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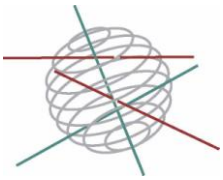

ENERGY

FINAL REPORT

Development of quality references in distributed renewable energy concepts in Belgium "Q-DIRECT"

SD/EN/04

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SUMMARY

A. Context

Until 2008, the development of renewable energy was driven by a loose legislative framework of non-binding targets. Since the adoption of the Renewable Electricity Directive and the EU RES Directive, energy and environmental policies have to reach legally-binding objectives and should therefore dispose of real performance evaluation systems.

Some Renewable Energy Technology (RET) markets are increasing at a fast pace, giving rise to constant evolutions. In Belgium, major differences exist in terms of market penetration and supply chain of RETs, a.o. because of differentiated regional public support schemes.

Some support schemes attracted large numbers of suppliers and installers, leading to a highly diversified offer of products and to a lack of qualified professional structures.

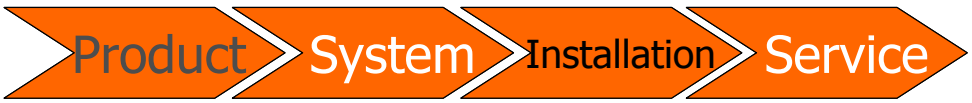
On the other hand, end-users wishing to buy or lease small generation units usually expect good to high quality of related products and services. Quality insurance for (emerging) RET have proven to be of utmost importance for their sustainable market deployment.

A particular aspect of the research consisted in approaching the design of a quality scheme at multiple levels according to the target group, the market chain level and the technologies covered.

B. Objectives

The main goal of the research was to set-up guidelines for policymakers to encompass the growth of distributed small-scale energy systems in Belgium, according to common ambition levels and requirements and high quality standards.

The so called Integrated Quality Scheme (IQS) should be designed to be further operated by an independent third party and offer the same confidence level & guarantees on product quality, system design, performance and installation reliability to the end-user, no matter the technology.



The aim of the first phase was to structure the quality requirements for each technology in order to provide policy and market instruments allowing policymakers and the professional sector to help the renewable energy sector to meet higher quality standards.

The overall objective of the second phase was to assess the interest and opportunity to integrate global & specific quality requirements and verification means into a comprehensive quality scheme, covering the full market chain for the reviewed renewable energy technologies, producing heat or electricity in the residential housing sector.

C. Conclusions

Quality schemes with self-commitment and generic content can be considered as an initial ambition level in quality assurance. Those with independent control and based on specific references can be recommended as a higher ambition level.

Quality assurance from the end-user perspective covers the whole market chain, from component to product, from system design to installation, up to commissioning, monitoring and maintenance of the installation in operation.

Common quality requirements (cross-technology) should cover the following areas:

Components and system design

- Installation works, guarantee and after sale service
- Function control and monitoring of performance
- Third party evaluation of systems in operation.

An important insight that came out of the methodological approach is that the definition and verification of requirements are more closely related to each other that one could expect. The way of defining a requirement closely related to the approach intended to verify this requirement in practice.

End-user expectations - covering the whole market chain, from component level to system design, up to commissioning, monitoring and maintenance of installations in operation – were found to be an important driver for innovation offering a good starting point and a comprehensive framework for quality requirements.

A common labelling or certification process of products (e.g. solar keymark) and installers as persons (e.g. EUCERT. HP) at EU level would offer a more accurate basis for end-users to compare respective quality levels than national and especially regional labels; although EU marks and certification schemes might look for minimal requirements at first stage.

The approach envisaged for an Integrated Quality System would be based on voluntary product & systems (EU) requirements combined with installer certification (as a person, conform to EU RES DIR) and installer company labelling at national level (QUEST-like labeling process).

This would fit current structure & market organization of most of the reviewed technologies.

Quality Labelling must be related to quality assurance systems based on specific technical references. Moreover, granting quality labels requires an independent verification of quality standards of the participating companies. This verification

should contain regular evaluation and on site inspections of RET installations in operation.

One of the challenge of an IQS is to further harmonize references between the Regions at installer level in order to get a common base for installer certification (as persons) in a mutually recognized scheme from 2012 onwards. The implementation of such scheme should lead to:

higher quality standards of RET installations

- higher consumer confidence and choice among skilled professionals
- healthy competition within the EU RET installation market
- pan-European recognition of certified RET installers
- increased market share for RETs installed by certified professionals

D. Contribution of the project in a context of scientific support to a sustainable development policy

By involving representatives from the CONCERE group, the project contributed to identify ambition levels, quality requirements and verification means which are common to most of the reviewed technologies and can be implemented by both three Regions in the same way.

Since the very beginning of this project, both Regions made genuine efforts to collaborate among each other and with the federal government, especially through the ENOVER/CONCERE group, to harmonize and streamline quality requirements of distributed renewable energy technologies.

In the coming year (2011), the group is aiming to further elaborate a common certification system for RES installer (as persons), to comply with EU RES DIR and to improve professional skills in a coherent and harmonized way.

Results from the first phase showed that efficient (EU) marks ensuring minimal or higher quality level of RET components, products and systems were available on the belgian market. While at Installer level, existing tools (e.g. trainings, support schemes, labels) were not sufficient to ensure a minimum quality level to the end-users of RETs.

During the second phase of the research, partners attempted to identify the necessary steps to organize the implementation of an integrated quality scheme within the Belgian institutional context and in the broader panel of Energy Policy & Quality instruments.

Early 2009, project partners managed to implement and test quality requirements, evaluation guidelines & labeling scheme for residential PV systems in real life conditions, through the operational structure of the belgian quality

centre for sustainable energy technologies (QUEST). A voluntary quality label for PV system integrators - based on EN and IEC standards – was enforced in a complex and moving institutional framework.

Evaluation guidelines for Heat pumps, Solar thermal and Ventilation systems with heat recovery, followed, based on technological roadmaps. Those guidelines were designed to be operated by a single operator in Flanders, Walloon and Brussels, in first instance as a common voluntary labelling scheme for installer companies.

The research further showed that In Belgium, it would be largely more effective to have an Integrated Quality Scheme common to both three Regions, even if the building sector regulation is a regional competence.

The challenge is now to move from policy design to implementation at national level, with concrete action on the ground.

E. Keywords

Q-Direct; Renewable Energy Technology; Integrated Quality Scheme; Small-scale distributed energy system;

1 INTRODUCTION

Renewable energy is crucial to any move towards a low carbon economy. It is also a key component of the EU energy strategy. The European industry leads global renewable energy technology development and employs 1.5 million people. By 2020 it could employ a further 3 million. The promotion of renewable energy also develops a range of mostly indigenous energy resources.

In Belgium, the Regions are mainly responsible for RES policy. As such, they put their own support policy for green electricity and green heat in place, as well as their own financial schemes and quality requirements; while the federal authority is using tax reduction to support RES.

A quickly and highly diversified offer of RET products due to very attractive public support schemes sometimes led to a lack of qualified professional structures and workforce. The recrudescence of self declared PV installer companies in Flanders and Walloon is a good example of such situation.

Moreover, differentiated requirements linked to several support schemes operated on small markets pretty close from each other - like Brussels, Walloon and Flanders - shall counteract the development and structuration of the sector, as well as higher qualification standards at product, system and installer level.

Even if such split of competences showed some good results locally (e.g. boosting the installation of SDHWS in Walloon thanks to the Soltherm action plan or the installation of large turn-key PV systems in Flanders thanks to the Green Certificate mechanism), regional schemes are fully depending on the political mood. Further on, RET suppliers and installer companies are usually active in more than one Region and therefore unnecessarily bothered by regional differences.

A low quality level of distributed energy systems in operation would in turn impact some of the objectives officially pursued by Belgium's support to Renewable Energy Sources (RES), according to its National Renewable Energy Action Plan (NREAP), namely:

- The reduction of fossil fuel consumption;
- The reduction of GHG emission;
- Belgium's dependence from foreign countries re energy imports;
- The mitigation of fossil fuel (and other energy sources) prices;

The need for objectives and independent quality references was hence expressed and turned into a research project led by five knowledge centres, further identified as project partners

The research showed that a national framework looking for higher quality standard at installer level was urgently needed for most of the reviewed RETs and that in order to identify companies able to deliver quality random quality control had to be organized at installation level according to a mix of prescriptive and performance based requirements.

One of the challenges of an integrated quality scheme was therefore to find a balance between performance-based and prescriptive requirements at product and installer level.

2 METHODOLOGY AND RESULTS

2.1 SCOPE

The scope of the technologies under review covers:

- Solar Thermal Energy for Domestic Hot Water Systems (ST)
- Solar Photovoltaic systems for residential applications (PV)
- Small-scale Biomass Energy Systems (pellet boilers, biomass burners, …) (BES)
- Urban Wind Turbines (small wind turbines integrated into the built environment) (SWT)
- Geothermal Heat Pump systems (HP)
- Building ventilation systems with heat recuperation (VwHR)

Table 1: Technological scope of the research (blue cells are part of the scope)

E-Demand / E-Source	Space heating Distribution system			DHW	Electric power	Swimming pool
	Direct radiation/ convection	Supply air	hydronic			
Extract air	-	VwHR t1,2 / VwHR+HP t3/ (HP t6)	VwHR+HP t4,5 (HP t8)	(HP boiler)	-	()
Outside air	(HP-split air)	(HP)	(HP)	(HP boiler?)	-	(HP)
Geothermal	-					
Vertical	-	(HP)	HP	HP	-	(HP)
Horizontal	-	(soil to air HX, t7) (HP)	HP	HP	-	(HP)
water	-	(HP)	HP	HP	-	(HP)
Solar radiation	(Passive Solar)	(Double facades / extraction out of greenhouse/air collectors)	(solar thermal space heating)	Solar Thermal	PV grid-connected	(Solar Thermal plastic)
Biomass	stoves	boilers	boilers	(+)	(CHP)	()
Wind	-	-	-	-	urban wind turbine	()

Recent work about the organisation and financing of an integrated scheme was used to upgrade technological roadmaps and the question of including the insight of roadmaps with the insight of organizing and financing the scheme was further elaborated.

Quality references are also dealing with technical issues and requirements which are common to several technologies, regarding their integration into:

- the building envelope
- the HVAC system
- the electrical grid

A review of common technical basis for quality systems covering cross-technology related requirements regarding building, HVAC & electro technical integration is available in respective reference documents analyzing electro technical (grid) integration of PV/SWT (D9); HVAC integration (D10) and Building integration of RET (D11), finalized during the first phase.

Reminder:

- Grid integration :
    - There are no specific rules for decentralized production in the AREI (RGIE), although a PV system is required to be inspected by an accredited body for overall conformity with the AREI.
    - The production installation needs to be designed in such a way that no intentional unbalances occur between the supplied power in the different phases.
    - Inverters without transformers are accepted provided either that it is certified that a DC higher than 1 % nominal current can never be injected or they are protected against DC.
    - If it is mentioned on the website of the DSO and in case of a single phase connection of a total power > 5KVA, an application has to be done before purchase and placing of the installation. Before the connection to the grid, the DG unit has to be tested for compliance at the owner's cost.
    - The DSO has to do anything to guarantee that the voltage in each connection point complies with the power quality characteristics as reported in the NBN EN 50160 standard.
    - The introduction of distributed generation connected at lower voltages causes bidirectional power flows and as such voltage rises in the distribution system. Still the EN50160 norm has to be fulfilled. Several experimental set-ups aimed at determining the maximum penetration of DG in the system by analyzing the voltage at minimum load (i.e. the worst case scenario). This resulted in situation where even small amounts of DG power injection became unacceptable. The research showed that a transition of passive to active grid operation was essential to facilitate the integration of DG.
- the interactions between the reviewed RET and the building are summarized in the table below:

Table 2: overview of building requirements to integrate RETS and installation requirements for building integration (source: final report phase 1)

	Renewable energy technologies					
	1	2	3	4	5	6
	ST	PV	Wind	Biomass	HP	Ventilation
Building pre-requirements						
Envelope airtightness				x	x	x
Envelope insulation				x	x	
Space required	x	x	x	x	x	x
Building orientation and position	x	x	x			
Building structure/stability	x	x	x			
Installation requirements towards building integration						
Building envelope						
Water tightness of the building envelope	x	x	x	x		x
Air tightness of building envelope	x	x	x	x	x	x
Insulation layer of the building envelope	x	x	x	x	x	x
Acoustical comfort						
Limitation of noise		x	x	x	x	x
Indoor air quality						
Exhaust of used air close to opening				x		x
Safety						
Fire safety	x			x		
Electrical safety		x				
Mechanical safety						
Lightning protection	x	x	x			

- The interactions of each of the reviewed RET with the relevant HVAC domain is illustrated in the table below.

Table 3: RETs Interaction with remaining HVAC installation (source: Final report phase 1)

HVAC Domain	SDHWS	Heat pumps	Biomass	Ventilation
Heating system		x	x	x
Hot water system	x	-	x	
Ventilation systems		x	x	-
Regulation and control	X	x	x	x

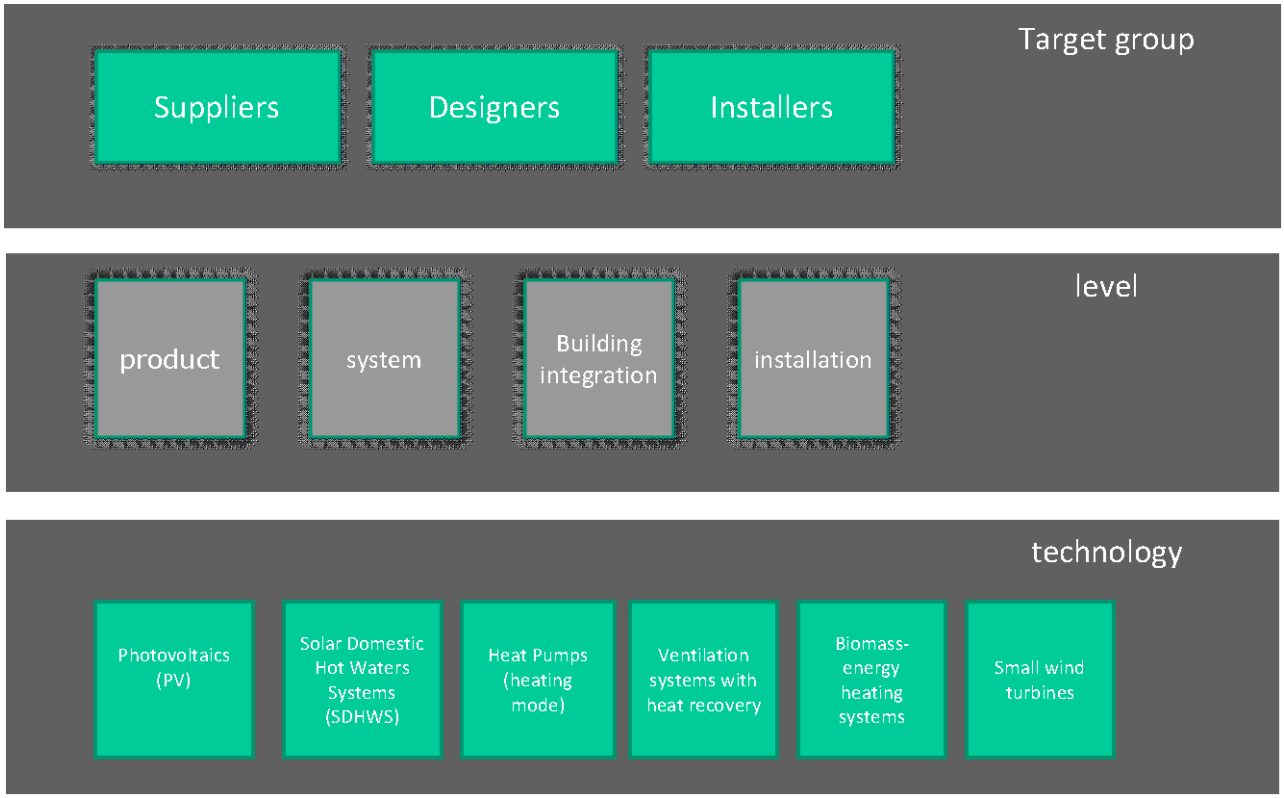
- Two common ambition levels were identified for quality requirement re grid integration of PV & SWT, as illustrated below

Table 4: common ambition level for Grid integration of RETs

Element of Value Chain	Ambition Level 1	Ambition Level 2
Component – Inverter	Compliance with existing codes and standards	
System		Active grid support from DG ⇨ driven by R&D, pulled by DSO
Installation	Good practice + AREI/RGIE Conformity	

A particular aspect of the research consisted in approaching the design of a quality scheme at multiple levels according to the target group, the market chain level and the technologies covered, as illustrated below.

Table 5: areas to be covered by an integrated quality scheme



2.2 MARKET, STANDARDS, AND STATE OF THE ART OF TECHNOLOGY

BES

Within the scope of the Q-Direct project, it was foreseen to evaluate the performance of a multi-heat boiler (40kW) with respect to the relevant standards and quality labels, using 9 different sorts of agro-forestry pellets.

Indeed, several researches tended to showed that performance of biomass boilers was significantly lower in real life situation than under standard test laboratory conditions (STC). Therefore, partners agreed to evaluate the performance of BES in real life situation, since a key objective of the IQS is to provide end-user confidence in the real performance of a RET system in operation. In that respect, some pellet boilers of the following companies were tested in real operating situation

- Burneco: http://www.burneco.com,
- Stroomop: http://www.stroomop.be/
- SaintRoch: http://www.saint-roch-couvin.com/

The testing was performed under STC at ISO-17020 and ISO-17021 certified combustion laboratory K.V.B.G.-A.R.G.B. Linkebeek Belgium (http://www.technigas.be).

The results of the tests (STC conditions) were published in the *International Journal of Biomass and Bioenergy* in 2010, as two separate articles.

The results of the tests in real life conditions were published in *the International Journal of Applied Energy* in 2011, as two separate articles.

As a consequence of this case study, ARGB decided to take the necessary steps to get EU accreditation and became one of the most active BES boiler testing facilities in Belgium.

- The ARGB is accredited by DIN CERTCO as test lab to perform testing according to DIN EN-13240-room heaters (solid fuel stoves) with low pollutants combustion and DIN-13229 (insert appliances including open fires fired with solid fuels).
- New DIN CERTCO accreditation of ARGB is expected to test and certify heating boilers for solid fuels, hand and automatically fired, with a nominal heat output of up to 300 kW according to EN-303-5.
- TECHNIGAS (http://www.technigas.be) has been actively seeking accreditation to perform testing according to NBN EN 303-5 and was designated as notified body by the Belgian Ministry of Economic Affairs for the Gas Appliances directive 90/396/EEC; the Boiler Efficiency directive 92/42/EEC. TECHNIGAS is accredited by BELAC according to EN 45011, ISO 17020 and ISO 17021.
- C.R.A.-Gembloux (subcontracted by VUB during the first phase of the project) is now an ISO 17025 accredited test lab equipped to perform testing of solid biofuels.

Beside this testing activity, VUB organized a Follow-up Committee meeting specific to BES, to finalize the technological roadmap based on the feed-back & endorsement by the sector (WP3). During this meeting, representatives of the BES sector went in contact with QUEST and discussed the opportunity to setup evaluation guidelines for BES installer companies, in line with the ones made for other RETs (PV, SDHWS, HP and VwHR sofar).

HP

Market

- Market sales are increasing as the technology finds its way to the Belgian market. Market potential by 2020 is estimated to be 6.000 GWh (green heat and cold).
- The structure of the heat pump industry is changing. Once characterized by a large amount of small manufacturers, it is now moving towards the mainstream EU HVAC market. Thanks to positive market development over the last years and good projections for the future, large companies formerly producing oil and gas appliances are gradually introducing heat pumps in their portfolios. Where independent development seemed too slow or not

economically feasible, several big players have simply bought know-how, production capacity or market access. Small manufacturers are finding it increasingly difficult to compete with multinational giants benefitting from economies of scale, capital resources, and established distribution networks.

- An important challenge results from strong market growth – as experienced in the 80's in several markets already - success draws competitors lured by the perception of easy profits, but with limited experience and capability.
- With respect to high standards installations, such market players put the integrity of systems and the sector at risk. Their arrival on the market makes qualification schemes of installers (as persons) even more necessary.
- The overall extent of industry's effort towards high quality standard for production, products and installation will decide whether quality and bad reputation problems can be avoided.

Note: EHPA is participating in the IEE Qualicert initiative (2.4.7) aiming at establishing success factors for a common qualification and certification scheme for small-scale RES installers.

Policy

- The growing environmental concern regarding the use of HFCs is perceived as an overall threat by the whole HP industry. There is currently a lot of research and development undertaken in order to find new synthetic refrigerants with much lower global warming potential (GWP) than the typical HFCs commonly used today.
- The HFO1234 YF, HFO1234 ZE and blends with these refrigerants and other HFCs are among the most frequently assessed new refrigerants. In addition, there is a lot of development in the field of natural refrigerants whose the most viable options are CO2, Ammonia and hydrocarbons.
- This refrigerant policy is frequently discussed among policy-makers and industry representatives. However, extensive studies on these natural refrigerants led by the industry tend to show that the largest amount of greenhouse gas emissions results from the indirect emissions related to the generation of electricity needed for the operation of the appliance while only a minor fraction results from leakage during operation, manufacturing and destruction of products. As the alternatives are often reducing the energy efficiency, they cannot overcome the benefits of HFC's use for the moment.
- The industry claims it will use HFCs with care, reduce refrigerant charge as much as possible and recover refrigerant from heat pumps reaching their end of life. Such an operation would require qualified staff, underlining the need for appropriate training and certification schemes.
- The increasing recognition of heat pumps by Member States and their integration into existing or newly established support schemes goes hand in hand with product and service quality requirements.
- They are usually based on unit efficiency measured as coefficient of performance (COP) according to EN 14511 / EN 12309. Some countries (i.e.

Switzerland, UK) are tentatively accepting third party quality labels such as the EHPA label as a sufficient proof.

- Such an approach contributes to an easier and cost efficient administration of the underlying schemes.

Technology

- Energy sources for heat pumps

A stream of innovation is developing around the combination of different heat sources. Many manufacturers are selling products which can be used in bi-valent systems, e.g. combining heat pumps with solar thermal collectors.

In order to strive to an efficient application of such systems in harsh climates, they are often equipped with a small gas-fired boiler or electric resistant heater to provide heating and cooling even without sunshine and by low outdoor temperatures (tri-valent units).

Several companies from the Netherlands are offering such systems as wall hung units for simple replacement of existing boilers.

Air-source heat pumps are increasingly required by the growing renovation market in countries like Germany, Sweden and Switzerland.

Air-source heat pumps, in particular air-water units, are sold in a wide range of products, regarding the size, the noise level of the outside unit and the temperature range covered.

- Capacity control

Capacity modulating compressors are on the rise in several new heat pumps and may already be considered as standard in air-source units. Multi-compressor systems for air source units are using the specific advantages of different refrigerants over low and high temperature ranges. They combine two compressors using different refrigerants to provide an efficient answer to the specific requirements for heating and for sanitary hot water production.

- Use of efficient components

This year's improvement of overall systems efficiency was supported by the use of efficient components. In addition to the previously mentioned capacity modulating compressors, high efficiency (class A and higher) pumps are used for the heating and/or brine cycle. For air/water units, similar pumps for the heating cycle and high efficiency motors are now used to power the fans.

- High temperature heat pumps

The growth of the building renovation market requires products that are able to provide temperatures up to 65°C, not only for SHW but also for heating purposes. Nearly all manufacturers are now proposing such products in their portfolio.

- Large heat pumps

Large heat pumps are increasingly used in heating systems. They can be used in most applications: Commercial/industrial buildings, schools, hospitals, hotels, agriculture, and infrastructure projects.

They are esp. interesting when heating and cooling is required and in low-energy industrial processes (up to 100°C), such as food processing or cooling of large buildings. Large heat pumps are available in capacities up to 1,5 MW in single units or cascading devices. Several studies show that their potential is not used and that their widespread use would dramatically improve energy savings and climate protection while saving cost for the end-user.

SDHWS – PV

Market

There are about 5 solar thermal collectors manufacturers in Belgium, and as much PV modules manufacturers.

- The major part of the solar thermal domestic market is made of SDHWS suppliers and wholesalers.
- The major part of the PV domestic market is made of system integrators assembling PV components bought elsewhere.

Standards and testing

- The availability of a testing facility in Belgium for local solar thermal collectors and PV modules manufacturers or suppliers is offering a real adde value – in terms of procedure, cost control, decision taking process - to the proposed quality scheme and/or subsidy schemes requiring performance and/or durability tests.
- In that respect, a testing facility like Eliosys offering the opportunity for local manufacturers to compete at arm's length with (bigger) foreign manufacturers, active on an international level is definitely a plus when it comes to product quality control & performance test.
- Eliosys is currently audited by BELAC to get ISO 17025 accreditation to perform a full range of tests on PV modules and solar thermal collectors and systems according to the following standards:
  - IEC 61215 (Crystalline silicon terrestrial photovoltaic);
  - IEC 61646 (Thin-film terrestrial photovoltaic);
  - IEC 61730 (Photovoltaic module safety qualification);
  - EN 12975
  - EN 12976

In line with the BELAC accreditation, Elyosis is looking for accreditation by the Solar Keymark organization to issue the Solar Keymark for solar thermal collectors and for factory made systems. All steps should be completed by june 2011. With competitive test prices, such laboratory might even become attractive for foreign manufacturers. On top of that, this new and unique Belgian test lab is able to perform testing under a whole range of simulated climate/weather conditions, thanks to its climatic simulation chamber and its solar simulator suited for solar collectors and PV modules up to 5 m², which means an accelerated testing period, independant from local weather conditions.

An IEA task is exploring the possibility to create a harmonized set of testing standards that all certification bodies would recognize and require from testing facilities they work with, so that a certification in one country or region can be recognized as equivalent to certification in another country or region. Enough flexibility shall be provided for certification bodies to require additional tests related to specific characteristics of an individual country or region's solar resource and/or markets.

The group made recommendations to improve certification schemes for emerging technologies where standards and testing are under development, for example by exploring the possibility of "provisional" or "light" certifications based on Technical Specifications rather than final CEN, NBN or ISO standards

Experts also defined the extent to which individual collector and component testing can be aggregated into whole system predictions of lifetime, performance, and reliability.

Standardization and labeling

Further implementation of PV, SDHWS (and soon HP and VwHR) roadmaps through the evaluation guidelines of QUEST quality scheme provided the raw material to assess the feasibility of an integrated scheme .

Two main organisational paths towards an IQS were experienced:

1. one starting from the product (**top-down approach**) towards installers and installer companies; potentially applicable for factory made systems sold as 'kits' by autonomous Installer companies working with a network of qualified installers. Evaluation guidelines for SDHWS submitted to stakeholders ATTB-Belsolar and Bouwunie in 2010 is an example of this approach. Some practical issues linked to the implementation of such scheme were identified and discussed. A key issue was raised by system suppliers who didn't feel rewarded for their quality investments and felt 'skipped' between the scheme's reference to EU marks (i.e. Solar Keymark) rewarding manufacturers on the one hand and Installer Company's requirements on the other hand. However, the added value for end-users of a 'national' voluntary mark for Belgian suppliers of factory made SHW systems is not demonstrated. Indeed:
    - The Solar Keymark for collector is a first ambition of a Belgian quality scheme for SDHWS at product level
    - A mid term ambition is to have a flexible solar keymark for a family of systems
    - In the meantime, a standard package of 'must have' tests will be proposed to ATTB-Section 5 (Equipments for active solar thermal energy) and included in the QUEST label for SDHWS product, as an intermediate (lower cost) step towards the solar keymark systems.
2. the other (**bottom-up approach**) focusing straigthforward on the installer company and related quality controls performed by a third party evaluator, such as:
    - Quality Management System of the company (ISO-like)
    - Training and certification of qualified installers (as persons) according to EU RES Dir

- Audit of a building integrated system in operation
- Monitoring of performance

Such approach would be better suited for custom built systems, assembled and designed by Installer companies or system integrators. Partners experienced it through the QUEST evaluation guidelines for PV systems submitted to BelPV in 2008 and approved by sector federations shortly after. This led to the implementation of an approval scheme early 2009. Requirements at product level are according to international standards, e.g.

- PV modules must be tested according to IEC EN 61215 for crystalline modules and IEC EN 61646 for thin film modules;
- Both must be tested according to EN 61730 for compliance with the European Low-Voltage Directive.

VwHR

Market

Market evolution for VwHR devices is underlining the following issues:

- The quality of products is not the main priority
- The custom built (case by case) design of VwHR is involving problems during the design and installation phase. Therefore, any quality scheme encompassing this technology should primarily focus on the quality / performance of full system in operation, preferably based on performance requirements.
- The market of VwHR installers is still young and heterogeneous. Therefore, improving installer's skills and competences through a mutually recognized qualification scheme would dramatically increase the quality of installation by the end-user.

Standardization and labeling

- Reaching higher quality standards is a must for installers of VwHR in Belgium. However an effective quality scheme at Installer level is currently missing in Belgium.
- Quality schemes in other countries underline the need for global requirements at operational level of a full system.
- The standard framework is pretty well developed re the definition of requirements for ventilation products. This framework should become more consistent in the future with appropriate verification means and new requirements regarding a.o. the efficiency of heat recovery, preferably at EU level since the ventilation market is international.
- A Ventilation Keymark could be an interesting approach for VwHR.
- In the short term, the Belgian EPBD product database could be used in an integrated scheme in order to check key features (e.g. heat recovery efficiency) of VwHR products. Technical requirement were detailed in the ad hoc procedure of the EPBD product database for ventilation units (www.epbd.be).

SWT

Market

- Experts do not expect the emergence of many new SWT designers as observed in the past years, unless they come up with a truly revolutionary (and certified) concept.
- As a consequence, since there is currently no Belgian manufacturer of SWT, one does not expect any newcomers to appear on the Belgian market in a mid-term horizon of 5 years.
- The nearest valuable small wind manufacturer - Fortis Wind Energy in the Netherlands - is amongst the applicants list for the British award. There should thus be no market for testing and certifying small wind turbines in Belgium in the coming years.
- Case studies carried out by 3E on agricultural sites in Flanders revealed potential profitability of SWT under the Flemish legislation of small wind installations on three out of the four selected sites. However, all sites present significant areas for siting the installation and are not representative of most sites identified in Flemish rural areas. Moreover, results rely largely on the assumptions made regarding maintenance costs and wind turbines life expectancy.
- So, beyond quality requirements, the profitability of SWT under current circumstances is not demonstrated and the support needed to make such RET profitable in the Belgian built environment is not offset by minimal guarantees of performance, safety and durability yet.

Standardization and labeling

Manufacturers from all over the world applied for the British SWT certification scheme, which is meant to be translated into EU regulation in the mid-term. Those manufacturers representing the best available urban wind technologies will strengthen their competitiveness thanks to such certification award. Increasing their market share will result in lower manufacturing costs, increased R&D budgets, and so forth… leading to the incorporation or the elimination of their non-certified competitors.

This certification process shall deeply modify the market for small wind turbine as we know it today since **a number of turbines commercially available are not providing the expected output**.

The main task performed in 2010 consisted in setting-up key elements of a quality charter for small wind installations. Specific aspects for Belgium pretty much came to a certifying procedure for SWT installer companies based upon similar criteria as the ones defined by the NABCEP/MCS.

Six requirements should be achieved by any SWT manufacturer to obtain certification and become eligible to regional subsidy schemes:

- Power Performance Test
    - Measures power curve and hence verifies energy yield.

- Safety and Function Evaluation
    - Evaluates the ability of the SWT to regulate its own speed and also reviews start up and shut down procedures.
- Acoustic Performance Test
    - Measures the noise emitted by the turbine, which can then be interpreted for varying slant distances.
- Durability Test
    - 6 month structural evaluation with minimum wind criteria e.g. 25 hours at > 15.3 m/s wind speed for a Class II turbine.
- Factory Process Control
    - Manufacturing audit to ensure consistent build specification and quality.
- Technical File Audit
    - Evaluation of the SWT technical file to ensure adherence to the requirements of IEC 61400-2.] Evance-MCS

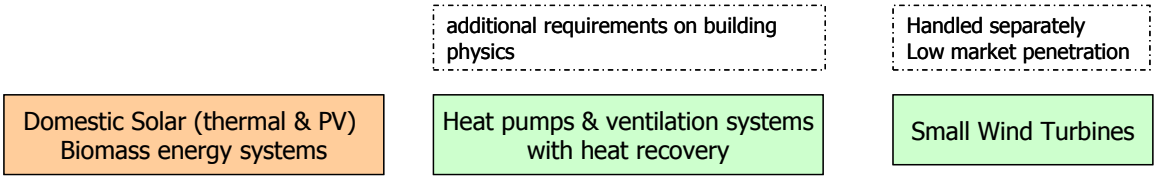
2.3 METHODOLOGY

During the first phase of the project, the natural way of working adopted by partners was to set-up technical requirements following a so called *technology-push* approach. Each researcher basically started from its own expertise & knowledge of one ore several technologies to define requirements aiming to improve the overall quality of the full RET system in operation.

Early in the process, partners agreed that a common basis of quality requirements for several technologies seemed essential to set up and organize the implementation of an IQS at national level (organizational requirements are dealing with the institutional context and the market impact of the Quality scheme as well as the procedure to implement such scheme).

This in turn resulted in a range of common, global or specific requirements organized in roadmaps over a timeframe of five years, in order to give enough time and market perspective to the RET sector to organize itself and to initiate a collective dynamic process of quality improvement among stakeholders.

Defining common ambition levels and quality requirements resulted in a first attempt of integrated but differentiated scheme, respectively dealing with domestic applications of solar and biomass energy systems on the one hand, and Heat pumps & ventilation systems with heat recovery on the other hand.



Partners agreed that cross-technology requirements should cover the following areas:

- Components and system design
- Installation works, guarantee and after sale service
- Function control and monitoring of performance
- Third party evaluation of systems in operation.

At the start of the second phase of the project (2009), it appeared that **end-user expectations** had to be more closely considered and that a so called *market pull* approach, expressing quality requirements from the end-user perspective was actually a better starting point towards an integrated scheme.

The way to **verify** requirements (means, level, accuracy) was broadly discussed amongst partners and with key stakeholders[1], since it exerts tremendous influence on the very nature and associated cost of the scheme.

The definition of quality requirements for RETs was the core of WP3 during the first phase of the project, while the verification means (organizational aspects) of those requirements was the core of WP4 in the second phase.

An important insight that came out of our methodology is that definition and verification of requirements are more closely related to each other that one could expect. The way of defining a requirement closely related to the approach intended to verify this requirement in practice.

Discussions between partners and stakeholders and further assessment of existing RET standards revealed some advantages and limitations of different approaches, such as:

- Voluntary requirements Vs mandatory or subsidy linked regulation
- QMS at company level Vs on site audit of installation in operation
- factory-made Vs custom-built systems (RET market specificity)
- Job splitting between Supplier and Installers Vs System Integrators

Over 2 years, partners organized and attended more than 40 bilateral meetings (see table below), with relevant stakeholders, to discuss the content of technological roadmaps, specific or global quality requirements as well as institutional and organizational paths to implement an IQS for RET at national level.

[1] Manufacturers and installers, certification organization (BCCA), public bodies (ENOVER/CONCERE…)

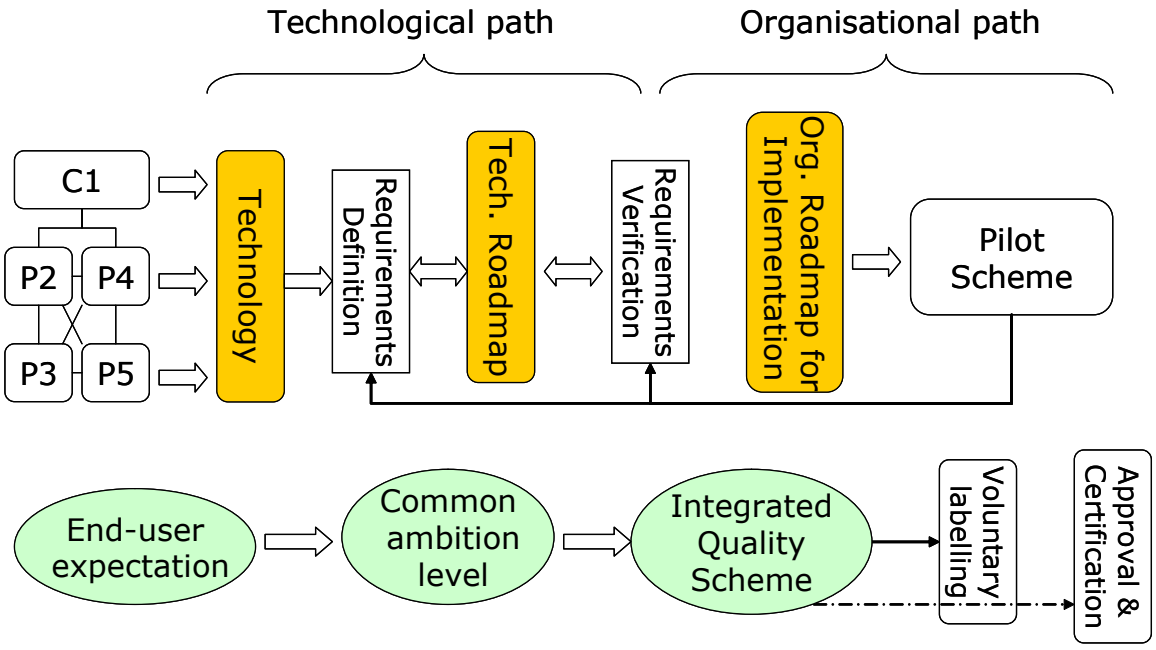
Date	Partners	Stakeholders	Topic	Key Issues	WP
20/01/2009		ARGB	BES Test lab	Test facility available at ARGB	WP4
21/01/2009	C1,P3	QUEST	Proposal CNC & FEDELEC re training accreditation & quality certification	Valuation of training certificate in quality systems ; Differentiated Quality label (*part of installation, ** full installation, *** Design & installation	WP2; WP4
17/02/2009	P3	BCCA	Quality certification scheme for PV (& other RET) product & installation companies		
10/03/2009	P3	BCCA	Quality certification scheme for PV (& other RET) product & installation companies		
10/03/2009	P4	Faculté polytechnique de Mons, EF4, Laborelec	voorbereidende vergadering met voorzitter van waalse warmtepompplatform en de 'facilitateur des pompes à chaleur' van EF4 betreffende de toetreding tot EHPA-kwaliteitslabel		WP3, WP4
27/03/2009	P2	ARGB	BES Test lab	Project description and desired tests requirements and Planning of test experiments on a multi-fuel boiler	WP4
15/04/2009	P2, C1	ARGB	BES Test lab	Discussion re test protocol	WP4
15/04/2009	P2, C1	ARGB, SainRoch and HS-TARM	BES Test lab, boiler manufacturer and suppiler in Belgium	Demonstration of the multi-heat boiler by SainRoch and HS-TARM	WP4
08/05/2009	P3	ENOVER/CONCERE	Organisation Quality Scheme	Cooperation between regions & common ambition level	
18/05/2009	P3	Ventibel stakeholders, VEA	Method for the determination of heat recovery efficiency	Sector consultation	
19/05/2009	C1,P3	CCW; FEDELEC; CCT; ABEE; ICS	ST & PV installers specificity; Installers training & certification ; Key aspects of quality control audit	Split between electrician (PV) Heating engineer & Roof tiler training & certification	WP3; WP4
20/05/2009	P2	Argo-pellet sprl	Agro-pellet supplier for the experiments	To define the necessary tests for agro-pellet quality evaluation and discussion over technical roadmap	
17/06/2009	C1	CERTIVEA	Quality certification in Building	Evolution of building certification schemes ; RET in BREEAM	WP4
17/06/2009	P2	CRA-G	Pellet fuel test lab	Desired tests requirements and test planning	
26/06/2009	P3	Lemmens (AHU manufacturer)	Method for the determination of heat recovery efficiency	Different markets: small AHU for residential vs. combination of WTW and components for big installations in non-residential	
30/06/2009	P3	GEA Happel (AHU manufacturer)	Method for the determination of heat recovery efficiency	Different markets: small AHU for residential vs. combination of WTW and components for big installations in non-residential	
01/07/2009	P4, P3, C1	Confederatie Bouw; CBB-H, CCW, BCCA, FVB, CB, Fedelec, ICS, Technolec, WTCB, Vormelek	vergadering ter oprichting van werkgroep 'Certificering van installateurs van energie uit hernieuwbare bronnen'		WP4
02/07/2009	P3	Menerga (AHU manufacturer)	Method for the determination of heat recovery efficiency	Different markets: small AHU for residential vs. combination of WTW and components for big installations in non-residential	
03/07/2009	P3	Daïkin (AHU manufacturer)	Method for the determination of heat recovery efficiency	Different markets: small AHU for residential vs. combination of WTW and components for big installations in non-residential	
08/07/2009	P4	WPP Vlaanderen; WPP Wallonie, EF4	aanpak op nationaal niveau van het EHPA-kwaliteitslabel voor warmtepompen met waalse partners		WP3, WP4
19/08/2009	P4	EHPA, RBF, WPP, EF4, Quest, IBGE-BIM, SPW	Implementation of the EHPA quality label for heat pumps in Belgium. .	Voorstelling van het EHPA-label aan de partners uit de 3 gewesten	WP3, WP4
21/08/2009	P3	BCCA	STS	New approach STS	
26/08/2009	C1,P3	QUEST	Implementation PV Roadmap Financing Quest Quality system	PV Evaluation guidelines Price issue for voluntary label (differentiated pricing for <5 co-workers)	WP4
26/08/2009	P4	WPP Vlaanderen	Kwaliteitslabel HP		WP4
01/09/2009	C1, P3	BCCA, Quest	Uitvoerend bureau PV, STS PV	Technical Assessment of PV component - input on technical specifications re PV integration in buildings	WP3; WP4
10/09/2009	C1	EDORA, APERE, RBF, PV system integrators	PV Quality System: Working place Safety, Quality of installation (pre & post installation), product quality	legal framework for safety as opposed to regulated ocupation access, guaranteed solar performance through telemetry, ISO & IEC standards to be completed by specific weather related requirements	WP3
17/09/2009	C1,P3	QUEST	Role of (PV) technical committee EHPA label Vs HP roadmap ambition level	Technical Committee Quest --> Executive Bureau Ubatc EHPA limited to HP unit performance test < EcoLabel & HP roadmap requirements	WP4
19/09/2009	C1,P3, P4	EHPA;	Rules and regulations for the International quality label committee	Establishing a National (EHPA) Quality Label Commission in Belgium	WP4
29/09/2009	C1	QUALICERT	EU Installers certification scheme	Experiences from Fr, UK, Ger, …, Be ; Common ambitions & practices	WP2; WP4
05/10/2009	P3,P4	FOD Economie	STS PV and WP	New approach STS - input on technical specifications re HP…	WP3
19/10/2009	C1, P3	BCCA	Quality certification scheme for PV (& other RET) product & installation companies	Guidelines for Technical Agreement of PV product (innovative & building integrated system)	WP4
19/10/2009	P3	VCB, Fedelec, Quest, ODE,…	Training PV installers	general approach	
20/10/2009	P2	www.Stroomop.be	Pellet Boiler supplier	Planning to perform real life measurement at 25 kW pellet boiler	
11/11/2009	P2	www.Stroomop.be	Pellet Boiler supplier	Perform real life measurement at 25 kW pellet boiler	
12/11/2009	P2	www.Burneco.com	Pellet Boiler manufacturer	To describe the project scope and inspect the technical aspects of the manufactured boiler	
13/11/2009	C1, P3	BCCA, Quest	Uitvoerend bureau PV, STS PV	Technical Assessment of PV component - input on technical specifications re PV integration in buildings	WP3; WP4
19/11/2009	C1	IBGE-BIM	Brainstorming Qualité photovoltaïque/ kwaliteit fotovoltaïsche Zonne-energie	Quality requirements for domestic applications of PV systems & modalities of implementation	WP3; WP4
20/11/2009	C1,P3	QUEST	STS status as quality reference ; ATG status as quality reference ; Common ambition level for Installers training examination	Status & role of Quality references (STS, ATG & Training examination) in Organisational Roadmap	WP4
07/12/2009	C1,P3	BCCA	Quality certification scheme for PV (& other RET) product & installation companies	MoU between BCCA & QUEST	WP4
09/12/2009	P3	VCB, Fedelec, Quest, ODE, CCW,…	Training PV installers	general approach, split up roof / electrical	
17/12/2009	P3	TUV (Labo, Essen, Germany)	Test facilities and method for the determination of heat recovery efficiency of air handling units for ventilation	Standardisation of the method needed at european level; Test facilities at belgian level not necessary; Calculation method (based on different tests) to be adapted for EPB in Belgium	
17/12/2009	P4	EHPA, WPP wallonie, WPP vlaanderen	EHPA meeting (Munich)		WP3, WP4
21/12/2009	P2	www.Burneco.com	Pellet Boiler manufacturer	To perform onsite (factory) measurements	

Date	Partners	Stakeholders	Topic	Key Issues
12/01/2010	C1, P3	QUEST	Proposal / feed-back from Vlaams Elektro Innovatiecentrum (VEI) meeting with HLA. Role of the Regions towards common ambitions of training examination	Discussion on possible ways to avoid interregional split of installer training & certification schemes as for GCS & EPB regulation. (example of federal ambition level: passive building standard & PHPP
14/01/2010	C1, P3	BCCA	Quality certification scheme for PV (& other RET) product & installation companies	Role of Agreement Operators & Certification operator under new UBatc/Butgb
15/01/2010	P2	www.Burneco.com	Pellet Boiler manufacturer	To discuss sites of measurements
26/01/2010	P4	WPP wallonie, WPP vlaanderen	Product label heat pumps	
10/02/2010	P2	www.Stroomop.be	Pellet Boiler supplier	Real life measurement
23/03/2010	P4	WPP wallonie, WPP vlaanderen	Product label heat pumps	
13/04/2010	C1	ATTB-Belsolar, Quest	ST Roadmap & guidelines for evaluation	Discussion Quality requirements SDHWS with the heating engineers & solar equipement suppliers sector
13/04/2010	P4	EHPA, WPP wallonie, WPP vlaanderen	EHPA meeting (Leuven)	
19/04/2010	C1, P3	/	Common approach and ambition level of RETs quality control	Quality control requirements and procedure tends to favour standard systems pre-designed by manufacturer; while true building integrated RETs like HP & VwHR require a case by case design by the installer company. Some technology differenciation on that side
29/04/2010	C1	ATTB-Belsolar, Quest	Technological Roadmap implementation & evaluation guidelines SDHWS installers & product	Requirements Implementation in time (start level & gradual strengthening)
06/05/2010	C1, P5	/	Content & methodology of test protocol designed by KUL	Set guidelines on the scope & methodology of a protocol to test compatbility between RES (ie. PV & SWT) and the belgian electricity grid
18/05/2010	P3	TC HVAC (BBRI)	Approach for quality system for ventilation	Cost issue; Always the good are controlled; Need controls on site (elec, gaz, etc)
16/06/2010	P3	Ventibel + Installers (bouwunie, fedelec	Approach for quality system for ventilation	responsability of designers (architects + bureau); Need of controls of final installed systems; Product level is not the priority; Training and recognition of installers is priority
24/06/2010	C1	Building Federations	Workgroup on Quality references for ST & PV domestic installations	integration of technical specs re ST/PV within "Construction Quality" SME management scheme
11/08/2010	C1, P3, P4	QUEST	common approach towards belgian RET integrated Quality scheme	finding common Q control procedure and ambition level to set-up quality standards for RETs in Belgium
25/08/2010	C1, P2	Valbiom, Stroomop, Oekofen, VITO	FUC BES: basis of a Quality scheme for BES fuel & boilers in Belgium	Quality requirements should stimulate the few actors active on Belgian ground (esp walloon) but high quality standards might threaten further development of this emerging market in Belgium
01/09/2010	C1	Selfenergy, Vermeulen, Eolice, Echotech	Quality charter SWT	Technical Requirements & ambition level
23/09/2010	P4	EHPA Installer Education in Paris		
24/09/2010	P4	EHPA Product Quality label		
30/09/2010	C1	QUEST - Qualicert Consortium	EU validation workshop of a "common quality certification & accreditation for installers of small-scale RET	Key success criteria for a common framework for RES installers certification
01/10/2010	C1, P3	/	D16 - structure & content of org. requirements	common quality approach - IQS for BES,HP,ST,PV & VwHR
05/10/2010	P2	ARGB-Linkebeek-BES	Tests and certification of BES	Accredited EN 13240, EN 13229 - ongoing accreditation process for EN303-5
12/10/2010	P2	QUEST, BES	QUEST label for BES product / Installer company	Investigating possibilites - market maturity - worry of Installers company
29/10/2010	C1	ESTIF, Committee of the Regions (EU)	ST ordinances through building codes - legislative framework conditions	Impact of solar obligation on system & installation quality
29/10/2010	P3	Installers (Committee Optivent project)	Remarks and discussion on the Quest Reference document (doc B)	
19/11/2010	P3	Turnkey company of passieve houses	Test of the Reference Quest doc B in practice on turnkey passive houses	
22/11/2010	P2	Flemish Energy Agency, Maarten De G	http://ode.be/bio-energie/studiedagen	Confernece: Sustainable Biomass for European Energy
29/11/2010	P2	http://ode.be/bio-energie/studiedagen	SUSTAINABLE BIOMASS FOR EUROPEAN ENERGY	Bioenergyday: Use of biomass energy systems in residential houses
17/01/2011	P2	University of Eastern Finland, Kuopio	Residential biomass combustion	Training: Fine particle emissions from residential biomass combustions
20/01/2011	C1, P5	Laborelec	Guidelines to test compatibility of PV/SWT inverters with belgian electricity grid	
04/02/2011	P2	EHSB	Use of agro-pellets in domestic boilers	Poster presentation: Quality issues of residential pellet boilers

Technological roadmaps were updated and finalized based on stakeholders feedback and results of real-life experiment with a pilot scheme. The latter consisted in labelling RET installer companies through an independent labelling body (QUEST) composed of Q-Direct partners and stakeholders from RET sector federations, test institute and building federations; the whole process being supported by the flemish Region.

The advisory board of QUEST, composed of partners and sector federations, became the Follow-up committee of the second phase of the project.

Our methodological path, built and followed during the project is illustrated below:



2.4 RESULTS

The **first phase of the project** laid down the technical basis of an integrated quality scheme through a review of the state of the art of 6 RETS, leading to quality references & roadmaps, respectively for Biomass Energy Systems, Heat Pumps and Ventilation systems with Heat Recovery, Solar Domestic Hot Water System, Photovoltaics and Small (Urban) Wind Turbine.

The partners identified **common basis** for building integration, HVAC integration and grid integration of RETs.

Technical roadmaps were reviewed and finalized based on stakeholders feedback and pilot experiment of QUEST quality schemes they inspired (WP3). Major changes in state of the art of technology, prescriptive or performance based standards and quality insurance (WP2) were updated .

The research showed that end-user expectations - covering the whole market chain, from component level to system design, up to commissioning, monitoring and maintenance of installations in operation - was an important driver for innovation but was also offering a good starting point and a comprehensive framework for quality requirements .

Table 6 End-user expectations regarding Quality of a RET installation

DESIGN	COMPONENT /PRODUCT	SYSTEM	INSTALLATION	← **END USER PERSPECTIVE** →	Inst.USE	Inst. MAINTENANCE
X				Heat / Power needs	X	
	X			Availability		X
	X			Durability	X	
	X			Safety	X	
		X		Performance results	X	
				Comfort	X	
			X	Building/HVAC Integration		
				Easyness	X	X
		X	X	Quality / price		X
	X			Environmental impact	X	

Partners agreed that an integrated quality scheme for small-scale RES should:

- Cover a range of RE technologies and services able to achieve substantial CO2 emission reductions in the residential housing sector;
- Provide consumers with independent certification of products and services ;
- Remain independent from the professional sector in its management ;
- Be designed to follow rapidly evolving technology and evaluate installers skills & competences as well as Installer companies against robust criteria, providing long term guarantees to end users ;
- First labelled, then certify technologies and installers (as persons) in accordance with harmonized standards and training schemes respectively;
- Get full support from major stakeholders (regional public authorities, microgeneration sector, building sector federations, consumer associations, environmental protection groups…)

Partners further concluded that In Belgium, it would be largely more effective to have an Integrated Quality Scheme common to both three Regions, even if the building sector regulation is a regional competence.

2.4.1 Key points from Project Group Meetings, Bilateral Meetings and Follow-up Committees

Common ambition levels

The exchanges and bilateral meetings hold throughout the year led to a first definition of **common ambition levels** for initial, short and mid-term quality standards to be reached by Renewable Energy Technologies:

- The initial ambition level of an IQS for RET is to provide well designed, cost-effective and efficient **systems**, supported by global (at least EU wide) and independent **quality marks**, and installed by skilled labor.
- The short term ambition level foresees that the full renewable energy system is tested as a whole under STC and that (each part of) the whole system is installed by certified installers (persons) according to controllable technical requirements and best practices.
- The mid term (5 years) ambition level would consist in differentiating the most performing systems through real-life measurements available online and get optimal design and installation by labelled installer companies.

Note:

- Each ambition level is including the previous one.
- The definition does not apply to small wind turbines (SWT) which is perceived as a non mature technology, requiring minimal performance tresholds attested by power curves and a simple quality charter to streamline Installer companies activities.
- VwHR technology might skip the short term objective since the whole system is designed on a cas by case approach and therefore, real-life perfomance measurements are more appropriate. A table of initial, short term and mid term ambition level for VwHR is presented below

Table 7: table of initial, short term and mid term ambition level for VwHR

	Initial	Short term	Mid term
General			Extend the scheme to other types of ventilation systems: A, B and C
Product (Supplier, Manufacturer)	Use the existing EPBD product database to check product characteristics (e.g. heat recovery efficiency)		Extend the scheme at product level through Keymark, as appropriate
Installed system (Installer Company)	Set-up voluntary scheme based on: • Self control by the company itself • Random third party control on site		
Installer (person)		Set-up certification system for individual Installers as an extension of the EU RES DIR to other technologies	

Product Vs Installer Quality approach

The research confirmed the geographical area level difference between quality control of components, products and systems on the one hand, and installers and installer companies on the other hand.

- Requirements and quality marks of RET **components, products and system** are better defined and managed internationally since:
  - Most RET Products are manufactured and sold on the internal EU market and even worldwide, by multinational companies (like the Austrian GREENoneTEC for Solar thermal systems);
  - Accredited test institutes and labs are spread in EU member states; some tests required by EN standards cannot be performed in Belgium, like measuring the efficiency of ventilation devices heat exchangers).
  - Trade requirements for products are set by a federal authority, mainly based on CE marking and EN standards
  - Economies of scale are carried out by organizing quality control and product certification at EU level.
- The same holds true for **renewable fuel** (e.g. pellet fuel for BES should comply with DIN*plus* / *ENplus* / *prEN14961*).
- At first sight, requirements and quality marks for **installers and installer companies** are better defined and managed at national or regional level since:
  - installer companies are usually active on a local, regional or national level;
  - installer companies are usually small and medium enterprises close to their local market and sensitive to regional quality marks (e.g. in 2010 the voluntary quality charter for PV installers 'PVQUAL' counted more than 100 companies labelled in Walloon);
  - Building practice vary from one country to another. Although, the specificity on building integration of factory made RET systems is not demonstrated).

The research and discussions with stakeholders (namely RET federations and regional bodies participating in the CONCERE group) showed that a Quality Scheme integrated at national level would be more valuable and long lasting for installers and installer companies, even if building regulation is regionalized.

One of the main barriers identified during the project and preventing this from happening is the strong regional organization and sphere of influence of large building sector federations developing their own quality schemes for their members.

End-user expectations: mainly performance based

End-user expectations are mainly performance based and focused on the full system in operation. The elaboration of technological roadmaps showed that it was technically and economically not always possible to define quality requirements and associated means of verification at the level of a full system in operation. Therefore, an integrated quality system shall not only rely on (performance-based) global system requirements but also on (prescriptive) specific, product/component and installer requirements.

End-user expectations might be differentiated according to the innovative character of the technology since end users are usually less requiring for new products coming on the market than for standard products.

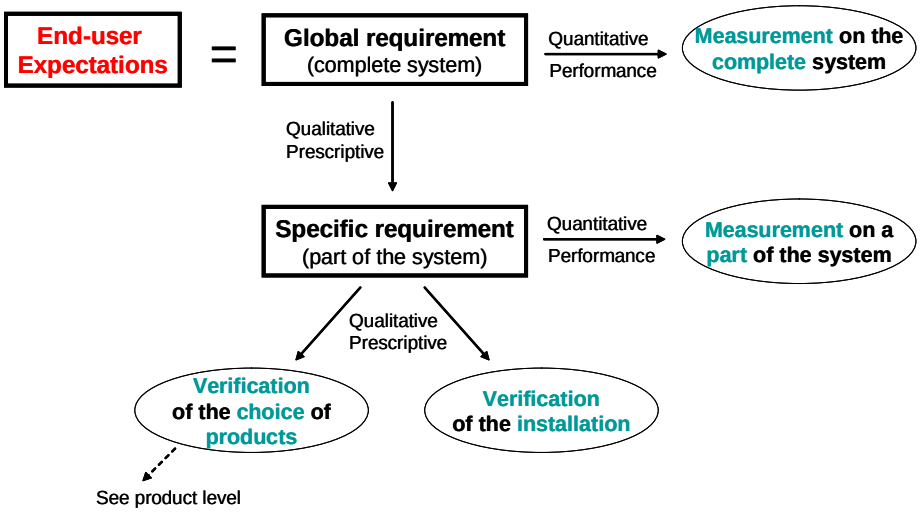


Figure 1: Framework for bottom-up approach starting from End-user expectations

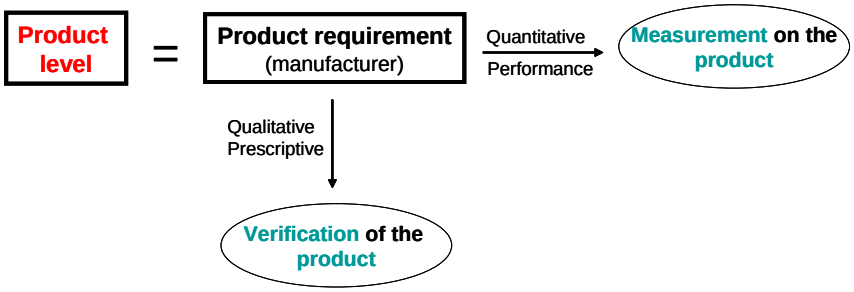
The research showed that, in order to implement a quality scheme:

- The verification of the requirement's fulfilment is as important as the definition of the requirement itself
- Performance based requirements is offering some decisive advantages compared to prescriptive ones
- There is an essential distinction to make between the definition of a quality requirement and their means of verification.

Indeed, defining a (technical) criterion and its associated quality level (or value) indicates the minimal requirement to fulfill, according to the quality scheme.

- The distinction between definition of a quality requirement and its verification is key since the sole definition of a requirement without its verification modalities is not likely to improve the overall quality level;
- Both aspects (definition & verification of a requirement) are closely linked; i.e. the way a requirement is defined is influenced by the way it is verified or controlled;

- If the criterion is *performance based*, the definition of the requirement doesn't show the technical means of verification or the way a manufacturer or installer is expected to fulfill the requirement. Hence, those means need to be further explained in good practice codes or technical manuals.
- If the criterion is *descriptive*, the definition of the requirement already indicates the technical means that can be used to fulfill it.
- The balance between *performance based* & *prescriptive* requirements is influencing the very nature of the quality scheme and supporting reference documents. Indeed, the choice of the definition & the way of verification of a requirement are impacting the content of related good practice codes, technical manuals, installer trainings...
- Since a *performance based* design frequently involves features that do not comply with prescriptive requirements, it is necessary to *verify* that (part of) the final system meets the goals and objectives. Verification can involve tests, examinations, calculations, or a combination of those.



- Users of the quality scheme (suppliers, installers...) may not have the skills to judge successful verification of *performance based* requirements; as a consequence, a *certifying body* may have to do the *verification*.
- When *performance based* requirements lead to costly and complicated testing procedures, *prescriptive* requirements should be considered, possibly with alternate performance based requirements.
- As *Performance based* requirements and standards focus on desired characteristics of the final system, service or activity, rather than on processes requirements to produce it, they offer a range of advantages of particular relevance for RETs, namely:
  - Encouraging earlier use of new technology, as soon as it is demonstrated;
  - Stimulating system manufacturer, designer and installer innovation by finding optimum ways to meet performance criteria;
  - Reducing trade barriers and widening the marketplace by allowing the use of new or non traditional (parts of) systems and methods when they meet the performance criteria;
  - Clearly stating goals and objectives of a requirement, answering the question of what is to be achieved in a transparent way;

- Making the development and maintenance of the quality scheme ultimately easier and more efficient; while it seems initially more difficult to establish goals and objectives, the (non-)inclusion of various requirements afterwards is much easier.

However, in practice a requirement will usually find itself on an intermediate scale between two extremes (100% prescriptive Vs 100% performance based),

This is important to keep in mind while setting up a quality scheme: performance based and prescriptive requirements are not opposing each other.

Example: with the indoor air quality provided by a ventilation system, it is impossible to quantify each air pollutants; therefore, one usually considers the flow rates reached by the ventilation system to be the more appropriate criteria, as illustrated below:

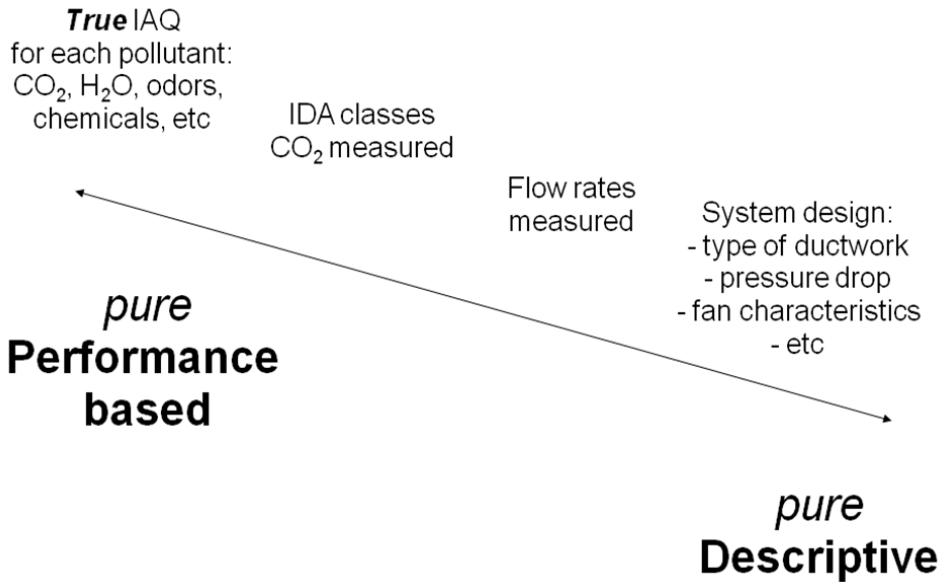


Figure 2: Illustration of intermediate scale between performance and prescriptive requirements for IAQ reached by a ventilation system

Another example to illustrate the intimate relationship between a requirement and its verification mean is illustrated by the efficiency of heat recovery of VwHR.

Table 8: Example of definition (incl. evaluation method) and verification of requirements underlining their relationship

Definition of the requirements		Verification of the requirements
Criterion	Evaluation (measurement) method	
Efficiency of heat recovery for ventilation: at least 75%	according to the standard NBN EN 308	1) To be verified on each product type by the manufacturers 2) To be verified that such conform (recognized) products are used by the installer
Ventilation flow rates conform to NBN D 50-001	measurement using instrument of type X or Y	1) Measurement carried out by the installer on each installation 2) Verification of the presence of measurement report in the as-built dossiers 3) Randomly, third party control of the measurements carried out by the installer, for 20% of the installations
Noise level in the building conform NBN S 01-400-1	measurement according to standard ISO …	Randomly measured on site by a third party organization, for 20% of the installations

A third example is illustrated by the power consumption of fan in a ventilation device:

- If on site verification of the system in operation is foresseen, the requirement could be: "the electric consumption of all fans at the maximum flow rate must be ≤ 0,35 W/(m³/h)";
- If technical specs of the product issued by the manufacturer is foreseen, the requirement could be: "the electric consumption of the fan must be ≤ 0,35 W/(m³/h) for a flow rate ≥ 400 m³/h and a pressure difference ≥ 150 Pa".

Because the true compliance of a requirement is a key expectation from end-users and since the verification means strongly influence the definition of a requirement, setting up an integrated quality system should use an iterative process such as:

1) Identifying the most important set of criteria to assure a minimum quality level of the considered RET
2) Describe the most appropriate way to verify requirements taking into account technological maturity, market specificity and cost issues
3) Defining additional requirements, corresponding to a second set of criteria based on the ones identified in (1) and the means of verification base on the ones described in (2).

Key elements of such a comprehensive certification scheme are illustrated in the figure below.

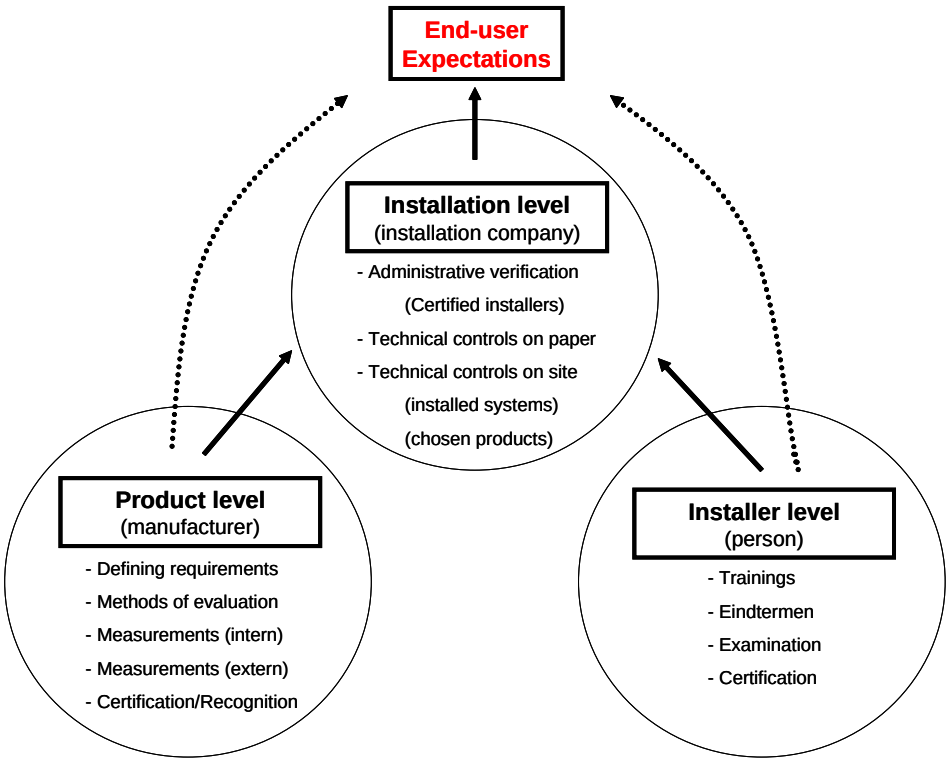


Figure 3: key elements of an IQS

Installer Certification

Certification of installers means an accreditation of professionals (individuals) in the frame of the EU RES Directive. Certification means that an installer has demonstrated necessary skills, knowledge and ability typically required of a practitioner to competently install, maintain and troubleshoot a small-scale RET system.

Such certification is normally provided via a training program. Those training programs in turn need to be accredited by a credible authority to make sure they apply sufficiently stringent and uniform training standards and are suitably designed to reach their goals.

The partners agreed that training certification of installers, to be efficient and representative, should only occur at individual level. It is not enough for a company to employ skilled and trained workers to be labelled or certified.

The research further showed that:

- Training, education and third party evaluation were essentials to a truly integrated quality scheme. Specific technical background of individual installers is an essential upstream requirement that must be updated and regularly controlled in practice.
- The EU RES directive has been identified as a cornerstone of Installer training schemes from 2012 onwards and a strong incentive to move ahead from regional approvals towards true certification schemes by third parties.

To date the regions do not have a legal framework ruling qualification or certification of small-scale RES as required by article 14 of the EU RES (2009/28/EC) Directive.

Although in 2004, the walloon region put an offical recognition scheme of individual solar thermal (and more recently PV) installers in place.

Regional energy agencies are responsible for setting up such qualification scheme and recently decided to entitle Q-Direct (and other) partners and stakeholders to set-up a global certification scheme. Both Regions are working together within the CONCERE Installers working group to develop a national qualification or certification regulation to implement article 14, paragraph 3 of EU RES DIR. Discussions ran during policy sessions of the follow-up committees laid down the base of this scheme.

2.4.2 Lessons learned from other Quality Schemes in Belgium

An international **survey of product quality insurances** was performed during the first phase of the project in order to underline their respective strength and weaknesses.

In the second phase, the survey was extended to product and installer (as persons) quality insurances in Belgium regarding gas habilitation, electrical safety controls, optimaz, HR+ label…and their respective **financing means.**

The partners discussed if and how verification procedures and associated financing means of quality schemes regarding conventional gas and fuel boilers, commissioning of electrical house wiring or alarm systems could be applied or extended to the RET systems.

Technology related quality schemes reviewed

- ARGB (http://www.gaznaturel.be): Royal Association of the natural gas suppliers; manages a quality label for natural gas boilers (HRTOP) and a quality label for installers of natural gas boilers (CERGA).
- INFORMAZOUT/CEDICOL (http://www.informazout.be): Information and reference Center of oil boilers suppliers and distributors; manages a quality label for oil boilers (Optimaz) and a quality label for installers of oil boilers (MazoutExpert).
- Vlaamse Innovatie Centrum – TECNOLEC - VEI (http://www.vei.be): Research center for the electricians federations; manages a quality label for installers of domotica installations.
- Belgian Electrotechnical Committee – CEB (http://www.ceb-bec.be): CEB is a neutral and independent standardisation platform for electrotechnics and electronics in Belgium. It is member of IEC and recognised nationally by NBN as sectoral standardisation operator for electrotechnics and electronics. It manages the INCERT label for alarm systems and for installers of alarm systems.
- UBAtc-BUtgb (http://www.ubatc.be) is Belgium's single authority offering technical approval of construction materials, products, systems and installers. The main deliverables of their work are European (EOTA) and national (ATG) technical approvals for materials, products and systems. The national technical approvals (ATG) are voluntary assessments, covering both regulated and other characteristics, demonstrating the fitness for the intended use
- Comité d'attribution du label écologique-Ministère fédéral de l'Environnement / European Commission (http://www.ecolabel.be); manage the EU Ecolabel, which covers a wide range of products and services, including heat pumps
- Confédération Construction (http://www.confederationconstruction.be): sector federation of building contractors; manages the Coqual/Qualibouw Quality label for building contractors, which is inspired by ISO-9000 quality

system, and which should soon evolve into a more technology-oriented "Construction Quality" label, notably in the field of renewable energy installations.

Their respective Installer Labels are:

- CERGA label for natural gas boilers installers; operated by ARGB (http://www.cerga.be);
- MAZOUTEXPERT label for oil boilers installers; operated by Informazout/Cedicol (http://www.informazout.be/mazoutexpert);
- DOMOTICA label for domotica installers; operated by VEI-TECNOLEC (http://www.vei.be/ons-aanbod/kwaliteitslabel-domotica/toelichting) ;
- INCERT label for alarm system installers; operated by CEB (http://www.incert.be);
- Construction Quality (Coqual-Qualibouw) for building contractors; operated by the Confédération Construction (http://www.constructionquality.be).

Their respective Product Labels are:

- HRTOP label for natural gas boilers; operated by ARGB (http://www.gaznaturel.be);
- OPTIMAZ label for oil boilers; operated by Informazout/Cedicol (http://www.informazout.be/mazoutexpert);
- INCERT label for alarm systems; operated by CEB (http://www.incert.be);
- ATG voluntary technical approval with certification of construction products and systems; operated by UBAtc (http://www.ubatc.be/index.cfm?n01=services);
- European Eco-label for green products and services, among others heat pumps (http://www.ecolabel.be) ;

Main characteristics of the reviewed quality schemes

- *The ambition level*: showed much variation from purely technical towards product efficiency, quality of materials, quality management (manuals, after sales service...), quality of installation. Some schemes include legal requirements; others conformity requirements, others look for higher quality strandards. The ambition level is usually inked to the initiator and secondly to the manager of the scheme (sector federation, NGOs, consumers organisation, certification body, public bodies or a combination of those).
- *The certification procedure:* conformity is assessed in several ways. Some inspectors are independent from the labeling or certification body which may or may not be accredited by BELAC. Selection guidelines of inspectors may vary a lot. Some schemes include administrative control, others audit of installations in operation. Not all schemes do register consumers' complaints.
- *The costprice:* In some case, it is linked to the turnover of the applicant or its manpower (or other quantitative factors). This raises the question of the

amount of products or installations which have to be sold to get a ROI. Some schemes are linked to financial incentives (subsidy, tax credit…) or to a mandatory provision (insurance coverage...). The single cost of labelling or certification is often far below the cost of associated standardized tests.

Key observations

- All shemes investigated are voluntary;
- Most quality schemes for products are managed by private bodies involving representatives from manufacturers and suppliers through their respective federations;
- Representatives from installers may also be involved, as well as knowledge centers;
- Certification bodies usually manage most of the awarding process. Certification relies very much on providing test reports & certificates delivered by accredited test institutes and labs;
- Most quality schemes for installers target the installation company, except the CERGA certification also targetting individual technicians.
- Most schemes are managed by bodies involving representatives from installer's federations. By CERGA and MAZOUTEXPERT, installers are involved in ad hoc commissions (Appeal board, Management Committee…). Manufacturers and suppliers may also be involved (DOMOTICA, INCERT).
- Most product & installers labels are operated by the same entity (INCERT, HRTOP/CERGA, OPTIMAZ/MAZOUTEXPERT…). Managing product and installers labelling or certification through the same scheme is the common pattern .
- A range of stakeholders are involved in the set up, the management and the awarding of installer company labels.
- Installer's schemes usually include a technical or safety assessement of at least one of their installation by a third-party (accredited or not), next to the file evaluation.
- Installer's schemes often impose the use of certified or labelled products or systems, as well as the use of skilled and trained workers. In any case, qualification of installers is additional to certification or labelling of installer companies.

Financing Quality Schemes

Partners identified existing voluntary quality systems in Belgium in several technology sectors (see above). Those were analysed in order to find the best practice and successful examples that could be applied to small-scale renewable energy technologies.

The survey was conducted in collaboration with the actors involved in the reviewed quality schemes, based on a questionnaire like the one used by Qualicert (cfr. 2.4.7).

Comparing the price of the reviewed labelling/certification schemes is not straightforward and should consider the economical value of the installations, the turnover of the sector, the ambition level and associated requirements, as well as the internal cost of the procedure.

Partners concluded that in the renewable energy sector, the financing concept should be self-sustaining after initial set-up supported by public authorities at start-up phase. The full labelling or certification cost should be divided into initial certification fee, annual management fee, periodic audit costs and renewal fee.

For quality schemes at product level, the research showed that:

- Public authorities do usually not substantially finance product quality schemes managed by private organisations. Applicants bear the full cost of a keymark, ecolabel or ATG mark for example.
- The price to certify a product is usually a fixed amount whatever the size of the applicant. The cost associated to product testing according to international or EN standards far exceeds the certification or labelling cost as such.
- When public authorities do support such schemes, it is usually limited to the initial set up cost of the operator during its first years of activity and the cost related to the technical references and requirements.
- Most of the schemes reviewed in 2.4.5 are more or less self-sustaining; applicants bear most of the cost to get the label or certificate. Additional funding from sector federations is possible. However some public incentives (e.g. subsidies, tax credits, eco-cheques,...) are only available for products bearing a given label (e.g. the Eco-label, Incert, HRtop label for gas boilers,...
- the lawfullness and regularity of public incentives linked to private labels such as optimaz and HRtop was questioned by the EC and might even be prosecuted under the free trade directive.

Table 9: Quality schemes related to technology Products in Belgium

	HRTOP	OPTIMAZ elite	ATG	INCERT	EUROPEAN ECOLABEL
SCOPE	gas boilers	heating oil boilers	building products/systems	alarm systems	consumer goods and appliances
AMBITION	efficiency-emissions	efficiency-emissions	fitness for use	quality-reliability	craddle-to-grave
TARGET	producers	producers	producers	producers	producers distributors
MEMBERSHIP OF MANAGING BODY	gas suppliers and distributors (producers consultative)	heating gas oil producers and distributors (producers consultative)	producers, installers, knowledge centers, control bodies	producers / certification bodies	European Commission and members states
CERTIFICATION PROCEDURE	administrative/technical documents control (test certificates,..) + test in labo	administrative/technical documents control (test certificates,..)	administrative/technical documents control (test certificates,..) + factory audits	administrative/technical documents control (test certificates,..) + factory audits	administrative/technical documents control + third party factory audit
AVERAGE PRICE/MODEL (€)	1€/boiler sold in Belgium each year (total sales 320.000)	1.150 €	3,600-12.000 €	1.000 €	300€ + 0.15%/year of product turnover in EU (min 500 - max 25.000 €)
AVERAGE PRICE TESTS/MODEL (€)	2.000 €	na	na	10.000 €	na
PRICE INCLUDES TOTAL COST	No	Yes	Yes	Yes	No
LINK WITH FIN INCENTIVES TO CONSUMERS	Yes	No	No	Federal tax rebates	Ecocheques (220 million€/year)
SINCE	1998	1985	<2000	2004	1992
NUMBER CERTIFIED PRODUCTS/MODELS	800 (boilers)	48	840	700	550 in 30 categories (Belgium)
SPECIAL	3.000€ contribution by producers to a special fund designed to compensate for series problems in case of bankruptcy				

Table 10: Quality schemes related to Building sector's Installers in Belgium

	CERGA	MAZOUT EXPERT	DOMOTICA	INCERT	Constr quality (Coqual-qualibouw)
SCOPE	gas boilers	heating oil boilers	domotica installations	alarm systems	building contractors
AMBITION	safety-quality	quality-performance	quality- added value end-user	quality-reliability	ISO 9001
TARGET	technicians	installation companies	installation companies	installation companies	installation companies
MEMBERSHIP OF MANAGING BODY	gas suppliers and distibutors (installers consultative)	oil and heating gas oil producers and distributors (installers consultative)	installers (producers consultative)	installers, producers, insurance (consumers consultative)	installers-building contractors
CERTIFICATION PROCEDURE	third party installation audit + proof of education	third party installation audit + proof of & experience	control of documents + third party installation audit + proof training	control of documents + third party installation audit + proof training	na
AVERAGE PRICE PER YEAR (€)	480/year	Free of charge	500/year	850/year + 2€/installation	700-2500/year (Coqual-Qualibouw)
PRICE INCLUDES TOTAL COST	No (promotion)	No	No	Yes	na
LINK WITH FIN INCENTIVES TO CONSUMERS	Yes	No	No	with insurance policies	No
SINCE	1999	2006	2001	2005	2002
NUMBER CERTIFIED INSTALLERS	2500	220	65	300	45 (Coqual) + 118 (qualibouw)

For quality schemes at installer level, the research showed that:

- All schemes reviewed are managed by private bodies and do not benefit from public funding, except in a start-up phase.
- Most schemes rely on additional funding by sector federations: applicants (mostly SMEs and independent workers) bear only a part of the cost to get the label or certificate. This is a key difference with product quality schemes.
- Except for CERGA, installer's labels are not linked to public incentives. However, in certain field of activity (e.g. alarm systems) insurance companies impose the choice of an INCERT installer to cover the risks.
- The price to get a certificate or label ranges between 500 and 2.500 € per year for the reviewed shemes, note that:
    - The INCERT label also requires an annual fee linked to the turnover of the company
    - Construction Quality applies progressive fees depending on the size of the applicant company
    - MAZOUTEXPERT is free of charge for the installer
- The full cost is usually divided into initial certification fee, annual management fee and periodic audit costs.
- For applicants such as SME's and independent workers:
    - the cost and the administrative burden linked to the scheme can be critical and need to be addressed by quality operators
    - the labelling or certification cost might require additional funding from sector federations.
    - Little or no public funding has to be expected in operational phase.

The following cost-limiting factors were identified, which are all pleading for an integrated scheme managed by a single operator in both Regions :

- Economies of scale are possible if a single quality operator:
    - reaches a critical mass of applicants (spreading of the fixed costs);
    - offers a diversified range of RET quality related services (e.g. technical references, agreement operator, technical assessment, audit of installation…)
    - Outsources expert tasks to specialized bodies empowered by an authority or accredited body;
    - Opens some routine activities (e.g. on site inspection and audit of installation) to competition;
- Ongoing assessment of legal and regulatory requirements would avoid double checks and/or controls already performed by legal entities (e.g. registration of the installer, CE marking of a product…). However, the information flow between legal entities and the quality operator has to be organized and secured.

2.4.3 Lessons learned from QUEST experiment

Quest (http://www.questforquality.be) is the Quality Center for small-scale renewable energy technologies in Belgium. This non profit organisation currently grants quality labels at solar photovoltaic and solar thermal installer companies. The membership of Quest is shared between knowledge centers (50%) and sector federations (50%).

Early 2009, project partners managed to implement and test quality requirements, evaluation guidelines & labeling scheme for residential PV systems in real life conditions, through the operational structure of the belgian quality centre for sustainable energy technologies (QUEST). A voluntary quality label for PV system integrators - based on EN and IEC standards – was enforced in a complex and moving institutional framework.

The PV evaluation guidelines based on the technological roadmap were updated thanks to the feedback of BelPV and some applicants to the label:

- technical details and output estimates in offer phase were streamlined
- requirment for as-built file at commissionning was added

Although the Quest label is not linked to any subsidy, 7 PV System integrators applied to date, 5 are labelled, 2 are pending.

The updated version was used as overall framework to set up evaluation guidelines for Installer companies of SDHWS (april 2010) and VwHR (end 2010). In order not to counteract the set-up of the European EHPA label for Heat Pumps on the Belgian market, it was decided to delay the HP installer company label. EU initiatives as EUCERT training program for HP installers (as persons) and EHPA label for HP product were further analyzed and regular contact with Belgian Heat Pump federations (WPP in Flanders, RBF in walloon) led to the establishment of a National Quality Label Committee for EHPA label in 2010, using QUEST as operator.

Hence, Partner's methodology to elaborate requirements and roadmaps and to identify an organisational path to verify and implement them in Belgium's complex institutional framework was heavily influenced and inspired (and to a certain extent limited) by the QUEST experiment.

2.4.4 Lessons learned from the EHPA label and EUCERT.HP qualification scheme

An example of a segmented approach towards quality, using a product label for the main components of a system and an training and certification scheme for installers is illustrated by the **Heat Pump** technology.

The EHPA label (originally D-A-CH quality label) came out of from the activities of the heat pump associations of Austria, Germany and Switzerland who decided to set up a common set of requirements to ensure quality of product and service for heat pumps.

This basic scheme was further developed by the European Heat Pump Association which extended its geographical scope.

EHPA aims at overcoming market barriers to a wider application of heat pumps through a voluntary mark of their systems, namely the EHPA label.

EHPA quality label will be granted in Sweden from this year onward and its use in Denmark, Finland, France and Ireland (a.o.) is under discussion.

This label is granted to standard electrically driven heat pumps designed for space heating (with or without sanitary hot water heating capability), with heat output up to 100 kW from air, geothermal or water heat sources.

In order to qualify for the EHPA quality label, the heat pump must comply with EHPA test criteria and the supplier must provide a required level of service, as the main parameters influencing HP efficiency are:

- Efficiency of the heat pump unit
- Quality of installation
- Design of the system and temperature level of the heating system
- Insulation level of the building envelope
- Climatic condition where heat pump is employed.

The label is aiming at the broader acceptance of heat pump systems and improved quality assurance for heat pump systems in the building sector. underlying objectives are:

- providing buying security and improved long term benefits to the end-user
- providing sound requirements for parties looking for institutional and financial support
- reinforcing the HP image of energy efficient and reliable products
- setting up HP as innovative technology producing renewable and environmentally friendly ambient heat
- protecting current HP manufacturers against low-quality, low price competition

Some key requirements of the EHPA label are listed in the table below:

Table 11: Key requirements of the EHPA label

Component Level	Conformity of main components and compliance with national and EU rules and regulation (CE marking…)
System level	Minimum efficiency values defined by COP for a given Temperature set point
	Declaration of sound power level
Customer Services	sales & distribution, planning, service and operating instructions in the language of the distribution area
	customer service network in the sales area handling consumer complaints within 24 hours
	two years 'omnium' warranty including a statement of availability of spare parts for at least ten years
Recent or Future requirements	change of initial COP values towards Ecolabel COP values (January 2011)
	Testing Regulations for HP with heating capacities > 100 kW
	Testing Regulations for inverter-driven HP
	Centralized data base of tested heat pumps

Beside this top-down approach at Product level, EHPA designed a European certified HP installer qualification scheme, based on the 2004 SAVE project EU-CERT.HP, initiated by seven partners and associates from ten EU countries. This EU training scheme and quality campaign for heat pump technology installers was supported by the EC within the Intelligent Energy Program and was completed end 2006.

Further management and development of the training and certification scheme was taken over by the EHPA's Education Committee in order to assess the overall quality of the training and to provide new material for the training course, as heat pump technology continues to evolve.

In 2009, roughly 1500 installers (persons) in participating countries passed through the EU-Cert training, more than 2200 did in 2010.

In Belgium, the Renewable Business Facilitator (RBF-Walloon) and the Warmtepomp Platform (WPP-Vlaanderen), both members of EHPA, fully implemented the EHPA label in 2010, using QUEST as operator of the label. Both are now members of the EHPA Heat Pump Quality Label Committee.

Q-Direct partners facilitated the whole process.

RBF & WPP are currently assessing the possiblity to implement the qualification scheme for HP installers.

2.4.5 Lessons learned from the UK MCS applied to SWT

The UK Government and the Small Wind Turbine (SWT) industry introduced a **product certification scheme** to provide a base standard of performance and safety in order to inform and protect the end user.

The route of certifying to IEC 61400-2:2006, however, is generally cost prohibitive for the majority of SWT manufacturers. Hence the AWEA and subsequently the BWEA developed an alternative standard, using IEC 61400-2 as it's foundation, to provide a more pragmatic and realistic route to achieving product certification, whilst still protecting the end customer.

The UK Government's Department for Energy and Climate Change subsequently developed the Microgeneration Certification Scheme (MCS) which provides a certification route for all microgeneration technologies. The BWEA standard is used for SWT certification and there are a number of MCS documents which describe how this should be conducted. The testing can be conducted by a UKAS or equivalent accredited test site, a non accredited test site or by the SWT manufacturer. In all cases this must be audited by a UKAS or equivalent Certification Body.

Note that the recent installer's regulations set in place in the USA rely on opposite logics as compared to the one suggested by the British standard:

- The British standard defines technical requirements for installations and (to a certain extent, their means of verification). Certification is granted to installers that are able to prove their installations meet those requirements.
- The American standard requires candidates to show proof of experience (gained either as a non-certified installers) by following a training, and to successfully pass an exam to get certified. But it does not specify any global nor specific requirements their installations should meet.

The research showed that such scheme was necessary to ensure quality standards comparable with other RETs, but that is was not a priority to set-up such voluntary scheme for SWT in Belgium in the short term.

2.4.6 Lessons learned from RET Quality Schemes in other countries

The survey of other countries relevant quality schemes for RETS showed some major differences compared to the Integrated Quality Scheme proposed for Belgium, no matter the technology, i.e.:

- Successive ambition levels to be achieved with respect to time and technology evolution are not considered by most of the existing quality labels
- Quality Installation and after sale servicing are not considered as essential by most of the reviewed quality schemes (at least in their means of verification), e.g. only a few of them foresee third party on-site inspection of a complete system in operation

- There is a wide variation in the minimum quality requirements among the reviewed quality schemes and many of them are still in early stage of implementation
- Many schemes rely on quality of materials, installation and information by means of simple technical criteria, cooperation with associations of installers and effective control mechanisms.

In that respect, partners agreed that a common labelling or certification process of products (e.g. solar keymark) and installers (e.g. EUCERT. HP) at EU level would offer a more accurate basis for end-users to compare respective quality levels than national and especially regional labels; although EU marks and certification schemes might look for minimal requirements at first stage.

2.4.7 Lessons learned from the QualiCert Initiative

The initiative financed by the Intelligent Energy – Europe program is based on two pillars:

- National platforms and roadmaps
- New or upgraded qualification schemes.

European activities should reinforce these two pillars and ensure mutual acceptance of the results, including exchange and possibly even the creation of a common brand for Installers (persons) certification.

In the Heat pump sector, EHPA is operating its own certification and training program for heat pump installers (EUCERT), which complies largely with the requirements set. Bilateral meetings with the WPP in Flanders showed that the EHPA program was very advanced in covering training and certification requirements and in its regional and professional scope.

Qualicert issued a list of key success factors for a mutually recognized RES installer certification system conform with the EU RES DIR.

2.4.8 Analysis opportunity Belgian test labs accreditation

In overall terms, the testing & certification procedures reviewed showed that

- RET components and systems manufacturers sometimes have to repeat expensive and time-consuming testing and certification processes for each market they wish to enter and that it was a strong market barrier reducing competition and consumers access to valuable products.
- Certification bodies should take advantage of the most effective testing standards for existing or new products to be effective in providing consumers protection and quality products.
- A lack of coordination on testing standards and cooperation among certification bodies may unnecessarily constrain market growth by limiting the resources available for testing and certification.

- New test procedures and characterization methods should be developed at EU level and worldwide, in order to address the testing of both conventional and advanced products.

Partners went in contact with (potential) **testing facilities** to know their plans regarding RET product and system and stimulate them to take the necessary step in order to be accredited once an integrated Quality scheme becomes operational.

The minimal outcome of this task was to stimulate test institutes to take the necessary steps to be able to perform some quality/performance tests required by EN standards.

- Bilateral meetings were orgnised with ARGB / Techni-gas (Gas devices test facility) and Eliosys (Solar Thermal & PV collectors test facility) to assess their readiness and potential for ISO / Keymark accreditation in order to perform a range of test according to EN standards. Partners interacted with test lab officers and facilitated contacts with EU accreditation bodies or Belgian Construction Certification Association (BCCA).
- Furthermore, connecting a new load or generation unit to the electrical grid must preserve power quality; therefore the compatibility between (mainly invertors of) grid-connected Photovoltaics and urban wind turbine and the electricity grid was also tested. The research confirmed this is a key issue when the number of DER is sharply increasing.
- Bilateral meeting hold with Test Institute Laborelec (advising network operators or industrial companies on power qulaity issues) showed there was a potential in Belgium to perform such **test for small-scale decentralized green electricity systems**. This was the subject of a specific task performed by KULeuven who wrote guidelines about testing compatibility of green power sources with the electrical grid. Laborelec is an accredited facility for certification for decoupling protection relays for all decentralized production units based on grid parameters. An in house developed device, the digital wave recorder (DWR) performs specific measurements to assess power quality issues of units or sites. Although it is not a requirement at the moment, laborelec could test signal to noise ratio (SNR) for PLC (power line communication) in a low voltage grid, which might become an important factor in the future smart electricity grid. For the moment, the testing of inverters to comply with the relevant standards is left up to the manufacturer. In the future smart grid context, communication, control and distributed services meeting requirements will become key. This would mean that the testing of requirements should be better documented by then and achieved by a third party.
- The ventilation sector does not require a Belgian test institute for AHU since each manufacturer usually get its products tested according to the test standard applied in its own country. In Belgium, there are very few or no manufacturer of air handling units with heat recovery. The Belgian market is mainly composed of dealers and wholesalers of foreign products. Beside

that, the main issue for testing ventilation system with heat recovery is the determination of the efficiency of heat recovery. There are currently several European and national test standards regarding heat recovery efficiency. Those standards differ mainly in the way they express the test result (EN 308, EN 13141-7, NEN 5138 in The Netherlands, Dibt-TZWL in Germany, VTT for Finland, etc.).

- BBRI is working out a calculation procedure in order to express the heat recovery efficiency in a common way, whatever the test standard, based on the raw data from the test. Indeed, providing a common way to express heat recovery efficiency, at least at national level, is essential for EPB regulation, quality requirements, subsidy policies...). Moreover, AHU manufacturers are not requested to test their products again according to a different standard.
- On the other hand, there is a need for test facilities in Belgium, mainly for natural ventilation openings (for the flow-pressure relation) for natural ventilation systems, but those systems are out of the project scope.

2.4.9 Organisational framework towards an integrated scheme for small-scale RES

Recognizing that renewable energy will form the heart of any future low carbon energy sector, the EU introduced a comprehensive and robust supportive framework of directives and regulations to improve energy efficiency in energy-using products, buildings and services.

The legal european framework as it stands sets strong boundaries for the employment of technologies with higher energy efficiency and a shift in energy use from non-renewable to renewable sources. Further change in this legal framework should positively influence the technology and the development of the EU RET market.

Assuming RETs will be more and more handled as building integrated systems, the partners reviewed in first instance the main institutional components of quality control and certification schemes for building products. Useful elements for an Iintegrated scheme encompassing RETs are reviewed hereunder:

Product Quality at EU level:

- The CE mark is a self-declaration of the product manufacturer that confirm the presumption that building products comply with the essential requirements of the respective directive and allows them to move freely within the EU territory. The CE mark only covers the regulatory or harmonized part of a directive and is usually not subject to third party certification.
  Only construction products that comply with the national standards transposing the harmonised standards into a EU technical approval or, into national technical specifications complying with the essential standards (like STS) are eligible to bear the "CE" marking.
  This ensures that all construction works bearing the "CE" marking satisfy the essential requirements. According to an amendment introduced by

Directive 93/68/EEC, the conditions governing its use are made the same for a whole range of products that are likely to come simultaneously within the scope of various Directives which had previously involved different marking systems. Among these products one find simple pressure vessels, hot-water boilers and electrical equipment.

- The **Keymark** is a harmonized European Mark System for standardized products showing their conformity with European Standards and providing a real added value for the consumer: tested and certified observance of uniform European Quality Standards, where CE-marking shows the observance of legal minimum requirements.. The Keymark verifies, certifies and garantees that a collector or full solar system fulfills all requirements imposed by EN12975 or EN12976 respectively.
- To get the Solar Keymark:
  - A sample of the product is selected in the factory to be tested by an inspector authorised by an accredited test institute
  - The collector or full system is tested under STC (EN12975 or EN12976)
  - The manufacturer's quality management system is audited
- To maintain the Solar Keymark :
  - An audit of the manufacturing quality takes place once a year
  - The QMS has to be documented by the manufacturer

Every 2 years, a sample of the keymarked product is selected randomly on the production site by an authorised inspector who examine it.

- The Ecolabel for electrically driven and gas driven heat pumps is based on Regulation (EC) n°66/2010 of the EU Ecolabel. The ecological criteria for heat pumps were published as commission decision 2007/742/EC. They cover all electrically-driven, gas-driven or gas-absorption heat pumps up to an output capacity of 100kW. Domestic hot water heat pumps and exhaust air heat pumps are deliberately excluded. Requirements are stated for:
  1. Efficiency in heating mode (COP value at standard rating points),
  2. Efficiency in cooling mode,
  3. The global warming potential (GWP) of the refrigerant used (< 2000 over a 100 year period and a bonus for refrigerants with a GWP < 150),
  4. The secondary refrigerant (must not be environmentally hazardous),
  5. Noise emission,
  6. Heavy metals and flame retardants (Cadmium, lead, mercury, chromium6, PBB, PBDE may not be used),
  7. Installer training,
  8. Documentation,
  9. Spare part availability,
  10. Information leaflet,
  11. Information to appear on the label.

- These requirements address the efficiency and environmental performance of the heat pump unit and stress the need for a proper planning (match of heat source, heat pump and building) and installation.
- The ecolabel for heat pumps will be reviewed in 2011. The issue of its future within the set of legislative documents is raised. Another issue regards its limited scope; as outlined before, the ecolabel does not cover the full product range of heat pumps. Considering that the RES Directive makes reference to the Ecolabel in article 13, paragraph 6 ("only those heat pumps shall be promoted, that fulfill the requirements of the eco-labeling for heat pumps"), it also means that, irrespective of their performance, some heat pumps that are not eco-labeled shall not be promoted by Member States.

Product Quality at National level:

- Product related quality control in Belgium is usually organized by accredited bodies under the responsibility of an administrative body. There is a logical gradation in the control level, from the mandatory minimal requirement of the CE mark to the voluntary higher standards like the keymark and/or european eco-label.
- Product quality control and certification is a federal competence; **BELAC** is the only Belgian accreditation body for test facilities and certification bodies, placed under the supervision of the Federal Public Service of Economy, SMEs, Independent Professions and Energy. It's been observed that **BELAC** had limited expertise for auditing solar test lab (amongst others).
- **BENOR** mark stipulates that a product fulfills a Belgian standard (NBN). For conventional building products, Technical Specifications (PTV, STS…) are also considered as a basis for conformity.
- An **ATG** is an assessment by experts from the Belgian Union for technical approval in the construction industry (UBatc-BUtgb) of one particular product from a single manufacturer for a particular application. It is a voluntary technical approval by a technical committee, providing technical advice including a description of the technical properties of a building product or system. It must allow the user to check the conformity of the products delivered on the construction site with the existing approval. **BUtgb-UBatc** did reorganize its structure and status in order to keep FPS economy out of the structure, following EC recommendation.
- ATG is usually delivered to products which are either not covered by standards, like complete (building integrated) systems, or innovative products consisting of several components sold under a given commercial name. Some technologies (like VwHR) does not suit such product approach since their design is never the same from one system to another (fully custom-built). Such approval is now systematically linked to a certificate issued by an accredited building construction certification association (like BCCA).

- **Testing and assessment** can take various forms: from the supplier's declaration of conformity to third-party assessment, from prototype-testing to type examination, or the assessment of a quality or environmental management system.
- Content and status of the **Unified Technical Specifications (STS)** being issued by FPS Economy were recently upgrade to match the evolving building regulation. The first three STS regarding RETs are in preparation (re building integration of Photovoltaic, solar thermal modules and Heat pumps). Those references might be referred to in future royal & governmental decrees at federal and regional level.

Results from the first phase showed that:

- efficient (EU) marks ensuring minimal or higher quality level of RET components, products and systems were available on the belgian market;
- at Installer level, existing tools (eg trainings, support policies, labels) were not sufficient or efficient enough to ensure a minimum quality level to the end-user.

The main institutional components of quality control and certification for RET installers and installer companies that would be useful for an IQS are listed below:

Installer Quality at EU level:

- The EU RES DIR is aiming to upgrade the overall skills and competences of small-scale RETs installers through a common, mutually recognized, qualification or certification framework put in place by the member states and relying on (practical) training and examinations of profesionals.
- Another initiative that is worth mentioning is the European Qualifications Framework (EQF) formally adopted early 2008 and acting as a translation device to make national qualifications more readable across Europe, promoting workers' and learners' mobility between countries and facilitating the transparency and portability of qualifications and the lifelong learning of workers. EQF applies to all types of education, training and qualifications, from school education to academic, professional and vocational. This approach shifts the focus from the traditional system which emphasises 'learning inputs', such as the length of a learning experience, or type of institution. It also encourages lifelong learning by promoting the validation of non-formal and informal learning. The associated quality level is specified in three categories ranging from basic (Level 1) to advanced (Level 8):
    - Knowledge
    - Skills
    - Competence

Installer Quality at National level:

- Quality control at installer level is a distributed competence; the initial control performed at federal level is the so called 'registration procedure' of installer companies which is a non technical issue and does not presume of any quality standard, except the overall solvency of the installer.
- Specific quality controls of building system installations happen mainly for safety reasons, according to technical regulations and through accreditation procedure of installers, like the gas habilitation procedure - CERGA - set up in partnership with the gas federation or building control agencies like SGS, Vinçotte... being accredited to check the conformity of a PV system with the RGIE).
- Quality control at installer level usually occurs through training and examination of individuals and company labeling; both aiming to provide end-users sufficient confidence in their skills to deliver installation quality standards which go beyond the market average.

The way to promote quality of RETs in buidlings (BES boilers, HP, SDHWS...) is currently not harmonized between the Regions; this is lowering their market development as well as the quality level, since the stakeholders are basically the same while the procedures and the requirements are different, especially re support mechanism, as illustrated below :

- Flanders : The Quest Quality Centre was established to set-up and operate a profesional quality system for small-scale RETs.
- Walloon: A network of facilitators was put in place to provide expert advise re RET to prescribers, building designers and end-users. As well as a specific subsidy scheme to integrate RETs in buildings according to EN standards. An additional condition for SDHWS at Installer level is to be recognized by the energy administration as a 'qualified Soltherm installer' (theoretical & practical course of 52 hours + exam).
- In Brussels, a reflexion regarding the adoption or use of standards and labels to assess the quality of materials and/or Renewable fuel just started. The brussels region also put Energy Facilitators on place as well as RET subsidy based on technical specifications and international standards.

An overview of the panel of voluntary and regulatory useful marks encompassing quality of some of the reviewed RET in Belgium is shown in the figure below.

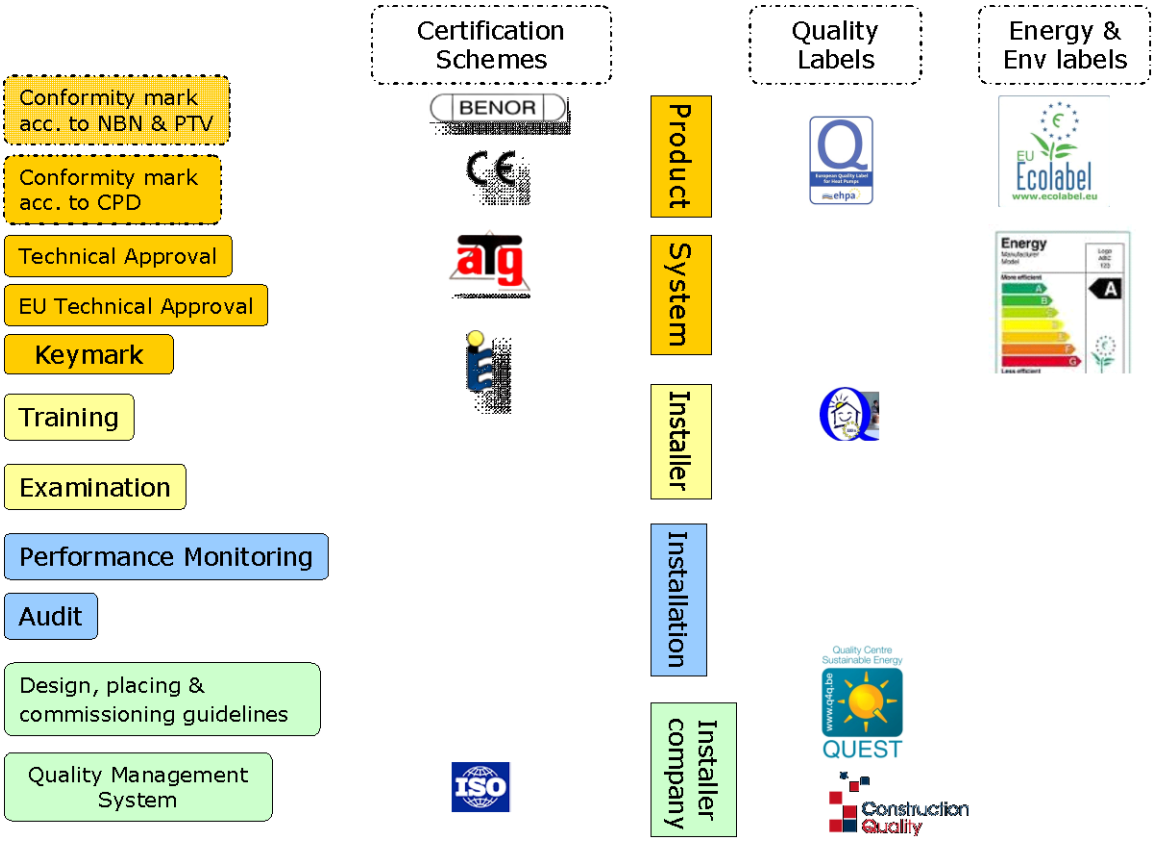
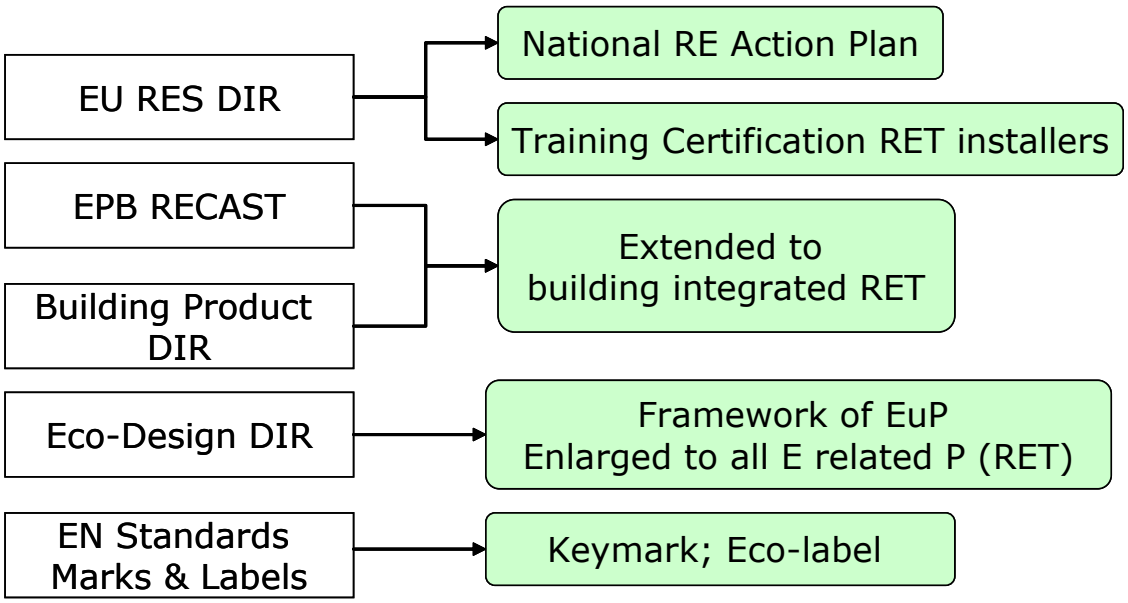


Figure 4: Voluntary and regulatory marks covering some of the reviewed RET

Within the European legal framework including the Eco-Design Directive, the Energy Star Regulation, the Labeling Directive, the Directive on Energy End-Use Efficiency and Energy Services and the Energy Performance of Buildings Directive, the research pinpointed a range of Directives pretty much influencing or impacting the proposed integrated quality scheme for RETs in Belgium :



The Construction Product Directive

- The purpose of the CPD is to ensure the free movement of all construction products within the EU by harmonising national laws with respect to the essential requirements applicable to these products in terms of health and safety. Such requirements are defined in interpretative documents drawn up by technical committees and then elaborated further in the form of technical specifications (e.g. STS).
- **From CPD to CPR** : On May 2010, the European Council reached an important political agreement on the revision of the CPD, soon to be replaced by a regulation, the **CPR,** shifting the overall framework of CE marking from voluntary to compulsory, whenever a European standard or European Technical Assessment (**ETA**) exists for a certain product. Key element of the agreement lays in:
    - the power of the EC to fix threshold levels for the performance of some products to be declared at EU level.
    - simplified procedures allowing for the replacement of type-testing for certain products and production processes by a Specific Technical Documentation (**STD**), which means great economic savings and reduction of administrative burden for SMEs, while guaranteeing the right information and levels of performance.

The Energy Performance of Buildings Directive (EPBD)

- The aim of this regulatory tool is to promote higher energy performance of building by imposing decreasing level of primary energy consumption for the building (E-level), taking into account the performance of the building envelope (insulation, airtightness, …) and of the HVAC devices.
- The current EPB regulation defines some basic requirements for RET products and installed systems. higher quality standard is promoted for some technologies. (e.g. More E points for ventilation systems whose flow rates are conform to the regulation, stated in the commissioning report of the installer). The weak point of such requirements is the lack of means of verification by the authorities or the third party certifying the building.
- Each of the reviewed RET is (to a certain extent) designed to be integrated into buildings and will therefore have an impact on its E level. The way to calculate the contribution of a solar system or a heat pump to the global performance of a building might influence the quality required for such systems. This is even more the case if their output is monitored and taken into account into the (renewal or continuation of the) building and/or (installer) company labeling or certification procedure.

The EPB Recast

- The recast Directive 2010/31/EU published in June 2010 aims at clarifying some provisions of the 2002 Directive. A first transposition deadline is set for July 2012 and the law must be fully implemented by July 2013.
- The updated framework of the EPBD Directive strengthened energy performance requirements and is aiming to reduce the carbon footprint of buildings to an energy standard of nearly zero by 2018 - 2020.
- The recast is aiming to improve the energy performance of new and existing buildings within the EU thanks to minimum requirements on:
    - a framework to calculate the energy performance of buildings,
    - energy performance of new and existing buildings, building elements and technical building systems,
    - the share of nearly zero energy buildings,
    - the energy certification of buildings (incl. a control system thereof), and
    - regular inspection of heating and air-conditioning systems in buildings.
- To achieve the necessary improvement to meet the targets, a portfolio of solutions is required; many of which are currently available or are being developed through the adoption of new technologies, especially RETs

The reserarch showed that additional requirements on building physics (e.g. minimum energy requirements for the building envelope) and on the efficiency of heating, hot water, air-conditioning and ventilation systems (alone or as a combination) should benefit RETs, especially HP & VwHR, as long as these requirement allow for a comparison of systems and energy sources used.

The Ecodesign Directive (2010/30/EU) and subsequent Energy Labelling

- The Ecodesign for Energy-related Products (ErP) Directive (2009/125/EC recasting Dir. 2005/32/EC) aims at establishing Ecodesign requirements for several product groups. The most important change brought by the new directive is the extension of the scope of the energy label from energy-using to **energy related products** in the commercial and industrial sectors, (incl. construction products). the Directive now also covers these products which do not consume energy but "have a significant direct or indirect impact" on energy savings.
- The challenge of Ecodesign is to eliminate disparities in the classification of performance between Energy-related Products belonging to the same family, such as HP, BES and SDHWS which are subject to the implementing measures of Lot 1 (boilers, 3–400kWinput capacity, heating and combisystems), Lot 2 (water heaters) and/or Lot 10 (Air-conditioning units below 12 kW – HP only).

- Energy consumption of the heating installation will become transparent to the consumer and should stimulate his choice of energy efficient products using energy from renewable sources. Requirements will be based on a common methodology for the calculation of each product's primary energy efficiency.
- The results of the calculation will be translated by an energy label. For Lot 1, it is currently foreseen to display the primary energy demand, the efficiency class in a range from A+++ to G, the suitable heat distribution system and the variations of these values per climate zone. Other parameters might be added.
- The provision of accurate, relevant and comparable information on the specific energy consumption of energy-related products shall influence the end-user's choice in favour of those products which consume or indirectly result in consuming less energy and other essential resources during use.
- This Directive introduces a uniform, easily recognisable label (A…G) for all products of the same type, providing end-users with additional standardised information on those products' costs in terms of energy use and consumption of other essential resources, measured in accordance with harmonised standards and methods.

The energy label will advertize the "intelligent performance" of buildings for heating to the prospective tenant or buyer.

- The ErP leaves the responsibility for the Energy Label and the CE-marking on the manufacturer who put the Energy-related Product on the market.
- The Ecodesign Energy Efficiency Factor (ETA) widens the scope from "*energy related heat generator*" to "*energy related heating system*". The "boiler" as referred to in Lot 1 includes all parts of the Heating-Systems (i.e. the sub-system heat generator and the sub-system distribution-emission installed in the building).
- all standards currently used to calculate boiler efficiency will have to be adapted to Ecodesign Lot 1. Some HP standards like the prEN 14825 (capacity modulating heat pumps and SCOP/SEER) currently under preparation is already adapted to the requirements of Lot 1.
- Ecodesign Lot 1 can also be used to calculate ETA for a heating system including several heat generators. In that case, giving the responsibility for the system label to the installation contractor is still under discussion. According to the ErP Directive 2009/125/EC, the installing contractor is the representative who places the extended boiler on the market and it is therefore his responsibility to calculate and declare the new ETA on the final energy Label of the boiler.
- The EC is validating the default values of the Ecodesign "reference boiler" through a stakeholder consultation. Once implemented, ErP will have far-reaching implications for manufacturers, importers, consumers, contractors, consultants and architects. It links the ErP Directive to the EPB Directive and it will promote innovation in design and marketing of boilers.

- To facilitate consumer's understanding, ETA % PE will be rated in 10 colour coded energy classes, from A+++ (ETA % PE >120%) to G (ETA % PE <40%).These classes will be visible on the energy label of the boiler. The consumer who chooses the better ETA % PE will benefit from financial and fiscal incentives.

Most influential EU Directives

The research stressed that regional policies should link and harmonize their future quality requirments for RETS with the most influencial EU directive regarding the implementation of an integrated Quality Scheme in Blegium, as illustrated in the figure below.

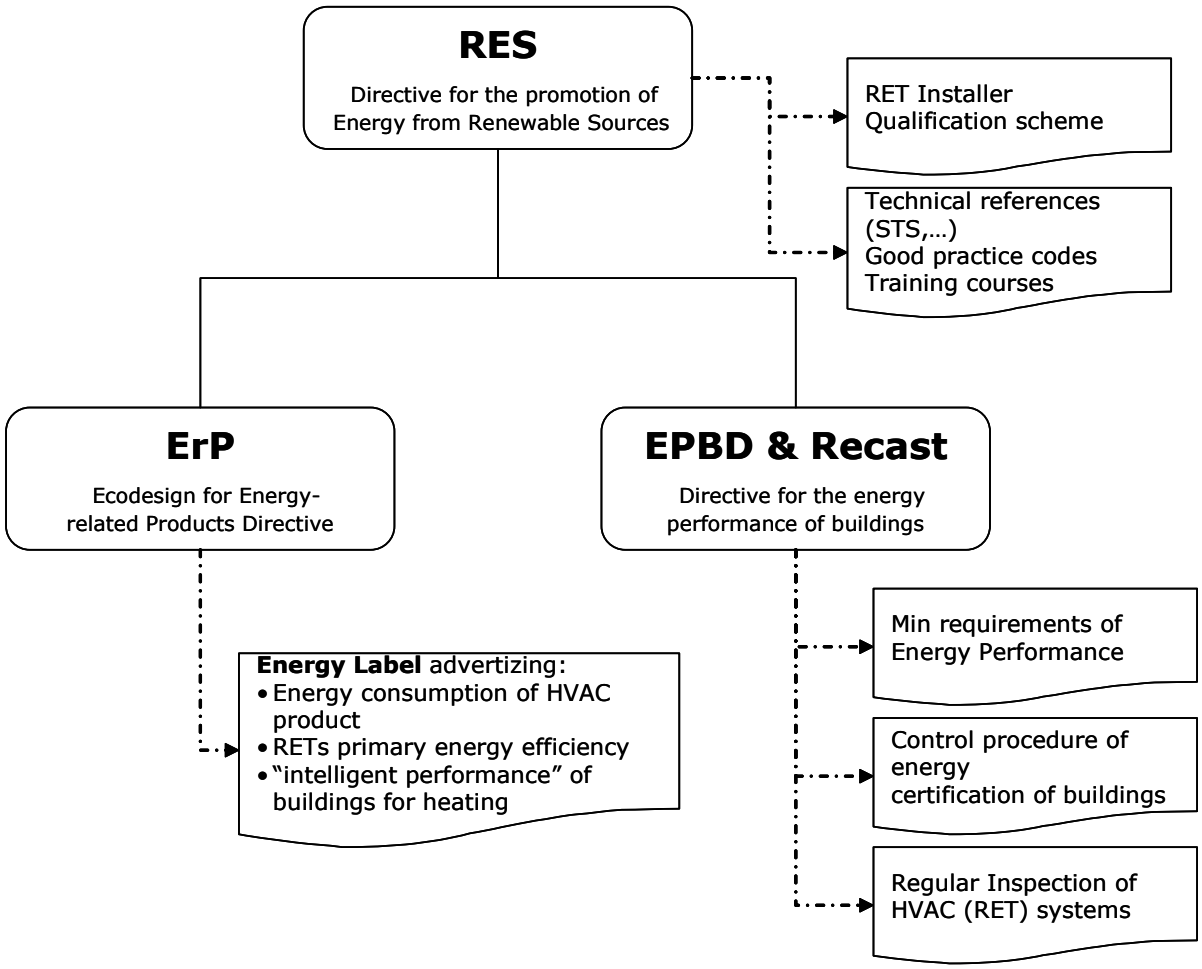


Figure 5: EU directives mostly influencing or impacting national RET quality schemes

Supporting References for an Integrated Quality Scheme

Beyond EN standards, a range of technical specifications are supporting the set-up of an integrated quality scheme for RETs products and installers, as illustrated in the figure below.

The references on the right of the figure are originated from the european voluntary or regulatory framework (except Constuction Quality which is grouping the walloon building construction sector CoQual and the flemish Qualibouw and their associated references).

The STS and ATG on the left side of the figure are respectively offering harmonized technical specs for RET (in preparation) and national certification schemes for technical agreement of building product.

Technical prescriptions (PTV) and Technical Information Notice (NIT) issued by BBRI can be assimilated to good practice codes for installers.

Beside those references, some Regions issued their own code of good practice such as the flemish code for Heat Pump installation, training content such as the Soltherm syllabus for SDHWS installers or Maintenance guide for Solar Thermal systems from the Brussels Region...

One of the challenge of an IQS is to further harmonize references between the Regions at installer level in order to get a common base for installer qualification in a mutually recognized scheme from 2012 onwards.

Ultimately, the single difference between technical references such as code of good practice for a given RET should be the language, since the way to install or maintain a heat pump, a solar system or a ventilation device does not significantly change from one Region to another. The differences are rather from administrative nature (support schemes, local regulation...). Such administrative requirements are also frequently changing and should therefore be kept out of common quality references which should evolve with technological progress and market innovation.

Comprehensive quality references should be based on three type of elements:

- the list of requirements subject to evaluation
- the means of verification of each of the requirements
- the weighting scheme of the requirements.

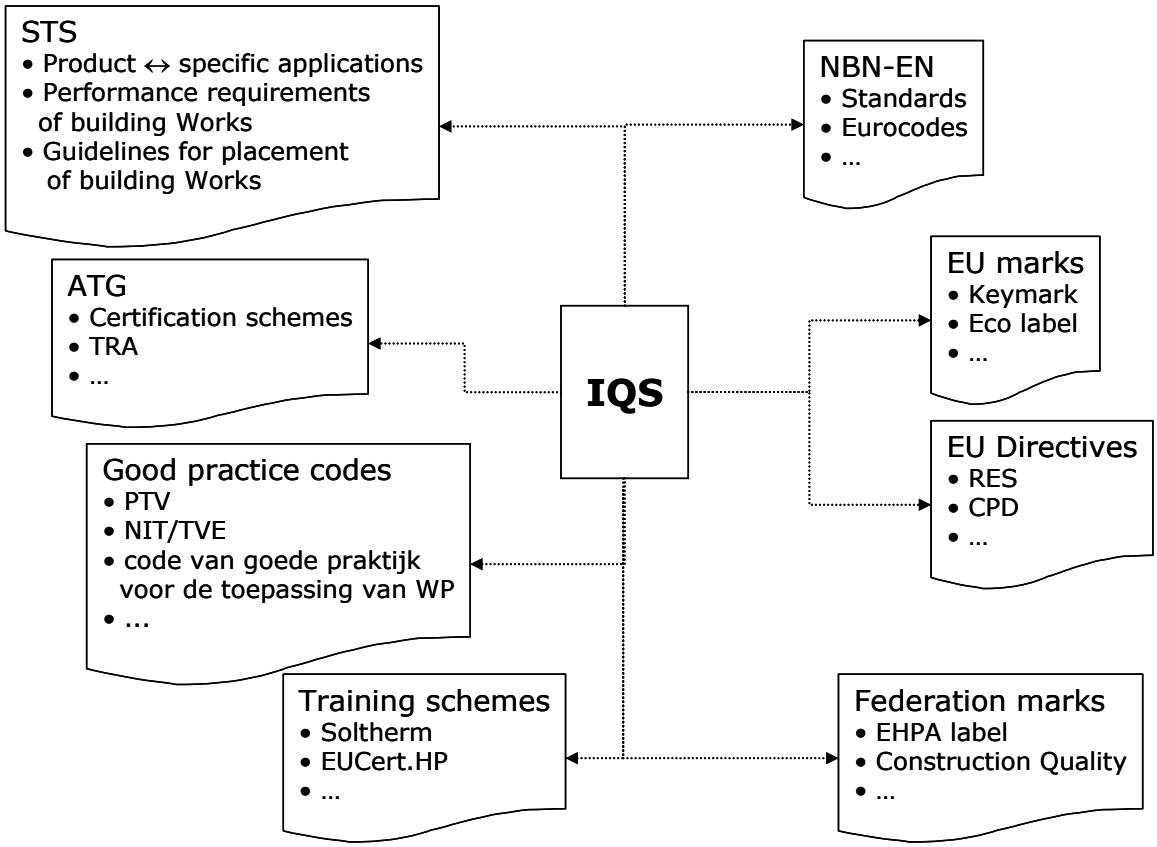


Figure 6: Supporting references for an integrate scheme for RETs in Belgium

2.4.10 Guidelines for a Belgian IQS

The approach envisaged for an Integrated Quality System would be based on product & systems requirements combined with installer and designer requirements at company level in a labelling and further certification process.

This would fit current structure & market organization of most of the reviewed technologies.

This concept of a multi-technology, independent & voluntary scheme for RET products & installer companies was submitted to representatives of public bodies (ENOVERE/CONCERE group) who basically agreed with the principle of having common short to mid term ambitions and procedures for quality assessment of RET at product and installer level operated at national level in Belgium.

Discussion

A purely national quality mark for RET products makes little sense in a small market like Belgium. Introducing European voluntary schemes into Belgian regulation and/or support scheme seems to be the way forward, adding some specific requirements as requested. Relevant examples of such quality schemes are:

- Din*plus* / EN*plus* for pellet fuel
- Solar Keymark for solar thermal collectors and (family of) systems

- EHPA label for Heat Pumps
- …

For innovative systems that are not yet covered by standards, a technical approval and certification scheme such as the ATG might be an option in the current institutional context; although the suitability of current ATG schemes to complex and rapidly evolving systems such as solar-thermally assisted heat pumps is not demonstrated, since indicators for assessment of complex systems do not exist.

In that respect, a collaboration between a BELAC accredited third party certification organism (like BCCA) and an agreement operator empowered by BUtgb-UBatc (such as QUEST) in an appropriate quality scheme, might provide an efficient combination of technical know-how and certification expertise on a national level.

A national quality scheme for RET installer companies, based on minimal requirements imposed by the EU RES directive, should apply in first instance to those technologies that are covered (i.e. PV, ST, HP and BES). It shall be extended to energy efficient technologies (VwHR…) and other RETs (SWT) once those rely on common quality standards and ambition levels and fit into harmonized approval & certification procedure towards the applicants.

Such scheme should rely on requirements based on appropriate technical references (good practice codes, STS, technical assessment & evaluation guidelines…), with particular emphasize on:

- Conformity of installed components and products with international standards (certified furthermore);
- Guarantee of performance, compatibility and availability of components used (certified furthermore);
- Regular training and third party certification of installers;
- Third party inspections of systems in operation, certificate of good executions and quality/performance control.

Conform to our mid-term ambition level, RET installation quality should ultimately be assessed through on site performance monitoring, by means of key performance indicators compared to the electricity, heat and/or hat water demand of the building and, considering external factors (e.g. solar radiation, outside temperature...) as appropriate.

Such approach is illustrated below; custom-built systems (PV, VwHR, HP) and Factory made (BES boilers, SDHWS) are evaluated at product level by EU marks such as the EHPA label for HP or the Solar keymark for solar thermal systems. When ready, the Energy Label from ErP Directive should add-on.

At installer level, current training schemes such as the walloon solwatt and soltherm for PV and SDHWS respectively should be replaced in a next step by the qualification scheme for RES installers common to both Regions.

Partially based on the EU-CERT.HP training scheme, the common qualification scheme should apply first to those RES covered by the EU RES DIR, then later to other energy efficient technologies such as VwHR.

At installer company level, the QUEST voluntary labeling scheme might soon encompass both RETs (except SWT reaching lower ambition level).

Quality assessement is based on company quality management assessment, (as-built) file evaluation and on-site audit on installation in operation.

Such scheme is aimed to be self- sustainable thanks to a combination of initial certification fee, annual management fee, periodic audit costs and renewal fee.

An annual fee from respective sector federations represented in the Boad of Administration shall be added.

In the long run, on site performance measurements should phase in as installation monitoring becomes technically relevant and affordable for single houses, a.o. thanks to the extension of smart-grids.

Note: the EU Smart Grids definition states that "Microgrids are generally defined as low voltage networks with DG sources, together with local storage devices and controllable loads (e.g. water heaters and air conditioning). They have a total installed capacity in the range of between a few hundred kilowatts and a couple of megawatts. The unique feature of microgrids is that, although they operate mostly connected to the distribution network, they can be automatically transferred to islanded mode, in case of faults in the upstream network and can be resynchronised after restoration of the upstream network voltage."

Ultimately, RET installation performance should become part of the full Building Performance Assessment and subsequent building certification scheme(s).

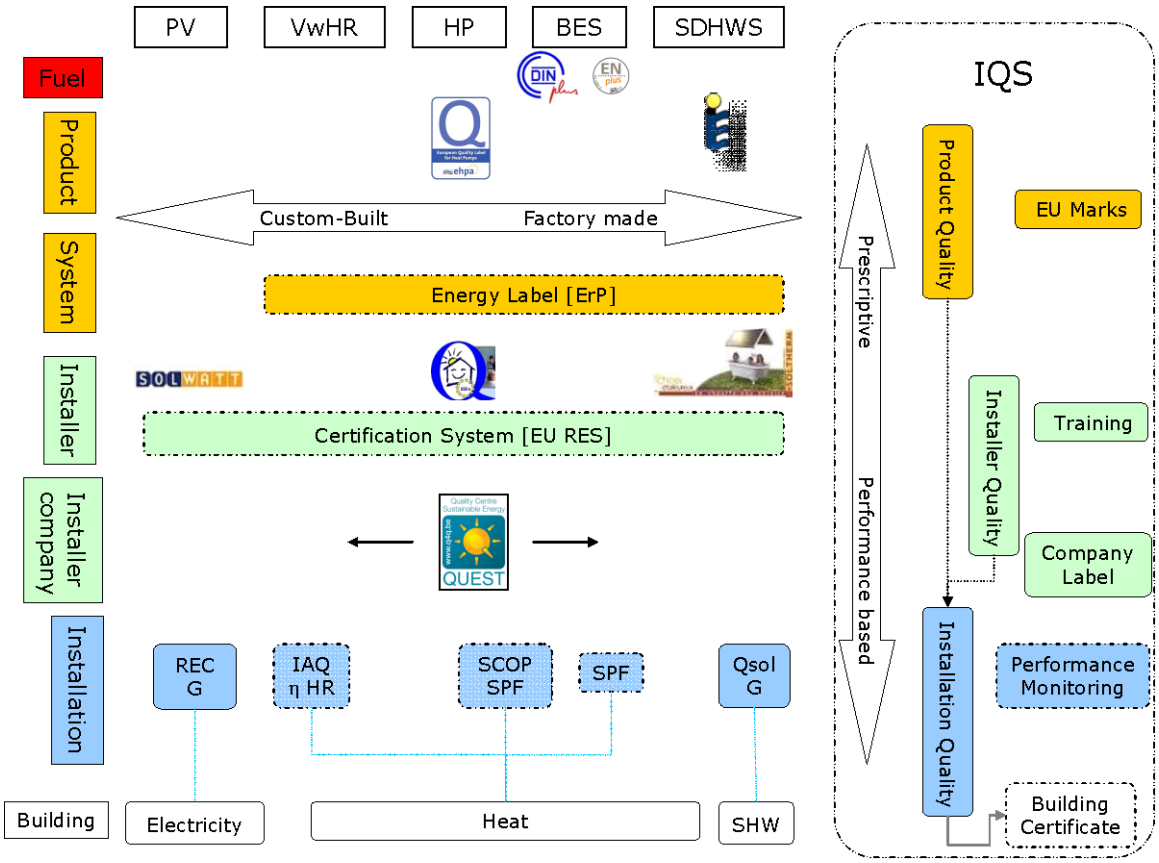


Figure 7: Overview of an Integrated Quality Scheme for RETs in Belgium

- REC: Renewable Energy Certificate (based on green electricity production)
- G: Solar irradiation
- IAQ: Indoor Air Quality
- η HR: Heat Recovery efficiency
- SCOP: Seasonal Coefficient of Performance
- SPF: Seasonal Performance Factor
- Qsol: Solar contribution (solar energy stored in the hot water storage)
- SHW: Sanitary Hot Water

A voluntary labelling scheme for installer companies like the one provided by QUEST should be regarded as an intermediate step towards a comprehensive "RETs approval and certification scheme".

Such scheme is the subject of discussions between project partners (3E, BBRI) agreement operators (QUEST) and Certification Associations (BCCA) but is not established yet.

Major issues identified by the partners so far are:

- profile of the applicant: autonomous installer company, wholesaler with or without own installer network, independent worker (size effect of the company);
- scope of approval: technical skills linked to a product performance that can be verified in many ways (under STC, in situ, through simulation or self-declaration of the manufacturer…);

- qualifying period: from 3 month for an Installer company asking for a voluntary label, up to 6 month for an ATG product;
- financial capacity of the applicant (financial burden of the scheme strongly depends of the company profile/size)
- lock-out of the market for quality control of installer companies by (sub)national building federations
- …

It should be noted that in order to provide appropriate quality assurance and control to end customers, the Regions are considering a common (integrated) labeling or certification scheme at Building level for:

- Companies (Installer / Craft approach)
- Materials (product approach)
- Buildings (building system approach)

In our view, a labeling or certification scheme for small scale RET's should not dispute any building labeling or certification scheme recognized by public authorities for residential housing.

In the best case scenario, a basic set of common requirements for RETs is part of the labeling / certification scheme of the building and verified during the third party audit to certify the building.

Beyond the valorization of the building performance, such approach could also bring added value to the system design and the installer company.

It would further prevent the competition and confusion between separate labels or undesired situation where a very badly designed RET installation is integrated into a certified building and vice-versa.

Moreover, building designers and architects would have to consider specific requirements for RET system integration (inner & outer space required, roof orientation, heat load,…), at least in new or heavily retrofitted house.

An integrated scheme to certify residential buildings paying special attention to RETs design, installation and performance would ensure a higher and/or longer term energy performance of the building.

Exploring the way towards an IQS for RET

In the field of Renewable, as in other building technology related schemes reviewed (2.4.2), product and installer company labelling or certification of persons would benefit from an common management through an integrated scheme with following characteristics:

- The coming installers certification system, required by art.14 of EU RES DIR should be common to both three regions respective to technical content, skills base, examination and third party certification.

- It should be designed for individuals with profesional background in HVAC and or electricity, under preparation of medium term dedicated profession of Heat pumps, solar thermal, PV and ventilation systems installers.
- RES installers certification should be ready by end 2012 and supported by Regional authorities through European training credits like ECVETS.
- It should be further integrated into a voluntary labelling scheme for RET installer companies.
- In order to get the label, the company should employ a growing share of certified intstallers (persons), covering the whole set of training modules for a given RET or a combination of RETs (e.g. 50% of qualified installers at start, 75% after 2 years and 100% at renewal of the company label).
- In a later phase, such scheme shall be extended to a range of technologies, beyond the ones covered by EU RES DIR (ie. VwHR, SWT…).
- This voluntary scheme shall turn into a mandatory company certification scheme by a third party accredited body within 5 years from now.
- Such approach might end up in a high quality standard certification scheme of RET installers and installer companies.

The proposed scheme should further be:

- meeting expectations from end-users, building / RET sector and industry in a balanced way, notwithstanding the fact that the end consumer is the one that ultimately pays for quality;
- open for the broadest share of qualified installer companies offering a single procedure for applicants whatever the technology and with an access fee based on the size and/or the turnover of the company;
- empowered by federal regulatory department and regional energy agencies and comply with their common specifications and requirements;
- commonly applied and referred to by both three Regions;
- designed to issue quality marks going from technical agreement for innovative products up to individual installers' certificate and installers company labels.

Parties involved would have to work together to make such scheme truly operational, i.e.:

- Quality centers such as QUEST should bring expertise and technical assessment (as agreement operator entiteld by UBatc-BUtgb where appropriate);
- Accredited bodies such as BCCA should look for credibility and national market profile of the whole process, thanks to third party labelling or certification through transparent procedures;
- Building/Installer federations should look for the profiling and dissemination of the scheme among professionals

- Local professional associations (helped and supervised by agreement operator) should be responsible to set-up info sessions for candidate applicants (such sessions play a key role in ongoing labelling or certification scheme).

2.4.11 Market impact of IQS implementation

Partners evaluated the expected market and policy impact of an IQS in operation based on a theoretical exercise (technology review and quality schemes assessment) on the one hand and the practical experiment of designing a voluntary labelling scheme for RET installer companies on the other hand.

Implementing an independent quality system might have quite an impact on the Belgian RET sector and its market structure.

The research showed that, to date, *regulatory products requirements* are often limited to safety aspects and CE mark obligation.

For some RETs, commercially available products already achieve higher standards than those required by regional support schemes (e.g. most of the solar thermal collectors are Keymarked, while there is no regulatory requirement to do so).

RET product quality standard being driven by EU market players, any requirements to fulfill existing product quality schemes at EU level would have a limited impact on local suppliers and manufacturers, except for those who are only active locally and whose product would never succeed EN or IEC testing, or which cannot afford the cost of product certification.

Regulatory Installers' requirements are usually limited to the rules of access to a regulated occupation. In the best case, an official agreement of installers (persons or companies) is required (e.g. agreement of SDHWS installers in walloon), proving the individual installer successfully followed a theoretical and practical training.

The research showed that for installation companies, requirements including random site inspection of installations might impact their activity in a much stronger way, since:

- There is currently no specific occupation like solar, HP or BES installer. Installing such systems is perceived as a natural extension of heating engineers or electricians work. Installing energy efficient or renewable energy technologies is usually driven by financial support of public authorities and urging demand from end-users, rather than professional skills and concern for energy savings.
- Trainings provided are not always mandatory and sometimes a bit *light* compared to the variety of installation situations; moreover, they do not always consider the low level of expertise amongst new generation of installers.
- Inspection performed by independent third parties documented installation failure of SDHWS, PV and HP, which in turn showed a significant potential for improvement of residential application of some RETs.

- There is very little environmental awareness amongst installers when it comes to energy savings. RET market is usually perceived as a green opportunity business with little consideration for - and knowledge of - energy and CO_2 savings achievable by an installation in operation.

Discussions with RET suppliers and system integrators showed large difference in the acceptance of a quality scheme even on a voluntary base. Sector federations basically agreed with the need to have a framework and some rules to kick bad products and installers out of the market but worried about higher ambition level, procedures for implementation and third party control.

Some stakeholders are pleading for a higher visibility through better communication of current quality standard thanks to a local label (e.g. PV QUAL label of Walloon PV system integrators).

Others found the proposed timeframe for implementation of evaluation guidelines too short (e.g. ATTB-Belsolar found QUEST quality requirements and evaluation guidelines for SDHWS comprehensive but requiring a slower phase in than foreseen).

It has to be mentioned that building confederations (regional federations representing building contractors interests) turned out to be pretty sensitive to any third party quality assessement at installer company level.

The 'market' of qualified company labels in the Belgian building sector appears like a 'no-trespassers' domain, dominated by regional ISO-like, self declared 'certification' procedures such as *CoQual Energie*.

The implementation of article 14§3 of the EU Directive on renewable energy (certification of installers) will have a decisive impact on requirements related to training and requested skills and competences.

The implementation of a mutually recognized qualification scheme for RET installers should lead to:

- higher quality standards of RET installations
- higher consumer confidence and choice among skilled professionals
- healthy competition within the EU RET installation market
- pan-European recognition of certified RET installers
- increased market share for RETs installed by certified professionals

3 POLICY SUPPORT

3.1 GENERAL POLICY GUIDELINES AND RECOMMENDATIONS

Since the very beginning of this project, both three Regions made genuine efforts to collaborate among each other and with the federal government, especially through the ENOVER/CONCERE group, to harmonize and streamline quality requirements of distributed renewable energy technologies.

In the coming year (2011), the group should further elaborate a common certification system for RES installer (as person), to comply with EU RES DIR and to improve professional skills in a coherent and harmonized way.

3.1.1 Infrastructure and planning

- Both Regions currently lack spatial planning strategy organizing the deployment of renewables; although much can be done to streamline complex authorisation and planning procedures and to remove non-cost barriers to the growth of renewable energy. Simply making planning regimes more transparent and faster while respecting existing environmental legislation can improve uptake of renewable energy and harmonize quality requirements.
- Therefore, public authorities should streamline infrastructure planning regimes while respecting existing EU environmental legislation and strive to conform to best practice.
- Faster progress in developing the electricity grid to balance higher shares of renewable energy should be achieved since the projected expansion of electricity from renewable sources in Belgium's NREAP carries a number of implications:
    - First, it highlights the need to accelerate the modernisation of the electricity grid. Urgent action is necessary to prepare the grid for the integration of significant volumes of electricity produced from renewable sources, facilitating grid balancing, flexibility and distributed generation.
    - Electricity systems have to become more interconnected and flexible, and new infrastructure development and reinforcement will be necessary, including the deployment of smart grid technologies.
    - Multiple, flexible, smaller scale distributed forms of electricity generation need different grid and market design rules compared to traditional large, centralised power sources, typical of the Belgian landscape.

3.1.2 Financial Support Mechanisms

According to the NREAP, two types of financial schemes are supporting Renewable energy production installations in Belgium:

- Production support schemes (i.e. green certificates mechanisms and associated rules);
- Investment support schemes (subsidy, tax credit, premium…)

No less than 7 financial tools, illustrated below, were enforced by Belgian authorities at different levels, to stimulate RES; each of those might influence to a certain extent the quality of installations.

Table 12: Member States Financial support instruments for electricity, heating and transport (source: Renewable Energy: Progressing towards the 2020 target; communication from the EC – 31/01/2011)

		AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Electricity	FIT	x	x	x	x	x	x		x	x		x	x	x	x	x	x	x	x	x			x			x	x	x
	Premium					x		x	x	x											x					x		
	Quota obligation		x													x						x		x	x			x
	Investment grants		x		x	x					x		x	x			x	x	x	x								
	Tax exemptions		x							x	x		x						x		x	x			x		x	x
	Fiscal incentives			x			x		x											x	x	x				x		
Heating	Investment grants	x	x	x	x	x	x		x		x	x	x	x	x		x	x	x	x	x	x	x		x	x	x	x
	Tax exemptions	x	x					x				x	x			x	x				x				x			x
	Financial incentives			x			x		x			x											x					
Transport	Quota obligation	x		x	x	x	x	x		x	x	x			x		x	x	x		x	x	x	x		x	x	x
	Tax exemptions	x	x		x	x	x	x	x	x		x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x

Some guidelines regarding the management of those incentives and tax exemptions when it comes to quality standards are given below:

- Sudden changes are disruptive and undermine all renewable energy investment strategies. These have to be avoided as they undermine investor confidence and efforts to achieve the targets. Retroactive changes to support schemes in particular must be avoided given the negative effect such changes have on investor confidence.
- Decision to fasten decreasing support to green electricity (as the one recently announced by the Flemish energy minister) might negatively affect the quality of PV installations (causing a rush before each date of expiry), as much as an unusually high financial support did (free riding effect for inexperienced installers).

- Once a technology is able to be deployed but not yet competitive, support tends to shift from capital to operating support and here again there is a continuum of instruments, depending on circumstances. Whatever the instrument, it is important that it has a predictable and transparent way of adapting support levels so as to avoid "stop and go" policies or political calls for retroactive changes to conditions, allowing adjustments to reflect the falling production costs of renewables, thus avoiding excessive returns on capital. It is also important to note that operating support is more commonly financed by energy consumers rather than from taxation.
- The use of multiple instruments can be appropriate, given the different status of technologies in terms of maturity, users, and markets. The choice of instruments should however be clearly framed in order not to create confusion and engender negative consequences for end users.
- RET financing scheme should remain "off budget" i.e. borne by energy consumers rather than tax payers, to avoid "stop-start" interruptions as government budgets become more constrained.
- Developing cheaper resources in other parts of the single market would reduce costs and free some financial means to support quality. EC analysis estimates that up to 10 billion Euro could be saved annually if Member States treated renewable energy as a commodity in a single European market rather than in national markets. In Belgium also, the move to market integration, in particular the evolution to feed in premiums should be fastened, less fragmented and reinforced.
- Support schemes should be adapted over time to always match best practice and technologies so as to avoid undue market distortions and excessive costs.
- In the same way, quality schemes would need to be adapted as legal requirements to install RETs in new buildings replace financial incentives.
- In the heating sector for example, investment grants focuses on household installations of small solar thermal or solar photovoltaic units. Given the cost reductions that have occurred in micro units in recent years, Belgium could start to consider regulatory rather than financial solutions at the household level, as proposed by a recent study of the Flemish government about mandatory share of renewable energy in the building prescriptions by 2015.
- More, Art. 13.4 of the Renewable Energy Directive includes rules for building regulation codes to include minimum shares of renewable energy in buildings, ensuring growth and major savings, through regulatory rather than financial means.
- Rules and requirements linked to regional support mechanisms should not run counter to broader voluntary labelling schemes or marks (e.g. the Walloon subsidy for HP imposing set points and COP measured according to NBN EN255-3 might not be in line with EHPA, nor Ecolabel requirements, using NBN EN 14511 as basis)

- When available, Belgium's support policy and incentives for energy efficient RETs products should refer to performance classes (Energy label) as a criteria to be eligible for financial support since a voluntary scheme would lead to only some products being labelled, resulting in confusion or misinformation for end-users. The energy labels should be regularly adapted in order to ensure predictability for the industry and comprehension for consumers.

3.1.3 Evaluation of the fulfilment of the 2020 RES target

As for building performance, the energy output of a RET installation and associated savings is highly dependent of the evaluation system used. If the 2020 RES objective is the single concern of policymakers, it might counteract requirements for higher quality standards at installation level, since the usual way to measure the objective is not *per se* an indicator of installation's quality or performance; therefore:

- The roll out of RET towards the 2020 objective and further calculation of the share of renewable, such as the cumulative area of solar collector installed or the number of AHU or HP units sold, together with possible sanction from EC in case of non compliance, must be assessed in the prospects of higher quality standards.
- Both can be complementary if the overall goal of reducing non renewable energy and CO2 emissions is clearly stated and appropriately controlled. Otherwise EU target and quality standards might play against each other.

3.1.4 Communication about RES

- Labeling schemes for renewable energy technologies are potentially boosting *Demand* for higher standard installations, rather than the *Offer*. Hence, such schemes must be accompanied by a targeted, long lasting communication:
  - Promoting quality standards and associated (long term) benefits, instead of the subsidy itself
  - Informing end-users and applicants about the added value, the scope and limitation of any scheme supported
  - Recording and updating databases with labeled or certified products and installers as well as further monitoring results of installations in operation
- Policymakers must find a balance between a simple "One label fits all" approach and a clear communication of the scope and limitations of any particular labeling or certification scheme supported (or not) by public authorities.
- The way energy agencies communicate about RET support schemes could give the (sometimes right) impression to end-users that the only tools used to stimulate RES market are economical, triggering a search for the lowest price instead of the best quality for price by end-users.

- As long as public support schemes are reflecting minimal or legal obligations required by competent public bodies, it is better keeping it low level in the end-user communication.
- Moreover, promoting a subsidy scheme as such does not result in higher quality standards/practice amongst installers but might result in a rather chaotic move of consumers towards low-cost installation.
- A communication focusing on 'Subsidy' could remain necessary to develop new markets locally or to boost emerging technologies. Although, once a given RET registers a two digit growth, public support should smoothly switch towards promoting higher quality standards.
- From 2011 onwards, it is proposed to switch from the single promotion of RET subsidy towards structured communication on Quality (as already underlined in the AEON country report for Belgium re Non-Cost barriers to Renewables). In practice, Energy agencies should progressively:
    - shift communication on subsidy and financial support schemes towards quality schemes and issues (in a positive way)
    - gather measurement of RET production results in a central database
    - evaluate compliance with the 2020 target through measured datas from monitoring devices on installation
    - guide end-users towards a single operator fully dedicated to quality control and technical assessment of RETs at national level

3.1.5 Installer Certification

- In order to comply with EU RES Dir 2009/28/EC, Belgium has to ensure that a certification scheme is available by 31 December 2012 for RES installers (as persons). To this end, the EHPA certified HP installer scheme should be used as background information or become part of the Belgian qualification scheme, as appropriate.
- As a minimum ambition level, one single harmonized qualification or certification scheme should be available for RES installers of both three Regions by December 2012 to avoid competition distortion between them.
- As the coming certification scheme for RES installers will be mutually recognized by Member states, it would make sense to organize (common part of) training and examination at EU level, at least among a range of member states showing product / building / climate /… similarities.
- At the operational level, European RET association such as EHPA, ESTIF, EPIA, EUBIOM… might be best placed to manage and update part of the technology specific training materials. The very fact that those EU associations and federations are based in Brussels is an extra incentive for both Regions of Belgium to work with.

3.1.6 Building certification

- For domestic installations, accredited building control agencies or empowered installers already checking the conformity of a building system with safety requirements might be further trained and certified to perform comprehensive control regarding the overall quality and performance of RET installations. The means of verification are key to that end
- Requirements for building integrated RETs to be conform with standards and/or regulation should be systematically applied and verified by third party organisms, if necessary together with the builiding certification procedure, so as to further integrate RET schemes into EPB requirements.
- EPB regulation should in turn evolve to take quality requirements for RETs and their verification means into account, such as reporting measured performance of (part of) these systems at commissioning or certification of the building. According to NREAP The E level currently takes into account (in a simplified way) the output of:
    - Active solar systems and other heating and power systems relying on RES;
    - Heat and electricity from high efficiency cogeneration unit;
    - Collective heating and cooling systems
- Such evolution of the building regulation is already observed in financial support schemes; in new buildings, there is no direct subsidy for a HP anymore, but support schemes for building performance (E level) takes into account the output of the HP.
- CONCERE should further investigate how a voluntary scheme for small-scale RETs could be part of - or linked to - future comprehensive national (or regional) building certification schemes like SUSTINEO, currently under preparation in the Brussels Region.

3.1.7 Research

- Further research is needed on standard solutions to implement renewable energy in buildings and neighborhoods in an optimal way since the design phase.
- Combined Product Quality Schemes like ATG-CEN Keymark should be further investigated. Certification organisms like BCCA have tested procedure for approval but lack of technical expertise in Renewable Energy
- Building System simulation in predesign phase should be promoted for coming NZEB and nearly Zero Energy Buildings (like in the automotive industry where a new car is fully digitalized and simulated before assembly).
- Belspo and/or Regional energy agencies should further support active participation of experts in key tasks of the Solar Heating and Cooling Programme from IEA dealing with the development of indicators for assessment of complex RET systems such as SHC task 44 which aims at

optimising combinations of solar thermal energy and heat pump. Further work on advanced system classification should also be promoted.

3.2 GUIDELINES AND RECOMMENDATIONS BY STAKEHOLDERS

3.2.1 Building sector federations

Building sector federations should endorse an IQS that goes beyond their area of influence and/or member list. This would eventually further stimulate the Belgian RES market, strengthen quality stadards and reduce administrative and financial burdens for applicants to the scheme.

If this issue cannot be solved at political level, regional quality schemes with appropriate certification procedure would be a best second choice, with a graduation of quality standards such as:

- CE mark: documenting a product that fulfils essential requirements with respect to safety, health and environmental protection
- Specific Safety mark: proving the product and/or company work fulfils specific safety requirements (like the safety class 2 testing of PV modules)
- Qualified enterprise: a quality mark for companies (like Quest label for installer companies or CoQual Energie for building contractors) attesting a higher quality standard of RET installation according to the best practice
- Certification mark: proving that a component, product or system was tested according to the standard in force
- Keymark or combined ATG-CEN Keymark schemes, including :
    - Successful product testing
    - Inspection of the manufacturer's management system for the relevant product line
    - Factory inspection
    - Surveillance of using the mark

3.2.2 BES Technology Group

Thanks to the inclusion of the heating and cooling sector in the new EU renewable energy framework, Member States are planning reforms to their grants, feed in tariff regimes or other instruments in the heating sector.

Thus development and investments in Europe's biomass pellet industry and biomass boiler technology can be expected.

As BES market is rather young and small in Belgium (compared to conventional technologies), promotion of an integrated scheme would eventually further stimulate the Belgian BES market, strengthen quality standards and reduce administrative and financial burdens for applicants to the scheme.

- new DIN CERTCO accreditation of ARGB is expected to allow them testing and certifying heating boilers for solid fuels (≤ 300kW), according to NBN EN-303-5.

- EN*plus* labeling will allow an easy quality control and international trading of wood pellets for BES.
- Regional policy should make training of BES installers a priority.
- Our field measurements indicated that in real life conditions, periodic optimization of BES was key to their efficient and pollutants free operation. In that way regular (yearly) maintenance of BES should become mandatory, as for fuel heating systems in the Brussels Region.

3.2.3 HP Technology Group

Some parts of the EU-CERT.HP training & examination scheme shall be promoted by WPP/RBF to further design a national qualification scheme for RET installers in 2011, since the aim of the HP certificate is to valorize competent & skilled professionals, able to design and install reliable, faultless and efficient HP systems and gain customer confidence

3.2.4 VwHR Technology group

If the market evolves towards factory made ventilation systems sold as kits, it could be worth developing a comprehensive quality scheme focusing on products, using a top-down approach, such as ATG (however, such evolution towards standard kits seems unlikely in the ventilation sector).

3.2.5 Solar Thermal Technology Group

- The Keymark is an interesting EU quality mark for collectors and factory made systems (so far) which is successfully applied since 2003. Solar keymark for systems should be endorsed by section 5 of ATTB, since:
  - recent evolution allow a single range of testing for a family of systems
  - A fully equipped Belgian test lab is being accredited by BELAC and by the Keymark organisation to respectively perform full collectors and system testing according to NBN EN 12975 and 12976 and to issue the solar keymark.
  - The ongoing definition of a new concept of *Hot Water Comfort for Solar Thermal Systems* illustrates the overall trends in RETs Quality Assurance to further meet end-user expectations. Within a few years from now, existing SDHWS test methods should be reviewed and adapted for assessment of Hot Water Comfort, which is a key global requirement of any solar thermal system user.
  - New areas for quality assurance systems should be investigated in order to develop a basic set of requirements and test methods for emerging or advanced solar thermal energy technologies and combined technologies; e.g.:
    - Some applications already on the market need quality assurance measures which are not covered by any standards so far (e.g. large solar thermal systems, solar cooling)

- Some application are new on the market and no quality assurance measures exist yet (e.g. combined solar & heat pump systems)

3.2.6 PV Technology Group

- Future Evaluation guidelines and Product requirements should include an obligation to recycle modules after decommissioning and provide an LCA analysis of PV technologies, in particular innovative ones.
- The decision on whether to participate in international standardisation activities should be left to the industry. If regional and national authorities whish to support the international role of the Belgian PV industry, a support for participation in international standardisation activities may be considered in consultation with the industry.
- Policy on regional federal and European level should strive to harmonise requirements for safety and PV grid connection. This should cover the required safety and control functions but not necessarily the required set points for such functions. Regarding the specific set points, an agreement at Belgian federal level should be pursued.
- Regional policy should make training of PV engineers and installers a priority. In all regions, training programmes are required for active professionals, students of higher education and students of professional education. The curricula and levels should be aligned and based on international good practice references.

3.2.7 SWT Technology Group

- The main policy recommendation is to enforce the six requirements listed above (2.2) regarding the eligibility of SWT to financial support schemes (e.g. green certificates) which are conditioning the profitability of small wind projects.
- It is recommended to small wind turbines suppliers and installers in Belgium to endorse those requirements and comply, for the sake of the sector development.

3.3 GENERAL CONCLUSIONS

- Building and Renewable technologies markets don't know regional or linguistic frontier. A common approach between the Regions and a greater convergence of regional and national support schemes to facilitate trade and move towards a pan-European approach to development of renewable energy sources must be pursued.
- The most efficient way to streamline RET product quality labelling in Belgium is to refer to operational EU marks endorsed by the CEN and/or by sector federations (e.g. the Solar Keymark, the EHPA label…).

- A common certification process of products and installers (persons) at EU level would offer a more accurate basis for comparison to the end-users than national or regional labels, even if such certification scheme only covers minimal quality requirements at first stage.
- In the longer term, a comprehensive and binding regulatory framework is expected to drive forward renewable energy development and achieve EU targets better than a partial and voluntary framework.

Quality Labelling must be related to quality assurance systems based on specific technical references. Moreover, granting quality labels requires an independent verification of quality standards of the participating companies. This verification should contain regular evaluation and on site inspections of RET installations in operation.

- Performance based certification schemes should be preferred to prescriptive ones (although a mix of both type of requirement is unavoidable) since they tend to objectively evaluate quality achievements and stimulate innovation.
- It is essential that quality requirements and subsequent RET regulations are integrated and adapted to the current best practices.
- Product & installer label or certificate schemes should be operated by the same entity like for other technology related schemes (cfr. 2.4.2). showing that managing product and installers labelling or certification through the same scheme is a common pattern.
- In the renewable energy sector, the financing concept of an IQS should be self-sustaining after initial set-up supported by public authorities at start-up phase.
- There is a risk for policymakers to mainly/only use economic instruments to stimulate RETs, since it doesn't necessarily change end-users habits and might even initiate a pure market reflex (e.g. PV investment for high financial returns) disregarding overall quality aspects and long term efficiency of systems.
- Furthermore, beyond the technological and regulatory aspects, The Regions and the cities need to step up their efforts to strengthen skills, knowledge and capacities, in particular within the relevant administrations and agencies, to ensure adequate governance for the efficient delivery of renewable energy investment programs and projects.

4 DISSEMINATION AND VALORISATION

- Final report of the first phase and scientific report 2009 as well as meeting report and preparatory documents from the Follow-up Committees were sent to relevant stakeholders and interested parties to the research.
- During the second phase of Q-Direct, quality requirements discussed and processed through technological roadmaps were organized in an operational way by the QUEST Quality centre for Sustainable Energy.
- Common labelling scheme and procedure were designed to reward domestic application of RETs by installer companies working in one or several Regions, relying on existing (EU) product quality marks as appropriate.
- Evaluation guidelines for PV system integrators based on preliminary results of the research were proposed to the market. Initial requirements were upgraded in 2010 and disseminated towards end-users and professional sector through Quest website and publications.
- Guidelines for Solar thermal, Heat pumps and VwHR installer companies are currently being proposed to the market.
- Quality requirements for companies installing biomass boilers are in the early process of being taken up into the Quest voluntary labelling scheme. In the meantime, quality requirements and test performed on several boilers were subject to a range of publications (see section 5).
- The table here below summarizes the status of quality references by RET. Those referentials are available in French & Dutch directly on Quest Website or (for the time being) via the partners.
- As part of a privately owned voluntary labelling scheme, compliance with those referentials is not linked to municipal, regional or federal subsidy schemes, although both regions committed to promote and refer to Installer companies labelled by Quest, as and when a list is available.
- The results of the research will be further valorised through a formal request from both Regions to further design the operational framework for a certification system for RES installers according to art.14 of the EU RES DIR. A consortium composed of Q-direct partners and major stakeholders (training facilities, building federations, consumer associations...) was selected to that end.

Table 13: Status of Quest evaluation guidelines by technology

REF DOCUMENTS	LINK TO PRODUCT QUALITY MARK	LINK TO INSTALLER TRAINING	DATE OF PUBLICATION	NUMBER OF LABELS ISSUED*
Evaluation Guidelines PV	None (IEC standards)	None	February 2009	6
Evaluation Guidelines SDHWS	Solar keymark Collector	(BRU)SOLTHERM	March 2011	
Evaluation Guidelines HP	EHPA label	EUCERT.HP	May 2010	9 types – 3 brands
Evaluation Guidelines VwHR	None	None	May 2011	
Evaluation Guidelines BES	DINplus (fuel)			

*January 2011

Quality References in French and Dutch can be downloaded for free:

- **PV**:
http://www.questforquality.be/sites/default/files/A_DIV/Quest_Doc_B_PV_Referentiel%20qualit%C3%A9_v01.04_20101217_FR.pdf

http://www.questforquality.be/sites/default/files/A_DIV/Quest_Doc_B_PV_Beoordelingsrichtlijn_v01_04_20101217_NL.pdf

- **HP**:
http://www.questforquality.be/sites/default/files/Quest_Doc_B_PAC_Referentiel%20qualit%C3%A9_v01_20100504_r_0.pdf

http://www.questforquality.be/sites/default/files/QUEST%20Doc%20B_WP_finaal%20versie_01%2001_%2004-05-2010_r.pdf

- **ST**: (Evaluation Guidelines for Installers companies – Doc B)
- **VwHR**: (Evaluation Guidelines for Installers companies – Doc B)

- Beside scientific reports, mid-term evaluation report and final reports, the partners issued a range of deliverables used and/or discussed during the whole research period. An exhaustive list of deliverables available as separate reports is presented below:

		Available on Project Intranet	Annex to Final Report	Available as separate Report	Specific Report by technology					
Work package 1 and its subtasks										
D2	Project website containing all internal working documents, project reports and reference documents	X								
D3	Meeting reports for Project Group Meetings (PGM)	X								
D4	Meeting reports for follow up committee	X	X	X						
Work package 2 and its subtasks					BES	HP	VwHR	PV	ST	SWT
D5	Summary report on international and Belgian state of the art on the level of technology, market & quality issues	X		X	N	N	Y	Y	N	N
D7	Specific policy document presenting the current status with respect to standardisation , normalisation, quality assurance & quality labelling for the technologies under consideration.	X		X	Y	Y	(Y)	Y	Y	Y
D8	Updated report on status of technology , supply chain and market and on Standardisation, normative framework & quality systems.	X		X	N	Y	Y	Y	N	N
Work Package 3 and its subtasks					BES	HP	VwHR	PV	ST	SWT
D9	referential document containing a complete set of technical requirements concerning electrotechnical integration aspects directly of importance to quality systems for the different technologies.	X		X						
D10	referential document containing a complete set of technical requirements concerning HVAC integration aspects directly of importance to quality systems for the different technologies.	X		X						
D11	referential document containing a complete set of technical requirements concerning building technical aspects directly of importance to quality systems for the different technologies.	X		X						
D12	Technological roadmap indicating which criteria would need to be implemented at which point in time in the process of realisation of the quality systems.	X		X	N	N	N	Y	Y	Y
D13	Opportunity analysis report for the introduction of new technologies for which quality referentials need to be established	X		X	N	Y	N	N	N	N
D14	Referential document per technology including technical, technological , normative criteria on component, product and system level	X		X	N	N	Y	N	N	N
D15	Detailed roadmap with phasing of technical requirements for each of the technologies based on the market development status & expectations.	X		X	N	N	Y	N	N	N
Work Package 4 and its subtasks					BES	HP	VwHR	PV	ST	SWT
D16	referential document containing a complete set of organisational requirements concerning the institutional context, market impact and procedural & organisational aspects related to quality systems for the different technologies.	X		X						
D18	Report analysing opportunity of Belgian Test Lab accreditation. Grid testing guidelines for PV & SWT	X		X	Y	N	N	Y	Y	Y
T4.4	Financing Concepts	X		X						
D20	Specific policy document presenting the envisaged initiatives with respect to standardisation , normalisation, quality assurance & quality labelling for the technologies under consideration.	X		X	N	N	Y	N	N	N
Reports other than mentioned under WP1										
FUC 1	Follow up committee meeting / handouts / meeting report	X	X	X						
FUC 2	Follow up committee meeting / handouts / meeting report	X	X	X						
FUC 3	Follow up committee meeting / handouts / meeting report	X	X	X						
FUC 4	Follow up committee meeting / handouts / meeting report	X	X	X						
FUC 5	Follow up committee meeting / handouts / meeting report	X	X	X						
AR1	Startup report	X								
AR2	Annual activity report year 1	X		X						
AR3	Intermediate report for evaluation of phase 1	X		X						
AR4	Final report phase 1	X		X						
AR5	Scientific report year 3	X		X						
AR6	Final report phase 2	X		X						

5 PUBLICATIONS

5.1 PEER REVIEW

5.1.1 BES

1. Verma V K, Bram S, Vandendael I, Laha P, Hubin A, De Ruyck J (2011). Residential pellet boilers in Belgium: Standard laboratory and real life performance with respect to European standard and quality labels. International Journal of Applied Energy, 10.1016/j.apenergy.2011.02.004.

2. Verma V K, Bram S, Delattin F, Vandendael I, Laha P, Hubin A, De Ruyck J (2011). Agro-pellets for domestic heating boilers: standard laboratory and real life performance. International Journal of Applied Energy, doi:10.1016/ j.apenergy.2010.12.079.

3. Verma V K, Bram S, Gauthier G, De Ruyck J (2011). Evaluation of the performance of a multi-fuel domestic boiler with respect to the existing European standard and quality labels: Part-1. International Journal of Biomass and Bioenergy, Vol.35, 1, 80-89.

4. Verma V K, Bram S, Gauthier G, De Ruyck J (2011). Performance of a domestic pellet boiler as a function of operational loads: Part-2. International Journal of Biomass and Bioenergy, Vol.35, 1, 272-279.

5. Verma V K, Bram S, De Ruyck J (2009). Small scale biomass heating systems: Standards, quality labelling and market driving factors-An EU outlook. International Journal of Biomass and Bioenergy, Vol.33, 10, 1393-1402.

6. Verma V K, Bram S, De Ruyck J (2011). Emissions and efficiency of three different pellet boiler technologies as a function of operational loads. Under Review, International Journal of Biomass and Energy.

5.2 OTHERS

5.2.1 BES (international proceedings)

1. Verma V K, Bram S, De Ruyck J (2011). Real life performance of domestic pellet boiler technologies as a function of operational loads: A case study of Belgium. Submitted to International Conference on Applied Energy; ICAE-2011- Perugia Centro Congressi, Perugia, Italy.

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2. J. Hoogmartens, G. Franck, L. Helsen, W. Van Passel: 10 December 2009: 4th Strategic Energy Forum (Brussels): Determination of SPF for residential heat pump systems

3. G. Franck, W. Van Passel, B. Van Pee, J. Hoogmartens, L. Helsen: IWT-collectief (070662): WarmtePompen in duurzame, Innoverende en Realistische EnergieConcepTen

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5 Workshop WP in EPB (27-08-09): J. Hoogmartens : Kritische evaluatie van WP in EPB

6 Workshop Vlaams Actieplan Groene Warmte (6/11/2009) : W. Van Passel : Het aandeel WP in groene warmte

7 De Onderneming 11-2009 : Warmtepomp heeft brede toepassingsmogelijkheden

8 Cool & Comfort 10-11-12 2009 : WPP Warmtepompsymposium

9 Energy & Buildings 41 (2009): M. Sourbron: Efficiently produced heat and cold is squandered by inappropriate control strategies: a case study

http://www.ehpa.org/ehpa-quality-label/participating-countries/

5.2.3 SDHWS

1. B. Huberlant (26-05-2009) "Development of a Reference Framework for a Belgian Quality Scheme for Distributed Renewable Energy Concept " - ESTEC 2009 – parallel sessions on Quality assurance; oral communication

5.2.4 PV

1 B. Huberlant, A. Woyte, J.Crotteux(1), B. Verbruggen (24/09/2009); Methodological approach to ensure high quality installtion of small grid connected photovoltaics, Abstract N°1325 – 6DV.3 – & poster presentation at EU PVSEC 2009.

5.3 CO-PUBLICATIONS

5.3.1 Peer review

1. Rodríguez M A R, De Ruyck J, Díaz P R, Verma V K, Bram S (2011). An LCA based indicator for evaluation of alternative energy routes. Applied Energy, Vol.88, 3, 630-635.

5.3.2 Others

1. Rodríguez M A R, Verma V K, Bram S, De Ruyck J, Díaz P R (2010). Strategy for sustainable energy matrix conversion based on exergy life cycle analysis: a case study. 23rd International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems, ECOS 2010- Lausanne, Switzerland.

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8 ANNEXES

ANNEX 1 : COPY OF THE PUBLICATIONS

ANNEX 2 : MINUTES OF THE FOLLOW-UP COMMITTEE MEETINGS

The annexes 1 & 2 are available on the website
http://www.belspo.be/belspo/ssd/science/pr_energy_en.stm

ANNEX 3 : ABREVIATIONS & ACRONYMS

ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie
AHU	Air Handling Unit
APF	Annual Performance Factor
AREI	Algemeen Reglement op de Elektrische Installaties
ATG	Agrément Technique – Technische Goedkeuring
AWEA	American Wind Energy Association
BOVERKET	The National Board of Housing, Building and Planning (Sweden)
BBRI	Belgian Building Research Institute
BES	Biomass Energy System
BIPV	Building Integrated Photovoltaics
BMS	Boiler Management System
BRUGEL	Régulateur Bruxellois pour le marché du Gaz et de l'Electricité
BWEA	British Wind Energy Association
CEN	European Committee for Standardization
CIAC[2]	Certification Industry Against Counterfeiting
COP	Coefficient of Performance
CRA	Centre de Recherche Agronomique (Gembloux)
CWaPE	Commission Wallonne pour l'Energie

[2] organisation of globally active testing and certification organisations aiming to counter the misuse of test marks

DER	Distributed Energy Resource[3]
DG	Distributed Generation[4]
DNI	De Nayer Instituut
DIN	German Institute for Standardization
DIN CERTCO	Certification organization of TÜV Rheinland Group
DSO	Distribution System Operators
ECVET	European Credit system for Vocational Education and Training
EN	European standards
EER	Energy Efficiency Ratio
EHPA	European Heat Pump Association
EPB	Energy Performance in Buildings
EPBD	Energy Performance of Buildings Directive of the EU Council and the European Parliament
ErP	Energy-related Products Directive (2009/125/EC) recasting Dir. 2005/32/EC)
ESTIF	European Solar Thermal Industry Federation
ETA	European Technical Agreement
EU	European Union
EU-RES	European Directive promoting the use of energy from renewable sources
EWEA	European Wind energy Association
FUC	Follow-Up Committee Q-Direct
GCS	Green Certificate Scheme
HP	Heat Pump
HVAC	Heating ventilation and air conditioning
HX	Heat Exchanger
IEC	International Electro-technical Commission
ISO	International Standard Organization
KUL	Katholieke Universiteit Leuven
MQS	Microgeneration Quality Scheme
NBN	Norme Belge / Belgische Norm (Institut Belge de Normalisation)

[3] small-scale power generation technologies (typically in the range of 3 kW to 10,000 kW) used to provide an alternative to or an enhancement of the traditional electric power system.

[4] also called on-site generation, dispersed generation, embedded generation, decentralized generation, decentralized energy or distributed energy, generates electricity from many small energy sources

NIT	Note d'Information Technique
NREAP	National Renewable Energy Action Plan
NZEB	Net Zero Energy Buildings
PER	Primary Energy Ratio
PV	Photovoltaic
QUEST	Quality Centre for Sustainable Energy Technologies
RBF	Renewable Business Platform
RES	Renewable Energy Systems
RET	Renewable Energy Technology
RETs	Renewable Energy Technologies
SCOP	Seasonal Coefficient of Performance
SDHWS	Solar Domestic Hot Water Systems
SHW	Sanitary Hot Water
SHWS	Solar Hot Water System
SME	Small and Medium Enterprises
SOA	State Of the Art
SPF	Seasonal Performance Factor
STC	Standard Test Conditions
SWT	Small Wind Turbines
UWT	Urban Wind Turbines
VEA	Vlaams Energieagentschap
VREG	Vlaamse Reguleringsinstantie voor de Elektriciteits- en Gasmarkt
VUB	Vrije Universiteit Brussel
VwHR	Ventilation with Heat Recovery
WP	Work Package
WPP	Warmtepomp platform