technical reports and deliverables and resolution of problems of technical and administrative nature. He is responsible for implementing the decisions of the MTB and tracking the progress of the project. He supervises the project administration, is responding to important changes during the project life and coordinating necessary adaptation to meet conditions of the external environment. He is in charge of dealing with the contract, work plan, reporting and billing of efforts, budget and review organisation, and assumes the responsibility of representing the project in front of the EC. The Project Manager is the primary interface of the Consortium to the European Commission. To ensure coherent management of all critical project aspects, his tasks encompass:

- **Financial management**, including budget supervision, preparing the final consolidated cost statements sent to the EC, obtaining audit certificates and bank guarantees as and when required;
- **Scientific management**, including a scientific community watch, evaluating RTD work related to the scientific progress, matching it with the scientific watch and the exploitation strategy; the matching results will be presented at each MTB meeting together with a draft of adjusted and updated project objectives;
- **Risk management**, including analysis of internal and external projects risks, selection of risk mitigation measures and development of contingency plans, and presentation of a synopsis at each MTB meeting.

Manager Assistants

Whilst strategic management will be performed by the MTB and operative management by the Project Manager on daily basis, there are various management related tasks that are less critical but require more detailed technical knowledge. For such tasks the Project Manager will be supported by three manager assistants as indicated below. They will have only **advisory status**, including monitoring, reporting, synthesizing outcomes, preparing actions and suggesting alternatives, whereas all final decisions are taken by the MTB and – operatively – by the Project Manager.

The **S/T manager assistant**, **Dr. Katranuschkov of TUD**, will be supporting the Project Manager in his daily work. Therefore, it is important that he is from the same contractor company and possesses adequate management and technical abilities and experience.

The role of the S/T manager assistant comprises:

- **Technical support**, including collection of the partner progress reports and drafting of the consolidated PPRs, organising and maintaining the project management infrastructure, technical help in tracking work progress, and preparing respective management tables, charts and diagrams;

– **Financial management support**, including book-keeping, collecting partner cost statement, checking of costs and preparing respective cost tables and diagrams;
– **Quality management support**, including the setting up of a quality handbook as part of the project manual, monitoring quality assurance practices[3];
– **Risk management support**, incl. the collection of risks identified by the partners in periodic request rounds, managing and consolidating these risks, generating risk reports and diagrams of risk developments and risk categories;
– **Scientific management support**, incl. scientific community development watch, inquiries on specific topics, preparation of reports and presentation material.

The **Dissemination, Exploitation and IPR Manager Assistant**, **Dr. Protopsaltis of SOF**, will be responsible for all dissemination work, i.e. collection of information from partners, running web page newsletters, scheduling fairs and conferences, promoting papers, designing PR material, arranging, printing and distributing flyers etc. Furthermore, he will be responsible for the development of the exploitation strategy of the consortium together with the partners, respecting the IPR of the individual partners, and the generation of an evolving exploitation plan presented and discussed at the MTB meetings. His actions have to be agreed with the MTB, and the Project Manager has to be informed and to approve beforehand. Content has to be circulated in the Consortium and agreed in due time before publishing. IPR has to be respected and content has to be adopted accordingly.

Work Package Leaders

The work package leaders assist the Project Manager in addressing specific work package related issues. They have the responsibility for the day-to-day detailed management of the work packages. They report to the Project Manager and prepare progress and management reports related to their respective WP. The appointed project manager, exploitation manager and work package leaders are named in the following table 6.

Table 6: Management roles and WP leaders

Management role	Participant	
	Organisation	**Person**
Project Manager	TUD	Prof. Scherer
Dissemination, Exploitation & IPR Manager	SOF	Dr. Protopsaltis
Leader WP1	LAP	Mr. Zschippang
Leader WP2	TUD	Dr. Katranuschkov
Leader WP3	UL	Prof. Turk
Leader WP4	NMI	Mr. Gudnasson
Leader WP5	TUD	Prof. Grunewald
Leader WP6	OG	Mr. Laine
Leader WP7	UL	Dr. Dolenc
Leader WP8	SOF	Dr. Protopsaltis
Leader WP9	TRI	Mr. Zaletelj
Leader WP10	TUD	Dr. Katranuschkov

Management Tools

Beside the communication with standard e-Mail programs or internet telephony applications, the management will be supported by project management tools like Microsoft SharePoint or Mind Manager for creating mind maps. Other support will be given by file servers and version management tools.

[3] Neither the S/T manager assistant nor the Project Manager is responsible for the content of deliverables. This is the responsibility of the owning partners and those contributing.

European Construction Technology Platform (ECTP)

Leading European experts from the ECTP will be invited to monitor the project and give advice with regard to working culture and their knowledge and views. In this way, the ECTP will contribute to more general and internationally valid results. The participating members will take care that objectives of the different regions are properly considered and adapted in the re-engineered design, refurbishment and retrofitting processes of public use facilities. In exchange, they will have privileged access to restricted project deliverables, and will benefit from early awareness and better insight into the project results.

B 2.1.2 Management Infrastructure

The management infrastructure comprises the following issues:

- **The Project Manual**: (as defined at the beginning of this section).
- **Project meetings.** Project meetings will be held at the start of the project (the kick-off meeting) immediately before review meetings and half way between review meetings if required. The board will meet on each of these occasions headed by the Project Manager. Communication between partners outside meetings will be via exchange of documents (progress reports, working papers etc) and informal correspondence. These communications will remain confidential to the project partners, but will be used by the Project Manager as basis for the Progress Reports.
- **Intra-project collaboration.** The coordinating partner will set up a Web based infrastructure for intra-project collaboration which will include a document management system, conferencing and email lists, shared calendar, as well as real time communication channels such as video-conferencing.

E-Mail, videoconferencing, document management and the World Wide Web will be used as the *main communication channels* for internal communication and document exchange. The meetings mentioned above will be held to tackle discussions on important issues that require the participation and opinion of all partners. This is also an opportunity for partners to meet in small workshops in order to solve technical problems, doubts and requests not concerning the whole project.

B 2.1.3 Quality Assurance and Decision-Making Procedures

The project will operate within certain administrative procedures, which will be defined at a very early stage. They will cover management reporting, document standards, collaborative specification and development, review, configuration, change control and quality assurance. The quality reviewing functions are important to make sure that all contributions and conclusions are consistent to meet the requirements of the deliverables. A common format will have to be agreed upon for the preparation of all documentation and the deliverables.

Decision making will be made by consensus or by voting, with each partner having a single vote. In case of a tie, the Project Manager will have a casting vote. Decisions that are related to changing the funding of the project or adding new contractors need to be supported by 2/3 majority or all partners. At least 2/3 of the partners need to take the vote for a voting to be valid. A specific conflict management procedure for serious technical / financial / legal issues will be defined in the Consortium Agreement.

B 2.1.4 Exploitation Planning and Management of Intellectual Property

Together with the partners, the exploitation and IPR manager assistant Dr. Protopsaltis of SOF will develop a marketing strategy by identifying marketable products in the very early stage of the project, track the development of these products and market development in general, and refine and adapt the exploitation strategy accordingly to result in an optimized exploitation strategy at the end of the project. In accordance to the evolving character of the exploitation strategy the exploitation plan worked out by the exploitation manager will be an evolving document, which will be consolidated five times during the project life cycle, namely at the **milestones of the project on m6, m12, m18, m24** and **m30** respectively. The development of the exploitation plan will be supervised by the project manager and will be presented to the consortium at the MTB meetings to obtain a common consensus, identify exploitation risks continuously and hence very early, and develop commonly a strong exploitation perspective.

In parallel, the exploitation manager assistant will develop the IPR agreement proposal, co-ordinating the individual interests of the partners and their IPR rights. He will take care of the consistence of the exploitation plan and the IPR agreement. He will be responsible for drafting the IPR agreement, which will be verified by the project manager before it will be discussed in the kick-off meeting, and as a part of the Consortium Agreement it will be agreed upon in written form by all partners. The partners will sign the Consortium Agreement at an early stage to clearly identify IPR, exploitation rights, dissemination policy and possible future collaborations (after the end of the project). All partners will have the rights to use the deliverables for internal purposes. The IPR for exploitation will be developed together with the exploitation plan during the project, reported as part of the corresponding deliverables and agreed upon in written form by all the partners at the final project meeting. The project manager will supervise and ensure that (1) rules are identically applied to all contractors, and (2) rules concentrate on the principles and provisions considered necessary for efficient co-operation and appropriate use and dissemination of the results.

The following table presents the list of IPR-relevant project deliverables and respective results that will be watched by the IPR management.

Table 7: IPR-relevant project deliverables

Deliverable Number	Title	Product type	WP number	Lead partner [acronym]	Delivery date [month 0..36]
D1.2	Use case scenarios and requirements specification	Spec.	1	LAP	6
D2.1	Overall stochastic approach for the Virtual Energy Lab Platform	Technical Document	2	TUD	12
D2.2	Architecture and components of the Virtual Lab Platform	Spec.	2	TUD	12
D4.1	Technical specification of the overall framework and the principal energy profile and consumption patterns	Spec.	4	NMI	12
D4.2	Prototype of the intelligent search, access and interoperability services to the energy-related ICT	Software	4	NMI	15
D4.3	Prototype of the intelligent services for BIM-based product catalogue profiling and BIM integration	Software	4	SOF	18
D4.4	Characteristic energy profile and consumption patterns for the ISES Virtual Energy Lab	Software	4	NMI	24
D5.1	Prototype of the multi-model integration services	Software	5	TUD	15
D5.2	Prototype of the multi-model combiner	Software	5	SOF	24
D5.3	Prototype of the simulation configurator	Software	5	TUD	30
D6.1	Prototype of the host product multi-model filters	Software	6	TUD	18
D6.2	Prototype of the simulation synthesis and the version management service	Software	6	OG	21
D6.3	Prototype of the simulation evaluation service and the multi-model navigator	Software	6	OG	30
D7.2	Cloud-enabled software integration	Tech. doc. & software	7	UL	30
D7.3	Prototype of the developed intelligent workflow definition, execution and monitoring services	Software	7	UL	33
D7.4	Use of the Prototyped Virtual Energy Lab on a Cloud Environment	Technical Document	7	UL	33
D10.3	Final Project Report	Technical Document	10	TUD	36

B 2.1.5 Risk Management

The goal of risk management in the project is to identify, quantify and manage risks that could endanger the project or its parts. The risk management process will be set up as a part of the Project Management WP. Collaborative software support for risk identification and management will be set up on the Web. Risk management will proceed through the typical risk management phases, namely:

(1) **Identification,**

(2) **Qualitative Assessment of the risk** that can be between **'**Very High' and 'None' and is related to schedule, cost and end-user satisfaction,

(3) **Actual Risk Management** focusing mostly on the process of risk mitigation through pro-active management which involves the identification of remedial action for the risks that require active management, segregates those that only require monitoring and records secondary risks that might arise from implementing the risk mitigation plans,

(4) **Post-Risk Evaluation** where risks are re-assessed, and finally

(5) **Fallback Plans** to identify actions to be taken should a risk occur in spite of risk management actions.

In ISES the particular focus of the risk management will be in WP2–WP7 that must keep the goals in realistic frames so that they can be properly implemented and exploited, and the WP 9 related to the demonstration and validation of the overall platform on real scenarios. Already identified risks to be mentioned are listed in sect. 1.3.5 above.

B 2.2 Beneficiaries

In the following the profile of each participating organisation is presented. These profiles are structured uniformly providing (1) an overview of the organisation, if applicable, with the specific department engaged in the project, (2) the specific skills and know-how that are relevant to and will be brought into the project, and (3) key personnel that will be involved in the work. For the co-ordinator, TUD, the expertise related to project management is indicated in addition.

B 2.2.1 Technische Universität Dresden, Germany [TUD]

TUD will be represented in ISES by two complementary institutes, thereby enabling a holistic attitude to concepts and implementations. These are: the Institute of Construction Informatics (**CIB**) and the Institute of Building Climatology **(IBK)**. Their roles and key personnel for ISES are presented separately below.

TUD-CIB

TUD-CIB will be the ISES **co-ordinator**. Its competence for both the management and RTD work is grounded on numerous national and international research projects. The research areas of CIB comprise product and process modelling, concurrent engineering, virtual organisations, ontologies, information logistics, Internet-enabled network infrastructures, Semantic Web technology, stochastic simulation and fuzzy methods. The institute works on the application of distributed systems and multi-dimensional data management as well as on methods of artificial intelligence for dynamic business process modelling. Software technology know-how encompasses advanced Internet solutions based on EJB, Java, XML, Web Service and Grid technology. CIB will lead the design architecture of the ISES platform (**WP2**) from ICT point of view. In addition, it will provide its special knowledge in ontologies and description logics for the development of intelligent access services (**WP3**) and it will provide the expertise in multi-model combination (**WP5**), multi-model management and simulation evaluation (**WP6**).

Key Personnel

Prof. Dr. Raimar J. Scherer is the head of CIB. His expertise includes the broad spectrum of construction IT topics of the institute. Prof. Scherer will be the project manager of ISES. He will be particularly engaged in the strategic coordination and harmonisation of the overall RTD work and in the quality management.

Dr. Peter Katranuschkov is the senior engineer of CIB. He has nearly 25 years' experience in construction IT. His know-how involves product modelling, ontologies, distributed systems and SOA. Dr. Katranuschkov will be deputy project manager of ISES. He will be particularly engaged in the ICT-related work coordination and in the risk management.

Dr. Gerald Faschingbauer, is a civil engineer with 8 years of experience in research and teaching in construction informatics. His interests are in simulation-based system identification with focus on description logic based product and process modelling that allows integration of BIM with ontologies and combination of BIM modeling with knowledge explication using logical reasoning. He will contribute to ISES especially with his know-how in stochastics, ontology modeling and BIM.

Mr. Ken Baumgärtel, is a computer scientist with specific knowledge in service-oriented architectures, web applications, web services and research in the field of IT component adaptation and Mashups. He will contribute to ISES with his experiences in component specification and the composition of heterogeneous components in one holistic system.

NN (civil engineer) is a new position at CIB, dedicated to energy-related modelling and the respective service integration. Activities in ISES shall involve infrastructure and web pages content and RTD work focused on WPs 5 and 6.

TUD-IBK

Research at **IBK** focuses on the theoretical basis of combined heat, moisture, air and salt transport in building materials as well as other areas of building physics. Its expertise includes modelling and software development (dynamic hygrothermal room model, building envelope model etc.), energy-efficient building (with special emphasis on "zero-energy building" in the new-built and refurbishment sectors), durability and risk analysis. The institute has long-term experience in development of efficient numerical solvers for solution of coupled parabolic differential equations with highly non-linear transport coefficients. This is typical for transient building physics problems related to durability and energy. In ISES, the main contributions of IBK will be in **WP5 (WP leader)**.

Key Personnel

Prof. Dr. John Grunewald is the head of IBK and professor for building physics at TUD. Besides overall coordination work within the work packages of ISES related to energy simulation and moisture risk evaluation tools, he will be focusing on physical model adaption of the BES and MBES to the requirements. He will also coordinate the combination of various models and configuration of the energy simulation in WP5.

Dr. Andreas Nicolai is head of the Software Development and Traineeship Department at IBK. He will be focusing on extending the specific energy simulation tools from WP5 with BIM data models used in ISES such that automatic simulation setup with minimum of user interaction becomes possible. Also, he will be working on automated analysis and representation of simulation results with the aim of near instantaneous evaluation of energy.

B 2.2.2 Insinööritoimisto Olof Granlund Oy, Finland [OG]

OG is a Finnish building services consulting company with headquarters in Helsinki and subsidiaries in Lahti, Kuopio, Tampere, Vaasa and Moscow. Its core businesses are building services design, facility management consulting, and the development and sale of design and facility management software. It is the leading company in its field in Finland and has a subsidiary and strong presence in Russia, projects in several European countries and increasingly in the USA. In the development of integrated energy analysis and FM software OG is one of the leading companies in the world. It is a pioneer to widely implement building information models and other advanced ICT in design and facility management tools to generate reliable and timely information that supports clients' decision making processes throughout design, construction and management of facilities and enables informed management of energy efficiency, environmental impacts and good indoor environment throughout the facilities lifecycle. Due to this expertise OG will lead the evaluation of simulation results and the management of multi-models (**WP6**) and will provide its special knowledge for the adaptation of energy performance and life cycle simulation tools in a cloud-enabled environment (**WP7**).

Key Personnel

Mr. Tuomas Laine, MSc in Mechanical Engineering, is head of Granlund R&D department. He has 23 years' experience in energy simulation and mechanical engineering and 18 years' experience in research and development. His role and responsibility in ISES is coordination of Granlund's R&D work and leader for work package 6.

Mr. Antti Karola, M.Sc. in Mechanical Engineering, has 16 years' experience in ICT research and development. He has carried responsibility of energy simulation software development at Granlund for 12 years. He will contribute in data interoperability and BIM-based processes supporting building energy analysis.

Dr. Piia Sormunen, Ph.D. in Mechanical Engineering has expertise in energy efficiency in building process, reporting building systems for operation phase and energy auditing. He will contribute in tasks of capturing and managing the client requirements and value creation throughout the facility lifecycle.

B 2.2.3 University of Ljubljana, Slovenia [UL]

UL will be represented by the Institute of Structural Engineering, Earthquake Engineering and Construction IT (ISE) at the Faculty of Civil and Geodetic Engineering. UL-ISE has considerable experience in participation and management of international projects. UL-ISE has great competences in the field of data management, service-oriented architectures and the development and integration of web services. This knowledge is applied in the fields of cloud, grid and high-throughput computing, where the usage of multiple computer resources over long periods is addressed. In the scope of the ISES project UL-ISE will mainly focus on semantic technologies for the development of system ontology (**WP3 leader**) and on intelligent workflow definition for the cloud-enabled simulations (**WP7 leader**).

Key Personnel

Prof. Dr. Žiga Turk is the chair in Construction Informatics at the Faculty of Civil and Geodetic Engineering at the University of Ljubljana. He will provide his knowledge about computer integrated construction, Web and grid computing, design communication, philosophy of conceptual modeling and CAD. His role and responsibility in ISES is coordination of UL's R&D work and leader for WP 7.

Dr. Matevž Dolenc is expert for grid and cloud computing and has technical expertise in client-server systems, component-based and service-based software development, technology, high-throughput and high-performance computing systems, open standards, and open source technologies.

Dr. Robert Klinc is expert for computer-integrated construction, communication in construction, mobile computing and Web 2.0.

B 2.2.4 SOFiSTiK Hellas S.A., Greece [SOF]

SOF offers state-of-the-art software tools for bridge engineering, structural steel, tunneling, and wind loading on structures resulting from CFD calculations, aerodynamic plus fluid-structure interaction problems, and energy-related design optimizations of structures and mechanical components. Besides software development SOF delivers engineering consulting activities, especially in the areas of reinforced concrete design, the mechanical behavior of structures and energy performance.

Furthermore the company provides a wide spectrum of knowledge in numerical methods, CFD computations, energy simulations, geometrical modelling of complex geometries and the engineering of analysis software. SOF expects the following from the project: (a) to develop an advanced software product which will provide the company with a decisive competitive advantage; (b) to be able to offer its existing customers new advanced versions of its products with enhanced cloud computing capabilities; (c) to gain more experience on a new promising market for energy simulation and energy efficiency applications; (d) to gain experience on evaluation of results of real tests; (e) to gain experience on building models according to IFC; and (f) to provide to its customers the innovative capability of a use-and-pay-per-demand HPC environment. SOF will provide its special knowledge about numerical methods to the intelligent search services (**WP4**) and the stochastic profile-based multi-model combiner (**WP5**). It will also be active in the adaptation and re-engineering of existing simulation tools for their most efficient use on cloud.

Key Personnel

Dr. Byron Protopsaltis has more than fifteen years' experience in developing and marketing software solutions for mechanical and civil engineering. He has been responsible for many finite element computations in large structural engineering projects. His role and responsibility in ISES is coordination of SOFiSTiK's R&D work and leader for the dissemination.

Dr. Theodora Pappou has worked for more than 15 years in Research and Application Projects in the field of Computational Methods in Fluids, Aerodynamics, Structures, Fluid-Structure interaction problems, Optimization Techniques and 3D mesh generation techniques.

Mr. Sotiris Bitzarakis is expert for finite elements and parallel computation techniques as well as wind influence on structures. Therefor he will mainly contribute to work package 7 to enable the cloud-environment.

Thrasos Rekouniotis has extensive experience in designing applications with object-oriented languages and the Microsoft Development Environment. He will working on Java Client applications for accessing process, product data and document servers as well as on implementing applications for Grid and Cloud computing. He has long experience on data exchange using IFC and STEP and will be the leading programmer of SOF in these areas.

B 2.2.5 Nyskopunarmidstod Islands, Iceland [NMI]

NMI operates under the Ministry of Industry and receives revenue from both the public and private sectors. The Innovation Center is a multidisciplinary research institute with research areas ranging from material, environmental and energy to nano and building technology. Projects include applied and basic research in these key areas, consultation and technology and knowledge transfer. NMI has technical divisions in Concrete Technology, Building Technology, Geology and Soil Mechanics, Road Research and ICT in Construction. The unit in this project provides expertise in sustainable design and construction, service life planning, LCC, LCA, environmental assessments, renewable energy, energy performance and energy efficiency of new and existing buildings and ICT development including domain semantics, usage scenarios, information modelling and management, web-service and Internet technologies and interoperability. In the ISES project, NMI mainly focuses on the definition of energy profile and consumption patterns for built facilities and their components (**WP4 leader**).

Key Personnel

Mr. Gudni Gudnason is the Manager of Computer and Information Systems since 1987, with special skills on R&D in Construction Informatics. His current interests focus on ICT and Building Information Modelling for sustainable buildings and facilities management. He has participated in state sponsored programs on energy efficiency and developed and maintains several on-line information products. His role and responsibility in ISES is coordination of NMI's R&D work and leader for work package 4.

Dr. Bjorn Marteinsson is research specialist in thermal insulation and energy efficient building technology for new and old houses, e.g. development of building elements and components and (re-) insulation of walls and roofs in buildings, building damages and durability and service life planning (SLP).

B 2.2.6 National Observatory of Athens, Group Energy Conversation, Greece [NOA]

NOA operates under the auspices of the General Secretariat of Research and Technology, Ministry of Education. The Institute for Environmental Research & Sustainable Development (**IERSD**) at NOA covers the fields of energy planning and conservation, renewable energy sources, meteorology, climatology, atmospheric pollution, water resources, and GIS. The **Group of Energy Conservation (GREC)** is an entity within IERSD at NOA, active since 1995 through research and development in energy efficiency issues, focusing in the building sector. GREC activities cover energy conservation, thermal and solar building applications, building renovations, analysis and numerical modelling of thermal energy systems, building energy audits, thermal simulations, indoor environmental quality assessment, HVAC systems with an emphasis on solar cooling, large scale solar heating systems, solar radiation and meteorological measurements, and related software development. NOA will offer expertise, in-depth knowledge and access to a calculation engine for performing building energy use calculations and building thermal performance based on the EPA-NR software, in compliance with existing European EN standards. It will work in ensuring compliance with revised or new relevant EN standards treating. In addition, NOA will provide computational and programming capabilities for software adaptation in compliance with the ISES requirements in an effort to couple the building energy calculation engine with the data from other models. The usage scenarios focusing on the building stock and the validation and energy efficient building design are further know-how that NOA will share with main focus on **WP4** and **WP5**.

Key Personnel

Dr. Constantinos Balaras is mechanical engineer and Research Director at GREC. He is engaged in numerous activities in the areas of energy conservation and rational use of energy in buildings and industry, development of methodologies and software for energy audits and assessment of buildings, air conditioning, solar energy, indoor environmental quality, renewable energy facilities and HVAC systems. His role and responsibility in ISES is coordination of NOA's R&D work. With his expertise he will mainly contribute to work package 4.

Dr. Elena Dascalaki is a Buildings Natural Environment Research Associate. She will provide her expertise in the fields of energy saving, thermal simulations of buildings, buildings CFD applications, computational analysis and natural ventilation.

Simon Kontoyiannidis is a M.Sc. Environmental Physics (1993) and B.Sc. Physics (1990) from the Department of Physics, University of Athens. Active in the areas of energy conservation, development of the national software for building energy audits and certification of buildings (TEE KENAK), programming and multimedia software development, design, and weather data processing.

Kalliopi Droutsa is a M.Sc. (1995) and B.Sc. Physical Environment (1992) from the Physics Department of the Faculty of Sciences of the University of Athens. Droutsa's activities are in savings energy, renewable energy, environmental impacts of energy use, indoor air quality and software programming (EPIQR, TOBUS).

B 2.2.7 Leonhardt, Andrä und Partner, Germany [LAP]

LAP is a leading German design company in the field of structural engineering, and especially in structural dynamics. LAP provides expertise in design and construction, usage scenarios, information modelling and management. It has developed calculation methods which simulate the dynamic loads and the reaction of the structure as a linked system and also visualize the performance of the structure in multiple domains (structural response, energy performance, emissions etc.) via monitoring the results on screen. In ISES, LAP will lead the definition of requirements for energy efficient design and life-cycle simulation (**WP1**) and is strongly involved in the development and the practical pilot implementation of the Virtual Energy Lab (**WP9**).

Key Personnel

Mr. Sven Zschippang has 17 years' experience in construction and design. He has particular expertise in managing projects and is also responsible for the quality management of LAP. His role and responsibility in ISES is coordination of LAP's R&D work and leader for work package 1.

Mr. Matthias Kahl has 18 years' experience in structural design and is a qualified planner for supporting structures. During his work at LAP he gained great experience in managing R&D projects. Mr. Kahl is the head of LAP Dresden and will provide integrative expertise for several end-user domains targeted by ISES.

B 2.2.8 Trimo d.d., Slovenia [TRI]

TRI is engaged in the engineering and production of pre-fabricated buildings. It is a high-tech company providing with its product range comprehensive solutions in steel prefabricated buildings, roofs and facades, steel structures and containers. The company has production facilities in Slovenia, Russia, Serbia and the United Arab Emirates. TRI research & development activities are in new construction materials, elements and structural systems where there is a possibility for marketing to other interested companies and organizations. TRI will provide its expertise in the development and specification of the energy profile and consumption patterns (**WP4**), the product catalogues and the use cases for new product design (**WP1**, **WP4**) and will lead the development, configuration, deployment and demonstration of the Virtual Energy Lab (**WP9**).

Key Personnel

Miha Kavčič is head of the Research Centre, focused on developing new material and new sustainable solutions for building envelope. He developed new insulating materials with low embodied energy based on natural materials. Beside material optimisation, he designed a technology to set up a pilot plant and with new-insulating materials he developed several solutions with combination of traditional materials and solutions. Mr. Kavčič will be particularly interested in the development and use of stochastic patterns for better life-cycle energy consideration of new material performance and is leader of work package 9.

Viktor Zaletelj is head of Systems Development at Trimo and is currently actively involved with the development of interactive facade system. He is actively engaged in the research of supervisory and complex adaptive systems, with special emphasis on fine-grained agent software architectures for modelling, control, and collaboration. His research covers the domains of manufacturing, hypermedia technology and its application to information management and supporting tools.

Boštjan Černe, Mech. Eng., Ph.D. (2006), is involved in research and solution development in the field of heat and mass transfer, renewable energy sources and energy efficiency in buildings. During that work he gained experience in design and thermal analysis of different types of radiators, convectors and solar collectors. He was responsible for calculation and optimization of building energy efficiency together with day lighting distribution.

Ludmila Koprivec, obtained a Ph.D. for the development of a new classification of materials suitable for use in façade wrapping that has not yet been presented in the field of architecture. Koprivec' main focus is on technological, aesthetic and economic impacts. These skills are essential for the application to the facades as they may contribute to innovative approaches and, consequently, progress in the development of new cladding systems.

B 2.3 Consortium as a whole

The ISES consortium features a mix of **8 partners from 5 European countries**, covering the whole knowledge transfer chain and all key areas of research and development relevant to the project goals. They represent 4 types of market segments, namely end users (TRI, LAP), software developers (OG, SOF), research institutes (NMI, NOA) and academia (TUD, UL). An overview of the partner roles in the project is provided in the following table.

Table 8: Participants types and roles in ISES

Part. no.	Participant legal name	Org. Type	Key competencies	Role in the project
1a DE	TUD – Institute of Construction Informatics (co-ordinator) **TUD-CIB**	University	BIM model hierarchies, data management, interoperability, model filtering and mapping , SOA, web services, ontologies	Academic research and development Leader WP 2,5,10 Project manager
1b DE	TUD – Institute for Building Climatology **TUD-IBK**		Energy and comfort analysis methods and software tools	Academic research and development
2 FI	Olof Granlund Oy **OG**	Industry	Energy consumption, lifecycle FM methods and software, SOA, web services and end-user (provide engineering services), cost estimation software	S/W developer, integrator and consultant Leader WP 6
3 SI	University of Ljubljana **UL**	University	Data management, SOA, web services, cloud/grid computing and high-throughput computing	Academic research and development Leader WP 3,7
4 GR	SOFiSTiK Hellas S.A. **SOF**	Industry	Numerical methods, CFD computations, modelling of complex geometries and the engineering of analysis software	S/W developer, integrator and consultant Leader WP 8
5 IS	Nyskopunarmidstod Islands **NMI**	Research	Sustainable design and construction, service life planning, LCC, LCA, environmental assessments, renewable energy, energy performance and efficiency	Developer and knowledge provider Leader WP 4
6 GR	National Observatory of Athens **NOA**	Research	In-depth knowledge and access to a calculation engine for performing building energy use calculations and building thermal performance	Developer and knowledge provider
7 DE	Leonhardt, Andrä und Partner **LAP**	Industry	Detailed design, construction engineering, site supervision, facility designer of technical and engineering aspects	End user Leader WP 1
8 SI	Trimo d.d. **TRI**	Industry	New construction materials, elements and structural systems, component product and facility developer	End user Leader WP 9

Subcontracting of work is not required except for project audits as shown in section B2.4 below.

B 2.4 Resources to be committed

The proposed budget for ISES is 4.406.169 EUR. The breakdown into type of activities and type of partners is shown in table 9 below. The eight consortium partners mobilise the critical mass of necessary ressources for success. They are willing to commit the necessary resources, which means 1.446.173 EUR, i.e. 33% of the total budget. The funding rate is 67% respectively. The project costs have been calculated using the most economic and appropriate means for each partner to ensure quality of the results within the allocated timeframe and budget. Each of the project partners evaluated the costs to enable the project to be successful.

Table 9: Overview of the project resources

RTD	TUD	OG	UL	SOF	NMI	NOA	LAP	TRI	Total
Number of Person months	80	60	53	59	36	33	26	27	374
Personnel costs	416000	522000	265000	405625	137700	95700	115700	113400	2071125
Travel	25000	21000	18500	21000	18500	16000	14000	16000	150000
Subcontracting	0	0	0	0	0	0	0	0	0
Other Specific Project costs	0	0	5560	0	0	0	0	0	5560
Total other direct costs	25000	21000	24060	21000	18500	16000	14000	16000	155560
Total RTD direct costs	441000	543000	289060	426625	156200	111700	129700	129400	2226685
Overhead RTD costs	264600	434400	173436	255975	218680	67020	123215	25880	1563206
TOTAL RTD	705600	977400	462496	682600	374880	178720	252915	155280	3789891
% Requested	75%	50%	75%	75%	75%	75%	75%	50%	
EC RTD contribution	529200	488700	346872	511950	281160	134040	189686	77640	2559248

DEMONSTRATION	TUD	OG	UL	SOF	NMI	NOA	LAP	TRI	Total
Number of Person months	4	6	3	6	4	8	8	14	53
Personnel costs	20800	52200	15000	41250	15300	23200	35600	58800	262150
Travel	0	0	0	0	0	0	0	0	0
Subcontracting	0	0	0	0	0	0	0	0	0
Other Specific Project costs	0	0	0	0	0	0	0	0	0
Total other direct costs	0	0	0	0	0	0	0	0	0
Total DEMO direct costs	20800	52200	15000	41250	15300	23200	35600	58800	262150
Overhead DEMO costs	12480	41760	9000	24750	21420	13920	33820	11760	168910
TOTAL DEMONSTRATION	33280	93960	24000	66000	36720	37120	69420	70560	431060
% Requested	50%	50%	50%	50%	50%	50%	50%	50%	
EC DEMONSTRATION contribution	16640	46980	12000	33000	18360	18560	34710	35280	215530

MANAGEMENT	TUD	OG	UL	SOF	NMI	NOA	LAP	TRI	Total
Number of Person months	11	1	1	1	1	1	1	1	18
Personnel costs	57200	8700	5000	6875	3825	2900	4450	4200	93150
Travel	0	0	0	0	0	0	0	0	0
Subcontracting	0	5000	0	5000	0	2500	2500	2500	17500
Other Specific Project costs	2500	0	2500	0	2500	0	0	0	7500
Total other direct costs	2500	0	2500	0	2500	0	0	0	7500
Total MANAGEMENT direct costs	59700	8700	7500	6875	6325	2900	4450	4200	100650
Overhead MANAGEMENT costs	35820	6960	4500	4125	8855	1740	4228	840	67068
TOTAL MANAGEMENT	95520	20660	12000	16000	15180	7140	11178	7540	185218
% Requested	100%	100%	100%	100%	100%	100%	100%	100%	
EC MANAGEMENT contribution	95520	20660	12000	16000	15180	7140	11178	7540	185218

TOTAL	TUD	OG	UL	SOF	NMI	NOA	LAP	TRI	Total
TOTAL BUDGET	834400	1092020	498496	764600	426780	222980	333513	233380	4406169
REQUESTED EC CONTRIBUTION	641360	556340	370872	560950	314700	159740	235574	120460	2959996

The detailed **allocation of Person Months broken down to tasks** is shown in the following indicative table 10. WP leaders are highlighted.

Table 10 [INDICATIVE]: Allocation of Person Months per partner broken down to tasks

	Workpackages	Partners								Sum PM	%
		TUD	OG	UL	SOF	NMI	NOA	LAP	TRI		
1	**Requirements for ICT-enabled energy efficient design and life-cycle simulation**	**3**	**3**	**3**	**3**	**3**	**5**	**6**	**6**	**32**	7,2%
1.1	Gap analysis	1	1	1	1	1	2	2	3	12	
1.2	Use case scenarios	1	1	1	1	1	1	2	2	10	
1.3	Requirements specification	1	1	1	1	1	2	2	1	10	
2	**Architecture, components and stochastic approach**	**12**	**8**	**6**	**8**					**34**	7,6%
2.1	Draft architecture and ICT components specification	3	3	3	3					12	
2.2	Development and specification of the overall stochastic approach	6	2		2					10	
2.3	Final specification of the platform architecture and principal service orchestration	3	3	3	3					12	
3	**Model and system ontology of the overall framework**	**8**	**10**	**16**		**6**				**40**	9,0%
3.1	Component and background models	2	4	4		3				13	
3.2	Ontology-based Building Information Model	2	6	4		3				15	
3.3	System ontology of the overall framework	4		8						12	
4	**Energy profile and consumption patterns for built facilities & their components**				**9**	**18**	**15**	**6**	**12**	**60**	13,5%
4.1	Framework and stochastic templates for product life cycle					4	4	2	4	14	
4.2	Intelligent search, access and interoperability services to the energy-related ICT resources				3	6	5			14	
4.3	Intelligent services for model-based product catalogue profiling and BIM integration				6	2		2	2	12	
4.4	Development and specification of characteristic energy profile and consumption patterns					6	6	2	6	20	
5	**Multi-Model Combiner and Simulation Configurator**	**24**			**14**	**6**	**10**	**6**		**60**	13,5%
5.1	Host product multi-model integration	6			4	1		1		12	
5.2	Sensitivity analysis of relevant parameters	6				2	6			14	
5.3	Stochastic profile-based multi-model combiner	4			6		2	2		14	
5.4	Model simplification and simulation matrix configuration	6				2	2	2		12	
5.5	Specialised GUI for the multi-model combiner and simulation configurator services	2			4	1		1		8	
6	**Multi-Model Manager and Simulation Evaluator**	**20**	**24**					**6**	**6**	**56**	12,6%
6.1	Host product multi-model filters	6	6					2	2	16	
6.2	Simulation synthesis and version management service	6	6						2	14	
6.3	Simulation evaluation service	4	6					1	1	12	
6.4	Multi-model navigator	4	6					3	1	14	
7	**Intelligent Cloud-Enabled Multi-Model Energy Simulations**	**8**	**12**	**24**	**12**					**56**	12,6%
7.1	Technical cloud architecture and cloud-enabled test-bed			3						3	
7.2	Cloud-enabled service APIs	4	6	6	4					20	
7.3	Adaptation of energy performance and cost simulation tools for use on a cloud		6	3	8					17	
7.4	Intelligent workflow definition, execution and monitoring services	4		12						16	
8	**Dissemination and exploitation of the project results**	**5**	**3**	**4**	**13**	**3**	**3**	**2**	**3**	**36**	8,1%
8.1	Project Web Site and Collaboration Indrastructure	2		2,5	2		1,5			8	
8.2	Dissemination planning and management	1	1	1	2,5	1	1	0,5	1	9	
8.3	Target User Groups		0,5		1,5	0,5		0,5	1	4	
8.4	Exploitation planning and management	0,5	1	0,5	3	0,5	0,5	1	1	8	
8.5	IPR and Risk Management	0,5			3,5					4	
8.6	Contribution to eeBDM Harmonisation	0,5	0,5		0,5	0,5				2	
8.7	Organisation of the 3rd eeBDM Workshop at the ECPPM 2012	0,5				0,5				1	
9	**Pilot Virtual Energy Lab and Public Demonstrators**	**4**	**6**	**3**	**6**	**4**	**8**	**8**	**14**	**53**	11,9%
9.1	Public demonstrator facility and demonstrator requirements specification	2	2	1	2	1	1	1	3	13	
9.2	Energy-related performance indicators					1	3	2	3	9	
9.3	Configuration, deployment and public demonstration of the Pilot Virtual Lab	2	3	2	3	1	1	3	5	20	
9.4	Comparison of state-of-the-art and ISES-based design and further needs		1		1	1	3	2	3	11	
10	**Project management**	**11**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**18**	4,0%
10.1	EC liaison and overall project management	7	1	1	1	1	1	1	1	14	
10.2	Project Manual	1								1	
10.3	Final Project Report	3								3	
	TOTAL	**95**	**67**	**57**	**66**	**41**	**42**	**35**	**42**	**445**	**100,0%**

The travel costs are justified as follows:

Table 11 is used as basis to estimate the **mean travel costs for one person** per project partner and location, whereby for the participation in conferences and workshops where exact locations and dates are not yet available a rounded value is taken from experience.

Table 11: Indicative travel costs for one person per participant and location (2-day meeting)

Location / Venue	Participant							
	TUD	OG	UL	SOF	NMI	NOA	LAP	TRI
Dresden	0	1000	700	800	1500	800	0	700
Helsinki	1000	0	1000	900	1600	1000	1000	1000
Ljubljana	700	1000	0	700	1600	700	700	0
Athens	800	900	700	0	1600	0	800	700
Reykjavik	1500	1600	1700	1600	0	1600	1600	1700
Brussels	800	800	1000	800	1400	800	800	900
ECPPM 2012 & eeBDM Workshop *)	300	300	300	300	0	300	300	300
Conference Travel (EU) (incl. Conf. Fees) **)	1500	1600	1500	1500	1600	1500	1500	1500

*) = 3-day event, planned together with project meeting Q3/2012; therefore only accomodation and subsistence costs are calculated

**) = 3-day event

Using this data as multipliers and the tentatively planned travel schedule (project meetings and dissemination events), the planned **indicative travel costs allocation per project partner** and the total travel costs have been calculated as shown in table 12 on the next page. The project meeting Q3/2012 (July 2012) is planned to be held in connection with the ECPPM 2012 conference (following the eeBDM Workshop organised by ISES) to lower the overall travel costs. Half early, a half to one day general assembly meeting is planned as part of the shown project meetings to deal with management issues. However, all travel costs as such are allocated to RTD activities. The travel costs of TUD are higher than others' because TUD participates with two institutes and is the co-ordinator of ISES.

Other direct costs are allocated as follows:

RTD Activities	
Equipment:	Additional equipment for the cloud facilities that will be used / tested by all RTD work packages throughout the duration of the project: UL: 5,560 EUR*)
Management	
Subcontracting:	Audit costs for preparation of the Financial Certificate Statements are estimated to approx. 2,500 EUR per audit, except for TUD, UL and NMI**). Two audits (= 5,000 EUR) are foreseen for those organisations that receive an EC contribution higher than 375,000 EUR, i.e. OG and SOF. One audit (= 2,500 EUR) is foreseen for NOA, LAP and TRI. Consequently, the total subcontracting for audits is 17,500 EUR.

*) If needed, additional equipment will be provided by TUD and UL in kind, i.e. without any additional EC contribution.

**) The audits for TUD, UL and NMI are done by a public officer and are part of the actual management costs, plus additional 60% overhead costs.

Table 12: Planned travel costs allocation

Date Quarter/ Year	Venue	Intention of Travel	Num. Days	Participants																Total [€]
				TUD		OG		UL		SOF		NMI		NOA		LAP		TRI		
				Persons	Costs [€]	Persons	Costs [€]	Persons	Costs [€]	Persons	Costs [€]	Persons	Costs [€]	Persons	Costs [€]	Persons	Costs [€]	Persons	Costs [€]	
Project Meetings																				
Q4/2011	Dresden	**Kick-off Meeting**	**2**	3	0	1	1000	1	700	1	800	1	1500	1	800	1	0	1	700	**5500**
Q1/2012	Ljubljana	Use cases, scenarios, requirements, expl. planning; Focus: WPs 1, 2, 8	**2**	1	700	1	1000	3	0	1	700	1	1600	1	700	2	1400	4	0	**6100**
Q2/2012	Dresden	Architecture, ontologies, stochastic approach; Focus; WPs 2, 3	**2**	5	0	1	1000	2	1400	1	800	1	1500	1	800	1	0	0	0	**5500**
Q3/2012	Reykjavik	Ontology development & energy patterns; Focus: WPs 3, 4 *)	**2**	2	3000	2	3200	1	1700	2	3200	2	0	1	1600	1	1600	1	1700	**16000**
Q3/2012	Athens	WP status & planning, Risk Mgmnt, Review Prep.; Focus: All WPs	**2**	3	2400	2	1800	1	700	3	0	1	1600	3	0	2	1600	2	1400	**9500**
Q3/2012	Brussels	**Project Review #1**	**1**	3	2400	1	800	1	1000	1	800	1	1400	1	800	2	1600	2	1800	**10600**
Q1/2013	Dresden	Charasteristic energy & consumption patterns, multi-model combiner & manager; Focus: WPs 4-6	**2**	5	0	2	2000	1	700	2	1600	1	1500	3	2400	2	0	2	1400	**9600**
Q2/2013	Helsinki	Cloud-enabled simulation - concept, framework & testbed; Focus: WPs 4-7	**2**	3	3000	3	0	1	1000	1	900	0	0	2	2000	1	1000	1	1000	**8900**
Q3/2013	Ljubljana	WP status & planning, prep. for 2nd proj. review & 1st public workshop; Focus: All WPs	**2**	2	1400	2	2000	3	0	2	1400	1	1600	1	700	1	700	3	0	**7800**
Q4/2013	Dresden	**Project Review #2**	**2**	3	0	1	1000	1	700	2	1600	1	1500	1	800	2	0	1	700	**6300**
Q1/2014	Helsinki	Internal Workshop. "Energy Services on Cloud" & Exploitation Planning, Focus: WPs 5-8	**2**	3	3000	3	0	2	2000	2	1800	1	1600	2	2000	2	2000	2	2000	**14400**
Q2/2014	Athens	Deployment of the VEL, Test run of the platform, indicators, gaps; All WPs	**2**	2	1600	2	1800	2	1400	4	0	0	0	4	0	2	1600	3	2100	**8500**
Q2/2014	Dresden	Preparation for the Final Review and Final Public Demonstrator; All WPs	**2**	5	0	2	2000	2	1400	3	2400	1	1500	2	1600	3	0	3	2100	**11000**
Q3/2014	Ljubljana	**Project Review #3 and Final Workshop**	**2**	3	2100	2	2000	3	0	3	2100	1	1600	1	700	2	1400	3	0	**9900**
Dissemination events (Workshops & Conferences)																				
Q3/2012	Reykjavik	9th ECPPM Conf. & eeBDM Workshop	**3**	2	600	2	600	1	300	2	600	2	0	1	300	1	300	1	300	**3000**
2012	Europe	22nd eChallenges Conference	**3**		0		0	1	1500		0		0		0		0		0	**1500**
2013	Europe	ICE 2013 (in conj. with Living Labs)	**3**	1	1500		0		0		0		0		0		0		0	**1500**
2013	Europe	12th ISWC 2013 Conference	**3**		0		0	1	1500		0		0		0		0		0	**1500**
2013	Brussels	EBDM Workshop	**1**	1	800	1	800	1	1000	1	800		0	1	800	1	800	1	800	**5800**
2013	Europe	20th EG-ICE Workshop	**2**	1	1000		0		0		0		0		0		0		0	**1000**
2014	Europe	30th CIB-W78 Workshop	**3**		0		0	1	1500		0		0		0		0		0	**1500**
2014	Europe	10th ECPPM Conference	**3**	1	1500		0		0	1	1500	1	1600		0		0		0	**4600**
		Total costs per participant			**25000**		**21000**		**18500**		**21000**		**18500**		**16000**		**14000**		**16000**	**150000**

*) in conjunction with the 9th ECPPM and the eeBDM Workshop

B3. IMPACT

B 3.1 Strategic impact

The main impact of ISES is the supply industry for the construction domain and the construction industry itself. The construction section is responsible for 40% of the energy use and 30% of greenhouse gasses emitted. The ISES virtual energy lab will have a big impact on the reduction of these energy consumption and emission, because:

Firstly, ISES provides a virtual lab to product developers, which allows the development of highly energy-efficient and emission-efficient and at the same time cost-balanced component products. With the lab, these products can be tested and validated their products under development virtually in the host products, i.e. the facilities and buildings and hence together with other component products which configure the host system. ISES will close a big gap that exists today and which has been identified as one of the main reasons why the target energy-efficiency of component products in the host product cannot be realized, because the component product is about developed independently from the host product today. Only some requirements or very simplified assumptions about the host product, its system and context can be modelled. Actual CAD systems for product design are mechanical or electrical CAD systems, which do not provide adequate modelling capabilities for facility or building modelling, nor exist libraries with models of characteristic facility or building which can be used for component product testing. Therefore today, full scale tests are needed, which are very cost-intensive and are single representative examples of the host product, i.e. the facility or building. Variants of the host product are even not imaginable. ISES virtual energy lab would allow extensive tests of virtually new component products in all variations of the host product and hence on low-cost basis before expensive realization. Therefore it is expected that ISES virtual energy lab will have a considerable impact on improving energy and emission reduction of facilities and buildings through the validated improvement of functionality of component products by about 30% or even more. ISES strongly contributes to the reduction of energy and CO_2 emission and contributes to the delivering a sustainable, low-carbon society and helps lessen the negative impact of our built environment on climate and on energy consumption.

Secondly, ISES provides a concurrent engineering design tool to the facility and building designers allowing them to optimize energy-efficient facilities and buildings and tests and hence validate their designed complex energy systems under virtual stochastic life-cycle conditions and overcome the today's praxis of designing facilities and buildings by architects independently from their energy analysis done by service engineers and more than that the stochastic life-cycle, which is simplified today by assumed deterministic one-year time histories for the climate. The advanced ISES capabilities will have an impact of lowering the energy demand and green gas emission of facilities and buildings by at least further 20% and at the same time reducing reinvestment costs for malfunctioning energy systems of built facilities and buildings.

Thirdly, ISES will open the green building and facility market for the general ICT industry, too, because ISES provides an integrated virtual energy design and test lab on an open SOA basis with full modelling of any possible facility and building providing the integration of STEP models of component products in the BIM model of facilities and buildings. Further on, the open SOA allows the integration of mechanical and electrical engineering tools and third-party ICT building blocks and is a basis to integrate and test ICT control equipment of the Building Automation Systems, too.

The project addresses the different key items of the *call text* as follows:

> *Definition of energy profiles and energy consumption patterns and their interrelation to support the development of ICT building blocks addressing energy efficiency and CO2 emissions reduction. Incorporation of these building blocks into one of the following types of systems:*
>
> *Systems to support development and planning. Examples are: modeling, simulation and design tools to assess the full life-cycle energy associated with new products and systems before their realization: decision support systems for urban planning to provide an understanding of the system implications, in terms of energy-performance and cost-effectiveness, of different design and planning alternatives.*

ISES will develop ICT building blocks to enhance existing design tools and systems to an integrated virtual energy lab in order to design holistic energy-efficient products and facilities and test them before realization virtually for their possible life-cycle conditions acknowledging the stochastic life-cycle nature. In this context also stochastically useful energy profiles and energy patterns in particular climate profiles and user activity patterns will be developed and existing deterministic ones appropriately enhanced respectively.

> *Appropriate validation of the resulting systems. Based on defined indicators, during this phase, projects shall record evidence of energy savings and CO2 emissions reductions, total cost of operations versus potential benefits, user acceptance and replication potential and extract lessons that may be used in different settings.*

ISES will validate the efficiency of the virtual energy lab through the design of a building component product in the state-of-the-art fashion of today and also through the application of the virtual energy lab and will oppose the resulting energy demand of a characteristic virtual facility with the product designed according to the state-of-the-art and another one designed in the virtual-energy-lab manner is built in.

In addition ISES will design a whole facility in the state-of-the-art fashion of today and with the virtual energy lab running a semi-stochastic life-cycle analysis and oppose the energy demand of both designed facilities.

> *In addition to partners with expertise in ICT, consortia must include partners from the relevant application domain. The final users must be involved in the validation phase but not necessarily as consortium partners.*

The ISES consortium comprises two end-users, one component-product designer and producer and one facility designer, who are responsible for requirement analysis and validation. In addition, two energy and climate experts are partners, one from the Mediterranean climate zone and one from the very northern climate zone. Also, two ICT developers are partners, one is a facility software developer and at the same time facility management consultant, the other one is a structural engineering software developer and consultant, too. The two other remaining partners are academic ones, which are experts in engineering data modelling, ontologies, grid and cloud computing SOA, energy calculation methods and stochastic engineering methods.

> *Verifiable and transparent methods of measuring energy performance.*

The ISES virtual energy lab allows to virtually model a complete facility with all technical energy system components and sensors and hence provides the possibility to run simultaneously to map the measure energy use and the sensor data and hence identifies the energy performance of the facility and energy system components in an objective way.

> *Strengthened and consolidated European excellence in engineering at the intersection of control engineering, computer science, communications technologies and power engineering.*

The ISES RTD work will strengthen the European excellence in the intersection of applied computer science and engineering concerning product and facility modeling with ontology and description logic, high-performance computing, semi-automatic simulation set-up, multi-model management, navigation and evaluation.

> *Quantifiable and significant reduction of energy consumption and CO2 emissions, achieved through ICT.*

Through the improvement of the design of component products and their assembly design to facilities and buildings concerning energy efficiency, ISES virtual energy lab will considerably reduce the energy consumption and CO2 emission of facilities, significantly and quantifiably (see above).

ISES will develop a cost-effective integrated energy, emission and cost simulator designed as a virtual lab for the design of facilities, supporting also the analysis of weaknesses in existing facilities to draw strategies for retro-fitting, and also to test and optimize building products and services before their realization in the facility concerning their energy and emission efficiency, maintenance and cost efforts. In addition it will provide a basis of integrative operation of ICT energy and non-energy control systems and hence will open the construction market for ICT providers.

The ultimate goal is to considerably reduce the energy need and emissions of new and existing facilities as well as interactively view the ICT control systems. This will be achieved through (1) an innovative ICT system, namely a SOA-based integrated system integrating actual in-depth tools and data bases, which will considerably increase the efficiency of design and decision-making of component products, facilities and buildings, (2) the re-engineering of the design, process and (3) the involvement of the owners in the decision process by providing them the technical results of the analysis and simulation in an easy-to-understand 3D building model based representation. ISES will contribute to the transformation of the EU industry from a (human) resource-intensive to a knowledge-intensive one and foster the use and further development of new technologies for the EE-building area, hence contribute strongly to economic stimulus packages.

The construction sector

The construction industry is the biggest industrial employer in Europe with 26 million workers and their products during usage are those, where most of the energy is used and emission produced. In the EU27[4] it is one of the biggest industrial sectors with an annual turnover of about 1,200 million Euros in 2006, what represents about 10.4% of the GDP. The great majority comprises SMEs, namely about 98%. The industry is very fragmented and due to the one-of-a-kind products and the one-of-a-kind projects (construction consortia) an in-depth planning and monitoring of the construction process is of utmost importance in order to guarantee a proper realization of the very complex energetic system of a facility.

Due to the high uncertainties concerning the dynamic life-cycle and due to the high complexity of the diverse energy systems assembled for a building from different providers, an in-depth simulation before realization as well as an intensive monitoring phase after commission is to be considered. Moreover, an in-depth analyse of the operation of the facility is required by an expert team co-operating via internet on a cost-efficient basis to tune the system, analyse gaps and ill-performances and work out overall cost-efficient retro-fitting strategies.

In this context the integration of building energy simulation and optimization and the design of buildings incl. shop floor drawings are a prerequisite to obtain this goal. The energy saving potential for new buildings is about 40%, whereas for old buildings this may increase up to 80%, where most of the potential is embedded in new supply products. The European building stock is consuming about 40-50% of the total energy and is responsible for about 30% of the carbon emission[5]. Only in a concerted action of product and facility designer, operator and service-business engineer during the design and operation phases supported by seamlessly integrated and interoperable tools, this savings potential can be activated.

Energy Policy

ISES will considerably contribute to achieve the mandate of the Action Plan on Energy Efficiency in Europe[6], which is a 20% saving by 2020 compared to the numbers of 2005 and will have stabilized the energy consumption at a level of 1990 by 2050 and contribute to EU energy independency. The contribution will have a leap effect, because about 90% of the EU wealth is invested in the built infrastructure (remark: about 8% in shares), which represents for Germany about 5,500 billion Euro and less than 0.5% a year are new buildings and up to 1.7% are refurbished buildings (if any small refurbishment is considered). Here the EU will increase this rate up to 3%. Therefore, the stronger impact may result from refurbishment and retrofitting of buildings. ISES is directed to both: new and refurbished buildings are included in its integrative view as well as the surrounding used as open space. ISES will increase the energetic investigation of new and existing buildings because the CAD-FM-integrated easy-to-apply sophisticated energy analysis tools will increase cost- and energy-efficient workout solution as well as because herewith it reduces considerably investment risks.

Environmental Politics

ISES will considerably contribute to the fulfilment of the Kyoto Protocol 1999[7] and related agreements, such as the Bali Declaration 2007 and the SET Plan that declares its target to reduce the greenhouse gas until 2020 by 20% compared to 1990 and to reduce CO_2 emissions by 60-80% until 2050. Due to the leap effect of renewing the building stock the efforts of the construction industry impacts more on the targets for 2050 and only partially on those for 2020. The scale of impact depends strongly on the activation potential of knowledge through easy to apply integrated concurrent engineering tools in collaboration environments and an integrative view and management of the complex energetic multi-

[4] FIEC (European Construction Industry Federation)

[5] REEB, Roadmap, http://www.ict-reeb.eu

[6] Renewed in the SET Plan from 07.10.2009

[7] http://unfccc.int/resource/docs/convkp/kpeng.pdf

systems under dynamic demands. Single tools, single views or single products and services do have mainly an under-potential impact.

Competitiveness Policy

On the Lisbon agenda[8] declaration was made to transform the EU industry from a resource-intensive to a knowledge-intensive one and at the same time to increase productivity and competitiveness of EU enterprises. ISES will contribute to this transformation. First, ISES will reduce the human-resource intensive working process for energy and emission efficiency design, re-design and retro-fitting and transform it to a knowledge-intensive one and second, ISES will decrease the consumption of energy and emission of buildings and publicly used facilities.

Besides a successful RTD work the following steps are needed

(1) A successful dissemination and raising awareness in the product designer and AEC community, construction companies and also among real estate companies and individual building owners but also among the ICT industry
(2) The integration of the whole value chain in design, simulation and testing of buildings and building components
(3) Best-practice cases based on the pilot platform, e.g. impressive use cases from practice with a sound comparative validation “before/after”
(4) A well-structured exploitation plans establishing a win-win situation for each partner to generate a strong team also beyond the project
(5) A strong technology implementation plan at the end of the project for the future commercial deployment of the project results
(6) The creation of possible joint ventures to multiply strength and investments of the partners for the commercialisation of the results

Greenhouse effect, energy and emission efficiency of buildings are (1) global request, (2) influenced highly of the climatic zones of the building location and (3) the problem to be solved, namely sophisticated BIM, hierarchical modelling, BIM interoperability, BIM management, sophisticated 3D-BIM-CAD, sophisticated energy analysis and international experience in design and upgrading buildings need on the one hand side international experienced partners and second advanced knowledge in the above mentioned topics. This is hardly to be gathered on national level. To be a lean RTD team, the consortium is to be cross-disciplinary, where the partner should show in-depth knowledge in construction, ICT and energy analysis, at least in two of these three main top areas in order to obtain seamless, progressive cooperation. The partners should show experience in international industrial and/or RTD work and should show experience in at least national, better international RTD projects. To receive sustainable exploitation results, these result should have an international impact, hence partners with an international standing and profile are needed. The problem to be solved is impacting all EU member states. It should address the different needs of the different EU member states, which can only be fulfilled if a cross-European consortium is developing the solution. It requires enough critical mass and complementary skills around Europe. With 8 partners from 5 different EU member states the consortium reflects the EU dimension.

The partners are involved in various national and international research projects from which account is taken for the RTD work of ISES. They are grouped in BIM-related, in Energy-related and in Computational Engineering projects.

Assumptions and External Factors

For the success of the project and a successful exploitation we have assumed

(1) That model-based work (BIM- and STEP-based) will further increase and distributed information and product model management will continuously make progress
(2) Ontologies will become not too complex and hence will be computable to serve as the meta-data method for system integration
(3) Energy models and climatic scenarios can be generalized and modularized that they can be applied through appropriate instantiation at any climatic location in semi-stochastic process approach.

[8] Lisbon European Council, Presidency conclusions, March 2000

The success of ISES from the research perspective is not depending on these assumptions, as the project is not relying on developments expected in advance. However, its exploitation potential is depending on external developments and evolution of standards. Therefore, ISES will periodically synchronize assumptions about possible factors and developments influencing the project with the respective state-of-the-art really observed. ISES members will be strongly engaged in dissemination and related standardization activities in order to influence and promote these and continuously watch developments for their possible feedback to the project and its evolving exploitation strategy and plan.

B 3.2 Plan for the use and dissemination of foreground

A *dissemination plan* will be prepared and implemented along the project and beyond. The plan will permit: to establish target audiences and define key messages, to select the appropriate modes and tools of communication, to implement the dissemination activities among partners. It will be mainly targeted to the construction and construction supplier (equipment, components, ICT) industries stakeholders and to the ICT industry but also to citizens for fulfilling the societal objectives of spreading education and generating enthusiasm for energy efficiency and emission reduction. In relation to dissemination activities, a dedicated website will be developed, at the beginning of the project, and maintained. This website will enable the publication and updating of the new advances to a wider audience. This site will be linked to all relevant organizations and maintained after the conclusion of the project, for being interactive and accessible by professionals and researchers. In addition the web-seminar will be organized for experts and for the public in particular for research directed journalists and video clips will be produced and published on the ISES website and on public websites like Youtube, too.

Dissemination to the *industry* will be done through the newsletters, web portals and the presence of the industrial partners and the research institutes at trade shows. ISES aims at becoming visible in the global construction community by presenting itself on the ETCP.

In addition the *academic and research* partners will publish scientific papers and participate in conference in the (1) energy and emission efficient buildings, (2) building and facility component developers, (3) BIM/model-based design, (4) distributed, collaborative systems and concurrent engineering, (5) ontologies and virtual enterprises. They will use their position in the editorial boards of conferences and journals (TUD, UL) to promote the idea of integrated collaborative energy and emission simulation tools and interoperability of STEP-BIM-BAS and organise special issues and sessions. Open access media will be preferred, because they allow faster and wider dissemination. The academic partners will also build the findings into their graduate and postgraduate curricula.

A *dissemination manager* acting as assistant for the project manager will be installed in order to coordinate on a daily basis the dissemination activities. This position is given to SOF, which has long time experience in this area.

Within the consortium the knowledge will be used according to the exploitation plans of the partners. The dissemination targets outside of the consortium include:

- *Energy Efficiency in particular ICT related Projects.* The project will participate actively in concerted activities, in particular organized by ICT4EE. It will be active in organizing concerted events.
- *The research community.* The partners will actively participate in the events and publish in journals in energy efficient design and construction, collaborative working, ICT in construction and engineering informatics communities. It will organize sessions and special issues at conference tracks such as ECPPM, CIB W78, ICCCBE, IABSE, FIP, ICT4SH, and make contributions to IAI/buildingSMART.
- *Green Building Initiatives.* The partners of ISES are active in these initiatives and enhance the promotion the important role of ICT to receive sustainable impact in improving energy efficiency.
- *The European Construction Technology Platform.* Several ISES partners are members of ECTP and will disseminate ISES findings and results there and will organize workshops and seminars in the course of ECTP.
- *The industry in general.* The industrial partners in the project will take care of the visibility of the project in the trade fairs and other promotional activities that they are making.
- *Education.* The academic partners will build the research results of this project into the graduate curricula and enhance and extend lecturing there.

The project will encourage publication of the project results in the popular green press and Real Estate and daily newspapers, such as the scientific supplement of the leading national dailies. The professional press and Web sites as well as professional events (trade fairs, addressed in the previous Section) will be targeted as well.

The main dissemination and awareness targets are:

- Building and facility product suppliers.
- FM companies and consultants as well as FM software developers.
- Architectural companies.
- Construction companies.
- Building owners and real estate companies. The people there are the secondary potential users of the ICT project results.
- Software developers. The authors of AEC software are the potential users of the project results.
- Associations, in particular ECTP and EAPPM as well as national associations in construction and energy agencies.
- Standardization committees, with focus on IAI / BuildingSMART and STEP, specifically:
  - BuildingSMART standardisation activities regarding BIM/IFC (ISO/PAS 16739)
  - BuildingSMART standardisation activities regarding IDM (ISO 29481)
  - ISO standardisation activities in conjunction with the development of new products, namely part libraries (PLib), ISO 13584, and ISO STEP AP 214 (ISO 10303-214)
  - ISO "Building Construction" for the organisation of informationabout construction works (ISO 12006, Parts 1-3).

Dissemination and awareness methods include:

- Project's *Web presence* will be used to inform the public about the project's progress and link to other resources addressed below. A series of sites is envisioned addressing various activities as well as languages and regions.
- Video clips will be produced and distributed on public providers, such as Youtube.
- *Wiki on ICT* for energy and emission efficiency will be established directed to the ICT construction, public authorities and real estate community. The Wiki will be built up in coordination with ICT4EE.
- *Newsletters* will be published semi-annually. Aimed at non-specialists they will summarize the results of the network. They will be distributed electronically.
- *European Technology Platforms.* Several partners (TUD, OG, UL) have positions in different platforms addressing the one-of-a-kind industry. They will spread ISES information and results over these platforms and provide the findings and lessons learned to future roadmap studies.
- *Seminars.* The project will organize pan-European as well as regional, local and web seminars.
- Project's *digital library* will be set up, using the technologies developed in projects like FP5-IST SciX and which will be used to archive and make available, to the targets addressed above, the project results. The archive will include all reports, working papers, preprints, public deliverables etc. created within this project. Advanced searching, classification, commenting, annotating facilities will be provided.
- *Scientific publishing.* The consortium includes a number of persons from TUD and UL that are involved in editorial boards of prestigious journals and that will use their influence to speed up the publishing of project results in academic journals. Since, to a large portion, the project is funded with public funds, preference will be given to publications that allow for open access on the Web.

Almost all partners of ISES have international relationships. They will use their contacts to disseminate ISES results on an international level, in particular the academic partners through conferences, journal papers and research co-operations.

"Green Building", "Energy Efficiency", "CO_2-Emission Control", "Sustainable Buildings" are key headlines which are widely discussed, nowadays. Experts are expecting the construction sector to become one of the double winners in this area, by activating private and public investments. The main winners are those who are integratively considering the whole lifecycle. The "Green"-market is already an important market segment for component product (building or equipment components) suppliers, facility operators/managers and building designers (architects and engineers) and this share will be increased for them in the future, especially in the fields of renovation of existing buildings, but also for the design of new buildings. Any means and tools, which will help them to improve their competence in this area, are an additional advantage. The most important end-users are component product suppliers, building planners and facility managers and therefore TRI, SOF and OG expect a considerable market potential for BIM-applications which are enhanced by functionality and interoperability, supporting energy-efficiency and CO_2-emission calculation and cost prognosis.

The project will deliver new methods, tools and data models for energy efficient design and operation of component products, facilities and buildings including integrated lifecycle testing, ill-performance indication and cost prognosis through simulation, which is in particular for large scale facilities of upmost important. Today there is a considerable gap to calculate operation cost, come up with sustainable best energy mix and analyse and identify ill-performance to draw the right consequences already during component design and hence before realization. It is expected that these ISES developments will have noteworthy impact on collaborative processes within the AEC, the related supply and FM industries. This in particular means for partner NMI, TUD, UL and OG as a consultancy company too that there is a need for knowledge transfer to decision makers and training activities for adoption of new methods and tools. OG and SOF furthermore expect that special emphasis will be requested on integration of energy optimization tools into existing design and operation processes, which depending on used tools and design principles requires further studies of provided interfaces and research on data integration tools. For the future NMI, TUD and UL also see great potential in the field of small and medium enterprises (SMEs), not for typical consultancy work but for affordable training programs and access to know-how databases. This view is supported by all other partners in particular the industry partners.

ISES will develop ICT building blocks and a SOA integrated system. Therefore there are two kinds of exploitable results, namely the integrated platform system and the individual components.

1) **The integrated ISES platform can be exploited**

   1a) as a technical Virtual Energy Lab to study new products (building components, technical components) and services before their realization and analyse in-depth ill-performance under lifecycle conditions to draw the right tuning or decisions and

   1b) as a concurrent engineering design tool for the design and redesign of facilities and buildings to study in depth alternatives under various life-cycle conditions to come up with the best-balanced design decision for the facility owner.

   1c) as a system analysis tool to analyse the energetic and emission behaviour of existing facilities and buildings in order to find out their weak components or ill-operation and make suggestions to the owner for redesign, retrofitting or reengineering of the operation processes.

2) **There are the individual components which can be used as stand-alone tools or together with other tools, which provide BIM based interoperability infrastructure.** These are

   2a) Building Operation (FM) tools which are enhanced with sophisticated energy and emission analysis tools, enhanced with BIM based interoperability capabilities and hence access capabilities to energy and climatic data and scenarios and enhanced graphical representation to study life cycle behaviour of the building and investigate upgrading scenarios.

   2b) Sophisticated energy and emission analysis tools enhanced with BIM model and interface related interoperable interfaces, which provide beneficial use of the service supported BIM world like databases (e.g. the Oracle IFC interface) presentation tools (e.g. the various browser, xml-based 3D presentation tools and e.g. Acrobat R9 with the IFC-interface for pdf presentations).

   2c) Intelligent Access Services as web services, which can be provided as ASP for intelligent data access in particular for BIM model and cloud and mapping capabilities for various uses.

   2d) API interfaces for various numerical engineering tools (structural, wind, airflow, moisture, cost) for the BIM model.

   2e) User sensitive multi-model navigator as a web service for general purpose use to represent nD information space, preferable simulation data of space (rooms, zones) structured objects (buildings), to be used by experts providing very detailed technical representation capabilities as well as by lay persons, like building owners with easy-to-understand 3D representation and navigation capabilities, like the cockpit functionality.

2f) Multi-model filter to generate model views for several interlinked models, which have the BIM model as basic model.

2g) Model combiner incl. semi-stochastic process combination and simulation for energy studies, which configures variations of a simulation model according to a variation matrix of the variation parameters and a simulation analyser that analyses and priorizes the simulation according to pre-defined criteria.

2h) An interface from BIM to STEP models, which is focused on a simplified geometric but full functionality representation of the STEP-modelled product.

2i) OntoBIM, a model ontology for BIM models to generically manage various BIM domain models, e.g. a supporting service for multi-model management, filtering and navigation.

2j) A product catalogue management system for management of BIM component products or STEP-imported products.

There are five different exploitation channels, which will be developed by the indicated partners during the project:

(1) Selling of the ISES platform as a whole as well as partially. This is the interest of SOF and OG.

(2) Application of the platform or components in the own company in order to improve efficiency becoming a market leader in their domains and improve reputation. This is the main interest of TRI for new building components and construction projects and of LAP for design of new buildings and refurbishment.

(3) Improve education and lecturing. This is the main exploitation interest of the academic partner TUD and UL.

(4) Consultancy to industry and specific client developments. This is the interest of the industry partners OG and LAP and the public-institute partners NMI and NOA.

(5) Improvement of research and competitiveness for research project. This is the exploitation interest of all partners.

The exploitable results, grouped in 2 exploitable packages, are described above. The grouping into selling packages will be done during the project, when feedback comes from the industry based on promoted mock-ups.

An Exploitation Plan will be elaborated and continuously updated during the project as an enrolling document with the first version submitted to milestone M1. The exploitation plan will be structured in an integrated exploitation plan for all partner and individual exploitation plans for each partner serving the individual market segments of the partners. The exploitation plan will contain:

(1) Identification of the exploitable results of the project, classified in products (software), services (consultancy) as well as scientific knowledge (acquiring future RTD projects, updating lecture courses) and technical knowledge (consultancy and acquiring industrial projects). These exploitations are further classified according to their commercial potential, expected barriers to enter the market, further investments in technical developments and advertisements and inherent risks,

(2) Market analysis, structured in the partners' national market, EU market and world-wide market. Due to the internationality of the software products and the business areas of the partners the EU and the world market plays a considerable role for all partners. There the relevant target groups will be identified and the competitive level will be examined. A continuous market watch will be carried out and documented in the enrolling exploitation report, resulting in trend analysis which will improve the objectiveness and stability of our prognosis of the final exploitation at the end of the project,

(3) A strategy and methods for the management of the tangible and intangible results generated in the project based on the IPR agreements stated in the consortium agreement document, but continuously updated during the project paying attention the dynamic market developments and the results achieved during the project,

(4) The impact of the project to standardisation, recommendations and regulatory aspects, i.e. the results of our efforts from dissemination and hence the socio-economic impact of the project,

(5) development of a risk plan opposing opportunities, strength, weakness and failure

(6) draft of business plans for the individual exploitations, routes of exploitation and related risks

(7) installation of a technology implementation plan for the future commercial deployment of the project results.

IPR of each component developed belong to the developing partner. In the case more than one partner is sharing the work for the development of a component, the IPR will be shared according to their invested PM (foreground knowledge). Provided technology and knowledge (background knowledge) will be considered only in the case, when an objective and heavy impact on the developed component can be shown. It will be considered as a weighting factor for the invested PM. Formal procedures and rules will be worked out in the consortium agreement. Publication has to be announced in time, that each partner can take his veto in a serious care. Publications have to respect agreed confidentially on IPR, as a basic rule.

Expected Exploitation Benefits per Partner

The exploitation expectations per partner are listed in the following ROI table. They have to be considered very preliminary and are based on a market study carried out for similar products by SOF and OG and for technologies by TRI and LAP. Transferring these general numbers to the individual ISES situations is therefore highly subjective. These numbers will be put on objective criteria in the first version of the exploitation report. The expected savings given in table 11 are those expected at the beginning of the learning curve.

Table 11: Preliminary expected Return of Invest

Partner	**Annual Turnover 2009** [million Euro]	**Partner's own contribution to ISES** [million Euro]	**Investment** [million Euro]	**5 year earnings** [million Euro]	**ROI** [million Euro]
TUD[*)]	1,50	0,18	0,20	1,00	0,62
OG	27,00	0,52	1,00	3,70	2,18
UL[*)]	0,50	0,13	0,10	0,50	0,27
SOF	0,76	0,20	0,50	1,50	0,80
NMI	7,20	0,11	0,20	0,60	0,29
NOA	5,60	0,06	0,15	0,60	0,39
LAP	18,00	0,10	0,16	0,90	0,64
TRI	154,34	0,11	0,80	2,70	1,79
Total	214,90	1,40	3,11	11,50	6,99

[*)] Only the participating institutes, earnings are the funding of new RTD projects in ISES topics