INTRODUCTION TO: D10-D2.3/2.4

Identified requirements for the development of the BIM Qualification Models.

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Network for Using BIM to Increase the Energy Performance

Grant Agreement Number: 754016
Net-UBIEP H2020

Summary

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement *No.754016*

A. Deliverable Details	
Document Reference #:	D10 – D2.3/D2.4
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Contributors:	All partners
Work Package	2 – IDENTIFICATION OF REQUIREMENTS
Type of deliverable	Document/Report
Format	Printed and Electronic
Dissemination Level:	PU – Public

Short description

The purpose of this workpackage 2 is to find an identification of the necessary BIM and energy efficiency requirements for:

a. The target groups:
   i. public administration,
   ii. professionals,
   iii. technicians and
   iv. owners.

b. The different BIM profiles:
   i. BIM Manager,
   ii. BIM Coördinator,
   iii. BIM Expert,
   iv. BIM Expert user,
   v. BIM Evaluator and
   vi. BIM Facility manager .

These identified requirements are needed to develop a BIM qualification model in workpackage 3.

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To achieve this the steps in figure 1 are taken:

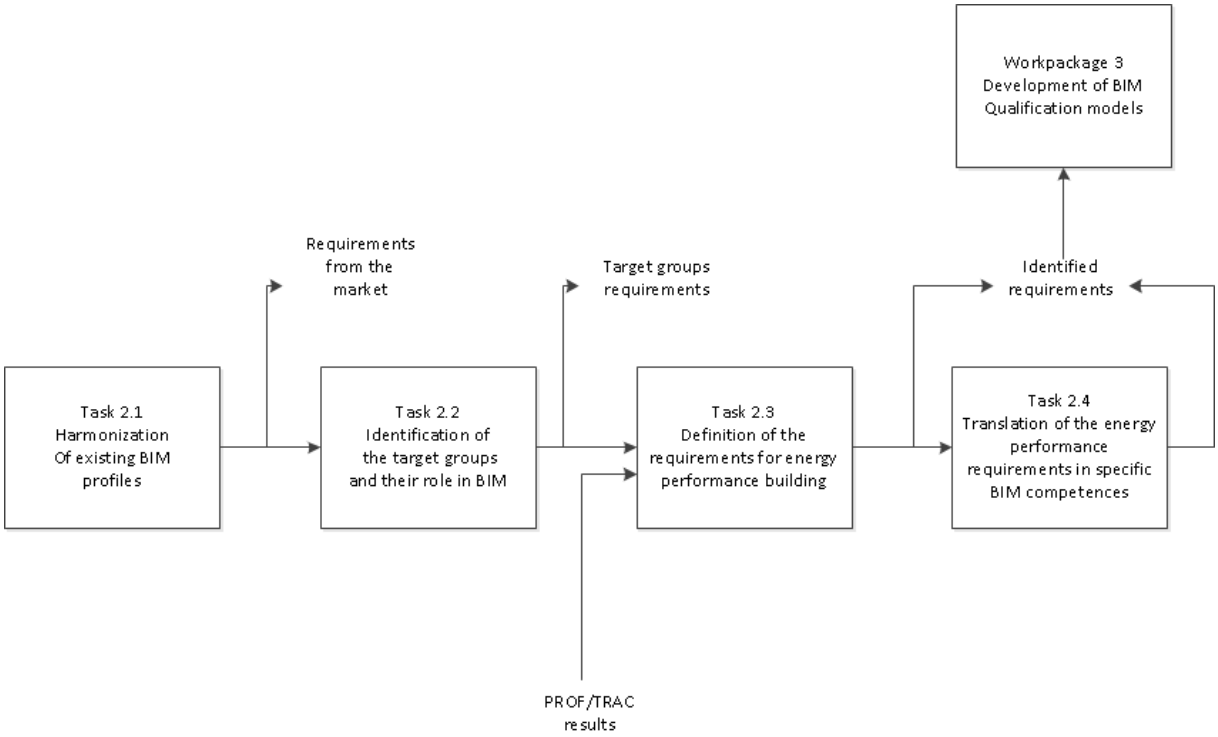

Figure 1: General process workpackage 2.

The process of each task is described in the following sections.

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Task 2.1 Harmonization of existing BIM profiles in accordance to EQF methodology

The purpose of working package 2.1 is described as: “Harmonization of existing BIM profiles in accordance to EQF methodology”.

The following steps have been taken to obtain this harmonization:

1. Inventory (national level)

- Deskresearch and harmonization at national level

Each country identifies and harmonizes its own BIM profiles. Each country gathers information about EQF level, working fields, tasks and the necessary competencies fort he profiles BIM Manager, BIM Coördinator, BIM Expert, BIM Expert user, BIM Evaluator and BIM Facility manager.

At national level the partners the harmonized results are discussed. The results of this discussion are integrated in the harmonization.

After these steps the market requirements related to the different BIM profiles have been made clear. These requirements are input data for task 2.2.

2. Comparing (between countries)

- For each **BIM profile** (**BIM Manager, BIM Coordinator, BIM Expert, BIM Expert user, BIM Evaluator and BIM Facility manager**) the harmonized results of each country are compared and integrated in one sheet. The integrated results are shared among the participating countries.

At European level the harmonized results are discussed in a web-meeting. The results from the discussion are integrated in the T2.1 report.

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Task 2.2 Identification of the target groups and their role in BIM

In task 2.2 the identification of the **target groups** and their role in BIM is decribed. Each role of each actor is identified in the construction workflow.

Four types of actors are considered in this task as having a relevant role in the building sector: **Public Administrations, Professionals (Architects-Engineers), Technician (Installers-Maintainers), Tenants/Owners/Building Administrators**.

Similar to task 2.1 the following steps have been taken:

1. Inventory (national level)
   For understanding the role of each actor in the different building life cycle phases, each partner is asked to inventory the role, tasks and competences for each actor.

2. Comparing between countries
   After inventarisation, the results were discussed among partners in webmeetings.

After comparison the results were integrated in the task 2.2 report.

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Task 2.3 Definition of requirements for energy performance building design and construction

In task 2.3 competencies on energy performance are mapped to the defined target groups:

i. Public administration,
ii. Professionals,
iii. Technicians and
iv. Owners.

The followed steps for task 2.3 and 2.4 are visualized in figure 2.

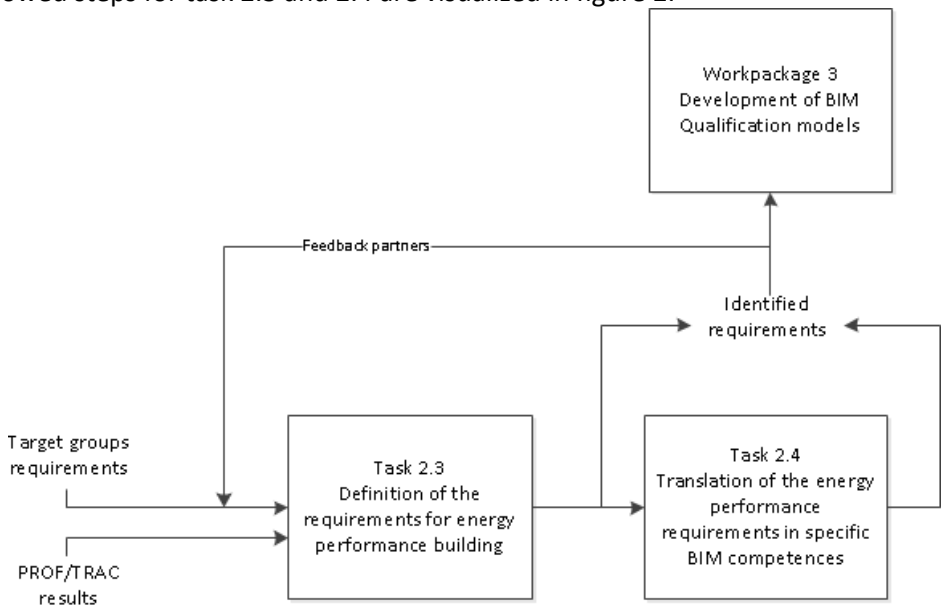

Figure 2: Process 2.3 and 2.4

Research methodology for task 2.3

Next to the found market requirements in task 2.1 and the target group requirements in task 2.2, NET-UBIEP task 2.3 uses the earlier work of the PROF/TRAC-project. The European PROF/TRAC project is an open training platform for NZEB professionals. In the PROF/TRAC project a NZEB skills and qualification scheme is constructed. The partners of the NET-UBIEP project have permission to use the PROF/TRAC results. To clarify the distinction between the two projects, the NET-UBIEP modified texts are displayed in red in the excel table 'NET-UBIEP 2.3 and 2.4_FINAL.xlsx'. For a thorough introduction to the PROF/TRAC results it is advised to read the public document PROF-TRAC_D3.2 explaining the nZEB Qualification structure

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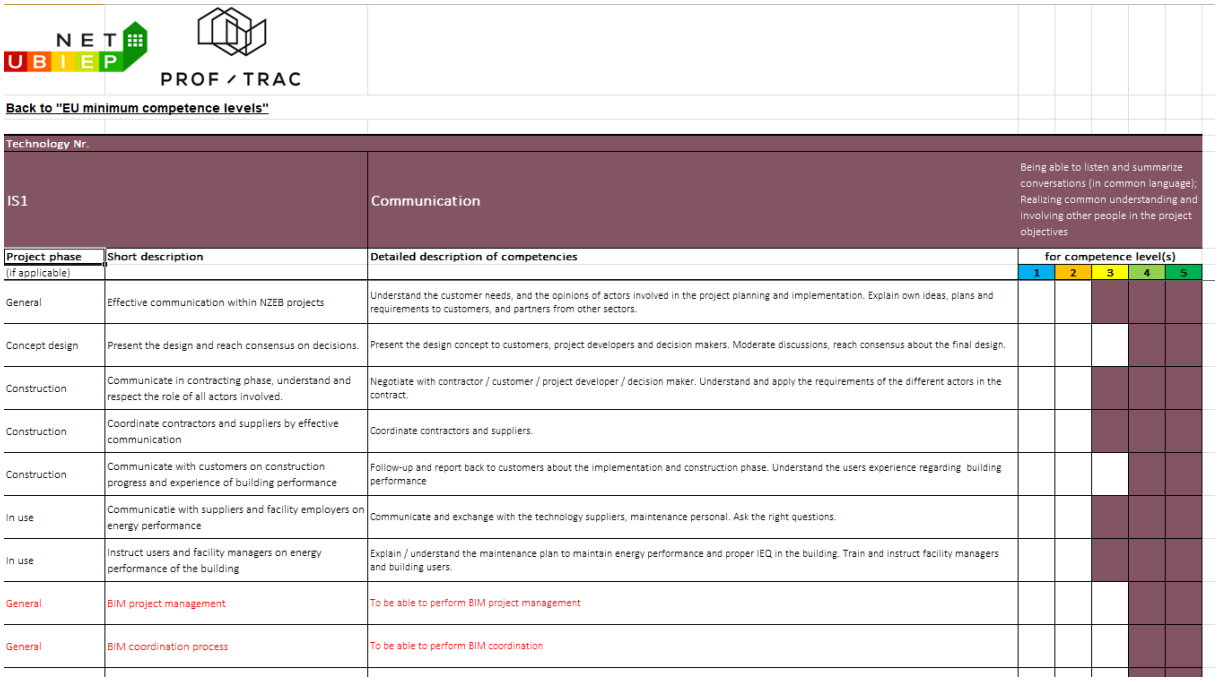
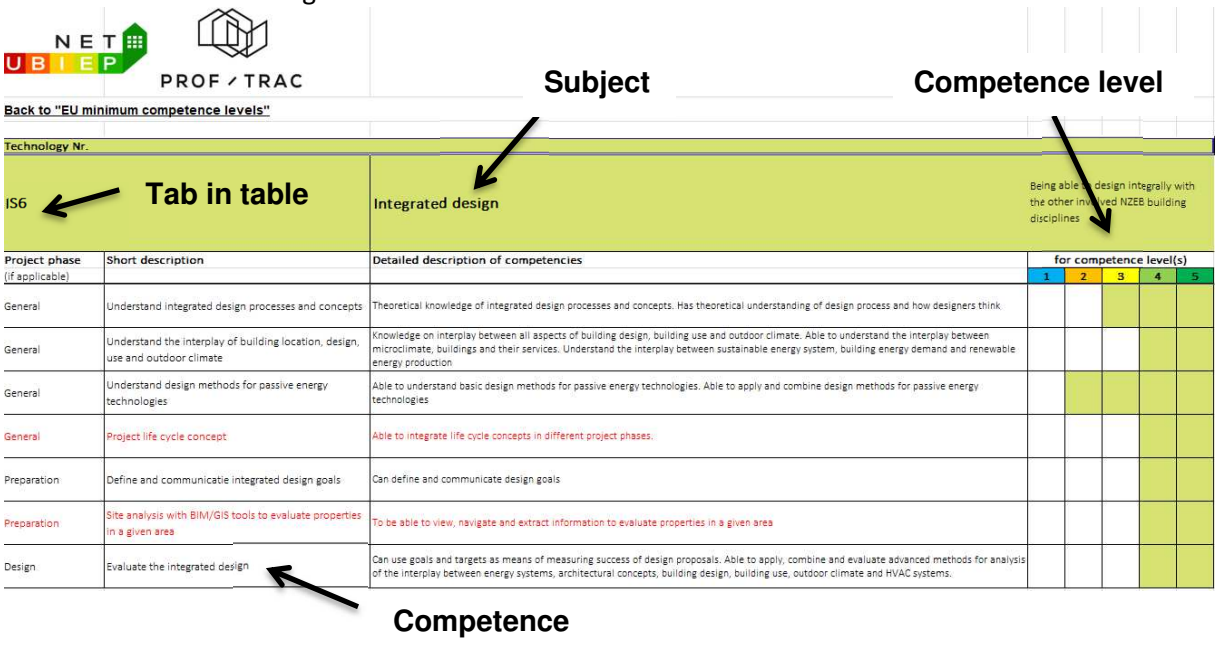


Back to "EU minimum competence levels"

Technology Nr.			
IS1		Communication	Being able to listen and summarize conversations (in common language); Realizing common understanding and involving other people in the project objectives
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s) 1 2 3 4 5
General	Effective communication within NZEB projects	Understand the customer needs, and the opinions of actors involved in the project planning and implementation. Explain own ideas, plans and requirements to customers, and partners from other sectors.	
Concept design	Present the design and reach consensus on decisions.	Present the design concept to customers, project developers and decision makers. Moderate discussions, reach consensus about the final design.	
Construction	Communicate in contracting phase, understand and respect the role of all actors involved.	Negotiate with contractor / customer / project developer / decision maker. Understand and apply the requirements of the different actors in the contract.	
Construction	Coordinate contractors and suppliers by effective communication	Coordinate contractors and suppliers.	
Construction	Communicate with customers on construction progress and experience of building performance	Follow-up and report back to customers about the implementation and construction phase. Understand the users experience regarding building performance	
In use	Communicatie with suppliers and facility employers on energy performance	Communicate and exchange with the technology suppliers, maintenance personal. Ask the right questions.	
In use	Instruct users and facility managers on energy performance of the building	Explain / understand the maintenance plan to maintain energy performance and proper IEQ in the building. Train and instruct facility managers and building users.	
General	BIM project management	To be able to perform BIM project management	
General	BIM coordination process	To be able to perform BIM coordination	

Figure 3: From excel table 'NET-UBIEP 2.3 and 2.4_FINAL.xlsx', PROF/TRAC texts are in black, NET-UBIEP additions/modifications are in red.

In PROF/TRAC for each NZEB technology a qualification scheme is developed, which describes the needed competencies in NZEB projects. The technologies and interdisciplinary competencies are based on the outcomes of the competencies mapping, performed in workpackage 2 of the PROF/TRAC project. Also the needed competencies levels for each work field are based on the outcomes of the competencies mappings by experts. Based on the minimum required competence level for a work field, the corresponding competencies can be found in the table of each technology/subject (Figure 4). In this table the results of tasks 2.1 and 2.2 are integrated.



Back to "EU minimum competence levels"

Technology Nr.			
IS6		Integrated design	Being able to design integrally with the other involved NZEB building disciplines
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s) 1 2 3 4 5
General	Understand integrated design processes and concepts	Theoretical knowledge of integrated design processes and concepts. Has theoretical understanding of design process and how designers think	
General	Understand the interplay of building location, design, use and outdoor climate	Knowledge on interplay between all aspects of building design, building use and outdoor climate. Able to understand the interplay between microclimate, buildings and their services. Understand the interplay between sustainable energy system, building energy demand and renewable energy production	
General	Understand design methods for passive energy technologies	Able to understand basic design methods for passive energy technologies. Able to apply and combine design methods for passive energy technologies	
General	Project life cycle concept	Able to integrate life cycle concepts in different project phases.	
Preparation	Define and communicatie integrated design goals	Can define and communicate design goals	
Preparation	Site analysis with BIM/GIS tools to evaluate properties in a given area	To be able to view, navigate and extract information to evaluate properties in a given area	
Design	Evaluate the integrated design	Can use goals and targets as means of measuring success of design proposals. Able to apply, combine and evaluate advanced methods for analysis of the interplay between energy systems, architectural concepts, building design, building use, outdoor climate and HVAC systems.	

Figure 4: Example of a tab with competences, technology/subject and compentence levels.

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In NET-UBIEP the minimum advised competencies level for each target group is indicated in the Tab "EU minimum competence levels for TG" (figure 5).

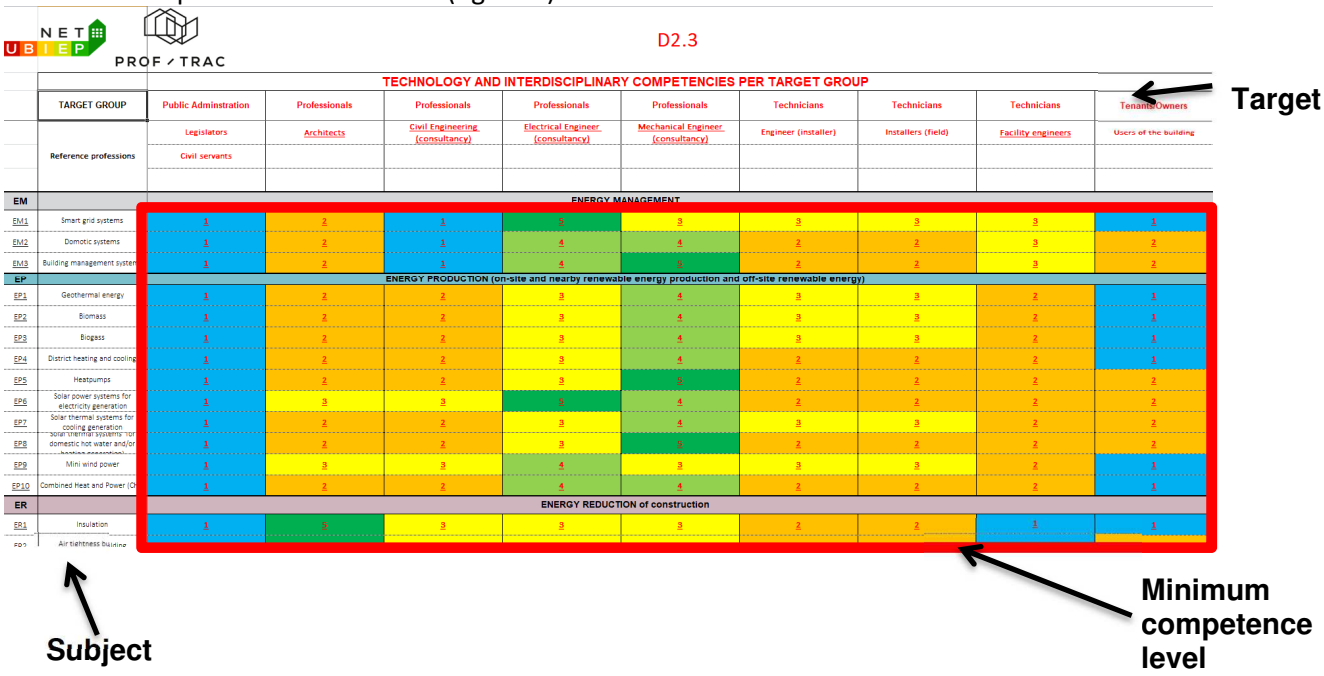

Figure 5: Tab "EU minimum advised competence levels of each target group.

Based on the minimum required competency level for a subject, the corresponding competencies can be found in the table of each technology (as in figure 4).
Example:
Architects are required to have minimum competencies level 3 on EP9 mini windpower (figure 6). In the excel table 'NET-UBIEP 2.3 and 2.4_v18042018.xlsx' tab EP9 the corresponding competencies can be found. Accordingly the need for additional training can be determined.

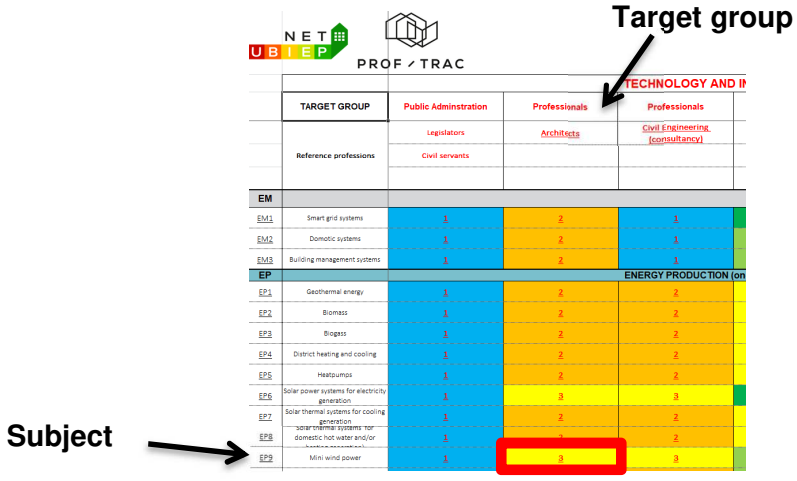

Figure 6: Example Architects/EP9 Mini wind power

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The resulting table was sent to all partners and was discussed in two different webmeetings. The excel table 'NET-UBIEP 2.3 and 2.4 _*FINAL*.xlsx' was finalized with the feedback of the partners.

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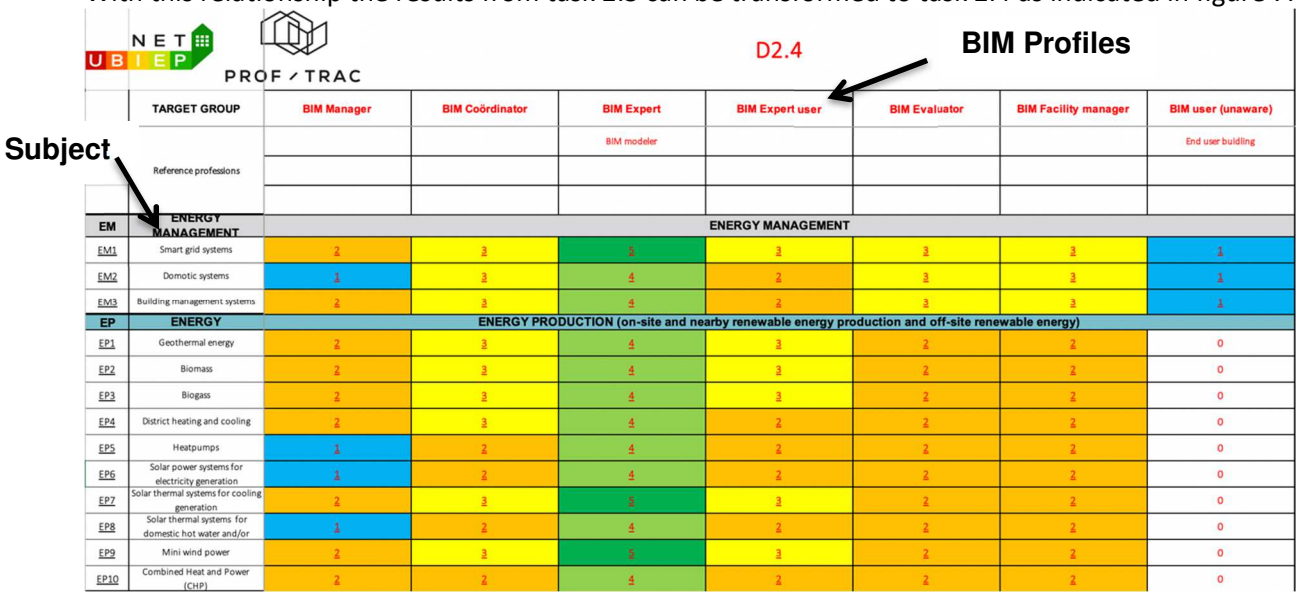
Task 2.4 Translate the energy performance requirements in specific BIM competences for each different target groups

In task 2.4 BIM competences related to energy performance are collected. A translation from the different target groups was needed to the different BIM profiles. The Grant Agreement 754016 Net-UBIEP describes this relation as indicated in table 1.

Table 1: Relationship target groups with BIM profiles (Grant Agreement 754016 Net-UBIEP)

Target group	**Public Administrations**	**Professionals (engineers & Architects)**	**Technicians (Installers and Maintainers)**	**Tenants, Owners & Building Administrators**
Role	They need to correctly prepare the rules and properly define the requirements for public tender using BIM for energy performance	They need to work in a collaborative environment by using the same basic BIM model implemented with the energy performances requirements through engineering analysis tools	They need to know how to read a BIM model, correctly interpret the data and ensure the owner that all the information for maintenance are available in the correct format	They need to know how to define the requirements for the correct maintenance of a building and how to handle the BIM model for the life time of the building
BIM profiles	**BIM Evaluator** **BIM Facility manager**	**BIM Manager** **BIM Coordinator** **BIM Expert**	**BIM Expert User**	**BIM Evaluator** **BIM Facility Manager**

With this relationship the results from task 2.3 can be transformed to task 2.4 as indicated in figure 7.



	TARGET GROUP	BIM Manager	BIM Coördinator	BIM Expert	BIM Expert user	BIM Evaluator	BIM Facility manager	BIM user (unaware)
				BIM modeler				End user building
	Reference professions							
EM	ENERGY MANAGEMENT	ENERGY MANAGEMENT						
EM1	Smart grid systems	2	3	3	3	3	3	1
EM2	Domotic systems	1	3	4	2	3	3	1
EM3	Building management systems	2	3	4	2	3	3	1
EP	ENERGY	ENERGY PRODUCTION (on-site and nearby renewable energy production and off-site renewable energy)						
EP1	Geothermal energy	2	3	4	3	2	2	0
EP2	Biomass	2	3	4	3	2	2	0
EP3	Biogass	2	3	4	3	2	2	0
EP4	District heating and cooling	2	3	4	2	2	2	0
EP5	Heatpumps	1	2	4	2	2	2	0
EP6	Solar power systems for electricity generation	1	2	4	2	2	2	0
EP7	Solar thermal systems for cooling generation	2	3	3	3	2	2	0
EP8	Solar thermal systems for domestic hot water and/or	1	2	4	2	2	2	0
EP9	Mini wind power	2	3	3	3	2	2	0
EP10	Combined Heat and Power (CHP)	2	2	4	2	2	2	0

Figure 7: BIM profiles related to advised competence levels (Tab 'EU minimum comp. levels for BP' in 'NET-UBIEP 2.3 and 2.4_FINAL.xlsx')

Also this resulting table was sent to all partners and was discussed. The excel table 'NET-UBIEP 2.3 and 2.4_v18042018.xlsx' was finalized with the feedback of the partners.

The final table links target groups, BIM profiles, competences, competence levels, project phases and technology/management subject in a very detailed way. Therefore the resulting tables from task 2.3 and 2.4 are necessary input which will be used in workpackage 3 'Development of BIM Qualification Models'

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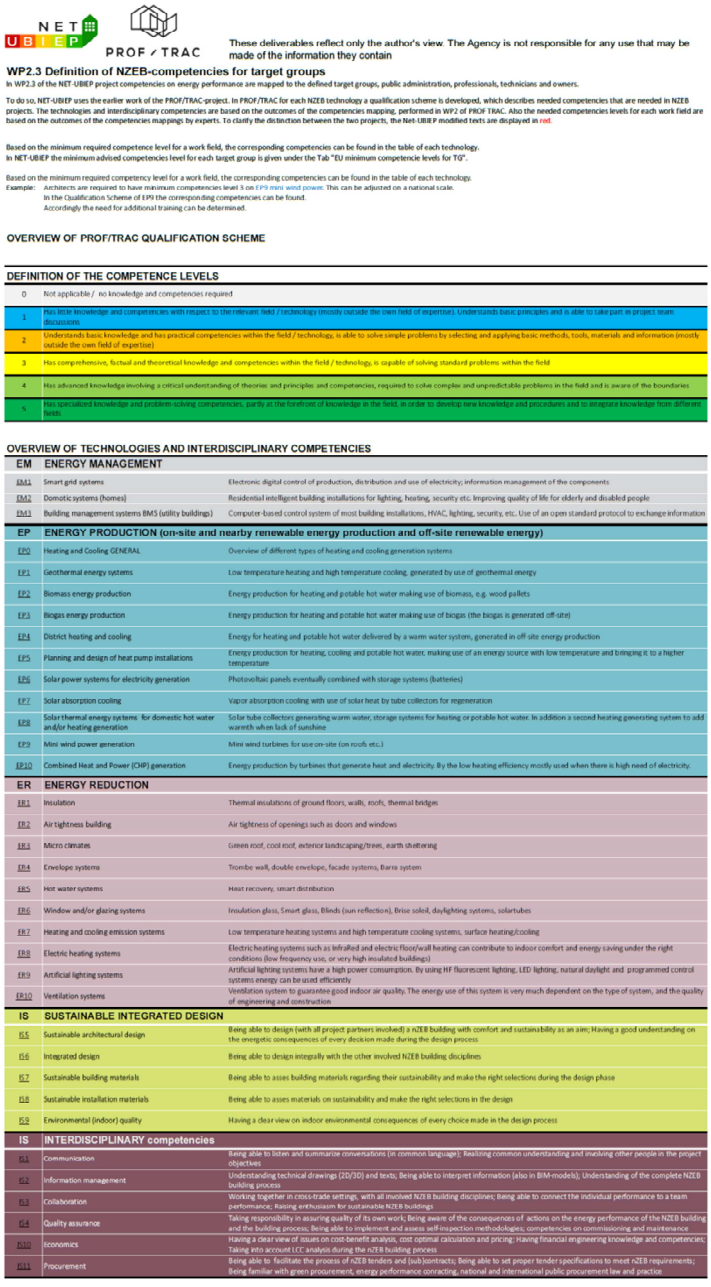
Appendix

In this appendix you will find the results from the excel deliverable NET-UBIEP 2.3 and 2.4_FINAL.xlsx. The presented results are the combined effort of NetUBIEP and Prof/Trac.



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WP2.3 Definition of NZEB-competencies for target groups

In WP2.3 of the NET-UBIEP project competencies on energy performance are mapped to the defined target groups, public administration, professionals, technicians and owners.

To do so, NET-UBIEP uses the earlier work of the PROF/TRAC-project. In PROF/TRAC for each NZEB technology a qualification scheme is developed, which describes needed competencies that are needed in NZEB projects. The technologies and interdisciplinary competencies are based on the outcomes of the competencies mapping, performed in WP2 of PROF TRAC. Also the needed competencies levels for each work field are based on the outcomes of the competencies mappings by experts. To clarify the distinction between the two projects, the Net-UBIEP modified texts are displayed in red.

Based on the minimum required competence level for a work field, the corresponding competencies can be found in the table of each technology.
In NET-UBIEP the minimum advised competencies level for each target group is given under the Tab "EU minimum competencie levels for TG".

Based on the minimum required competency level for a work field, the corresponding competencies can be found in the table of each technology.
Example: Architects are required to have minimum competencies level 3 on EP9 mini wind power. This can be adjusted on a national scale.
In the Qualification Scheme of EP9 the corresponding competencies can be found.
Accordingly the need for additional training can be determined.

OVERVIEW OF PROF/TRAC QUALIFICATION SCHEME

DEFINITION OF THE COMPETENCE LEVELS

0	Not applicable / no knowledge and competencies required
1	Has little knowledge and competencies with respect to the relevant field / technology (mostly outside the own field of expertise). Understands basic principles and is able to take part in project team discussions
2	Understands basic knowledge and has practical competencies within the field / technology, is able to solve simple problems by selecting and applying basic methods, tools, materials and information (mostly outside the own field of expertise)
3	Has comprehensive, factual and theoretical knowledge and competencies within the field / technology, is capable of solving standard problems within the field
4	Has advanced knowledge involving a critical understanding of theories and principles and competencies, required to solve complex and unpredictable problems in the field and is aware of the boundaries
5	Has specialized knowledge and problem-solving competencies, partly at the forefront of knowledge in the field, in order to develop new knowledge and procedures and to integrate knowledge from different fields

OVERVIEW OF TECHNOLOGIES AND INTERDISCIPLINARY COMPETENCIES

EM	**ENERGY MANAGEMENT**	
EM1	Smart grid systems	Electronic digital control of production, distribution and use of electricity; information management of the components
EM2	Domotic systems (homes)	Residential intelligent building installations for lighting, heating, security etc. Improving quality of life for elderly and disabled people
EM3	Building management systems BMS (utility buildings)	Computer-based control system of most building installations, HVAC, lighting, security, etc. Use of an open standard protocol to exchange information
EP	**ENERGY PRODUCTION (on-site and nearby renewable energy production and off-site renewable energy)**	
EP0	Heating and Cooling GENERAL	Overview of different types of heating and cooling generation systems
EP1	Geothermal energy systems	Low temperature heating and high temperature cooling, generated by use of geothermal energy
EP2	Biomass energy production	Energy production for heating and potable hot water making use of biomass, e.g. wood pallets
EP3	Biogas energy production	Energy production for heating and potable hot water making use of biogas (the biogas is generated off-site)
EP4	District heating and cooling	Energy for heating and potable hot water delivered by a warm water system, generated in off-site energy production
EP5	Planning and design of heat pump installations	Energy production for heating, cooling and potable hot water, making use of an energy source with low temperature and bringing it to a higher temperature
EP6	Solar power systems for electricity generation	Photovoltaic panels eventually combined with storage systems (batteries)
EP7	Solar absorption cooling	Vapor absorption cooling with use of solar heat by tube collectors for regeneration
EP8	Solar thermal energy systems for domestic hot water and/or heating generation	Solar tube collectors generating warm water, storage systems for heating or potable hot water. In addition a second heating generating system to add warmth when lack of sunshine
EP9	Mini wind power generation	Mini wind turbines for use on-site (on roofs etc.)
EP10	Combined Heat and Power (CHP) generation	Energy production by turbines that generate heat and electricity. By the low heating efficiency mostly used when there is high need of electricity.
ER	**ENERGY REDUCTION**	
ER1	Insulation	Thermal insulations of ground floors, walls, roofs, thermal bridges
ER2	Air tightness building	Air tightness of openings such as doors and windows
ER3	Micro climates	Green roof, cool roof, exterior landscaping/trees, earth sheltering
ER4	Envelope systems	Trombe wall, double envelope, facade systems, Barra system
ER5	Hot water systems	Heat recovery, smart distribution
ER6	Window and/or glazing systems	Insulation glass, Smart glass, Blinds (sun reflection), Brise soleil, daylighting systems, solartubes
ER7	Heating and cooling emission systems	Low temperature heating systems and high temperature cooling systems, surface heating/cooling
ER8	Electric heating systems	Electric heating systems such as InfraRed and electric floor/wall heating can contribute to indoor comfort and energy saving under the right conditions (low frequency use, or very high insulated buildings)
ER9	Artificial lighting systems	Artificial lighting systems have a high power consumption. By using HF fluorescent lighting, LED lighting, natural daylight and programmed control systems energy can be used efficiently
ER10	Ventilation systems	Ventilation system to guarantee good indoor air quality. The energy use of this system is very much dependent on the type of system, and the quality of engineering and construction
IS	**SUSTAINABLE INTEGRATED DESIGN**	
IS5	Sustainable architectural design	Being able to design (with all project partners involved) a nZEB building with comfort and sustainability as an aim; Having a good understanding on the energetic consequences of every decision made during the design process
IS6	Integrated design	Being able to design integrally with the other involved NZEB building disciplines
IS7	Sustainable building materials	Being able to asses building materials regarding their sustainability and make the right selections during the design phase
IS8	Sustainable installation materials	Being able to asses materials on sustainability and make the right selections in the design
IS9	Environmental (indoor) quality	Having a clear view on indoor environmental consequences of every choice made in the design process
IS	**INTERDISCIPLINARY competencies**	
IS1	Communication	Being able to listen and summarize conversations (in common language); Realizing common understanding and involving other people in the project objectives
IS2	Information management	Understanding technical drawings (2D/3D) and texts; Being able to interpret information (also in BIM-models); Understanding of the complete NZEB building process
IS3	Collaboration	Working together in cross-trade settings, with all involved NZEB building disciplines; Being able to connect the individual performance to a team performance; Raising enthusiasm for sustainable NZEB buildings
IS4	Quality assurance	Taking responsibility in assuring quality of its own work; Being aware of the consequences of actions on the energy performance of the NZEB building and the building process; Being able to implement and assess self-inspection methodologies; competencies on commissioning and maintenance
IS10	Economics	Having a clear view of issues on cost-benefit analysis, cost optimal calculation and pricing; Having financial engineering knowledge and competencies; Taking into account LCC analysis during the nZEB building process
IS11	Procurement	Being able to facilitate the process of nZEB tenders and (sub)contracts; Being able to set proper tender specifications to meet nZEB requirements; Being familiar with green procurement, energy performance contracting, national and international public procurement law and practice

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	TARGET GROUP	Public Adminstration	Professionals	Professionals	Professionals
	Reference professions	Legislators	Architects	Civil Engineering (consultancy)	Electrical Engineer (consultancy)
		Civil servants			
EM					ENERGY M
EM1	Smart grid systems	1	2	1	5
EM2	Domotic systems	1	2	1	4
EM3	Building management systems	1	2	1	4
EP					ENERGY PRODUCTION (on-site and nearby renewa
EP1	Geothermal energy	1	2	2	3
EP2	Biomass	1	2	2	3
EP3	Biogass	1	2	2	3
EP4	District heating and cooling	1	2	2	3
EP5	Heatpumps	1	2	2	3
EP6	Solar power systems for electricity generation	1	3	3	5
EP7	Solar thermal systems for cooling generation	1	2	2	3
EP8	Solar thermal systems for domestic hot water and/or heating generation)	1	2	2	3
EP9	Mini wind power	1	3	3	4
EP10	Combined Heat and Power (CHP)	1	2	2	4
ER					ENERGY REDUCT
ER1	Insulation	1	5	3	3
ER2	Air tightness building	1	5	3	3
ER3	Micro climates	1	4	4	4
ER4	Envelope systems	1	5	4	4
ER6	Window and/or glazing systems	1	4	3	3
ER					ENERGY REDUCT
ER5	Hot water systems	1	2	3	3
ER7	Heating and cooling emission systems	1	2	3	3
ER8	Electric heating systems	1	2	3	3
ER9	Artificial lighting systems	1	2	4	4
ER10	Ventilation systems	1	2	4	4
IS					SUSTAINABLE IN
IS5	Sustainable architectural design	1	4	4	3
IS6	Integrated design	1	4	4	4
IS7	Sustainable building materials	1	4	4	3
IS8	Sustainable installation materials	1	3	3	4
IS9	Environmental (indoor) quality	1	3	3	4
IS					INTERDISCIPLIN
IS1	Communication	4	4	3	3
IS2	Information management	3	5	3	3
IS3	Collaboration	3	4	4	4
IS4	Quality assurance	4	4	3	3
IS10	Economics	3	4	3	3
IS11	Procurement	5	4	3	3

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	TARGET GROUP	BIM Manager	BIM Coördinator	BIM Expert	BIM Expert user	BIM Evaluator	BIM Facility manager	BIM user (unaware)
	Reference professions			BIM modeler				End user buidling
EM	ENERGY MANAGEMENT	ENERGY MANAGEMENT						
EM1	Smart grid systems	2	3	5	3	3	3	1
EM2	Domotic systems	1	3	4	2	3	3	1
EM3	Building management systems	2	3	4	2	3	3	1
EP	ENERGY	ENERGY PRODUCTION (on-site and nearby renewable energy production and off-site renewable energy)						
EP1	Geothermal energy	2	3	4	3	2	2	0
EP2	Biomass	2	3	4	3	2	2	0
EP3	Biogass	2	3	4	3	2	2	0
EP4	District heating and cooling	2	3	4	2	2	2	0
EP5	Heatpumps	1	2	4	2	2	2	0
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EP7	Solar thermal systems for cooling generation	2	3	5	3	2	2	0
EP8	Solar thermal systems for domestic hot water and/or	1	2	4	2	2	2	0
EP9	Mini wind power	2	3	5	3	2	2	0
EP10	Combined Heat and Power (CHP)	2	2	4	2	2	2	0
ER	ENERGY REDUCTION of	ENERGY REDUCTION of construction						
ER1	Insulation	1	2	3	2	1	1	0
ER2	Air tightness building	2	2	3	2	2	2	1
ER3	Micro climates	2	3	4	3	2	2	1
ER4	Envelope systems	2	3	4	3	2	2	0
ER6	Window and/or glazing systems	1	2	3	2	2	2	1
ER	ENERGY REDUCTION of	ENERGY REDUCTION of installations						
ER5	Hot water systems	1	2	3	3	2	2	1
ER7	Heating and cooling emission systems	1	2	3	3	2	2	0
ER8	Electric heating systems	1	2	3	3	2	2	0
ER9	Artificial lighting systems	2	3	4	3	2	2	1
ER10	Ventilation systems	2	3	4	3	2	2	1
IS	SUSTAINABLE INTEGRATED	SUSTAINABLE INTEGRATED DESIGN						
IS5	Sustainable architectural design	2	3	4	3	2	2	1
IS6	Integrated design	2	3	4	3	3	3	1
IS7	Sustainable building materials	2	3	4	3	3	3	0
IS8	Sustainable installation materials	2	3	4	3	3	3	0
IS9	Environmental (indoor) quality	2	3	4	3	3	3	1
IS	INTERDISCIPLINARY competencies	INTERDISCIPLINARY competencies						
IS1	Communication	4	4	3	3	3	3	2
IS2	Information management	4	3	3	3	3	3	2
IS3	Collaboration	5	4	4	3	1	4	2
IS4	Quality assurance	3	4	4	3	3	3	0
IS10	Economics	3	1	1	0	3	3	2
IS11	Procurement	3	2	1	0	3	3	0

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Technology Nr.								
EM1		Smart grid systems		Electronic digital control of production, distribution and use of electricity; information management of the components				
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand smart grids in relation to energy performance	Has general knowledge and an holistic view on smart grids and buildings' energy profiles, understanding of it's contribution to energy performance						
General	Information management of smart grids in NZEB design	Can provide the (smart) grid manager with basic information on buildings' energy profiles						
General	Holistic approach of smart grids in NZEB design	Can think in a holostic way concerning energy demand, energy supply, storage and is able to make trade-offs						
Preparation	Determine smart grid concepts	Can perform a feasibility study to determine the basic concept within the project, based on energy saving contribution, costs, restrictions, etc.						
Preparation	Perform energy simulations	Can perform energy simulations in order to define building energy profiles (such as heat load duration curves)						
Preparation	Define energy profiles	Can define the energy profile of the building, i.e. the energy demand profiles, energy supply profiles, storage (in relation with heat pumps), based on input from team members.						
Design	Engineer smart grids	Can design and calculate the smart grid system, based on heat load duration curves, energy simulations etc.						
Construction	Specify smart grids in tender contracts	Can specify and describe the smart grid system in a tender contract, in a way that ensures the contribution to energy saving is realised.						
Construction	Quality assurance of smart grids according contract	Can manage, instruct and audit contractors on site during the realisation of a smart grid system, based on information given in the tender documents and given by the designer.						
Construction	Commission smart grids to ensure operation as planned	Can commission a smart grid system on it's functionality and quality, and determine wether the system operates as planned. Make sure the foreseen contribution to energy saving is realised.						
In use	Ensure optimal operation of smart grids during life cycle	Monitor and control of the smart grid system on critical parameters, in order to guarantee the designed performance during life cycle. Takes action on abnormalities and adjust settings to ensure optimal operation.						

Technology Nr.								
EM2		Domotic systems (homes)		Residential intelligent building installations for lighting, heating, security etc. Improving quality of life for elderly and disabled people				
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand contribution of domotic systems to energy performance	General knowledge on domotic systems, understanding it's contribution to energy saving possibilities						
Preparation	Determine energy saving potential regarding human behaviour	Calculate and predict the amount of energy that can be saved by automatic systems and knowledge on influence of human behaviour on energy demand / use.						
Preparation	Determine installations to include in domotic concept	Is able to make a weighting and balancing between which components and systems should be included in domotics and which are less usefull to include, in relation to energy saving.						
Preparation	Assess available integrated domotic systems	Is able to choose a concept that fulfills specific needs within the project. Domotic systems are mostly provided by producers of fully integrated systems, including switches, modules etc. Is able to understand designs and specifications provided by producers of integrated systems						
Design	Engineer a domotic system in NZEB residential buildings	Engineering of a complete domotic system. From design to contract documents and drawings						
Construction	Specify domotic systems in tender contracts	Detailed description of the demands and functionality of the domotic system, to enable the contractor to choose a product that fulfills the demands.						
Construction	Assure quality of realised systems according contract	Can manage, instruct and audit contractors on site during the realisation of a domotic system, based on information given in the tender documents and given by the designer.						
Construction	Commission domotic systems to ensure planned energy saving	Is able to commission the domotic system after realisation, in order to check if the system fulfills all demands and full functionality. This must be done under different conditions (e.g. day/night, residents are present / absent , etc)						
In use	User instruction to ensure optimal operation of domotic systems	Can write a clear userguide and/or instruct users, based on the type of residents (elderly, young, foreign etc), to see that the system is used as designed for in order to achieve the energy saving goals.						

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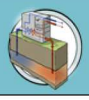
Technology Nr.								
EM3		Building management systems BMS (utility buildings) 						
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	Back to "EU"			
General	Understand BMS systems in relation to energy performance	General knowledge on the concept of building management systems and it's contribution to energy saving						
Preparation	Determine installations to include in BMS	Knowledge of installations that can be automised (heating, cooling, sun blinds, lighting, security etc). Is aware of the difference between automatisation strategies for one room or the whole building.						
Preparation	Determine IAQ parameters to be controlled in BMS	Knowledge of essential indoor environmental quality parameters and the impact of the BMS on it's performance						
Preparation	Determine energy saving potential regarding human behaviour	Knowledge of the amount of energy that can be saved by automatic systems and knowledge on influence of human behaviour on energy demand / use.						
Preparation	Perform a feasibility study	Can perform a feasibility study based on technical aspects as well as return of investment. BMS systems are expensive and will pay back in user phase of the building. During pre-design phase it must become clear how costs of investement can return, who is responsible etc.						
Design	Engineer the BMS system in interdisciplinary team	Can design and engineer the building managment system in an interdisciplinary team						
Design	Describe functionality and automatisation strategy	Describing the automatisation strategies, what is the demanded functionality. The person who designs the BMS must get input from other design partners what is needed. (heating/cooling: mechanical engineer. Lighting, security etc: electrical engineer. Sun blinds etc: architect).						
Construction	Specify the BMS for contracting	Specification of building management system for use in contracting. Make detailed descriptions of the BMS stategies, including drawings, so the contractor and supplier can programm the hardware / software.						
Construction	Assure quality of realised systems according contract	Management, instruction and auditing of contractors during the realisation of the BMS system						
Construction	Commission BMS system to ensure operation as planned	Is able to commission the BMS during, and after realisation, in order to check if the system fulfills all demands and full functionality. This must be done under different conditions (e.g. day/night, residents are present / absent , winter /summer, etc)						
In use	Ensure optimal operation of the BMS during life cycle	Can design a maintenance plan and instruct the facility manager, to guarantee that the system achieves the energy saving goals. Takes action on abnormalities and adjust settings to ensure optimal operation.						

Technology Nr.								
EP0		Heating and Cooling GENERAL	Overview of different types of heating and cooling generation systems					
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand influence of heating and cooling generation on energy performance	Has general knowledge on the application and specifics of several types of heating and cooling generation systems. Is able to take part in discussions in the design team. Is aware of the importance of the desicions made in the pre design phase for the total energy performance.						
General	Understand specifics and basic parameters	Has knowledge on specifics of heating and cooling generation types, and why or when to choose a specific type. E.g. energy sources, energy balance (smart grids)						
Preparation	Assess systems related to building function and architecture	Is able to select heating and cooling systems, specifically in relation with the buildings' architectural design and building function(s). Is able to discuss the relation between architectural design (esthetics) and selection of heating and cooling systems in a multidisciplinary team						
Preparation	Determine systems that fit NZEB demands	Can determine the appropriate system in relation to available energy sources (soil, gas, electricity, district etc) and that fit the NZEB demands.						
Preparation	Perform a feasibility study on financial and technical aspects	Is able to perform a feasibility study including financial and technical aspects and discuss the outcomes						

Technology Nr.								
EP1		Geothermal energy systems 	Low temperature heating and high temperature cooling, generated by use of geothermal energy					
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
Design	Engineer geothermal energy systems	Detailed engineering of the geothermal energy system. Can determine construction site boundaries e.g. needed space, area, depth. Make detailed descriptions and drawings of the design.						
Construction	Specification of a geothermal energy system for contracting purpose	Is able to select products that fit specifications and demands on given quality aspects. Is able to make financial calculations related to contracting phase.						
Construction	Quality assurance of geothermal energy systems	Can manage, instruct and audit contractors during the realisation of the geothermal energy system, based on information given by the designer and the tender documents. Can audit on construction site, on critical points.						
Construction	Commissioning of geothermal energy systems	Can commission the geothermal energy installation on functionality in all seasons, under full and partial load. Is aware of critical points and makes sure the designed energy perfomance is realised.						
In use	Design of a maintance and operation plan	Can design a maintenance and operation plan that guarantees trouble free performance, and instruct the facility manager on the designed performance and monitoring parameters						
In use	Ensure optimal operation of geothermal energy systems during life cycle	Monitoring and control of the system in order to guarantee the designed performance during life cycle. Takes action on anomalies and adjust system settings to ensure optimal operation.						

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Technology Nr.								
EP2		Biomass energy production 	Energy production for heating and potable hot water making use of biomass, e.g. wood pallets					
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand biomass systems in relation to energy performance	Has general knowledge on biomass energy production, an holistic view on contribution of biomass tot energy performance. Knows the difference between small products (consumerproducts) and large custom made installations.						
Pre design	Perform a feasibility study on (large) biomass systems	Is able to perform a feasibility study on energy performance, including financial aspects and discuss the outcomes for large biomass installations.						
Design	Engineer small biomass systems	Detailed engineering of the biomass energy system. Can determine construction boundaries e.g. needed space, weight. Make detailed descriptions and drawings of the design						
Design	Engineer large biomass installations	Detailed engineering of the biomass energy system. Can determine construction boundaries e.g. needed space, weight. Calculate capacity, flow, temperatures etc. Make detailed descriptions and drawings of the design						
Construction	Specify a biomass energy system for contracting purpose	Is able to select products that fit specifications and demands on given quality aspects. Is able to make financial calculations related to contracting phase						
Construction	Quality assurance of large biomass installations	Can manage, instruct and audit contractors on site during realisation of large biomass installations, based on information given in tender contracts, the designer and supplier.						
Construction	Commission large biomass energy system	Can commission the biomass energy installation on functionality in all seasons, under full and partial load. Can determine if the system operates as planned and makes sure the calculated energy saving is realised.						
In use	Design a maintanance and operation plan for large biomass installations	Design a maintenance and operations plan, critical parameters. Give instructions to user or facility manager.						
In use	Ensure optimal operation during life cycle	Monitor and control the biomass installation on critical parameters, take action on anomalies and ensure optimal operation.						

Technology Nr.								
EP3		Biogas energy production 	Energy production for heating and potable hot water making use of biogas (the biogas is generated off-site)					
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand biogas in relation to other forms of energy production and contribution to energy performance.	Has general knowledge on biogas energy production, which waste materials are used to generate biogas in biogas installations, knows the specifics that characterize biogas systems.						
Preparation	Perform a feasibility study on use of biogas energy	Can perform a feasibility study to determine the usefullness of generating biogas from waste materials (e.g. from own activities or form third parties). Is able to determine total cost of ownership. Can consider pros and cons of using biogas or other forms of heat / energy generation.						
Design	Integrate biogas energy in the installation concept	Can design and calculate installations for heating and potable hot water (PWH) making use of biogas. The biogas is produced off-site (biogas production is not part of the NZEB project).						
Construction	Specify biogas systems in tender contracts	Can specificy a biogas energy system for contracting purpose. The realisation of the biopas plant is not part of the project. Is able to select components that are fit for use with biogas.						
Construction	Quality assurance of installations using biogas	Can manage, instruct and audit contractors on site during realisation of the installation for heating and PHW with use of biogas.						
Construction	Commissioning of installations using biogas	Can commission installations for heating and PHW that use biogas on quality and functionality and make sure the foreseen contribution to energy saving is realised.						
In use	Ensure optimal operation of biogas installations	Monitor and control the installations for heating and PHW that use biogas on critical parameters, in order tot guarantee the designed performance during life cycle. Can design a maintanance plan.						

Technology Nr.								
EP4		District heating and cooling 	Energy for heating and potable hot water delivered by a warm water system, generated in off-site energy production					
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
Preparation	Understand district heating/cooling in relation to other forms of energy production and contribution to energy performance.	Has general knowledge on district heating and cooling systems, knows the specifics that characterize these systems. Understands the contribution to energy saving potential and the boundary conditions.						
Preparation	Perform a feasibility study on use of district heating and cooling.	Can investigate the need for district heating and cooling, is aware of consequences later on in the project. Can determine heating and cooling demand of the building and demand of potable water.						
Design	Engineer district heating and cooling energy systems	Can engineer a district heating and cooling system, including calculations of heat loss and cooling load, determining of capacity, flow, temperatures, hydraulic concepts etc.						
Construction	Specify district heating and cooling systems in tender contracts	Can specify a district heating and cooling energy system for contracting purpose, including description of hydraulic concept.						
Construction	Quality assurance of district heating and cooling inside the building	Can manage, instruct and audit contractors on site during realisation of the installation of district heating and cooling systems inside the building and integration with the building installations.						
Construction	Commissioning of district heating and cooling installations, inside the building	Can commission district heating and cooling systems inside the building, on quality and functionality and make sure the foreseen contribution to energy saving is realised. Is able to determine critical parameters for monitoring and control.						
In use	Ensure optimal operation of district heating and cooling installations	Monitor and control the district heating and cooling installations inside the building on critical parameters, in order tot guarantee the designed performance during life cycle. Can design a maintanance plan.						

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Technology Nr.									
EP5		**Planning and design of heat pump installations** 	Energy production for heating, cooling and potable hot water, making use of an energy source with low temperature and bringing it to a higher temperature						
Project phase (if applicable)	**Short description**	**Detailed description of competencies**	**for competence level(s)**						
			1	2	3	4	5		
General	Understand heat pumps in relation to energy performance	General knowledge of heat pumps, design and application. Is aware of specific need for low temperature energy source. Can take part in discussions in the design team.							
Preparation	Identify and select fitted heat source for use with heat pumps	Can determine available heat/energy sources. Is aware of types of available heat sources for use with heat pumps, understands the influence of source temperature on energy efficiency.							
Preparation	Perform a feasibility study on heat pump installations	Can perform a feasibility study on what type of heat pump fits the demands, including financial aspects, weighting and balancing of components that are needed in relation to energy saving.							
Design	Engineer standard heat pump installations	Can engineer a (standard) heat pump system, including calculations of heat loss (transmission), needed capacity, mono- or bivalent, energy balances (e.g. important when using geothermal energy), noise reduction.							
Design	Engineer complex and innovative heat pump installations	Can engineer a complex heat pump system, using innovative products, alternative heat sources etc. Can make detailed drawings and hydraulic schemes that determine it's functionality. Can describe the automatisation strategies.							
Construction	Specify heat pump installations in tender contracts	Can specify heat pump installations in tender documents. Can make detailed descriptions and drawings and select fitted products.							
Construction	Quality assurance of heat pump systems during realisation	Can manage, instruct and audit contractors on site during realisation of a heat pump system, based on information given by the designer and the tender documents.							
Construction	Commission a heat pump installation	Can commission a heat pump installation on functionality in all seasons, under full and partial load, seasonal performance. Can determine if the installation operates as planned, makes sure the foreseen energy performance is realised.							
In use	Ensure optimal operation of heat pump installations	Can design a maintenance plan and instruct the facility manager on monitoring parameters, to guarantee that the system achieves the designed energy saving goals							

Technology Nr.									
EP6		**Solar power systems for electricity generation** 	Photovoltaic panels eventually combined with storage systems (batteries)						
Project phase (if applicable)	**Short description**	**Detailed description of competencies**	**for competence level(s)**						
			1	2	3	4	5		
General	Understand PV systems in relation tot NZEB	Understands the basic working and application of PV systems, is able to explain and take part in discussions. Is familiar with different types (e.g. panels, roofs). Understands the influence of external aspects e.g. orientation, shadowing on the performance.							
Preparation	Perform a feasibility study on Photovoltaic systems	Can perform a feasibility study including financial aspects, the use of batteries and discuss the outcomes. Has knowledge of different types of PV systems, quality aspects, energy efficiency.							
Design	Engineer a PV system	Can engineer and calculate the needed PV energy (m2, Wp/m2, color, frame work). Understands basic principles needed in design and calculation, e.g. orientation, Wp, Wp/m2, power inverter. Knowledge and understanding of batteries to store power generated with PV cells. Can determine construction boundaries e.g. needed space, weight. Engineering of the electrical components e.g.							
Construction	Specify a PV system in tender documents	Is able to select products that fit specifications and demands on given quality aspects. Make detailed descriptions and drawings of the design. Is able to make financial calculations related to contracting phase							
Construction	Quality assurance on realisation of PV systems	Can manage, instruct and audit contractors on site during realisation of a PV system, based on information given by the designer and the tender documents. Is able to instruct the contractor on the specifics of the system. Can audit the realisation on critical points.							
Construction	Commission a PV system	Can commission a PV installation on functionality. Can determine if the installation operates as planned, makes sure the foreseen energy performance is realised.							
In use	Ensure optimal operation of PV during life cycle	Can give instructions to users (or to facility manager). Is able to set up a maintenance plan							

Technology Nr.									
EP7		**Solar absorption cooling** 	Vapor absorption cooling with use of solar heat by tube collectors for regeneration						
Project phase (if applicable)	**Short description**	**Detailed description of competencies**	**for competence level(s)**						
			1	2	3	4	5		
General	Understand solar absorption cooling systems	Understands the basic working and application of an absorption cooling system. Knows how absorption cooling is regenerated by heat from solar tube collectors. Can explain and discuss the application within the project team.							
Preparation	Perform a feasibility study on solar absorption cooling	Can perform a feasibility study on the application of solar cooling, can estimate the cooling demand of the building. Is aware of financial aspects and life cycle analysis.							
Design	Engineer a solar absorption cooling system	Can engineer an absorption cooling generation system with solar regeneration by heat tube collectors. Calculate accurate cooling demand of the building in order to select the right capacity (kW). Can make a detailed design of the installation, principle, automatisation strategy, using available products and concepts, select fitted products.							
Construction	Specify a solar absorption cooling system in tender contracts	Specify a solar cooling generation system for use in contracting. Is able to select products that fit specifications and demands on given quality aspects. Can make detailed and accurate descriptions and drawings of the design. Is able to make financial calculations related to contracting phase							
Construction	Quality assurance on realisation of solar cooling systems	Can manage, instruct and audit contractors on site during realisation of a solar cooling system, based on information given by the designer and the tender documents. Is able to instruct the contractor on the specifics of the system. Can audit the realisation on critical points.							
Construction	Commission a solar cooling system	Is able to commission the solar cooling system on functionality in all seasons, under full and partial load. Can determine if the installation operates as planned, makes sure the foreseen energy performance is realised.							
In use	Ensure optimal operation of solar cooling system	Monitor and control the solar cooling installation on critical parameters, in order tot guarantee the designed performance during life cycle. Can design a maintanance plan.							
In use	Communicate the appropriate use and maintenance of the solar cooling system	Can instruct the facility manager on monitoring parameters, to guarantee that the system achieves the designed energy saving goals							

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Technology Nr.			
EP8		Solar thermal energy systems for domestic hot water and/or heating generation 	Solar tube collectors generating warm water, storage systems for heating or potable hot water. In addition a second heating generating system to add warmth when lack of sunshine
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s) 1 2 3 4 5
General	Understand solar heating systems	Has general knowledge on solar thermal energy systems by heat tube collectors. Understands the basic working, is aware of boundary conditions. Is able to discuss within project team.	
Preparation	Perform a feasibility study on solar heating systems	Can perform a feasibility study and calculate available solar energy. Can estimate the heat loss of the building and heating demand. Can determine the demands of domestic hot water (average, peak demand). Can estimate the needed storage volume and possible types of storage tanks. Understands the interaction between water storage / peak demand / available solar energy / external heating	
Design	Engineer a solar heating system	Can engineer a solar thermal energy system. Calculate accurate heating demand of the building, calculate accurate domestic hot water demand in order to select the right capacity (kW, litres). Can make a detailed design of the installation, principle, automatisation strategy, using available products and concepts. CAn determine and calculate external heating.	
Construction	Specify a solar heating system in tender contracts	Can specify solar heating installations in tender documents. Can make detailed descriptions and drawings and select fitted products. Is able to make financial calculations related to contracting phase	
Construction	Quality assurance of realisation of solar heating systems.	Can manage, instruct and audit contractors on site during realisation of a solar heating system, based on information given by the designer and the tender documents. Is able to instruct the contractor on the specifics of the system. Can audit the realisation on critical points.	
Construction	Commission a solar heating system	Can commission a solar heating installation on functionality in all seasons, under full and partial load, seasonal performance. Can determine if the installation operates as planned, makes sure the foreseen energy performance is realised.	
In use	Ensure optimal operation of solar heating system	Monitor and control the solar heating installation on critical parameters, in order tot guarantee the designed performance during life cycle. Can design a maintanance plan.	
In use	Communicate the appropriate use and maintenance of the solar heating system	Can instruct the facility manager on monitoring parameters, to guarantee that the system achieves the designed energy saving goals	

Technology Nr.			
EP9		Mini wind power generation 	Mini wind turbines for use on-site (on roofs etc.)
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s) 1 2 3 4 5
General	Understand mini wind power related to nZEB	Understands the basic working and application of mini wind power, is able to explain and discuss within the project team. Is aware of constraints and boundary conditions (regulations, construction, available energy sources)	
Preparation	Perform a feasibility study on mini wind power	Is able to perform a feasibility study on mini wind power including financial aspects. Can estimate needed electrical power demand of the building, Can determine the part of mini wind power on total power supply. Understands basic principles needed in design and calculation, e.g. orientation, wind, power inverter.	
Design	Engineer the mini wind power system	Detailed engineering of the mini wind power system, including batteries and power inverters, in coherence with other power supply sources.. Engineering of the construction strenght for placing mini turbine. Accurate calculation of the needed power (kW)	
Construction	Specify a mini wind power system in tender contracts.	Can specify a mini wind power system for use in contracting. Is able to select products that fit specifications and demands on given quality aspects. Make detailed and accurate descriptions and drawings of the design. Is able to make financial calculations related to contracting phase.	
Construction	Quality assurance of mini wind power	Can manage, instruct and audit contractors on site during realisation of a mini wind power, based on information given by the designer and the tender documents. Is able to instruct the contractor on the specifics of the system. Can audit the realisation on critical points.	
Construction	Commission a mini wind power system	Is able to commission the mini wind turbine on functionality. Can determine if the installation operates as planned, makes sure the foreseen energy performance is realised.	
In use	Ensure optimal operation of mini wind power during life cycle	Can give instructions to users (or to facility manager). Is able to set up a maintenance plan to ensure optimal operation of the mini wind power system.	

Technology Nr.			
EP10		Combined Heat and Power (CHP) generation 	Energy production by turbines that generate heat and electricity. By the low heating efficiency mostly used when there is high need of electricity.
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s) 1 2 3 4 5
General	Understand CHP and it's contribution to nZEB	Has basic understanding on the principles of combined heat and power generation, can discuss within the project team.	
Preparation	Has knowledge on CHP in the project definition phase	Has knowledge on CHP in the project definition phase, regarding regulations, technical demands, energy sources, temperature levels.	
Preparation	Perform a feasibility study on CHP	Can perform a feasibility study on the use of CHP, regarding technical demands, regulations and costs. Can estimate the needed electrical power and heating demand as well as the heat storage needed in order to determine possibilities of CHP by means of load and load duration curves. Can make an inventory of possible solutions for power supply and heating (energy flows)	
Design	Engineer a CHP system	Engineer the CHP system, Can estimate the heating and cooling demands of the building. Can determine the demands of domestic hot water (average, peak demand). Can make a hydraulic scheme to fit in the CHP unit with a guaranteed return temperature and acceptable on/off switch numbers. Can make a description of the control strategy.	
Construction	Specify a CHP-system in tender documents	Specify a CHP-system for use in contracting. Is able to select products that fit specifications and demands on given quality aspects. Can make detailed and accurate descriptions and drawings of the design. Is able to make financial calculations related to contracting phase	
Construction	Quality assurance of a CHP system	Can manage, instruct and audit contractors on site during realisation of a CHP system, based on information given by the designer and the tender documents. Is able to instruct the contractor on the specifics of the system. Can audit the realisation on critical points.	
Construction	Commission a CHP-system	Is able to commission the CPH system on functionality in all seasons, under full and partial load	
In use	Ensure optimal operation of a CHP system	Monitor and control the CHP installation on critical parameters, in order tot guarantee the designed performance during life cycle.	
In use	Design a maintanance and operation plan for CHP systems	Design a maintenance and operations plan, determine critical parameters. Give instructions to user or facility manager.	

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Technology Nr.								
ER1		Insulation		Thermal insulations of ground floors, walls, roofs, thermal bridges				
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand the importance of insulation in relation to nZEB	Has general knowledge on insulation. Understands the basic concept of energy conservation, is able to take part in discussions within a project. Is aware of constraints and boundary conditions (regulations, construction)						
Preparation	Determine the insulation concept within a nZEB project	Understands the concept of energy conservation (reduction of losses) in terms of building shape, zoning of rooms, insulation, airtightness etc. Understands the nature of the thermal bridge. Can discuss and, to some extend evaluate, possible solutions for the thermal bridge problem. Can determine the effect of application of different types of construction elements for the energy performance of the building						
Design	Engineer the insulation concept and thermal bridges	Detailed engineering of insulation and solutions for thermal bridges						
Construction	Specify the insulation concept in tender documents	Specification of building insulation for contracting purpose. Is able to select products that fit specifications and demands on given quality aspects. Make detailed descriptions and drawings of the design						
Construction	Quality assurance of building insulation	Can manage, instruct and audit contractors on construction site, on critical points. Has knowledge on methodologies to measure quality, e.g. thermography.						
Construction	Commission building insulation	Knows how to measure and evaluate the insulation of the building and its effect on building energy performance						

Technology Nr.								
ER2		Air tightness building		Air tightness of openings such as doors and windows				
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand the importance of air thightness on energy performance	Has general understanding of the influence of air tightness building on energy performance. Understands the nature of air leakage, is able to take part in discussions within a project.						
Design	Design an air thight building	Can address the air tightness of the building as a part of energy conservation concept. Can guide the design on air thightness towards the desired level of air thightness. Has knowledge on materials, techniques and measures to reach the demanded air thightness.						
Construction	Specify air thightness in tender documents	Specify air thightness for contracting purpose. Is able to select products or suppliers that fit specifications and demands on given quality aspects. Make detailed drawings when needed. Is able to make financial calculations related to contracting phase						
Construction	Quality assurance on air thightness	Can manage, instruct and audit contractors on construction site, on critical points. Has knowledge on methodologies to measure quality, e.g. blower door test.						
Construction	Commission building air thightness	Knows how to measure and evaluate the air thightness of the building and its effect on building energy performance.						

Technology Nr.								
ER3		Micro climates		Green roof, cool roof, exterior landscaping/trees, earth sheltering				
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand micro climates in nZEB projects	General knowledge on mirco climates. Can understand the interplay between micro climate, buildings and their services. Understands climatic design principles.						
Preparation	Investigate mirco climates as strategy to reach nZEB	Can investigate the appriopriate solution and is aware of the importance of early decisions later in the project. Has knowledge of the main passive design strategies (i.e. daylight, passive cooling, natural cooling, thermal mass, solar heating, etc.)						
Design	Design of micro climates in nZEB	Can discuss and evaluate climatic and local conditions on the site for application of optimal passive strategies (micro and macro climate). Can understand, evaluate and follow climatic design strategies for an optimal energy performance. Can combine several design strategies and evaluate their performance as a whole building energy concept. Can perform optimal design of buildings according to micro and macro climate						

Technology Nr.								
ER4		Envelope systems		Trombe wall, double envelope, facade systems, Barra system				
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand envelope systems and contribution to energy performance	Has general knowledge on heat transfer within envelope systems, understands the principles and contribution to energy saving.						
Preparation	Investigate envelope systems as means te reach nZEB	Is aware of physical characteristics of envelope systems and their limitations. Can understand the heat transfer principle in the envelope systems. Can explain and address pros and cons of the envelope systems. Can name physical characteristics of such constructions and their limitations.						
Design	Design envelope systems	Can perform design of envelop system as a part of complete building energy system.						
Construction	Commission an envelope system	Has knowledge of performance evaluation of the envelope systems.						

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Technology Nr.								
ER5		Hot water systems  Heat recovery, smart distribution						
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand function of hot water systems	General knowledge on hot water distribution systems, is aware of it's function to distribute heating, cooling and potable hot water.						
Preparation	Investigate solutions for distribution of heating, cooling, potable hot water.	Understands the design principles of water distribution systems for e.g. heating, cooling and domestic hot water and the relation with insulation, energy saving by optimal hydraulic design. Understands the nature of energy loss in these systems caused by heat transfer, pressure loss (resistance of tubes and valves) and electrical power for pumps and valves. Is able to avoid large distribution						
Design	Engineer hot water systems	Can engineer a hot water distribution system for e.g. heating, potable hot water. Can perform the design of the system regarding insulation and solutions for heat recovery. Can describe and explain physical properties (e.g. static/dynamic pressure, authority, velocity, heat transfer). Is aware of the influence of insulation on total energy demand. Can calculate the needed insulation thickness						
Design	Hydraulic balancing of hot water systems	Can make a hydraulic balancing calculation, is able to calculate and select projects and components in the installation e.g. A-label pumps, balancing valves.						
Construction	Specify distribution systems in tender documents	Specification of a distribution system for contracting purpose, including drawings, hydraulic schemes, quality aspects and valves and monitoring devices.						
Construction	Quality assurance on distribution systems	Can manage, instruct and audit contractors on correct realisation of water distribution systems, hydraulic balancing and setting of parameters e.g. flow and temperatures						
Construction	Commission a hot water distribution system	Is able to commission the dsitribution system on functionality in all seasons, under full and partial load. Can determine if the installation operates as planned, makes sure the foreseen energy performance is realised.						
In use	Ensure optimal operation of hot water distribution systems	Can design a maintenance plan and instruct the facility manager, to guarantee that the system achieves the designed energy saving goals, including hydraulic balancing en monitoring parameters.						

Technology Nr.								
ER6		Window and/or glazing systems  Insulation glass, Smart glass, Blinds (sun reflection), Brise soleil, daylighting systems, solartubes						
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand window / glazing systems in relation to energy performance	General knowledge on window and/or glazing systems						
Design	Engineer window / glazing systems	Can understand and address the heat transfer principle in a glazing system. Can calculate properties of the glazing system. Can describe and explain physical properties of the glazing system (i.e. g-value, u-value, light transmittance.						
Preparation	Design energy efficient solutions for window / glazing systems	Can discuss and design window/glazing system for optimal comfort and energy performance. Can understand the effect of shading device for performance of a glazing system. Can evaluate and design optimal shading system and its control strategy.						

Technology Nr.								
ER7		Heating and cooling emission systems  Low temperature heating systems and high temperature cooling systems, surface heating/cooling						
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand heating and cooling emission in relation to comfort and energy performance	General knowledge on heating and cooling emission systems, influence on human comfort and energy demand. Understandig of relation with heating and cooling generation, high and low temperatures.						
Preparation	Investigate energy efficient solutions for heating and cooling emission	Understands the basic design principles of heating and cooling emission systems and can explain, regarding human comfort and energy use. Can investigate and select the appropriate system according to the heating and cooling generation system. Understands the specifics of high temperature cooling and low temperature heating. Is familiar with the specifications and functionality of e.g. climate ceilings, radiators, wall-heating, floor-heating, convectors, induction air units.						
Design	Engineer heating and cooling emission systems	Can design and evaluate solutions for different types of rooms and spaces regarding square metres, height, human comfort and occupation (Fanger model, PMV), adaptation and control strategies. Is able to design a system taking into account the relation with the heating and cooling generation system						
Construction	Specify heating and cooling emission systems in tender contracts	Specify heating/cooling emission systems for contracting purpose. Can make detailed drawings and descriptions of the demanded systems, in a way the contractor can offer a system or products that fulfill the demands.						
Construction	Quality assurance of heating / cooling emission systems	Can manage, instruct and audit contractors on site during realisation of heating/cooling systems, based on information given by the designer and the tender documents. Is able to instruct the contractor on the specifics of the system. Can audit the realisation on critical points.						
Construction	Commission heating / cooling emission systems	Is able to commission the heating / cooling emission system on functionality in all seasons, under full and partial load. Can determine if the installation operates as planned, makes sure the foreseen energy performance is realised.						
In use	Ensure optimal operation of heating / cooling emission systems	Can set up a maintenance plan and give instructions to users in order to maintain settings and energy efficiency						

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Technology Nr.								
ER8		Electric heating systems 	Electric heating systems such as InfraRed and electric floor/wall heating can contribute to indoor comfort and energy saving under the right conditions (low frequency use, or very high insulated buildings)					
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand contribution of electrical heating to NZEB	Has general knowledge on electric heating, understands the basic working and properties of electric heating systems, is able to take part in discussions. Is aware of the potential contribution to energy saving by local heating. Is aware of the interactions between electric heating versus power supply capacity.						
Preparation	Perform a feasibility study on electric heating	Is able to performe a feasibility study in order to determine wether application of electric heating is appropriate and sustainable under the given conditions (e.g. room occupation, temperature, comfort, available heat/energy source, construction of walls/floors/ceiling). Is familiar with different types of electric heating systems (Infra red, floor and wall heating foil or panels).						
Design	Engineer an electric heating system.	Detailed engineering of electric heating systems. Is able to calculate the needed capacity for space heating under given conditions. Has specialistic knowledge of radiation heating, PMV, properties and human interaction (e.g. how to design for high spaces). Is able to comply with available electrical power supply.						
Construction	Specify electric heating systems in tender documents	Is able to define and specify the electric heating system for use in contracting phase.						
Construction	Quality assurance of electric heating	Can instruct, manage and audit contractors on site during realisation of a electric heating system, to ensure the designed energy saving goals are met.						
Construction	Commission electric heating systems	Commission an electric heating system on functionality, energy efficiency and human comfort.						
In use	Ensure optimal operation of electric heating systems	Can design a maintenance plan and instruct the facility manager on monitoring parameters, to guarantee that the system achieves the designed energy saving goals						

Technology Nr.								
ER9		Artificial lighting systems 	Artificial lighting systems have a high power consumption. By using HF fluorescent lighting, LED lighting, natural daylight and programmed control systems energy can be used efficiently					
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand artificial lighting systems in relation to energy performance in NZEB	Understands and can explain the basic design principles of artificial lighting systems. Has general knowledge on different types of lighting and contribution to energy efficiency.						
Preparation	Investigate energy efficient solutions for artificial lighting regarding human factors.	Can investigate solutions for artificial lighting systems, taking into account human comfort, energy efficiency, maintenance, costs.						
Design	Engineer an artificial lighting system	Can design an artificial lighting system based on e.g. daylight, timer, occupation of spaces. Is aware of technical specifications and restrictions, such as power quality and energy efficiency (LED, HF fluorescent lighting). Is aware of influence of used materials in light bulbs/LED's on environment (chemical elements, mercury...)						
Construction	Specify artificial lighting in tender documents.	Specify an artificial ligthing system for contracting purpose. Choose products that fit specifications of lighting (lux, lumen) as well as electric restrictions (power quality), taking into account sustainability of products.						
Construction	Commission an artificial lighting system	Can commission artificial lighting systems on quality and functionality and make sure the foreseen contribution to energy saving is realised.						

Technology Nr.								
ER10		Ventilation systems 	Ventilation system to guarantee good indoor air quality. The energy use of this system is very much dependent on the type of system, and the quality of engineering and construction					
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Understand ventilation systems in relation to energy performance	Has general knowledge on ventilation systems, understands basic principles, is aware of the importance of IAQ on human performance and well being. Is familiar with concepts of oxygen, exhaust of carbon dioxide, pollution, allergens.						
General	Understand basic design principles of ventilation and IAQ systems.	Understands the basic design principles of ventilation systems, such as natural, semi natural and mechanical systems, central or decentral (façade) systems.						
Preparation	Advise on required IAQ	Explain, discuss and advise to project developer and future user which minimum indoor air quality is wished for.						
Preparation	Investigate and select fitted ventilation systems	Can investigate and advise on a ventilation system that fits the energy demands but also guarantees good indoor air quality according the minimum IAQ levels. Is open to alternative ways of ventilation (e.g. stack ventilation, use of chimney effect). Also advises on need or use of opening windows.						
Preparation	Perform energy calculation of ventilation systems	Can calculate and evaluate the total energy use of the ventilation system regarding electrical power consumption, heat loss of the system and the building, on a yearly base in order to select a fitted concept.						
Preparation	Advise on natural ventilation for (summer) night cooling	Can advise on the use of natural ventilation at night to cool down the building during summer time.						
Design	Engineer a ventilation system	Can engineer a ventilation system, regarding future aspects of maintenance. Knows the interplay between an nZEB building, it's use (occupation) and the right ventilation strategy. Can design a system regarding specific needs of the building and its users. Engineer the air ducts, inlets, outlets, fans, filters etc.						
Construction	Specify a ventilation system in tender contracts	Can specify the design, describe important specifications, make drawings of the ventilation system, in a way that ensures optimal performance on energy and IAQ (indoor air quality).						
Construction	Quality assurance of a ventilation system according tender contract	Can manage, instruct and audit contractors on site during realisation of the ventilation systems, based on information given by the designer and the tender contracts.						
Construction	Commission a ventilation system in relation to energy performance and IAQ	Can commission a ventilation system on funtionality, quality and realised energy performance. Can determine wether the system operates as planned and the designed energy performance is realised.						
In use	Ensure optimal operation of ventilation systems on energy performance and IAQ	Can monitor and control the ventilation system on critical performance parameters, in order to guarantee performance as designed. This includes monitoring of settings, design of a maintainance plan for cleaning of air ducts, filters etc.						
In use	Communicate with customers on appropriate use of ventilation	Can instruct building users in order to make sure the system is used as designed for in relation to energy performance and IAQ.						

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Technology Nr.								
IS1		Communication	Being able to listen and summarize conversations (in common language); Realizing common understanding and involving other people in the project objectives					
Project (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
General	Effective communication within NZEB projects	Understand the customer needs, and the opinions of actors involved in the project planning and implementation. Explain own ideas, plans and requirements to customers, and partners from other sectors.						
Concept design	Present the design and reach consensus on decisions.	Present the design concept to customers, project developers and decision makers. Moderate discussions, reach consensus about the final design.						
Construction	Communicate in contracting phase, understand and respect the role of all actors involved	Negotiate with contractor / customer / project developer / decision maker. Understand and apply the requirements of the different actors in the contract.						
Construction	Coordinate contractors and suppliers by effective communication	Coordinate contractors and suppliers.						
Construction	Communicate with customers on construction progress and experience of building performance	Follow-up and report back to customers about the implementation and construction phase. Understand the users experience regarding building performance						
In use	Communicatie with suppliers and facility employers on energy performance	Communicate and exchange with the technology suppliers, maintenance personal. Ask the right questions.						
In use	Instruct users and facility managers on energy performance of the building	Explain / understand the maintenance plan to maintain energy performance and proper IEQ in the building. Train and instruct facility managers and building users.						
General	BIM project management	To be able to perform BIM project management						
General	BIM coordination process	To be able to perform BIM coordination						
General	Giving support on BIM tools to employees	Able to give support on BIM tools to employees.						
General	External context for BIM, global, national, standards and support communities	Able to describe and use external context for BIM standards and support communities						
General	Barriers to successful adoption of BIM	Able to see and overcome barries with the purpose to successful adopt BIM						
General	The value, benefits and investment associated with BIM	Able to see and communicate the value, benefits and investment associated with BIM						
General	Facilitate BIM communication between different stakeholders	Able to facilitate BIM communication between different stakeholders						
General	Ensure compliance with BIM standards	Able to ensure compliance with BIM standards						
General	Establish organization/project BIM goals	Able to establish organization/project BIM goals						
General	Establish organization/project budgets, planning and costs for BIM implementation and maintenance	Able to establish organization/project budgets and costs for BIM implementation and maintenance.						
General	Test new staff in BIM knowledge and skills	Able to test new staff in BIM knowledge and skills						
General	Modeling competencies.	To be able to create, update and evaluate BIM (aspect)models						
General	Troubleshoot problems as they relate to the BIM systems	Able to troubleshoot problems related to BIM systems						

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Technology Nr.								
IS2		Information management	Understanding technical drawings (2D/3D) and texts; Being able to interpret information (also in BIM-models); Understanding of the complete NZEB building process					
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)					
			1	2	3	4	5	
Preparation	Select appropriate modelling tools for NZEB design	Can select appriopriate design and modelling tools. Has knowledge on the different available models for NZEB design.						
Design	Supervise the use of information modelling in design teams	Is able to analyse and interpret data from modelling tools, has experience to guide the team.						
Design	Use and management of information models within the NZEB design	Can use design and BIM software to prepare technical drawings. Can define dataset criteria, manage and analyse data, calculate (nZEB) energy performance.						
Construction	Manage data, keep records of implementation, monitor outcome.	Can manage data within the information model, keep records of implementation, monitor outcomes						
Construction	Monitor the energy and IEQ performance with use of information modelling.	Manage data, continouosly monitor the building (nZEB) energy and IEQ performance.						
Construction	Site utilization planning to graphically represent both permanent and temporary facilities on site during multiple phases of the construction process	Able to graphically represent utilization planning during construction						
Construction	Perform 4D visualization of construction schedules	Able to perform 4D visualization of construction schedules						
Construction	3D construction control and planning to layout facility assemblies or automate control of equipment's movement and location	Able to layout facility assemblies/automate control of the location/movement.						
Construction	Record modelling to depict an accurate representation of the physical conditions, environment, and assets of a facility	Able to record modelling to depict an accurate representation of the physical conditions/environment, and assets of a facility						
General	Integrate with project partner (supply chain) databases	Able to integrate models in different databases						
In use	Building maintenance scheduling to maintain the functionality of the building structure and equipment serving the building over the operational life of a facility	Able to build maintenance schedulings						
In use	Building system analysis to measures how a building's performance compares to the specified design	Able to build analysis systems						
In use	Asset management, an organized management system where information is bi-directionally linked to a record model to efficiently aid in the maintenance and	Able to set up an organized management system						
In use	Space management and tracking to effectively distribute, manage, and track appropriate spaces and related resources within a facility	Able to set up an space management systems						
General	Use laser scanning pointclouds to model, compare and evaluate facility and related systems	Able to use laser scanning pointclouds to model, compare and evaluate facility and related systems						
General	Photogrammetry to model, compare and evaluate facility and related systems	Able to photogrammetry to model, compare and evaluate facility and related systems.						
General	BIM workflows and processes	To be able to set up BIM workflows and processes						
General	BIM execution plan	To be able to set up an BIM execution plan						
General	Advantages and disadvantages of BIM for design and construction processes	To be able to evaluate the use of BIM for design and construction processes						
General	Manage BIM knowledge in organizations/projects	Able to manage BIM knowledge in organizations/projects.						
General	Manage BIM roles and responsibilities in organizations/projects	Able to manage BIM roles and responsibilities in organizations/projects						
General	Managing organization and project BIM risks	Able to manage organization and project BIM risks						
General	Monitor, report and control BIM implementation in organizations/projects	Able to monitor, report and control BIM implementation in organizations/projects						
General	Stay up to date on BIM trends, current developments and new directions	Able to incorpate information about BIM						
General	Study and evaluate new BIM or related technologies	Able to evaluate new BIM related technologies						
General	Study, analyze and evalute best BIM processes, routines and workflows	Able to evaluate BIM processes, routines and workflows						
General	BIM standards development, implementation and enforcement in organizations/projects	Able to develop and implement in organizations/projects						
General	Have a thorough knowledge of current BIM standards in the office	Able to apply BIM standards						

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Technology Nr.							
IS3		Collaboration	Working together in cross-trade settings, with all involved NZEB building disciplines; Being able to connect the individual performance to a team performance; Raising enthusiasm for sustainable NZEB				
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)				
			1	2	3	4	5
Preparation	Work together in cross-trade teams towards common goals	Contribute to the work in cross-trade teams applying, adapting own methods and knowledge from its own sector/discipline. Follow a cross-disciplinary approach, able to define and work towards common goals.					
Design							
Construction							
Construction							
Construction							
In use							

Technology Nr.							
IS4		Quality assurance	Taking responsibility in assuring quality of its own work; Being aware of the consequences of actions on the energy performance of the NZEB building and the building process; Being able to implement and assess				
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)				
			1	2	3	4	5
Preparation	Define QA criteria to ensure energy and IEQ performance	Define measureable QA criteria with appropriate data input, according to customer needs to ensure nZEB energy and IEQ performance.					
Design	Apply QA criteria in design phase	Apply the defined QA criteria in the design phase. Integrate the means of QA measurement and monitoring in the design, using BIM and BAC where applicable.					
Construction	Define QA monitoring methodology	Define the QA monitoring methodology with measureable QA criteria as part of the contract					
Construction	Manage QA during realisation	Apply quality management according to the agreed QA methodology throughout the realisation phase					
Construction	Monitor QA data and manage performance gaps	Measure and analyse the defined QA input data, define and manage performance gaps					
General	Establish quality management in organizations/projects: assurance, control and improvement	Able to establish quality management					

Technology Nr.							
IS5		Sustainable architectural design	Being able to design (with all project partners involved) a nZEB building with comfort and sustainability as an aim; Having a good understanding on the energetic consequences of every decision made during the design				
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)				
			1	2	3	4	5
General	Understand the impact of architectural design on sustainablity and energy performance	Has knowledge on a holistic and integrative sustainable architectural design approach, understands the various participants and roles in the sustainable construction project. Is familiar with means for energy reduction, production and management.					
Preparation	Select sustainable constructions and materials	Has knowledge on various construction materials and technologies, their performance, benefits versus costs. Is able to describe project demands regarding sustainability performance and discuss within project team how to achieve					
Preparation	Design passive energy measures	Knowledge on how far the performance can be achieved using passive measures, less prone to failures and without maintenance costs and requirements. Complement passive measures with as few as necessary active measures					
Design	Design of an architectural sustainable building	Has an holistic view on integrative sustainable architectural design process. Can produce an holistic design, which includes passive measures that are complemented by active technologies in a sensible way. Is able to select materials and technologies that fulfill the specified demands on sustainability, taking into account national regulations and certification structure of materials.					
Design	Design of a sustainable and flexible floorplan	Can design location of technologies in an easy to access for maintenance location and to not infere with the occupant and her comfort. Can design, based on the project room book, in a flexible and hence durable sustainable way: the floorplan can be easily adapted over the years to various occupants and their needs in order to extent the life expectancy of whole building. How to translate project requirements into a roombook used for sustainable design					
Construction	Define the buildings' energy performance in tender documents	Define building performance as part of the contract. Select companies with experience and training of the selected technologies					
Construction	Coordinate the project team to ensure building quality	Apply quality management throughout the realisation phase. Coordinate between team members of different diciplines					
Construction	Quality performance control on site	Measure and analyse the realised performance, define and manage performance gaps					
In use	Instruct the facility manager on running and maintaining the buildings energy performance	Ensuring the building manager has all the knowledge he/she needs to run the building in a way the energy performance is achieved. Hand over and train building manager in running and maintaining the building.					

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Technology Nr.			
IS6		Integrated design	Being able to design integrally with the other involved NZEB building disciplines

Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s) 1	2	3	4	5
General	Understand integrated design processes and concepts	Theoretical knowledge of integrated design processes and concepts. Has theoretical understanding of design process and how designers think					
General	Understand the interplay of building location, design, use and outdoor climate	Knowledge on interplay between all aspects of building design, building use and outdoor climate. Able to understand the interplay between microclimate, buildings and their services. Understand the interplay between sustainable energy system, building energy demand and renewable energy production					
General	Understand design methods for passive energy technologies	Able to understand basic design methods for passive energy technologies. Able to apply and combine design methods for passive energy technologies					
General	Project life cycle concept	Able to integrate life cycle concepts in different project phases.					
Preparation	Define and communicatie integrated design goals	Can define and communicate design goals					
Preparation	Site analysis with BIM/GIS tools to evaluate properties in a given area	To be able to view, navigate and extract information to evaluate properties in a given area					
Design	Evaluate the integrated design	Can use goals and targets as means of measuring success of design proposals. Able to apply, combine and evaluate advanced methods for analysis of the interplay between energy systems, architectural concepts, building design, building use, outdoor climate and HVAC systems.					

Technology Nr.			
IS7		Sustainable building materials	Being able to asses building materials regarding their sustainability and make the right selections during the design phase

Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s) 1	2	3	4	5
General	Understand sustainability of materials	Has general knowledge on sustainability of building materials, influence of materials on the global environment during its whole lifecycle. Can explain the importance of using sustainable materials.					
General	Understand the importance of correct application of materials on sustainability	Can explain the necessity of use of sustainable materials. Is aware of the consequences of wrong application of materials on their and the building's sustainability. Knowledge on how far the performance can be achieved using passive measures such as sustainable construction materials, less prone to failures and without maintenance costs and requirements					
Pre-design	Knowledge on various installation materials, their performance, benefits versus costs	Is able to describe demands on sustainability of materials within the project and discuss within project team. E.g. life expectancy, recycling. Follows developments and innovations.					
Design	Select sustainable materials in design	Is able to select materials that fulfill the specified demands on sustainability, taking into account national regulations and certification structure of materials. Has general knowledge on applicable regulations. Holistic design with chosen materials applied in correct manner and composition with each other and other materials.					
Tender	Define performance of materials in tender documents	Can define sustainability of materials in tender documents. Can select companies with experience and training of the selected technologies					
Realisation	Quality assurance of sustainable materials	Can apply quality management throughout the realisation phase on sustainability of materials.					
Commissioning	Quality performance control	Measure and analyse the defined performance, define and manage performance gaps. Measure indoor air quality/ pollution of used materials (VOC source)					
Use & Maintain	Ensure optimal maintenance of materials	Has knowledge on any requirements of materials (maintainance, cleaning). Train building manager in any requirements regarding the materials					

Technology Nr.			
IS8		Sustainable installation materials	Being able to asses materials on sustainability and make the right selections in the design

Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s) 1	2	3	4	5
General	Understand sustainability of technologies and appropriate application	Has general knowledge on sustainability of technologies, influence of them on the global environment during its whole lifecycle. Is aware of the consequences of wrong application of technologies on their and the building's sustainability.					
Pre-design	Understand performance, benefits and costs of various technologies	Has knowledge on various technologies, their performance, benefits versus costs. Is able to describe project demands regarding sustainability performance and discuss within project team how to achieve.					
Pre-design	Understand application of passive or active technologies	Has knowledge on how far the performance can be achieved using passive meassures, less prone to failures and without maintenance costs and requirements. Complement passive measures with as few as necessary technologies					
Design	Select sustainable technologies in nZEB design	Produce a holistic design, which includes passive measures that are complemented by active technologies in a sensible way. Is able to select materials and products that fulfill the specified demands on sustainability, taking into account national regulations and certification structure of materials.					
Tender	Define performance of materials in tender documents	Choose companies with experience and training of the selected technologies					
Realisation	Quality assurance of sustainable materials	Can apply quality management throughout the realisation phase on sustainability of materials. Coordinate the project team to ensure design intent is built in correctly					
Commissioning	Quality performance control	Measure and analyse the realised performance, define and manage performance gaps . Train building manager in running and maintaining technologies					
Use & Maintain	Ensure optimal maintenance and operation	Has knowledge on any requirements of materials and technologies (operate, maintenance, cleaning). Train building manager in any requirements regarding the materials					

Technology Nr.		
IS9		Environmental (indoor) quality

Project phase (if applicable)	Short description	Detailed description of competencies
General	Understand the interplay between energy performance and IEQ	Has general knowledge on environmental indoor quality, understands environmental quality.

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Technology Nr.							
IS10		Economics	Having a clear view of issues on cost-benefit analysis, cost optimal calculation and pricing; Having financial engineering knowledge and competencies; Taking into account LCC analysis during the nZEB building				
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)				
			1	2	3	4	5
Financial planning	Define the financial boundary condition, prepare a financial plan	Prepare a financial plan with cost-benefit anaysis, and LCC scenarios about the nZEB construction project. Collect information on market prices. Identify available public and private incentives and funding.					
Design / tendering	Comply with the financial boundary conditions of the decision maker.	Apply cost optimal calculation for the nZEB contruction project. Design bankable projects. Apply LCC analysis. Define the financial framework and plan for the energy performance contracting offer according to the call for tender.					
Contracting	Negotiate the financial plan of the contract	Negotiate the financial plan of the contract with aceptable prices,contracting with private and public funding. Negotiate better prices with suppliers. Evaluate the financial feasibility of the offers, select the best value for money offer. Agree and integrate a financial plan with appropriate fiancial guarantees in the contract.					
Contracting	Design a bankable project, apply for funding	Apply for private and public funding, present bankable projects, negotiate the loan agreement with financial institutions/funding bodies.					
Realisation	Ensure compliance of spendings	Monitor and ensure that spendings comply with the financial plan and boundary conditions. Monitor the spending and manage the financing of the investment. Identify and handle deviations from th financial plan, apply financial guarantees of the contract.					
Realisation	Financial management	Financial management of the agreements involving public funding and the energy performance contracts.					
Commissioning and use	Identify and solve problems in financing	Identify and handle deviations from the financial plan, apply financial guarantees of the contract					

Technology Nr.							
IS11		Procurement	Being able to facilitate the process of nZEB tenders and (sub)contracts; Being able to set proper tender specifications to meet nZEB requirements; Being familiar with green procurement, energy performance contracting, national				
Project phase (if applicable)	Short description	Detailed description of competencies	for competence level(s)				
			1	2	3	4	5
General	Understand tender and contracting phase	Has knowledge on the criteria for a succesfull tender and contracting. Is aware of compliance with legal and technical aspects and green procurement. Is able to define appriopriate tender specifications within the own field of expertise					
Tender specification	Specify tender to achieve nZEB performance	Prepare appropriate tender specifications to achieve nZEB level performance. Understand the technical needs, define the adequate technical specification including measurable energy and IEQ performance criteria.					
Tender specification	Define, understand and comply with the legal, financial and project management related criteria.	Has knowledge of the legislation, technical aspects, and international good practice of green procurement and energy performance contracting. Knowledge of national and international public procurement legislation, state aid rules and the use of public funding.					
Tender specification	Define guarantees to nZEB performance	Define appropriate guarantees that apply if the technical / performance criteria is not met. Integrate appropriate guarantees in the contract that apply if the technical / performance criteria is not met.					
Tendering and contracting	Negotiate and achieve contracts enabling nZEB.	Prepare offers that meet the tender specification to reach nZEB performance. Sucsesfully manage the public procurement process, analyse tenders and select the appropriate offer. Handle legal issues, manage contract preparation. Negotiate with tenderers/contractor.					
Realisation	Monitor project realisation and handle deviations	Monitor project realization according to the TS and the contract. Identify and handle deviations/breach of the contract, negotiate eventual changes.					
Commissioning	Monitor building performance	Hand and take-over the building, monitor whether the contracted performance is met. Analyse and report whether the contracted nZEB performance is met, identify and report about performance gaps at handover and during the operational phase.					
Use & Maintain	Identify and solve problems in building performance	Identify and handle deviations/breach of the contract, apply guarantees during the operational phase. Negotiate and take the necessary legal steps if the contractual requirements were not met.					

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