



## **Analysis of energy competences and barriers to energy competence development in the construction sector and its upper secondary vocational education and continuing education systems**

### **Build Up Skills Denmark**

#### **Pillar I, Phase II**

## Colophon

### **Project coordinator:**

Charlotte Vartou Forsingdal  
Danish Energy Agency  
Amaliegade 44  
1256 Copenhagen K

### **Project manager**

Vagn Holk Lauridsen  
Danish Technological Institute  
Gregersensevej 1  
2630 Taastrup

### **Text and data collection:**

Kai Borggreen, Danish Technological Institute  
Pia Bodal, KommunikationsKompagniet  
Ulrik Ryssel Albertsen, KommunikationsKompagniet

### **Financing**

**The report is financed by the EU programme Intelligent Energy Europe - IEE**

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# 1. Introduction

## 1.1 The Build Up Skills project

Build Up Skills Denmark is part of the Intelligent energy - Europe (IEE) programme that supports energy optimisation and renewable energy. The EU contributes 90% of Build Up Skills financing. The overall goal of Build Up Skills is to map current education offers in construction and develop a national roadmap for skills upgrading of craftsmen in the building and construction sector, in order to thereby reach the Danish 2020 goals for energy efficiency and use of renewable energy. The following is a contribution to the development of the national roadmap.

## 1.2 Analysis and problem area

This analysis is part of the second stage of the Build Up Skills project. Its goal is to identify concrete initiatives that can close the gap between current education programmes for the construction sector and the projected needs for a specialised workforce in 2020. Concurrently the analysis will identify barriers to an effective and targeted skills upgrading of craftsmen currently working in construction. The analysis takes stock of existing upper secondary vocational education (EUD) and continuing and further education offers from private suppliers and in the public adult vocational training system (AMU).

The analysis makes use of interviews with central stakeholders in the construction sector and in the construction education sector, establishing how upper secondary vocational programmes and continuing and further training programmes deal with energy, sustainable energy, and energy optimisation. The analysis presents the challenges that must be faced if EU's 2020 goals for energy reduction in buildings are to be met.

The interviewers have attempted to present themselves in as neutral a manner as possible. The analysis results are based solely on input from stakeholders and do not necessarily reflect the consortium's opinion. Further work on the interview analysis results is therefore necessary before they can be used as a basis for the recommendations in the final Roadmap.

The analysis report is built up as follows: An introduction presents the analytic method, data basis, and definitions. The analysis itself is then presented in the six following sections. Each section is delimited to those issues that were seen in the preliminary examination and the analysis itself as having special influence on energy competences of craftsmen in the construction sector. In addition, there is a section that presents construction craftsmen's general and occupation-specific competence gaps regarding energy. Each section starts with a summary of its results, which together are presented and summed up in the section "Summary and Analysis Results".

## 2. Method

The methodology used for this study follows the main features described in the consortium's tender. The methodology has been adjusted slightly either as a result of practical considerations, or because dialogue with construction sector respondents indicated that the original methodological description was not the most appropriate to reach the study goals as described in the original proposal to the EACI.

### 2.1 Interviews and focus groups

In-depth interviews have been carried out with 64 stakeholders from a range of construction sector professions and education institutions. These are described in greater detail in the section on the study data basis. The interviewed stakeholders were designated by the steering committee or stakeholder group of the Build Up Skills Denmark project, supplemented with interviewees chosen on the basis of their experience with and knowledge of energy competences in construction. Among the stakeholders were specialist teachers, education managers, headmasters and heads of training at vocational colleges, architects, engineers, social partners representing the construction trades, alternative education providers, knowledge centre representatives, etc.

In addition, interviews and focus groups were carried out with craftsmen chosen because they had completed one or more continuing or further education programmes in energy. Their participation in these programmes was assumed to provide a basis for reflections on the lack of energy competences in the construction sector, since these interviewees can relate to their own competences both before and after their skills upgrading.

The interviews were semi-structured, so that the interviewer was free to manoeuvre among the questions. This was designed to keep the interviews flowing, and to give the opportunity to follow up on interesting comments or skip questions that the interviewee does not feel capable of answering.

All of the questions in the interview guide are to the greatest possible extent covered, but not necessarily in the order presented in the guide, and not necessarily with the exact wording in the guide. The interviews were carried out either by telephone or face-to-face, and took about 1-1½ hours.

The stakeholder interviews were carried out to establish stakeholders' assessment of and attitude towards for example energy and interdisciplinary competences in upper secondary vocational education and adult vocational training, specialist teachers' competences in energy topics, and barriers for energy competence upgrading of construction craftsmen. The attitudes and assessments expressed in the stakeholder interviews are used in the study in so far as they are shared by a broad segment of the interviewees. Similarly, quotations from the stakeholders are used when they are representative for a number of stakeholders or stakeholder groups.

### 2.2 Questionnaire

An electronic questionnaire was sent to 1984 construction sector craftsmen who all had completed one or more modules in the Energy Counsellor education programme. The craftsmen were sent an

e-mail with a link to participate in the study. As an incentive, an iPad was awarded to one of the participants.

Of the total population of 1984 persons who were invited to participate in the study, 330 answered the questionnaire. This is a response per cent of 16.5, which by experience can be considered satisfactory in relation to the target group of craftsmen. The 330 responses also present an acceptable spread of the most important construction competences, though with an overrepresentation of joiners/carpenters. Since the Energy Guidance qualification is primarily taken by master craftsmen and enterprise owners, 81% of the responses are from these groups. The questionnaire results thus for the most part reflect the attitudes of enterprise decision-makers about energy competences and continuing and further education in energy topics for the construction sector. The assessment by these decision-makers can be seen as especially important since they will often be the ones to decide on continuing education and skills upgrading of employees in the individual craftsman enterprises.

The questionnaire begins with background questions about education, tenure, enterprise size, and age, and questions about what respondents feel is important for skills upgrading and where they obtain relevant information.

The remaining questions deal with how respondents assess their own and other craftsmen's energy competences, and where they see the need for increased education efforts.

The questionnaire was tested before use by four craftsmen, and relevant comments and suggestions for improvement were incorporated in the final design.

### **2.3 Desk research**

Comprehensive desk research was carried out prior to the questionnaire and interviews. Existing reports, studies, evaluations and notes regarding energy competences in education and continuing education were reviewed and analysed in order to understand the problem field and construct a solid foundation for the current study.

This analysis also builds on meetings with the Build Up Skills steering committee comprising the following organisations:

- Dansk Byggeri
- TEKNIQ
- DS Håndværk og Industri
- BAT-Kartellet
- Byggeriets Uddannelser
- Energistyrelsen
- Teknologisk Institut
- Dansk Industri
- DI Erhvervs- og Arbejdsmarkedsuddannelser
- Statens Byggeforskningsinstitut (ad hoc)
- KommunikationsKompagniet A/S (ad hoc)



In addition there have been three workshops/stakeholder group meetings for a wider group of stakeholders, and input from these meetings is included in the desk research. Finally, this report is based on the results of the national Status Quo, the first part of the Build Up Skills project.

See [www.buildupskills.dk](http://www.buildupskills.dk) for National Status Quo, abstracts, and further information about the steering committee and the stakeholder group.

## **2.4 Definitions**

This analysis uses a number of terms, titles, and texts which all are central to understanding the analysis. The central elements are defined in the following:

### **Stakeholder quotations**

Quotations from stakeholders are all individual respondents' personal attitudes to given problems. The quotations are not representative of all stakeholders; quotations are however only used when the attitudes represented are shared by a substantial portion of the stakeholders/stakeholder groups.

### **Energy competences**

Energy competences should be understood as competences relating to renewable energy, low-energy construction, and energy renovation, that individual craftsmen need in order to carry out their profession and in order to adhere to applicable regulations. Energy competences also include vapour barriers and air-tightness, re-insulation, general energy/building understanding including dimensioning, installation and operations of energy systems, building automation, CCM, air conditioning, and ventilation systems.

### **Construction sector education programmes**

These refer to the following upper secondary vocational education entryways: civil construction worker, concreter and paver, housing assembly, wall, ceiling and unit installer, house painter, glazier, woodcutting machinist, bricklayer, chimney sweep, carpenter/joiner, stonemason, plasterer, roofer, technical insulator, woodwork construction, plumber<sup>1</sup>, and electrician.

### **Stakeholders and respondents**

The interviewed stakeholders were as mentioned either designated by the steering committee or stakeholder group of the Build Up Skills Denmark project, or they were chosen on the basis of their experience with and knowledge of energy competences in construction. Stakeholders include specialist teachers, education managers, headmasters and heads of training at vocational colleges, architects, engineers, social partners representing the construction sector, education consultants, alternative education providers, knowledge centre representatives, etc.

### **Heads of vocational colleges**

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<sup>1</sup> The Danish occupational term "VVS" translates literally as 'water, heating, and sanitation'. The corresponding Danish DB07 is the equivalent to the NACE code for 'plumbing, heat, and air conditioning installation. The simplified terms 'plumbing' and 'plumber' will be used here.

Respondents from vocational colleges include several education managers, heads of school, business development managers, and heads of training. All are referred to as "heads of vocational colleges" in the study.

**Education consultant**

To assure anonymity, all consultants from social partner education providers, public, and private and alternative providers are referred to in the study as "education consultants".

## 3. Data basis

Data were collected from June to November 2012.

### **3.1 Vocational colleges: specialist teachers<sup>2</sup>, education managers, heads of school, and heads of training**

Qualitative face-to-face and telephone interviews were conducted at six Danish vocational colleges with specialist teachers, education managers, heads of school, and heads of training. A semi-structured questionnaire served as a point of departure for the interviews. Altogether, 21 interviews were carried out, each taking 1-1½ hours.

The respondents are from the following vocational colleges:

- SDE college
- EUC Nord (Hjørring)
- Technical College Silkeborg
- Construction College Aalborg
- EUC Syd
- Roskilde Technical School

### **3.2 Education consultants: Construction Sector Education Programmes, EVU (Electrician Education Programmes), SUS (Service Professions Education Programmes), and Industry's Trade Committee Education Programmes:**

Qualitative face-to-face interviews were held with 10 respondents from the above institutions.

A semi-structured questionnaire served as point of departure for the interviews, which took 1 hour each.

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<sup>2</sup> The Danish term "faglærer" is translated as specialist teacher. The term refers to a teacher who is a trained high-level occupational specialist and who has additional pedagogical qualifications.

### **3.3 Craftsmen and installation technology: Carpenters/joiners, bricklayers, plumbers, electricians, etc.**

**Focus groups:** Three interdisciplinary craftsmen/installation technology focus groups were held in the towns of Middelfart, Rønne and Høje Taastrup. An average of six professionals participated in each focus group. A semi-structured questionnaire served as a point of departure for the focus group interviews, which took around 1½ hours each.

**Qualitative interviews:** To supplement and elaborate on the focus group interviews, 10 qualitative telephone interviews were held with craftsmen/installation technologists with diverse backgrounds. Each interview took around ½ hour.

**Questionnaire:** A questionnaire-based study was carried out among participants in energy counsellor modules. The questionnaire was sent electronically to 1984 e-mail addresses belonging to craftsmen who had participated in one or more modules of the energy counsellor programme; of these, 330 (16%) responded.

Except for background and preference questions, questionnaire answers were based on a scale of 1 to 10, where 1 is a low degree and 10 a high degree of agreement with the question posed

### **3.4 Consultants: engineers and architects**

Eight qualitative telephone interviews were carried out with four architects and four consulting engineers.

A semi-structured questionnaire served as a point of departure for all of the interviews.

### **3.5 Alternative education providers, industry associations, and manufacturers.**

Nine qualitative telephone and face-to-face interviews were carried out with representatives of these groups.

A semi-structured questionnaire served as a point of departure for all of the interviews.

### **3.6 Knowledge and competence centres**

Ten qualitative telephone interviews were carried out with representatives from knowledge and competence centres.

A semi-structured questionnaire served as a point of departure for all of the interviews.

### **3.7 Employer and employee organisations**

Meetings, discussions, and/or telephone interviews were held with representatives of the relevant employer and employee organisations in the construction sector.

A semi-structured questionnaire served as a point of departure for all of the telephone interviews.

## 4. Introduction to the analysis of energy competences and barriers

The following presents the primary analysis results in six sections, each with a number of subsections. The results in each section are derived from the statements, attitudes, and assessments from the stakeholder interviews and the questionnaire. The analysis is primarily descriptive and therefore only contains concrete recommendations for actions that can be directly deduced from the interviews. Each of the 6 sections starts with a summary of its primary results.

### **The six analysis sections are:**

- Energy competences in upper secondary vocational education (EUD)
- Intake and recruitment to construction sector vocational education and the construction sector
- Teaching resources and praxis in upper secondary vocational education (EUD) and adult vocational training (AMU)
- Specialist teacher competences - EUD/AMU
- Adult vocational training (AMU) and private/alternative continuing education provision
- Competence gaps in construction sector craftsmen

## 5. Energy competences in upper secondary vocational education (EUD)

Construction sector vocational education is the backbone of training for its workforce and therefore the primary factor in assuring energy competences. The most relevant education programmes are for carpenters/joiners, electricians, bricklayers, concreters and pavers, plumbers, and electricians, since these jobs represent the great majority of construction employees and comprise that group which will carry out most of the energy improvements to fulfil the 2020 goals. The study of energy competences will thus concentrate on these trades.

### 5.1 Summary - primary analysis results

The analysis of energy competences in upper secondary vocational education (EUD) indicates a need to:

- further investigate if there is a basis for adapting the executive orders for these programmes in order to improve graduates' energy competences,
- prioritise energy competences in carpenter/joiner and bricklayer education programmes,
- investigate whether to establish joint occupational or competence outcomes for construction sector vocational education programmes,
- establish interdisciplinary projects during school-based portions of the education programmes,
- establish occupational collaboration between vocational education students and engineering and architect students,
- investigate if there is a basis for establishing joint curricula at upper secondary vocational education programmes in order to strengthen teaching quality, and investigate the current reasons for the lack of joint curricula,
- prioritise the themes of energy, sustainable energy, low-energy construction, and energy optimisation so that they become compulsory subjects in the final apprenticeship exam.

### 5.2 Energy topics in upper secondary vocational education

In general, respondents point to a need to develop energy competences in construction sector vocational education programmes and to make buildings more energy efficient, if Denmark and the EU are to reach their ambition of a 20% reduction in CO<sub>2</sub> emissions by 2020.

*"In general, energy is not seen as very important in vocational programmes. This may be because the subject is not part of the final exam. Instruction targets subjects that are part of the final exam, because vocational colleges are judged on how well students perform on this exam. If it is not on the exam, it doesn't get taught." (Specialist teacher, carpenter/joiner)*

If energy competences are to be improved in vocational education, respondents feel there is a need to revise the executive orders for construction sector programmes so that there is an explicit focus on energy, sustainable energy, low-energy construction, energy renovation, and interdisciplinarity. Several respondents mention that building envelopes and vapour barrier problems should be emphasised, and there should be greater focus on how to carry out energy renovation projects, since many students will work in these fields after graduation.

*"Requirements and standards, complexity, and the number of new materials have all increased quite a bit the past years, but our knowledge has not kept pace. This is also true of instruction at vocational colleges, where we spend too much time on outdated competence and trade-related outcomes. We need to clean out the old guard and replace them with a new group with focus on energy and interdisciplinarity." (Education consultant)*

It is also pointed out that there should be joint professional or competence outcomes in construction sector vocational education programmes, so that students obtain a general understanding of buildings and their energy consumption, and craftsmen thus become better acquainted with what happens elsewhere in the building when they for example replace windows or doors or install heat recovery ventilation systems.

*"We need to adjust plumbing education programmes so they focus more on energy and interdisciplinarity. The creation of the joint education secretariat (EVU) has helped, but we need more because there are many points of congruence between electric and plumbing trades. The same holds true for bricklayers and joiners/carpenters." (specialist teacher, plumber)*

Energy competences are weighted differently in the various construction trade vocational education programmes. Plumbers and electricians focus greatly on energy, sustainable energy, and energy renovation as prioritised and recurring themes, whereas in other programmes the focus is much less explicit or decidedly peripheral.

*"In my opinion, electricity and plumbing are the two trades that focus best on energy themes, while the other trades show less interest. A good deal of this probably has to do with tradition, where electricity and plumbing - especially electricity - are always at the technological forefront. The other trades are more conservative and less curious and less willing to adapt, and they therefore change at a slower pace." (Knowledge and competence centre consultant)*

Among the major construction sector vocational education programmes, carpenter/joiner and bricklayer are often named as lagging behind in energy topics. Respondents mention that this is due to occupational tradition and culture, and the differences in how the trades absorb new technology. In addition, energy themes are naturally "built-in" to electricity and plumbing trades.

To sum up, respondents indicate that the individual construction trade vocational education programmes need to strengthen themes of energy, sustainable energy, low-energy buildings, and energy renovation:



### **Woodwork construction (carpenter/joiner)**

- Installation of vapour barriers/building air-tightness
- Replacement and sealing of windows and doors
- Thermal bridges in building envelopes
- Re-insulation
- General energy and building understanding

### **Bricklayer**

- Installation of vapour barriers/building air-tightness
- Transition to foundations, windows, and other potential thermal bridges
- Exterior wall re-insulation
- General energy and building understanding

### **Concreter and paver**

- General energy and building understanding
- Transition to foundations and other potential thermal bridges

### **Electrician**

- Vapour barriers/building air-tightness
- Dimensioning, installation, and operations of sustainable energy systems (heat pumps, solar heat, solar cells, etc.)
- Technical system instruction for end users and owners of buildings
- Dimensioning, installation, and operations of CCM, building automation, air conditioning, and ventilation systems
- General energy and building understanding

### **Plumber**

- Technical system instruction for end users and owners of buildings
- Dimensioning, installation, and operations of CCM, building automation, air conditioning, and ventilation systems
- General energy and building understanding
- Understanding of hydraulic balance in heating systems

## **5.3 Interdisciplinarity in vocational education**

According to respondents there is a need to focus more on interdisciplinary questions and on general building and energy understanding in all phases of vocational education. This is because the construction sector is becoming increasingly specialised, which in turn is leading to increasing demands for knowledge sharing and collaboration between trades and occupations.

*"We need a joint subject for all construction trade vocational programmes, where students can get a general understanding about buildings and about energy themes. All craftsmen should know what happens in the rest of a building if you for example replace a heat pump, re-insulate, install new windows or doors, or put up solar cells on the roof. A building is a closed circuit, and when you change one part of it you change all the other parts too."*  
(Head of vocational college)

Construction trade vocational education is experienced as subject-matter partitioned and vertical, meaning that students only obtain a limited amount of knowledge and insight about energy themes in other trades and professions. Many respondents mention a need for increased interdisciplinary collaboration to create understanding of energy problems across a range of professions. This could be done by for example specifying joint competence outcomes regarding energy and prioritising interdisciplinary subjects during school-based periods. Respondents also note that there will be practical and logistic difficulties for vocational colleges in relation to implementing interdisciplinary subjects and projects.<sup>3</sup> One solution could be to reserve one or more elective subjects during school-based periods for energy themes or interdisciplinary subjects or projects.

*"The training committees need to start thinking outside the box and think of construction as one body of knowledge rather than a whole range of subject matter. The culture of the construction sector has to change. Subject matter is not an enemy, it is a collaborative partner."* (Head of vocational college)

Respondents mention that increased interdisciplinarity and collaboration between trades will help students to learn - already while they are in school - to collaborate and understand each other's trades when on the construction site. This is not only important regarding energy themes, but also regarding improved efficiency throughout construction processes.

*"We are missing something, some common thread. It is not so much the technical aspects of each profession we need to look at - we need to think holistically. If we can better integrate and collaborate among trades, we can increase efficiency and quality in construction."* (Education consultant)

Interdisciplinary deficiencies are not the only problem. Collaboration and understanding between consultants and craftsmen need to be dealt with in vocational education programmes. Lack of understanding or poor collaboration can lead to serious quality issues in energy renovation and the installation of sustainable energy systems, and in construction in general.

*"Collaboration with engineers and architects should always be part of the curriculum, because this is often the cause of misunderstandings and errors in construction processes. It is like collaboration between doctors and nurses."*

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<sup>3</sup> Dansk Byggeri and TEKNIQ have received funding from the Energy Fund to develop an elective subject "Energy across the grain". This is being done in collaboration with vocational colleges EUC Nord and Tradium Randers. It is expected to be ready in 2014.

*Many vocational education students could benefit from the knowledge that engineering students have, but there are no real lines of communication open (in either direction)." (Specialist teacher, carpenter/joiner)*

Consultants remark that most problems stem from craftsmen not following job descriptions and diagrams. This is seen as happening either because the craftsmen do not understand them, or because it is easier to do things 'the same old way'. Part of the problem is that diagrams and descriptions are usually drawn up not so much for craftsmen but rather as part of a tender, and are therefore difficult to interpret. Efforts should therefore be made to "translate" diagrams and instructions for craftsmen and then assuring that these are adhered to.

*"In general craftsmen lack competences and knowledge for proper construction techniques - this lack can usually be traced back to a lack of professional pride and meticulousness. We need specific subject matter that can assure that craftsmen adhere to the BR10 regulations. This could be courses in sealing, vapour barriers, re-insulation, or transition to foundations, and we also need interdisciplinary courses on general understanding of buildings and of energy themes. At the same time consultants need to lend a hand - we have to come up with a collaborative responsibility for construction processes as a whole." (Consultant)*

Among craftsmen there is somewhat of an understanding of the challenges related to collaboration with consultants. This is supported by craftsmen/energy consultants answer to the question: **To what degree are architects/engineers on one side and craftsmen on the other good at solving problems together?** 45 per cent answer that craftsmen and consultants to a lesser or low degree are good at solving problems together, while 55 per cent answer that craftsmen and consultants somewhat or to a great degree are good at solving problems together.<sup>4</sup>

## **5.4 Quality assurance of EUD**

On the basis of relevant executive orders specifying vocational education, vocational colleges draw up local curricula in collaboration with local training committees. The curricula describe how applicable executive orders are translated into practical education and training activities in the relevant EUD entryways. This implies local interpretation of executive orders, which many respondents see as a challenge.

*"From my point of view the local schools have too much influence on curriculum, which makes it difficult to assess quality. In order to assure uniform quality you need a centrally designed curriculum that schools must follow." (Education consultant)*

There seem to be great differences in how the individual construction trade vocational education programmes deal with energy, low-energy buildings, sustainable energy, and energy renovation.

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<sup>4</sup> Questionnaire answers were based on a scale of 1 to 10, where 1 is a low degree and 10 a high degree. Answers were then categorised into two overall groups: (1-5) = a low degree or lesser degree, and (6-10) = somewhat or a great degree.

Vocational colleges for the most part comply with the energy competence specifications in the executive orders, but there seem to be major differences in how energy competences are weighted in the individual vocational colleges.

*"If I only complied with the executive order's competence outcomes and professional outcomes regarding energy, then the students would be poorly equipped on graduation. I therefore try to include energy aspects in instruction and in projects whenever possible. But it is always a question of balance, because I have to focus on the final apprenticeship exam, which is where the student as well as the college is judged. Energy questions are almost completely absent from this exam." (Specialist teacher, carpenter/joiner)*

Some vocational colleges set the bar even higher, and there are schools where dedicated specialist teachers prioritise energy more than required by executive order. When this happens it is because the schools and teachers feel that current executive orders lack the focus on energy, sustainable energy, and energy renovation that is needed to respond to increasingly stringent legislative and market demands.

*"We have decided to emphasise energy because graduates simply have to possess these competences. We try to assure that specialist teachers are prepared through skills upgrading. We are doing a lot and would like to do more, but existing executive orders are in fact a barrier." (Head of vocational college)*

Several respondents indicate that joint curricula can raise the level of awareness in the respective EUD entryways of the importance of energy, sustainable energy, low-energy buildings, and energy renovation.

## **5.5 Final apprenticeship examination**

Respondents indicate that the lack of priority of energy, sustainable energy, low-energy buildings, and energy renovation is due to the fact that these subjects are not included in the final apprenticeship examination. Instruction targets subjects that constitute the exam, since the school is also evaluated on the basis of exam results. If a subject is not part of the final exam, it is not taught.

*"Energy efficient buildings, building envelopes, and especially vapour barrier issues should be weighted much more in education programmes; but since these are not important to the final examination, they are not considered important during teaching. There should also be more focus on energy renovation of housing, because many students will be working in this field after graduation." (Specialist teacher, carpenter/joiner)*

A number of respondents emphasise that if energy, sustainable energy, low-energy buildings, and energy renovation are to be prioritised, then they must be included as compulsory elements of subjects that are part of the final apprenticeship examination.

## 5.6 Revising executive orders for vocational education

A general problem related to executive orders is that there currently is no way to extend the amount of time permitted for a vocational education programme. Many respondents do not consider such an extension to be desirable, since the time frame for becoming a craftsman should be manageable in the foreseeable future. However, if certain trades or competences are to be emphasised and the overall time frame is to remain the same, then some subjects must be removed from or reduced in importance in the executive orders.

*"School-based and enterprise-based; a great political ideal. But the basic level is too low. You learn old things, and you cannot introduce new subjects, new technology. There is no instruction in building management systems. There is no understanding of coordinated operations. Heating and air conditioning each work quite well, but sometimes they are both on at the same time and create a horrible indoor climate." (Education consultant)*

The respondents emphasise that it is very difficult to phase out obsolete and unimportant subjects and competences because so much professional identity is bound up in them. Executive orders for vocational education therefore change only very gradually, still maintaining an umbilical cord to olden tradition.

*"It is hard to change executive orders for vocational education. Most agree that we need to prioritise energy subjects. But since we cannot extend the time frame for a vocational qualification, we have to remove something if a new element is to be introduced. And this is hard, because some of the old competences are important for professional identity and therefore "hard to do without". So we end up taking only tiny steps forward." (Education consultant)*

Overall then, instruction and competence outcomes in construction trade vocational education programmes only adapt very slowly to those competences required by the construction sector. New requirements in building regulations and codes and the development of new technology and products are not reflected in vocational education programmes. There is an undesirable gap between the reality of the construction site and construction trade vocational education programmes.

*"I remember that when I was at school I used lots of time learning to make dowelled joints. I have never done that since. It is of course part of the carpenter tradition, but maybe it is time for schools to focus on competences we need when we graduate." (Master craftsman, carpenter/joiner)*

Executive orders are in a formal sense difficult to change. The process is complicated and it can take years to get through public hearings and be politically approved. Then it takes three to four years before the first students graduate from programmes run in accordance with the new executive orders.

Several respondents therefore indicate that executive orders should be more flexible so that it is easier to make on-going adjustments within an existing framework.

Several construction trade vocational education programmes are currently revising their executive orders so that they can focus more on competences necessary for energy, low-energy building, sustainable energy, and energy renovation. Among those being revised are carpenter/joiner and bricklayer. The latter is expected to divide the school-based portion into specialisations, including an energy-bricklayer specialisation.

## 6. Intake and recruitment to construction sector vocational education and the construction sector

The Build Up Skills Status Quo report showed that upgrading of the current construction workforce skills level is not sufficient if the 2020 goals for construction are to be met. Up to 13,000 extra craftsmen are necessary. This can be done by increasing uptake to construction trade vocational education programmes, upgrading skills levels of skilled craftsmen, and by attracting persons with construction qualifications who now work in other trades.

### 6.1 Summary: Primary analysis results

The analysis of intake and recruitment to construction sector vocational education and adult vocational training and to the construction sector indicates a need to:

- Investigate whether vocational colleges' responsibilities towards academically disadvantaged students has an effect on intake,
- Initiate efforts to show whether vocational education programmes lead to multifaceted career pathways,
- Initiate efforts to attract more academically advantaged students via general upper secondary vocationally oriented programmes (EUX),
- Prioritise information efforts about credit transfer arrangements for semi-skilled.

### 6.2 Intake at construction sector vocational education programmes

The combination of economic downturn and lack of jobs and apprenticeships is seen as the primary cause of several years of declining student population and intake at construction sector vocational education programmes.

*"Vocational education follows the construction industry, but whatever the economic climate we need better qualified youth." (Education consultant)*

In addition, vocational colleges' responsibilities towards academically disadvantaged students is seen as a major challenge and supplementary cause of the declining student population; challenged students require special attention and give vocational colleges a "negative" reputation, which in turn pushes academically advantaged students with craftsman potential towards general upper secondary or other more "prestigious" youth education programmes. Vocational education programmes and vocational colleges have to grapple with an image problem if they are to attract advantaged and motivated students.

*"Vocational education programmes suffer from the political goal of having 95% of a cohort completing a youth education programme. This goal means that vocational colleges have to 'sweep up' those students who are not motivated for learning. These students need extra attention from teachers, they drop out more often, and they leave vocational colleges with an undeserved reputation of being institutions for maladjusted youth who are tired of school." (Head of vocational college)*

Respondents also indicate that lower secondary school counselling for students is insufficient if a greater number of students are to be attracted by construction sector vocational education. Education counsellors do not have enough focus on or knowledge about what a vocational education programme can be used for. They often therefore recommend general upper secondary programmes or business colleges to the "advantaged" students, and they recommend a vocational education programme to the "disadvantaged".

Respondents indicate a need for efforts to emphasise that vocational education can be a career path with many possibilities, and that the apprenticeship final examination is not necessarily the end station. There is a need to communicate 'best practice' stories about the long-term opportunities in vocational qualifications if a greater number of students (and in particular talented students) are to choose this pathway. There is also a need for targeted information to change attitudes about learning and competence development in the construction sector and at vocational colleges, so that construction sector stakeholders naturally assure employees' competence development and maintenance throughout their working life.

*"We have to break with this idea that the final apprenticeship exam is the end of learning. In the real world this exam is only proof that you have acquired your trade's basic competences. Mastery comes later, and continuing training is an important element." (Education consultant)*

EUX (general upper secondary vocationally oriented) programmes are named positively as something that can contribute to change. EUX programmes combine a general upper secondary qualification with a vocational qualification. EUX supports vocational education goals of appearing as a knowledge institution where the final examination is not the end of learning but on the contrary is the start of a range of continuing and further education opportunities and career possibilities. The programmes also attract a greater number of academically advantaged students.

*"The EUX programmes are a catalyser for innovation at vocational colleges, and it is therefore an initiative that I warmly welcome. I hope that EUX can contribute to vocational education's reputation, so that vocational colleges can attract a greater number of academically advantaged students." (Head of vocational college)*

The new Centres of Excellence (COE) give talented students in vocational education programmes opportunities to study in a separate talent track, which is seen as strengthening professional competences. Another example of fostering talent is EUC Nord's *Building and Construction Plus*, which is an add-on for apprentices who want to get more out of their education and who are backed by their apprentice place master craftsman. Bricklayer and carpenter/joiner apprentices



work together on four short school-based and apprenticeship-based courses with focus on energy and interdisciplinarity.

### **6.3 Semi-skilled in the construction sector**

It is widely noted that the basic adult education (GVU) programme and the individual assessment of competences (IKV) represent opportunities for semi-skilled who want to obtain qualification as skilled workers.

*"The GVU and IKV credit schemes make it possible for people with short-cycle education and/or practical construction experience to build an individually designed education programme that leads to an upper secondary vocational qualification. But the schemes are not well known." (Consultant)*

Many respondents indicate that these schemes are not used to any appreciable degree, especially because the target group (semi-skilled) and enterprises are not made aware of the opportunities.

*"We have to be better at reaching out to the semi-skilled when they take adult vocational training courses. Most of the semi-skilled are not aware of the opportunities, and that is too bad because the GVU and IKV are really good schemes." (Head of vocational college)*

A study among enterprises in the evaluation report "New AMU" from 2008 shows that only 8% of construction industry enterprises knew about IKV, which was the lowest figure among all industrial sectors.

There seems to still be a need for increased information activities about credit schemes. A number of respondents indicate that it can be problematic if the individual education institutions carry out competence assessment, since they can have an interest in making an individual's competences appear less sufficient than they are, thus assuring course activity for the institution.

## 7. Teaching resources and praxis in upper secondary vocational education (EUD) and adult vocational training (AMU)

### 7.1 Summary: Primary analysis results

The analysis of teaching resources and praxis in upper secondary vocational education and in adult vocational training indicates a need to:

- Develop interdisciplinary and/or occupation-specific resources related to energy themes as part of the joint education repository,<sup>5</sup>
- Increase the resource base so that schools can acquire equipment used in the construction sector,
- Examine the possibilities of increased quality monitoring of continuing education programmes.

### 7.2 Teaching resources for energy

Teachers in the plumber and electrician trades are for the most part satisfied with the state of existing resources, whereas teachers in bricklayer and carpenter/joiner occupations want better and more relevant teaching material for energy.

There is a generally indicated lack of sufficient interdisciplinary and occupation-specific resources about energy in the joint repository. The lack of resources treating energy, sustainable energy, and energy renovation (especially regarding bricklayer and carpenter/joiner occupations) is related to the fact that neither energy nor interdisciplinary studies are mentioned in the executive orders or included in the final examinations.

In other words, there is a vicious circle where little satisfactory teaching material is developed because of a lack of competence outcomes. The development of teaching resources is often left to dedicated teachers who insist on including energy themes in their instruction

*"We need to update the education repository where schools and specialist teachers have access to pedagogical resources, so that there is a greater amount of material with focus on energy. Final exams with compulsory themes about energy will also "force" energy into the curriculum." (Head of vocational college)*

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<sup>5</sup> [www.undervisningsbanken.dk](http://www.undervisningsbanken.dk)

### 7.3 Lack of resources

Lack of resources is mentioned as a major problem. Schools especially find it difficult to acquire the resources necessary to buy new materials and the expensive new machinery that is used in the construction industry of today. The schools find it difficult to carry out relevant instruction and position themselves as a central source of knowledge and technology.

*"We often lack the latest equipment. We cannot afford a blower door and the instruments necessary to show the energy consequences of improper insulation and sealing. If vocational colleges are to be centres of knowledge and continuing education, we should have the possibilities of demonstrating the newest methods and technologies. Either we need better collaboration with manufacturers and distributors, or the number of colleges needs to be reduced so that there are sufficient resources for those that remain."(Specialist teacher, carpenter/joiner)*

## 8. Specialist teacher competences - EUD/AMU

### 8.1 Summary: Primary analysis results

The analysis of specialist teacher competences (EUD -upper secondary vocational education, and AMU - adult vocational training) indicates a need to:

- Prioritise courses for specialist teachers targeting occupation-specific and interdisciplinary energy competences,
- Increase specialist teacher participation in continuing education,
- Investigate whether allocated resources for specialist teacher continuing education and competence development are sufficient,
- Investigate whether specialist teachers' energy competences should be quality assured.

High quality teaching and instruction in energy themes in vocational education and training requires specialist teachers with advanced professional skills. This demands not only an adequate basic understanding of energy issues related to reducing energy consumption in buildings, but also opportunities and the ability to be at the forefront with the newest methods, regulations, and products.

### 8.2 Specialist teacher energy competences

Specialist teachers have varying degrees of professional knowledge about energy. Many have a satisfactory and well-founded grasp of energy issues, while others lack competences necessary for teaching EUD and AMU at a satisfactory level.

*"Many teachers simply do not live up to the standards demanded of teachers at vocational education institutions; some have nothing more than a successful final exam and some occupational experience, and that is not enough. If you are to teach and instruct you have to be at a significantly higher level than your students." (Specialist teacher, bricklayer)*

Many specialist teachers and alternative education providers point out that a number of specialist teachers severely lack knowledge and teaching competences regarding energy themes. There is thus a need for specialist teacher courses targeting occupation-specific and interdisciplinary energy competences.

### 8.3 Low levels of participation in continuing education

The frequency of specialist teacher continuing education is dependent on the culture within the education institution regarding continuing education. There is a general lack of follow-up and

monitoring to assure teacher skills upgrading, and several vocational colleges have more or less delegated skills upgrading responsibilities to the specialist teachers themselves. The frequency and quality of competence development activities are also dependent on the resources allocated by the individual education institution.

*"I know a bunch of really talented specialist teachers, but there are unfortunately also many who simply lack professional curiosity and never develop themselves - they do what they always have done, and that's really a shame for the students. A lot of times competence development is merely a specialist teacher who has taken a course then teaches the same course to his colleagues. This does not lead to an especially high level of competence."  
(Specialist teacher, carpenter/joiner)*

When competence development is the responsibility of the individual specialist teacher, then the success or failure of competence development is dependent on the teacher's professional curiosity and the allocated resources.

The low level of participation in continuing education is problematic. Many specialist teachers have no other formal qualifications than an upper secondary vocational education final exam; many respondents feel that this is insufficient ballast if the teacher is to maintain insight into new methods, technologies, and products, and be able to introduce the student to the broader perspectives of his profession.

Several respondents propose that the low level of participation in continuing education can be improved by making continuing education compulsory and by earmarking resources especially for continuing education.

#### **8.4 Resources for competence development**

Vocational colleges are obliged to allocate resources and time for specialist teachers' continuing education and competence development. Especially among specialist teachers and heads of vocational colleges there is an impression that the amount of resources is insufficient to assure energy competences. One challenge is that resources for competence development come from the operating budget, and teachers at competence development courses are not available for teaching or production.

*"There are resources and calendar time allocated to continuing education and competence development. It is my impression that a number of teachers do not make use of the opportunities. Many of them use the last week before summer vacation to relax, or they only participate in professional arrangements for the social and networking aspects."  
(Specialist teacher, carpenter/joiner)*

There are textbook committees and course committees that produce continuing education courses for specialist teachers, but many teachers never participate. A number of schools create in-house specialist teacher courses because these are seen to be less expensive.

*"I think that the electrician sector educational secretariat is good at telling us about continuing education opportunities, but we have limited means at our disposal so it is always a question of budget." (Specialist teacher, electrician)*

## **8.5 Quality assurance of specialist teacher competences**

Vocational colleges are monitored to assure that they carry out construction sector education programmes in accordance with regulations and the overall framework for the educational institutions' operations. The point of departure for quality assurance is how schools carry out the education programmes, including testing and examinations, and statistics on dropouts and graduation. A number of respondents, however, indicate that the overall assessment and evaluation of education output does not give a clear picture of specialist teachers' professional competence levels.

*"There is no or very little surveillance of specialist teacher competences, including energy competences. As long as output is satisfactory, no one questions specialist teacher competences." (Education consultant)*

Respondents mention that schools or heads of schools should be obliged to send specialist teachers on continuing education courses, and there should be greater monitoring of the quality of these courses.

## **8.6 Specialist teacher courses in energy**

Most respondents - including specialist teachers - recognise the need to upgrade specialist teacher competences relevant to energy themes. Several mention that there already exist a range of good continuing education courses for specialist teachers, such as those organised and provided by textbook and course committees, but that something must be done to assure that specialist teachers participate.

*"The textbook committees and course committees arrange continuing education courses for specialist teachers, but many teachers never participate. Many schools arrange their own in-house courses because they are less expensive, but I have my doubts about the quality. Heads of vocational colleges should be obliged to send specialist teachers on continuing education courses, and there should be better monitoring of course quality." (Specialist teacher)*

There is a demand for long courses that can give specialist teachers better professional ballast and knowledge about energy issues. A number of respondents - especially specialist teachers - characterise current continuing education provision as "damage control" where teacher competences are updated to the current state of the art, but not developed in order to reach even higher competence levels.

*“There is a lack of resources allocated to continuing education and competence development. Too many specialist teachers are poorly equipped, and many of the courses that target them are very short-term and superficial and seldom contribute to any visible competence development. Many specialist teachers are in need of long-cycle continuing education.” (Head of vocational college)*

Respondents indicate in general that schools need to be better at individual competence assessment of specialist teachers so that continuing education provision can be tailored to turn them into better and more competent teachers.

## 9. Adult vocational training (AMU) and private/alternative continuing education provision

### 9.1 Summary: Primary analysis results

The analysis of adult vocational training (AMU) and private/alternative continuing education provision points to a need to:

- Improve AMU's image,
- Clarify the commercial and professional value of AMU courses,
- Clarify that AMU is also valuable for craftsmen, and not only for the semi-skilled,
- Develop new course packages that lead to qualifications such as energy-carpenter or energy-bricklayer,
- Improve the economic incentives to take courses or course packages on energy themes,
- Prioritise vocational colleges' outreach and networking activities with local skilled worker/craftsman enterprises,
- Establish closer collaboration with the construction industry, vocational training committees, and adult education and continuing training centres (VEU),
- Develop differentiated continuing education provision (AMU) targeting the semi-skilled, skilled craftsmen, master craftsmen, etc.,
- Prioritise enterprise-located courses and instruction,
- Investigate the need for and gains associated with increased use of the open workshop concept,
- Develop standardised curricula and teaching resources for the individual AMU outcomes.

### 9.2 Many continuing education courses and few participants

There are many continuing education courses related to energy. Respondents indicate that the courses seem to match subject and content demands from enterprises, employees, the unemployed, and the market in general. There does not seem to be any acute need to develop new AMU courses; however, participation in existing courses is at a very low level.

Respondents emphasise that many courses are cancelled because of lack of enrolment, and industry certification courses are the only ones with a satisfactory enrolment level. Normal AMU courses are simply not "necessary" enough for craftsmen, because neither legislation nor the market requires specific competences or courses.

*"We need obvious incentives for continuing education. Without them we might as well just do things the way we always have done. If continuing education is to be of interest then we need an economic reward or be required to have a compulsory building envelope certificate." (Specialist teacher, carpenter/joiner)*



Many respondents indicate that craftsmen perceive AMU courses as targeting the semi-skilled or the unemployed or marginally employed. Employed persons do not consider AMU as relevant to them, which does not strengthen the incentive to participate in AMU courses.

*"The quality of AMU courses seems high, but many skilled workers feel that the courses primarily target the semi-skilled. This makes it hard to attract craftsmen, and many choose instead to take supplier-run or other private courses." (Specialist teacher, electrician)*

### 9.3 AMU's image

Many respondents feel that AMU programmes have an image problem among potential participants.

AMU seems to distinctly need to improve its image, clarify the commercial value of its courses and the competences that can be obtained, and demonstrate that AMU courses are also of value to skilled workers and craftsmen and are not only for the semi-skilled - the latter being the most common impression among craftsmen and master craftsmen. The poor AMU image is emphasised as a central cause of the low level of enrolment in AMU courses, because actual participant satisfaction levels are in fact very high.<sup>6</sup>

*"We will always have a low participant rate until AMU gets an image as a place where you get new knowledge that can help your business. Supplier- and manufacturer-run courses have an advantage in that they can subsequently give discounts on their products." (Specialist teacher, carpenter/joiner)*

There are many reasons for AMU's poor image. Many respondents indicate that it is because AMU was started up in the 1960s to help the semi-skilled migrate from agriculture to production and to help upgrade women's qualifications levels. In addition, AMU in the 1970s and 1980s primarily was used to upgrade the skills levels of the unemployed. In other words, AMU targeted the semi-skilled and the unemployed. There is at the same time a general impression that the quality of AMU is low, and that courses take a longer time than necessary.

*"There is a lot of prejudice about AMU, some of it probably correct. But we have to do something about it if AMU is to also become attractive for skilled workers and craftsmen." (Education consultant)*

Many respondents indicate a need for rebranding AMU (perhaps including a name change) and for marketing efforts to make AMU be seen as a place for competence development and knowledge mediation - also for energy.

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<sup>6</sup> Conclusions from a 2008 evaluation report, *Nyt AMU – med fokus på kompetencer og fleksibilitet*. Danish Evaluation Institute.

## 9.4 The value of AMU courses

There is a need to make the value of AMU visible; what does a craftsman or an enterprise gain from an AMU course, and what do you gain from continuing education in energy. The gain offered by continuing education is unclear and there is therefore little incentive to participate.

*"If you want to sell continuing education and skills upgrading to a craftsman or to an enterprise you have to show that it can be seen in black ink on the bottom line. The individual employee has to see how it raises his market value and negotiation strength, and the master craftsman must see that better qualified employees lead to a better bottom line. You have to be up-to-date with the market situation, whether you are an employee or an employer."*  
 (Education consultant)

The following table shows that economics, marketing potentials, and competences are the most important factors for those craftsmen who have participated in at least one energy counsellor qualification module when they choose a course in continuing education.<sup>7</sup>

Table 9.1: **What is important for you when you choose continuing education courses in energy and environment? (more than one answer possible)**

The course is close to my home	98	29%
The course is free and the enterprise receives wage reimbursement	68	21%
I receive a diploma and a title that can be used for company marketing	94	28%
I obtain competences that can increase company turnover	255	77%
I improve my professional competences	285	86%
The course is held when the company doesn't have much to do	96	29%
The course is flexible, and I can enrol at the last minute	94	28%

Although the question is only addressed to craftsmen who have participated in at least one module of the energy counsellor qualification (81% of whom are either master craftsmen or business owners), it still indicates that the experienced value of a course is an important factor in enrolment. At the same time, the business owner/master craftsman is central to the decision to participate in continuing education.

*"You have to feel that you are getting something for your money. Even though AMU is free and you get wage reimbursement, many feel that you don't get value for your money because the course standards are so low."*  
 (Carpenter/joiner)

<sup>7</sup> **Energy counsellors** are craftsmen who have been trained to consult comprehensively and multi-disciplinarily on the technical aspects of energy conservation in buildings. A qualified energy counsellor can identify energy saving potentials in individual buildings.

## 9.5 Course packages and economic incentives

In order to create better value and structure for AMU energy courses, several respondents propose creating continuing education 'packages' combining occupation-specific AMU outcomes and interdisciplinary AMU outcomes. A completed package would lead to a qualification of for example energy-carpenter or energy-bricklayer.

*"We need an AMU energy craftsman qualification built up in the same way as the restoration craftsman qualification, where you participate in a series of modules within your own profession and a series of interdisciplinary modules." (Carpenter/joiner)*

Consolidating several existing AMU outcomes within an energy qualification can create value for AMU courses because craftsmen can use the qualification in customer consultations and marketing. An example of this is Green Construction on Bornholm, where several existing AMU outcomes have been consolidated into a 5 week continuing education programme focusing on energy and green construction.

Other initiatives, for example Green Business Growth, emphasise the marketing and sale of green and energy efficient solutions. The need for marketing and sales competences is indicated by answers to the questionnaire. Only 45% of the craftsmen feel that they have satisfactory sales and marketing competences, and 55% feel that carpenters/joiners only to a small or to some degree have sufficient competences to sell green solutions to customers.

Several respondents indicate that energy programmes should be more economically attractive than other provision in order to add incentives to education packages that focus on energy.

*"We need to make energy courses more attractive. The electrician sector subsidises all energy courses in its continuing education catalogue, because the sector wants to promote these courses and make them more attractive. Other occupations could consider doing the same." (Specialist teacher, electrician)*

## 9.6 Energy education provision

There does not seem to be any acute need for more or more differentiated energy education provision. Interview respondents agree that supply is sufficient and varied.

Except for the above mentioned packages and courses addressing interdisciplinary issues, the majority of respondents did not mention any shortage of specific AMU or private courses.

Craftsmen were also predominantly satisfied with the current course supply related to energy. Given the question **"To what degree are there sufficient continuing education opportunities related to energy renovation, low-energy, and sustainable energy?"**<sup>8</sup>, 65% replied somewhat or

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<sup>8</sup> Questionnaire answers were based on a scale of 1 to 10, where 1 is a low degree and 10 a high degree. Answers were then categorised into two overall groups: (1-5) = a low degree or lesser degree, and (6-10) = somewhat or a great degree..

to a great degree, which means however that 35% feel that there is a lesser or low degree of sufficient course supply.

The questionnaire does include any way to evaluate which concrete course provision the respondents refer to as a shortage; however the section on competence gaps in construction sector craftsmen presents an account of respondents' views on competence gaps related to energy.

### 9.7 Information about continuing education

Suppliers and vocational training committees can supply and compose AMU energy theme course packages that match individual sector needs. One of the problems indicated is that the target group - craftsmen and related enterprises - is not sufficiently informed. The courses need to be marketed much more than they are today, and guidance and information better tailored to the many participant segments and enterprises.

VEU (adult education and continuing training) centres are named as examples of counselling services for enterprises and participants. VEU was established in 2010, and there are currently 13 VEU centres in Denmark.

The Build Up Skills steering committee indicated the need for closer collaboration between the construction sector, vocational training committees, and the VEU centres. One concrete recommendation was that each VEU centre appoint a permanent contact person that the vocational training committees and the vocational colleges could collaborate with and refer enterprises and staff to. This could improve collaboration on joint efforts regarding information, guidance, and marketing of continuing education on energy.

*"We should use a greater amount of resources to market our continuing education provision. Our goods are first class, but there are no customers in our shop. It is strange to use money to develop empty courses with no participants, so maybe we should use some of the money for outreach to enterprises and for other advertising and information activities." (Consultant)*

Answers to the next question from the questionnaire indicate the need for overview and coordination of information about construction sector education provision:

**Table 9.2:** "Where do you look for opportunities for continuing education and skills upgrading (more than one answer possible)"

The local AMU supplier or vocational college	93	28%
Other professional education and course suppliers (Danish Energy Service, Danish Technological institute)	230	69%
Manufacturers of the materials and components I use	102	30%
Suppliers and wholesalers where I buy materials and components	135	41%
The internet site efteruddannelse.dk	41	12%
I ask colleagues or use my professional network	114	34%

There is no clear cut pattern in the above table. Information about continuing education comes from many sources, though "other professional education and course suppliers" is indicated notably more often. Several respondents indicated a need to gather all of the available information in one place, for example at [www.efteruddannelse.dk](http://www.efteruddannelse.dk), or present all AMU provision in one portal, for example [www.amukurs.dk](http://www.amukurs.dk).

## 9.8 Outreach

Vocational colleges' outreach efforts and the ability to network with local craftsman enterprises are seen as the key for attracting participants to AMU courses. Several vocational colleges have already had success with this. It is mostly larger enterprises that are relevant as targets for this type of activity, because vocational colleges' outreach resources are limited and because large enterprises typically have an education manager and a more systematic approach to continuing education for employees.

Because of their limited resources, vocational colleges' outreach efforts towards SMEs are limited. This is seen as problematic, because SMEs often have the greatest need for skills upgrading, also regarding energy. Small and medium-sized craftsman enterprises need information, dialog, and guidance regarding continuing education.

*"We try to play the part of mini-HR consultants for these enterprises, because it is a job most of these craftsman enterprises cannot cope with. Instead of sitting and waiting for people to enrol, we visit enterprises and try to find out what they need and how we can tailor education provision to their employees. Often the enterprises need skills upgrading, but haven't had the overview to do anything about it. Continuing education is - in my mind - just as much to do with outreach as with teaching." (Head of vocational college)*

A number of specialist teachers at vocational colleges point out that schools need to be better at reaching out to small craftsman enterprises and offering enterprise-tailored courses, rather than sitting back and waiting for enrolment. The respondents also indicate that outreach is often a precondition for enterprise-located courses, which are more popular among craftsmen than traditional AMU courses held at vocational colleges.

*"We have to reach out more to enterprises and be willing to move the classroom out to the shop floor or construction site. We must be flexible and accessible and ready when a need for education arises." (Head of vocational college)*

Craftsmen agree on the need for more outreach, and indicate that AMU has to sell itself just as private education suppliers do. At the same time, AMU must be better at explaining and clarifying what it is an enterprise gains from upgrading energy competences.

*"I don't always have the time to orient myself on all of the continuing education provision available, so it would be good for me if the vocational colleges were more active and sales minded." (Bricklayer)*

Respondents emphasise that AMU faces a challenge in that its target group seldom has any long term plans for competence development or continuing education; this is inconsistent with vocational colleges' long term planning of AMU provision. This could be solved for example by establishing open workshops as some schools have done with success. Skilled and semi-skilled employees can on short notice attend skills development sessions related to a specific current need. Successful open workshops however require strategic outreach on the part of vocational colleges towards local enterprises.

The study indicates that course provision is seldom coordinated with craftsman enterprises. In addition, several schools plan continuing education provision on the basis of which specialist teachers have free spots in their monthly calendar, rather than on the basis of enterprise needs and demand.

*"AMU is facing a basic challenge; we plan our course provision for the future, but our primary target group, SMEs, cannot plan or cannot cope with planning months ahead of time. The two systems are out of synch. I think the use of the open workshop can be a partial solution." (Specialist teacher, carpenter/joiner)*

Respondents indicate that if AMU courses in energy are to be more successful, the schools must think out and organise outreach more systematically and strategically, instead of - as many schools do today - trying to sell empty spots on courses that are not sufficiently coordinated with local market needs.

*"I really don't think that many craftsmen and master craftsmen realise just how flexible and high-quality the AMU system is. I have designed continuing education course programmes precisely tailored to enterprise and to employee needs." (Master electrician)*

## **9.9 Need for differentiated course supply**

Respondents indicate a need for differentiated continuing education supply (AMU) so that there is provision targeting master craftsmen, craftsmen, apprentices, and the semi-skilled. It seems especially problematic for craftsmen and master craftsmen to have to participate in courses together with the semi-skilled, since this sends a signal of insufficient professional quality levels.

*"We need better opportunities for continuing education for master craftsmen who currently cannot receive wage reimbursement. I think that master craftsmen can jump start continuing education of craftsmen. If we can get them to accept the need for continuing education and its benefits, then we can probably get the craftsmen to also jump on the wagon." (Specialist teacher, plumber)*

In general, many craftsmen consider AMU as a school for the semi-skilled and the unemployed, and not a natural source of knowledge and skills upgrading. At the same time only a handful are aware of the opportunities within the AMU system, for example enterprise-tailored courses and wage reimbursement. Only a few of the interviewed craftsmen indicated that they had been contacted by AMU or in any other way been made aware of AMU provision; this means that they most often choose one of the many manufacturer or wholesaler courses that are continually on the market.

*"I can't remember ever having been contacted by AMU, but I often receive course offers from manufacturers and suppliers." (Carpenter/joiner)*

There is a demand for greater flexibility between the AMU system and enterprises. This could occur through specific course packages which are in accordance with applicable regulations while at the same time tailored to individual enterprise needs, organised for example to match seasonal sector variation.

### **9.10 The number of AMU schools and collaboration between them**

Several respondents indicate that there are too many AMU schools given the number of course participants, and that it would be easier to maintain quality levels with fewer schools. In contrast, others indicate that the current number is appropriate because it assures access for all craftsmen, wherever they live. In other words, there are arguments and attitudes that support and that question the current AMU school structure.

*"I think there are too many schools for too few students. Vocational colleges should collaborate rather than compete for customers. If you could collect competences and efforts into fewer schools you could afford better quality and increase the chances of establishing new course provision." (Specialist teacher, electrician)*

As shown in table 9.1, only 30% of craftsmen felt that location close to home was important in choosing a continuing education course. This supports respondents who feel that schools in geographical proximity should collaborate rather than compete.

*"Schools should collaborate more, for example by sharing teaching resources or through joint course provision. I think this would improve professional quality levels." (Education consultant)*

### **9.11 Quality assurance of AMU**

All participants in AMU courses are asked to evaluate their experience through a joint instrument produced by the Ministry of Children and Education for the evaluation and effect measurement of vocational education. Several respondents indicate, however, a need for heightened quality

assurance, for example by developing standardised curricula and teaching resources for each AMU outcome so that course content at different schools can be uniform and high-quality.

*"At first glance AMU looks fine, but many of the courses lack the professional qualities to attract skilled craftsmen, and teachers are often not good enough. We need standardised teaching resources and quality control - there are too many unprofessional schools." (Education consultant)*

### **9.12 AMU's limitations**

According to applicable legislation, AMU is not allowed to provide courses that are already provided by a private stakeholder. Several respondents considered this to be problematic, because such courses are then only available for a fee, and because this hinders vocational colleges from providing courses that could attract craftsmen to AMU courses at vocational colleges.

*"Competition is rough from private suppliers, for example manufacturers. Often the only thing left for us are certification courses or courses that manufacturers are in no way interested in providing. A good example is our district heating course, which has no competition from private suppliers because it isn't product-specific enough." (Specialist teacher, plumber).*



## 10. Competence gaps in construction sector craftsmen

### 10.1 General competence gaps

As described previously, respondents do not indicate any acute need for new energy courses or programmes for the construction sector. The necessary initiatives already exist, but respondents indicate that construction craftsmen lack the necessary competences regarding energy issues. That there is a competence gap regarding energy is supported by the questionnaire results, where craftsmen who had participated in at least one energy counsellor qualification modules were asked to evaluate Danish craftsmen's general and profession-specific energy competences.<sup>9</sup>

To the question ***“To what degree do Danish craftsmen in general possess sufficient competences to carry out satisfactory work in energy renovation, construction of low-energy buildings, and sustainable energy?”***, under half (48%) answer that Danish craftsmen somewhat or to a great degree possess these competences.

Over half of the questionnaire respondents (52 %) thus agree with the other study respondents that there is a real need for upgrading competences among craftsmen.

To the question ***“To what degree do you possess sufficient competences for energy renovation, low-energy building construction, and sustainable energy?”***, 86 % indicate that they possess these competences somewhat or to a great degree.

It is unknown whether these respondents have participated in one or in several energy counsellor modules; but regardless, the answers seem to reflect a very high assessment of competence levels when compared to the respondents' assessment of general competence levels.

The high level of self-evaluation is seconded by indications from the qualitative stakeholder interviews, where several respondents mentioned that craftsmen have a hard time assessing their own competences or recognizing their needs for skills upgrading. This is emphasised by several respondents as a barrier to competence development and continuing education.

*“They think that they are in control, but a whole lot of them make serious basic mistakes because their competences are not up to date and have not followed changing and more restrictive regulations. They read the regulations but they carry on as they always have done and don't realise that things are going wrong. They think they are on top of it.” (Manufacturer consultant)*

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<sup>9</sup> **General note** about the questionnaire. Questionnaire answers were based on a scale of 1 to 10, where 1 is a low degree and 10 a high degree. Answers were then categorised into two overall groups: (1-5) = a low degree or lesser degree, and (6-10) = somewhat or a great degree.

The questionnaire respondents are split regarding interdisciplinary competences. In answer to the question "***To what degree do craftsmen in your occupation possess sufficient interdisciplinary competences for insight and collaboration between professions in the construction sector?***" around half (51%) indicate that craftsmen possess a low or lesser degree of sufficient collaborative and interdisciplinary competences related to energy. In other words a large share of craftsmen is seen as lacking sufficient energy competences, which supports statements from the stakeholder interviews.

*"There is something missing 'across the grain'. It is not so much technical issues in the individual profession, but something to do with a holistic overview." (Consultant, construction goods manufacturer)*

Overall, the questionnaire results indicate a need for upgrading craftsmen's occupational and interdisciplinary energy competences.

## **10.2 Occupation-specific competence gaps**

Questionnaire respondents assessed the general occupational competence levels within the individual occupational groups (carpenter/joiner, electrician and electrical contractor, plumber, and bricklayer) related to energy, sustainable energy, low-energy buildings, and energy renovation.

The results are however not statistically valid, and cannot lead to general conclusions about the need for skills upgrading in the individual occupations. This is in part because the respondents are not a representative population, and in part because the overall population and the population in the individual professions are too small to lead to valid general conclusions. The results do however give an indication of whether occupations seen as problematic in the stakeholder interviews are also seen as such by craftsmen working in them.

## **10.3 Plumber energy competences<sup>10</sup>**

### **Summary:**

Plumbers are for the most part critical in their evaluation of colleagues' competences in topics that respondents in the qualitative interviews identify as problematic. In general, over half of the plumbers indicate that colleagues have a low or lesser degree of sufficient energy competences, which confirms the picture seen in the interviews and focus groups.

### **Answers: Plumber energy competences**

A total of 53 plumbers answered the questionnaire's occupation-specific questions.

#### ***To what degree do craftsmen in your occupation possess sufficient competences to understand vapour barriers and air-tight construction?***

39% indicate that plumbers somewhat or to a great degree possess sufficient competences in these topics, while 61% indicate that plumbers to a low or lesser degree possess these

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<sup>10</sup> As mentioned earlier, the Danish occupational term "VVS" translates literally as 'water, heating, and sanitation'. The corresponding Danish DB07 is the equivalent to the NACE code for 'plumbing, heat, and air conditioning installation. The simplified terms 'plumbing' and 'plumber' will be used here.

competences.

***To what degree do craftsmen in your occupation possess sufficient competences to understand how to adjust heating installations and equipment?***

45% indicate that plumbers somewhat or to a great degree possess sufficient competences in this topic, while 55% indicate that plumbers to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences related to dimensioning, installation, and operations of building automation systems?***

53% indicate that plumbers somewhat or to a great degree possess sufficient competences in these topics, while 47% indicate that plumbers to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences related to dimensioning, installation, and operation of ventilation systems?***

37% indicate that plumbers somewhat or to a great degree possess sufficient competences in these topics, while 63% indicate that plumbers to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences related to dimensioning, installation, and operations of refrigeration systems?***

28% indicate that plumbers somewhat or to a great degree possess sufficient competences in these topics, while 72% indicate that plumbers to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences related to dimensioning, installation, and operations of sustainable energy systems (heat pumps, solar heat, solar cells, etc.)?***

52% indicate that plumbers somewhat or to a great degree possess sufficient competences in these topics, while 48% indicate that plumbers to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences to instruct building users/owners in the operations of technical systems?***

47% indicate that plumbers somewhat or to a great degree possess sufficient competences in this topic, while 53% indicate that plumbers to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences to understand heating system hydraulic balance?***

37% indicate that plumbers somewhat or to a great degree possess sufficient competences in this topic, while 63% indicate that plumbers to a low or lesser degree possess these competences.

## **10.4 Bricklayer energy competences**

### **Summary**

Bricklayers are more or less split down the middle in their assessment of colleagues' competences in topics that respondents in the qualitative interviews identify as problematic. Over half of the bricklayers indicate that colleagues to a low or lesser degree possess sufficient competences, which confirms the picture seen in the other respondents and the focus groups.

### **Answers: bricklayer energy competences**

A total of 20 bricklayers answered the questionnaire's occupation-specific questions:

***To what degree do craftsmen in your occupation possess sufficient competences related to vapour barrier installation and building air-tightness?***

45% indicate that bricklayers somewhat or to a great degree possess sufficient competences in these topics, while 55% indicate that bricklayers to a low or lesser degree possess these competences

***To what degree do craftsmen in your occupation possess sufficient competences related to the transition to foundations, windows, and other potential thermal bridges?***

47% indicate that bricklayers somewhat or to a great degree possess sufficient competences in these topics, while 53% indicate that bricklayers to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences to understand the re-insulation of exterior walls?***

47% indicate that bricklayers somewhat or to a great degree possess sufficient competences in this topic, while 53% indicate that bricklayers to a low or lesser degree possess these competences.

## **10.5 Carpenter/joiner energy competences**

### **Summary**

Carpenters/joiners are decidedly positive in their assessment of colleagues' competences in topics that respondents in the qualitative interviews - including carpenters/joiners in focus groups - identify as problematic.

The results thus indicate that a large share of respondent carpenters/joiners either lacks a realistic understanding of the challenges posed by energy competences, or that the challenges are less drastic than indicated by the other respondents. Despite this discord, it is interesting that craftsmen and the other respondents agree that there is a need for skills upgrading efforts.

The fact that so many carpenters/joiners see their colleagues' energy competences as somewhat or to a great degree sufficient must be seen a challenge; if these craftsmen do not see a pressing need for continuing education, then efforts to get carpenters/joiners to participate in skills upgrading will be difficult.

### **Answers: carpenter/joiner energy competences**

A total of 154 carpenters/joiners answered the questionnaire's occupation-specific questions:

***To what degree do craftsmen in your occupation possess sufficient competences to understand vapour barrier installation and building air-tightness?***

74% indicate that carpenters/joiners somewhat or to a great degree possess sufficient competences in these topics, while 26% indicate that carpenters/joiners to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences related to the replacement and sealing of windows and doors?***

83% indicate that carpenters/joiners somewhat or to a great degree possess sufficient competences in these topics, while 17% indicate that carpenters/joiners to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences to understand thermal bridges in building envelopes?***

62% indicate that carpenters/joiners somewhat or to a great degree possess sufficient competences in this topic, while 38% indicate that carpenters/joiners to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences to understand re-insulation?***

79% indicate that carpenters/joiners somewhat or to a great degree possess sufficient competences in this topic, while 21% indicate that carpenters/joiners to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences to understand solar cell systems?***

46% indicate that carpenters/joiners somewhat or to a great degree possess sufficient competences in this topic, while 54% indicate that carpenters/joiners to a low or lesser degree possess these competences.

## **10.6 Electrician energy competences**

### **Summary**

As with other occupational groups, electricians are split regarding their assessment of colleagues' occupational energy competences. Around half of the electricians agree with the majority of the other respondents; that a large group of electricians need skills development related to energy, sustainable energy, low-energy buildings, and energy renovation.

### **Answers: electrician energy competences**

A total of 59 electricians/electrical contractors answered the questionnaire's occupation-specific questions:

***To what degree do craftsmen in your occupation possess sufficient competences to understand vapour barrier installation and building air-tightness?***

51% indicate that electricians/electrical contractors somewhat or to a great degree possess sufficient competences in these topics, while 49% indicate that electricians/electrical contractors to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences related to dimensioning, installation, and operations of sustainable energy systems (heat pumps, solar heat, solar cells, etc.)?***

71% indicate that electricians/electrical contractors somewhat or to a great degree possess sufficient competences in these topics, while 29% indicate that electricians/electrical contractors to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences to instruct building users/owners in the operations of technical systems?***

63% indicate that electricians/electrical contractors somewhat or to a great degree possess sufficient competences in this topic, while 37% indicate that electricians/electrical contractors to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences related to dimensioning, installation, and operations of CCM and building automations systems?***

56% indicate that electricians/electrical contractors somewhat or to a great degree possess sufficient competences in these topics, while 44% indicate that electricians/electrical contractors to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences related to dimensioning, installation, and operation of ventilation systems?***

42% indicate that electricians/electrical contractors somewhat or to a great degree possess sufficient competences in these topics, while 58% indicate that electricians/electrical contractors to a low or lesser degree possess these competences.

***To what degree do craftsmen in your occupation possess sufficient competences related to dimensioning, installation, and operation of air conditioning systems?***

45% indicate that electricians/electrical contractors somewhat or to a great degree possess sufficient competences in these topics, while 55% indicate that electricians/electrical contractors to a low or lesser degree possess these competences.

# 11. Summary of analysis results

This analysis has presented challenges facing the construction sector and its vocational education and continuing education system, in order to help identify concrete recommendations and initiatives for a national plan of action.

NOTE: The summary conclusions presented here are identical to those presented in the first five analysis sections above. The conclusions can be summed up as follows:

## **Energy competences and upper secondary vocational education (EUD)**

The analysis of energy competences related to upper secondary vocational education indicates a need to:

- further investigate if there is a basis for adapting the executive orders for these programmes in order to improve graduates' energy competences,
- prioritise energy competences in carpenter/joiner and bricklayer education programmes,
- investigate whether to establish joint occupational or competence outcomes for construction sector vocational education programmes,
- establish interdisciplinary projects during school-based portions of the education programmes,
- establish occupational collaboration between vocational education students and engineering and architect students,
- investigate if there is a basis for establishing joint curricula at upper secondary vocational education programmes in order to strengthen teaching quality, and investigate the current reasons for the lack of joint curricula,
- prioritise the themes of energy, sustainable energy, low-energy construction, and energy optimisation so that they become compulsory subjects in the final apprenticeship exam.

## **Intake and recruitment to construction sector vocational education and adult vocational training and to the construction sector**

The analysis of intake and recruitment to construction sector vocational education and adult vocational training and to the construction sector indicates a need to:

- Investigate whether vocational colleges' responsibilities towards academically disadvantaged students has an effect on intake,
- Initiate efforts to show whether vocational education programmes lead to multifaceted career pathways,
- Initiate efforts to attract more academically advantaged students via general upper secondary vocationally oriented programmes (EUX),
- Prioritise information efforts about credit transfer arrangements for semi-skilled.

## **Teaching resources and praxis in upper secondary vocational education (EUD) and in adult vocational training (AMU)**

The analysis of teaching resources and praxis in upper secondary vocational education and in adult vocational training indicates a need to:

- Develop interdisciplinary and/or occupation-specific teaching resources related to energy themes as part of the joint education repository,
- Increase the resource base so that schools can acquire equipment used in the construction sector,
- Examine the possibilities of increased quality monitoring of continuing education programmes.

## **Specialist teacher competences (EUD - upper secondary vocational education/AMU - adult vocational training)**

The analysis of specialist teacher competences (EUD - upper secondary vocational education, and AMU - adult vocational training) indicates a need to:

- Prioritise courses for specialist teachers targeting occupation-specific and interdisciplinary energy competences,
- Increase specialist teacher participation in continuing education,
- Investigate whether allocated resources for specialist teacher continuing education and competence development are sufficient,
- Investigate whether specialist teachers' energy competences should be quality assured.

## **AMU (adult vocational training) and private/alternative continuing education provision**

The analysis of adult vocational training (AMU) and private/alternative continuing education provision points to a need to:

- Improve AMU's image,
- Clarify the commercial and professional value of AMU courses,
- Clarify that AMU is also valuable for craftsmen, and not only for the semi-skilled,
- Develop new course packages that lead to qualifications such as energy-carpenter or energy-bricklayer,
- Improve the economic incentives to take courses or course packages on energy themes,
- Prioritise vocational colleges' outreach and networking activities with local skilled worker/craftsman enterprises,
- Establish closer collaboration with the construction industry, vocational training committees, and adult education and continuing training centres (VEU),
- Develop differentiated continuing education provision (AMU) targeting the semi-skilled, skilled craftsmen, master craftsmen, etc.,
- Prioritise enterprise-located courses and instruction,
- Investigate the need for and gains associated with increased use of the open workshop concept,
- Develop standardised curricula and teaching resources for the individual AMU outcomes.